Instructions for Installation, Maintenance and Storage of Type "O Plus C" Bushings 115 kV and Higher

June 1991
Supersedes IL 44-666E
Dated September 1990

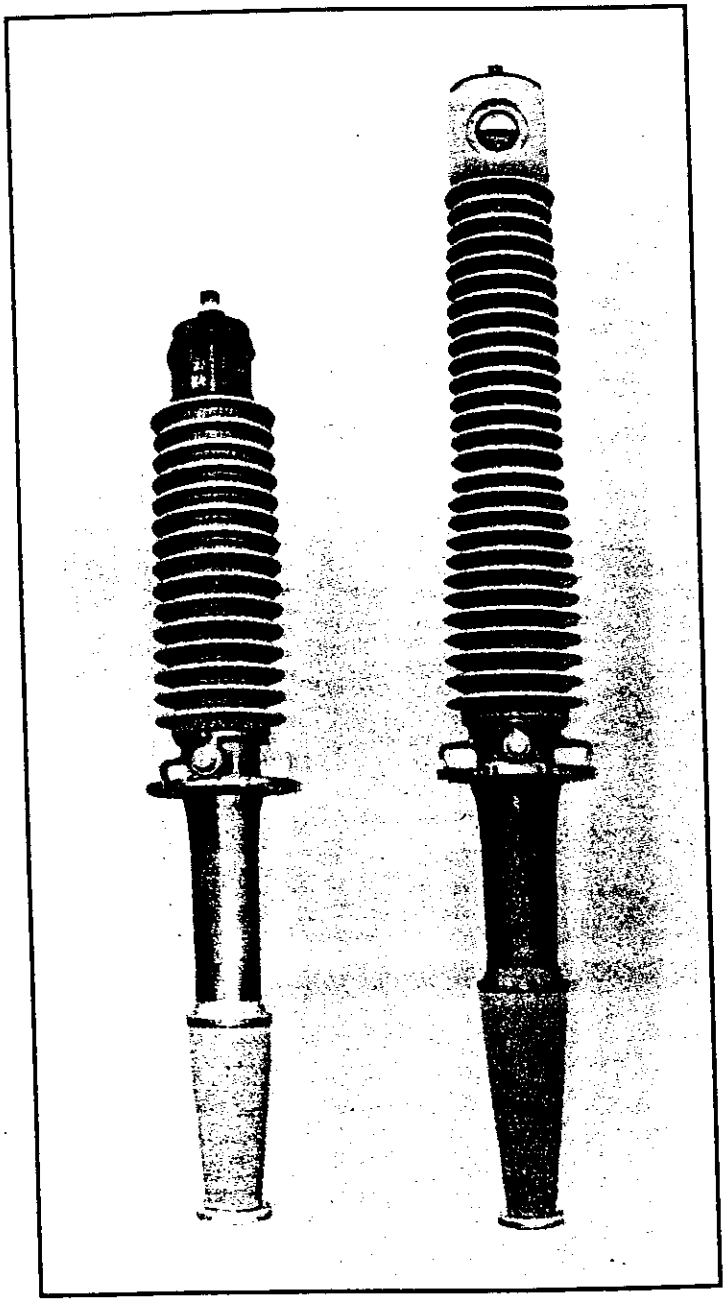


Figure 1: Typical Type "O Plus C" bushings

SCOPE

This leaflet contains general procedures to be followed from the time the bushings are received until they are put into operation. These instructions do not purport to cover all possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment. If you require further information regarding this particular installation or the operation and maintenance of your equipment contact the local ABB Power T&D Company representative.

GENERAL INFORMATION

Type "O Plus C" condenser bushings are designed for transformer and oil filled circuit breaker applications. Type "O Plus C" condenser bushings meet all applicable dimensional requirements of the ANSI/IEEE Standard 24-1984 and meet or exceed all applicable electrical and mechanical requirements of the ANSI C76.1-1976 Standard and IEC Publication 137-1973 Standard. Type "O Plus C" condenser bushings are also manufactured to meet E.E.M.A.C. Standards. Type "O Plus C" condenser bushings are manufactured exclusively at the Components Division Plant in Alamo, Tennessee.

Type "O Plus C" condenser bushings (Figure 1) consist of an oil-impregnated, multi-layered, paper condenser wound on a central tube. The condenser is housed in a sealed cavity formed by the upper and lower porcelain insulators, the high strength one-piece aluminum flange and ground sleeve, and the metal or glass expansion domes. This cavity along with the condenser is evacuated and then filled with highly processed transformer oil for a very low moisture content and low bushing power-factor. This low moisture content and low power-factor is maintained throughout the life of the bushing by permanently sealing the bushing cavity. Spring loaded center clamping hardware is used to apply sufficient clamping pressure to seal the bushing cavity during manufacturing. This seal is never broken.

SAFETY INFORMATION

Keep this Instruction Book available to those responsible for the installation, maintenance, and operation of the Bushing.

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

- High pressures
- Lethal voltages
- Moving machinery
- Heavy components

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

Additionally, all applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices, and good judgment must be used by personnel when installing, operating, and/or maintaining such equipment.

Safety, as defined in this instruction book, 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 notations are headed by one of three hazard intensity levels which are defined as follows:

1. DANGER — immediate hazard which will result in severe personal injury, death, or property damage.

2. WARNING — hazard or unsafe practice which could result in severe personal injury, death, or property damage.

3. CAUTION — hazard or unsafe practice which could result in minor personal injury, or property damage.

SHIPPING METHOD

The preferred method of shipping "O Plus C" bushings is in the vertical or inclined position that holds the upper end above the lower end. An angle of seven degrees or higher above the horizontal must be maintained to prevent any entrapment of gas in the insulation and to insure its integrity. Bushings rated 138 kV and below may be shipped and stored in the horizontal position if the following guidelines are observed.

CAUTION

FAILURE TO FOLLOW THESE GUIDELINES MAY RESULT IN DAMAGE TO THE BUSHING AND CAUSE AN ELECTRICAL FAILURE. FAILURE TO FOLLOW THESE GUIDELINES WILL ALSO CANCEL THE WARRANTY ON THE BUSHING.

1. Horizontal shipment or storage is limited to bushings rated 138 kV and below. Bushings rated above 138 kV must have the top end elevated during shipment and storage.

2. The bushings can be shipped in a horizontal position from the plant in Alamo, TN to the Purchaser if the maximum period in transit does not exceed 15 days.

3. The bushings can then be stored in a horizontal position for a maximum period of 15 days.

4. Bushings that have been in a horizontal position for a total period of 30 days or less must be placed in a vertical position for a minimum of 48 hours prior to the application of voltage. This applies to any time period 30 days or less. Gently rock the bushing to release any nitrogen gas that may have been trapped in the insulation prior to applying any voltage.

5. After the bushings have been in a vertical position for at least 48 hours, the bushings can then be shipped in a horizontal position to the ultimate destination if the transit time period is 21 days or less. Upon arrival at the destination, the bushings must again be placed in a vertical position for 48 hours minimum before voltage is applied.

6. If the bushings are in transit or are stored in a horizontal position exceeding the time in these guidelines, contact Customer Service, Components Division, Alamo, TN 38001, telephone (901) 696-5561. Reimpregnation of the condenser at the factory will be required if the specified time periods are exceeded.

RECEIVING

When a bushing is received, it should be examined for damage incurred during shipment. If damage or rough handling is evident, file a claim with the transportation company, and notify your ABB Power T&D Company Sales Representative immediately.

Note the oil level as explained under the heading "Liquid Level Indication", then examine the surface of the porcelain for small breaks or cracks which might cause leakage later, but which will not immediately affect the oil level.

Although surface oil is removed carefully from Type "O Plus C" bushings after electrical tests, occasionally bushings show evidence of an oil film when received. While this is cause for concern, the following information should be considered.

1. Type "O Plus C" bushings are oil pressure tested at pressure exceeding 20 psi prior to shipment.

2. The presence of an oil film on the surfaces or joints of bushings can be residual oil remaining after the immersion of the bushings for electrical tests.

3. To check for hidden damage to gasket seals and porcelains which might permit leakage, wipe all bushing surfaces and joints clean and dry during a 48 hour period.

STORING

A Type "O Plus C" bushing can be stored outdoors in the shipping crate for short periods (Figure 2).

For long term storage, a bushing should be stored in a vertical position.

If a bushing must be stored in a position other than the vertical, adequate oil coverage must be provided by positioning the upper end above the lower end. An angle of seven degrees or higher above the horizontal must be maintained. Bushings rated 345 kV and above are generally shipped with their top end elevated to assure coverage of the condenser insulation. These bushings can be stored in their skids for long periods.

For long term storage, suitable protection should be provided for terminals and mounting hardware. The gasket surface on the underside of the mounting flange should be heavily greased to protect it from rusting and corrosion. The potential tap housing should be filled with clean, dry transformer oil by removing the filler plug (Item 17, Figure 6) to prevent condensation and corrosion. When filling, leave a space of one quarter of an inch in the chamber for oil expansion. Coat the threads on the filler plug with a suitable sealer and replace the plug in the filling hole. Be certain that the plug is tight.

Figure 2A: Shipping Crate for bushings below 345 kV.

Figure 2B: Shipping crate for bushings 345 kV and above.

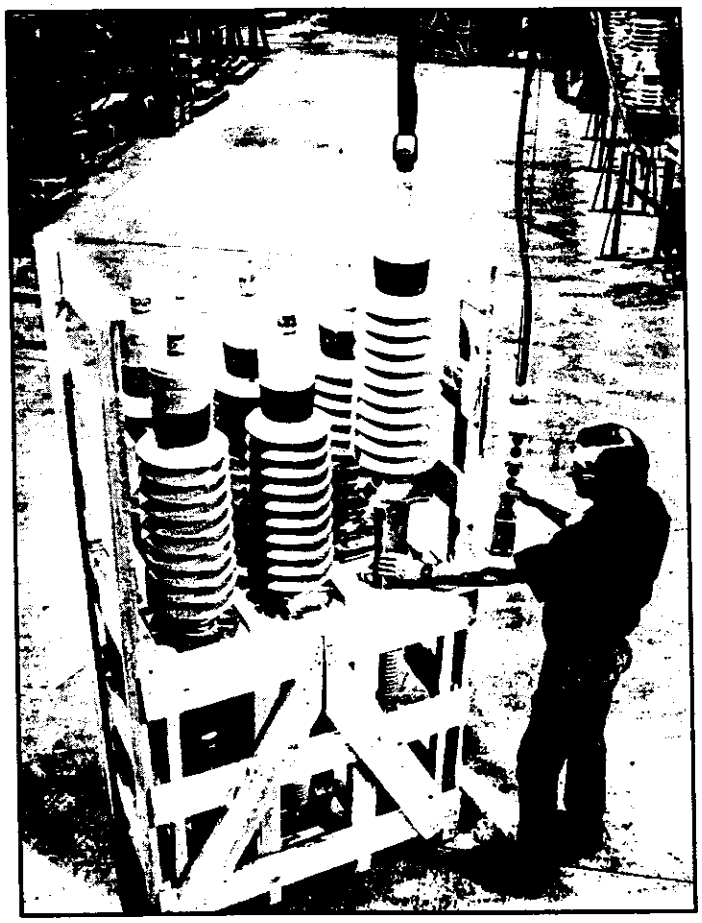


Figure 2C: Bushing shipping crate for upright shipments.

HANDLING AND MOUNTING

A bushing rated under 345 kV is provided with lifting eyes in the flange. Because of the weight and dimensions of the bushing, the main lifting tackle should always be attached to the lifting eyes.

Bushings rated 345 kV and above are shipped in a special skid that holds the upper (dome) end above the lower end. The bushing is held at approximately seven degrees above the horizontal. The seven degree or a greater angle must be maintained to prevent any entrapment of gas in the insulation.

Before lifting the bushing, remove any banding iron, clamps, or mounting flange bolts holding the bushing to the skid or the shipping crate.

HANDLING AND MOUNTING

1. Bushings Rated 550 kV and Higher

Before lifting the bushing from the shipping skid/crate, remove any shipping flange bolts holding the bushing to the skid.

a. These bushings are provided with two guide brackets bolted to the top of the metal dome which should only be used to guide the slings during lifting. Use two crane hooks to lift the bushing as shown in Figure 3A.

b. Attach two slings to one crane hook. Pass the other ends of the slings through each of the upper guide brackets. Use a spreader bar to keep the slings parallel above the guide brackets. Attach the lower ends of the slings to mounting flange lifting lugs 180 degrees apart. Use shackles in the lifting lug eyes.

c. Attach a sling to the second crane hook. Attach the other end to a shackle. Attach this shackle to the third mounting flange lifting lug located between the other two lifting lugs.

d. Lift the bushing by raising both the crane hooks simultaneously maintaining the seven degree or greater angle.

e. For mounting the bushing at an angle, raise or lower the crane hooks to get the desired angle. These bushings are provided with a magnetic oil level gage. The bushing should be mounted with the gage facing downwards as shown in Figure 3C for proper oil level indication.

Note; We recommend using two crane hooks while lifting a bushing. If these are not available then a single crane hook can be used with a chain hoist as shown in Figure 3B.

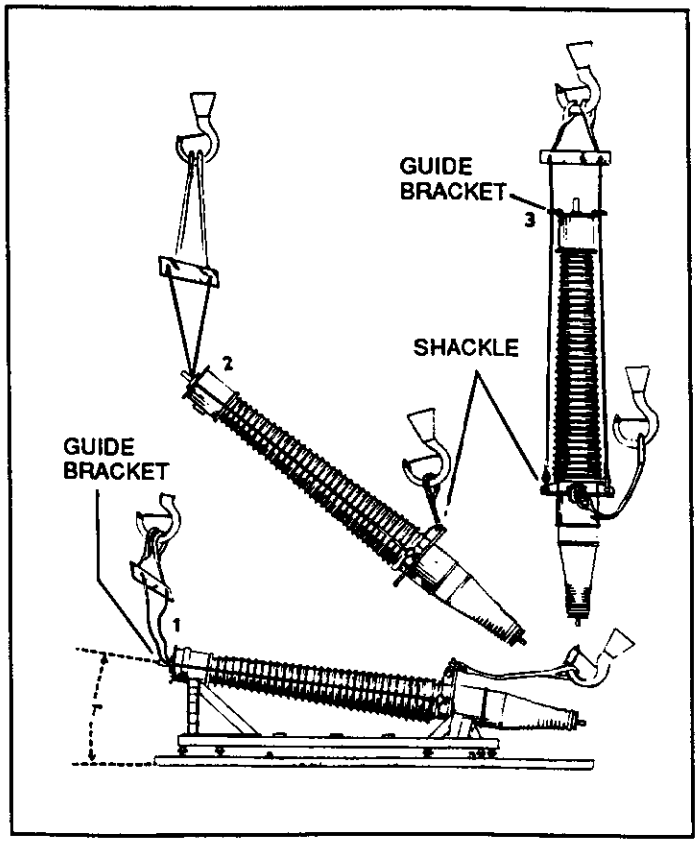


Figure 3A: Method of lifting a bushing rated 500 kV and above.

WARNING

THE UPPER GUIDE BRACKETS ARE PROVIDED FOR GUIDING THE LIFTING SLINGS ONLY AND MUST NOT BE USED FOR LIFTING THE BUSHING. REMOVE THESE AND OTHER SHIPPING HARDWARE BEFORE ENERGIZING THE BUSHING.

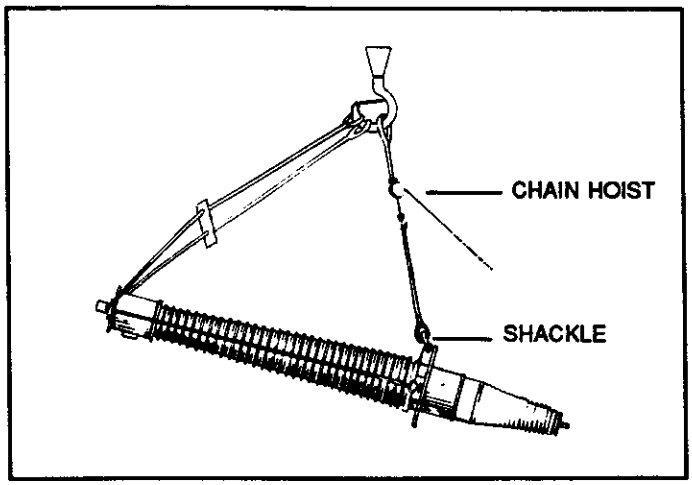


Figure 3B: Method of lifting a bushing rated 500 kV and above using one crane hook and a chain hoist.

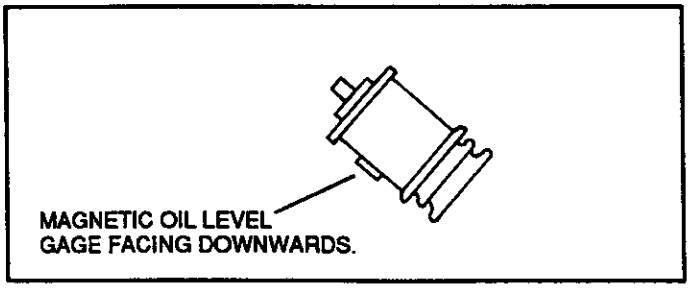


Figure 3C: Orientation of magnetic oil level gage on bushing rated 500 kV and above when mounted at an angle.

2. Bushings under 345 kV rating

a. Bushings under 345 kV can be lifted as shown in Figure 4A. Unlike bushings rated 550 kV and higher, these bushings do not have guide brackets bolted at the top and therefore two nylon choker ropes/slings should be tied around the top porcelain just under the metal dome or under the first porcelain shed on bushings without metal dome to guide the lifting sling in each side.

b. Attach two slings to one crane hook. Pass the other ends of these slings through the eye of each choker rope/sling. Attach a shackle to each of these slings. Attach the shackles to the two mounting flange lifting lugs 180 degrees apart.

c. Pass a sling through the hole in each of the two mounting flange lifting lugs and then attach the two ends of this sling to the second crane hook.

d. Lift the bushing by raising both the crane hooks simultaneously maintaining the seven degree or greater angle.

e. When a bushing has to be mounted at an angle, it should be lifted as shown in Figure 4C. Attach a sling to a crane hook. Pass the other end of this sling through the eye of a choker rope/sling tied around the porcelain shed just under the dome or under the first porcelain shed on a bushing without the metal dome. Attach a shackle to this sling and then attach this shackle to the mounting flange lifting lug. Pass a sling through the hole in each of the two lifting lugs and then attach the two ends of this sling to the second crane hook. Mount the bushing by raising or lowering the crane hooks.

Bushings rated 161 kV thru 362 kV are provided with prismatic glass oil level gages. This gage should be oriented towards the side as shown in Figures 4C and 4D for proper oil level indication.

Note: We recommend using two crane hooks while lifting or mounting a bushing. If these are not available then a single crane hook with a chain joist can be used as shown in Figure 4B and 4D.

3. Angle of Inclination

Bushings with cylindrical oil level sight glasses may be mounted at any angle up to 60 degrees from vertical. Bushings with magnetic oil level gages and those with prismatic glass oil level gages should not be used at angles exceeding 20 degrees from the vertical. Refer to the outline drawing for specific information. All other applications should be referred to the factory.

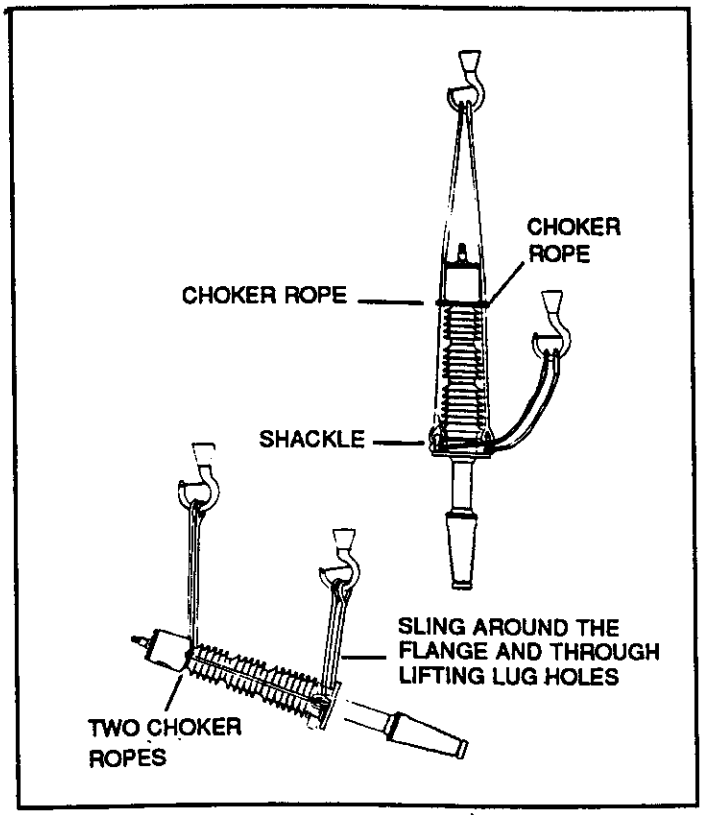


Figure 4A: Method of lifting a bushing rated 362 kV and below.

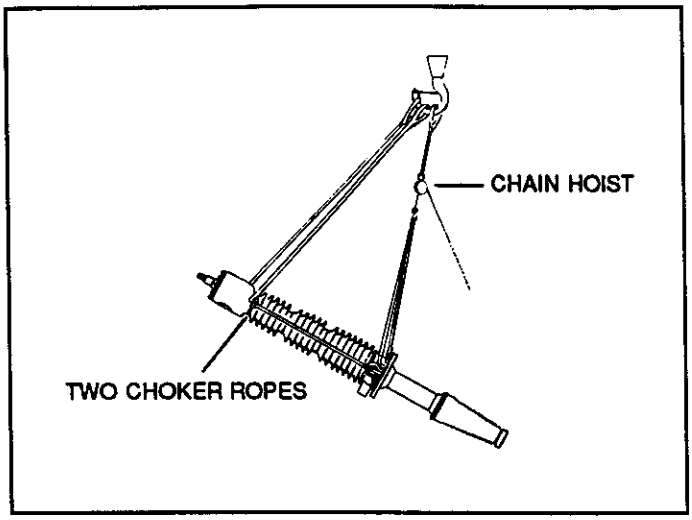


Figure 4B: Method of lifting a bushing rated 362 kV and below using one crane hook and a chain hoist.

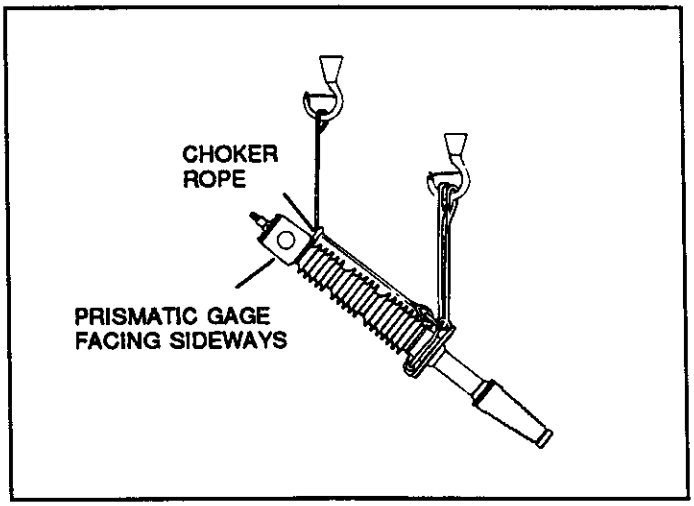


Figure 4C: Method of mounting a bushing at an angle and orientation of the prismatic glass oil level gage.

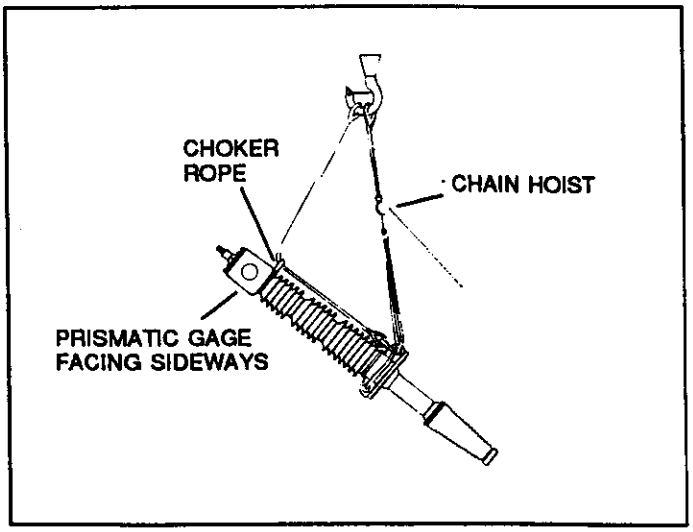


Figure 4D: Method of mounting a bushing rated 362 kV and below using one crane hook and a chain hoist.

INSTALLATION

Prior to installation, wipe the bushing clean of all dust, grease, oil, or particles of packing materials using a clean dry cloth. The capacitance and power factor of the bushing should be measured in accordance with the "CAPACITANCE TAP AND POWER FACTOR MEASUREMENT" section of this booklet prior to energizing. After uprighting the bushing, check to insure that the internal bushing oil is at the proper level. Depending on the voltage class of the bushing, the oil level is indicated by viewing the oil in the sight glass, the prismatic gage, or by the position of the float type indicator. The bushing should be checked for any indications of oil leakage. Always allow the bushing to equalize to the temperature of the apparatus on which it is being installed prior to putting into service.

PAINTING

The metal parts at the top end are painted for protection against the weather. Care should be used to prevent scratching these painted surfaces. If the metal becomes exposed because the paint is scratched or chipped, the exposed area should be wiped with a commercial safety solvent, and then wiped dry. The cleaned area should be coated with a suitable outdoor gray enamel paint.

BOLTING

Tighten the mounting bolts a fraction of a turn at a time, working progressively in one direction around the bolt circle until all bolts are uniformly tight. Tighten sufficiently to seal the bushing to the apparatus. Normally, the torque values listed below will provide adequate gasket compression for sealing.

SIZE OF BOLT Inch-Thread	TORQUE ft-lb (N-m)
1/2 - 13	25 (34)
5/8 - 11	30 (41)
3/4 - 10	35 (48)

CAUTION

BEFORE APPLYING VACUUM TO A TRANSFORMER, BE CERTAIN THERE IS SUFFICIENT SLACK IN THE EXTERNAL LINE CONNECTIONS TO THE BUSHING TO ALLOW FOR BUSHING MOVEMENT CAUSED BY FLEXING OF THE TRANSFORMER COVER AND/OR WALLS. FAILURE TO RELIEVE THIS STRESS AT THE BUSHING CONNECTION MAY RESULT IN DAMAGE TO THE BUSHING SEALS AND LOSS OF OIL. LOSS OF OIL WILL CAUSE AN ELECTRICAL FAILURE.

CONNECTIONS

Internal Electrical Connections
The method used in making connections between a bushing and the apparatus on which it is mounted will depend upon the type of connection used in the apparatus.

Draw Lead Connected Bushings
Bushings with current ratings of 800 amperes are generally designed with a hollow conductor through which a flexible cable can be pulled. The cable is considered a component of the apparatus on which the bushing is mounted and is not supplied with the bushing.

Refer to Figure 5A. Remove the top terminal, the retaining pin, and the draw lead stud. Pass a wire or cord through the bushing center conductor and attach it to the hole in the top end of the draw lead stud on the flexible cable. Lower the bushing into the opening in the cover, simultaneously pulling the cable up through the center conductor. Secure the draw lead stud to the draw lead cap by replacing the retaining pin. Refer to the paragraph on "Top Terminal Tightness" for assembly and tightening.

Bottom Connected Bushings
Bushings rated 1200 amperes and higher are designed to carry the current through the center conductor. A circuit breaker interrupter or transformer terminal may be connected to the lower support of the bushing. Figure 7 shows different arrangements for bottom connections. Figures 7B and 7D show a bevelled machine surface with a four inch spherical radius as per Table 6 Figure 2 and 3 ANSI/EEE 24 1984. This surface is designed to carry current when in contact with a bevelled surface on the bottom terminal. Figure 7F shows an example of a transformer bottom end connection.

Top Terminal Tightness
Coat the gasket with a thin film of light oil and assemble it in position as shown in Figures 5A or 5B. Screw the top terminal onto the draw lead stud for draw lead bushings (Figure 5A) or into the cap nut or center conductor for bottom end connected bushings (Figure 5B) until a metal to metal seat contact is made.

Tightness of the top terminals on both draw lead and bottom connected bushings is essential for trouble free operation and must be ensured at the time of installation and checked periodically during service.

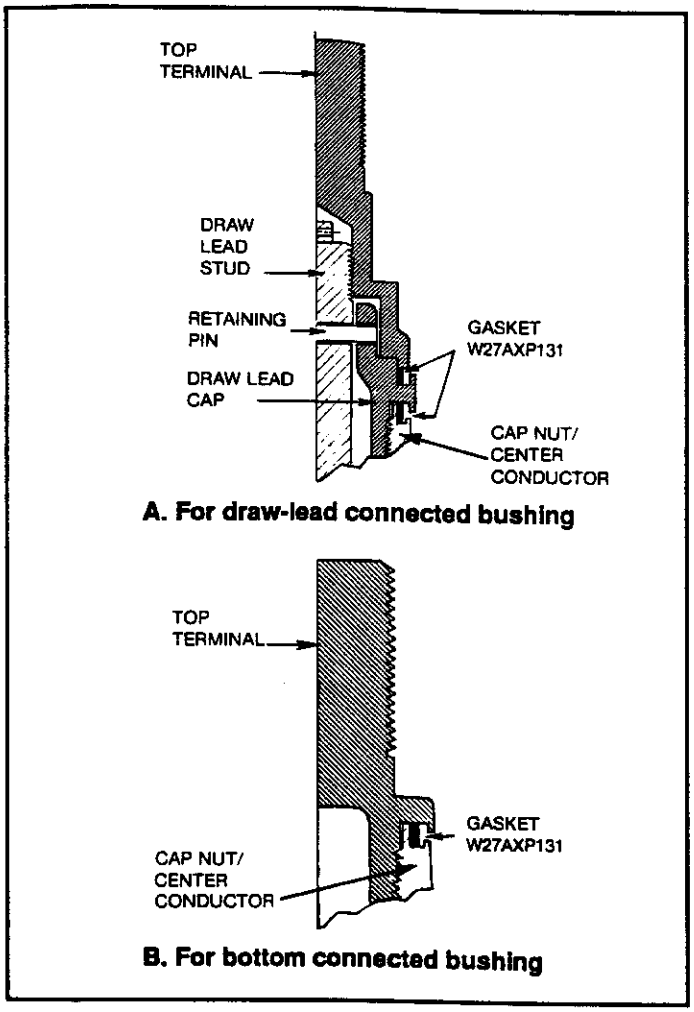


Figure 5: Details of the end construction.

The following torque values will normally provide adequate tightness of the terminal caps.

TOP TERMINAL SIZE Inch-Thread	TORQUE ft-lb (N-m)
1.125 - 12	100 (136)
1.5 - 12	100 (136)
2.0 - 12	100 (136)
3.0 - 12	100 (136)

Gaskets shown in Figures 5A and 5B are provided for proper seal and protection of internal threads against corrosion. If these gaskets are damaged or become hard and lose their resiliency, they should be replaced promptly. USE FACTORY SUPPLIED GASKETS ONLY. DO NOT SUBSTITUTE WITH ANY OTHER TYPE OF MATERIAL.

External Electrical Connections
The external connection to the bushing must be sufficiently slack or flexible to avoid putting a mechanical strain on the bushing parts.

Terminal connectors should be of ample size to keep the bushing terminal temperature below 70ºC at rated current. The use of even more generously sized connectors is recommended to minimize bushing overheating during possible overloads. DO NOT LOOSEN THE TOP TERMINALS WHEN INSTALLING LINE TERMINAL CONNECTORS.

LIQUID LEVEL INDICATION

The oil level in the bushing is adjusted in the factory to the normal level at approximately 25ºC. Unless there is subsequent mechanical damage to the bushing, which results in loss of oil, the filler level should be satisfactory for the life of the bushing. Since fluctuations in oil level will necessarily occur with changing temperatures, the column of oil in the bushing is topped with a compressible cushion of nitrogen gas to fill any space left by a varying oil volume.

Figure 6 shows alternate ways of indicating the oil level in bushings rated 115 kV and above.

The actual oil level can be seen on a bushing equipped with a sight glass, Figure 6A, or a prismatic oil level gage shown in Figure 6B. As long as the oil level can be seen, the level is at a satisfactory height.

When a low oil level is indicated, examine the bushing for possible loss of oil which could result in eventual electrical failure. A low level exists when the pointer on a float type indicator is on "Low" or when the level has disappeared below the sight glass or prismatic gage.

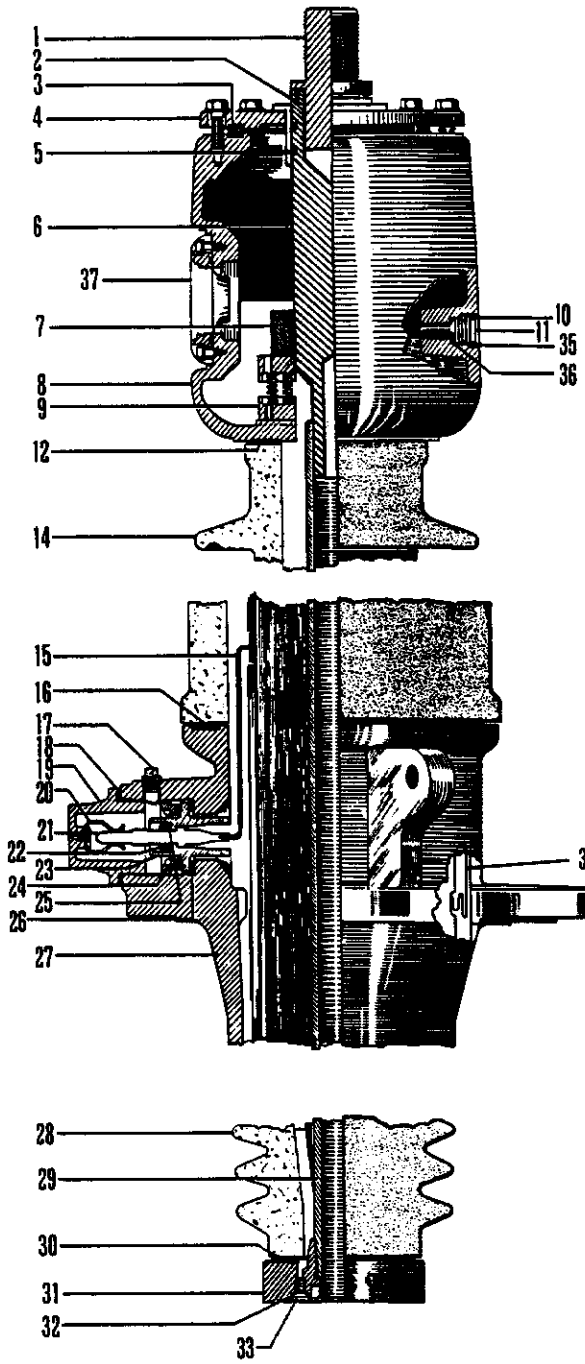
WARNING

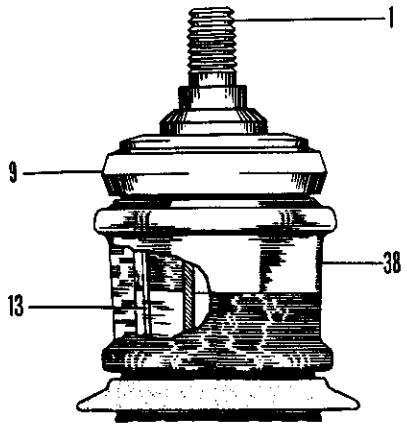
DO NOT OPERATE OR TEST A BUSHING WITH A LOW INTERNAL OIL LEVEL. THIS COULD RESULT IN SERIOUS DAMAGE TO THE BUSHING, APPARATUS ON WHICH THE BUSHING IS MOUNTED, AND/OR THE TESTING OF EQUIPMENT BEING USED. OPERATION COULD RESULT IN SEVERE PERSONAL INJURY, DEATH OR PROPERTY DAMAGE.

CAPACITANCE CAP
(And Power-Factor Measurements)

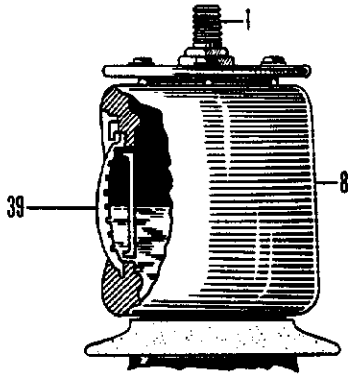
A standard Type, "O Plus C" bushing rated 115 kV and higher has a small housing containing a capacitance tap outlet just above the mounting flange. The terminal in the capacitance tap is grounded to the outlet by means of a spring clip in the capacitance tap cover. While the purpose of the capacitance tap outlet is to provide connection to a bushing potential device, it also provides a convenient means for making connections for measuring power-factor by the UST (Ungrounded Specimen Test) method.

Many bushing users make it a practice to measure the UST power-factor at the time of installation. We endorse this practice and it is discussed in more detail under the heading of "Maintenance."





A. With glass dome for liquid level indication



B. With prismatic-type liquid level indication

1. Top Terminal
2. Gasket
3. Gasket
4. Cover
5. Core seal gasket
6. Core extension
7. Cap nut
8. Dome
9. Spring assembly
10. Gasket (outerseal)
11. Plug (innerseal)
12. Gasket
13. Terminal shield
14. Top porcelain
15. Low voltage tap lead
16. Gasket
17. Plug
18. Gasket
19. Cover
20. Grounding clip
21. Low voltage contact stud
22. Sealing nut
23. Low voltage insultator
24. Nut
25. Gasket
26. Gasket
27. Flange
28. Bottom porcelain
29. Condenser
30. Gasket
31. Lower support
32. Gasket
33. Plug
34. Ground connection
35. Gasket (innerseal)
36. Plus (innerseal)
37. Liquid level indicator
38. Sight glass
39. Prismatic liquid level gage

Figure 6: Sectional view of bushing.

When a connection is made to the capacitance tap, either for use with a potential device or for power factor measurement, open the housing by removing the capacitance tap cover (Item 19, Figure 6). Assemble the potential device connection or proceed with the power factor measurement.

After the power factor measurement is completed and if there is no connection to a potential device, remove the test connection and close the housing by replacing the capacitance tap cover. Be certain the cover is on tight.

If the capacitance tap is used for a connection to a potential device, after the connection is assembled, remove the filler plug (Item 17, Figure 6) and fill the chamber with clean, dry transformer oil. Leave an expansion space of approximately one quarter of an inch at the top of the chamber when you fill it. Coat the threads on the filler plug with a suitable sealer and replace the plug in the filling hole. Be certain the plug is tight.

CAUTION

NEVER OPERATE THE BUSHING WITH THE CAPACITANCE TAP COVER REMOVED, EXCEPT WHEN USING A POTENTIAL DEVICE.

ENERGIZING

If the bushing has been moved to a horizontal position anytime within 48 hours before energizing at rated conditions, gently rock the bushing to release any nitrogen gas which may have been trapped in the insulation. If proof testing over-voltage is to be applied to the bushing, keep it vertical for 48 hours prior to testing.

TRANSFORMER-BREAKER INTERCHANGEABLE (TBI) BUSHINGS

An outstanding feature of this line of bushings is that the 1200 ampere and 1600 ampere bottom connected bushings (ANSI Standard for circuit breakers) can be converted to 800 ampere, draw lead connected bushings which comply with ANSI Standards for transformers.

Identification of TBI Bushings

TBI bushings are identified by a supplementary nameplate stating "convertible — See Instruction Book."

Conversion

Converting a bottom connected bushing to a draw lead connected bushing is accomplished by replacing the top and bottom terminal parts. The internal connection of the bushing to the transformer is accomplished by means of a cable which is threaded through the bushing center conductor and pinned to the draw lead cap at the top end of the bushing. The cable is a component of the transformer and is not furnished with the bushing. For assembly, pass a wire or cord through the hole in the stud attached to the end of the cable, and draw the cable into the bushing center conductor as the bushing is being lowered into position in the transformer.

Screw the top terminal into the draw lead stud as shown in Figure 5A. Tighten it by following the top terminal tightening procedure on Page 6. Conversion of a draw lead bushing to a bottom connected bushing is accomplished by reversing the procedure. A variety of bottom end constructions are shown clearly in Figure 7.

Ampere Ratings

Interchangeable bushings are available in current ratings of 800,1200, 1600 and 2000 amperes. ALL DRAW LEAD TYPE BUSHINGS (within the scope of these instructions) ARE LIMITED TO OPERATION AT 800 AMPERES.

The illustration in Figure 5 shows two possible current paths from the conductor to the top terminal.

In the case of draw lead connections, the current flow is from the transformer draw lead to the stud, through the threads, and into the top terminal. This current path is limited to 800 amperes.

In the case of bottom connected bushings, the current flow is up the center conductor of the bushing into the cap nut, through the threads, and into the top terminal. Although the top end accessories are interchangeable physically, the bushings should not be operated at currents higher than the nameplate ratings.

The maximum current rating for each interchangeable bushing is shown on the nameplate as a "T" for transformers, and as a "B" for breakers. The rating applies only when the bushing has accessories for use when bottom connected. It does not apply to draw lead accessories.

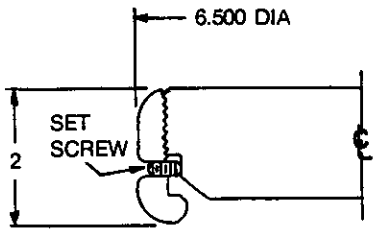
CAUTION

IF THE DRAW LEAD ACCESSORIES ARE INADVERTENTLY USED WHEN THE BUSHING IS BOTTOM CONNECTED, A DISCONTINUITY IN THE CURRENT PATH MAY DEVELOP. IN THIS CASE, THE CURRENT FLOW WILL BE UP THE CENTER CONDUCTOR TO THE CAP NUT, THROUGH THE THREADS INTO THE DRAW LEAD CAP, AND ACROSS THE JOINT JUST UNDER THE GASKET INTO THE TOP TERMINAL.

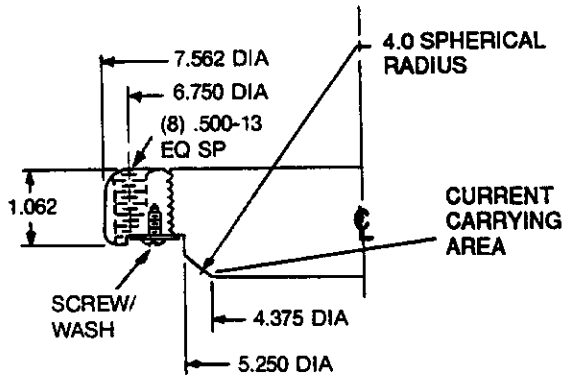
The joint under the gasket is not designed to be a current carrying contact. The draw lead top accessories must not be used when the bushing is bottom connected even at less than 800 amperes.

ORDERING ACCESSORIES

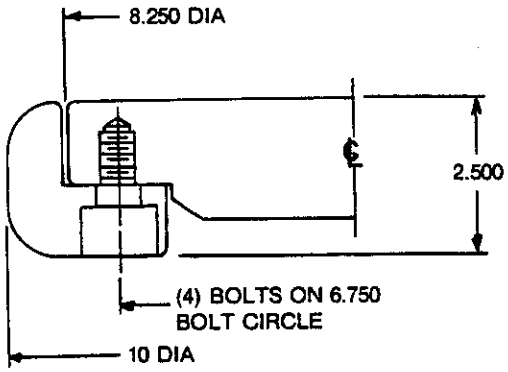
Most TBI bushings are shown on the outline drawings in pairs. One of the pair is equipped with terminals suitable for use on bottom end connection, and the other has terminals suitable for draw lead connected.



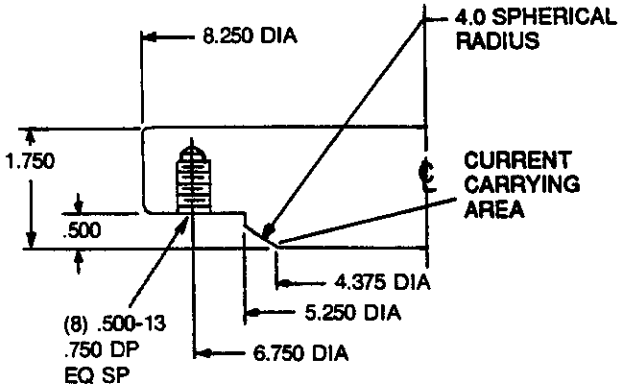
7A. TRANSFORMER DRAW LEAD
550, 650, & 750 BIL
800 AMP



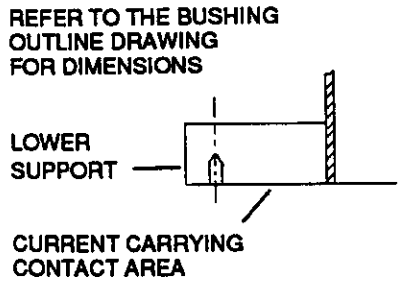
7B. TRANSFORMER OR BREAKER BOTTOM
CONNECTED BUSHING
550, 650 AND 750 kV BIL
1600 AND 2500 AMP TRANSFORMER
2000 AMP BREAKER



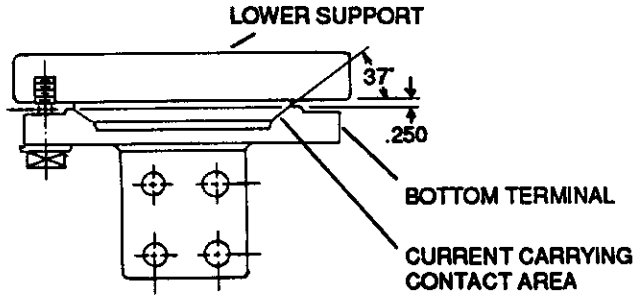
7C. TRANSFORMER DRAW LEAD BUSHING
900 BIL
800 AMP



7D. TRANSFORMER OR BREAKER
BOTTOM CONNECTED BUSHING
900 BIL
1200, 1600 AND 2500 TRANSFORMER
1600 AND 2000 AMP BREAKER



7E. TRANSFORMER BOTTOM
CONNECTED BUSHINGS
362 kV AND ABOVE
800 AMPS - DRAW LEAD
1600 AMPS & ABOVE TRANSFORMER



7F. EXAMPLE OF A TRANSFORMER BOTTOM END
CONNECTION SHOWING CONTACT BETWEEN
THE TERMINAL AND THE BEVELLED SURFACE
REFER TO THE TERMINAL DRAWING FOR
DIMENSIONS.

Figure 7: Transformer and circuit breaker bottom-end accessories.

Two catalog numbers are assigned to the same basic design. If, at a later date, a user decides to apply a TBI draw lead bushing to bottom connected use, he must order suitable terminal parts, or he must use parts removed from the bushing being replaced. A careful record should be kept for the interchangeable bushings since complete information about the applications of the bushings must be given in any correspondence with the factory concerning the bushings.

Accessories for conversion purposes may be taken from bushings being replaced in the field or may be ordered from the factory. When ordering, give the following information:

1. Catalog and version number of the bushing being converted.
2. Type of apparatus on which the bushing will be used.
3. BIL and current rating of the bushing.

NAMEPLATE DATA

Nameplate data can be of special importance in answering questions about bushings.

All requests will be expedited if the factory is furnished the serial number, the catalog number, the functional style number, and the year of manufacture as stamped on the bushing nameplate. IT IS ABSOLUTELY NECESSARY FOR THE FACTORY TO HAVE AT LEAST THE SERIAL NUMBER.

The functional style number or the catalog number identifies the bushing by type and rating. When corresponding with the factory, provide the complete functional style number and/or catalog number information shown on the nameplate. All bushings of the same functional style number or catalog number are completely interchangeable.

MAINTENANCE

Little maintenance is required other than periodic checking of the oil level as indicated in the sight glass or by the gage, measuring of the power-factor, and condition of the top terminals. Bushings exposed to salt spray, cement dust, and other abnormal deposits are subject to a special hazard and must be cleaned regularly to prevent flashover and corrosion of parts.

The sight glass transparency may become impaired due to reaction with atmospheric contaminants and should be cleaned regularly to deter this reaction. In the event that the sight glass does become opaque, it should be replaced in order to maintain good visibility of the oil level.

Metal parts are painted for protection against the weather. Care should be taken to prevent scratching these painted surfaces. Refer to the "Painting" paragraph under "Installation."

Due to the inconvenience and possible service interruptions resulting from bushing outages, many users have programs of Planned Preventative Maintenance. We endorse such programs and recommend:

1. Measurement of power-factor and capacitance at the time of installation and repeating the measurements annually.

Field measurements of power-factor and capacitance can differ from measurements made under the controlled conditions in the factory. Therefore, the power-factor and capacitance should be measured at the time of installation and used as a base to compare future measurements. You should contact your ABB Power T&D Company representative for corrective action procedures if:

a. The power-factor doubles the original installation value; or
b. The capacitance increases to 110 percent of the original installation value.

2. Examination of the top terminals for loose connections and overheating.

In the unlikely event it becomes necessary to add oil to a bushing, the fill plug in the spring assembly or the metal dome can be removed. Insertion of a clean standpipe, with an outside diameter of slightly less than the diameter of the hole will provide a means of adding small quantities (two quarts or less) to the bushing. This should return the oil to the proper level. If not, the bushing must be removed from service and returned for repair and processing. Follow the procedure outlined below for oil additions in the field.

A. Obtain the necessary oil from the Components Division Plant, Alamo, TN 38001, or provide oil that meets the following standard:

Transformer oil (PDS 55822AG) processed to have additional requirement of:

1. Moisture content less than 5 PPM
2. Neutralization less than 0.02 Mg KOH/g
3. Dielectric breakdown min. 45 kV
4. Power factor less than 0.05%

To prevent oxidation of the bushing oil, the air space above the oil level should be purged with dry nitrogen and the fill plug replaced immediately afterward.

FIELD REPAIRS

Any repair of Type "O Plus C" bushings should be done in the factory because of the danger of contamination to the insulation if the seal is broken. In addition, the very high vacuum and clamping pressure require the use of equipment not usually available in the field.

Any damage to a bushing which might make repair either desirable or necessary, should be reported to the factory. DO NOT ATTEMPT TO REPAIR A TYPE "O PLUS C" BUSHING WITHOUT SPECIFIC RECOMMENDATIONS FROM THE ABB POWER T&D COMPANY INC.

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The information, recommendations, description and safety notations in this document are based on our experience and judgement with respect to Bushings. THIS INFORMATION SHOULD NOT BE CONSIDERED TO BE ALL INCLUSIVE OR COVERING ALL CONTINGENCIES. If further information is required, the ABB Power T&D Company Inc. should be consulted.

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