

PNR PORCELAIN

Condenser Bushing 24kV-300kV 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 Vernova Bushings – your Partner of choice

GE Vernova, a company you can trust to harness your power. Following the acquisition of Passoni and Villa in 2008, former GE Vernova Grid now Grid Solutions at GE Vernova 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

Seismic solutions can be provided on request against specific site requirement.

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.



GE VERNOVA



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

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.

PASSANTE-VILLA	
N.	
PASSANTE-BUSHING-TRAVERSEE-DURCHFUEHRUNG	
TYPE	
⊕ STD REF.	50-60Hz ⊕
Um	kV BIL/SIL/AC kV Ir A
C1	pF C2 pF P.F. % AT 10kV/20° C
	kg

Fig. 5: Nameplate



Fig. 6: Electrical test

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 porcelain insulator.

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.

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.

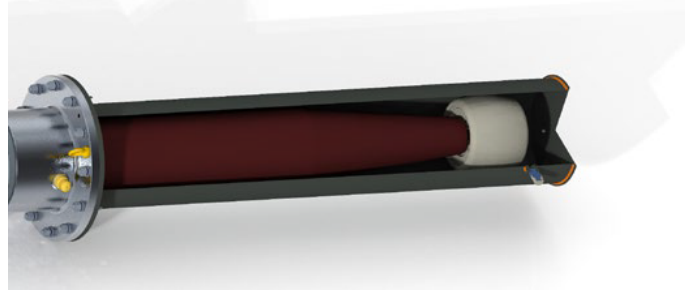


Fig. 16: Long term storage RIP bushings

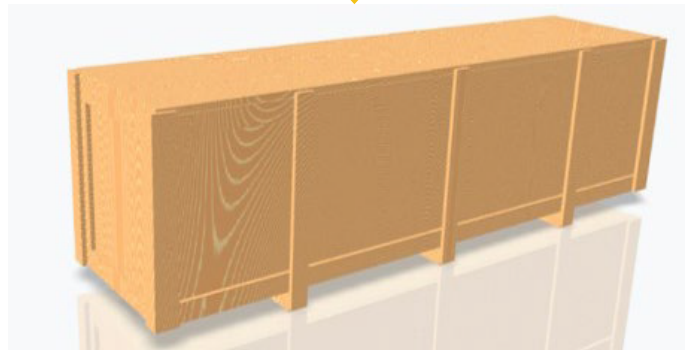
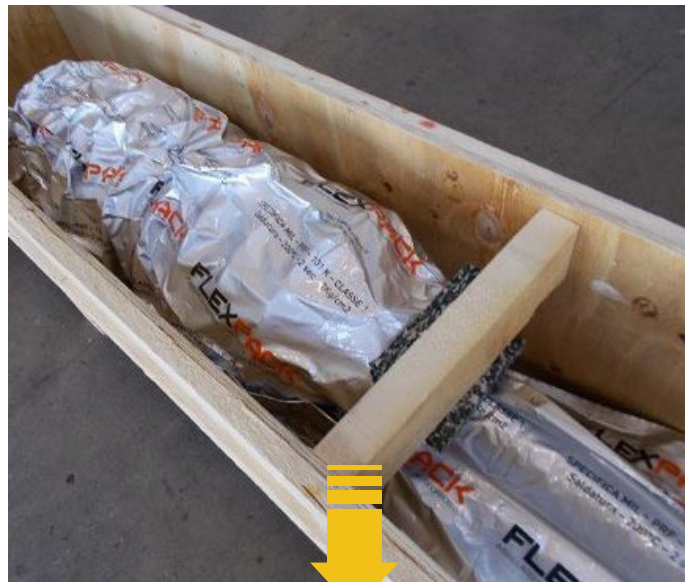


Fig. 17: Packaging - transportation



Fig. 15: Cantilever Test

PNR Range from 24 to 300 kV:

Ratings/Dimension

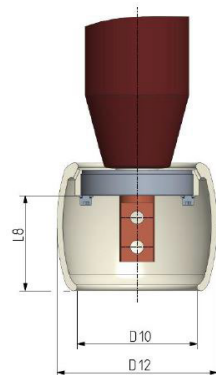
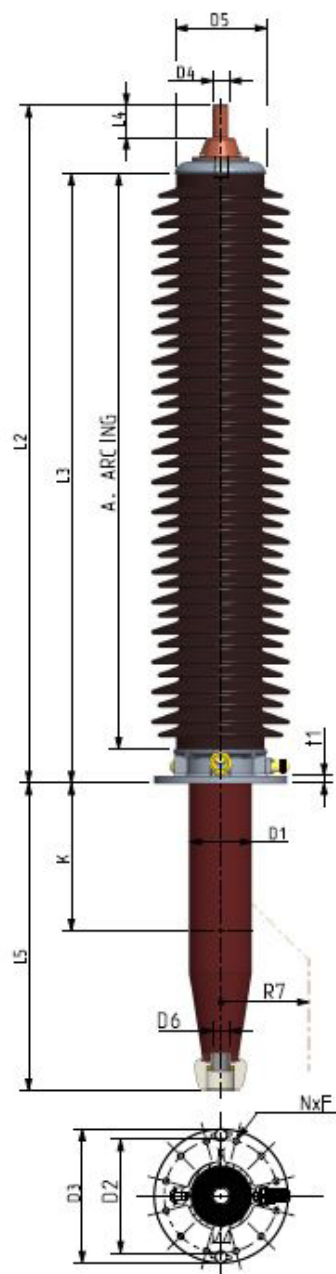


Fig. 1

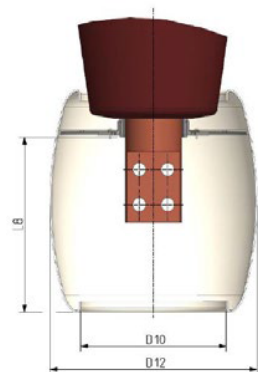


Fig. 2

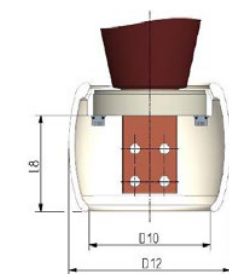
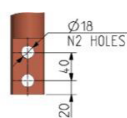
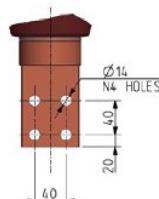
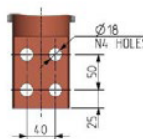


Fig. 3 Transformer side



Draw-rod connections



PNR Bushing 24kV to 300kV With Porcelain 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 60S) DRY/WET	WET SWITCHING IMPULSE WITHSTAND	DRAW LEAD CONNECTION	DRAW ROD CONNECTION	BOTTOM CONNECTION	MINIMUM NOMINAL CREEPAGE DISTANCE	MINIMUM ARCING DISTANCE	CANTILEVER WITHSTAND LOAD	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	125	1000	55/50	-	x			900	251	1250	1000	25	35/20
	1600							x		40					57/33	
	2000								x	50					71/41	
	3150								x	78,75					111/64	
36.170	1000	36	20	170	1000	77/70	-	x			1185	321	2000	1000	25	35/20
	2000								x	50					71/41	
	2500								x	62,5					88/51	
	3500								x	87,5					124/71	
52.250	1000	52	30	250	1000	105/95	-	x			1700	480	2500	1000	25	35/20
	2000								x	50					71/41	
	2500								x	62,5					88/51	
	3150								x	78,75					111/64	
72,5.325	800	72,5	42	325	800	155/140	-	x			2300	700	2000	1600	20	28/16
	1250							x		31,25					44/26	
	1600							x		40					57/33	
	2000								x	50			71/41			
	3150								x	78,75			111/64			
123.550	800	123	71	550	800	255/230	-	x			3840	1040	3150	1000	20	28/16
	1250				x					31,25					44/26	
	1600							x		40					57/33	
	2000								x	50					71/41	
	3150								x	78,75					111/64	
145.650	800	145	84	650	800	305/275	-	x			4590	1260	3150	1000	20	28/16
	1250				x					31,25					44/26	
	1600							x		40					57/33	
	2000								x	50					71/41	
	3150								x	78,75					111/64	
170.750	800	170	98	750	800	355/325	-	x			5330	1440	4000	1000	20	28/16
	1250				x					31,25					44/26	
	1600							x		40					57/33	
	2000								x	50			71/41			
	3150								x	78,75			111/64			
245.1050	1250	245	141	1050	1250	505/460	850	x			8940	2370	4000	1000	31,25	44/26
	1600							x		40					57/33	
	2000								x	50			71/41			
	2500								x	62,5			88/51			
300.1050	1250	300	173	1050	1250	505/460	850	x			8940	2370	4000	1000	31,25	44/26
	1600							x		40					57/33	
	2000								x	50			71/41			
	2500								x	62,5			88/51			

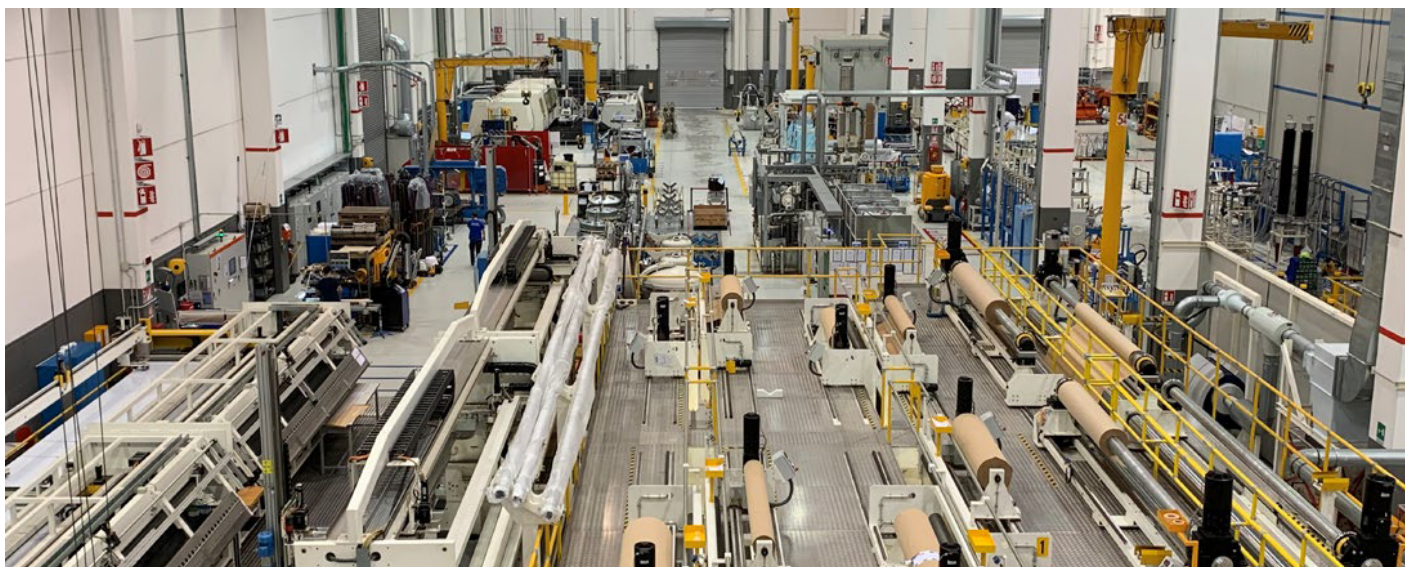
Note: For ratings not listed, please contact us

PNR Bushing 24k to 300 kV: dimensions with Porcelain 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
24.125	1000	Draw Lead	251	92	185	225	40	170	38	100	67	95	501	336	80	202	22	0	30	14	6	16	-
																502		300	34				
																702		500	37				
	1600	Draw Rod	251	92	185	225	40	170	38	100	67	95	501	336	80	202	22	0	35	14	6	16	-
																502		300	39				
																702		500	42				
	2000	Bottom Connection	251	92	185	225	40	170	NA	100	NA	NA	546	336	125	230	NA	0	31	14	6	16	Fig. 1
																530		300	34				
																730		500	36				
	3150	Bottom Connection	251	92	185	225	60	170	NA	100	NA	NA	546	336	125	230	NA	0	51	14	6	16	Fig. 1
																530		300	60				
																730		500	68				
36.170	1000	Draw Lead	321	92	185	225	40	170	38	100	67	95	571	406	80	202	22	0	30	14	6	16	-
																502		300	33				
																702		500	35				
	2000	Bottom Connection	321	92	185	225	40	170	NA	100	NA	95	616	406	125	255	NA	0	37	14	6	16	Fig. 1
																555		300	40				
																755		500	42				
	2500	Bottom Connection	321	92	185	225	50	170	NA	100	NA	95	616	406	125	255	NA	0	50	14	6	16	Fig. 1
																555		300	58				
																755		500	63				
	3500	Bottom Connection	480	140	250	290	60	205	NA	100	NA	NA	821	566	125	282	NA	0	90	14	8	16	Fig. 3
																582		300	105				
																782		500	115				
52.250	1000	Draw Lead	480	92	185	225	40	170	38	100	67	95	730	565	80	225	22	0	43	14	6	16	-
																525		300	45				
																725		500	47				
	2000	Bottom Connection	480	92	185	225	40	170	NA	100	NA	95	775	565	125	282	NA	0	40	14	6	16	Fig. 1
																582		300	43				
																782		500	45				
	2500	Bottom Connection	480	92	185	225	50	170	NA	100	NA	95	775	565	125	282	NA	0	55	14	6	16	Fig. 1
																582		300	63				
																782		500	68				
	3150	Bottom Connection	481	140	250	290	60	205	NA	100	NA	NA	821	566	125	282	NA	0	90	14	8	16	Fig. 2
																582		300	105				
																782		500	115				
72.5.325	800	Draw Lead	700	92	185	225	40	170	38	140	67	95	950	785	80	222	22	0	86	14	6	16	-
																522		300	95				
																722		500	102				
	1250	Draw Rod	700	92	185	225	40	170	38	140	67	95	950	785	80	222	22	0	86	14	6	16	-
																522		300	95				
																722		500	102				
	1600	Draw Rod	700	92	185	225	40	170	38	140	67	95	950	785	80	222	22	0	87	14	6	16	-
																522		300	96				
																722		500	103				
	2000	Bottom Connection	700	92	185	225	40	170	NA	140	NA	95	1023	785	125	322	NA	0	90	14	6	16	Fig. 1
																622		300	95				
																822		500	105				
3150	Bottom Connection	701	140	250	290	60	205	NA	140	NA	NA	1041	786	125	300	NA	0	130	14	8	16	Fig. 2	
															600		300	145					
															800		500	155					

PNR Bushing 24k to 300 kV: dimensions with Porcelain Insulator (cont'd)

DIMENSIONS		TYPE OF CONNECTION																						WEIGHT	T1	NO. OF HOLES	F	BOTTOM TERMINAL
TYPE/Voltage[kV]/ Current Range [A]			A	D1	D2	D3	D4	D5	D6	R7 (MIN)	D10	D12	L2	L3	L4	L5	L8	kg	mm	N	mm							
123.550	800	Draw Lead	1040	135	250	290	40	205	40	200	70	130	1295	1125	80	375	50	0	112	16	8	12	-					
																675		300	118									
	875	500	122	Fig. 1																								
	1250	Draw Lead	1040		135	250	290	40	205	40	200	70	130	1295	1125	80	375	50	0	113	16	8	16	-				
																	675		300	119								
	875	500	123		Fig. 2																							
	1600	Draw Rod	1040			135	250	290	40	205	40	200	70	130	1295	1125	80	375	50	0	138	16	8	16	-			
																		675		300	149							
	875	500	156			Fig. 1																						
	2000	Bottom Connection	1040				135	250	290	40	205	NA	230	145	200	1340	1125	125	450	110	0	121	16	8	16	-		
																			750		300	129						
	950	500	134				Fig. 2																					
3150	Bottom Connection	1060	143					290	335	50	280	NA	230	165	220	1613	1303	125	477	130	0	250	18	12	16	-		
																			777		300	265						
977	500	280	Fig. 1																									
800	Draw Lead	1260		143				290	335	40	280	50	225	80	130	1768	1503	80	435	38	0	195	18	12	16	-		
																			735		300	200						
935	500	210		Fig. 1																								
1250	Draw Lead	1260			143			290	335	40	280	50	225	80	130	1768	1503	80	435	38	0	195	18	12	16	-		
																			735		300	200						
935	500	210			Fig. 2																							
1600	Draw Rod	1260				143		290	335	40	280	50	225	80	130	1768	1503	80	435	38	0	240	18	12	16	-		
																			735		300	235						
935	500	245				Fig. 1																						
2000	Bottom Connection	1260					143	290	335	50	280	NA	230	165	220	1813	1503	125	527	130	0	235	18	12	16	-		
																			827		300	240						
1027	500	250	Fig. 2																									
3150	Bottom Connection	1260					143	290	335	50	280	NA	230	165	220	1813	1503	125	527	130	0	292	18	12	16	-		
																			827		300	300						
1027	500	305		Fig. 1																								
800	Draw Lead	1440					143	290	335	40	280	50	260	80	130	1948	1683	80	495	38	0	215	18	12	16	-		
																			795		300	220						
995	500	230			Fig. 1																							
1250	Draw Lead	1440					143	290	335	40	280	50	260	80	130	1948	1683	80	495	38	0	215	18	12	16	-		
																			795		300	220						
995	500	230				Fig. 2																						
1600	Draw Rod	1440					143	290	335	40	280	50	260	80	130	1948	1683	80	495	38	0	255	18	12	16	-		
																			795		300	265						
995	500	275	Fig. 1																									
2000	Bottom Connection	1440					143	290	335	50	280	NA	260	165	220	1993	1683	125	587	130	0	265	18	12	16	-		
																			887		300	270						
1087	500	280		Fig. 2																								
3150	Bottom Connection	1440					178	400	450	50	305	NA	260	165	220	2012	1697	125	587	130	0	330	22	12	23	-		
																			887		300	338						
1087	500	344			Fig. 1																							
1250	Draw Lead	2370					178	400	450	40	305	55	350	165	220	2897	2627	80	757	130	0	400	22	12	23	-		
																			1057		300	410						
1357	600	420				Fig. 1																						
1600	Draw Rod	2370					178	400	450	40	305	55	350	165	220	2897	2627	80	757	130	0	470	22	12	23	-		
																			1057		300	480						
1357	600	490	Fig. 2																									
2000	Bottom Connection	2370					178	400	450	50	305	NA	350	165	220	2942	2627	125	757	130	0	470	22	12	23	-		
																			1057		300	480						
1357	600	490		Fig. 1																								
2500	Bottom Connection	2370					178	400	450	50	305	NA	350	165	220	2902	2627	125	757	130	0	470	22	12	23	-		
																			1057		300	520						
1357	600	535			Fig. 1																							
1250	Draw Lead	2370					178	400	450	40	305	55	350	165	220	2897	2627	80	1057	130	300	410	22	12	23	-		
																			1357		600	420						
1600	Draw Rod	2370				178	400	450	40	305	55	350	165	220	2897	2627	80	1057	130	300	480	22	12	23	-			
																		1357		600	490							
2000	Bottom Connection	2370				178	400	450	50	305	NA	350	165	220	2942	2627	125	1057	130	300	480	22	12	23	-			
			1357															600		490								
2500	Bottom Connection	2370	178			400	450	50	305	NA	350	165	220	2902	2627	125	1057	130	300	520	22	12	23	-				
																	1357		600	535								



Manufacturing Site
Grid Solutions at GE Vernova Sesto San Giovanni,
Sesto San Giovanni
Milan, Italy

For more information, visit
governova.com/grid-solutions

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