

PGFR

Condenser Bushing Resin Impregnated Paper for AC Generators

PGFR are bushings designed for use on AC power generators. The dielectric insulation is achieved by a capacitance-grade condenser body, for installation in any position.

Design, components and manufacturing technology ensure an average life time of over 40 years under normal operating conditions.

Manufacturing of Capacitance Graded Bushings

The main electrical component is the condenser body that is manufactured using resin impregnated paper (RIP) technology. This technology utilizes a continuous sheet of pure crepe paper, wound around a support tube. During the winding process, the first step is to reduce its water content to 1% maximum by drying the paper with heated cylinders and infrared rays. During winding, a series of aluminum foils are coaxially inserted between the layers of the paper in order to grade the best possible distribution of radial and longitudinal electrical gradients between the central conductor and the grounded flanges.

The winding and foil placement is made by computer-controlled machines. After winding, each condenser core is placed into an autoclave for resin impregnation under vacuum. Each core is then machined to achieve the final shape.

Depending on the overall dimensions of the bushing, when the gradients are very low, the insulation can be achieved directly by a tube impregnated in epoxy resin and reinforced by a fiber glass filament winding.



Key Benefits

- Bushings with longer lifetime and higher
- Even voltage distribution across the bushing thanks to the capacitance-graded condenser core.
- No deterioration of grounding part for CT installation realized internally and protected by porcelain
- Helical springs to absorb conductor dilatation and vibrations in service.
- Installation in any position.



PGFR Bushings Main Features

Condenser Bushings

- Rated voltages up to 30 kV outer envelopes: Porcelain and/or Fiberglass tube
- Cooling: Natural, hydrogen, water
- Coupling by means of helical springs placed on the air side
- Inner conductor made of aluminum or copper casting
- Dry filling (polyurethane foam) of the space between the porcelain and condenser body
- Installation in any position
- CT accommodation on request
- Flange made of aluminum or stainless steel, low permeability
- Maximum current rating up to 45,000 A
- All o-ring gaskets, FPM material: elastomer



Bushing Designation

The bushing is designated as follows:

PGFR.24.125.25000

P	Condenser bushings ("P" from the Italian word "Passante")
G	Power generator
F	High current application (force cooled)
R	Resin Impregnated Paper (RIP)
24	Rated voltage in kV
125	BIL class in kV
25000	Rated current in A



Fig. 1
24 kV - 9,000 A



Fig. 2
24 kV - 12,000 A



Fig. 3
24 kV - 25,000 A



Fig. 4
24 kV - 25,000 A



Fig. 5
24 kV - 20,000 A



Fig. 6
24 kV - 25,000 A



Fig. 7
20 kV - 10 kA

Envelope

For outdoor application, the air side envelope is made of brown porcelain, with a creepage distance for very highly polluted atmospheres (31 mm/kV).

For indoor application, the air side envelope is made of porcelain or a tube impregnated in epoxy resin and reinforced by a fiber glass filament winding. The hydrogen side envelope can be made of porcelain or filament winding tube.

Flange

The flange is made of low-permeability, stainless steel casting. It is made of aluminum only for low current ratings (natural cooling applications).

Gaskets

The o-ring type gaskets are made of FPM. They are compatible with the fluids they are in contact with. Air side, the gaskets are sealed to protect them effectively from polluting weather conditions.

Assembling

The porcelain and metal parts (top fixing plate, flange and bottom fixing plate) are coupled by means of springs, generally helical springs, placed in the air side of the bushing. The helical springs are very effective against the vibration and impact load stress caused by the normal service of the bushing installed on the power generator.

The air and hydrogen side envelopes consist of two completely separate parts, and the flange is fixed between them. This design avoids any possible movement of the flange during the life time of the bushing.

The space between the porcelain and condenser body is filled with dry insulating material (no fluids are used).

Current Rating

The PGFR bushing has been designed to satisfy any requirement in terms of current ratings and cooling method.

The inner conductor is made of an aluminum or copper tube.



Common Solutions

The most common solutions and their respective maximum current ratings are:

- Natural cooling up to about 10,000/12,000 A
- Forced hydrogen cooling up to about 25,000 A
- Forced water cooling up to about 45,000 A

Tests

All bushings are tested and have electrical and mechanical characteristics that comply with the main standards:

- IEC 60137 "Bushings for alternating voltage above 1000 V"
- ANSI/IEEE C57.19
- DIN 48123

GE's Grid Solutions can satisfy any special test requirements such as:

- Mechanical impact load test
- Vibration test
- Equivalent thermal test with or without cooling simulation
- Inside pressure test at any pressure level
- Leakage test, including by leak meter
- Drop flow rate

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 and includes the following information (fig. 14):

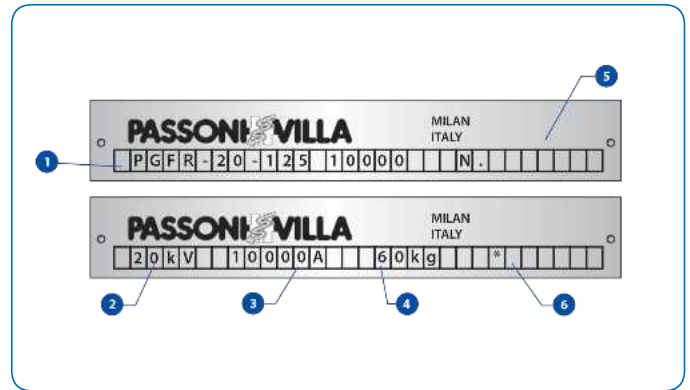


Fig. 8: Identification Nameplate

1. Type of bushing
2. Insulating voltage
3. Rated current
4. Weight
5. Serial number
6. Month and year of production

For more information please contact
GE
Grid Solutions

Worldwide Contact Center

Web: www.GEGridSolutions.com/contact
Phone: +44 (0) 1785 250 070

GEGridSolutions.com

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Imagination at work