

# POBR

## Condenser Bushing 72.5kV-420kV Oil-to-SF<sub>6</sub> Application Resin Impregnated Paper Bushing

POBR bushings are capacitance graded type (bushings made) manufactured with Resin Impregnated Paper insulation (RIP-dry type). 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 of the RIP bushings can guarantee an average lifetime of 30 years under normal operating conditions. Being dry type RIP bushings, they offer benefits compared with conventional bushings (oil, gas, etc.) mainly in terms of the safety, environment protection and maintenance-free products.

### Manufacturing of Capacitance-graded Bushings

The main electrical insulation consist of a condenser core made of a continuous sheet of pure dried crepe paper and aluminum foils wound around a conductor rod/tube made of aluminum or copper, designed according to Customer specification.

- The paper is pre-dried by heated cylinders and infra-red rays during the winding process, which is fully automated, and computer controlled. The water content is reduced to less than 1%.
- During the winding stage, the aluminum foils are inserted coaxially between paper layers to create a co-centric cylindrical condenser core.
- The graded bushing technology assures a uniform distribution of the electrical field between high voltage conductor and earthed parts such as the main aluminum flange used for fitting on the transformer and the test tap used to earthing the last layer.
- The wound condenser core is placed in an autoclave to achieve the final drying phase and to be fully impregnated with resin under vacuum.
- The result is a solid core, mechanically robust and thermally class E (120°C) according to IEC standard.

Manufactured in Sesto San Giovanni, Milano, Italy, the machining and shaping of the core is completely automated and computer-controlled to ensure high quality.



### Standards

- IEC 60137
- IEC 62271-211

### Key Benefits

- Partial discharge free
- Low  $\tan\delta < 0.35\%$
- Installation in any position
- Long lifetime and high reliability
- Maintenance-free
- Gas tight reliable solution
- High product flexibility



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## POBR Bushings Main Features

### Resin Impregnated Paper Bushing

- Oil-to-SF<sub>6</sub>
- Resin Impregnated Paper
- Installation in any position
- Dimensions of flange and SF<sub>6</sub> terminals in accordance with IEC 62271-211 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

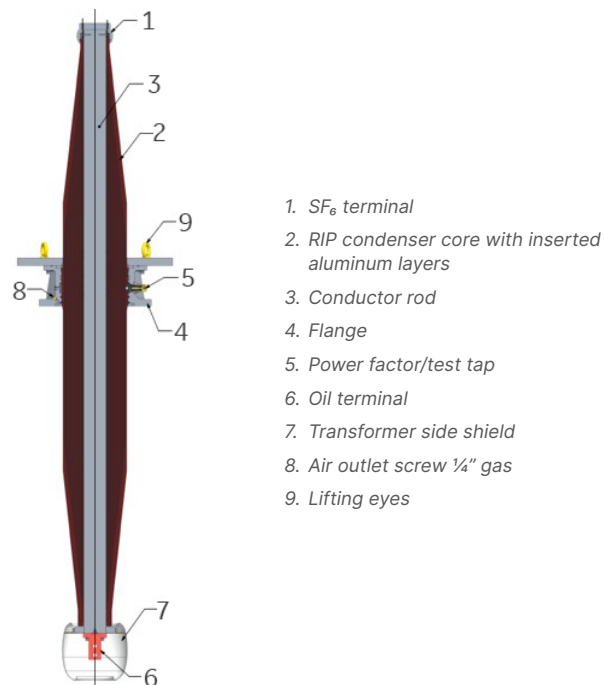


Fig. 1: POBR, typical cross section

### Bushing Designation POBR.145.650.800

| CODE | DESCRIPTION                                               |
|------|-----------------------------------------------------------|
| P    | Condenser bushings ('P' from the Italian word 'Passante') |
| OB   | Oil to SF <sub>6</sub> type                               |
| R    | Resin Impregnated Paper (RIP)                             |
| 145  | Rated voltage in kV                                       |
| 650  | BIL in kV                                                 |
| 800  | 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 Standards.

The aluminum nameplate is secured to the flange with rivets.

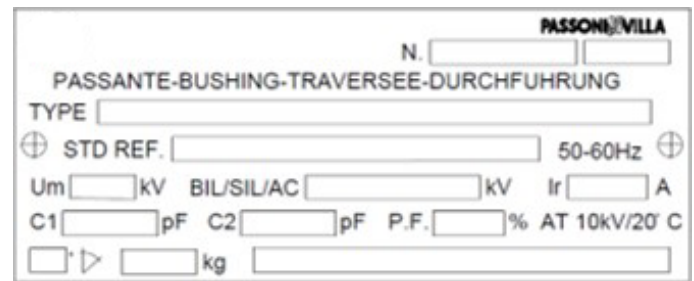


Fig. 2: Nameplate

### Oil-to-SF<sub>6</sub>

Bushings rated from 72.5 kV to 420 kV are equipped with, flange and SF<sub>6</sub> side terminal entirely designed in accordance with 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 to increase the dielectric strength in the oil for secure connection between the transformer winding lead and the bushing terminal.

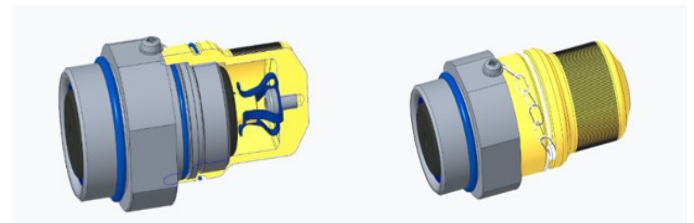


Fig. 3: Power factor tap

### Gaskets

Gaskets are made of Viton®, a fluorocarbon rubber elastomer (FPM), o-ring type. They are compatible with all the fluids and gases they are in contact with (i.e., SF<sub>6</sub> gas of GIS and transformer oil).

Bushing internal parts are carefully protected with a sealing system against the influence of external contamination.

For special requirements, such as low temperatures (down to -55°C), special gaskets are provided. The gaskets are highly controlled before assembling.



Fig. 4: Eyebolt for lifting

## 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.

The tapping (includes both) surface finish avoids any corrosion throughout lifetime and allows for easy removal and fixing of cover in service.

Any special 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/test tap (tested at 2 kV for 60s)
- Air outlet screw (1/4" gas outlet plug)
- Lifting holes

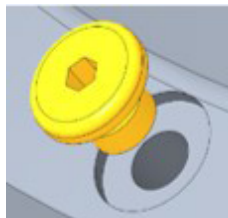


Fig 5: Air outlet screw  
1/4" GAS

## Electrical Test

The bushings are tested according to the 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 SF<sub>6</sub> 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 adequate withstand (a proper strength) to earthquakes and short circuits forces.

## Packing – Transportation

POBR bushings are normally shipped in the horizontal position in cases of three (for voltages up to 170 kV). Terminals and exposed parts are wrapped in polyethylene bags to apply an additional protection from ambient contamination such as dust and moisture and any transport damage. A special protection is used for the oil side electrode.

## 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 and moisture absorbing. (and humidity). The crate can also be equipped with shock indicator, (as well) on request.

## Assembling

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

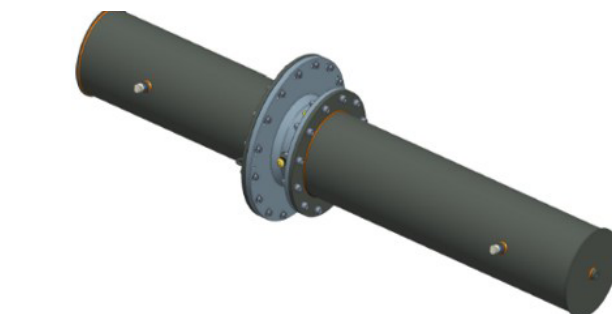


Fig. 6: Long term storage RIP bushings

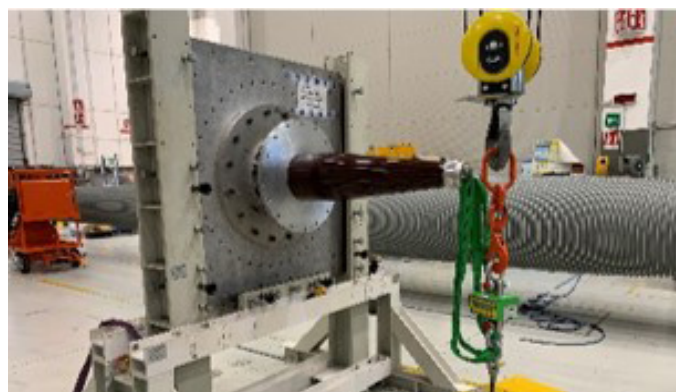


Fig. 7: Cantilever Test

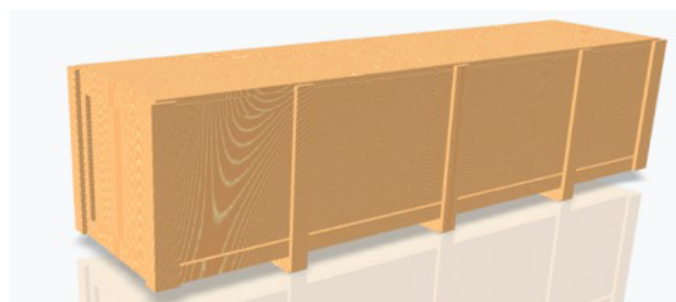
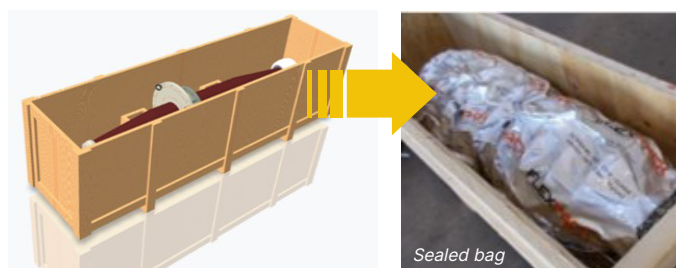
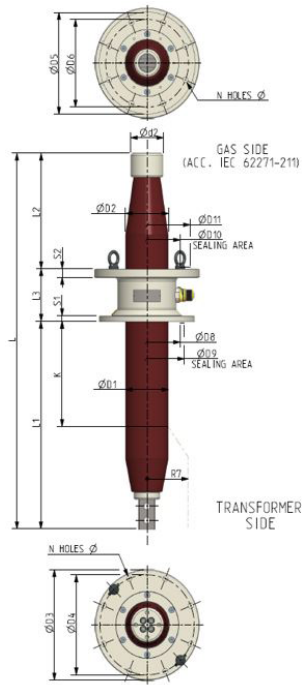


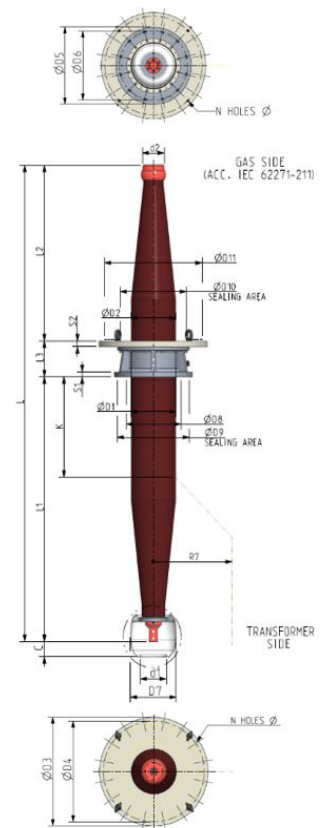
Fig. 8: Packaging - transportation

## POBR Range from 72.5 to 420 kV: Ratings/Dimensions

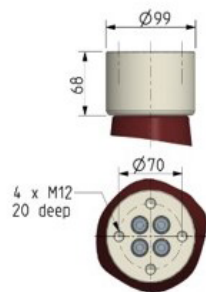


| CONDENSER BUSHING, OIL - SF <sub>6</sub> FOR TRANSFORMERS | RATED VOLTAGE | RATED CONTINUOUS CURRENT | RATED LINE TO EARTH VOLTAGE | DRY POWER-FREQUENCY VOLTAGE | DRY LIGHTNING IMPULSE (BIL) | SHORT TIME RATING FOR 2S (AS PER IEC 60137) | CANTILEVER WITHSTAND LOAD | MAX OPERATING PRESSURE | C  | d1  | d2  | D1  | D2  | D3  | D4  | D5  | D6  | D7  |
|-----------------------------------------------------------|---------------|--------------------------|-----------------------------|-----------------------------|-----------------------------|---------------------------------------------|---------------------------|------------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| TYPE/<br>Voltage<br>[kV]/Current<br>Range [A]             | kV            | A                        | kV                          | kV                          | kVp                         | kA                                          | N                         | kPa<br>gauge           | mm |     |     |     |     |     |     |     |     |     |
| POBR/72.5/<br>1600-3150                                   | 72.5          | 1600                     | 42                          | 155                         | 325                         | 62.5                                        | 2000                      | 350/750                | 0  | 0   | 99  | 130 | 130 | 315 | 285 | 290 | 250 | 0   |
|                                                           |               | 2500                     | 42                          | 155                         | 325                         | 62.5                                        | 2000                      |                        |    |     |     |     |     |     |     |     |     |     |
|                                                           |               | 3150                     | 42                          | 155                         | 325                         | 78.75                                       | 4000                      |                        |    |     |     |     |     |     |     |     |     |     |
| POBR/123/<br>1600- 3150                                   | 123           | 1600                     | 91                          | 255                         | 550                         | 62.5                                        | 3150                      | 350/750                | 42 | 165 | 99  | 155 | 155 | 335 | 305 | 335 | 290 | 220 |
|                                                           |               | 2500                     | 91                          | 255                         | 550                         | 62.5                                        | 4000                      |                        |    |     |     |     |     |     |     |     |     |     |
|                                                           |               | 3150                     | 91                          | 255                         | 550                         | 78.75                                       | 4000                      |                        |    |     |     |     |     |     |     |     |     |     |
| POBR/145/<br>1600- 3150                                   | 145           | 1600                     | 84                          | 305                         | 650                         | 62.5                                        | 3150                      | 350/750                | 42 | 165 | 99  | 155 | 155 | 335 | 305 | 335 | 290 | 220 |
|                                                           |               | 2500                     | 84                          | 305                         | 650                         | 62.5                                        | 4000                      |                        |    |     |     |     |     |     |     |     |     |     |
|                                                           |               | 3150                     | 84                          | 305                         | 650                         | 78.75                                       | 4000                      |                        |    |     |     |     |     |     |     |     |     |     |
| POBR/170/<br>1600- 3150                                   | 170           | 1600                     | 98                          | 365                         | 750                         | 62.5                                        | 4000                      | 350/750                | 42 | 165 | 99  | 155 | 155 | 335 | 305 | 335 | 290 | 220 |
|                                                           |               | 2500                     | 98                          | 365                         | 750                         | 63                                          | 5000                      |                        |    |     |     |     |     |     |     |     |     |     |
|                                                           |               | 3150                     | 98                          | 365                         | 750                         | 78.75                                       | 5000                      |                        |    |     |     |     |     |     |     |     |     |     |
| POBR/245/<br>1600- 3150                                   | 245           | 1600                     | 142                         | 505                         | 1050                        | 62.5                                        | 4000                      | 350/750                | 42 | 165 | 139 | 202 | 202 | 565 | 535 | 450 | 400 | 220 |
|                                                           |               | 2500                     | 142                         | 505                         | 1050                        | 62.5                                        | 5000                      |                        |    |     |     |     |     |     |     |     |     |     |
|                                                           |               | 3150                     | 142                         | 505                         | 1050                        | 78.75                                       | 5000                      |                        |    |     |     |     |     |     |     |     |     |     |
| POBR/420/<br>1250-2500                                    | 420           | 1250                     | 242                         | 750                         | 1550                        | 62.5                                        | 5000                      | 350/750                | 91 | 166 | 139 | 285 | 285 | 690 | 640 | 500 | 450 | 291 |
|                                                           |               | 2500                     | 242                         | 750                         | 1550                        | 62.5                                        | 5000                      |                        |    |     |     |     |     |     |     |     |     |     |

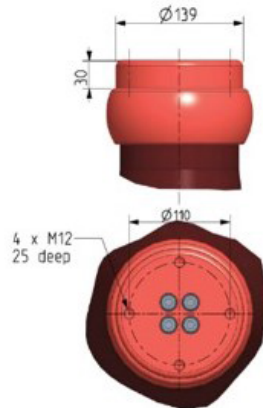
| CONDENSER BUSHING OIL<br>- SF <sub>6</sub> FOR TRANSFORMERS | RATED VOLTAGE | RATED CONTINUOUS CURRENT | D8  | D9  | D10 | D11 | S1 | S2 | R7  | L                    | L1                  | L2   | L3  | K               | N° OF HOLES SF <sub>6</sub> SIDE | N° OF HOLES OIL SIDE | CONNECTION OIL | HOLES OIL TERMINAL |
|-------------------------------------------------------------|---------------|--------------------------|-----|-----|-----|-----|----|----|-----|----------------------|---------------------|------|-----|-----------------|----------------------------------|----------------------|----------------|--------------------|
| TYPE/<br>Voltage [kV]/<br>Current<br>Range [A]              | kV            | A                        | mm  |     |     |     |    |    |     |                      |                     |      |     |                 | N x<br>mm                        | N x<br>mm            | mm             | N x<br>mm          |
| POBR/72.5/<br>1600-3150                                     | 72.5          | 1600                     |     |     |     |     |    |    |     | 772                  | 292                 |      |     | 0               | n8 d16                           | n8 d16               | 45X85          | 2 d18              |
|                                                             |               | 2500                     | 205 | 265 | 220 | 280 | 16 | 25 | 125 | 1072                 | 592                 | 329  | 150 | 300             |                                  |                      |                |                    |
|                                                             |               | 3150                     |     |     |     |     |    |    |     | 1272                 | 792                 |      |     | 500             |                                  |                      |                |                    |
| POBR/123/<br>1600-3150                                      | 123           | 1600                     |     |     |     |     |    |    |     | 1210                 | 498                 |      |     | 0               | n8 d16                           | n8d16                | 45X85          | 2 d18              |
|                                                             |               | 2500                     | 205 | 265 | 220 | 280 | 20 | 25 | 235 | 1510                 | 798                 | 520  | 150 | 300             |                                  |                      |                |                    |
|                                                             |               | 3150                     |     |     |     |     |    |    |     | 1710                 | 998                 |      |     | 500             |                                  |                      |                |                    |
| POBR/145/<br>1600-3150                                      | 145           | 1600                     |     |     |     |     |    |    |     | 1263<br>1563<br>1863 | 551<br>851<br>1151  |      |     | 0<br>300<br>500 | n8 d16                           | n12d16               | 45X85          | 2 d18              |
|                                                             |               | 2500                     | 205 | 265 | 220 | 280 | 20 | 25 | 235 | 1263<br>1563<br>1863 | 551<br>851<br>1151  | 520  | 150 | 0<br>300<br>500 |                                  |                      |                |                    |
|                                                             |               | 3150                     |     |     |     |     |    |    |     | 1263<br>1563<br>1863 | 551<br>851<br>1151  |      |     | 0<br>300<br>500 |                                  |                      | 75X85          | 4 d18              |
| POBR/170/<br>1600-3150                                      | 170           | 1600                     |     |     |     |     |    |    |     | 1263<br>1563<br>1863 | 551<br>851<br>1151  |      |     | 0<br>300<br>600 | n8 d16                           | n12d16               | 45X85          | 2 d18              |
|                                                             |               | 2500                     | 205 | 265 | 220 | 280 | 20 | 25 | 260 | 1263<br>1563<br>1863 | 551<br>851<br>1151  | 520  | 150 | 0<br>300<br>600 |                                  |                      |                |                    |
|                                                             |               | 3150                     |     |     |     |     |    |    |     | 1563<br>1863         | 851<br>1151         |      |     | 300<br>600      |                                  |                      | 75X85          | 4 d18              |
| POBR/245/<br>1600-3150                                      | 245           | 1600                     |     |     |     |     |    |    |     | 1686<br>1986<br>2286 | 724<br>1024<br>1324 |      |     | 0<br>300<br>600 | n16 d16                          | n12d20               | 45X85          | 2 d18              |
|                                                             |               | 2500                     | 270 | 370 | 450 | 510 | 20 | 35 | 350 | 1686<br>1986<br>2286 | 724<br>1024<br>1324 | 770  | 150 | 0<br>300<br>600 |                                  |                      |                |                    |
|                                                             |               | 3150                     |     |     |     |     |    |    |     | 1986<br>2286         | 1024<br>1324        |      |     | 300<br>600      |                                  |                      | 75X85          | 4 d18              |
| POBR/420/<br>1250-2500                                      | 420           | 1250                     |     |     |     |     |    |    |     | 2337<br>2637<br>2937 | 981<br>1281<br>1481 |      |     | 0<br>300<br>600 | n16 d20                          | n12<br>d23           | 48X80          | 2 d18              |
|                                                             |               | 2500                     | 360 | 420 | 420 | 620 | 30 | 35 | 500 | 2337<br>2637<br>2937 | 981<br>1281<br>1481 | 1050 | 215 | 0<br>300<br>600 |                                  |                      |                |                    |



## SF<sub>6</sub> Interface (GIS)



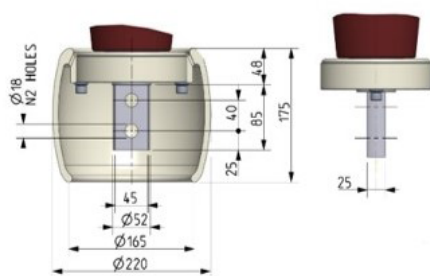
Type 1: 72.5 - 170 kV



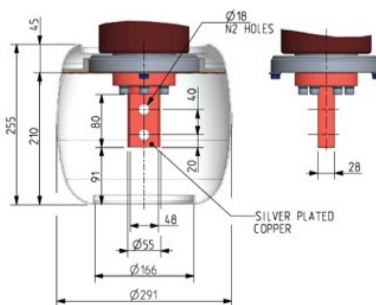
Type 2: 245 - 420 kV



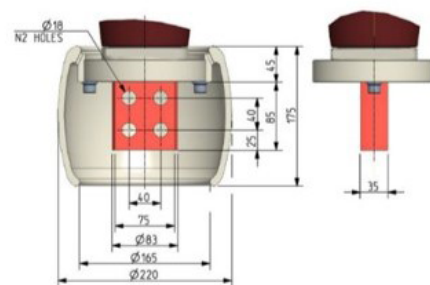
## Transformer Side



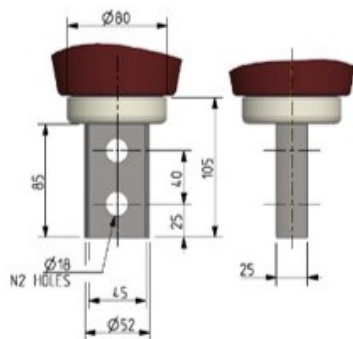
Fix - conductor  
n2 holes 123 - 245 kV



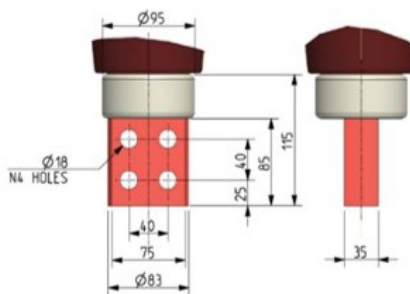
Fix - conductor  
n2 holes 420 kV



Fix - conductor  
n4 holes 123 - 245 kV



Fix - conductor  
n2 holes 72.5 kV



Fix - conductor  
n4 holes 72.5 kV





Manufacturing Site: Grid Solution, Sesto San Giovanni, Milan, Italy

For more information, visit  
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