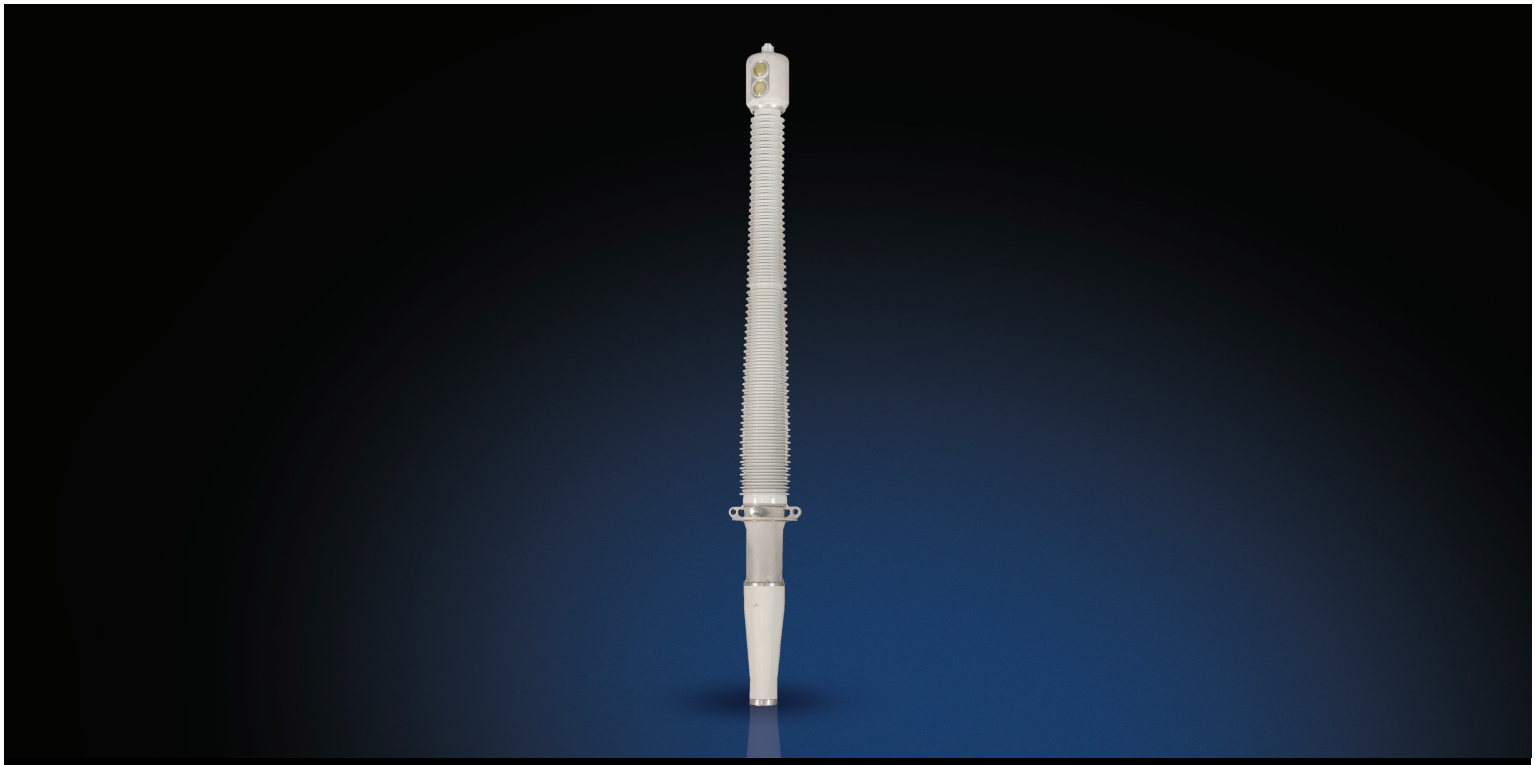


Technical guide

Type O Plus C II™
EHV condenser bushings

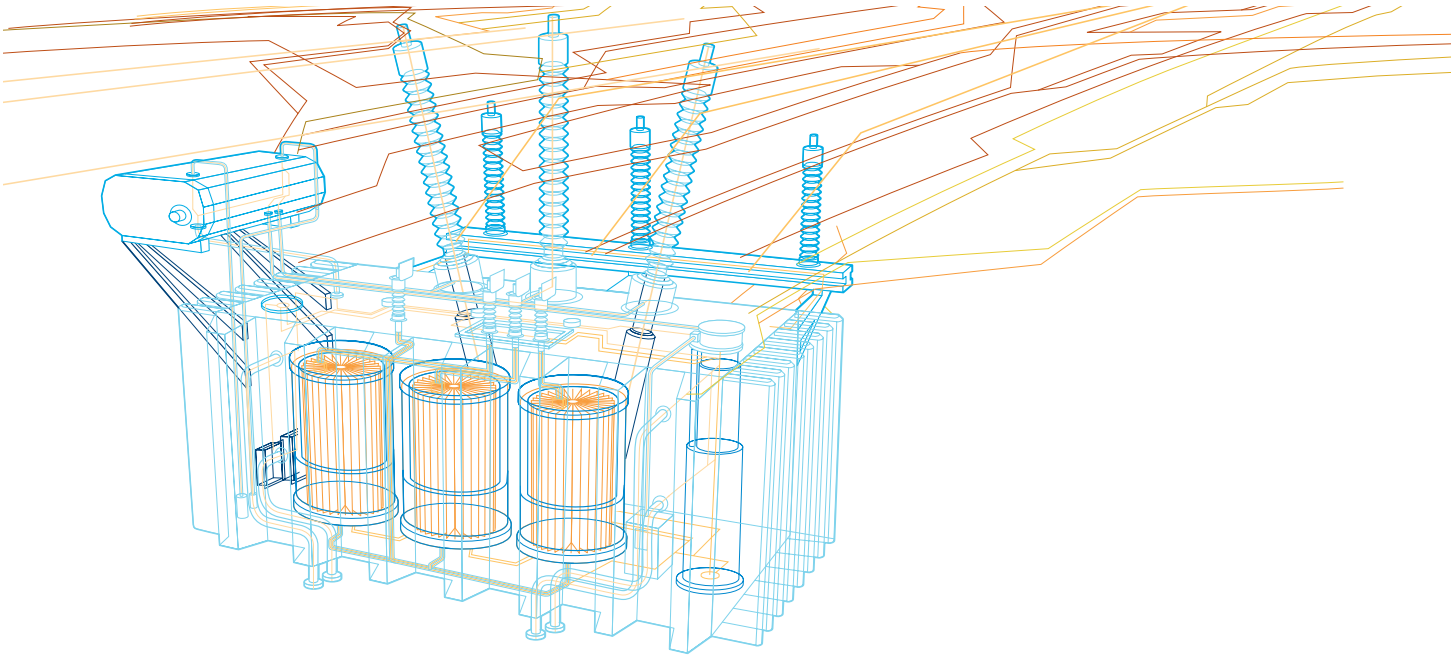
Power and productivity
for a better world™

This Technical guide has been produced to allow transformer designers and engineers access to the necessary technical information to assist in the selection of an appropriate transformer bushing. The technical information contained herein pertains to ABB O Plus C II bushings rated 230 to 550 kV. For information relating to products outside of this scope, please see the website for a listing of all product literature.

The information provided in this document is intended to be general and does not cover all possible applications. Any specific application not covered should be referred directly to ABB, or an authorized representative. ABB makes no warranty, expressed nor implied, and assumes no liability for the accuracy of the information in this document or for the use of such information. All information in this document is subject to change without notice.

Table of contents

Introduction



O Plus C II condenser bushings replace the existing O Plus C condenser bushings. With voltage ratings from 230 kV to 550 kV, these extra high voltage (EHV) condenser bushings utilize innovative design and manufacturing techniques to provide a slim-line, high-performance condenser bushing. For more information regarding ratings see section 4.1, *Type O Plus C II 550, 420, 345, and 230 kV electrical specifications.*

Style number	Information
345Z0800AA	345 kV bushing 800 A, draw-lead
550Z2000AD	550 kV bushing 2000 A, bottom connect
345Z1800DD	345 kV bushing 1800 A, draw-rod
550Z3000AE	550 kV bushing 3000 A, bottom connect

Table 1- Sample style numbers

1.1 Style number

The style number for O Plus C II bushings follow the nomenclature of “vvvZnnnnAA” where “vvv” is the bushing voltage class, “nnnn” is the current rating in amperes, and the final two characters e.g., “AA”, are used by ABB to describe the other characteristics of the bushing. Note that the fourth character “Z” becomes “Y” for brown porcelain. See table 1 for style number examples, and figure 1 for a graphical depiction of a style number.

345 Z 2000 AD

Bushings voltage class	Bushings type designation	Bushings amperage rating	Style specific identifier
230 = 230 kV	Z = O Plus C II (gray)	600 = 600 A - draw-lead only	xx = no defined meaning
345 = 345 kV	Y = O Plus C II (brown)	0800 = 800 A - draw-lead only (cable limited)	
420 = 420 kV		1216 = 1200 A - transformer, 1600 A-circuit breaker	
550 = 550 kV		1600 = 1600 A - draw-rod	
		2000 = 2000 A - bottom connect only	
		3000 = 3000 A - bottom connect only	

Figure 1 - Style number example

Basic characteristics

2.1 Applicable standards

O Plus C II bushings meet all requirements of the applicable IEEE electrical and dimensional standards. Additionally, all withstand voltages for routine test meet or exceed the levels required by IEC standards.

Standards organization	Designations
IEEE	C57.19.00-2004
	C57.19.01-2000
	C57.19.100-1995
IEC	60137

Table 2

2.2 Construction

The bushings are of center-clamped construction, ie, the bushing is held together by the action of clamping springs which act on the bushing conductor tube and hold the entire bushing assembly under a compressive load.

The bushings are built around a central conductor tube on which the condenser body is wound, forming the condenser assembly. The condenser body consists of full width insulating paper and conductive ink layers, thus forming the capacitive grading layers necessary to control and shape the electric field. The field is controlled in such a way as to optimize the bushing size, mass and electrical performance.

The upper and lower insulators, mounting flange, lower support, dome and clamping nut form an oil tight shell to contain the condenser assembly and insulating oil. Compression limited O-rings and/or flat, fiber-reinforced gaskets create the seals between components. High grade transformer insulating oil fills the space between the shell and the condenser assembly.

Above the oil, there is an expansion space to accommodate internal thermal expansion. This expansion space is filled with dehydrated nitrogen gas at atmospheric pressure.

On 550 and 345 kV bushings, a horizontal gap between the upper insulator base and the mounting flange is filled with a silicone rubber-like compound for improved mechanical performance, specifically during seismic activity
The bushing oil level is easily visible through the sight glass, which is a prismatic design to enhance observation of the oil level. Note that on 420 kV and higher O Plus C II condenser bushings, there are two vertically aligned sight glasses to provide adequate oil level observation over the full range of operating temperatures (see figure 2). The oil level and expansion space are designed in such a way that the oil level is visible with bushing temperature variations in ambient temperature ranges from -50 to +40 degrees Celsius.

The mounting flange and flange extension are high strength, corrosion-resistant aluminum. The upper (air end) insulator is high quality porcelain with a shed configuration designed for maximum performance. Bushings are available that exceed the minimum creepage requirements of IEEE C57.19.01-2000 for “Heavy Contamination” of 44 mm/kV of the nominal line-to-ground voltage, and also IEC 60815 “Heavy Pollution” (Class D) of 25 mm/kV of the nominal system voltage.

Type O Plus C II™
EHV condenser bushings

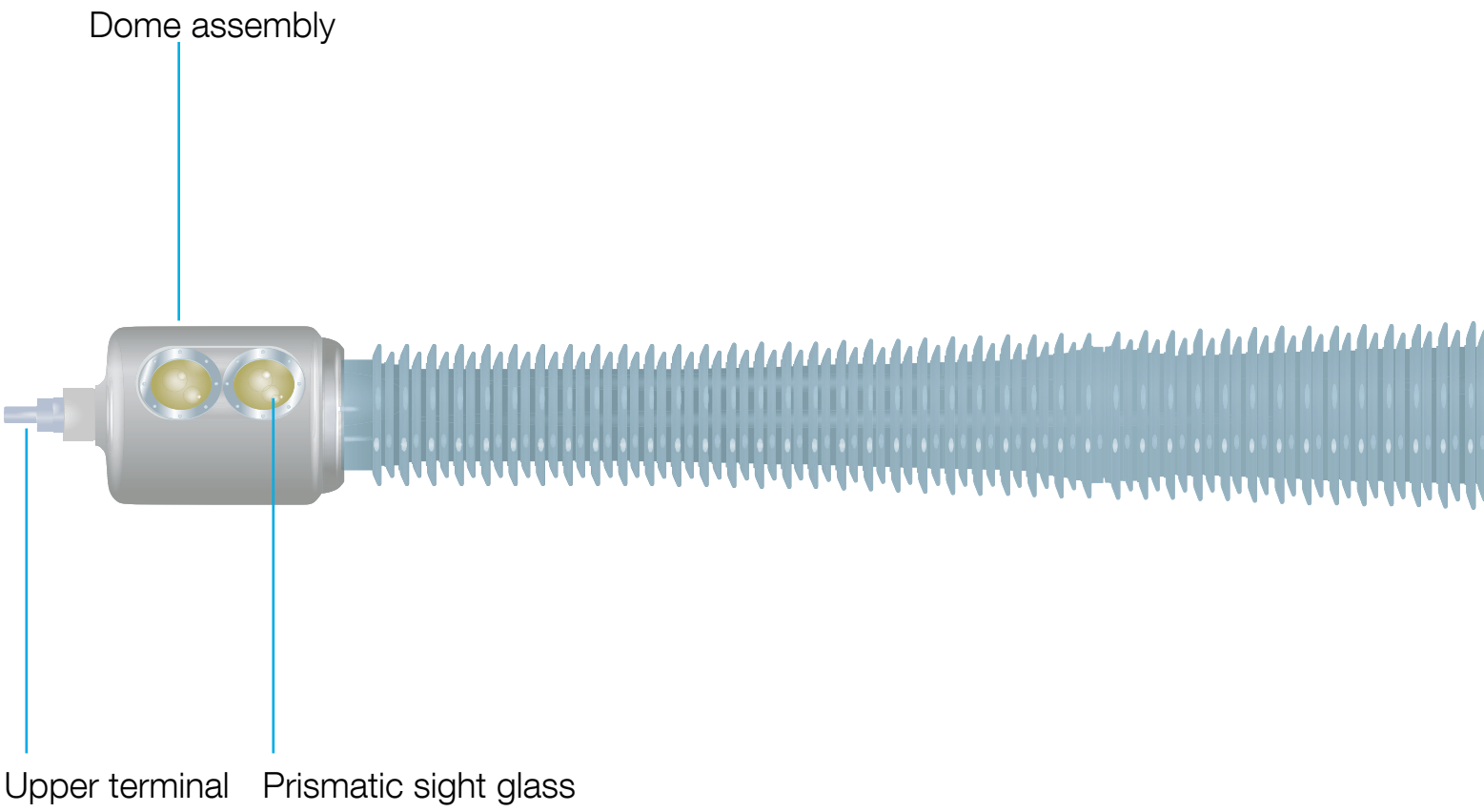
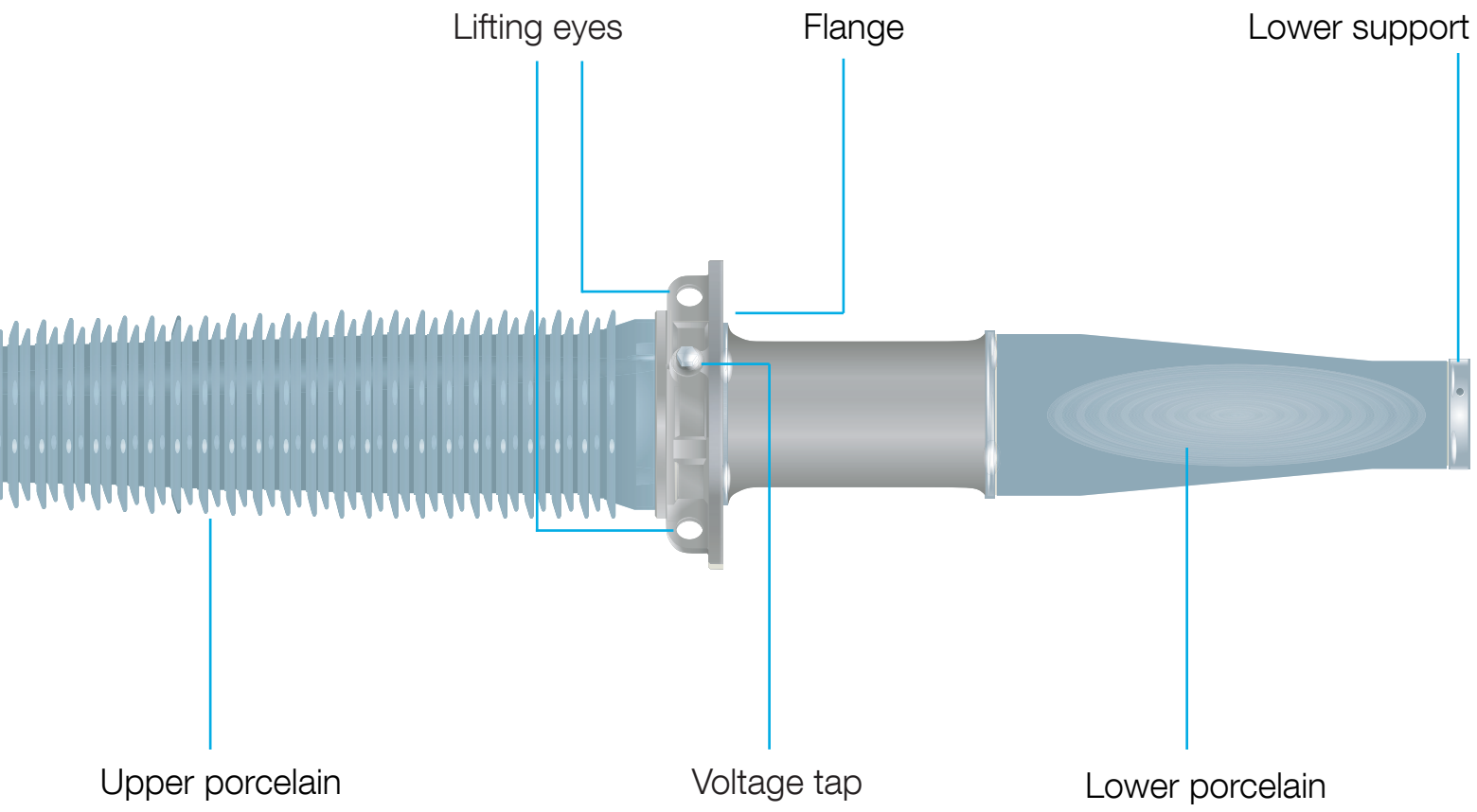


Figure 2


Lifting eyes
Flange
Lower support
Upper porcelain
Voltage tap
Lower porcelain

Basic characteristics

2.3 Dome assembly
The bushings utilize an inverted dome assembly, as seen in figure 3, which is self-aligning and helps to prevent moisture ingress. While previous versions of EHV condenser bushings incorporated a dome comprised of mulitple parts, this version utilizes a dome formed by one single piece, thus eliminating the need for hardware on top of the dome. In the unlikely event of a leak, the oil will leak out, instead of moisture seeping into the bushing. This reduces the risk of bushing failure.

2.4 Insulating oil
The bushings use high grade transformer insulating oil as a part of the insulation and cooling systems. This oil contains an added inhibitor which aids in the resistance to oxidation. The oil is tested by batch against corrosive sulfer compounds using ASTM D1275, Method B, and ABB/Cigre Covered Conductor Deposition (CCD) tests.

2.5 Voltage tap
The bushings are provided with a Type A (normally grounded) voltage tap as described in figure 1 of IEEE C57.19.01-2000 and shown here in figure 4. This tap is connected to one of the inner foil electrodes of the condenser, commonly referred to as the C1 foil.

With the tap cover installed, the tap is grounded under normal operation. If the voltage tap is used in conjunction with a potential or monitoring device, the voltage between the tap and ground should be limited to 8 kV continuous.

2.6 Insulator shed form
The shed form for all bushings uses an alternating long and short shed design, as shown in figure 5. The alternate shed profile offers an increased creep distance without diminishing performance in rain or ice.

2.7 Seismic capabilities
ABB has a complete line of seismically qualified bushings aligning to IEEE 693-2005. Our current offering includes high seismic performance through 345 kV / 3000 A applications, and moderate seismic performance through 550 kV / 3000 A applications. For further information contact your ABB representative.

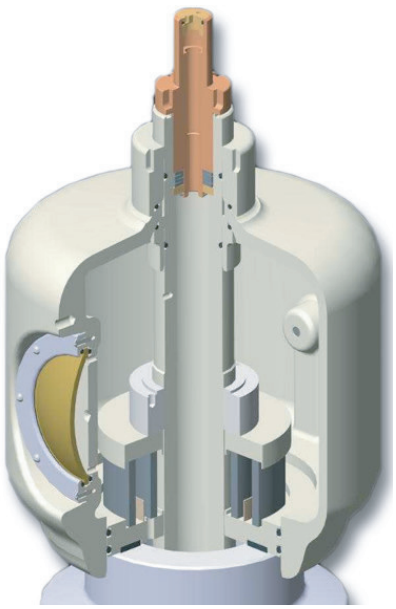


Figure 3: Dome assembly

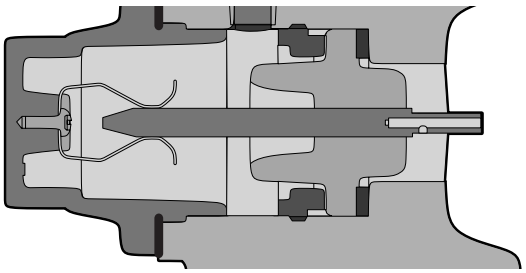


Figure 4: Voltage tap

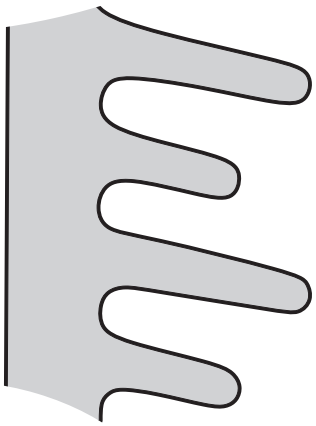


Figure 5: Insulator sheds

Testing

3.1 Routine testing

As part of the manufacturing process, O Plus C II bushings are subjected to a number of routine tests. The routine tests for 230 to 550 kV bushings includes:

- Power factor and capacitance baseline established at 10 kV with an ABB maximum power factor limit of .35%.
- Voltage tap withstand test at 20 kV for 1 minute
- Full-wave lightning impulse withstand test at rated BIL
- Partial discharge test at 1.5 times maximum line-to-ground voltage rating
- Power frequency, one-minute dry withstand test with partial discharge measurement
- Partial discharge test at 1.5 times maximum line-to-ground voltage rating for 15 minutes
- Power factor and capacitance verified at 10 kV and recorded on the nameplate

3.1.1 Mechanical seal integrity tests

The integrity of the bushing sealing system is tested and verified through a series of pressure and vacuum tests. A near-full vacuum is first pulled in the bushing and held for a minimum of 12 hours. An oil over-fill pressure test is then performed at approximately 20 psig for 12 hours at ambient temperature. No evidence of a leak is permitted throughout the entire process.

3.1.2 Electrical tests

Each bushing is subject to final electrical tests at ambient temperature with the lower end of the bushing submerged in transformer oil. All power frequency and one-minute dry withstand test levels are in accordance with the applicable IEEE and IEC requirements.

3.2 Design / type tests

Design tests have been performed for bushing product families to verify conformance with the IEEE and IEC standards referenced in section 2.1, *Applicable standards*. Design test reports are available upon request.

Ratings

4.1 Type O Plus C II 550, 420, 345, and 230 kV electrical specifications

Dimensions listed in this guide are for general reference and may change at anytime. For specific dimensions you must refer to the outline drawing.

Style number	Nominal system voltage (kV)	Basic impulse level (kV)	Max line to ground voltage (kV)	Rated current (A)	Connection method
550Z0800AA	500	1675	318	800	Draw-Lead
550Z2000LD	500	1675	318	2000	Bottom
550Z2000DD	500	1675	318	2000	Draw-Rod
550Z3000LE	500	1675	318	3000	Bottom
550Z3000SE	500	1675	318	3000	Bottom
550Z0800BA	500	1800	318	800	Draw-Lead
550Z2000BD	500	1800	318	2000	Bottom
550Z2000ED	500	1800	318	2000	Draw-Rod
550Z3000BE	500	1800	318	3000	Bottom
550Z3000SA	500	1800	318	3000	Bottom

Table 3 - 550 kV electrical details

Style number	Nominal system voltage (kV)	Basic impulse level (kV)	Max line to ground voltage (kV)	Rated current (A)	Connection method
420Z0600AA	420	1550	243	600	Draw-Lead
420Z1600AB	420	1550	243	1600	Bottom

Table 4 - 420 kV electrical details

Style number	Nominal system voltage (kV)	Basic impulse level (kV)	Max line to ground voltage (kV)	Rated current (A)	Connection method
345Z0800AA	345	1175	220	800	Draw-Lead
345Z1800DD	345	1175	220	1800	Draw-Rod
345Z2000AD	345	1175	220	2000	Bottom
345Z3000AE	345	1175	220	3000	Bottom
345Z3000SE	345	1175	220	3000	Bottom
345Z0800BA	345	1300	220	800	Draw-Lead
345Z1800ED	345	1300	220	1800	Draw-Rod
345Z2000BD	345	1300	220	2000	Bottom
345Z3000BE	345	1300	220	3000	Bottom
345Z3000SA	345	1300	220	3000	Bottom

Table 5 - 345 kV electrical details

Style number	Wet switching pos. impulse (kV)	Dry switching neg. impulse (kV)	Dry withstand (kV)	Min creep distance (in | mm)	Min arcing distance (in | mm)	Max altitude (ft | m)
550Z0800AA	1175	1390	750	562 | 14275	155 | 3937	8000 | 2438
550Z2000LD	1175	1390	750	562 | 14275	155 | 3937	8000 | 2438
550Z2000DD	1175	1390	750	562 | 14275	155 | 3937	8000 | 2438
550Z3000LE	1175	1390	750	562 | 14275	155 | 3937	8000 | 2438
550Z3000SE	1175	1390	750	562 | 14275	155 | 3937	8000 | 2438
550Z0800BA	1360	1500	800	562 | 14275	155 | 3937	3300 | 1006
550Z2000BD	1360	1500	800	562 | 14275	155 | 3937	3300 | 1006
550Z2000ED	1360	1500	800	562 | 14275	155 | 3937	3300 | 1006
550Z3000BE	1360	1500	800	562 | 14275	155 | 3937	3300 | 1006
550Z3000SA	1360	1500	800	562 | 14275	155 | 3937	3300 | 1006

Style number	Wet switching pos. impulse (kV)	Dry switching neg. impulse (kV)	Dry withstand (kV)	Min creep distance (in | mm)	Min arcing distance (in | mm)	Max altitude (ft | m)
420Z0600AA	1175	1286	680	516 | 13106	144 | 3658	7550 | 2301
420Z1600AB	1175	1286	680	516 | 13106	144 | 3658	7550 | 2301

Style number	Wet switching pos. impulse (kV)	Dry switching neg. impulse (kV)	Dry withstand (kV)	Min creep distance (in | mm)	Min arcing distance (in | mm)	Max altitude (ft | m)
345Z0800AA	825	975	520	370 | 9398	102 | 2591	8400 | 2560
345Z1800DD	825	975	520	370 | 9398	102 | 2591	8400 | 2560
345Z2000AD	825	975	520	370 | 9398	102 | 2591	8400 | 2560
345Z3000AE	825	975	520	370 | 9398	102 | 2591	8400 | 2560
345Z3000SE	825	975	520	370 | 9398	102 | 2591	8400 | 2560
345Z0800BA	950	1080	575	370 | 9398	102 | 2591	6400 | 1951
345Z1800ED	950	1080	575	370 | 9398	102 | 2591	6400 | 1951
345Z2000BD	950	1080	575	370 | 9398	102 | 2591	6400 | 1951
345Z3000BE	950	1080	575	370 | 9398	102 | 2591	6400 | 1951
345Z3000SA	950	1080	575	370 | 9398	102 | 2591	7250 | 2210

Ratings

Style number	Nominal system voltage (kV)	Basic impulse level (kV)	Max line to ground voltage (kV)	Rated current (A)	Connection method
230Z0800QA	230	900	146	800	Draw-Lead
230Z1216RA	230	900	146	1200	Bottom
230Z2000TA	230	900	146	2000	Bottom
230Z3000VA	230	900	146	3000	Bottom
230Z0800QB	230	1050	146	800	Draw-Lead
230Z1216RB	230	1050	146	1200	Bottom
230Z2000TB	230	1050	146	2000	Bottom
230Z3000VB	230	1050	146	3000	Bottom

Table 6 - 230 kV electrical details

4.2 Type O Plus C II 550, 420, 345, and 230 kV mechanical specifications

Style number	B (in | mm)	L (in | mm)	CT (in | mm)	EL (in | mm)	D (in | mm)	P (in | mm)	Q (in | mm)
550Z0800AA	193 | 4902	65.00 | 1651	23 | 584	23 | 584	15.0 | 381	16.8 | 426	23.6 | 599
550Z2000LD	191 | 4851	65.00 | 1651	23 | 584	23 | 584	15.0 | 381	16.8 | 426	23.6 | 599
550Z2000DD	191 | 4851	65.00 | 1651	23 | 584	23 | 584	15.0 | 381	16.8 | 426	23.6 | 599
550Z3000LE	191 | 4851	65.00 | 1651	23 | 584	23 | 584	15.0 | 381	16.8 | 426	23.6 | 599
550Z3000SE	190 | 4826	65.00 | 1651	23 | 584	23 | 584	15.0 | 381	16.8 | 426	23.6 | 599
550Z0800BA	193 | 4902	65.00 | 1651	23 | 584	23 | 584	15.0 | 381	16.8 | 426	23.6 | 599
550Z2000BD	191 | 4851	65.00 | 1651	23 | 584	23 | 584	15.0 | 381	16.8 | 426	23.6 | 599
550Z2000ED	191 | 4851	65.00 | 1651	23 | 584	23 | 584	15.0 | 381	16.8 | 426	23.6 | 599
550Z3000BE	191 | 4851	65.00 | 1651	23 | 584	23 | 584	15.0 | 381	16.8 | 426	23.6 | 599
550Z3000SA	191 | 4851	65.00 | 1651	23 | 584	23 | 584	15.0 | 381	16.8 | 426	23.6 | 599

Table 7 - 550 kV mechanical details

Please see figure 6 for dimensioned illustration.

Style number	Wet switching pos. impulse (kV)	Dry switching neg. impulse (kV)	Dry withstand (kV)	Min creep distance (in | mm)	Min arcing distance (in | mm)	Max altitude (ft | m)
230Z0800QA	N/A	825	435	256 | 6509	80 | 2033	10000 | 3048
230Z1216RA	N/A	825	435	256 | 6509	80 | 2033	10000 | 3048
230Z2000TA	N/A	825	435	256 | 6509	80 | 2033	10000 | 3048
230Z3000VA	N/A	825	435	256 | 6509	80 | 2033	10000 | 3048
230Z0800QB	N/A	935	505	256 | 6509	80 | 2033	7000 | 2134
230Z1216RB	N/A	935	505	256 | 6509	80 | 2033	7000 | 2134
230Z2000TB	N/A	935	505	256 | 6509	80 | 2033	7000 | 2134
230Z3000VB	N/A	935	505	256 | 6509	80 | 2033	7000 | 2134

Style number	BC (in | mm)	Bolt holes (in | mm)	LHV (in | mm)	CH (in | mm)	Top terminal (in)	Mount. angle from vert. (deg.)	Approx. weight (lb | kg)
550Z0800AA	25 | 635	12 holes 1.25 | 31.8	162 | 4115	183 | 4648	1.5-12UN-2A x 2.0 L SILVER PLATED	0 to 30	2075 | 941
550Z2000LD	25 | 635	12 holes 1.25 | 31.8	162 | 4115	N/A	2.0-12UN-2A x 2.5 L SILVER PLATED	0 to 30	2080 | 944
550Z2000DD	25 | 635	12 holes 1.25 | 31.8	162 | 4115	N/A	2.0-12UN-2A x 2.5 L SILVER PLATED	0 to 30	2080 | 944
550Z3000LE	25 | 635	12 holes 1.25 | 31.8	162 | 4115	N/A	3.0-12UN-2A x 2.5 L SILVER PLATED	0 to 30	2135 | 968
550Z3000SE	25 | 635	12 holes 1.25 | 31.8	162 | 4115	N/A	3.0-12UN-2A x 2.5 L SILVER PLATED	0 to 30	2180 | 989
550Z0800BA	25 | 635	12 holes 1.25 | 31.8	162 | 4115	183 | 4648	1.5-12UN-2A x 2.0 L SILVER PLATED	0 to 30	2075 | 941
550Z2000BD	25 | 635	12 holes 1.25 | 31.8	162 | 4115	N/A	2.0-12UN-2A x 3.0 L SILVER PLATED	0 to 30	2080 | 944
550Z2000ED	25 | 635	12 holes 1.25 | 31.8	162 | 4115	N/A	2.0-12UN-2A x 2.5 L SILVER PLATED	0 to 30	2080 | 944
550Z3000BE	25 | 635	12 holes 1.25 | 31.8	162 | 4115	N/A	3.0-12UN-2A x 2.5 L SILVER PLATED	0 to 30	2135 | 968
550Z3000SA	25 | 635	12 holes 1.25 | 31.8	162 | 4115	N/A	3.0-12UN-2A x 3.0 L SILVER PLATED	0 to 30	2180 | 989

Ratings

Style number	B (in | mm)	L (in | mm)	CT (in | mm)	EL (in | mm)	D (in | mm)	P (in | mm)	Q (in | mm)
420Z0600AA	181 | 4597	64.00 | 1626	23 | 584	23 | 584	15.0 | 381	16.9 | 429	19.6 | 498
420Z1600AB	180 | 4572	64.00 | 1626	23 | 584	23 | 584	15.0 | 381	16.9 | 429	19.6 | 498

Table 8 - 420 kV mechanical details

Style number	B (in | mm)	L (in | mm)	CT (in | mm)	EL (in | mm)	D (in | mm)	P (in | mm)	Q (in | mm)
345Z0800AA	132 | 3353	51.00 | 1295	23 | 584	23 | 584	11.5 | 292	12.8 | 324	19.6 | 499
345Z1800DD	131 | 3327	51.00 | 1295	23 | 584	23 | 584	11.5 | 292	12.8 | 324	19.6 | 499
345Z2000AD	131 | 3327	51.00 | 1295	23 | 584	23 | 584	11.5 | 292	12.8 | 324	19.6 | 499
345Z3000AE	130 | 3302	51.00 | 1295	23 | 584	23 | 584	11.5 | 292	12.8 | 324	19.6 | 499
345Z3000SE	130 | 3302	51.00 | 1295	23 | 584	23 | 584	11.5 | 292	12.8 | 324	19.6 | 499
345Z0800BA	132 | 3353	51.00 | 1295	23 | 584	23 | 584	11.5 | 292	12.8 | 324	19.6 | 499
345Z1800ED	131 | 3327	51.00 | 1295	23 | 584	23 | 584	11.5 | 292	12.8 | 324	19.6 | 499
345Z2000BD	131 | 3327	51.00 | 1295	23 | 584	23 | 584	11.5 | 292	12.8 | 324	19.6 | 499
345Z3000BE	130 | 3302	51.00 | 1295	23 | 584	23 | 584	11.5 | 292	12.8 | 324	19.6 | 499
345Z3000SA	130 | 3302	51.00 | 1295	23 | 584	23 | 584	11.5 | 292	12.8 | 324	19.6 | 499

Table 9 - 345 kV mechanical details

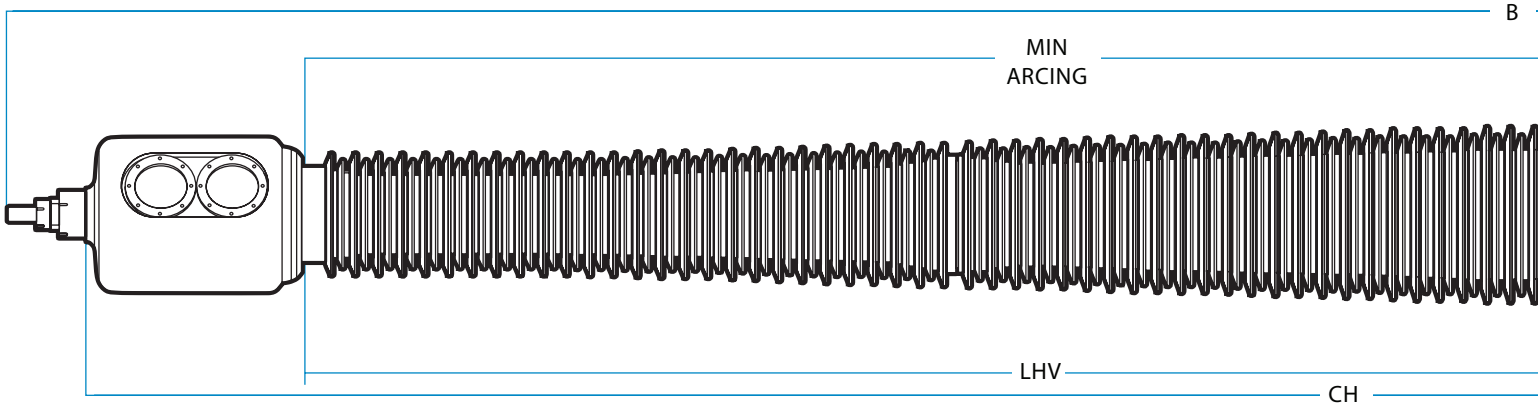
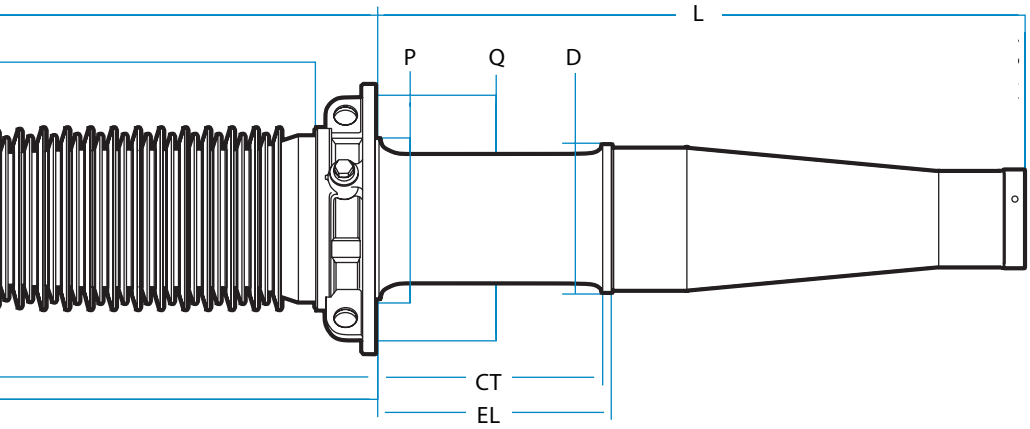


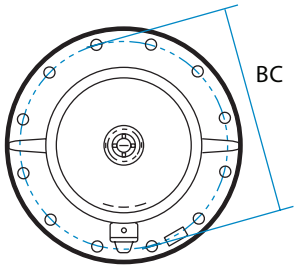
Figure 6

Tube ID is 2 inches (50.8 mm) for 550Z0800AA, 550Z0800BA, 420Z0600AA, 345Z0800AA, and 345Z0800BA.

Style number	BC (in | mm)	Bolt holes (in | mm)	LHV (in | mm)	CH (in | mm)	Top terminal (in)	Mount. angle from vert. (deg.)	Approx. weight (lb | kg)
420Z0600AA	21 | 533	12 holes 1.25 | 31.8	150 | 3810	171 | 4350	1.5-12UN-2A x 2.5 L SILVER PLATED	0 to 30	2075 | 941
420Z1600AB	21 | 533	12 holes 1.25 | 31.8	150 | 3810	N/A	1.5-12UN-2A x 2.5 L SILVER PLATED	0 to 30	2080 | 943

Style number	BC (in | mm)	Bolt holes (in | mm)	LHV (in | mm)	CH (in | mm)	Top terminal (in)	Mount. angle from vert. (deg.)	Approx. weight (lb | kg)
345Z0800AA	21 | 533	12 holes 1.25 | 31.8	108 | 2756	122 | 3103	1.5-12UN-2A x 2.1 L SILVER PLATED	0 to 30	1080 | 490
345Z1800DD	21 | 533	12 holes 1.25 | 31.8	108 | 2756	N/A	2.0-12UN-2A x 2.5 L SILVER PLATED	0 to 30	1105 | 501
345Z2000AD	21 | 533	12 holes 1.25 | 31.8	108 | 2756	N/A	2.0-12UN-2A x 3.0 L SILVER PLATED	0 to 30	1105 | 501
345Z3000AE	21 | 533	12 holes 1.25 | 31.8	108 | 2756	N/A	3.0-12UN-2A x 3.0 L SILVER PLATED	0 to 30	1100 | 499
345Z3000SE	21 | 533	12 holes 1.25 | 31.8	108 | 2753	N/A	3.0-12UN-2A x 3.0 L SILVER PLATED	0 to 30	1135 | 515
345Z0800BA	21 | 533	12 holes 1.25 | 31.8	108 | 2756	122 | 3103	1.5-12UN-2A x 2.1 L SILVER PLATED	0 to 30	1080 | 490
345Z1800ED	21 | 533	12 holes 1.25 | 31.8	108 | 2756	N/A	2.0-12UN-2A x 3.0 L SILVER PLATED	0 to 30	1105 | 501
345Z2000BD	21 | 533	12 holes 1.25 | 31.8	108 | 2756	N/A	2.0-12UN-2A x 3.0 L SILVER PLATED	0 to 30	1105 | 501
345Z3000BE	21 | 533	12 holes 1.25 | 31.8	108 | 2756	N/A	3.0-12UN-2A x 3.0 L SILVER PLATED	0 to 30	1100 | 499
345Z3000SA	21 | 533	12 holes 1.25 | 31.8	108 | 2753	N/A	3.0-12UN-2A x 3.0 L SILVER PLATED	0 to 20	1135 | 515





Ratings

Style number	B (in | mm)	L (in | mm)	CT (in | mm)	EL (in | mm)	D (in | mm)	P (in | mm)	Q (in | mm)
230Z0800QA	106 | 2696	50.73 | 1288	23 | 584	23 | 584	9.5 | 241	15.0 | 381	19.6 | 498
230Z1216RA	104 | 2642	50.23 | 1276	23 | 584	23 | 584	9.5 | 241	15.0 | 381	19.6 | 498
230Z2000TA	105 | 2664	50.23 | 1276	23 | 584	23 | 584	9.5 | 241	15.0 | 381	19.6 | 498
230Z3000VA	104 | 2642	50.23 | 1276	23 | 584	23 | 584	9.5 | 241	15.0 | 381	19.6 | 498
230Z0800QB	106 | 2696	50.73 | 1288	23 | 584	23 | 584	9.5 | 241	15.0 | 381	19.6 | 498
230Z1216RB	104 | 2642	50.23 | 1276	23 | 584	23 | 584	9.5 | 241	15.0 | 381	19.6 | 498
230Z2000TB	105 | 2664	50.23 | 1276	23 | 584	23 | 584	9.5 | 241	15.0 | 381	19.6 | 498
230Z3000VB	104 | 2642	50.23 | 1276	23 | 584	23 | 584	9.5 | 241	15.0 | 381	19.6 | 498

Table 10 - 230 kV mechanical details

Please see figure 6 for dimensioned illustration.

4.3 Maximum voltage

The bushing maximum continuous line-to-ground voltage is indicated on the outline drawing and should serve as the limit for voltage application. Any voltage applied above these levels may cause damage to, and/or failure of, the bushing. For temporary overvoltage conditions, contact ABB.

4.4 Current rating & overload

The current rating of the bushing indicates the maximum continuous current that the bushing can carry without abnormal loss of life. ABB designed these bushings for overloading according to IEEE C57.19.100-1995, with loss of life not to exceed the calculations included in the standard. For further information relative to bushing overload scenarios, contact ABB.

Style number	BC (in | mm)	Bolt holes (in | mm)	LHV (in | mm)	CH (in | mm)	Top terminal (in)	Mount. angle from vert. (deg.)	Approx. weight (lb | kg)
230Z0800QA	21 | 533	12 holes 1.25 | 31.8	85 | 2160	96 | 2440	1.5-12UN-2A x 2.0 L SILVER PLATED	0 to 20	740 | 338
230Z1216RA	21 | 533	12 holes 1.25 | 31.8	85 | 2160	N/A	1.5-12UN-2A x 2.0 L SILVER PLATED	0 to 20	729 | 331
230Z2000TA	21 | 533	12 holes 1.25 | 31.8	85 | 2160	N/A	2.0-12UN-2A x 2.5 L SILVER PLATED	0 to 20	751 | 341
230Z3000VA	21 | 533	12 holes 1.25 | 31.8	85 | 2160	N/A	3.0-12UN-2A x 3.5 L SILVER PLATED	0 to 20	753 | 342
230Z0800QB	21 | 533	12 holes 1.25 | 31.8	85 | 2160	96 | 2440	1.5-12UN-2A x 2.0 L SILVER PLATED	0 to 20	740 | 338
230Z1216RB	21 | 533	12 holes 1.25 | 31.8	85 | 2160	N/A	1.5-12UN-2A x 2.0 L SILVER PLATED	0 to 20	729 | 331
230Z2000TB	21 | 533	12 holes 1.25 | 31.8	85 | 2160	N/A	2.0-12UN-2A x 2.5 L SILVER PLATED	0 to 20	751 | 341
230Z3000VB	21 | 533	12 holes 1.25 | 31.8	85 | 2160	N/A	3.0-12UN-2A x 3.5 L SILVER PLATED	0 to 20	753 | 342

4.5 Short circuit current rating

There are no existing short circuit ratings for condenser bushings defined by the IEEE or IEC standards. There are, however, requirements for transformers in both the IEEE and IEC standards which can serve as a guideline for bushing short circuit ratings.

In IEEE C57.12.00-2006 section 7.1.3.1, the maximum short circuit duration for category II, III, and IV transformers is defined as two seconds. By solving the equation given in the same section, it can be determined that the symmetrical short circuit current rating is equal to 25 times the normal rated current.

In IEC 60137 section 4.3, the standard states that the short circuit current rating shall be 25 times the normal rated current for a two second duration with reference to IEC 60076-5. The rated short circuit current shall not exceed 100 kA symmetrical.

Draw-rod applications have short circuit current ratings of 20 times the normal rated current for a duration of two seconds. The rated short circuit current shall not exceed 80 kA symmetrical.

For short circuit loss of life data relative to the bushing condenser insulation, contact ABB.

Connection details

5.1 Draw-lead application
Proper sizing of the draw-lead cable is the responsibility of the transformer designer. The maximum rated current for a bushing using a draw lead application is 600 amperes for 420 kV bushings and 800 amperes for 230 kV, 345 kV, and 550 kV bushings. The transformer designer must note the inside diameter of the bushing conductor tube because this will limit the choice of cable size. He/She must also ensure the draw-lead is adequately insulated to isolate it from the inner diameter of the bushing tube.

5.2 Draw-rod application
Draw-rod configurations of the bushings are available. This connection method provides the rated current of a bottom connection, but with the installation and removal flexibility of a draw-lead connected bushing.

Bushings that are suitable for draw-rod application have an opening through the main axis of the bushing conductor. The draw-rod is pulled through this opening and secured at the top of the bushing. This makes it possible to remove/install the bushing without draining the apparatus on which it is applied.

With this application, the current is not carried by the draw-rod, but is transferred to the bushing conductor at the lower end of the bushing. Therefore, the draw-rod rating of the bushing is the same as for bottom connected. However, the rating of the bushing and draw-rod combination is never greater than the maximum rating of the lower support.

5.3 Bottom connected application
O Plus C II bushings are provided with bolting provisions on the lower support to accommodate the use of lower terminals, see figures 8 - 10 for examples. The bolting provision details are provided on the bushing outline drawings. These terminals are typically included in a kit which includes the shield and mounting hardware.

5.4 Draw-lead connected
If a draw-lead bushing is ordered, it will be shipped with the standard brazed-type draw-lead connector as shown in figure 7. If the standard draw-lead connector is not suitable for the application, contact ABB for additional options.

5.5 Draw-rod connected
When ordering a bushing that is draw-rod connected, the bushing will be supplied complete with upper and lower terminals, as well as the inner draw-rod itself. The draw-rod is constructed from several sections of rod joined by threaded couplers. These sections may then be disconnected for shipment of the transformer to site or storage of the transformer with bushings removed. To install the bushing, the rod sections are simply re-connected with the threaded couplers and the rod is inserted into the bushing. More detailed information and instructions may be found in the Type O Plus C II EHV draw-rod installation guide, 1ZUA2751-245.

Note: The lower terminal is provided with a draw-rod bushing. However, a separate shield kit is required that includes the mounting adapter and hardware. Please see Table 11 for specific shield information.

5.6 Bottom connected
The bottom connected bushing features the IEEE C57.19.01-2000 lower support bolting configuration. Figures 8 - 10 are samples of the current-carrying lower connection terminals that are available from ABB.

5.7 Top terminal connections
O Plus C II EHV bushings generally have IEEE C57.19.01-2000 standard top terminals. The purchaser can order bushings with other terminals if so desired.

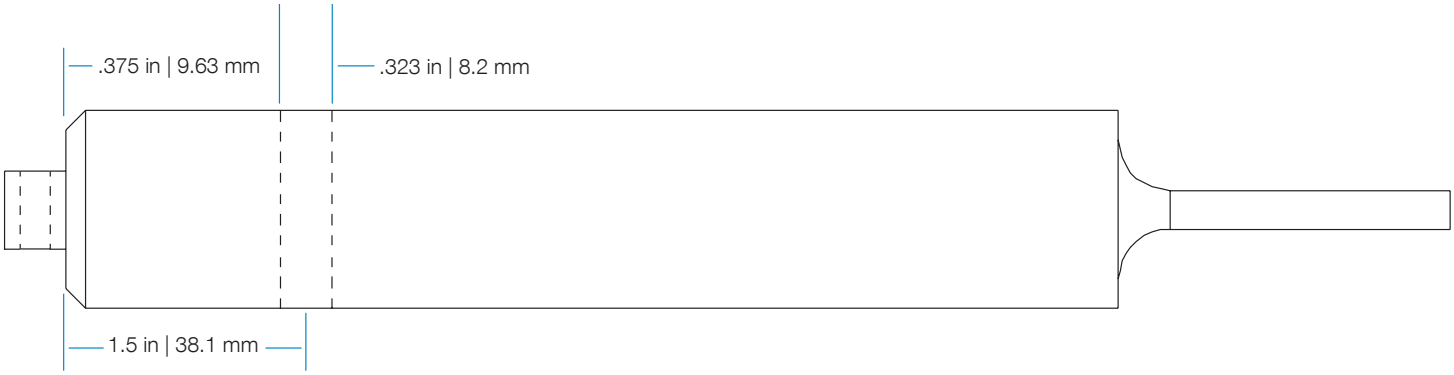


Figure 7: Draw-lead connector

Connection details

Sample 230 kV lower support

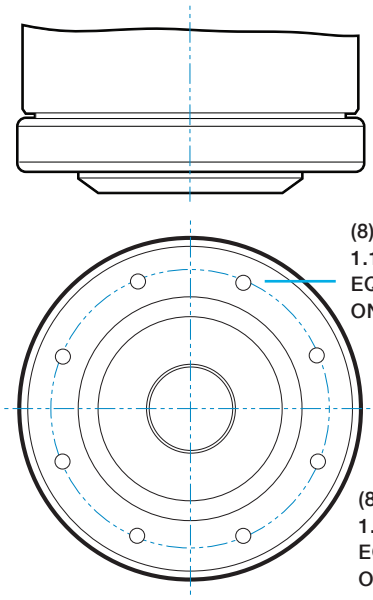


Figure 8

Sample 345 kV lower support

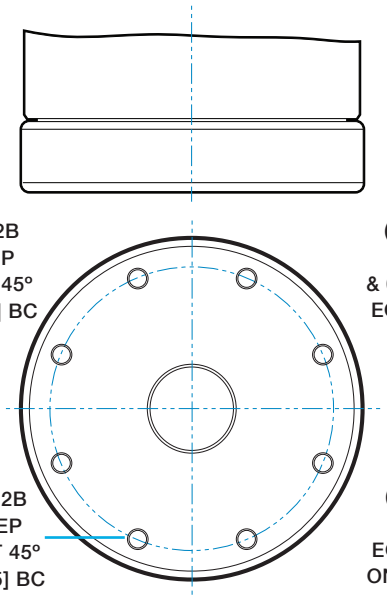


Figure 9

Sample 420 kV and 550 kV lower support

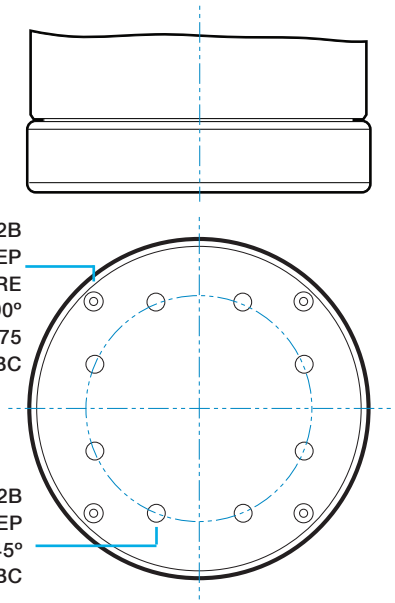


Figure 10

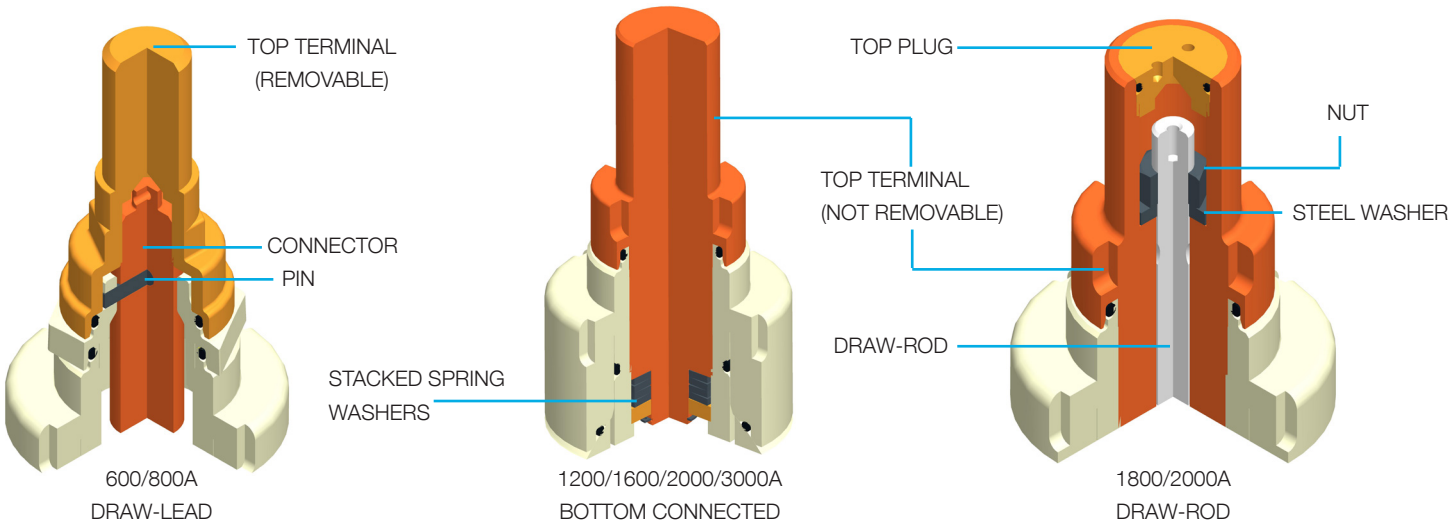


Figure 11: Upper terminal connections

Connection details

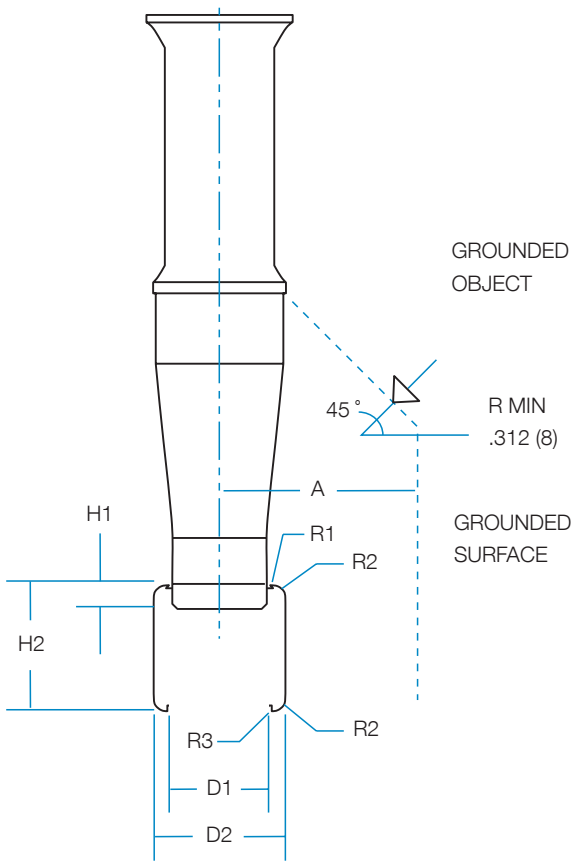


Figure 12: Shielding diagram

Shield/terminal kit part number	BIL (kV)
1ZUA274801-AEN	750
1ZUA274801-AQA	750
1ZUA274801-ASC	750
1ZUA274801-AEN	900
1ZUA274801-AQA	900
1ZUA274801-ASC	900
1ZUA274801-AEN	950
1ZUA274801-AQA	950
1ZUA274801-ASC	950
1ZUA274801-AEN	1050
P4B237G01	1050
1ZUA274801-AEN	1050
P4B237G01	1050
P4B237G01	1175
P4B237G01	1175
P4B237G01	1300
1ZUA274801-ADJ	1550
1ZUA274801-AEA	1550
1ZUA274801-AEB	1550
1ZUA274801-ANG	1550
1ZUA274801-APC	1550
1ZUA274801-ADJ	1675
1ZUA274801-AEA	1675
1ZUA274801-AEB	1675
1ZUA274801-ANG	1675
1ZUA274801-APC	1675
1ZUA274801-ADJ	1800
1ZUA274801-AEA	1800
1ZUA274801-AEB	1800
1ZUA274801-ANG	1800
1ZUA274801-APC	1800

Table 11 - Shielding dimensions

Smooth grounded surface clearance - A (in | mm)	Shield dimensions (in | mm)						
	R1	R2	R3	D1	D2	H1	H2
11.5 | 292	0.25 | 6.3	1 | 25.4	0.25 | 6.4	8.75 | 222	11 | 279	1.438 | 36.5	8.75 | 222
11.5 | 292	0.25 | 6.3	1.25 | 31.8	0.25 | 6.4	8.75 | 222	11.5 | 292	2.875 | 73	11 | 279
11.5 | 292	0.25 | 6.3	1.25 | 31.8	0.25 | 6.4	8.75 | 222	11.5 | 292	2.875 | 73	11 | 279
12.75 | 324	0.25 | 6.3	1 | 25.4	0.25 | 6.4	8.75 | 222	11 | 279	1.438 | 36.5	8.75 | 222
12.75 | 324	0.25 | 6.3	1.25 | 31.8	0.25 | 6.4	8.75 | 222	11.5 | 292	2.875 | 73	11 | 279
12.75 | 324	0.25 | 6.3	1.25 | 31.8	0.25 | 6.4	8.75 | 222	11.5 | 292	2.875 | 73	11 | 279
13 | 330	0.25 | 6.3	1 | 25.4	0.25 | 6.4	8.75 | 222	11 | 279	1.438 | 36.5	8.75 | 222
13 | 330	0.25 | 6.3	1.25 | 31.8	0.25 | 6.4	8.75 | 222	11.5 | 292	2.875 | 73	11 | 279
13 | 330	0.25 | 6.3	1.25 | 31.8	0.25 | 6.4	8.75 | 222	11.5 | 292	2.875 | 73	11 | 279
13.75 | 350	0.25 | 6.3	1 | 25.4	0.25 | 6.4	8.75 | 222	11 | 279	1.438 | 36.5	8.75 | 222
13.75 | 350	0.25 | 6.3	1.25 | 31.8	0.5 | 12.7	8.75 | 222	11.5 | 292	2.188 | 55.6	6 | 152.4
14.75 | 375	0.25 | 6.3	1 | 25.4	0.25 | 6.4	8.75 | 222	11 | 279	1.438 | 36.5	8.75 | 222
14.75 | 375	0.25 | 6.3	1.25 | 31.8	0.5 | 12.7	8.75 | 222	11.5 | 292	2.188 | 55.6	6 | 152.4
15.25 | 388	0.25 | 6.3	1.25 | 31.8	0.5 | 12.7	8.75 | 222	11.5 | 292	2.188 | 55.6	6 | 152.4
16.25 | 413	0.25 | 6.3	1.25 | 31.8	0.5 | 12.7	8.75 | 222	11.5 | 292	2.188 | 55.6	6 | 152.4
16.75 | 426	0.25 | 6.3	1.25 | 31.8	0.5 | 12.7	8.75 | 222	11.5 | 292	2.188 | 55.6	6 | 152.4
20.078 | 510	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
20.078 | 510	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
20.078 | 510	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
20.078 | 510	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
20.078 | 510	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
21.656 | 550	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
21.656 | 550	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
21.656 | 550	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
21.656 | 550	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
21.656 | 550	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
24.609 | 625	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
24.609 | 625	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
24.609 | 625	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
24.609 | 625	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343
24.609 | 625	0.25 | 6.3	2 | 50.8	0.5 | 12.7	9.5 | 241	14.5 | 368	3 | 76.2	13.5 | 343

Connection details

6.1 Shielding

The maximum stresses in the oil at the lower end of the bushing must be limited to typical threshold values for non-insulated conductors of similar components in the transformer. When applying these recommendations, all sharp edges must be shielded using a static shield assembly or other appropriate shielding method. ABB has designed shields for each Type O Plus C II bushing style and has made accommodations for different connection methods, ie draw-lead, draw-rod, or bottom connect. These shields are available with a variety of coating options including: bare, epoxy coated, cellulose coated, or epoxy and cellulose coated. Table 11 provides a list of epoxy coated shields and terminal kits for each bushing style. This list does not represent all of the shield offerings available from ABB. Contact your ABB representative for additional shield options.

6.2 Distance of grounded surfaces from live parts

The following recommendations are intended as guidelines only. ABB recommends that specific design calculations be made to verify the proper clearances.

The calculations for clearances as recommended in these tables are assuming an epoxy-coated aluminum static shield and a bare grounded surface. Design consideration should be given to the coating on the shield and any possible coating on the grounded surface as these can have a significant impact on these distances. The dimensions in Table 11 provide guidelines for the bushing as referenced in Figure 12.

Common specifications and ordering details

7.1 Common specifications

- The bushing manufacturer shall have specialized in the design, manufacture, and assembly of liquid-filled condenser bushings for a minimum of 30 years.
- Bushings shall meet IEEE C57.19.100-1995 heavy contamination or IEC 60815 long creepage distance at a minimum.
- Bushings shall meet minimum altitude requirement of up to 1000 meters.
- Bushings shall use prismatic type sight glass(es) for oil level indication.
- Bushings shall conform to all electrical requirements as outlined in IEEE C57.19.00-2004
- Bushings shall conform to all dimensional requirements as outlined in IEEE C57.19.01-2000
- Bushings shall be of condenser type using oil-impregnated paper.
- Bushings shall be rated for (low, moderate, or high) seismic performance per IEEE 693-2005 criteria.
- Ambient temperature shall not exceed the limits of +40°C to -50°C, and the 24 hour average ambient shall not exceed +30°C.

7.2 Ordering details

When ordering please specify the following:

- Bushing type and style number
- Current rating
- Voltage class and BIL
- Any non-standard requirement such as impulse tests or high temperature application must be specified at the time of quotation.

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1ZUA2751-240, rev. 1

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