Product Information

HVDC Transformer bushing with oil side porcelain type GOF for horizontal mounting

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The bushing shall be de-energised and grounded when any kind of work is carried out on the bushing.

Note!!! The sealing plug must be removed from the flange extension before mounting the bushing in the transformer. When oil filling of the transformer, the bushing shall be handled as a bushing of type GOF without oil side porcelain.

After de-mounting from the transformer the specified oil volume has to be sucked out from the bushing. The plate that warns that the sealing plug shall be removed before mounting in the transformer shall be refitted!!!
Description

The design principle is shown in Figure 2.

The air side insulator of the bushing is cemented to a flange that is bolted to the fastening flange. A set of concentric tubes are pre-stressed and serve as a spring that holds the main bushing components together and provides adequate pressure on the gaskets at all expected temperature and load conditions. The outermost tube is made of aluminium and is also used as the current conductor.

The leads from the transformer is bolted to a bottom contact made of copper. This contact is drawn against the bottom end of the bushing by means of a draw rod made of steel. The upper part of this rod is connected to a spring device designed so that a constant contact force is achieved at all expected temperatures.

The outer terminal is made of aluminium.

Between the fastening flange and the condenser body a sealing system is built in. The seal prevents oil from flowing out from the transformer in case of damage to the air side porcelain. In the seal, pressure valves are mounted that allows oil flowing from one side of the seal to the other side at temperature differences in the bushing. This is further explained in the paragraph "Description of sealing system" below.

In service the bushing is designed to share the oil with the transformer. For that reason, the bushing is equipped with an oil plug in the flange extension. This plug shall be removed before the bushing is mounted in the transformer. The oil filling procedure for this bushing is the same as for the GOF built without oil side insulator.

Spare parts

In case of major damage to the bushing, it shall be sent back to ABB Components AB for repair and re-testing.

For certain parts that may be lost or damaged in transportation or handling, the article numbers or the dimensions are given in the Figures.

Note the design of the sealing plug 2522 731-A, in figure 1, used on the flange extension and the voltage tap is changed.

Any sealing plug ordered as spare part will be of the new design.

New design of sealing plug 2522 731-A

1) BOLT WITH FLANGE DIN6921 ABB Art no. 2121 738-18
2) GASKET ABB Art no. 2152 899-132

Figure 1a
Previous design of sealing plug 2522 731-A

1) HEXAGON SOCKET SCREW ABB art no. 2121 738-4
2) GASKET ABB art no. 2152 899-132
3) CONICAL SPRING WASHER ABB art no 2154 4004-3

Figure 1b

Horizontal mounting
The bushing is considered mounted horizontally if the mounting angle is more than 60° from the vertical plane.
A horizontally mounted bushing has the oil system connected to the transformer.

*On request GOF bushings with higher mounting angle than 60° with separate oil system can be delivered and are then considered to be vertical mounted.*

A bushing mounted with a mounting angle of 0-60° from the vertical plane is considered to be vertically mounted.

0-60

Vertical mounting

60-90

Horizontal mounting
Figure 2 Bushing design
Voltage tap

In the mounting flange, a voltage tap is mounted that is insulated from the flange and connected to the outermost layer of the condenser body. The voltage tap must always be earthed or connected to an impedance. The voltage tap is shown in Figure 3.

Figure 3a.

1. Test tap 2769 522-T
2. Test tap cover 2769522-M
3. Sealing plug 2522 731-A

Figure 3b Terminal box (ABB Art. No 2769 522-C)
Description of the sealing system

The bushing is mounted almost in horizontal position. The air side penetrates the valve hall.

In order to prevent oil from flowing out from the transformer into the valve hall, the bushing has a sealing system built in between the fastening flange and the condenser body. In the sealing system pressure valves are mounted. These valves remain closed in case of damage to the porcelain.

As the oil conservator of the transformer is exposed to open air via a silica gel breather, increase of pressure in the transformer tank due to temperature differences is not possible.

![Diagram of the sealing system]

**Figure 4. Sealing system**

Rapid changes in temperature causes the valves to open in the following manner:

1. The temperature rises in the air side of the bushing. The pressure in the air side of the bushing increases until it reaches a pre-set value. Valve 2 opens and oil flows from the bushing into the transformer.

2. The temperature goes down in the air side of the bushing. The pressure in the air side of the bushing decreases until it reaches a pre-set value. Valve 1 opens and oil flows from the transformer into the bushing.

3. The air- or oil side porcelain is totally cracked: The valves remain closed and no oil can flow from the transformer into the valve hall. See table 1 for the volume of oil that is enclosed in the air side of the bushing.
Service and maintenance

Capacitance and dissipation factor measurements

The desired capacitance and dissipation factor (tan δ) measurements can be carried out, without removing the bushing from the transformer, because the GOF bushings are furnished with a test tap. See figure 2.

With the transformer de-energised and the bushing terminal disconnected, the test tap cover is removed and the measuring equipment is connected to the tap and measuring voltage source is applied to the bushing terminal. The dissipation factor varies with the temperature of the bushing body and the measured value should thus be multiplied with the correction factor (multiplier) given below.

<table>
<thead>
<tr>
<th>Bushing body temperature (°C)</th>
<th>Multipliers to 20°C (IEC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - 7</td>
<td>0.85</td>
</tr>
<tr>
<td>8 - 12</td>
<td>0.90</td>
</tr>
<tr>
<td>13 - 17</td>
<td>0.95</td>
</tr>
<tr>
<td>18 - 22</td>
<td>1.00</td>
</tr>
<tr>
<td>23 - 27</td>
<td>1.05</td>
</tr>
<tr>
<td>28 - 32</td>
<td>1.10</td>
</tr>
<tr>
<td>33 - 37</td>
<td>1.15</td>
</tr>
<tr>
<td>38 - 42</td>
<td>1.20</td>
</tr>
<tr>
<td>43 - 47</td>
<td>1.25</td>
</tr>
<tr>
<td>48 - 52</td>
<td>1.30</td>
</tr>
</tbody>
</table>

Mounting instruction

Packing  The bushings are delivered from ABB Components in wood cases with the bushing supported by cellular blocks and fibre boards. The case is marked with "Top End". On receiving, the bushing shall be inspected with regard to shipping damages.

Storing  The bushing may be transported and stored horizontally up to 6 month. The bushings should always be kept dry and clean and protected against mechanical damages during storing. Storing of the bushing longer than 6 months shall always be done leaned with the top end of the bushing upwards at an angle of at least 5°. The time between delivery from ABB Components to mounting of the bushing in a transformer is often longer than 6 months. It is therefore recommended that the case with the bushing is placed leaning at an angle of at least 5° when delivered to site.

The bushings can be stored outdoor in the cases provided they are protected against penetrating water. This means that the case must not be stored in areas where it can be foreseen that the ground will be wet and muddy during heavy rains. It is also recommended to use a tarpaulin to protect the case from water penetration.

Before installation (in a transformer) the bushing shall be inspected and thoroughly cleaned.

Storing of spare bushings  Spare bushings are recommended to be stored mounted in a frame that gives the bushing a mounting angle of at least 5° from the horizontal. Preferably the bushings can be stored vertically. If the bushing is stored in the case it must be leaned with the top end of the bushing upwards at an angle of at least 5°.
The bushings must be stored indoor in a dry and clean atmosphere and protected against mechanical damages. Before installation (in a transformer) the bushing shall be inspected and thoroughly cleaned.

**Lifting**
When lifting of the bushing out from the case, two lifting slings shall be used as shown in Figure 6. The lifting sling is not allowed to be placed around the sheds because of the risk to damage the sheds. Place the bushing on the ground supported under the same places as in the case using the same blocks.

**Dismounting of oil plug on flange extension**

*Before mounting of the bushing in the transformer, the oil plug on the flange extension must be removed.*

**Mounting in transformer**
In order to simplify the oil filling when the bushing is mounted in the transformer, it is best to completely drain the bushing from oil via the valves in top of the bushing. The bushing is then mounted according to Figure 5. The centre hole as well as the outer part of oil side of the bushing shall be inspected with regard to cleanliness. A wire cord is inserted in the bushing centre hole and connected to the upper part of the draw rod. The bushing is then ready to be mounted in the transformer.

**Mounting of draw rod**
The lower part of the draw rod, that shall be mounted in the bushing turret, is usually mounted inside the transformer and is held during transportation by a special bracket in the transport cover. Before mounting of the bushing, this cover shall be opened and the bracket loosened after which the bracket and the cover is removed.
The top end of the draw rod system is equipped with a double concentric compensation device in order to give a correct contact regardless of the temperature. This device is inserted in the top of the bushings innermost centre tube. This tube always has a certain length and is not depending on the length tolerances of the porcelain insulator.

The wire cord, inserted in the bushing and the compensating device, is used to lower the upper part of the draw rod so that the two parts can be connected, see Figure 7.

*Check that the valves in top of the bushing are closed.*

*The condenser body must not be exposed to open air for more than 2 hours.* However, the bushing is allowed to be without oil up to one week if it is mounted in the transformer. If it is necessary, this time may be prolonged up to maximum three weeks *provided that the vacuum time for the transformer is increased with additional 24 hours, and to have at least 5 days from the impregnation is complete (the oil level is above the bushings) to service voltage is applied.*

After bolting the bushing fastening flange to the transformer, the washer and the nut is mounted according to Figure 7. *The threads and the nut shall be tightly oiled before mounting.* Try the nut so it can be easily moved.

1. Tighten the nut with 10 Nm.
2. Measure the distance from the top of the nut to the top of the bolt, according to figure 7. If the free thread above the nut is less than 10 mm, tighten the nut with a wrench until the distance “a” is at least 10 mm.
3. The draw rod shall be pre-stressed with a jack according to figure 7.
4. Stress the draw rod with a force F=45000 N and tighten the nut by hand.
5. Release and remove the jack.
Oil filling

For simultaneous oil filling of transformer and bushing, hoses are connected to the valves in top of the bushing. One hose is connected to a suitable valve at the bottom of the transformer or to the hose for oil filling. The other hose is connected to a suitable valve to the vacuum system. When oil filling of the transformer also the bushing will be completely oil filled. After oil filling, the valves in top of the bushing are closed and the hoses removed. The hole in the valves shall be plugged with sealing plug 2522 2028-4 and thread tape.

Dismounting from transformer

After that the oil level in the transformer has been lowered, the bushing can be removed. The oil plug in the flange extension is then mounted. Oil shall be removed to assure that the bushing can withstand temperature differences at storing.

If your bushing is not in the list below contact ABB Components for correct information.

<table>
<thead>
<tr>
<th>Type of bushing</th>
<th>Drawing number see rating plate</th>
<th>Oil volume to be removed.</th>
<th>Oil volume on the air side of the bushing</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOF 875</td>
<td>2745 322-BC</td>
<td>min 55 litres</td>
<td>289 litres</td>
</tr>
<tr>
<td></td>
<td></td>
<td>max. 70 litres</td>
<td></td>
</tr>
<tr>
<td>GOF 1175</td>
<td>2745 322-AW</td>
<td>min 55 litres</td>
<td>394 litres</td>
</tr>
<tr>
<td></td>
<td></td>
<td>max. 142 litres</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.

Mounting of outer terminal

The inner contact surfaces, both on the bushing tube and on the terminal stud, are tin plated. *Therefore no wire brushing or contact grease is needed.*

The surfaces shall be cleaned carefully before assembly. The gasket retainer ring, the gasket itself and the outer terminal stud is assembled according Figure 5. The bolts that press the stud against the bushing tube shall be tightened first. Tightening torque 40 Nm. When this is done, the screws that hold the retainer ring are inserted and tightened in order to press the gasket into place.

*It is extremely important in both cases to tighten evenly.* The bolts shall thus be tightened in steps, alternating on both sides.
**Figure 5 Assembly of terminal stud**

1. Terminal stud
2. Hexagon screw M8x40
3. Hexagon screw M10x60
4. Conical spring washer 8.4x18x1 (Bleville)
5. Washer 10.5x22x2
6. O-ring 99.1x5.7
7. Retainer ring for gasket
Figure 6. Lifting of bushing out of crate

Cellular block

Hole D=50 for shackle
Conical washer 17x39x4
Hexagon nut M16
The thread slightly oiled!

Compensation device

Wire cord ABB art.No. 9760 669-A
Top end of bushing

Box spanner ABB Art.No. 9760 669-B

Hydraulic pump with manometer

The nut shall be mounted so that the free thread above it is > 10 mm

Jack (12 tons) with accessories (Manometer class 2.5)
ABB Art.No. 9769 897-A

The applied tensile force on the draw rod with the jack shall be 45 kN. Tighten the nut just by hand with the box spanner. The jack is then released and removed.

Figure 7. Mounting and tightening of draw rod.