



1ZSC000563-AAD en, Rev. 3

Resin impregnated paper bushing, oil to air, type GSB

Installation and maintenance guide

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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

GSB is a Resin Impregnated Paper (RIP) bushings intended for immersed oil – air service. The bushing is built around an aluminium centre tube on which the condenser core is wound. This core is wound of creped paper with aluminium foil inserts for electrical stress control and impregnated and cured under vacuum, giving a partial discharge free bushing with low $\tan \delta$ (dissipation factor). After curing, the body is machined and a flange and an insulator are fitted. The insulator is made of composite. The space between the RIP body and the insulator is then filled with an insulating gel.

As current conductor, GSB uses the centre tube, which is molded into the RIP core. The oil side connection can be made with a draw-rod system with bottom contact, an inner terminal for draw lead, or a fixed bottom contact. Bottom contact is normally delivered with an end shield. Alternative bottom contact is available if different end shield is intended to be used. For the airside connection there are studs available in a number of standard configurations, but can also be modified to suit any connection need.

The mounting flange is an aluminium alloy casting with the gasket surface machined flat. On the flange there is a test tap. The outer conducting layer of the condenser body is connected to the insulated test tap. During operation the protective cap must be fitted to earth the outer layer to the flange. The maximum test voltage is 2 kV, 50 Hz for 1 minute. The maximum service voltage is 600 V. A voltage tap, $U_T = 6$ kV, and a test tap adapter for permanent connection are available as option.

The bushing is designed to be mounted at an angle not exceeding 90° from the vertical. The standard colour of the composite insulator is light grey.

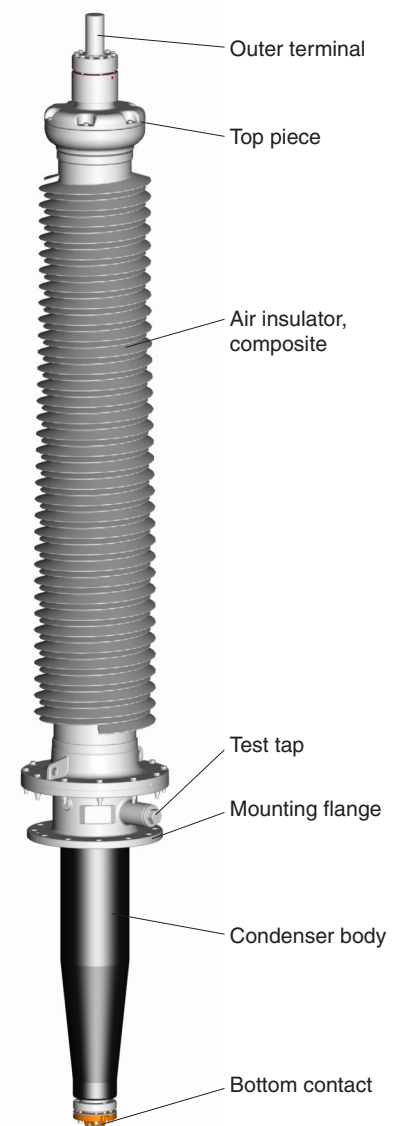


Fig. 1. Design of bushing type GSB

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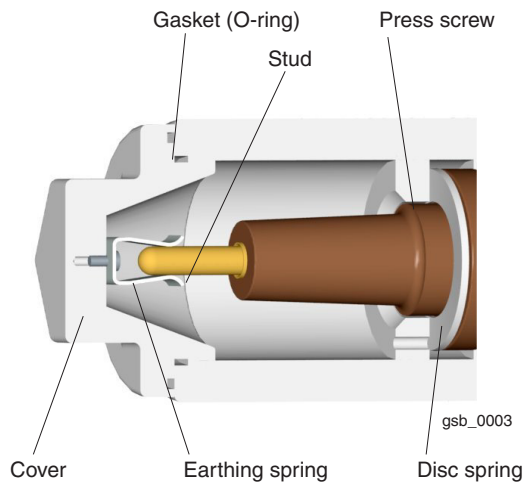


Fig. 2. Test tap.

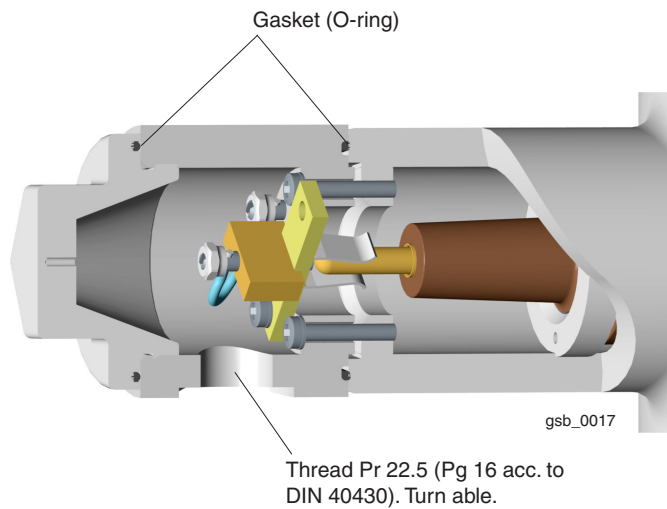


Fig. 3. Test tap adapter.

1.2 Operating conditions

The table below shows the standard technical specifications for the GSB bushings. For conditions exceeding the below values, please contact ABB.

Common specifications:

Application:	Transformers
Classification:	Resin impregnated paper, capacitance graded, oil immersed bushing
Ambient temperature:	+40 to -40 °C as per temperature class 2 of IEC 60137
Altitude of site:	< 1000 m
Level of rain and humidity:	1-2 mm rain/min, horizontally and vertically, as per IEC 60060-1, and 5 mm/min as per IEEE
Pollution level:	According to specified creepage distance and IEC 60815 ("Guide for the selection of insulators in respect of polluted conditions")
Immersion medium:	Transformer oil. Maximum daily mean oil temperature 90 °C, according to IEC 60137.
Max. pressure of medium:	100 kPa (over pressure)
Angle of mounting:	Horizontal to vertical
Test tap:	According to IEEE potential tap type A. Voltage tap 6 kV as option.
Capacitance C2 of test tap:	< 5000 pF
Conductor:	Centre tube or flexible draw lead conductor.
Markings:	Conforming to IEC/IEEE.

1.3 Mechanical loading

The bushings are designed for the following cantilever loads applied to the midpoint of the top terminal, perpendicular to the bushing axis. In axial direction the GSB bushing can withstand 20 kN continuously. The maximum torque on the outer terminal stud is 200 Nm.

Table 1. Mechanical loading.

Bushing GSB	Max. cantilever operating load for vertical mounting kN	Max. cantilever operating load for horizontal mounting kN	Max. cantilever test load kN
245	2.8	2	5.6
362	3.2	2	6.3
420	3.3	2	6.6
550	6.5	4	13

1.4 Spare parts

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

2 Installation

2.1 Tools

- Soft slings.
- Lifting gear, 9760 667-A
- Shackles, for hole Ø 25 mm, for connection of soft slings to the bushing flange.
- Torque wrench key for hexagon head screws, head width 16 mm (M10) and 13 mm (M8).
- Tackle for mounting the bushing at a certain angle.
- Soft bedding.
- Flexible pull-through cord, 9760 669-A, for assembly of draw rod.
- Box spanner, 9760 669-B, for assembly of draw rod.

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 earth 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, storage and handling

CAUTION: *On the oil side a special sealing tube containing drying agent, is fitted. This sealing tube will protect the bushing during storage and transport. Bushings for long time storage shall be equipped with a metallic sealing tube.*

Keep the bushings protected from 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.

The bushing may be transported and stored in any angle. Carefully inspect the bushing on receiving with regard to shipping damage. Please note that the bushing has been routine tested in oil and some oil may be left, especially in the narrow opening between condenser body and flange. Vaseline is used for lubrication of threads, and at some temperatures the vaseline may appear as oil.

2.4 Lifting from the box

WARNING

For lifting the bushing from the box, apply two clean lifting slings around the flange and the terminal tap, as shown in the figure below. Slings shall not be applied around the insulator because the sheds may be damaged. If placed on the ground, the bushing shall be supported at the same points as in the box, i.e. at the flange and the top housing or terminal tap. It may not be supported by the sheds.

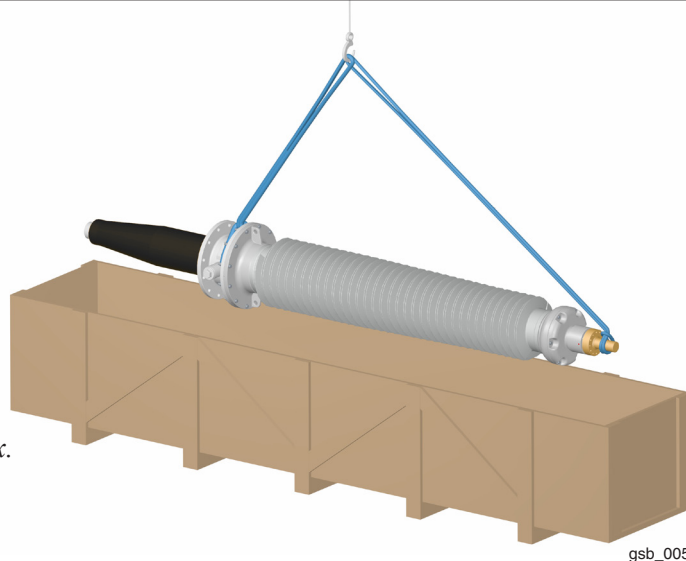


Fig. 4. Lifting from the box.

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2.5 Lifting and mounting

WARNING

Soft bedding - e.g. a rubber mat or a wood board - must be used under the bottom end of the bushing.

CAUTION: *Do not lift in the silicone part of the composite insulator. The silicone or glass fibre tube may be damaged.*

The mass of the bushing is stated on the nameplate. Bushings may be lifted to the vertical position according to Fig. 5.

For lifting to a certain angle, the lifting gear shall be arranged according to Fig. 6. Bushings with composite insulator shall not be lifted in the insulator. The centre hole in the bushing conductor and the oil end below the mounting flange shall be carefully cleaned and inspected before mounting on the transformer. A cord or a flexible wire with an M8 swivel is pulled through the centre hole and the top connection details according to Fig. 10 for draw rod system, and Fig. 15 for draw lead. The bushing is now ready to be lifted on to the transformer.



Fig. 5. Raising of bushing.

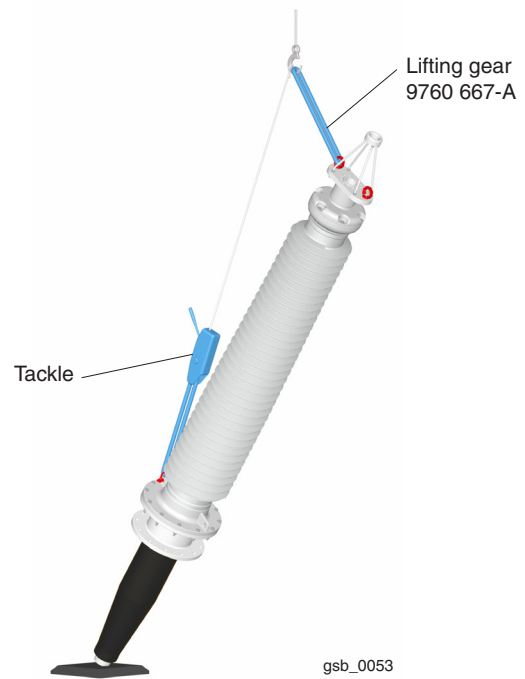


Fig. 6. Raising of bushing to a certain angle.

WARNING

The lifting eye of the lifting gear must be aligned with the lifting eye on the flange to avoid that the top nut rotates and comes loose.

2.6 Draw rod for connecting the bottom contact

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

The parts below the transformer cover are usually supported in the transport cover during transport, Fig. 8.

1. As shown in Fig. 7, the temperature compensating device is placed on top of the bushing inner tube. The upper draw rod is pulled through the bushing by the pull-through cord. The compensating device is unique for each bushing size.
2. If the draw rod is supplied with an additional joint, e.g. to make it possible to remove a bushing turret for transport, the additional jointing sleeve shall be locked with locking fluid (Loctite 242 and activator Loctite T747) at site in order to avoid an unintended loosening of this joint at an eventual dismounting of the draw rod system later on. Fig. 13 shows the joints that are locked at delivery.

The draw rod shall be well tightened to the jointing sleeves when these are assembled.

3. The cord, pulled through the bushing with the compensating device, the washer, the nut, and the box spanner in place, as shown in Fig 10, is used for lowering of the upper part of the draw rod to the correct position for jointing with the threaded sleeve of the lower end part, Fig 9.
4. The bushing is then lowered into the transformer with the cord well stretched.

WARNING

If fixed stud bolts are used for fastening of the bushing flange, it is recommended to apply plastic sleeves on 2 or 3 of the studs in order to guide the flange and prevent cutting of metal chips, which may fall down into the transformer.

5. Fix the bushing to the transformer cover.
6. The washer and the nut are fastened according to tightening method A or B, see Figs. 11 and 12.

The threads and the nut are treated with lubricant at the ABB factory. If the nut cannot be screwed on the bolt smoothly, carefully apply Molykote 1000 on the bolt. Remove excess of the Molykote with a rag.

Each bushing with draw rod is supplied with an information sheet about the measurement (b-a), which was measured at the factory, and the tightening force. If a bushing is non-standard, the value shall be according to this information. The torque is to be between 70 and 140 Nm.

CAUTION: Make sure that the right force is achieved in the draw rod. The tightening of the nut shall be done according to one of the following two procedures:

Tightening method A

1. Tighten the nut with 10 Nm and measure the distance (a) from the top of the nut to the top of the bolt.
2. Continue tighten the nut until the difference between the first and second measurement (a-b) shall be according to the value given in Table 2. Each turn corresponds to an extension of 2 mm.
3. Check with a dynamometric wrench that the nut is tightened with a torque of more than 70 Nm and less than 140 Nm.

Tightening method B

Use a jack to pull the draw rod bolt to a force according to the value given in Table 2. Tighten the nut by the hand and then release the jack.

Table 2.

Type	Difference (b-a) (mm)	Force with CT extension 0.3 / 0.6 (kN)
GSB 245	7.0	36.0 / 34.5
GSB 362	8.5	37.5 / 36.1
GSB 420	9.5	38.0 / 36.5
GSB 550	12.0	38.5 / 37.3

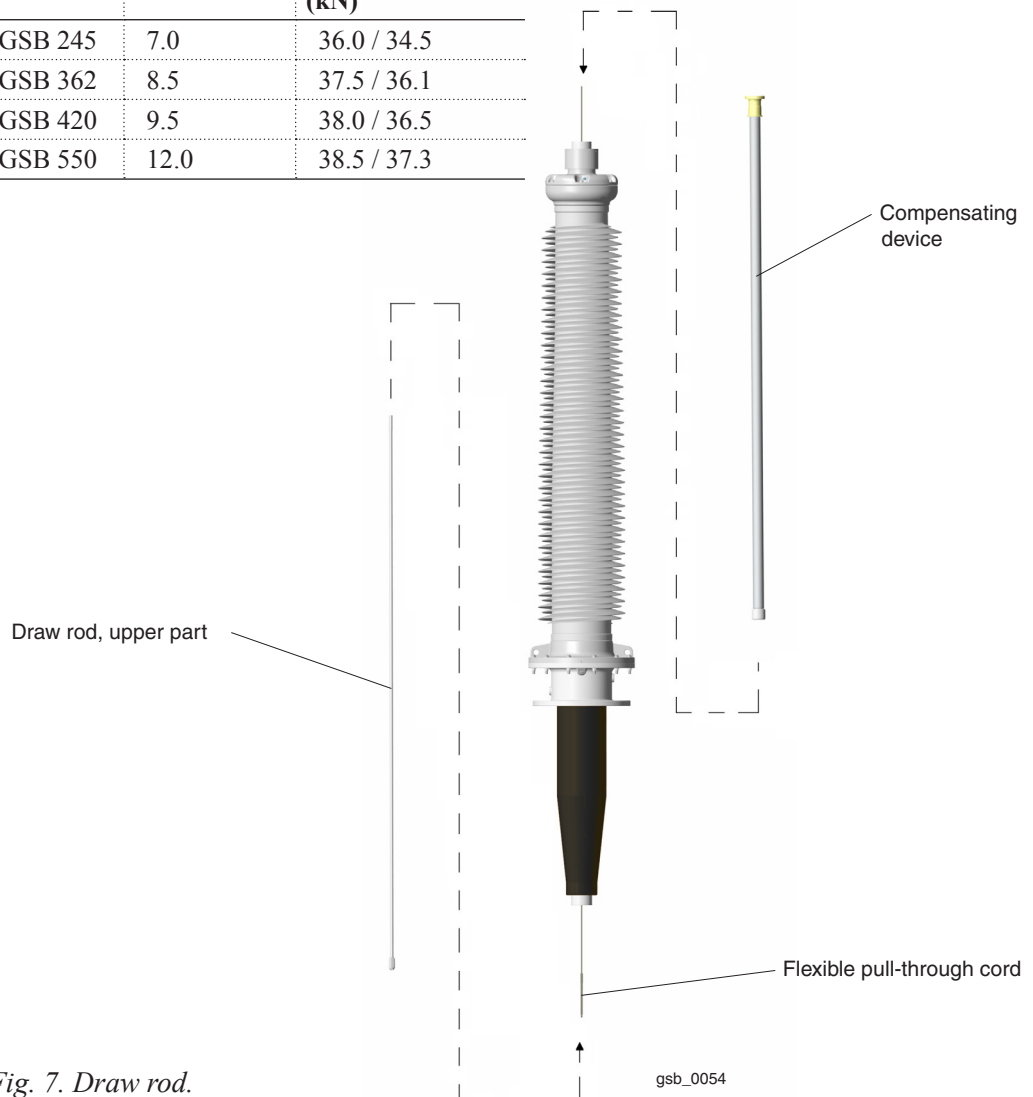


Fig. 7. Draw rod.

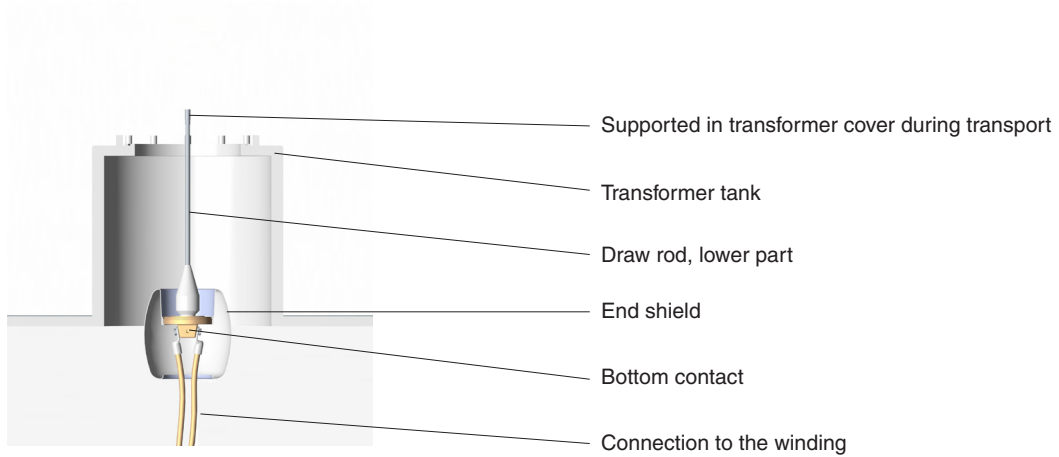


Fig. 8.

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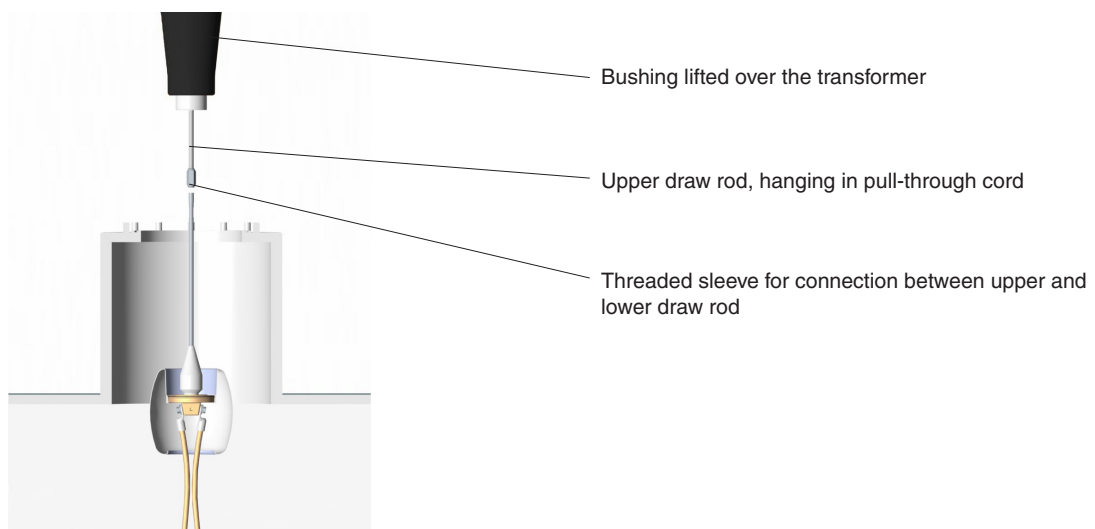


Fig. 9.

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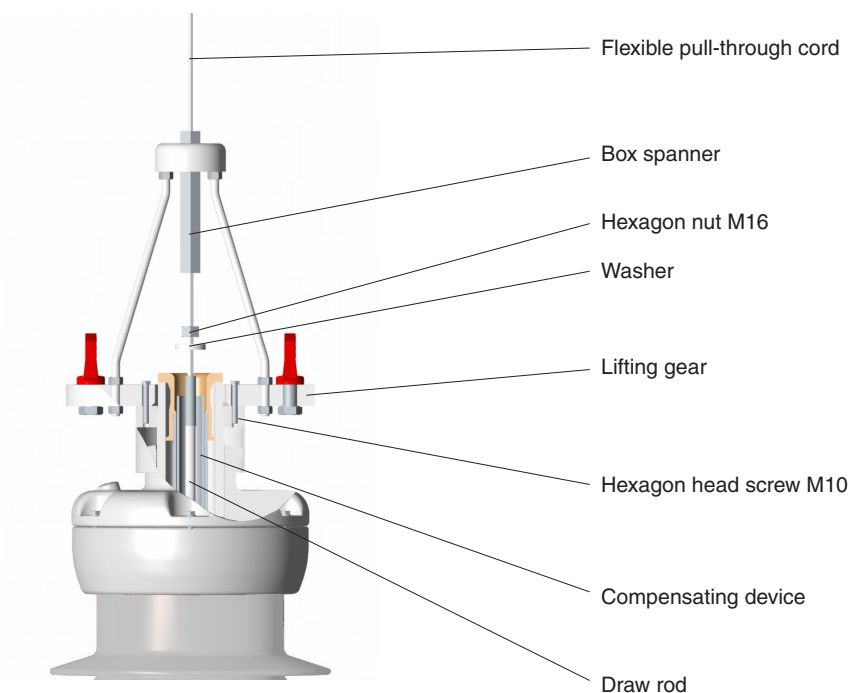


Fig. 10.

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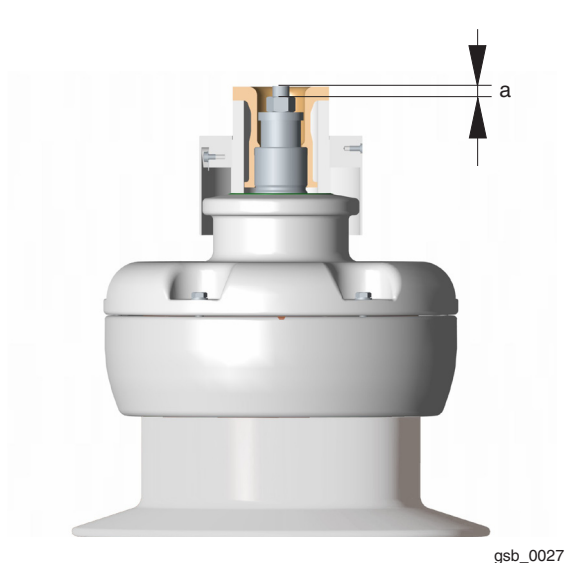


Fig. 11.

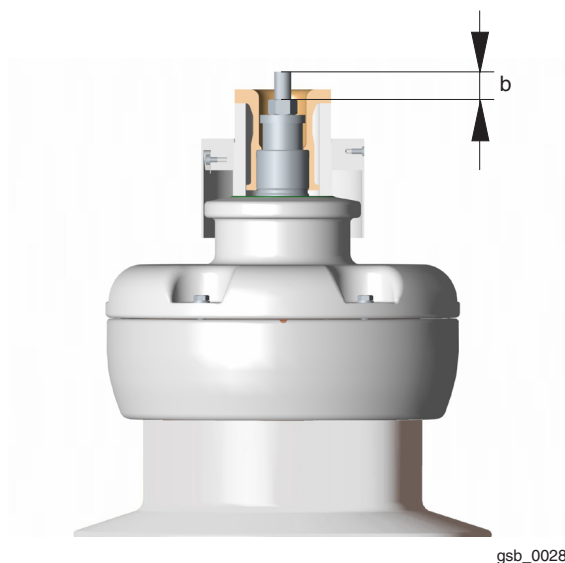


Fig. 12.

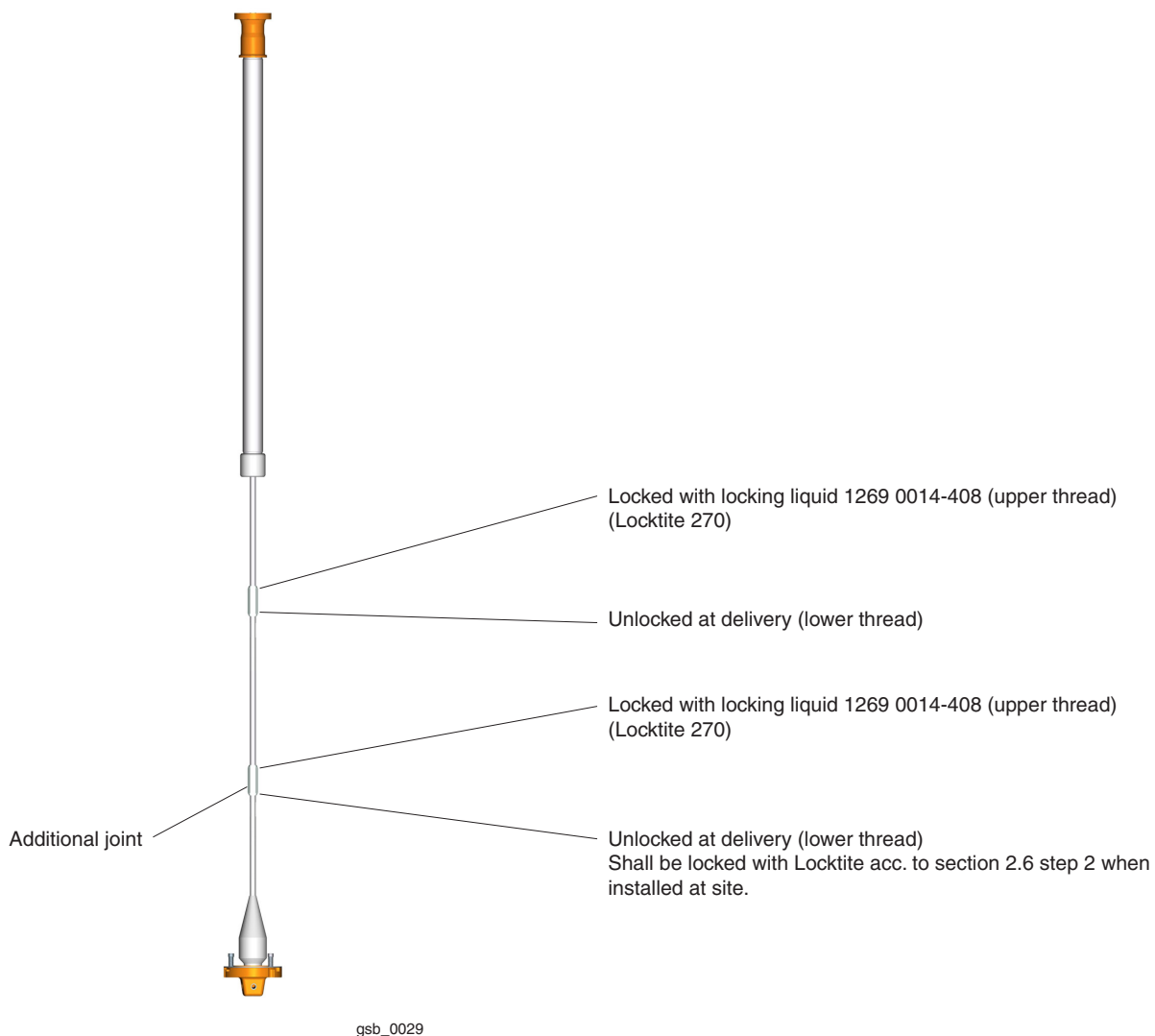


Fig. 13.

2.7 Inner terminal / Stranded cable

CAUTION: Mounting of the stranded cable 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.

If fixed stud bolts are used for fastening of the bushing flange, it is recommended to apply plastic sleeves on 2 or 3 of the studs, in order to guide the flange and prevent cutting of metal chips, which may fall down into the transformer.

The inner draw lead terminal, see Fig. 14, is brazed to the flexible lead at the transformer factory. The draw lead length measured from the sealing surface on the bushing flange shall be according to Table 3. To this an extra length should be added, large enough to avoid over stretching of the draw lead in service position. The bushing and transformer shall be marked for final erection at the same position. The reason for this is that there is some difference in the bushing length due to the tolerances.

Table 3.

Type	Distance from flange to inner terminal (mm)
GSB 245	2577
GSB 362	3467
GSB 420	3847
GSB 550	4877

During transport the inner terminal may be fastened to the blind cover. At erection, the blind cover is removed, and the terminal loosened.

1. Reassure that the shield adapter fitting is correct after transport and handling, using the procedure for fixed bottom contact in section 2.8.
2. Stretch the stranded cable with the brazed inner terminal normally fastened to the cover plate. Avoid making any loops.
3. Drop the pull-through cord through the bushing centre hole.
4. Lift the bushing above the opening.
5. Assemble the shield on the shield adapter according to section 2.8.1 (Type 1) step 5 and 6. Make sure to position the wider end of the shield towards the bushing.
6. Fasten the pull-through cord to the inner terminal.
7. Lower the bushing into the transformer while directing the stranded cable by keeping the pull-through cord taut. If inspection openings are arranged near the bushings on the transformer, they shall be open during the mounting of the bushing, in order to check that the lead is entering on the bushing in the correct manner.
8. If the lead length is found to be too short or extremely long, the bushing must be lifted again and the lead length adjusted.
9. Fix the bushing to the transformer cover.
10. Pull the pull-through cord a little bit above the final position and mount the divided stop ring in the groove. Then lower the complete assembly into place. Be sure the stop ring is in right position. Figs. 15 and 16.
11. Gently release the pull-through cord and then remove it. Fig. 17.
12. Proceed immediately to section 2.9 Mounting of outer terminal.

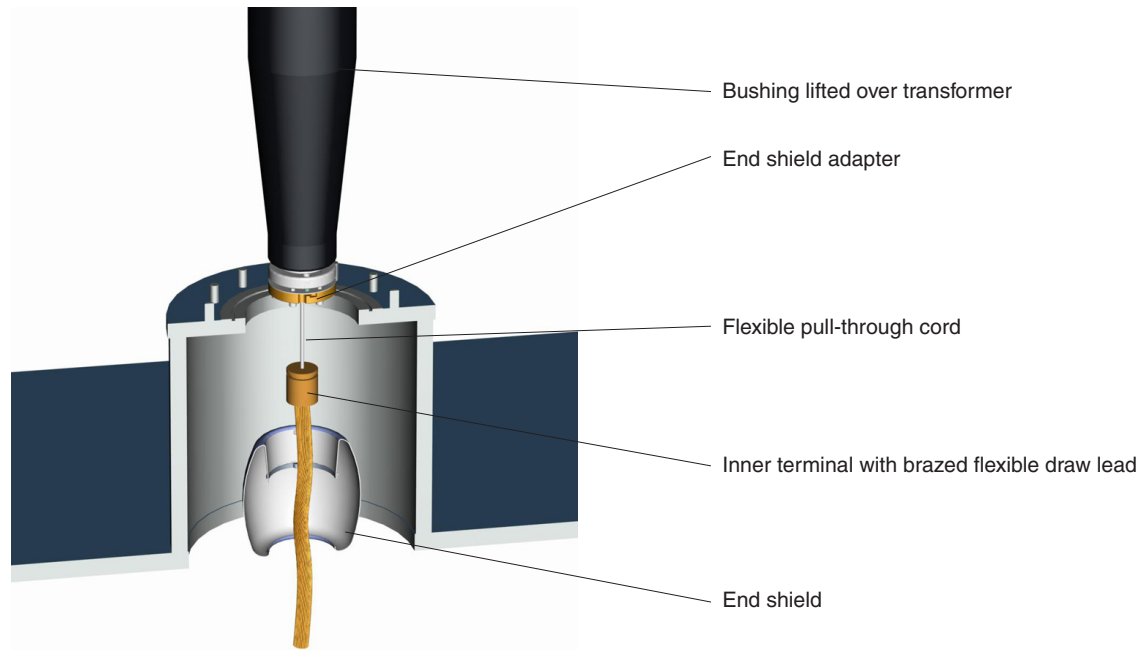


Fig. 14.

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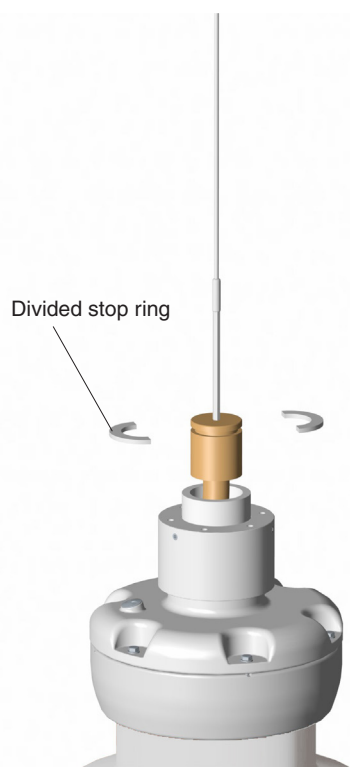


Fig. 15.

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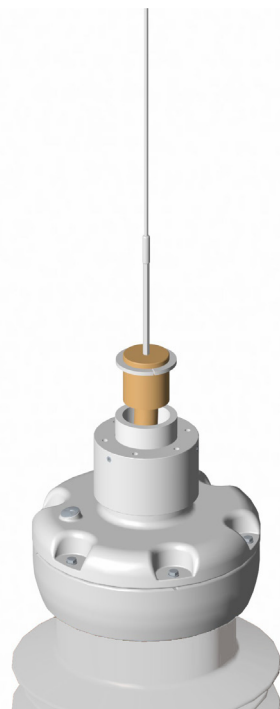


Fig. 16.

gsb_0032



Fig. 17.

gsb_0033

2.8 Fixed bottom contact

The fixed bottom contact is mounted at ABB factory and should need no further adjustment. However, to reassure the fitting is correct also after transport and handling, we recommend the following procedure:

1. Check that there is a distance of 7 ± 0.5 mm between the washer on top of the bottom contact and the pulling ring, see. Fig. 18.
2. Check that the tightening torque on the six bolts is 40 Nm.

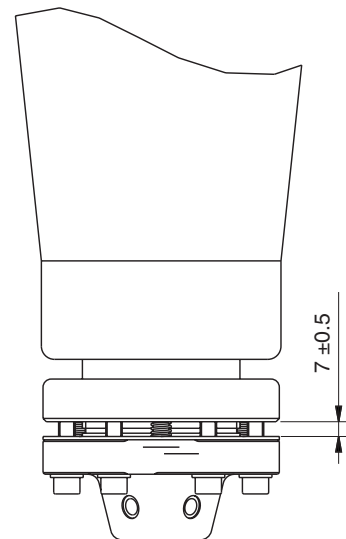


Fig. 18. Fixed bottom contact.

2.8.1 Connecting cable lugs to bottom contact and mounting oil side shield

The oil side terminal consists of a bottom contact with 4 threaded holes for cable lugs. The mounting of the bottom contact depends on which system is used, draw rod or fixed bottom contact, and is therefore described in corresponding chapter. If the inner terminal is used, the end shield is mounted with an adapter. The adapter is installed exactly like the fixed bottom contact shown in section 2.8. There are two types of bottom contacts. The difference is in the way that the end shield is mounted to the bushing. Mounting of the two types are described below.

Type 1 bottom contact

The standard bottom contact (type 1) is designed for easy installation. The connection of the cable lugs and mounting of the shield proceeds as follows:

1. Mount the bottom contact as shown in section 2.6 or 2.8.
2. Place the shield temporarily as shown in Fig. 19. Make sure to position the wider end of the shield towards the bushing.
3. If the fixed bottom contact system is used, lower the bushing and fasten it to the transformer.
4. Connect the cable lugs to the bottom contact. Tightening torque 68 ± 6 Nm.
5. Push the shield gently against the bushing flange. Apply force until the top position is reached.
6. Turn the shield clockwise approximately 20 degrees and then release the force.
7. Make sure that the end shield is in the locked position.

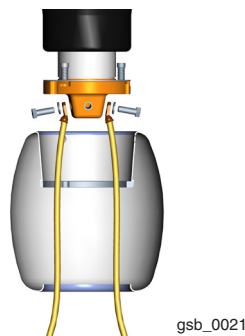


Fig. 19. Connecting to bottom contact.

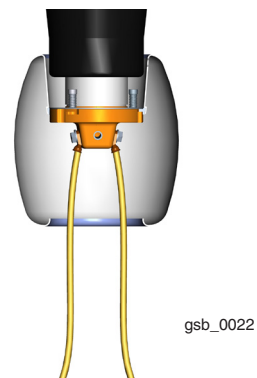


Fig. 20. Mounted cables and end shield.

Type 2 bottom contact for customized shields (only for draw rod)

The design of customized shields shall always be approved by the bushing manufacturer.

The non-standard bottom contact (type 2) has three threaded holes, M10, for fixing the shield. Connecting cable lugs and mounting oil side shield proceeds as follow:

1. Depending on the shield type it may be mounted over or under the bottom contact. If it will be mounted over it shall be placed temporarily over the centre tube. In the other case, pull the cable lugs temporarily through the end shield.
2. Mount the bottom contact.
3. If the fixed bottom contact system is used, lower the bushing and fasten it to the transformer.
4. Connect the cable lugs to the bottom contact. Tightening torque 68 ± 6 Nm.
5. Secure the shield to the bottom contact with three M10 bolts.

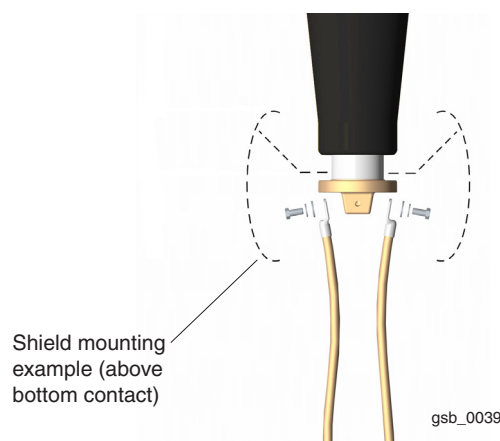


Fig. 21. Positioning of customized shield.

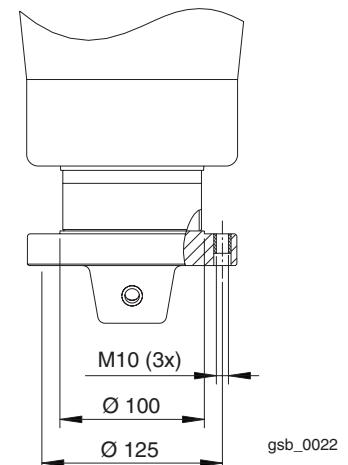


Fig. 22. Hole pattern in bottom contact for customized shield

2.9 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. The inner contact surfaces on aluminium outer terminals are tin-zinc plated, and wire brushing must thus not be carried out.

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

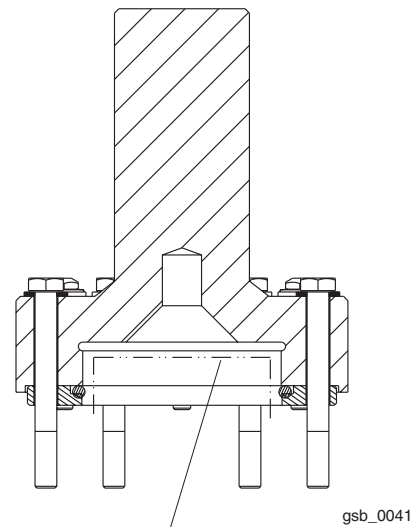
1. Clean the contact and gasket surfaces carefully.
2. Lubricate the O-ring with Mobilgrease 28.
3. Assemble the retainer ring, the O-ring, and the outer terminal stud and push them over the conductor tube. An extra O-ring intended for final installation is delivered with the bushing.

4. Grease all bolts on thread and underneath the head with Molykote 1000, or other suitable compound.
5. Insert and tighten the screws M10, with plane washer, which press the stud against the conduction tube, the inner terminal or the upper draw rod, depending on which system is used. Tighten stepwise to a final torque of 40 ± 4 Nm.
6. Insert the M8 screws, with conical spring washer and plane washer, which hold the tightening ring. Tighten them to press the gasket into place. Tighten cross-wise to a final torque of 20 ± 2 Nm.

CAUTION: It is extremely important in both cases to tighten evenly. The bolts shall thus be tightened in steps, alternately on both sides.



Fig. 23.



CAUTION: Do **not** wire brush inner contact surfaces!

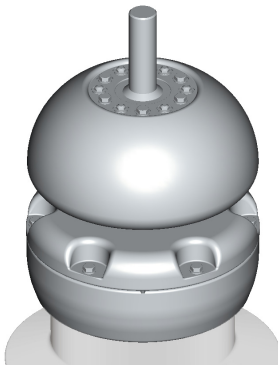


Fig. 24. Top shield for GSB 420.
Option for GSB 245 and GSB 362.

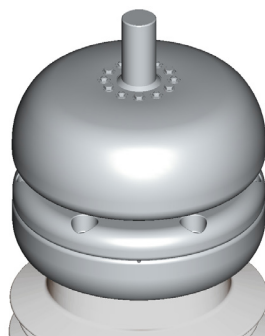


Fig. 25. Top shield for GSB 550.

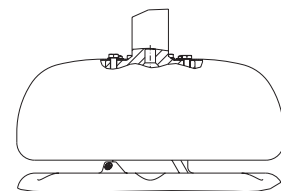


Fig. 26. Assembly of top shield.

2.10 Flange earthing

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

Alternative 1

Insert a greased (Mobilgrease 28 recommended) pointed set screw M12 (stainless steel A4-80 preferably). Tighten to 40 Nm, penetrating the paint of the transformer tank down to the metal underneath. This makes an electrical connection between the bushing and the transformer tank, keeping them at the same voltage.

Alternative 2

Apply a flexible cable between the M12 earthing hole in the bushing flange and a corresponding connection point in the transformer. Grease the screw (Mobilgrease 28 recommended) and tighten the M12 in the bushing to 40 Nm. Connect the other end of the cable to the transformer.

2.11 Waiting time before energizing

***CAUTION:** Some waiting time may be necessary before energizing, in order to avoid flashovers or partial discharges due to air bubbles at the bushing surface. Choose a suitable procedure below.*

Vacuum filled transformer

No waiting time is necessary from the bushing point of view.

De-gassed oil-filled transformer

During mounting, use a clean and dry paintbrush to release surface bubbles. Wait 6 hours before energizing.

Gas-saturated oil-filled transformer

During mounting, use a clean and dry paintbrush to release surface bubbles. Wait 24 hours before energizing.

De-gassed oil filled transformer with reduced oil-level

After restoring the oil-level, wait 24 hours before energizing.

For all alternatives except vacuum filled transformer, the oil should be allowed to enter the centre tube to at least flange height by releasing the outer terminal sealing system and allowing air to escape this way.

2.12 Recommended tests before energizing

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

1. Tightness test between transformer and bushing flange
2. Tightness test of bushing outer terminal
3. Measurement of capacitance and $\tan \delta$
4. Check of through resistance

2.12.1 Tightness test between transformer and bushing flange

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

2.12.2 Tightness test of bushing outer terminal

Since the top 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 this way. It is therefore recommended to make a tightness test after assembly, preferably both with vacuum and over-pressure. Several different methods may be used and we refer to instructions given by the firm responsible for the field erection. One possible method is the tracer gas method:

1. Put a tracer gas into the centre 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 with a gas detector (sniffer) for leaking gas at the gasket.

2.12.3 Measurement of capacitance and $\tan \delta$

WARNING

Since C_2 usually is relatively small, the test tap must never be open-circuited when applying a voltage to the bushing. It shall always be earthed or connected to an external impedance. No connection may destroy the bushing.

CAUTION: *When not measuring, always make sure that the cap nut is properly tightened with the gasket in place. This is to prevent dust and water from coming in to the test tap.*

After mounting, a capacitance measurement is recommended. Connect a measuring bridge between the outer terminal and the test tap. This is possible without removing the bushing from the transformer as the bushing has an insulated test tap, see Fig. 2. More details can be found in product information 2750 515-142, "Bushing diagnostics and conditioning".

With the transformer de-energized and the bushing outer terminal disconnected, the test tap cover is removed. The measuring equipment is connected to the test tap and the measuring voltage source to the bushing terminal.

The capacitances C_1 , between the outer terminal and the test tap, and C_2 , between the test tap and the flange, are marked on the marking plate. The nominal capacitances C_1 of the different bushing types are listed in Table 4. C_2 with test tap is highly dependent on the surrounding parts inside the transformer and it is not possible to give a nominal value valid for all service conditions.

Table 4. Nominal capacitances of C_1 in pF (Manufacturing tolerances $\pm 10\%$). C_2 only as information.

Bushing	CT = 300 mm			CT = 600 mm		
	C_1	C_2 (test tap)	C_2 (voltage tap)	C_1	C_2 (test tap)	C_2 (voltage tap)
GSB 245	663	<5000	6990	769	<5000	9200
GSB 362	619	<5000	9540	701	<5000	12300
GSB 420	579	<5000	10070	652	<5000	13100
GSB 550	553	<5000	13130	612	<5000	16900

2.12.4 Check of through resistance

The through-resistance measurement method depends on the design of the transformer. Generally, a current is applied from bushing to bushing. The voltage drop from outer terminal to outer terminal is measured. The resistance is calculated with Ohm's law, $U = R \cdot I$. (U: Measured voltage drop. I: Through current. R: Total circuit resistance.)

The total through resistance is the sum of the transformer winding and lead resistance and the bushing conductor and contact resistance. The additional resistance from the bushing conductor should not be more than $150 \mu\Omega$. Since the through resistance of the HV winding of a typical power transformer is in the order of $0.1 \dots 1 \Omega$, this is a very rough method that can only be used to detect very large faults in the current path, such as disruptions.

Less-than-perfect contacts can only be detected by making a sensitive measurement across each connection point, or by measuring the temperature increase during operation with an infrared sensitive camera (thermovision).

3 Maintenance

The GSB bushings are in principle maintenance free; no regular maintenance is needed.

DANGER

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

3.1 Recommended maintenance and supervision

1. Cleaning of insulator surface
2. Measurement of capacitance and $\tan \delta$
3. Thermovision (infrared camera) check for local overheating on connectors
4. Check for leakage

3.1.1 Cleaning of insulator surface

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

Composite: Under conditions with extreme pollution it may be necessary to clean the siliconerubber insulator surface. This should be done by wiping with a moist cloth. If necessary ethyl-alcohol or ethyl-acetate may be used. Trichloroethane or methylchloride are not recommended.

3.1.2 Measurement of capacitance and $\tan \delta$

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 temperature, 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 between bushing and transformer flange during normal station supervision.

3.2 Disposal after end of service life

The GSB bushing is delivered in a wooden box with plastic (PMMA) inspection window and with a plastic (PE or PP) tube on the oil side for moisture protection. The GSB bushing consists of the following:

The composite insulator consists of silicone rubber on a tube of glass fibre reinforced epoxy. Between the insulator and the condenser body there is a silicone gel, up to 150 l for the biggest bushings.

Resin impregnated paper condenser core containing mainly epoxy, creped paper and an embedded conductor tube in aluminium. The core also contains a smaller amount of aluminium foil inserts, rubber bonded cork, rubber sealings, braided copper wire (tinned), braided copper strap, silver glue and lead. By crushing the core the conductor tube can be separated and sorted, while the rest of the core can be incinerated in a suitable oven.

Removable flange in cast aluminium containing test tap, locking ring in aluminium, bolts in stainless steel and o-rings in rubber. Unscrew the locking ring and slide the flange off to separate it from the condenser core. O-rings fitted in the flange are easily removed.

Removable test tap containing test tap body in epoxy, test tap cover in aluminium, cable, contacts in brass and o-rings. These components can easily be separated except for the embedded brass center bolt of the test tap body. Crushing the test tap body can separate this bolt.

On the 20 kV voltage tap option the flange is filled with approximately 2 dl silicone gel. When flange is separated from the condenser body this gel can be scraped out and separated.

Outer 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. The bolts are made of stainless steel and o-rings in rubber. These components can easily be separated.

The draw rod contains details in aluminium, steel, brass and nylon. The bottom contact and the inner terminal are made of pure copper, the pulling ring and the bolts, of brass. End shield in epoxy painted aluminium and o-rings in rubber. These components can easily be separated.

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