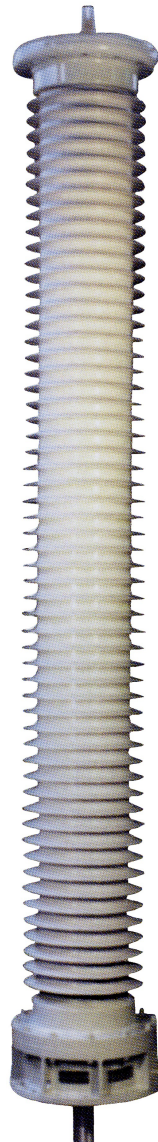




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AIR TO SF6 BUSHINGS SERIES PABS
VOLTAGE FROM 72.5 kV TO 362 kV



**INSTRUCTION FOR STORAGE, TRANSPORTATION,
INSTALLATION AND MAINTENANCE**



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First edition	November 1997
Rev. A	September 2001
Rev. B	June 2003
Rev. C	October 2005
Rev. D	April 2007
Rev. E	August 2017
Rev. F	September 2022



1 DESCRIPTION

1.1 GENERAL

These instructions are applicable to the air to SF₆ type bushings of the series:

“PABS” for rated voltage from 72.5 kV to 362 kV

according to IEC 60137 Standard “Insulated bushings for alternating voltages above 1000 V”, and give all general information to be followed from the receipt of bushings until their installation on GIS, GIL or dead tank Circuit Breakers. Other information are given regarding their service and maintenance.

The designation of the bushing is the following:

PABS 300.1050.1600

P	Condenser bushings (“P” from Italian word “Passante”)
AB	Air to GIS (“B” from Italian word “Blindato”)
S	SF ₆ insulation
300	Rated voltage (in kV)
1050	BIL class -Basic Insulation Level (in kV).
1600	Rated current (in A)

1.2 SAFETY

This manual must be available to the personnel responsible of the installation, operation and maintenance of the bushings.

The installation, operation and maintenance of the bushings present conditions of no safety and it is necessary to follow carefully specific procedures and instructions. No compliance with these procedures and instructions can involve very severe and dangerous conditions for the personnel and the property.

Please follow carefully all the instructions of the manual and pay attention to the WARNING (severe hazard), and CAUTION (minor hazard) signs.

1.3 TECHNICAL CHARACTERISTICS

SF₆ gas or SF₆-N₂ gas mixture (1), at certain density, is used as the main insulation. Until 362 kV rated voltage simple shield(s) (2) are used to achieve the proper electric field distribution over the bushing’s housing (3), porcelain or composite insulator.

The standard HV terminal (4) is a Ø40/50/60 mm aluminium stud, welded or fixed with screws to the top plate (5), without any gasket in the conductor (high temperature) region.

Other type of HV terminal, like tinned copper stud or NEMA type, is available on request.

Central conductor (8), aluminium or copper type, is fixed to the top plate, while the opposite extremity, usually silvered, is intended for connection with GIS,

GIL or CB. The type of bottom connection is done according to the request.

The flange (7) is adaptable to customer’s fitting.

The bushing is always protected during transportation with a suitable cap (8).

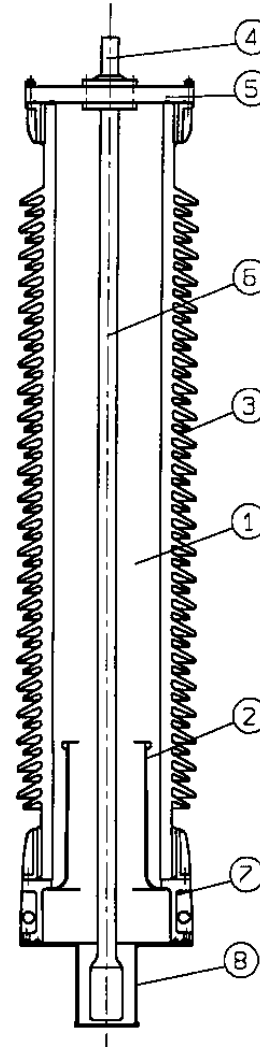


Fig. 1

1.3.1 SF₆ INSULATION

The basic insulation is gas Sulphur-hexafluoride (SF₆), which is known as:

- poison less;
- inert;
- non-inflammable;
- good dielectric and arc-quenching medium.

In comparison with oil paper-insulated bushings, the SF₆ bushings are less sensitive on the humidity and air presence, what leads to a shorter production time and a more reliability in the service.



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1.3.2 NAME PLATE

Each bushing is provided of a name plate, with serial number and all the electrical data, in accordance with the prescription of IEC Standards.

The plate (fig. 2) is made of aluminium and is placed on the flange by nails. On the plate there are indicated the following information:

- Type of bushing
- Insulating voltages
- Rated current
- Max. mounting angle (in degrees from vertical)
- Weight
- Serial number
- Month and year of production
- Number of outline drawing
- Minimum operating. Filling, design pressure

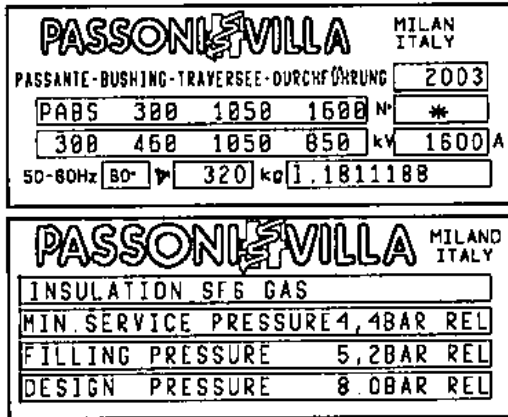


Fig. 2

The month is indicated by a code, as follows:

- A = January L = July
- B = February M = August
- C = March P = September
- D = April R = October
- E = May S = November
- H = June T = December

2 PACKING AND STORAGE

2.1 PACKING

Transport of the bushings is performed in horizontal position.

Usually the bushings are transported without any inside overpressure.

On request they can be delivered with a small overpressure (0.2 – 0.3 bar rel.) of dry N₂. In this case on the protective cap is placed an automatic valve (type DILO DN8) which permits the vacuuming and filling of the object with proper dry gas.

Preferable vehicle for land transport is truck. Maximum recommended transportation velocity is 70 km/h. Care has to be paid to avoid strong vibrations and bumps. To verify this, check the shock indicator (with value of

25g x 50m.s.) attached on the transport assembly; if it indicates irregular transport conditions, or if the wooden case is visibly damaged, make a note in the presence of the transport company responsible person. Inform immediately the manufacturer's representative.

2.2 ACCEPTANCE

Upon receipt of the goods, before taking the bushings down from the truck, customer should operate as follows:

- Check the external surfaces of the packing cases:
 - No sign of damage have to be found;
 - The shockwatch indicator (with value of 25g x 50 ms), placed in the external part of each packing case (fig. 3), must be white.



Fig. 3

If the shockwatch indicator is red don't refuse shipment, make a notation on delivery receipt and inspect for damage as follow:

- Open the packing case by removing its cover;
- Make sure that the anchoring elements are in order and securely fixed;
- Make sure that there are no breaks or broken parts.

In case any damage is found, leave in original packaging and request an immediate inspection from carrier within 15 days of delivery.

Moreover give the forwarding agent a written claim and notify the manufacturer with the details of the packing list, including the number of the case and the serial number of the bushing, to the following address:

Grid Solutions Spa- Unit RPV
Via Mario Villa, 210
20099- Sesto San Giovanni (ITALY)
PHONE: +39-02-24105001



2.3 STORAGE

Internally in the bushing, in the protective cap, is placed a silicagel bag, which maintains dry the air inside the bushing, hermetically closed through the same cap: in such a way the bushing is protected in dry air against the humidity of the ambient.

Every bushing with composite insulator is protected externally with a polyethylene bag hermetically sealed and containing a silicagel bag.

Although there is no preclusions for the bushings remaining in the open air, it is better to store them in a weather proof ambient.

The bushing must be kept in its original packing with silicagel bag, and if foreseen under the original small overpressure of 0.2-0.3 bar, until the installation.

If the bushing has to be opened and used for some tests, at the end of use it is recommended to close it with its protective cover after having been placed in it a new or a regenerated silicagel bag. If foreseen, make the vacuum for minimum 2 hours (pressure less than 10 Pa), and then fill it with dry N₂ at 0,2-0,3 bar relatives.

3 LIFTING AND TRANSPORTATION

The bushing type PABS is sturdy, nevertheless, in order to avoid dangerous movements, it is better to follow the suggested options.

3.1. PACKED BUSHING

The case containing the bushing can be easily lifted with a tackle by applying the ropes on the points and with the inclination as indicated in fig.4, or using a fork vehicle.

Some indications appear also in the packing case.

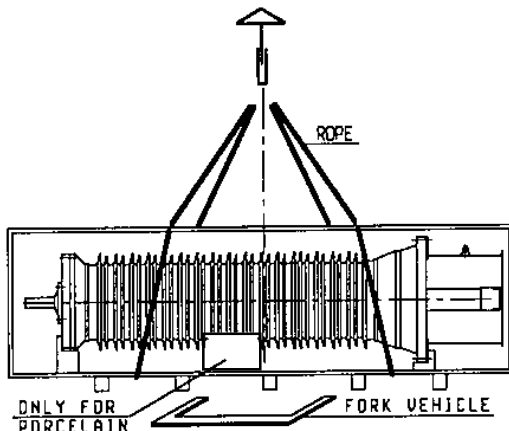


Fig. 4

3.2. UNPACKED BUSHING

Before unpacking check the delivery documentation on the packing list fixed on the wooden case.

After unpacking, check the porcelain (or composite insulator) and the other parts of bushing. Any damage, especially on the porcelain, must be carefully analysed.

Inform PASSONI & VILLA agent for further instructions.

CAUTION

Bushing with broken or partially broken porcelain is not useful for service and is very dangerous for personnel and surrounded equipment.

To take the bushing out of the case, the operations to make depend by the bushing's weight (see the nameplate) and by the bushing's insulator type, porcelain or composite.

3.2.1 Porcelain insulator

Bushing's weight less than 200 kg

To take out the bushing from the case is sufficient to use one crane, fixing the lifting rope at the level of the fourth smaller shed, head side, according to fig. 5.

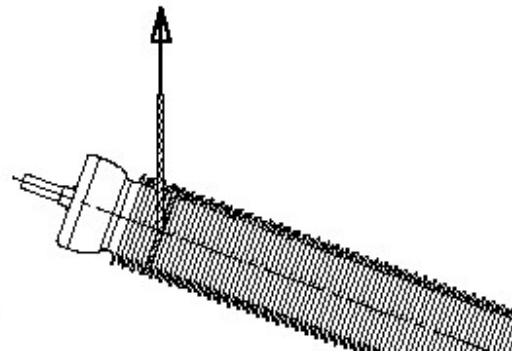


Fig. 5
Bushings with porcelain and ≤ 200 kg

CAUTION

This is a delicate operation. Before starting the handling, be sure that the ropes are well fixed.

Make all these operations only by expert people.

Bushing's weight over 200 kg

To take out from the case a bushing that weights more than 200 kg and with porcelain insulator, it is necessary the use of two cranes: connect two metallic ropes to the two opposite cast eyebolts (or to the screwed ones) foreseen on the flange; from the same eyebolts connect the two ropes going to the first crane.

At the level of the fourth-fifth smaller shed, head side, make a connection through a second rope, not metallic, that goes to the second crane and locks the two metallic ropes (pay attention to protect the porcelain sheds from the metallic ropes). See fig. 6.

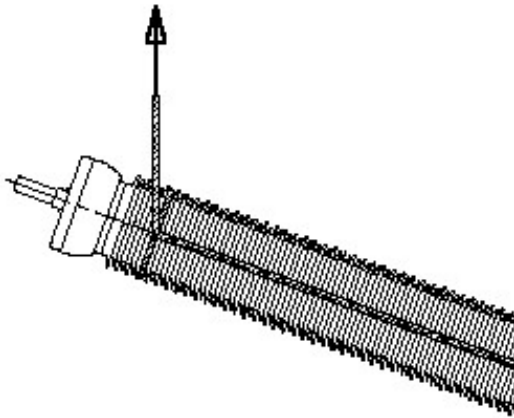


Fig. 6
Bushings with porcelain and >200 kg

3.2.2 Composite insulator

Bushing's weight less than 200 kg

To take out the bushing from the case is sufficient to use one crane, connecting the lifting rope to an eyebolt screwed on the M12 hole foreseen on the top of the HV terminal, according to fig. 7.

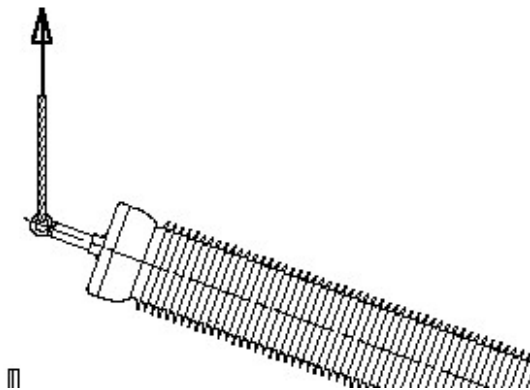


Fig. 7
Bushings with composite insulator and ≤ 200 kg

Bushing's weight over 200 kg

To take out from the case a bushing that weights more than 200 kg and with composite insulator, it is necessary the use of two cranes: connect two metallic ropes coming from the crane to the two opposite cast eyebolts or to the screwed ones foreseen on the flange; the other rope has to be connected to an eyebolt screwed on the M12 hole foreseen on the top of the HV terminal, according to fig. 8.

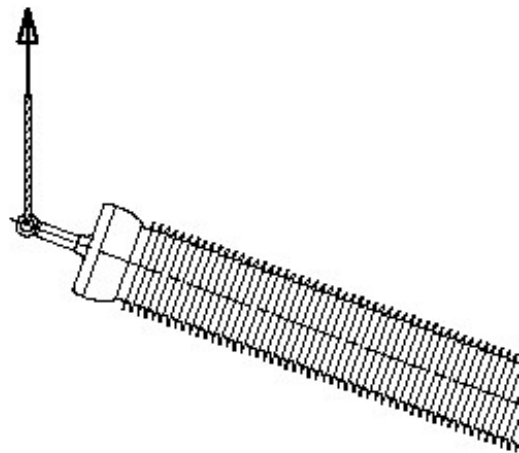


Fig. 8
Bushings with composite insulator and >200 kg

Pay attention to following items:

- Handling with porcelain or composite insulator bushing has to be very careful, with special attention not to damage the sheds of the insulator
- Use preferably "nylon" lifting ropes.
- In case of silicon sheds, never lift the bushing putting the lifting rope over sheds or between the sheds, but use the eyebolts foreseen on the flange or the threaded hole on the top HV terminal.
- In the local transport or during putting the composite insulator bushing in horizontal position, don't use any kind of supporters, between sheds and base. Soft rubber sheds could be highly deformed or even broken. Support the bushing only at the metal flanges.
- Plastic sheet cover on the composite insulator has to be removed carefully. If a blade is used, be careful that insulator will not be cut.

On the flange of bushings two cast eyes or two/four holes M12 are foreseen for the lifting. In case of holes, they can be used also for the connection to earth, or to tighten some screws working as extractors during the dismant of the bushing, in case of difficulties.

WARNING

When the bottom protection cover is taken out, be careful to maintain the bushing in vertical position: the central conductor is fixed only in its upper part to the bushing's head, and for this reason it can oscillate in its bottom part, up to damage itself or the internal shield surfaces if they enter in contact between them.

NOTE



Due to possible oscillations of the bottom side of the central conductor after removing of the bottom protection cover, during movements of the bushing we suggest to put between the central conductor and the internal part of the flange same protection soft thickness.

3.3. SHIPMENT TO THE END USER

The shipment of the bushings by the GIS or CB manufacturer to the final destination, must be made with the original packing or with a new one, made with the same principles (silicagel bag inside the cap), and if foreseen under the originally small N₂ overpressure (0.2-0.3 bar), until the installation.

4 INSTALLATION

The outdoor installation can be done only during good weather conditions without rain, snow, and very high humidity.

Before the installation, reduce the inside (transport) pressure, pressing the automatic valve on the transport cover, if present.

Put the bushing in vertical position.

When the bushing is in vertical position take off the protective metallic (transport) cap by unscrewing the M12 screws that fix the cap to the bushing's flange and the silicagel bag (put inside the protective cap if the small overpressure is not foreseen).

WARNING

Remember that the conductor is fixed only in the upper part of the bushing, so in this phase of mounting procedure do not incline the bushing.

Make than a control of the followings things:

- Diameter of fixing holes;
- Conductor dimensions in the lower part (for multi contact GIS connection);
- The state of contact surfaces;
- Dimensions and state of groove(s);
- Dimensions of HV upper terminal.

Clean the bottom part of the bushing conductor with clean cloth and alcohol.

During the coupling of bushing with GIS, in vertical position, control the centring of bushing conductor, that is fixed only in upper part and can not to be perfectly in centre line.

For service condition it is allowed a conductor eccentricity of ± 1 mm. If it is necessary, use some clean and soft tools to centre the conductor inside the contact, which is sensitive to mechanical damages.

If the bushing's HV terminal is aluminium made, remove the oxide thin layer from bushing (aluminium) terminal, brushing it (with steel brush) under the right angle direction and put immediately over the brushed surface a thin layer of contact grease in order to prevent further oxidation.

Fix then the air line terminal to the bushing.

5 FILLING-REFILLING TREATMENT

When the bushing, with proper gasket, is installed and fixed to the GIS (CB), make the vacuum (pressure ≤ 10 Pa) for at least 2 hours.

Fill the bushing with gas (SF₆-IEC 60376 or SF₆/N₂; N₂ – 99,998% purity) until the pressure reaches the value indicated on the nameplate (fig. 2).

Bushing has to be maintained under pressure for at least 4 hours, before applying the voltage.

In case the bushing is intended to operate under SF₆/N₂ mixture, for example 60% - 40%, filling has to be performed with an already prepared mixture or making it with partial pressures:

60% x 6 bar (abs) SF₆ = 3.6 bar (abs) (2.6 bar rel.);
40% x 6 bar (abs) N₂ = 2.4 bar (until a filling pressure of 6 bar abs). SF₆ acc. to IEC 60376; N₂ : 99,998%.

NOTES

As the bushing has normally a common gas zone with GIS/GIL, vacuum and filling plug is on the GIS body.

When during service the pressure drops at minimum operating pressure, under normal leakage <1% (alarm signal appears), the bushing needs to be refilled up to the filling pressure indicated on the nameplate.

The filling with pure SF₆ or mixture SF₆/N₂ has to be done through the automatic valve, which is placed on the GIS part. The user can make the refilling from SF₆ device or simply from SF₆ bottle paying high attention to the cleanliness of the connecting tube and valves.

If the leakage is greater than 1% per year it is necessary to analyse the reason and location of it. In case that SF₆ loss is located on the bushing itself, inform P&V for further instructions.

WARNING

The bushing cannot be maintained in service if the gas filling pressure drops at a value less than the minimum one indicated on the nameplate.



6 SERVICE AND MAINTENANCE

The bushings PABS are considered as maintenance free.

Control periodically the system pressure through a temperature compensated manometer, to be sure that the internal bushing pressure be greater then the minimum working one.

As for the preservation of the external surfaces, generally is recommended to perform the following inspections.

Porcelain

Check for chips, cracks and contamination. Minor chips maybe painted with an insulating varnish to obtain a glossy finish which will prevent dirt and moisture attack. Bushings with major chips or cracks which appreciably decrease the creepage distance should be removed from service and replaced.

Clean periodically with alcohol the porcelain surfaces, on which dust, saline compounds, combustion resituates, dirt, oil and other deposits may easily collect and reduce consequently the flashover value.

Composite insulator

Clean periodically with alcohol the composite insulator surface and wait at least 24 hours before energising, to allow the silicon to recover its hydrophobicity.

In case of small damages on silicon sheds, it is possible to make acceptable repairs.

WARNING

Bushing washing under voltage is NOT allowed.

HV terminal

Check and fasten the connection in order to avoid poor contacts and consequent overheating.

If the bushing's HV terminal is aluminium made, remove the oxide thin layer from bushing (aluminium) terminal, brushing it (with steel brush) under the right angle direction and put immediately over the brushed surface a thin layer of contact grease in order to prevent further oxidation.

Metal parts

It is advisable after a period of 10 years to give a further paint coating.

7 SPARE PARTS

No spare parts are delivered with the bushing.

8 LIFE TIME

The lifetime of bushing depends of various factors (ambient conditions, service conditions....).

In normal ambient conditions (-25/+40°C, normal pollution...) and normal service conditions, the estimated lifetime of the bushing is about 30 years.

Lifetime of composite insulator is estimated at around 25 years, based on the experience and severe tests, made on this new material (acc. to IEC 61462).