

Installation, Operation, and Maintenance Instructions

RIP Bushings upto 170 kV 3150 Amp


Content


Sl.	Heading	Page
1.	General	3
1.1	Safety	3
1.2	Transport and Storage	3
2.	Product Description	4
3.	General Operating Conditions	5
4.	Installation of bushings	6
4.1	Unpacking and lifting	6
4.2	Repacking	8
4.3	Mounting of bushing	8
4.3.1	Procedure of connecting draw lead / draw rod (upto Flange level) type bushings	9
4.3.2	Procedure of connecting Bottom connected- Draw rod and Solid stem type bushings	12
4.3.3	Terminal Connection and Electrode re-fixing arrangement for Draw-rod and Solid stem bushing	12
4.3.4	Air end terminal fixing arrangement for Draw rod (bottom connected) and Solid stem	14
4.4	Air release	14
5.	Check before/after energising	15
6.	Maintenance	17


1. General

Read this manual carefully and follow all safety regulations at work.

1.1 Safety


	<p>Work on bushings may only be performed by qualified persons. Only materials provided by YASH must be used.</p>
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	<p>Caution - Do not work on systems that might be under Highvoltage! Follow below safety rules in the given order.</p> <ol style="list-style-type: none"> 1 Disconnect from the mains 2 Secure against reconnection 3 Verify that the system is off-line 4 Carry out earthing and short circuiting 5 Provide protection from adjacent live parts <p>Failure to comply with these rules can be fatal!</p>
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	<p>Caution Strong electromagnetic fields can occur along the bushings. People with pacemakers may not go near! Sensitive technical devices must be protected by appropriate measures.</p>
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1.2 Transport and Storage

The bushings are packed and supplied in wooden box (Figure 1). Each bushing is sealed individually in a plastic bag with desiccant material for humidity protection.
Check the packaging for any damage right after delivery.

	<p>Attention - transport damage Obvious damage to carrier must be acknowledged to YASH as soon as possible.</p>
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	<p>Attention Bushings must at all times be protected from moisture. Keep the bushings inside protective foil and Protection tank until the installation.</p>
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	<p>Attention Contact of Transformer oil with silicone rubber must be avoided as it may result into Silicon rubber shed's deformation and change in properties.</p>
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	<p>Bushing storage method Bushings are supplied in Wooden box. Whole bushing is packed inside Protective foil with desiccant bags (Figure 2). Oil-side of Bushing is sealed in oil filled tank (Figure 3).</p>
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	<p>For long term storage of bushings, refer YASH's detailed Instructions.</p>
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Figure 1: Wooden box



Figure 2: Protective plastic cover



Figure 3: oil tank

2. Product Description

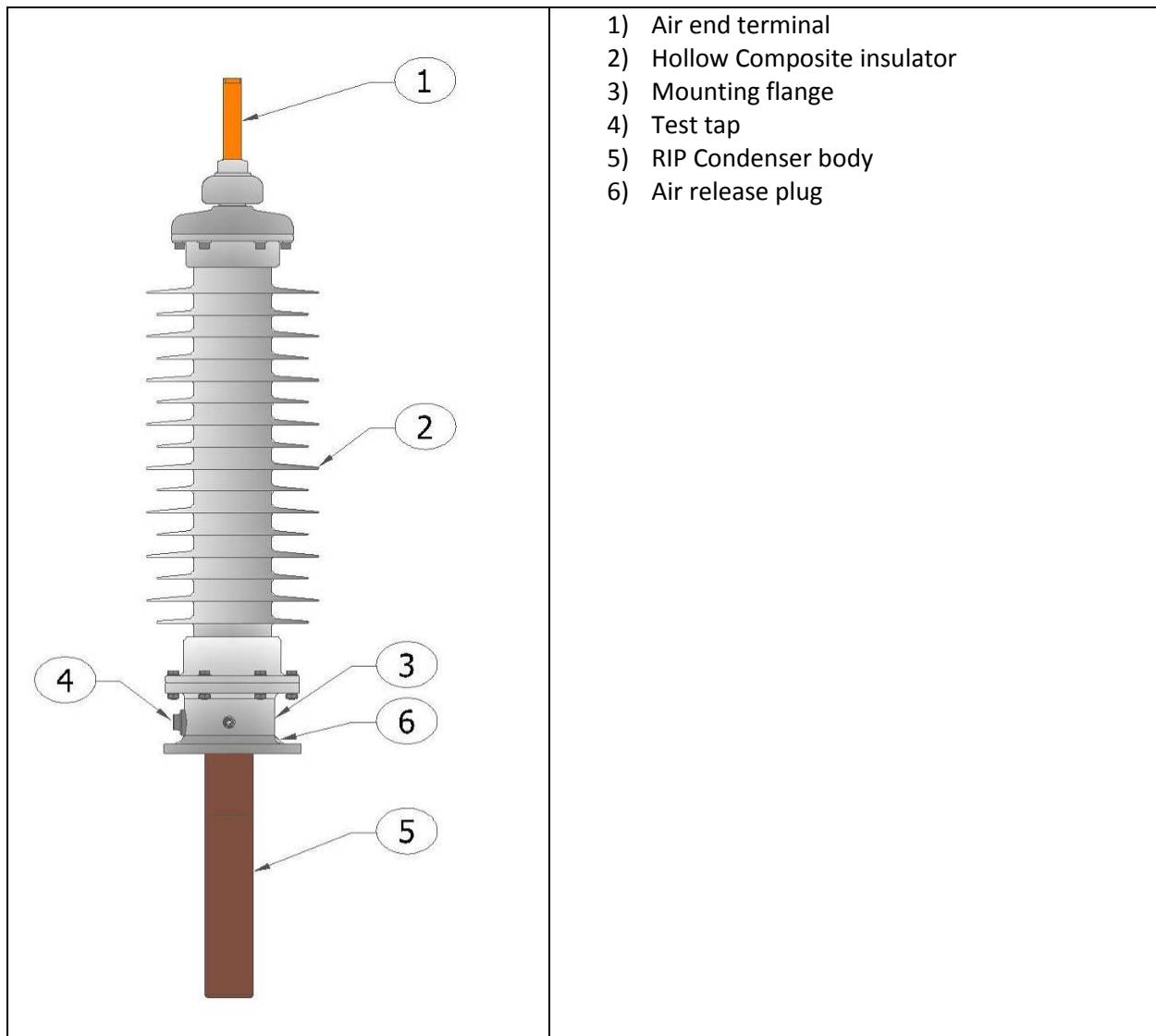


Figure 4: Transformer-Outdoor bushing

The VRL/VRD/VRS model of transformer bushing is designed for oil to air application.

These bushings are characterised by their compact design and the partial discharge-free operation. These transformer bushings can be described as practically maintenance-free.

The transformer bushing has a dry insulation of RIP (Resin Impregnated Paper). The insulation is directly wound on the conductor or centre pipe depending on the design and consists of wound insulating paper, which is impregnated with special epoxy resin under vacuum. Aluminium foil grading layers are

embedded during the wrapping of the paper insulation for the optimal distribution of the electrical field. This structure ensures the longest possible operational reliability and the highest possible human safety. The **VRL** transformer bushing is draw lead type and conducts the electrical current by transformer lead drawn through bushing's centre pipe up to air end terminal.



Attention Draw lead type bushings are sent with transport bolt attached to air end terminal, which should be detached before connecting the thimble (see clause 4.3.1).

The **VRD** transformer bushing is draw-rod type and conducts the electrical current by a split type conductor rod, drawn through bushing's centre pipe.

The **VRS** transformer bushing is solid stem type and conducts the electrical current by a centre conductor/stem. Stem is an integral part of the bushing.

The bushing is provided with test tap to enable tangent delta, capacitance and partial discharge measurement.

All metal parts are mainly corrosion-proof aluminium.


The air side of the bushing is housed inside hollow composite insulators with silicone rubber sheds. The gap between RIP insulating body and composite insulator is filled with special insulating material which ensures non-porous flexible joint between them.


3. General Operating Conditions:


3.1 Application	: Transformers
3.2 Insulation	: Resin Impregnated Paper
3.3 Application	: Oil to Air.
3.4 Ambient temperature	: -20 to + 40 °C
3.5 Oil Temperature	: ≤ 60 °C above ambient.
3.6 Altitude of site	: ≤ 1000 m.
3.7 Mounting angle	: 0° to 90° from Vertical.
3.8 Oil level	: Upto Flange level

Special requirements are guaranteed in GA dwg and superceeds above data.

4. Installation of bushings


	<p>Caution Do not work on systems that might be under High-voltage!</p>
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	<p>Attention Silicon rubber shed must be protected from damage while lifting, due to abrasion or any other way.</p>
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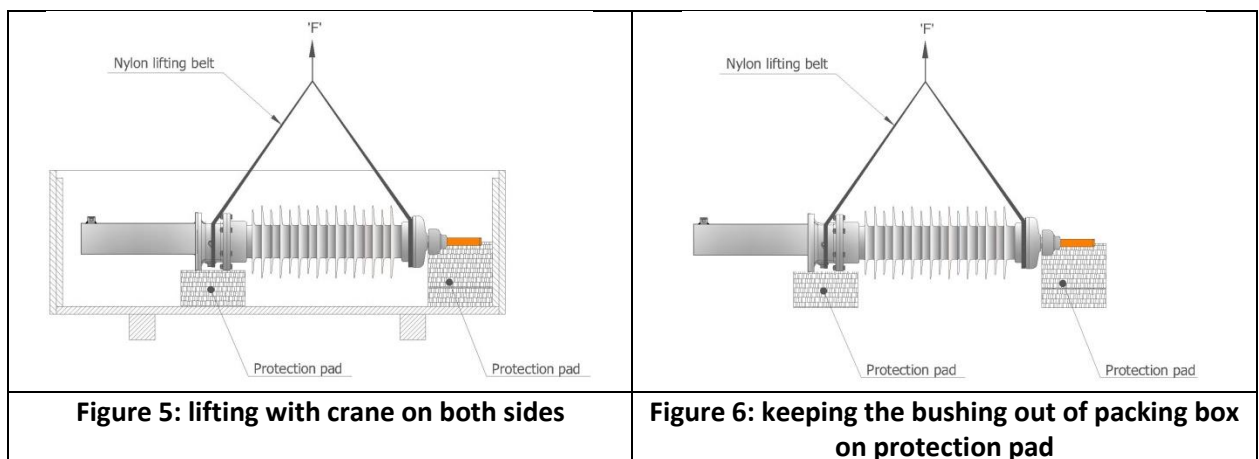
	<p>Attention Do not attach the sling onto the silicone insulator. Prevent contact of any Kind of Oil (Transformer Oil in Particular) with Silicon Sheds, as this will lead to permanent distortion of Sheds & hence permanent damage.</p>
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4.1 Unpacking and lifting


Remove Plastic from Bushing as it can be reused for repacking of Bushing.

	<p>Attention Do not use cutting tools to remove the protection foil as they might damage the silicone sheds.</p>
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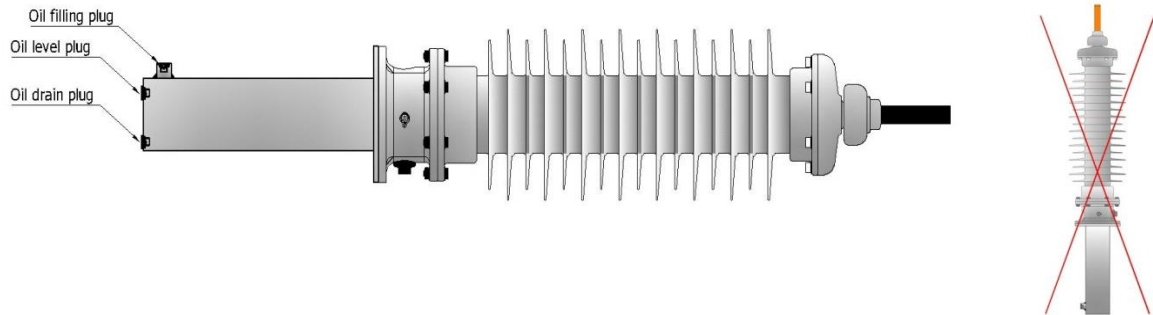
Bushings should be lifted by nylon belt/rope and lifting equipment.
Lift the bushing horizontally up from packing case by nylon lifting belt, supported on bushing mounting flange and bushing head plate, and put bushing outside of packing case on supports/protection pad so as silicon rubber sheds do not touch the ground.



All Bushings are supplied with Metallic Protection tank fixed on Oil side of Bushing to protect the RIP Insulation from Moisture ingress.


	<p>Attention Do not keep Bushing in vertical Position by support of Protection tank mounted.</p>
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	<p>Attention At all times, ensure that Silicon sheds do not touch any surface to avoid deformation of sheds. (i.e. during storage in packing box or on ground while erecting and dismantling).</p>
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Remove protection tank fixed on Transformer side of Bushing in following steps;

- Drain all oil through Oil-drain plug of Protection tank. Keep the Oil level plug slightly open to facilitate this.
- Remove all fasteners and detach Protection tank from Bushing flange.
- Store the Protection tank(closed reasonably), fasteners and O-ring in indoor, clean and dry place so as to avoid contamination due to dust, foreign particles, moisture etc and damage to bushing.
- Wipe the Oil side of Bushing thoroughly using dry lint free cloth. Clean the Bushing thoroughly so as dust particles, foreign particles and moisture, if any is removed.
- After testing and using the Bushing, fix back the Protection tank on Oil side of Bushing as per Repacking section of this manual immediately.

 **Attention** Exposure of RIP active part (Transformer side of Bushing) to ambient may result in deterioration of Tan Delta value of RIP Insulation.

 **Attention** Bushings must be handled with care. Bumps, Impacts and shocks must be avoided. Damage to the bushings must be reported immediately to YASH.

 **Attention** Bushing terminal holes should not be used for lifting the bushing. Terminals' surface must be protected from damage.

Lift the bushing vertically up by nylon belt, attached to the bushing's head plate or using two eye-bolts(not in scope of supply) fixed in tapped hole provided on head plate at 180° apart.

While raising the bushing, put a protection pad of soft material/ rubber pad underneath, to avoid damage to RIP body.

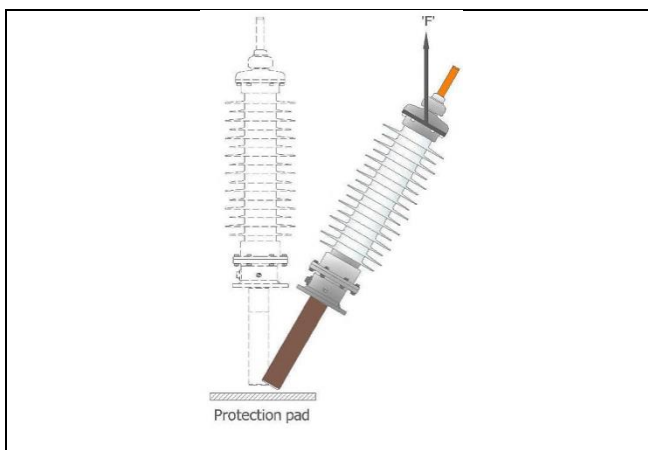


Figure 7: Lifting the Bushing

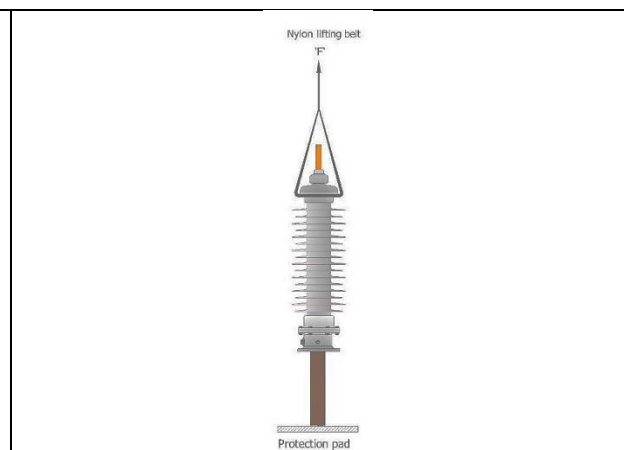





Figure 8: Lifting to the transformer


4.2 Repacking

The bushings should be repacked and stored/transported in original packing box maintaining the original packing scheme as delivered from manufacturer's premises i.e Protection tank, Plastic/Aluminum foil packing.

	Attention Bushing must be repacked with a Protection tank on Oil side to protect from Moisture during repacking and for storage for more than 3 days in indoor clean and dry environment.
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	Attention After fixing the tank, The Oil filling plug of Protection tank must be straight upwards and Oil drain plug and Oil level plug should align to vertical straight line.
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	Caution Oil filling must be done in clean and dry environment to avoid moisture/foreign particles ingress.
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	Caution During Oil filling in protection tank, ensure Bushing is in straight horizontal condition.
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Fix the Protection tank horizontally on Oil side of Bushing in below steps;

- Clean the tank inner surface with dry lint free cotton and suitable cleaning agent.
- Fix the Protection tank on Oil side of Bushing with O-ring for sealing and fix all the fasteners
- Close the drain plug of Protection tank, keep the Oil level plug slightly open and start filling tank from Oil filling plug by high Quality Mineral Oil having BDV> 70kV, Tan delta< 0.005, Water content < 5PPM.
- Once the Oil floods out from "Oil level plug", stop filling Oil in Protection tank. Let the excess oil out from "Oil level plug" fully and then close the "Oil level plug" and "Oil filling plug".
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4.3 Mounting of bushing

	Hint YASH recommends to insulate the draw lead from transformer winding to the bushing.
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	Caution The contact surfaces of the bushing are electroplated; hence do not use emery or any abrasive articles to clean. Wipe clean with a lint free cloth using suitable cleaning agent.
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	Attention In order to maintain a contact pressure, the terminals should be properly tightened. Failure to perform a proper connection may result in overheating.
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- Clean the sealing surfaces of the bushing and transformer, oil-side and air-side, and make sure that everything is completely dry.
- Lift the bushing using lifting belt and place above the transformer at the designated place.

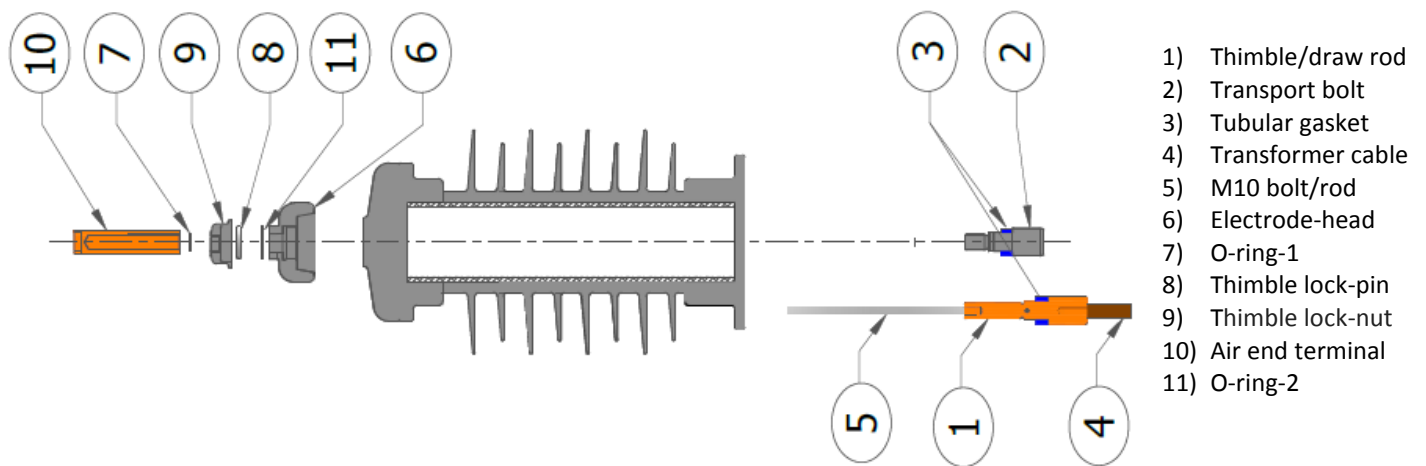




Figure 9: Bushing part details

4.3.1 Procedure of connecting draw lead/ draw rod (upto Flange level) type bushings

	<p>Caution Keep the O-rings on 'thimble lock-nut' and 'Electrode-head' in same position and do not remove them to avoid damage.</p>
	<p>Caution Terminal connection to the thimble shall be done carefully so that the threads are not damaged.</p>

<p>Figure 10.1</p> <ol style="list-style-type: none"> 1) Unscrew the 'Air end terminal' (Fig 9, Part 10) from 'Transport-bolt' (Fig 9, Part 2). 2) Retain the 'O-ring 1' (Fig 9, Part 7) for later use. 3) Remove 'thimble lock-nut'(Fig 9, Part 9) from 'Transport-bolt' (Fig 9, Part 2) 	<p>Figure 10.2</p> <ol style="list-style-type: none"> 4) Remove cylindrical 'thimble lock-pin' (Fig 9, Part 8) from 'Electrode-head' (Fig 9, Part 6). 5) Take out the 'Transport-bolt' (Fig 9, Part 2) from bushing 6) Retain the 'tubular gasket' (Fig 9, Part 3) and 'O-ring 2' (Fig 9, Part 11) for later use. 	<p>Figure 10.3</p> <ol style="list-style-type: none"> 7) Carry out brazing of 'transformer cable' (Fig 9 Part 4) with 'thimble/draw rod' (Fig 9 Part 3) 8) After sufficient cooling, insert the 'tubular gasket' (Fig 9 Part 3) on the 'thimble/draw rod' (Fig 9 Part 1) <p>Attention: Do not carry out brazing with tubular gasket attached to thimble/draw rod, it can cause the gasket to melt.</p> <ol style="list-style-type: none"> 9) Pull the 'thimble/draw rod' (Fig 9, Part 1), in brazed condition with 'transformer cable' (Fig 9, Part 4), through bushing's centre pipe up to 'electrode-head' (Fig 9, Part 6) using M10 bolt/rod and tapped hole provided on thimble top side, while slowly lowering the bushing onto transformer.

<p>Figure 10.4</p> <p>10) Insert 'thimble lock pin' (Fig 9, Part 8) through hole provided in the thimble/draw rod and place the thimble/draw rod firmly by resting lock pin on both sides in the grooves provided on 'electrode-head' (Fig 9, Part 6)</p> <p>11) Remove the M10 rod/bolt from thimble/draw rod top side.</p> <p>12) Hand tighten the 'electrode-head' (Fig 9, Part 6) on bushing center pipe threads till firm.</p> <p>Do not try to apply extra force or over tighten the part.</p>	<p>Figure 10.5</p> <p>13) Ensure proper placement of 'O-ring-2' (Fig 9, Part 11) on 'Electrode-head' (Fig 9, Part 6).</p> <p>14) Ensure proper placement of 'O-ring-1' (Fig 9, Part 7) on top of 'thimble lock-nut' (Fig 9, Part 9).</p> <p>15) Screw on 'thimble lock-nut'(Fig 9, Part 9) with 'thimble/draw rod' (and fully tighten by hand and then after tighten it about ½ to ¾ turn using adjustable spanner.</p>	<p>Figure 10.6</p> <p>16) Screw on 'Air end terminal' (Fig 9, Part 10) with threads of 'thimble/draw rod' (Fig 9, Part 1) tighten at 40 N.m torque using torque wrench.</p> <p>Caution: Use of torque wrench is must. Any over tightening can cause thread damage.</p> <p>17) Fasten the bushing flange to the transformer/turret cover and connect the flange to earth potential.</p>

Figure 10: Procedure of connecting draw-lead type bushing

Procedure of connecting draw-rod (upto flange level design) type bushing

- Draw rod (upto flange level design) is supplied in two parts. Both Upper and lower part of Draw rod are fixed by fasteners and supplied with bushing.
Lap joint dimensions between upper and lower part of draw rod and fastener details are provided in GAD.
- At Transformer works, whole Draw rod (upto flange) is to be removed from bushing as illustrated in Figure 10.
- Lower part of Draw rod to be detached from upper part and to be connected to Transformer winding lead as illustrated in Figure 10.

- Lap joint of upper part of draw rod and bottom part of draw rod to be done by lowering the upper part of Draw rod below bushing and connecting the bottom part of draw rod to it by using fasteners as shown in GAD.
- Bushing can be dispatched to site with Upper part of Draw rod (upto flange) inside Bushing and bottom part of draw rod (upto flange) inside transformer.

4.3.2 Procedure of connecting Bottom connected-Draw rod and Solid stem type bushings

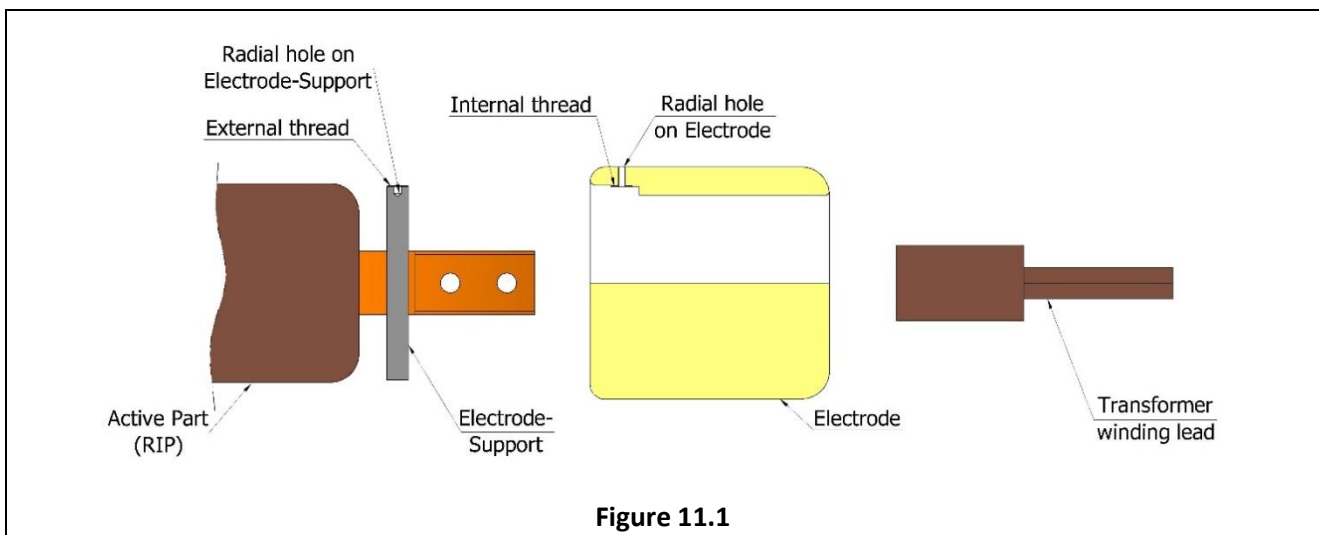
- Draw-rod and Solid stem type Bushings are suitable for direct connection on both Air end and Oil end.
- Air end side terminal can be directly connected to suitable terminal connector.
- Oil end side terminal can be directly connected to transformer lead via flat-palm connection on transformer winding.

	Hint For split-rod design of Draw rod, split joint connections are not required to open.
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4.3.3 Terminal Connection and Electrode re-fixing arrangement for Draw-rod and Solid stem Bushing

	Attention Do not disturb fixing of Electrode-support while terminal connection and Electrode removal/re-fixing.
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	Attention Connection shall be done carefully so that the contact surfaces are properly seated.
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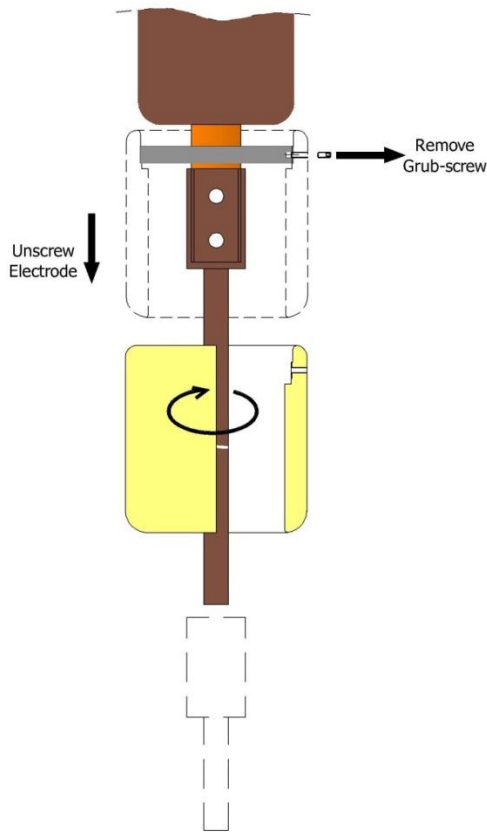


Figure 11.2

STEP-1 REMOVE THE ELECTRODE AND CONNECT TRANSFORMER LEAD TO BUSHING

- 1) Unscrew all three Grub-screws inserted in radial holes on 'Electrode' and 'Electrode-support'.
- 2) Unscrew the 'Electrode' from 'Electrode-support'.
'Electrode-support' is fixed at factory and need not be removed for connecting the bushing.
- 3) Slide down the 'Electrode' on transformer winding lead
- 4) Connect transformer winding lead to the bushing's oil end terminal

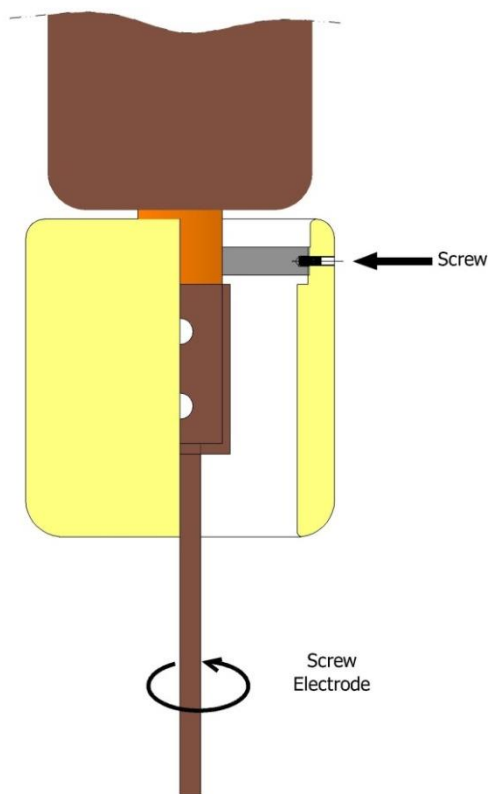


Figure 11.3

STEP-2 FIX THE ELECTRODE

- 5) Slide up the 'Electrode' on transformer winding lead and screw it on 'Electrode-support'.
- 6) Match orientation of any of the three radial holes on 'Electrode' and 'Electrode-support'
Hence all three radial holes on 'Electrode' will match with radial holes on 'Electrode-support'
- 7) Fix all three grub-screw in radial holes of 'Electrode-support' and tighten fully.

4.3.4 Air end terminal fixing arrangement for Draw rod (bottom connected) and Solid stem



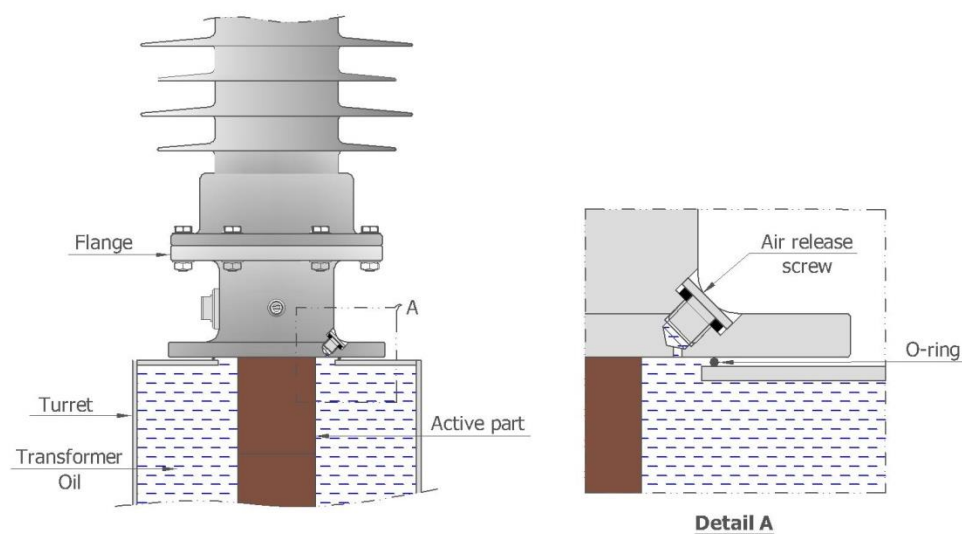
Hint

Air end terminal for both bottom connected draw rod and Solid stem Bushing is fixed before dispatch and are not required to open for connection of Bushing.

<p>Figure 12.1</p> <p>Components: Contact, O-ring, fixed conductor and top cover.</p>	<p>Figure: 12.2</p> <p>Place O-ring in contact's groove as shown.</p>	<p>Figure: 12.3</p> <p>Screw on 'Contact' with threads of 'fixed-conductor'. Tighten at 40 Nm torque using torque wrench.</p>


4.4 Air release


- Open air release screw on the mounting flange to let the air escape. The oil level should be up to the flange of the Bushing.



- After 24 hours waiting time vent again to ensure that no air bubbles are present on the insulating body.
- Apply transformer oil on the thread of the air release screw and tighten at 30N.m torque.

5. Checks before/after energizing

 **Attention:** Before commissioning, a waiting time of **24 hours** for repeated air release from transformer turret is required to avoid air bubbles on the insulating body which can cause flashovers or partial discharges.

 **Attention:** Fasten the flange to the transformer/turret cover and connect the flange to earth potential.
Check earthing! Inadequate earthing may lead to total failure of the system or damage to the bushings!

To ensure safe operation YASH recommends the following checks atleast once every year.

1. Verification of leakproofness at Sealing joint between Mounting Flange and Transformer Tank and at air release screw on mounting flange.
2. Verification of leakproofness at the electrode-head sealing of the bushing.
3. Tangent Delta and capacitance (C1) measurement at the test tap.

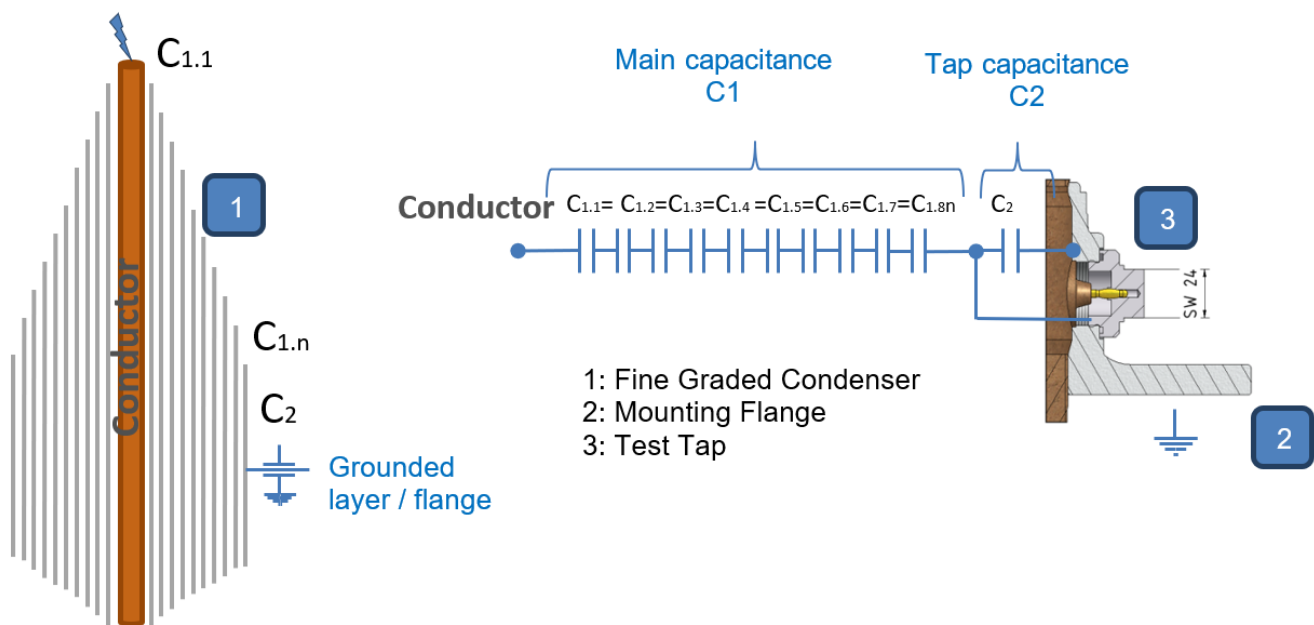


Figure 13: Principle of functioning - Capacitance and tangent delta measurement.

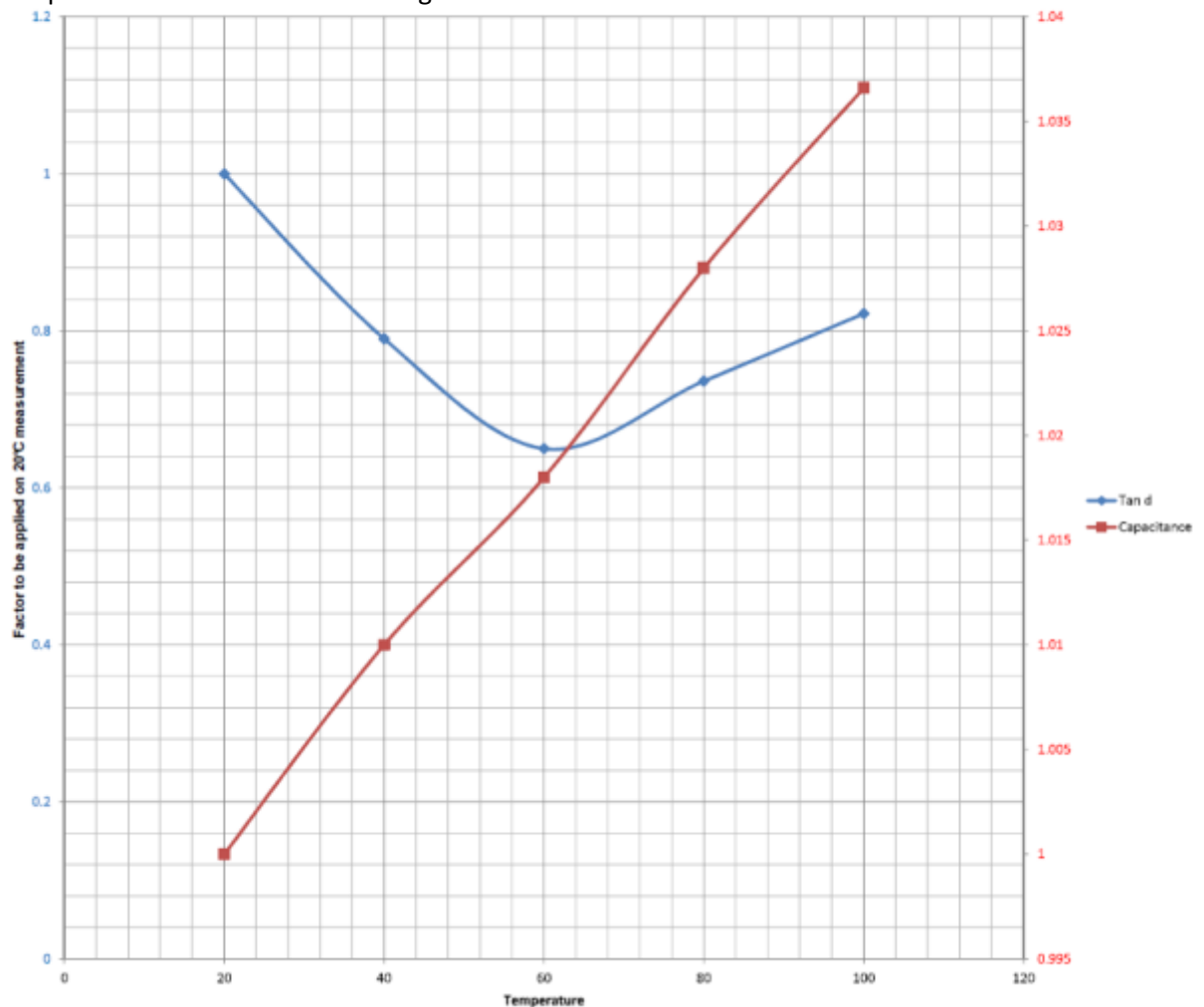
Capacitance and tan delta - measurements being routine tests, a test report is provided with the bushing. Capacitance and Tan delta is also indicated on the nameplate of Bushing.

Capacitance C_1	should not increase more than 3-4% under the same test conditions
Tangent delta	new bushings have tan delta in the range of 0.35 to 0.5% at 40 deg C. and should not exceed 0.7% within the ambient temperature range. Ask YASH for Temperature Correction characteristics when in doubt.

Incase test results do not conform to above limits, YASH must be contacted for further analysis and action.

The test results depend on the measurement method, temperature, air pressure and humidity. For better comparability of 'capacitance' and 'tangent delta', the influence of the ambient temperature should be essentially taken into consideration.

Refer below graph for conversion of capacitance' an 'tangent delta' when tested at different temperatures than measured during FAT.



Correction of Capacitance and Tan delta for comparison with factory test results, considering 20Deg C as base value for correction.

By example:

If the Tan Delta is measured at 40 Deg. C at site , then divide this by 0.79 to arrive at Tan Delta at 20 Deg. C (if the FAT Tan Delta results are at 20 Deg. and you want to compare the site results with Factory Results).

If the Capacitance is measured at site at 40 Deg., then divide this value by 1.01 to arrive at Capacitance at 20 Deg. C (if the FAT Cpacitance results are at 20 Deg. C and you want to compare the site results with Factory Results)

In case of doubt contact YASH for assistance.

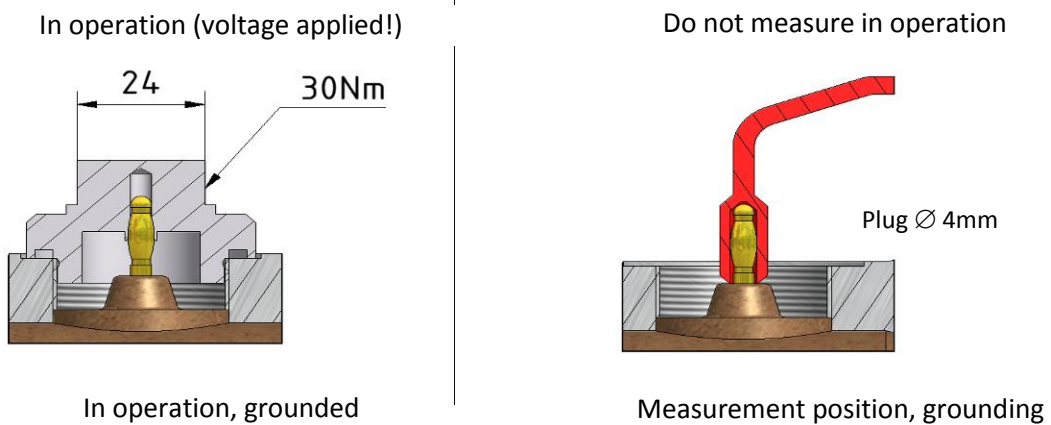



Figure 14: Test tap designed for maximum test voltage of 2kV at 50Hz



Figure 15: Standard test tap

The cap must be screwed tightly after measurement.

	<p>Attention: The measuring connection may only be used if the power supply is disconnected. After the measurements, the cap must be closed again to ensure earthing of Test Tap , if not done will result in failure of bushing</p>
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4. Thermography at air end connections


At maximum rated current, the bushing outer terminal normally takes a temperature of about 45 to 55 °C above the ambient air. Significantly higher temperatures, especially at lower current loading, can be a sign of bad connections.

Irregularities of temperature along the outdoor insulator length, metal parts have to be examined more closely. If necessary, contact YASH.

6. Maintenance

Bushings are practically maintenance free. Though, we do recommend the following every 6 months:

1) Capacitance and tan delta – measurements (See clause 5)

	<p>Caution Do not work on systems that might be under High voltage!</p>
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2) Cleaning the silicone sheds

The hydrophobic properties of silicone rubber cause significantly less leakage currents, resulting in an excellent performance in polluted environments. Therefore, there is no need to clean or grease. Silicone prevents the formation of conductive paths which lead to flashovers, line outages or erosions on the insulator.



Attention Contact of Transformer oil with silicone rubber must be avoided as it may result into Silicon rubber shed's deformation and change in properties.



Hint

In case of exceptional severe site conditions, the insulator can be cleaned manually with soap/water and soft cloth.










No oils or detergents should be used.

Silicone rubber retains its hydrophobicity after washing.

In case of contamination of silicone by transformer oil:

We recommend using Acetone, Isopropyl alcohol or White spirit. This solvent should be used together with a clean cloth to remove the transformer oil from the surface of the insulator.

DISTINGUISHED PRODUCT RANGE

			
<p>OIP bushings with Porcelain/Polymer housing upto 170kV</p>	<p>LV Oil Insulated Polymer Bushings upto 36kV 3150 Amp</p>	<p>LV OIP bushings Upto 4000 Amp</p>	<p>Retrofit/Replacement of reputed make bushings</p>
			
<p>Oil filled High-current bushings Upto 16000 Amps</p>	<p>OIP High-current bushings Upto 20000 Amps</p>	<p>Retrofit High-current bushings</p>	<p>Fibre-glass cylinder for test equipment and transformers Upto 1800 mm dia, 3 metre length</p>
			
<p>OIP wall bushings upto 145 kV</p>			

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