Transformer bushing, type GSA-OA
Installation and maintenance guide
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1 Safety

1.1 Levels of safety risks

Throughout the manual, various types of safety risks are indicated. The most serious level on this scale provides a warning about serious personal injury or possible death, or major damage to a product, if the instructions are not observed.

Symbols and their meanings.

The following describes the symbols that appear in the manual, along with their meaning.

**DANGER!**
The yellow, filled warning triangle warns that an accident will occur if the instructions are not complied with and that it will result in serious personal injury or death and/or major damage to the product.

It is used, for example, to warn of such dangers as: contact with high voltage, explosion or fire risk, risk for toxic gases, risk of crushing, impacts, falls from high places, etc.

**CAUTION!**
The round warning symbol warns that an accident could occur if the instructions are not observed, and that this could result in personal injury and/or damage to the product.

It is also used to warn of risks that entail burns, eye or skin injuries, impaired hearing, crushing or slipping injuries, tripping, impacts, falls from high places, etc.

In addition, it is used to warn about functional requirements when assembling or removing equipment where there is a risk of damage to the product or that it might cause downtime.

**NOTE!**
The comment symbol identifies important information and conditions. Also used to indicate any danger that could lead to property damage.

**Torque**
The torque symbol indicates the tightening torque.

1.2 Hazardous working situations

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working close to high voltage.</td>
<td>Disconnect all plant power. Then earth all objects at the workplace.</td>
</tr>
<tr>
<td></td>
<td>If work must be carried out close to live plant components, then make sure that the safety distance is in compliance with the applicable safety regulations.</td>
</tr>
<tr>
<td>Working on ladders and platforms.</td>
<td>Work must be done in accordance with the applicable safety regulations.</td>
</tr>
<tr>
<td></td>
<td>Do not use ladders or platforms in poor weather conditions.</td>
</tr>
<tr>
<td>Working with heavy objects.</td>
<td>Do not walk under lifted objects.</td>
</tr>
<tr>
<td></td>
<td>Make sure that heavy objects are stable before starting work.</td>
</tr>
</tbody>
</table>
## 1.3 Safety precautions

<table>
<thead>
<tr>
<th>Precaution</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformer oil</td>
<td>Collect used transformer oil in drums.</td>
</tr>
<tr>
<td></td>
<td>Transformer oil is dangerous. Fumes from warm oil can cause irritation to the respiratory organs and the eyes. Long and repeated contact with transformer oil can cause damage to your skin.</td>
</tr>
<tr>
<td>SF₆ gas</td>
<td>SF₆ gas must be recycled and never released into the atmosphere.</td>
</tr>
<tr>
<td>Waste and cleaning up</td>
<td>Clean up liquid waste with an adsorbent. Treat waste as hazardous to the environment.</td>
</tr>
<tr>
<td>Fire</td>
<td>Extinguish fire with powder, foam or carbon dioxide.</td>
</tr>
</tbody>
</table>
2 Product description

2.1 Design

GSA is a resin impregnated paper (RIP) bushing intended for immersed oil/air service. The bushing is of the dry type, with RIP as the primary insulation and silicone rubber (SiR) weather sheds on outdoor surfaces. Busings of this design can be installed at any angle from vertical to horizontal.

The bushing can be connected to the transformer by pull-through conductors of either the flexible or solid rod type.

For a detailed description, see the Technical Guide, 1ZSE 2750-111.

Overview

1. Outer terminal
2. Silicone rubber insulator
3. Mounting flange
4. RIP condenser core
5. Conductor
6. Test tap
Test tap

The bushing is equipped with a test tap that is connected to the outermost conductive foil of the condenser core. The test tap is used to measure the bushing insulation by capacitance and dissipation factor. The protective cap must be grounded during operation. The maximum one minute test voltage for this test tap is 2 kV$_{\text{rms}}$. The test tap can be used as a voltage tap, if it is connected to an external capacitance. The operating voltage is limited to 600 V.

⚠️ **CAUTION!**

The test tap may never be open during operation, it must always be connected to earth directly by the earthing spring or by an external impedance.

1. Stud
2. Earthing spring
3. Cover
2.2 Technical specifications

2.2.1 General specifications

The table shows the standard technical specifications for the GSA oil/air bushings. For conditions exceeding the specification, please contact ABB.

<table>
<thead>
<tr>
<th>Application:</th>
<th>Transformers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification:</td>
<td>Resin impregnated paper, capacitance graded, outdoor immersed bushing, temperature class E (120 °C) according to IEC 60137.</td>
</tr>
<tr>
<td>Ambient temperature:</td>
<td>+40 °C to -40 °C, minimum value according to temperature class 3 of IEC 60137.</td>
</tr>
<tr>
<td>Altitude of site:</td>
<td>&lt;1000 m (Bushings for other altitudes can be provided on request.)</td>
</tr>
<tr>
<td>Level of rain and humidity:</td>
<td>According to IEC 60060-1 and IEEE.</td>
</tr>
<tr>
<td>Pollution level:</td>
<td>According to specific creepage distance and IEC 60815.</td>
</tr>
<tr>
<td>Immersion medium:</td>
<td>Transformer oil</td>
</tr>
<tr>
<td></td>
<td>Maximum daily mean oil temperature: +90 °C.</td>
</tr>
<tr>
<td></td>
<td>Maximum temporary oil temperature, normal load: +100 °C.</td>
</tr>
<tr>
<td></td>
<td>Maximum temporary oil temperature, short time overload: +115 °C.</td>
</tr>
<tr>
<td>Oil level in transformer:</td>
<td>No lower than 25 mm from the bushing flange.</td>
</tr>
<tr>
<td>Max pressure of medium:</td>
<td>100 kPa gauge</td>
</tr>
<tr>
<td>Angle of mounting:</td>
<td>Horizontal to vertical</td>
</tr>
<tr>
<td>Test tap:</td>
<td>Test tap with 4 mm male contact pin.</td>
</tr>
<tr>
<td>Capacitance $C_2$ of test tap:</td>
<td>&lt;5000 pF</td>
</tr>
<tr>
<td>Arcing horns:</td>
<td>Optional</td>
</tr>
<tr>
<td>Conductor:</td>
<td>Solid or flexible draw lead conductor.</td>
</tr>
<tr>
<td></td>
<td>Flexible draw lead conductor</td>
</tr>
<tr>
<td>Markings:</td>
<td>Conforming to IEC/IEEE</td>
</tr>
</tbody>
</table>

2.2.2 Mechanical loading

The bushings are designed for the following cantilever loads applied to the midpoint of the outer terminal, perpendicularly to the bushing axis. The bushing mounting angle can be anywhere from horizontal to vertical. The values are valid for all different lengths on the oil side.

<table>
<thead>
<tr>
<th>Bushing</th>
<th>Type test load 1 minute (N)</th>
<th>Maximum cantilever operating load (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSA 52-OA/2000</td>
<td>4000</td>
<td>2000</td>
</tr>
<tr>
<td>GSA 73-OA/2000</td>
<td>4000</td>
<td>2000</td>
</tr>
<tr>
<td>GSA 123-OA/1600</td>
<td>4000</td>
<td>2000</td>
</tr>
<tr>
<td>GSA 145-OA/1600</td>
<td>4000</td>
<td>2000</td>
</tr>
<tr>
<td>GSA 170-OA/1600</td>
<td>4000</td>
<td>2000</td>
</tr>
</tbody>
</table>
3 Delivery

3.1 Transport and long term storage

Use the provided blocks when putting the bushing on the ground. Do not apply force to the silicone rubber sheds, deformation will occur. Keep the bushings dry, clean and protected against mechanical damage.

Keep the transport box protected from water when stored outdoors.

The bushing is delivered wrapped in a moisture proof material with a drying agent inside the wrapping. The moisture proof wrapping must not be opened if the bushing is put into storage.

After a transformer test, it is important to wrap the bushing in the supplied moisture proof wrapping, or an equal moisture proof material. Replace the drying agent. The wrapping works as protection for transport and storage (≤6 months). Note that bushings with standard wrapping must be stored in an area that is protected from precipitation.

For long term storage (>6 months) a container has to be ordered separately. The bushings may be transported and stored in any angle from vertical to horizontal.

The transport box may only be lifted with approved lifting gear at the correct locations.

Carefully inspect the bushings for shipping damage.

The bushings are delivered from ABB in transport boxes, with the bushing supported by blocks and fiberboard in the box. The transport boxes are marked with “Top End”, this identifies the end to lower when storing the bushing.
3.2 Lifting

3.2.1 Lifting the transport box

Overview

![Diagram showing lifting procedure]

1. Center of gravity
2. Soft lifting slings

Procedure

1. Make sure that the crane can lift the transport box with the bushing. Refer to the packing list.

2. Attach soft lifting slings (2) to the correct locations.

3. Make sure that the angle of the soft lifting sling does not exceed 20°.

4. Carefully lift the transport box.

5. Put down the transport box on flat ground.

End of instruction
3.2.2 Lifting the bushing out of the transport box

Overview

Procedure

1. Make sure that the crane can lift the bushing. Refer to the rating plate.

2. Record the position of the soft lifting sling.

3. Attach a soft lifting sling to the bottom end housing, as close to the flange as possible.

   **CAUTION!**
   Do not put the soft lifting slings on the polymeric insulator, damage will occur.

4. Attach a soft lifting sling to the outer terminal and to the crane hook.

5. Carefully lift the bushing.

6. Lower the bushing onto soft bedding.

End of instruction
3.2.3 Lifting the bushing

Overview

1. Lifting tool
2. Soft bedding, e.g. rubber mat or woodboard
3. Lifting eye

Procedure

1. Make sure that the crane can lift the bushing. Refer to the rating plate.
2. Remove the transport securing device.
3. Remove the M10 bolts (4) and washers (5), and then remove the outer terminal (6).

**NOTE!**
Keep the outer terminal (6), nuts (5) and bolts (4), they will be used again.
4. Install the lifting tool (1), and install the bolts (7) with the washers (5).

**NOTE!**
The bolts (7) are not supplied with the lifting tool (1), use three M10x20 bolts.

5. Align the crane hook with the lifting tool on the bushing.

**CAUTION!**
Make sure that the bushing does not rotate.

6. Carefully lift the bushing.

7. Lower the bushing onto soft bedding.

End of instruction
4 Installation

4.1 Tools

<table>
<thead>
<tr>
<th>Tool</th>
<th>Part number</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifting tool</td>
<td>2183 789-2</td>
<td>For weights up to 125 kg.</td>
</tr>
<tr>
<td>Soft bedding</td>
<td>-</td>
<td>E.g. rubber mat or wood board</td>
</tr>
<tr>
<td>Soft lifting slings</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pull-through cord with M8 swivel.</td>
<td>9760 669-A, -D</td>
<td>-</td>
</tr>
<tr>
<td>Torque wrench key for hex socket screws, 16 mm (M10) and 13 mm (M8), torque 20 to 40 Nm.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wrench for hex socket screws 30 mm or adjustable wrench for 30 mm bolts or larger.</td>
<td>-</td>
<td>For the test tap cover.</td>
</tr>
<tr>
<td>Tackle</td>
<td>-</td>
<td>For installation of the bushing at a specific angle.</td>
</tr>
</tbody>
</table>

4.2 Consumables

<table>
<thead>
<tr>
<th>Item</th>
<th>Type / Name</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil based vaseline</td>
<td>11715011-102</td>
<td>For lubrication of bolts. Does not react with transformer oil.</td>
</tr>
<tr>
<td>MOBIL</td>
<td>Mobilgrease 28</td>
<td>Lubricates and protects metals against corrosion. Protects rubber. Does not react with transformer oil.</td>
</tr>
<tr>
<td>Dow Corning</td>
<td>Molykote 1000</td>
<td>For the sealing of, and lubrication of the contact on the outer terminal.</td>
</tr>
<tr>
<td>Fomblin</td>
<td>1171 4016-616 / OT20</td>
<td>For lubrication of bolts. For the sealing and lubrication of the sealing plate on the top end.</td>
</tr>
</tbody>
</table>
4.3 Installation using stranded cable

**Procedure**

1. Solder the winding cables from the transformer to the inner terminal (7).

   **NOTE!**
   As an alternative, the winding cables can be crimped to the inner terminal.

2. Carefully clean the oil end of the bushing and the inside of the bushing. Inspect the cleaned areas for damage.

---

1. Hex bolt M8x45 stainless steel A4-80
2. Hex bolt M10x60 stainless steel A4-80
3. Conical spring washer stainless steel A4
4. Flat washer 10.5x2x20 stainless steel A4
5. Outer terminal
6. O-ring (1ZSC001606-ABH)
7. Tightening ring (2744 330-7)
8. Inner terminal
9. Divided ring (2151 811-45)
3. Lower the pull-through cord (10) through the bushing.

4. Attach the pull-through cord (10) to the inner terminal (7).

5. Lower the bushing into the transformer, and hold the pull-through cord (10) in tension while guiding the stranded cable.

   ![CAUTION!]
   Make sure that the stranded cable is entering the bushing correctly. Monitor the stranded cable through the inspection openings on the transformer.

   ![CAUTION!]
   If fixed stud bolts are used for fastening the bushing flange, it is advisable to apply plastic sleeves on two or three of the studs both to guide the flange and to prevent chipping of the stud bolts, with the subsequent risk of chips, falling into the transformer.
6. Install the bolts in the transformer flange. Tighten the bolts in a crosswise sequence.

7. Put the divided ring (6) in the slot in the inner terminal (7).

8. Carefully lower the pull-through cord (10) until the divided ring (6) touches the bushing top surface.

9. Remove the pull-through cord.


End of instruction
### 4.4 Installation using solid rod conductor

1. Hex bolt M8x45 stainless steel A4-80
2. Hex bolt M10x60 stainless steel A4-80
3. Conical spring washer stainless steel A4
4. Flat washer 10.5x2x20 stainless steel A4
5. Outer terminal
6. Divided ring (2151 811-45)
7. Solid rod (upper part)
8. O-ring (1ZSC001606-ABH)
9. Tightening ring (2744 330-7)
Procedure

1. Solder the winding cable/cables from the transformer to the lower part of the solid rod conductor (12).

   **NOTE!**
   As an alternative, the winding cables can be crimped to the solid rod conductor.

2. Carefully clean and inspect the oil end of the bushing and the inside of the bushing.

3. Lift the bushing above the opening on the transformer.

4. Lower the pull-through cord (10) through the bushing.

5. Attach the the pull-through cord (10) to the solid rod (7).
6. Clean the contact surfaces between the lower (12) and the upper (7) part of the solid rod. Apply grease to contact surfaces.

7. Apply Mobilgrease 28 to the bolts (11). Install the upper part (7) of the solid rod to the lower part (12).

   **NOTE!**
   Or use a lubricant similar to Mobilegrease 28.

   **Torque**
   35-40 Nm

8. Keep the pull-through cord in tension to guide the solid rod, and lower the bushing into the transformer.

   **CAUTION!**
   If fixed stud bolts are used for fastening the bushing flange, it is advisable to apply plastic sleeves on two or three of the studs both to guide the flange and to prevent chipping of the stud bolts, with the subsequent risk of chips, falling into the transformer.

9. Install the bolts on the transformer flange. Tighten the bolts in a crosswise sequence.

   **Torque**
   M12 50 ±5 Nm
   1/2” UNC 55 ±5 Nm
10. Put the divided ring (6) in the slot in the solid rod (7).

11. Carefully lower the solid rod (7) in place.

12. Remove the pull-through cord.


End of instruction

4.5 Installation of outer terminal

1. Carefully clean the contact and gasket surfaces.
   Apply Mobilgrease 28 on the O-ring.

   CAUTION!
   Do not use a wire-brush to clean the inner contact surface of the outer terminal. The inner contact surface is tin-zinc plated and a wire-brush can cause damage.

   NOTE!
   Or use a lubricant with equal properties to Mobilgrease 28.

2. Assemble the tightening ring (9), the O-ring (8), and the outer terminal stud (5). Install the M8 bolts (1) and the spring washers (3) and the plain washers (4). Tighten by hand.
3. Put the outer terminal (5) on the bushing.

4. Apply Molykote 1000 to the threads and the shank of the bolts (2).

5. Install the M10 bolts (2) and plain washers.
   CAUTION!
   Do NOT use an impact driver / wrench!
   Torque 40 ±4 Nm

6. Tighten the M8 bolts in a crosswise sequence.
   Torque 20 ±2 Nm

7. Use a wire-brush to clean the aluminum outer terminal and then apply Vaseline.
   NOTE!
   It is important to remove oxide from the aluminum terminals, before connecting the contact clamps.

End of instruction
4.6 Grounding of the bushing flange

Overview

The flange must be grounded after installation of the bushing on the transformer tank. This prevents electrical discharge between the bushing flange and transformer tank under normal service conditions.

There are two alternatives.

Using a pointed set bolt

1. Apply a large quantity of Mobilgrease 28 to the pointed set bolt (13).

   CAUTION!
   The quality of the pointed set bolt is important, stainless steel of A4-80 quality is recommended.

   NOTE!
   Or use a lubricant similar to Mobilegrease 28.

2. Install the pointed set bolt (13).

   NOTE!
   The tip of the bolt penetrates the paint. This makes an electrical connection between the bushing and the transformer tank, keeping them at the same voltage.

   Torque
   40 Nm

End of instruction

Using a flexible cable

1. Put a flexible cable (14) between the grounding hole in the bushing flange and a grounding point in the transformer.
2. Apply a large quantity of Mobilgrease 28 to the bolt (13).

   **CAUTION!**
   The quality of the bolt is important, stainless steel of A4-80 quality is recommended.

   **NOTE!**
   Or use a lubricant similar to Mobilgrease 28.

3. Install the bolt (13).

   **Torque**
   M12: 40 Nm

4. Connect the other end of the flexible cable (14) to the transformer.

   **NOTE!**
   This makes an electrical connection between the bushing and the transformer tank, keeping them at the same potential.

End of instruction
5 Commissioning

5.1 Waiting time before energizing

De-gassed oil-filled transformer with reduced oil-level

After restoring the oil-level, wait for 24 hours before energizing the transformer. For non-vacuum filled transformers: the oil must rise in the center tube to at least flange height. Release the outer terminal sealing system to allow air to escape.

Oil spillage will not cause damage to the silicone-rubber insulator, but oil attracts dirt and this can reduce the insulation performance. Remove oil with a paper cloth.

Do not allow oil that has been in contact with silicone-rubber to enter the transformer. It can contain small amounts of silicone oil that will reduce the surface tension of the transformer oil, this will cause foaming during forced oil circulation.

NOTE!
Some waiting time is necessary before energizing, to avoid flashovers or partial discharges due to air bubbles on the bushing surface. Select an applicable procedure.
5.2 Recommended tests before energizing

5.2.1 Overview

The tests should be performed to check the insulation, sealing and current path of the bushing.

**NOTE!**
The tests should be performed after installation, but before connecting the outer terminal of the bushing to the power circuit.

5.2.2 Tightness test between transformer and bushing flange

Several different methods may be used and we thus refer to instructions provided by the company responsible for field erection. As a simple example, the tightness of the seal between a transformer and bushing flange can be checked when the transformer is oil-filled by using chalk or, perhaps easier, with paper strips.

5.2.3 Tightness test of bushing outer terminal

Since the outer terminal is often situated above the oil level of the transformer expansion system, a leak at this point is extremely serious, because water could enter directly into the transformer insulation. It is thus recommended to conduct a tightness test after installation, preferably both with a vacuum and overpressure. Several different methods may be used and we refer to instructions provided by the firm responsible for field erection.

One possible method is the tracer gas method:

1. Put a tracer gas into the center tube before mounting the outer terminal. The oil-level of the transformer must be above the bottom end of the bushing but below the bushing flange.
2. Increase the pressure in the center tube by increasing the oil-level as much as possible.
3. Search for leaking gas at the gasket with a gas detector (sniffer).

5.2.4 Measurement of capacitance and tan δ

**Overview**

After installation of the bushing, it is recommended to measure the capacitances for future reference, such as repairs, service etc. Connect a measuring bridge between the outer terminal and the test tap, or use ABB’s test tap adapter (1ZSC003881-AAC). This can be done without removing the bushing because the bushing has an insulated test tap. Refer to 2750 515-142, “Bushing diagnostics and conditioning”.

**CAUTION!**
The test tap is not self-grounding!

The bushing can be destroyed if the test-tap is not grounded. Since the capacitance ($C_2$) is usually relatively small, the test-tap must never be open-circuited when applying a current to the bushing. It must always be grounded or connected to an external impedance.

**CAUTION!**
Make sure that the test-tap cover is correctly tightened with the O-ring in place, when the bushing is not in use. This is to prevent dust and water from entering the test-tap.

**NOTE!**
The transport container must be removed before measuring capacitance and tan δ.
The capacitance ($C_2$) depends on the transformer, and it is not possible to provide a nominal value that is valid for all service conditions. Thus, it is important to measure the capacitance ($C_2$) for future reference, such as repairs, service etc.

<table>
<thead>
<tr>
<th>Bushing</th>
<th>Space for CT = 0 $C_1$</th>
<th>Space for CT = 300 $C_1$</th>
<th>Space for CT = 500 $C_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSA-OA 52</td>
<td>222</td>
<td>415</td>
<td>541</td>
</tr>
<tr>
<td>GSA-OA 73</td>
<td>325</td>
<td>541</td>
<td>636</td>
</tr>
<tr>
<td>GSA-OA 123</td>
<td>205</td>
<td>305</td>
<td>369</td>
</tr>
<tr>
<td>GSA-OA 145</td>
<td>249</td>
<td>340</td>
<td>404</td>
</tr>
<tr>
<td>GSA-OA 170</td>
<td>311</td>
<td>404</td>
<td>467</td>
</tr>
</tbody>
</table>

**Test-tap adapter 600 V**

A test-tap adapter (IZSC003881-AAC) is available for permanent connection to measuring circuits.
Procedure

1. De-energize the transformer.
2. Disconnect the outer terminal of the bushing.
3. Remove the test-tap cover (2).

![NOTE!](image)
Cover (2749 528-B), O-ring (1ZSC001606-AAW)

4. Connect the measuring equipment to the test-tap (1), and then to the bushings outer terminal.
5. Measure the capacitance ($C_1$) between the outer terminal and the test tap.
6. Measure the capacitance ($C_2$) between the test tap and the flange.
   Refer to the table for the nominal capacitance ($C_1$).
7. Install the cover (2).

End of instruction
6 Maintenance

6.1 Recommended maintenance

The bushings are designed to be maintenance free, no regular maintenance is needed.

DANGER!
No work at all may be performed on the bushing while it is energized or ungrounded.

Cleaning of the insulator surface

Under conditions of extreme pollution it may be necessary to clean the insulator surface, then remove all pollution with a moist cloth. If necessary, ethyl alcohol or ethyl acetate may be used.

NOTE!
1,1,1-Trichloroethane or Methyl-chloride are not recommended due to their possibly harmful and environmentally detrimental properties.

CAUTION!
Do not wash the insulator sheds with a high pressure water jet. This can cause damage to the insulator sheds.

Thermography (infrared camera) check for local overheating on connectors

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

Tightness check

Make a visual inspection for oil leakage during regular station supervision.
7 Re-packing

7.1 Re-packing of bushing after testing

**CAUTION!**
For lifting the bushing to the box, apply two clean soft lifting slings as shown. 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.

**NOTE!**
The bushing and transformer must be marked for final erection at the same position.

**NOTE!**
During transport the inner terminal/oil side parts of the solid rod may be fastened to the transport cover in transformer. Upon erection, the transport cover is removed, and the terminal/solid rod loosened.

**NOTE!**
Please note the position of the soft lifting sling! For polymeric insulators, the soft lifting sling should be placed as close as possible to the flange and not on the rubber surface.

**NOTE!**
The transformer bushing(s) should be re-packed in the transport box as per delivered. The bushing should be fixed in axial and radial direction, and secured against rotation.

At the ABB factory, the bushing box is closed with bolts and plastic straps. It is advisable to use bolts and plastic straps when reclosing the box after transformer testing.
8 Spare parts

8.1 Summary

In the event of major damage to the bushing we recommend that it be returned to ABB for possible repair and re-testing. Certain parts that may be damaged or lost during transport or installation, can be ordered from ABB.
9 Disposal and environmental information

9.1 Disposal and recycling

ABB strives to minimize the product’s impact on the environment throughout its entire life cycle. Technical and product development focuses on environmental aspects. The ecocycle approach is strived for and consideration is taken to the materials’ environmental impact and recycling alternatives. The manufacturing processes are selected to be as safe for the environment as possible.

Disposing of worn-out equipment

Worn-out equipment must be phased out in an environmentally sound manner.

When disposing of used equipment, much of the material, or energy content in the material, can be recycled following sorting and cleaning. The amount that is recycled varies depending on the technical resources and experience in each country. Non-recyclable components should be sent to an approved environmental waste treatment plant for destruction or disposal.

Porcelain

After cleaning, the porcelain can be sent for disposal or used for other purposes, such as for use as filling material.

Electronics

Electronics equipment should be sent to an approved recycling company or sorted into different component materials for appropriate treatment.

Metals

Metals should be sorted according to type and surface coating and sent to an approved recycling company. Following the removal of any paint or other surface coating, clean metal can usually be melted down and used in new products. Many metal components of iron, steel and aluminum are large and easy to identify, e.g. support structures. ABB strives to reduce the use of precious metals and the release of environmentally hazardous metals.

Recycling of these is particularly important. Precious metals such as copper and silver are expensive and are only present in small amounts in the Earth’s crust. Copper is primarily used in current paths, contacts and cables. Silver-plating of contacts may occur. Emissions from certain metals may cause damage. This applies to copper, but also zinc and nickel, which are used sparingly as surface coatings.

Plastics

The different types of plastic should be separated and sent to an approved environmental waste treatment plant or recycling company. The energy content in thermoplastics and thermosetting plastics can often be recovered through combustion at a plant designed for the purpose. Thermoplastics can usually be melted down and reused without any major loss of quality. Composites can be fractioned and used as filling materials in other materials or be disposed of.
Oils and greases

Before disposal, oil, grease and similar products must be removed and sent to an approved environmental waste treatment plant or recycling company. By utilizing gravimetric forces, oil waste can be separated into oil, water and a range of contaminants. In many cases, the oil can then be reused. Alternatively, the energy content in oil can be recovered through combustion at a plant designed for the purpose.

Rubber

Rubber can be sent to an approved environmental waste treatment plant, either for disposal or reuse for various purposes.

Rubber is present in various seals.

Other materials

Other materials are sorted and sent to an approved environmental waste treatment plant.