

PNR Composite

Condenser Bushing 24kV-550kV
Oil-to-Air Applications
Resin Impregnated Paper Bushing

PNR Bushings are capacitance graded bushings with Resin Impregnated Paper core. Design, Components and manufacturing technology of RIP Bushings promote an average lifetime in excess of 30 years under normal operating conditions.

GE Bushings – your Partner of choice

GE, a company you can trust to harness your power. Following the acquisition of Passoni and Villa in 2008, former Alstom Grid now GE Grid Solutions offers a wide range of condenser bushings for AC and DC applications. Our partner acknowledges us as one of the most reputable and reliable Bushing manufacturers in the world.

A Wealth of Benefits

- We have pioneered in Bushing Technology with our combined experience and expertise over nine decades.
- RIP Bushings offer multiple benefits over conventional Bushings (OIP).
- RIP Bushings suitable for all transformers types are available.

Flexibility

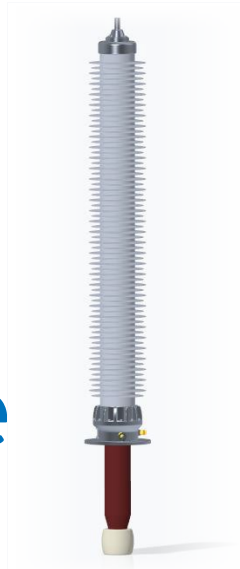
Ease of transport, handling, storage and installation. Flexibility in angle of installation.

Seismic Solutions

RIP Bushings have been seismic tested in accordance to IEC 61463 and IEEE 693-2018 for specific variants. Details on request.

Bushings to suit specific requirements

- Bushings in accordance to IEEE C57.19.01 with special flag dimensions available on request.
- Bushings in accordance to NF C52-062 including special power factor tap , flags available on request.
- Bushings for replacement with adaptation and interchangeability available on request. Specific terminals , lugs and counter flange can be provided.



Key Benefits

- Compact, Robust and Reliable design.
- Partial discharge-free up to rated nominal voltage
- Excellent mechanical strength
- High thermal strength (Class E, 120°C)
- Low dielectric losses ($\tan\delta \leq 0.4\%$)
- Suitable for Ester Oil immersion media.
- Suitable for low temperature of -50DegC

Safety – Our priority

- Personnel, Substation and Environment protection
- RIP bushings are fire and explosion-proof
- Oil and SF6 free means no environmental costs on end-of-life disposal
- Free from leakage issues
- Special Internal Arc test on Bushing
- Tracking and Erosion test on insulator

Minimal Maintenance

- RIP Bushings are 100% oil and pressure- free, hence no specific maintenance or on-site verification are required.
- Measurement of $\tan\delta$ and capacitance is recommended as part of maintenance check

Test Standards

- Bushings conform to IEC-60137
- Bushings conforming to IEEE C57.19.01 / NF C52-062 standard are also available.
- Very High Cantilever Solution available on request.
- Tailor made Design available on request.



PNR Bushings Main Features

Resin Impregnated Paper Bushing

- Oil-to-air
- Resin Impregnated Paper
- Installation in any position
- Dimensions of flange terminals in accordance with IEC 60137 standards
- Partial discharges < 5pC at 1.5 Um/V³
- Power factor tap grounded through the cap
- Flange made of corrosion-free aluminum
- Execution with fixed and solid conductor

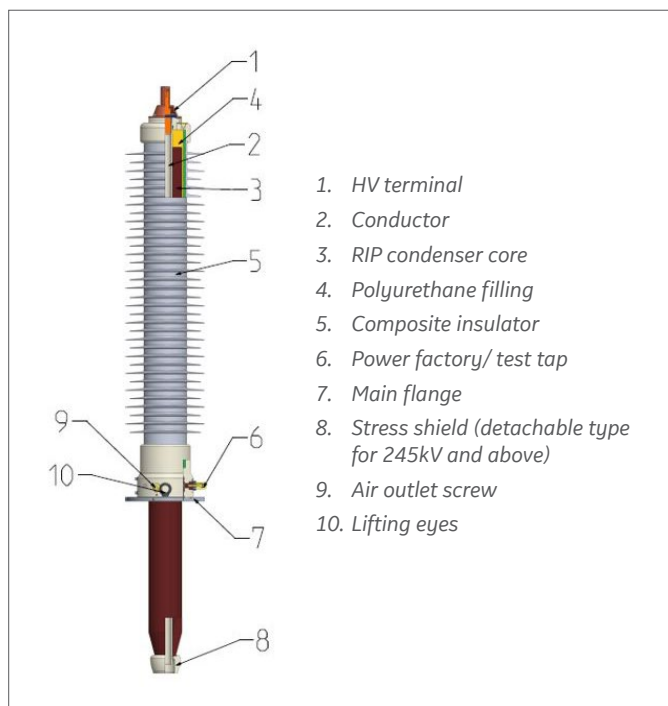


Fig. 4: PNR Bushing Typical Cross Section

Bushing Designation PNR.145.650.1250

CODE	DESCRIPTION
P	Condenser bushings ('P' from the Italian word 'Passante')
N	Normal
R	Resin Impregnated Paper (RIP)
145	Rated voltage in kV
650	BIL in kV
1250	Rated current in A

Nameplate

Each bushing is provided with a nameplate, containing complete electrical data and the serial number, in accordance with the requirements of IEC/IEEE requirements.

The aluminum nameplate is secured to the flange with rivets and carries the following information.

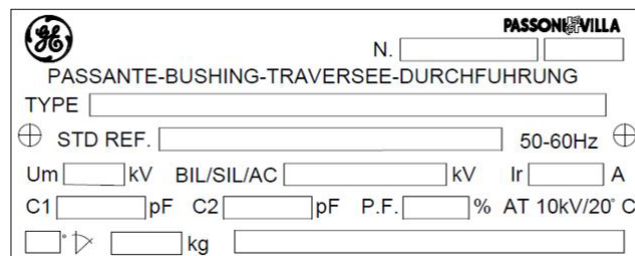


Fig. 5: Nameplate

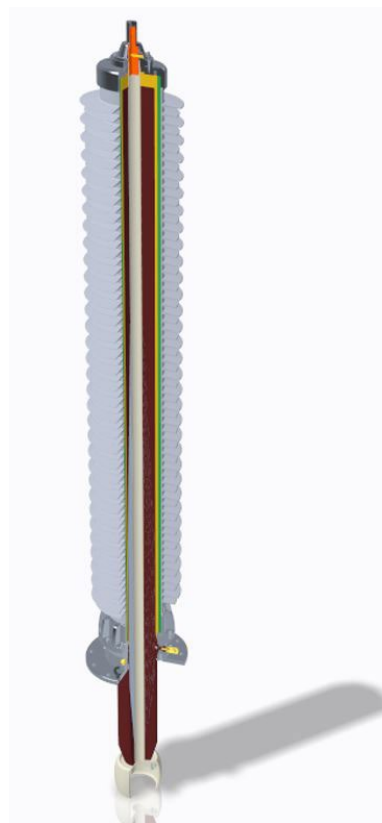


Fig.6 : Bushing section

Key Features

RIP Condenser Core

The main insulation of the bushing comprises of resin Impregnated paper. The condenser core is manufactured with crepe paper wound on central tube or rod. Winding is done under heat on a state of art winding machine. Series of Aluminum foils are inserted between the paper layers at predetermined positions to achieve the optimum distribution of radial and longitudinal electrical gradients between central tube and flange. The condenser core is then processed under heat, vacuum and resin impregnated under highly controlled conditions.

Air side insulator

The air side insulator is of composite or porcelain insulator. The composite insulator is reinforced with fiber glass tube to providing additional layer of protection, high mechanical strength and seismic performance.

Flange

The flange is made of corrosion free aluminum and is equipped with lifting holes, air vent screw and a power factor tap (tested at 3 kV for 60 s). Special coating up to CH5 class on request. Voltage tap can be provided on request.

Polyurethane Filling

The space between RIP core and the housing is dry- filled with polyurethane. Dry filling eliminates the risk of pollution (as in SF6 filling) and is leak proof should any damage exceptionally occur. Polyurethane has been specially selected for its high mechanical and electrical properties. High compressibility polyurethane makes the bushings more resistant to mechanical stress caused by thermal variation.

Assembling

The RIP condenser core and main flange are assembled in high controlled environment to avoid moisture and contamination of the RIP surface during the production.

Power Factor Tap

The PF tap is the connection to outer conducting layer of a capacitance-graded bushing. It is accessible from outside the bushing, insulated from the flange or other fixing devices, and measures the dissipation factor, capacitance and partial discharge while the bushing flange is earthed. A suitable fully mounted PF measuring tap is supplied with all RIP bushings.

Top Terminal

Bushings top terminal is made of aluminum or copper terminals. Tinned or silver-plated copper terminal can be supplied on request. Draw-lead or draw-rod type bushings (rated current up to 1600A) have a removable top terminal. This terminal is connected to the copper inner terminal lug or the draw rod by means of multi-contact and is screwed to the bushing head. In bottom-connected bushings, the inner non-removable rod extends as top terminal.



Fig.7/8: Lifting of the Bushings



Fig. 9: Air outlet screw



Fig. 10: Voltage tap (On request)



Fig. 11/12: Power factor tap

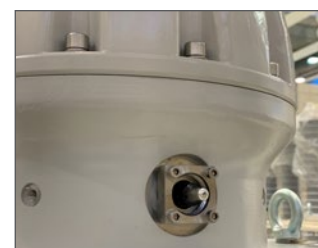


Fig. 13: Removable top terminal



Fig. 14: top terminal conductor

Key Features

Metal Surface Treatment

All metal bushing surfaces are made of aluminum alloy with high resistance in industrial environment, with high humidity content and aggressive atmosphere, like offshore with high salinity.

Power factor tap and voltage tap surface finish avoids any corrosion throughout lifetime and allows for easy fixing and unscrewing in service. Further finishing or final painting are the customer's option.

Electrical test

The bushings are tested according to latest edition of IEC 60137 – “Insulated bushings for alternating voltage above 1000 V”. Upon request it is possible to carry-out electrical test according to other relevant standards.

Mechanical test

The SF6 side and metal parts are tested in accordance with the most stringent international standards to ensure a proper resistance to gas pressure. The flange is designed to support the mechanical stress due to the double connection, GIS from one side and transformer on the other side. The design is made in compliance with IEC 62271-211 standards. Furthermore, the bushings successfully passed tests on shaking table to ensure a proper strength to earthquakes and short circuits.

Packing & Transportation

Bushings are thoroughly cleaned after testing before packing. Bushings are packed in vacuum sealed bag along with silica gel to avoid moisture ingress. For long term storage (for spares bushings) oil side is inserted in a metallic container and sealed with Nitrogen or Oil.

Oil Side shield

The oil end is provided with a carefully designed shield to reduce the electric field stress in transformer oil. The shield is epoxy painted. The shield is integrated part of the bushing up to 170kV. Bushings rated 245kV and above are detachable type of shield. Special type of coating available on request.

Long Term Storage Accessories

For long term storage and upon request the bushings are equipped with protective tank filled with nitrogen to protect the condenser core against any damage, moisture and humidity. The crate can be equipped with shock indicator as well.

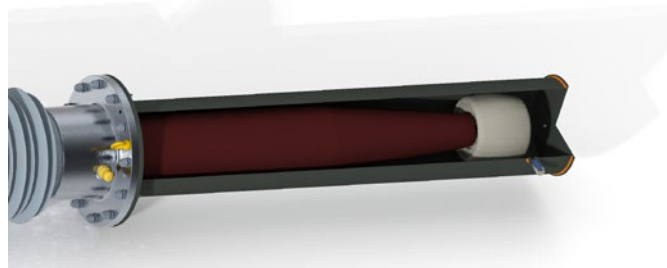


Fig. 16: Long term storage RIP bushings

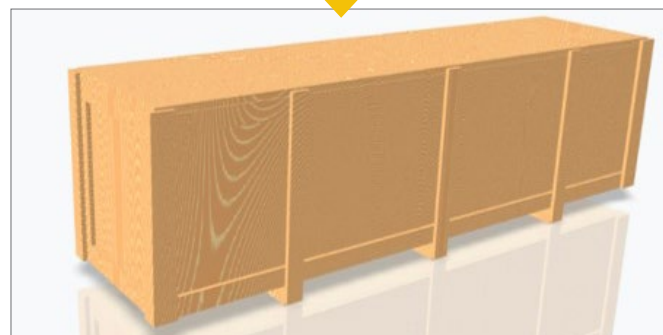
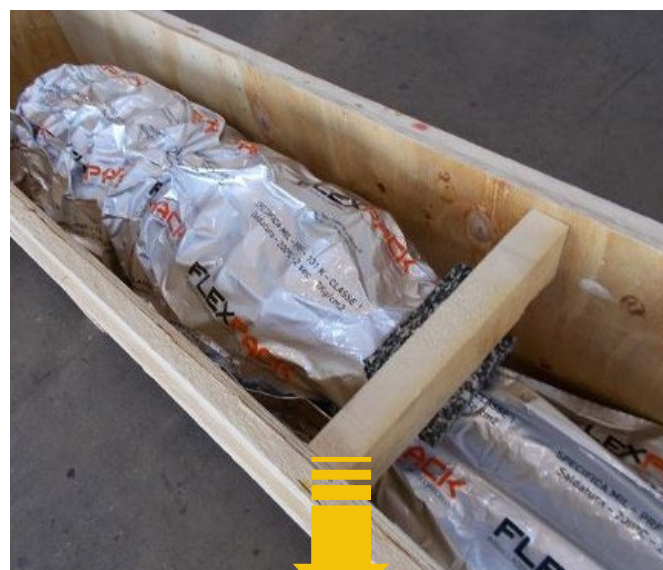


Fig. 17: Packaging - transportation



Fig. 15: Cantilever Test

PNR Range from 24 to 550 kV: Ratings/Dimensions

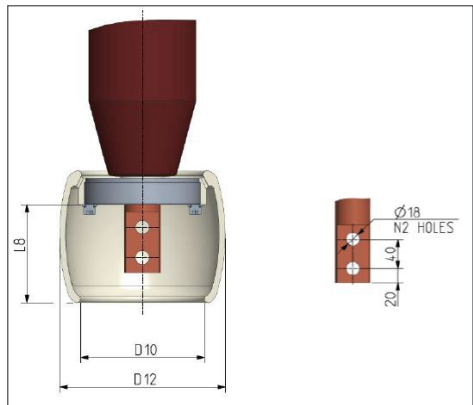
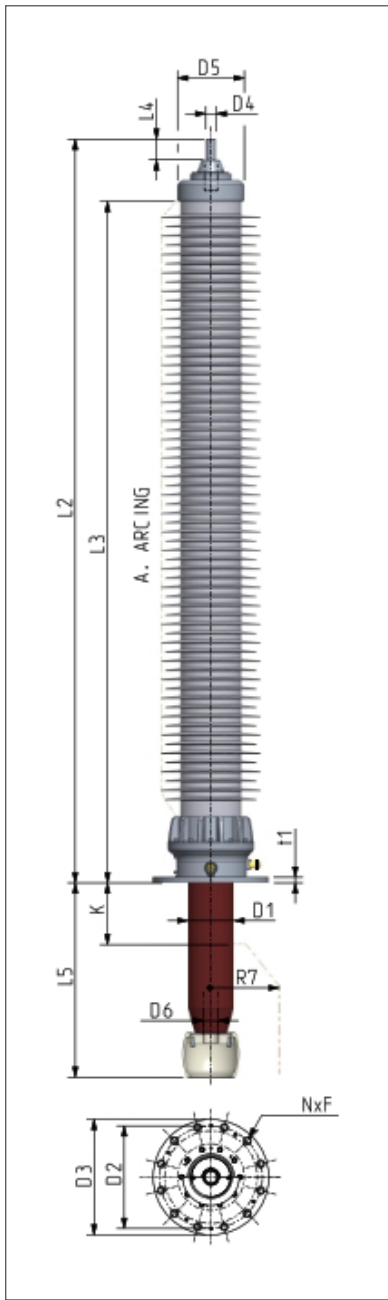


Fig. 1

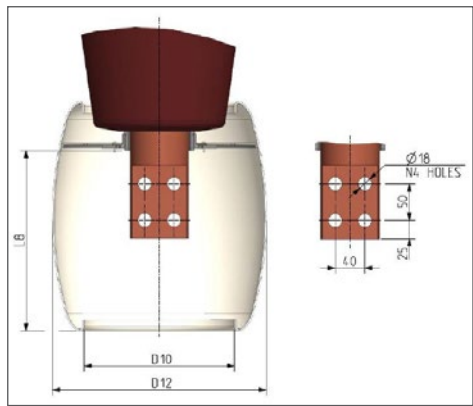


Fig. 2

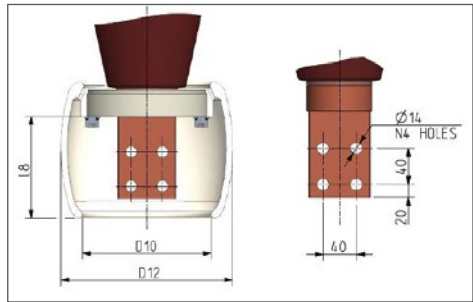
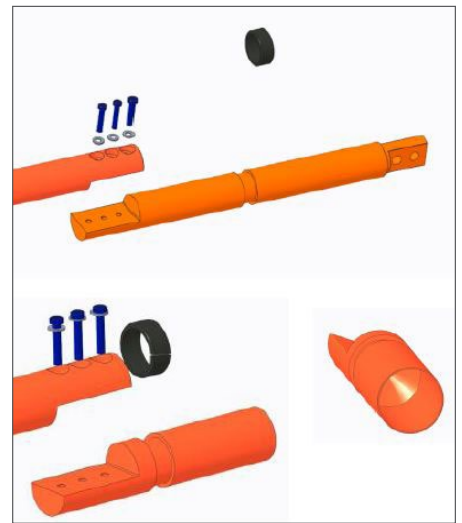


Fig. 3 Transformer side



Draw-rod connections

PNR Bushing 24kV to 550kV With Composite Insulator

Condenser bushing, oil - air, for Transformers	Nominal System Voltage	Rated line to earth Voltage	Dry lightning impulse (BIL)	Rated continuous current	Power frequency withstand voltage (for 60 s) Dry/Wet	Wet Switching Impulse withstand	Draw Lead connection	Draw Rod connection	Bottom connection	Minimum Nominal Creepage Distance	Minimum Arcing distance	Cantilever withstand load 1min	Max Operating Altitude	Short time rating for 2s (As per IEC 60137)	Short time rating for 1s / 3s
TYPE/Voltage[kV]/ Current Range [A]	kV	kV	kVp	A	kV	kV				mm	mm	N	Meter	kA	kA
24.125	1000	24	14	1000	55/50	-	x			800	250	1250	1000	25	35/20
	1600			1600			x	40	57/33						
	2000			2000			x	50	71/41						
	3150			3150			x	78,75	111/64						
36.170	1000	36	20	1000	77/70	-	x			1700	450	2000	3300	25	35/20
	2000			2000			x	50	71/41						
	2500			2500			x	62,5	88/51						
	3150			3150			x	78,75	111/64						
52.250	1000	52	30	1000	105/95	-	x			1700	450	2500	1000	25	35/20
	2000			2000			x	50	71/41						
	2500			2500			x	62,5	88/51						
	3150			3150			x	78,75	111/64						
72,5.325	1000	72,5	42	1000	155/140	-	x			2450	700	3150	1600	25	35/20
	1600			1600			x	40	57/33						
	2000			2000			x	50	71/41						
	2500			2500			x	62,5	88/51						
123.550	800	123	71	800	255/230	-	x			3880	1035	4000	1000	20	28/16
	1600			1600			x	40	57/33						
	2000			2000			x	50	71/41						
	3150			3150			x	78,75	111/64						
145.650	800	145	84	800	305/275	-	x			5500	1288	4000	1000	20	28/16
	1250			1250			x	31,25	44/26						
	1600			1600			x	40	57/33						
	2000			2000			x	50	71/41						
170.750	800	170	98	800	355/325	-	x			6175	1468	4000	1000	20	28/16
	1250			1250			x	31,25	44/26						
	1600			1600			x	40	57/33						
	2000			2000			x	50	71/41						
245.1050	800	245	142	800	505/460	850	x			10100	2398	5000	1000	31,25	44/26
	1250			1250			x	40	57/33						
	1600			1600			x	50	71/41						
	2000			2000			x	62,5	88/51						
300.1050	1250	300	173	1250	505/460	850	x			10100	2398	5000	1000	31,25	44/26
	1600			1600			x	40	57/33						
	2000			2000			x	50	71/41						
	2500			2500			x	62,5	88/51						
362.1300	1250	362	209	1250	560/NA	950	x			10375	2950	4000	1600	31,25	44/26
	1600			1600			x	40	57/33						
	2000			2000			x	50	71/41						
	2500			2500			x	62,5	88/51						
420.1550	1250	420	242	1250	750/NA	1175	x			14447	3750	4000	1300	31,25	44/26
	1600			1600			x	40	57/33						
	2000			2000			x	50	71/41						
	2500			2500			x	62,5	88/51						
550.1800	1250	550	318	1250	870/NA	1300	x			18300	4645	4000	1600	31,25	44/26
	2000			2000			x	50	71/41						

Note : For ratings not listed, please contact us.

PNR Bushing 24kV to 550kV dimensions with Composite Insulator

Dimensions		Type of Connection	A	D1	D2	D3	D4	D5	D6	R7 (Min)	D10	D12	L2	L3	L4	L5	L8	Weight	t1	No. of Holes	F	Bottom terminal				
TYPE/Voltage[kV]/ Current Range [A]			mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	kg	mm	N	mm					
24.125	1000	Draw Lead																202	0	20						
																			502	300	22	18	6	16	-	
																		702	500	23						
	1600	Draw Rod																	202	0	26					
																			502	300	31	18	6	16	-	
																		702	500	34						
36.170	2000	Bottom Connection																	230	0	24					
																				530	300	26	18	6	16	Fig. 1
																		730	500	27						
	3150	Bottom Connection																		230	0	35				
																				530	300	50	18	6	16	Fig. 1
																		730	500	55						
52.250	1000	Draw Lead																	217	0	22					
																				517	300	26	18	6	16	-
																		717	500	30						
	2000	Bottom Connection																		270	0	38				
																				570	300	43	18	6	16	Fig. 1
																		770	500	47						
72,5,325	2500	Bottom Connection																		255	0	56				
																					555	300	63	18	8	16
																			755	500	68					
	3150	Bottom Connection																		255	0	74				
																				555	300	90	18	8	20	Fig. 3
																			755	500	101					
72,5,325	1000	Draw Lead																		235	0	33				
																					535	300	35	18	6	16
																			735	500	36					
	1600	Draw Rod																			235	0	42			
																					535	300	48	18	6	16
																			735	500	52					
72,5,325	2000	Bottom Connection																		270	0	35				
																					570	300	37	18	6	16
																			770	500	38					
	2500	Bottom Connection																			275	0	90			
																					575	300	106	18	8	20
																			775	500	116					
3150	Bottom Connection																			275	0	90				
																					575	300	106	18	8	20
																			775	500	116					

PNR Bushing 24kV to 550kV With Composite Insulator

Dimensions	Type of Connection	A	D1	D2	D3	D4	D5	D6	R7 (Min)	D10	D12	L2	L3	L4	L5	L8	Weight	t1	No. of Holes	F	Bottom terminal	
		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	kg	mm	N	mm		
123.550	800 Draw Lead														370		0	71				
															670	48	300	77	18	8	16	-
															870		500	81				
	1600 Draw Rod														370		0	86				
														670	48	300	95	18	8	16	-	
														870		500	101					
2000 Bottom Connection														465		0	152					
														765	110	300	160	18	8	16	Fig. 1	
														965		500	165					
3150 Bottom Connection														477		0	192					
														777	130	300	197	18	12	16	Fig. 3	
														977		500	192					
145.650	800 Draw Lead														435		0	117				
															735	38	300	120	18	12	16	-
															935		500	122				
	1250 Draw Lead														435		0	117				
														735	38	300	120	18	12	16	-	
														935		500	122					
1600 Draw Rod														435		0	149					
														735	38	300	155	18	12	16	-	
														935		500	159					
2000 Bottom Connection														527		0	152					
														827	130	300	160	18	12	16	Fig. 1	
														1027		500	165					
3150 Bottom Connection														527		0	205					
														827	130	300	220	18	12	16	Fig. 3	
														1027		500	230					
170.750	800 Draw Lead														495		0	121				
															795	38	300	130	18	12	16	-
															995		500	136				
	1250 Draw Lead														495		0	121				
														795	38	300	130	18	12	16	-	
														995		500	136					
1600 Draw Rod														495		0	161					
														795	38	300	175	18	12	16	-	
														995		500	185					
2000 Bottom Connection														587		0	170					
														887	130	300	180	18	12	16	Fig. 1	
														1087		500	185					
3150 Bottom Connection														587		0	245					
														887	130	300	252	22	12	23	Fig. 3	
														1087		500	256					
245.1050	1250 Draw Lead														757		0	290				
															1057	130	300	300	22	12	23	-
															1357		600	310				
	1600 Draw Rod														757		0	350				
														1057	130	300	360	22	12	23	-	
														1357		600	370					
2000 Bottom Connection														757		0	350					
														1057	130	300	360	22	12	23	Fig. 1	
														1357		600	370					
2500 Bottom Connection														2942		0	350					
														2902	130	300	400	22	12	23	Fig. 1	

PNR Bushing 24kV to 550kV With Composite Insulator

Dimensions	Type of Connection	A	D1	D2	D3	D4	D5	D6	R7 (Min)	D10	D12	L2	L3	L4	L5	L8	Weight		t1	No. of Holes F	Bottom terminal		
		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	kg	mm				N	mm
300.1050	1250 Draw Lead		2398	178	400	450	40	260	55	350	165	220	2897	2655	80	<u>757</u> 1357	130	<u>300</u> 600	<u>300</u> 310	22	12	23	-
			2398	178	400	450	40	260	55	350	165	220	2897	2655	80	<u>757</u> 1357	130	<u>300</u> 600	<u>360</u> 370				
	1600 Draw Rod		2398	178	400	450	40	260	55	350	165	220	2897	2655	80	<u>757</u> 1357	130	<u>300</u> 600	<u>360</u> 370	22	12	23	-
			2398	178	400	450	50	260	NA	350	165	220	2942	2655	125	<u>1057</u> 1357	130	<u>300</u> 600	<u>360</u> 370				
362.1175	1250 Draw Lead		2950	202	400	450	40	297	60	400	110	201	3412	3112	125	<u>758</u> 1058 1358	124	<u>0</u> 300 600	<u>415</u> 430 445	25	12	23	-
			2950	202	400	450	50	297	NA	400	205	291	3381	3112	125	<u>907</u> 1207 1507	175	<u>0</u> 300 600	<u>470</u> 490 510				
	1600 Bottom Connection		2950	202	400	450	50	297	NA	400	205	291	3381	3112	125	<u>907</u> 1207 1507	175	<u>0</u> 300 600	<u>450</u> 500 550	25	12	23	Fig. 1
			2950	202	400	450	50	297	NA	400	205	291	3381	3112	125	<u>907</u> 1207 1507	175	<u>0</u> 300 600	<u>450</u> 500 550				
420.1550	1250 Draw Lead		3750	319	450	500	40	500	65	500	166	291	4400	4060	80	<u>1012</u> 1312 1612	177	<u>0</u> 300 600	<u>975</u> 1000 1025	30	12	23	-
			3750	319	450	500	40	500	NA	500	166	291	4400	4060	80	<u>1017</u> 1317 1617	190	<u>0</u> 300 600	<u>1034</u> 1077 1120				
	1600 Bottom Connection		3750	319	450	500	50	500	NA	500	166	291	4420	4060	125	<u>1017</u> 1317 1617	190	<u>0</u> 300 600	<u>1105</u> 1145 1185	30	12	23	Fig. 1
			3750	319	450	500	60	500	NA	500	205	291	4420	4060	125	<u>1065</u> 1365 1665	245	<u>0</u> 300 600	<u>1210</u> 1250 1290				
550.1800	1250 Draw Lead		4645	319	450	500	40	500	65	650	210	352	5400	5025	115	<u>1265</u> 1565 1865	250	<u>0</u> 300 600	<u>1560</u> 1190 1280	30	12	23	-
			4645	319	450	500	40	500	NA	650	210	352	5400	5025	115	<u>1265</u> 1565 1865	250	<u>0</u> 300 600	<u>1310</u> 1360 1400				
	2000 Bottom Connection		4645	319	450	500	40	500	NA	650	210	352	5400	5025	115	<u>1265</u> 1565 1865	250	<u>0</u> 300 600	<u>1310</u> 1360 1400	30	12	23	Fig. 1
			4645	319	450	500	40	500	NA	650	210	352	5400	5025	115	<u>1265</u> 1565 1865	250	<u>0</u> 300 600	<u>1310</u> 1360 1400				



*Manufacturing Site
GE Grid Solutions Sesto San Giovanni,
Sesto San Giovanni
Milan, Italy*

[GEGridSolutions.com](https://www.GEGridSolutions.com)

IEC is a registered trademark of Commission Electrotechnique Internationale. IEEE is a registered trademark of the Institute of Electrical Engineers, Inc.

GE, the GE monogram, Multilin, FlexLogic, EnerVista and CyberSentry are trademarks of General Electric Company. GE reserves the right to make changes to specifications of products described at any time without notice and without obligation to notify any person of such changes.

Copyright 2021, General Electric Company. All Rights Reserved.

GEA-33208-(E)
English
211201

