Wall bushings, type GOBL

Installation and maintenance guide
Safety information

Keep this instruction available to those responsible for the installation, maintenance, and operation of the bushing.

The installation, operation, and maintenance of a bushing present numerous potential unsafe conditions, including, but not limited to, the following:

- High pressures
- Lethal voltages
- Moving machinery
- Heavy components
- Slip, stumble or fall

Specialized procedures and instructions are required and must be adhered to when working on such apparatus. Failure to follow the instructions could result in severe personal injury, death, and/or product or property damage.

Additionally, all applicable safety procedures such as regional or local safety rules and regulations, safe working practices, and good judgement must be used by the personnel when installing, operating, maintaining and/or disposing such equipment.

Safety, as defined in this instruction, involves two conditions:
1. Personal injury or death.
2. Product or property damage (includes damage to the bushing or other property, and reduced bushing life).

Safety notations are intended to alert personnel of possible personal injury, death or property damage. They have been inserted in the instructional text prior to the step in which the condition is cited.

The safety conditions are headed by one of the three hazard intensity levels which are defined as follows:

_________________________ DANGER ___________________________
Immediate hazard which will result in severe personal injury, death, or property damage.

_________________________ WARNING ___________________________
Hazard or unsafe practice which could result in severe personal injury, death, or property damage.

CAUTION: Hazard or unsafe practice which could result in minor personal injury, or property damage.
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1 Description

1.1 Design

The design and dimensions of bushings type GOBL are given in the Technical Guide, IZSE 2750-104. The design principle is also shown in Figs. 1a-c. The bushing is delivered oil filled and it has an oil level glass of prism type according to Fig. 1a. The bushing is intended for mounting angles of 0-75° from vertical.

Fig. 1a. Design principle.

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Fig. 1b. Previous design of sealing plug, 2522 731-A.
1) Hexagon socket screw, 2121 738-4
2) Gasket, 2152 899-132
3) Conical spring washer, 2154 4004-3

Fig. 1c. New design of sealing plug, 2522 731-A.
1) Bolt with flange DIN 6921, 2121 738-18
2) Gasket, 2152 899-132
1.2 Operating conditions

The table below show the standard technical specifications for the GOBL Air - Air bushings. For conditions exceeding the below values, please contact ABB Components.

**Common specifications:**

<table>
<thead>
<tr>
<th><strong>Application:</strong></th>
<th>Walls</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Classification:</strong></td>
<td>Oil impregnated paper, capacitance graded, outdoor-indoor / indoor bushing</td>
</tr>
<tr>
<td><strong>Ambient temperature:</strong></td>
<td>+40 to -40 °C, minimum value as per temperature class 2 of IEC 60137</td>
</tr>
<tr>
<td><strong>Altitude of site:</strong></td>
<td>&lt; 1 000 m</td>
</tr>
<tr>
<td><strong>Level of rain and humidity:</strong></td>
<td>1-2 mm rain/min horizontally and vertically, as per IEC 60060-1</td>
</tr>
<tr>
<td><strong>Pollution level:</strong></td>
<td>According to specified creepage distance and IEC 60815&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Markings:</strong></td>
<td>Conforming to IEC/ IEEE</td>
</tr>
</tbody>
</table>

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<sup>1</sup> IEC 60815 "Guide for the selection of insulators in respect of polluted conditions".
1.3 Mechanical loading

The bushings are designed for the following cantilever loads applied to the midpoint of the top end terminal, perpendicularly to the bushing axis.

The bushing mounting angle can be 0-75° from vertical. In axial direction the GOBL bushings can be loaded with 10 kN continuously. The bushing can withstand 30 Nm torque on the outer terminal.

*Table 1. Mechanical loading*

<table>
<thead>
<tr>
<th>Bushing</th>
<th>Type test load 1 minute 0° (N)</th>
<th>Max. service load at mounting angle 0-75° from vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOBL 250/800</td>
<td>2340</td>
<td>900</td>
</tr>
<tr>
<td>GOBL 250/1250</td>
<td>4000</td>
<td>1500</td>
</tr>
<tr>
<td>LF 131 001-A, -B</td>
<td>4000</td>
<td>1500</td>
</tr>
<tr>
<td>GOBL 325/800</td>
<td>1950</td>
<td>750</td>
</tr>
<tr>
<td>2756 036-A, -C, -K, -L</td>
<td>1950</td>
<td>750</td>
</tr>
<tr>
<td>GOBL 380/800</td>
<td>1800</td>
<td>700</td>
</tr>
<tr>
<td>2756 036-N</td>
<td>1800</td>
<td>700</td>
</tr>
<tr>
<td>GOBL 380/1250</td>
<td>3750</td>
<td>1450</td>
</tr>
<tr>
<td>LF 131 002-A, -B</td>
<td>3750</td>
<td>1450</td>
</tr>
<tr>
<td>LF 131 002-C</td>
<td>3750</td>
<td>1450</td>
</tr>
<tr>
<td>2756 036-M</td>
<td>3750</td>
<td>1450</td>
</tr>
<tr>
<td>GOBL 550/1250</td>
<td>3100</td>
<td>1200</td>
</tr>
<tr>
<td>LF 131 003-A, -B</td>
<td>3100</td>
<td>1200</td>
</tr>
<tr>
<td>2756 036-P</td>
<td>3100</td>
<td>1200</td>
</tr>
<tr>
<td>GOBL 650/1250</td>
<td>3100</td>
<td>1200</td>
</tr>
<tr>
<td>LF 131 004-A, -B</td>
<td>3100</td>
<td>1200</td>
</tr>
<tr>
<td>2756 036-G</td>
<td>3100</td>
<td>1200</td>
</tr>
</tbody>
</table>

1.4 Spare parts

In case of major damage to the bushing we recommend that it is sent back to ABB Components for possible repair and re-testing. Certain parts (Figs. 1 and 4), which may be damaged or lost during transport or installation, can be ordered from ABB Components.
2 Installation

2.1 Tools

- Soft slings
- Pull-through cord with M8 swivel 9760 669-A
- Torque wrench key for hexagon head screws, head width 16 mm (M10) and adjustable up to 66 mm
- Key for hexagon socket head cap screw 6 mm. (For test tap cover)

2.2 Consumables

- Water free vaseline, Mobilgrease 28 or other lubricant not harmful to the transformer oil, to lubricate screws that come into contact with the transformer oil.
- Mobilgrease 28 or other suitable grease to lubricate and protect the earthing screw and the outer terminal o-ring gasket.
- Molykote 1000 or other suitable compound to lubricate the screws making the contact and sealing at the outer terminal.

2.3 Transport and handling

**CAUTION:** The bushing may be transported and stored horizontally up to 6 months. For storing over 6 months it is recommended to raise the bushing to vertical position with the top end upwards. Keep the bushings dry and clean and protected against mechanical damage.

Keep the bushings protected from penetrating water when stored outdoors. 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. Shelter the case from rain and snow with a tarpaulin or roofing.

Carefully inspect the bushing on receiving with regard to shipping damage.

The bushings are normally delivered from ABB Components in boxes with the bushing supported by blocks and fibre boards. The boxes are marked with "Top End".
2.4 Lifting from the box

**WARNING**

For lifting the bushing from the box, apply two clean lifting slings as shown in the figure below. Support the bushing at the same points as in the box if placed on the ground or block it under the flange and the metal top piece. Light bushings may be handled manually.

![Fig. 2. Lifting from the box.](gobl_007)

2.5 Mounting

**WARNING**

Light bushings may be handled manually. Lift heavier bushings with the aid of a lifting tool, see section 2.1 Tools. Lift the bushing to vertical position and to an angle according to the figures below. Use a soft bedding under the bottom end of the bushing, e.g. a rubber mat.

It is recommended that the insulator is protected by wood boards when mounting the bushing into the wall.

The mass of the bushing is stated on the marking plate.

![Fig. 3. Mounting.](gobl_008)
2.5.1 Inner terminal / Stranded cable

**CAUTION:** Mounting of the conductor must be performed according to the procedure below. The contact surfaces must be clean. The oxide on brazed terminals is to be removed by brushing.

1. Stretch the stranded cable with the brazed or crimped inner terminal. Avoid making any loops.
2. Drop the pull-through cord through the bushing centre hole.
3. Fasten the M8 swivel to the inner terminal at the end of the stranded cable. Direct the stranded cable by keeping the pull-through cord taut.
4. Lock the inner terminal with the locking pin according to Fig. 4.
5. Gently release the pull-through cord so the conductor rests on the locking pin.
6. Remove the pull-through cord.
7. Proceed immediately to section 2.6 Mounting of outer terminal.

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**Fig. 4. Assembly of terminals.**
2.5.2 Solid rod conductor

**CAUTION:** Mounting of the conductor must be performed according to the procedure below. The contact surfaces must be clean.

1. Pull the solid rod up into the bushing centre hole before or after mounting the bushing into the wall.
2. Lock the solid rod with the locking pin according to Fig. 4.
3. Proceed immediately to section 2.6 Mounting of outer terminal.

2.6 Mounting of outer terminal

**CAUTION:** Before connection of conductor clamps, the outer terminals of aluminium must be carefully wire brushed and greased with a contact compound or vaseline.

In order to obtain the correct pressure and a low contact resistance, the following must be carried out:

1. Clean the contact and gasket surfaces carefully.
2. The inner terminal / solid rod thread is to be lubricated with vaseline or other lubricant.
3. Lubricate the o-ring before putting it into the groove.
4. Screw on the outer terminal and tighten with 60-80 Nm according to Fig. 4.

2.7 Flange earthing

The bushing flange is provided with a tapped hole M12. After tightening the bolts fixing the bushing to the wall, the flange should be earthed. This prevents electrical discharges between bushing flange and the wall under normal service conditions.

Apply a flexible cable between the M12 earthing hole in the bushing flange and a corresponding grounded connection in the wall. Grease the screw (Mobilgrease 28 recommended) and tighten the M12 in the bushing to 40 Nm.

2.8 Waiting time before energizing

**CAUTION:** When a bushing has been stored horizontally, it must be raised with the top up for at least 12 hours before service voltage is applied and 24 hours before test voltage is applied. If, by mistake, the bushing has been stored horizontally more than one year, it must be placed in the vertical position for at least one week before energizing.
2.9 Recommended test before energizing

The following test may be performed to check the insulation, sealing and current path of the bushing. The test should be made after mounting, but before connecting the outer terminal of the bushing to the rest of the switchyard power circuit.

2.9.1 Measurement of capacitance and tan δ

**WARNING**

Do not apply voltage to the bushing with the bushing flange not grounded, except when connected for measurement. After testing, the ground connection shall be connected to the ground connection on the wall.

After mounting, a capacitance measurement is recommended. A measuring bridge is connected between the outer terminal and the bushing flange. This is possible without removing the bushing from the wall, if the bushing flange is insulated from ground at installation.

With the bushing outer terminal disconnected, the measuring equipment is connected to the flange and the measuring voltage source to the bushing terminal.

The capacitance $C_1$ between the centre tube and the flange is marked on the name plate. The nominal capacitances $C_1$ of the different bushing types are listed in Table 2.

**Table 2. Nominal capacitances in pF (Manufacturing tolerances for C1 ± 10%).**

<table>
<thead>
<tr>
<th>Type</th>
<th>Catalogue No. L123</th>
<th>Nominal capacitance (pF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOBL 250/1250</td>
<td>LF 131 001-A, -B</td>
<td>280</td>
</tr>
<tr>
<td>GOBL 325/800</td>
<td>2756 036-A, -C, -K, -L</td>
<td>265, 480</td>
</tr>
<tr>
<td>GOBL 380/800</td>
<td>2756 036-N</td>
<td>225</td>
</tr>
<tr>
<td>GOBL 380/1250</td>
<td>LF 131 002-A, -B</td>
<td>300</td>
</tr>
<tr>
<td>GOBL 380/1250</td>
<td>LF 131 002-C</td>
<td>400</td>
</tr>
<tr>
<td>GOBL 380/1250</td>
<td>2756 036-M</td>
<td>300</td>
</tr>
<tr>
<td>GOBL 550/1250</td>
<td>LF 131 003-A, -B</td>
<td>280</td>
</tr>
<tr>
<td>GOBL 550/1250</td>
<td>2756 036-P</td>
<td>280</td>
</tr>
<tr>
<td>GOBL 650/1250</td>
<td>LF 131 004-A, -B</td>
<td>310</td>
</tr>
<tr>
<td>GOBL 650/1250</td>
<td>2756 036-G</td>
<td>310</td>
</tr>
</tbody>
</table>

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 in Table 3.

**Table 3. Dissipation factor variations as a function of temperature.**

<table>
<thead>
<tr>
<th>Bushing body temperature °C</th>
<th>Multiplier to 20 °C</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>
3 Maintenance

The GOBL bushings are maintenance-free. It is recommended to note the oil level during normal routine inspections in the plant.

--- WARNING ---

No work at all can be performed on the bushing while it is energised or not earthed.

3.1 Recommended maintenance and supervision

1. Cleaning of insulator surface
2. Measurement of capacitance and tan δ
3. Thermovision (infrared camera) check for local overheating on connectors
4. Check for leakage
5. Checking and adjustment of the oil level

3.1.1 Cleaning of insulator surface

CAUTION: Avoid having solvent on the bushing gasket and porcelain joints.

Under conditions of extreme pollution it may be necessary to clean the porcelain insulator surface. This should be done by water-jet or by wiping with a moist cloth. If necessary, ethyl-alcohol or ethyl-acetate may be used.

3.1.2 Measurement of capacitance and tan δ

Please refer to Chapter 2 Installation.

3.1.3 Thermovision (infrared camera) check for local overheating on connectors

At maximum rated current, the bushing outer terminal normally takes a temperature of about 35 to 45 °C above the ambient air. Significantly higher temperatures, especially at lower current loading, can be a sign of bad connections.

3.1.4 Check for leakage

Make a visual inspection for oil leakage during normal station supervision.
3.1.5 Checking and adjustment of the oil level

CAUTION: Oil sampling and dissolved gas in oil analysis. Normally we do not recommend taking oil samples or opening our bushings. The bushing is sealed and tightness tested at the time of manufacturing. An oil sampling means that the bushing has to be opened. Thus, there is also a risk of improper sealing after the sampling is finished. However, when a problem is known, for example high power factor over $C_1$, or visible leakage, there might be a need for oil sampling and gas analysis or oil level check. In this case, ask for product information 2750 515-142 “Bushing diagnostics and conditioning”.

Bushings with oil level glass should show the oil level in the middle of the glass at 20°C. The oil level change is approximately 3 mm per 10°C.

If the oil level is too low, clean and dry transformer oil must be added. Adjustment of oil level is allowed only when the temperature of the bushing is +5°C to +35°C. It is recommended that the sealing plug be provided with a new gasket after the check. The sealing plug is to be tightened with 20 Nm. For further information on oil sampling, see product information 2750 515-142.

For topping-up of the bushing, any clean and dry transformer oil available at site may be used.

3.2 Disposal after end of service life

The bushing consists of the following material:
- Conductor of copper or low-alloy aluminium.
- Terminals of copper, brass or low-alloy aluminium may be plated with for instance silver, tin, gold or nickel in layer thickness up to 20 µm.
- Transformer oil as per IEC 60296, class 2.
- Transformer oil impregnated condenser body consists of paper and 1 % Al foils.
- Centre tube, on which the condenser body is wound, consists of Al alloy.
- Top washer, bottom washer, top housing, flange, top nut, bottom nut, flange extension and end-shield consist of Al alloys.
- Press ring for oil level glass consists of plated brass.
- Prism glass consists of glass.
- Insulators consist of quartz or alumino silicate based porcelain.