

POBO

Condenser Bushing 72.5-1050 kV Oil-Impregnated Paper

POBO are capacitance graded type bushings with oil-impregnated paper insulation. They are designed for use on power transformers for direct connection to a GIS and can be installed in any position, in compliance with latest editions of IEC 60137 and IEC 62271-211.

Design, components and manufacturing technology guarantee an average life time of over 30 years under normal operating conditions.

Manufacturing of Capacitance-graded Bushings

The main electrical insulation is provided by a condenser body made of a continuous sheet of pure kraft paper wound around a conductor rod made of aluminum or copper, depending on the current rating.

The paper is dried by heated cylinders and in-frared rays during winding to reduce the water content in the paper to a maximum of 1%. During winding, a series of cylindrical aluminum foils is inserted coaxially between the layers of paper. These foils assure the best possible distribution of the radial and longitudinal electrical gradient between the conductor and the fixing flange, which is grounded. Winding is computer-controlled, with simultaneous machining to the final shape.

After winding, the bushing is assembled and placed in an oven at 105°C, each bushing is vacuum treated, kept at 4.10^{-2} mbar for several days, and impregnated with oil with a maximum humidity content of 3 ppm. It is then degassed. Impregnation is carried out under pressure to maximize efficiency and to test for tightness. The whole treatment process is automatic and computer-controlled.



Standards

- IEC 60137
- IEC 62271-211

Key Benefits

- Installation in any position
- Longer lifetime and higher reliability
- Possibility to check the internal oil pressure by means of pressure gauge
- No performance reduction with age



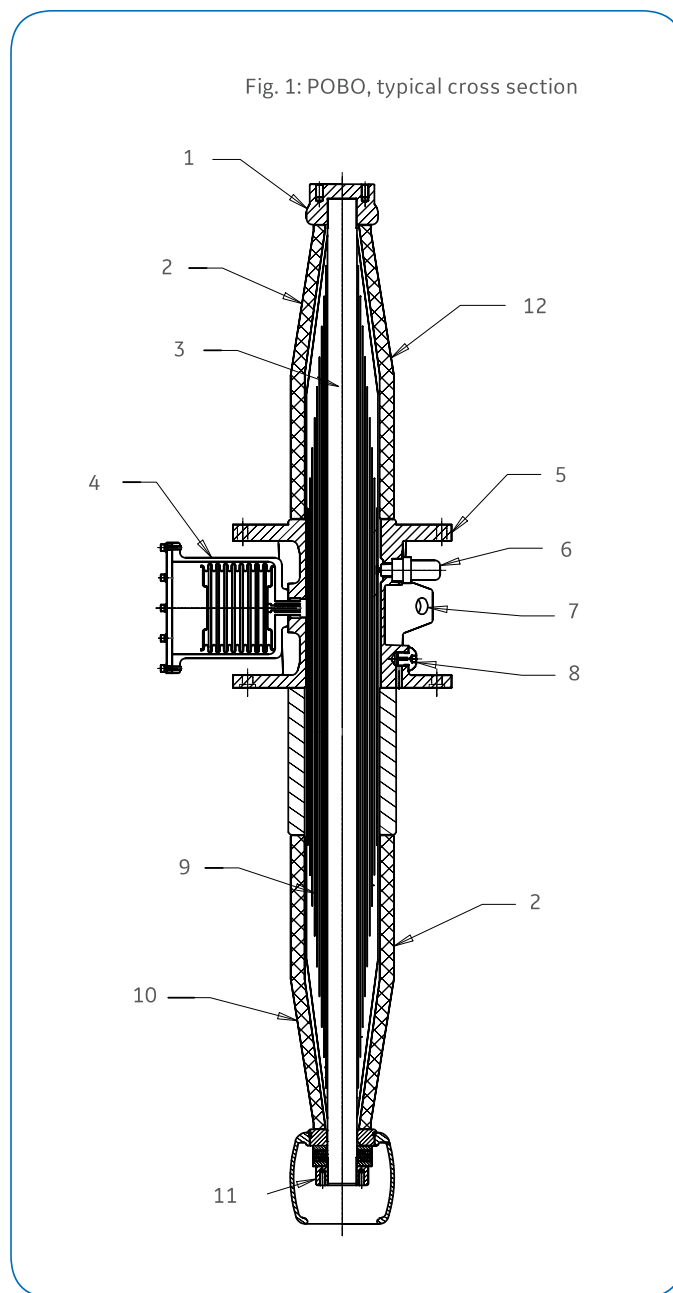
POBO Bushings Main Features

Oil-impregnated paper

- Oil-to-SF₆
- Oil-impregnated Paper
- Porcelain both sides
- Fully filled with oil, with compensation bellows
- Installation in any position
- Dimensions of flange and SF₆ terminals in accordance with IEC 62271-211 standards
- Partial discharges < 5 pC at 1.5 Um/V³
- Power factor tap, safety manometer with contacts for minimum and maximum pressure for the detection of oil/gas leakage, air draining plug, oil side deflector
- Flange made of aluminum alloy casting
- Execution solid conductor

Fig. 1: POBO Bushing components

1. SF₆ terminal
2. Porcelain
3. Conductor rod
4. Oil compensation bellows
5. Flange
6. Power factor tap
7. Lifting eyes
8. Air outlet screw ½" gas
9. Oil-impregnated paper core
10. Transformer side
11. Oil terminal
12. SF₆ side



Bushing Designation POBO.145.650.800

P	Condenser bushings ("P" from the Italian word "Passante")
OB	Oil to SF ₆ type
O	Oil paper insulation (OIP)
145	Rated voltage in kV
650	BIL in kV
800	Rated current in A

SF₆ Oil

Envelopes of the transformer and SF₆ sides are made of brown porcelain. Versions with an underflange sleeve in the oil side to accommodate the CT are available on request.

For voltages of 72.5 kV to 550 kV, the flange and the terminal of the SF₆ side are designed in accordance to IEC standard Publication 62271-211. The terminal is made of aluminum or copper. The transformer side is shielded by an electrode made of aluminum alloy. Its function is to reduce the dielectric strength in the oil and screen the connection between the lead coming from the transformer winding and the bushing itself.

Oil Compensation Bellows

POBO bushings are fully filled with oil and feature one or more bellows made of stainless steel and placed on the flange. The bellows compensate for oil volume variations caused by temperature changes during operation of the bushing. The number of bellows depends on the volume of oil to be compensated.

These bellows contain air and are hermetically sealed. They are completely immersed in the oil and, inside the bushing, maintain a slight overpressure (+0.4 to +2 bar) in the range of the design temperatures. The advantage of the bellows is that they improve the properties of the dielectric material: dielectric strength, inception and extinction of partial discharges (<5 pC at 1.5 U_m/V³).

Gaskets

Made of Viton®, a fluorocarbon rubber elastomer (FPM), o-ring type. They are compatible with all the fluids they are in contact with (bushing impregnating oil SF₆ gas of GIS and transformer oil).

Air side gaskets are carefully protected, by means of a sealing, against influence of polluting weather elements. For special requirements, such as low ambient temperatures (down to -55°C), special o-rings are used.

Metal Surface Treatment

All metal bushing surfaces are made of aluminum alloy.

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

Flange

The flange is made of aluminum casting and is equipped with the following accessories:

- Power factor tap (tested at 2 kV for 60 s)
- Valve for the connection of the safety manometer to the bushing
- Safety manometer with contacts for minimum and maximum pressure for the detection of gas/oil leakage
- Buchholz relay connection (1/2" gas outlet plug)
- Lifting holes

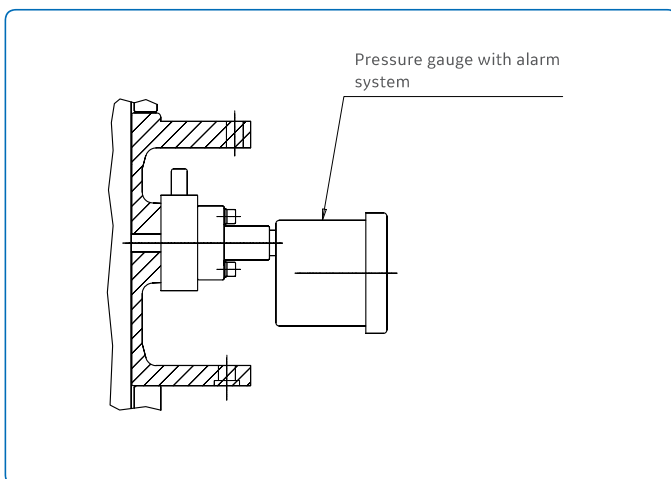


Fig. 2: Pressure gauge

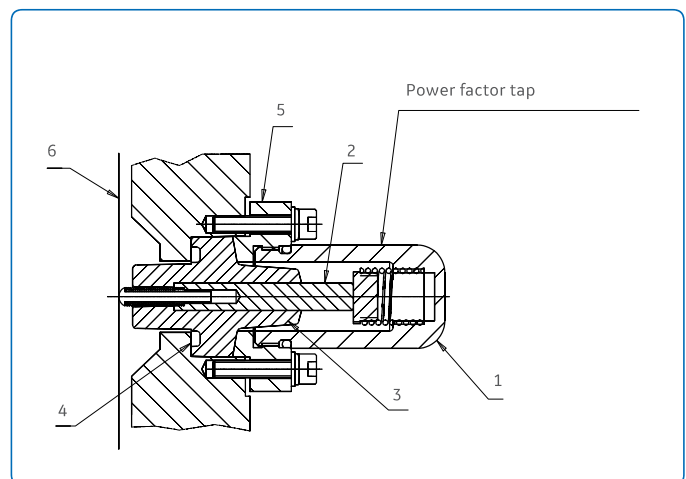


Fig. 3: Power factor tap

1. Closing and grounding cap
2. Measurement electrode
3. Insulating bushing
4. Gasket
5. Mounting flange
6. Last layer

Electrical tests

All the bushings are tested and have electrical characteristics in compliance with the latest edition of IEC 60137 Publication bushings for alternating voltage above 1000 V and the main national standards.

Mechanical Tests

The SF6 side porcelain and metal parts are tested in accordance with the most stringent international standards to assess their resistance to SF6 gas pressure.

The flange will support the mechanical stress caused by a metal clad GIS in accordance with IEC standards. Furthermore the bushings have passed tests on the vibrating table to ensure resistance to severe earthquakes and short circuits.

Packing – Transportation

POBO bushings are normally shipped in the horizontal position in cases of three (for voltages up to 170 kV).

Porcelains and metal terminals are wrapped in polyethylene bags to protect them from dust and ambient contamination.

Special protection is used for the oil side electrode.

Insulating Fluid

The impregnation is made with a top quality inhibited super grade mineral oil, fully complying to standards IEC 60296 and ASTM D3487, with the following outstanding characteristics:

- High dielectric strength (> 70 kV / 2.5 mm)
- Very good low temperature properties (pour point typically <-60°C)
- Low viscosity even at the lowest temperatures
- Very good oxidation stability
- Extremely good heat transfer

Assembling

The porcelain and metal parts are coupled by means of springs placed in the bottom part of the transformer side.

SF₆ or Cable Side

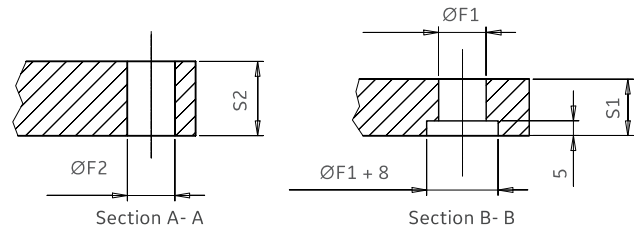


Fig. 4: SF₆ side

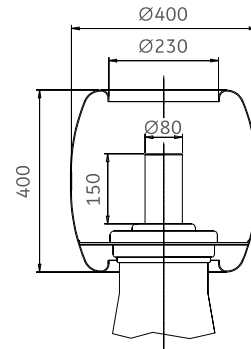


Fig. 5: POBO 765 kV-1600 A

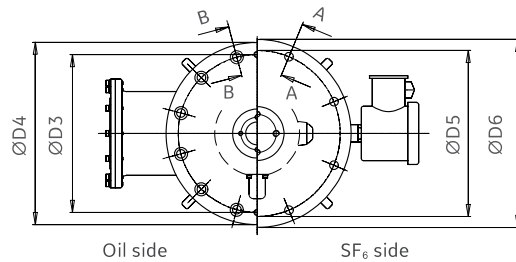


Fig. 6:

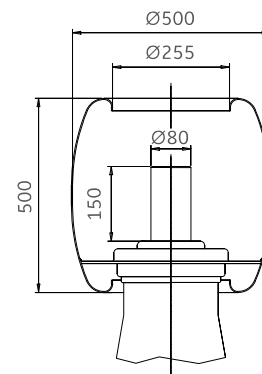


Fig. 7: POBO 1050 kV-1600 A

SF₆ or Cable Side

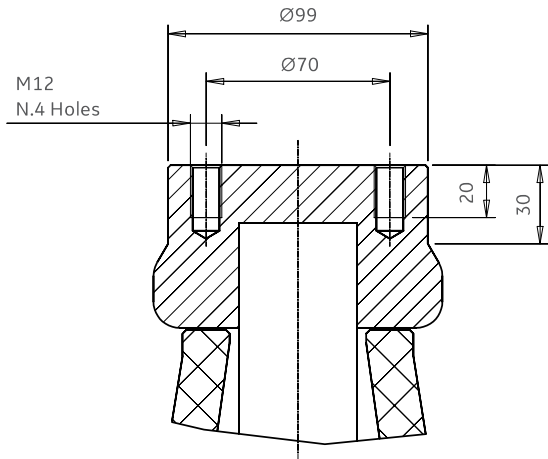


Fig. 8: POBO 72.5 - 170 kV, 800 - 2000 A

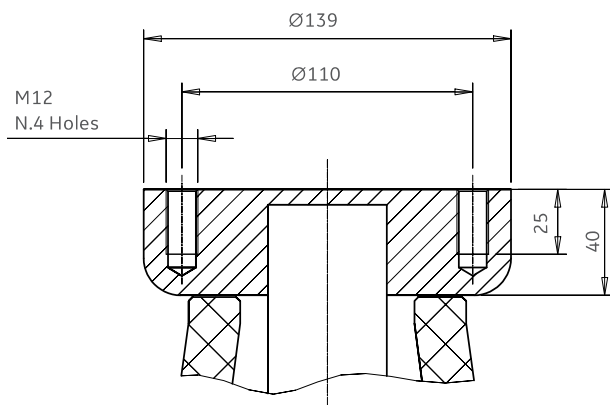


Fig. 9: POBO 245 kV, 1000 - 1600 A

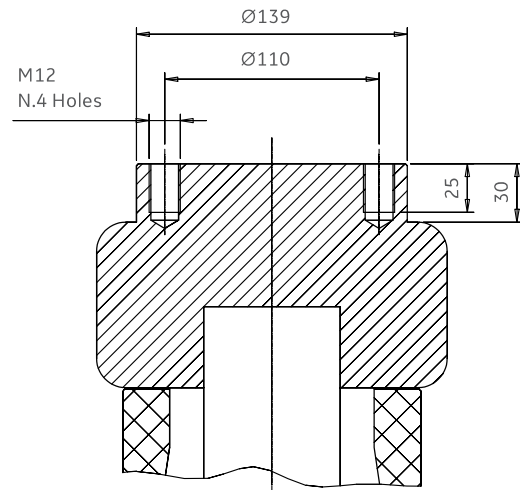


Fig. 10: POBO 420 - 550 kV, 1000 - 1600 A

POBO Range from 72.5 to 1050 kV: Ratings / Dimensions

Type	Rated Voltage	Rated phase to earth voltage	Dry and wet power frequency withstand voltage for 60 s.	Dry lightning impulse withstand voltage	Rated current	Cantilever load - SF ₆ side	Weight	SF ₆ side shield	Transf. side shield	Transformer side K min.	L	L1	L2	L3	D1
Type	kV	kV	kV	kV	A	N	kg	Fig.	Fig.	mm	mm	mm	mm	mm	mm
72.5.350.800 ⁽¹⁾					800	4000									125
72.5.350.1250 ⁽¹⁾	72.5	42	155	350	1250	4000	40	8	11	0	820	290	330	200	125
72.5.350.2000 ⁽¹⁾					2000	4000	75	8	12	0	835	305	330	200	125
123.550.800					800	4000									165
123.550.1250	123	71	255	550	1250	4000	55	8	11	0	1155	385	520	250	165
123.550.2000					2000	4000	75	8	12	0	1155	385	520	250	165
145.650.800 ⁽¹⁾					800	4000									165
145.650.1250 ⁽¹⁾	145	84	305	650	1250	4000	65	8	11	100	1305	535	520	250	165
145.650.2000					2000	4000	90	8	12	100	1305	535	520	250	165
170.750.800					800	4000									165
170.750.1250	170	98	355	750	1250	4000	70	8	11	0	1305	535	520	250	165
170.750.2000					2000	5000	90	8	12	0	1305	535	520	250	165
245.1050.1000	245	142	505	1050	1000	4000	200	9	13	0	1812	700	770	342	225
245.1050.1600					1600	4000	210	9	14	0	1812	700	770	342	225
420.1425.1000	420	242	695	1425	1000	4000	350	10	15	150	2510	1110	1050	350	340
420.1425.1600					1600		370								340
550.1675.1000	550	317	750	1675	1000	4000	400	10	15	50	2510	1110	1050	350	340
550.1675.1600					1600		420								340
765.2100.1600	765	442	880	2100	1600	2500	900	5	16	0	3293	1395	1600	260	530
1050.2400.1600	1050	606	...	2400	1600	2500	2600	7	17	0	4768	2000	2210	260	800

(1) They can have same dimensions but CT SPACE K = 100 mm on SF6 side

Transformer Side

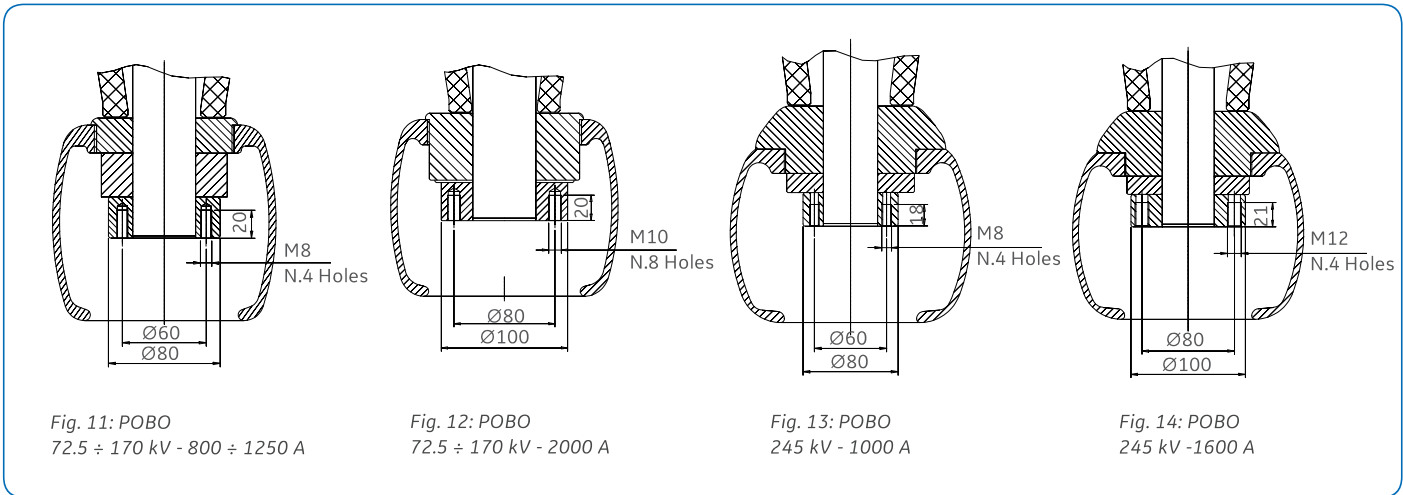


Fig. 11: POBO
72.5 ÷ 170 kV - 800 ÷ 1250 A

Fig. 12: POBO
72.5 ÷ 170 kV - 2000 A

Fig. 13: POBO
245 kV - 1000 A

Fig. 14: POBO
245 kV - 1600 A

Type	D3	D4	D5	D6	D7	d1	C	d2	s1	n°1	F1	s2	n°2	F2	R1	R2
Type	mm	mm	mm	mm	mm	mm	mm	N.	mm	nr.	mm	mm	nr.	mm	mm	mm
72.5.325.800(1)	250	290	285	315	120	90	50	99	16	8	16	25	8	16	280	250
72.5.325.1250(1)	250	290	285	315	120	90	50	99	16	8	16	25	8	16	280	250
72.5.325.2000(1)	250	290	285	315	180	120	60	99	16	8	16	25	8	16	360	250
123.550.800	290	335	305	335	160	100	60	99	19	12	16	25	8	16	440	300
123.550.1250	290	335	305	335	160	100	60	99	19	12	16	25	8	16	440	300
123.550.2000	290	335	305	335	180	120	60	99	19	12	16	25	8	16	440	300
145.650.800	290	335	305	335	160	100	60	99	19	12	16	25	8	16	460	300
145.650.1250	290	335	305	335	160	100	60	99	19	12	16	25	8	16	460	300
145.650.2000	290	335	305	335	180	120	60	99	19	12	16	25	8	16	460	300
170.750.800	290	335	305	335	160	100	60	99	19	12	16	25	8	16	520	300
170.750.1250	290	335	305	335	160	100	60	99	19	12	16	25	8	16	520	300
170.750.2000	290	335	305	335	180	120	60	99	19	12	16	25	8	16	520	300
245.1050.1000	400	450	535	565	200	110	80	139	22	12	20	30	16	16	700	450
245.1050.1600	400	450	535	565	200	110	80	139	22	12	20	30	16	16	700	450
420.1550.1000	620	680	640	690	290	210	60	139	25	16	22	40	16	20	920	540
420.1550.1600	620	680	640	690	290	210	60	139	25	16	22	40	16	20	920	540
550.1800.1000	620	680	640	690	290	210	60	139	25	16	22	40	16	20	1100	540
550.1800.1600	620	680	640	690	290	210	60	139	25	16	22	40	16	20	1100	540
765.2100.1600	711	780	711	780	400	255	40	12	32	40	12	32	1300	800
765.2100.1600	1100	1150	1100	1150	500	255	40	36	25	40	36	25	1500	1000

Transformer Side

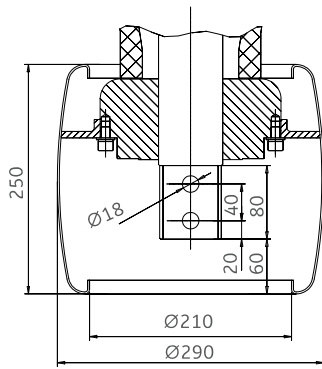


Fig. 15: POBO 420 - 550 kV, 1000 - 1600 A

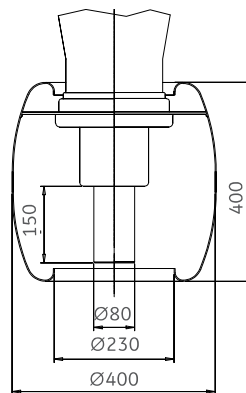


Fig. 16: POBO 765 kV - 1600 A

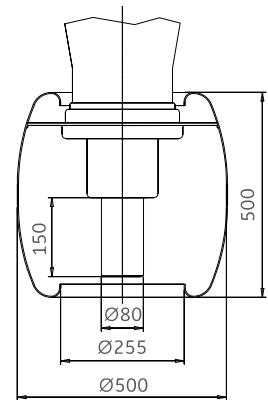


Fig. 17: POBO 1050 kV - 1600 A

Overall Dimensions

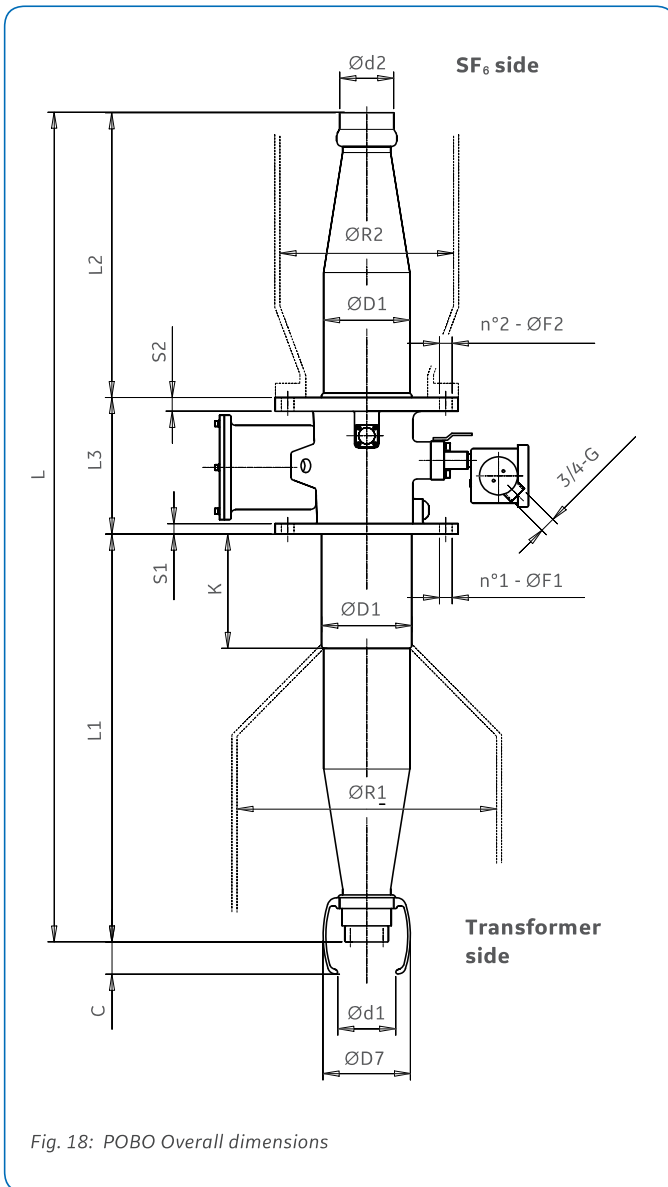


Fig. 18: POBO Overall dimensions

Nameplate

Each bushing is provided with a nameplate, containing complete electrical data and the serial number, in accordance with the requirements of IEC Standards. The nameplate, made of aluminum, is secured to the flange with rivets and includes:

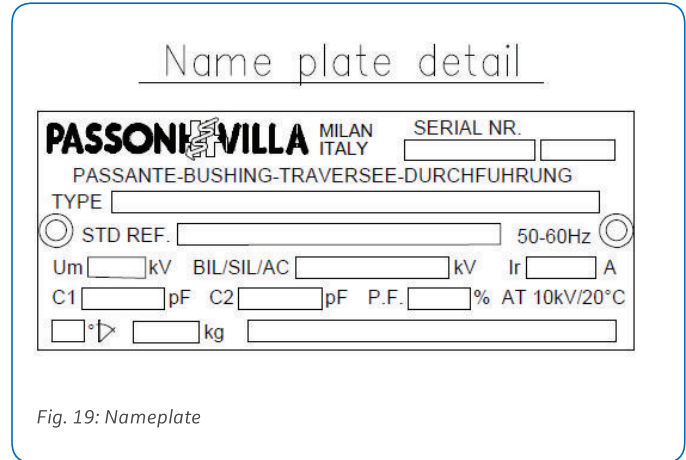


Fig. 19: Nameplate

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Imagination at work