34.5 kV and 69 kV, Type O Plus C II Condenser Bushings
Technical Guide
# Table of contents

1 Introduction ................................................................................................................ 3  
  1.1 Style Number ....................................................................................................... 3  
    1.1.1 Style Number Examples .............................................................................. 3  
  2 Basic Characteristics ............................................................................................... 4  
    2.1 Standards ............................................................................................................ 4  
    2.2 Ratings ................................................................................................................ 4  
    2.3 Features .............................................................................................................. 4  
    2.4 Mounting .............................................................................................................. 5  
    2.5 Test Tap .............................................................................................................. 5  
    2.6 Installation Instructions ........................................................................................ 5  
  3 Testing ........................................................................................................................ 5  
    3.1 Pressure/Vacuum Tests ...................................................................................... 5  
    3.2 Electrical Tests .................................................................................................... 5  
  4 Bushing Loading ......................................................................................................... 6  
    4.1 Current Rating & Over Load ................................................................................ 6  
    4.2 Short Circuit Current Rating .............................................................................. 6  
    4.3 Draw-Lead Application ......................................................................................... 6  
    4.4 Distance of Grounded Edge from Live Parts ..................................................... 7  
    4.5 Distance of Grounded Flat Surface from Live Parts ......................................... 7  
  5 Ordering Details ......................................................................................................... 8  
    5.1 Draw-lead Connected .......................................................................................... 8  
    5.2 Bottom Connected ............................................................................................... 8  
    5.3 Draw-rod Connected ........................................................................................... 8  
    5.4 Top Terminal Connections .................................................................................. 8  
  6 Drawings: Bushing Top End and Bottom End ............................................................ 9
1 Introduction

The 34.5 kV and 69 kV Type O Plus C II, condenser bushings, replace the Type AB, 34.5 and 69 kV, condenser bushings. The electrical and mechanical characteristics and physical dimensions are unchanged in the transition from Type AB to Type O Plus C II bushing. The change does two things: 1) the Type O Plus C II bushing uses much simpler style numbers (very similar to the standard Type O Plus C bushing) and 2) the Type O Plus C II bushing is not reconfigurable in the field except to change from 800 A draw lead to 1200 A bottom connected or visa versa.

1.1 Style Number

The style number for the 34.5 kV and 69 kV Type O Plus C II condenser bushing will be written as: 034 Z nnnn aa or 069 Z nnnn aa where nnnn is the current rating in amperes except in the case of a dual rated bushing, eg 400 draw lead / 1200 bottom connected which is written as “0412”. The final two characters eg, αα, are used by ABB to describe the other characteristics of the bushing. Note that the fourth character “Z” becomes “Y” for brown porcelain.

1.1.1 Style Number Examples

<table>
<thead>
<tr>
<th>Type O Plus C II Style Number</th>
<th>Replaces</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>034Z0412UT</td>
<td>1ZUA034012-AAASFSCBA, CA Through CF</td>
<td>Standard 34.5 kV bushing 400 A, draw-lead or 1200 A bottom connect</td>
</tr>
<tr>
<td>034Z2000AA</td>
<td>1ZUA034020-AAASGBAXX</td>
<td>Standard 34.5 kV bushing 2000 A, bottom connect</td>
</tr>
<tr>
<td>034Z3000AS</td>
<td>1ZUA034030-AAASMBBXX</td>
<td>Standard 34.5 kV bushing 3000 A, bottom connect</td>
</tr>
<tr>
<td>034Z1200AE</td>
<td>1ZUA034012-AAASFDAXX</td>
<td>Standard 34.5 kV bushing 1200 A, draw rod</td>
</tr>
<tr>
<td>034Z2000AM</td>
<td>1ZUA034020-AAASGDAXX</td>
<td>Standard 34.5 kV bushing 2000 A, draw rod</td>
</tr>
<tr>
<td>034Z3000AT</td>
<td>1ZUA034030-AAASMDAXX</td>
<td>Standard 34.5 kV bushing 3000 A, draw rod</td>
</tr>
<tr>
<td>069Z0412AN</td>
<td>1ZUA069012-AAASFSCBA, CA THRU CF</td>
<td>Standard 69 kV bushing 400 A, draw-lead or 1200 A bottom connect</td>
</tr>
<tr>
<td>069Z2000AA</td>
<td>1ZUA069020-AAASGBAXX</td>
<td>Standard 69 kV bushing 2000 A, bottom connect</td>
</tr>
<tr>
<td>069Z3000AX</td>
<td>1ZUA069030-AAASMBBXX</td>
<td>Standard 69 kV bushing 3000 A, bottom connect</td>
</tr>
<tr>
<td>069Z1200AF</td>
<td>1ZUA069012-AAASFDAXX</td>
<td>Standard 69 kV bushing 1200 A, draw rod</td>
</tr>
<tr>
<td>069Z2000AR</td>
<td>1ZUA069020-AAASGDAXX</td>
<td>Standard 69 kV bushing 2000 A, draw rod</td>
</tr>
</tbody>
</table>
2 Basic Characteristics

2.1 Standards

The Type O Plus C II condenser bushing meets all requirements of the IEEE bushing standards, ie, C57.19.00, C57.19.01, C57.19.100 and IEEE Seismic standard 693 (qualified at HIGH level). These bushings will also meet the electrical, mechanical and thermal requirements of the CSA bushing standard and of IEC 137.

2.2 Ratings

The standard ratings for this family of bushings are as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>34.5 kV Bushing</th>
<th>69 kV Bushing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal System Voltage</td>
<td>34.5 kV</td>
<td>69 kV</td>
</tr>
<tr>
<td>Maximum line-to-ground voltage</td>
<td>22 kV</td>
<td>44 kV</td>
</tr>
<tr>
<td>Lighting impulse voltage withstand (BIL)</td>
<td>200 kV</td>
<td>350 kV</td>
</tr>
<tr>
<td>Current rating</td>
<td>400 A to 3000 A</td>
<td>400 A to 3000 A</td>
</tr>
<tr>
<td>Creep distance</td>
<td>min 44 mm/kV_L-G &amp; higher, see outline drawing</td>
<td></td>
</tr>
<tr>
<td>Seismic (IEEE 693) Qualification Level</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

For other bushing technical features, please consult the specific bushing outline drawing

2.3 Features

The 34.5 kV and 69 kV Type O Plus C II bushing is designed to operate under “Usual Service Conditions” as defined in IEEE C57.19.00, IEEE Standard General Requirements and Test Procedures for Power Apparatus Bushings. If you require a bushing to operate outside of these defined, “Usual Service Conditions”, please contact ABB.

The 34.5 kV and 69 kV Type O Plus C II bushing is of center-clamped construction, ie, the bushing is held together by the action of clamping springs which act on the bushing central conductor and hold the entire bushing assembly under a compressive load. The bushing is built around the central conductor tube on which the condenser body is wound. The upper and lower insulators, mounting flange, flange extension, spring assembly, sight bowl, lower support and clamping nut form an oil tight shell to contain the condenser and insulating oil. O-rings in grooves and/or flat fiber reinforced gaskets create the seals between components. High-grade transformer oil fills the space between the shell and the condenser. This oil is part of the insulating and...
cooling systems of the bushing. Above the oil, there is a gas space to provide for thermal expansion of the oil. The gas space is filled with dehydrated nitrogen gas.

The bushing oil level is easily visible in the sight bowl. The sight bowl is prismatic to enhance observation of the oil level. See Figure 1.

The mounting flange and flange extension are high strength corrosion-resistant aluminum.

The upper (air-side) insulator is a one-piece, high quality porcelain with a shed configuration designed for maximum performance. The insulator meets the IEEE requirement for "Heavy Creep" which is $44 \text{ mm/ kvL-G}$. Note that higher creep versions are also available.

The 34.5 kV and 69 kV Type O Plus C II bushings meet or exceed the cantilever test requirements for interchangeable/circuit breaker (TBI) per Table 8 of IEEE standard C57.19.01 – 1991.

2.4 Mounting
Most 34.5 kV and 69 kV Type O Plus C II bushings are suitable for use at angles of up to 60 degrees from the vertical position. You should always verify maximum mounting angle by reviewing the outline drawing.

2.5 Test Tap
The bushing has a test tap which is normally grounded. This tap is connected to an inner foil electrode of the condenser. ABB tests the voltage tap at 2 kV, 50/60 Hz for 1 minute. The maximum continuous service voltage is 600 volts, AC. This tap is grounded under normal operation.

2.6 Installation Instructions
ABB publishes a separate document, which should be followed when installing these bushings. You can download the Installation Guide from our web site or contact ABB for a copy.

3 Testing
As part of the manufacturing process, the bushing is subject to a number of routine tests.

3.1 Pressure/Vacuum Tests
Vacuum tightness is performed at nearly a full vacuum and a test is made with an oil over pressure of 41 psig for 6 hours at ambient temperature. No evidence of a leak is permitted.

3.2 Electrical Tests
Each bushing is subject to final electrical tests at ambient temperature with the lower end of the bushing submerged in transformer oil. The power-factor and capacitance are measured and the bushing is subjected to a one-minute power frequency test at a level of one-half the BIL rating. During power frequency testing, the level of partial discharge is carefully monitored. The power-factor and capacitance are also confirmed after the one-minute test.
4 Bushing Loading

4.1 Current Rating & Over Load

The current rating of the 34.5 kV and 69 kV Type O Plus C II bushing indicates the maximum continuous rating of the device without abnormal loss of life.

4.2 Short Circuit Current Rating

The bushing will withstand a short circuit of 25 times rated current for 2 seconds or the $I^2t$ equivalent with the following exceptions:

Draw-lead bushings: short circuit rating is defined by the draw-lead cable

Draw-rod applications have contacts with short circuit ratings of 20 times the continuous rating for not more than 2 seconds and a dynamic peak not to exceed 2.5 times the rms value of the fault.

For short circuit loss of life data relative to the bushing condenser insulation, contact ABB.

4.3 Draw-Lead Application

The sizing of the draw-lead cable is the responsibility of the transformer designer. The maximum rated current for the bushing in the draw-lead application is 400 amperes. The transformer designer must note the inside diameter of the bushing conductor tube because this will limit the choice of cable size. As a service to our transformer customers, we make the following suggestions relative to draw-lead cable size.

<table>
<thead>
<tr>
<th>Cable Size (MCM)</th>
<th>Cable Size (mm²)</th>
<th>Maximum Continuous Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>167</td>
<td>85</td>
<td>265</td>
</tr>
<tr>
<td>250</td>
<td>127</td>
<td>350</td>
</tr>
<tr>
<td>300</td>
<td>152</td>
<td>400</td>
</tr>
</tbody>
</table>

Note that you must insulate the draw lead cable to isolate it from the internal diameter of the bushing’s conductor tube.
4.4 Recommended Positioning

The maximum stresses in the oil at the lower end of the bushing must be limited to those values normal for uninsulated conductors of similar components in the same transformer. The lower insulator must be totally under oil for all operating conditions.

The following recommendations are intended as guidelines only. ABB recommends that specific design calculations be made to verify the proper clearances.

4.4.1 Distance of Grounded Edge from Live Parts

Within the angle of 0°- 45° from the end of the ground sleeve, the “Radius A” shall be a minimum of 0.125” (3.175 mm).

Within the angle of 45°- 60° from the end of the ground sleeve, the “Radius B” shall be a minimum of 0.25” (6.35 mm).

4.4.2 Distance of Grounded Flat Surface from Live Parts

“S” is the minimum distance from bushing live parts to a large surface such as a tank wall or core clamp.

<table>
<thead>
<tr>
<th>Dimension “S” (inches)</th>
<th>34.5 kV</th>
<th>69 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.25</td>
<td>6.00</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimension “S” (mm)</th>
<th>34.5 kV</th>
<th>69 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>83</td>
<td>153</td>
<td></td>
</tr>
</tbody>
</table>
5 Ordering Details

When ordering please specify the following:

- Bushing type and style number
- Current Rating
- Voltage Class and BIL
- Special requirements
- Special Requirements: Any nonstandard requirement, such as impulse tests or high temperature application, must be specified at the time of quotation.

5.1 Draw-lead Connected

If a draw-lead bushing is ordered, it will be shipped with the standard draw-lead connector as shown in Figure 3. In many cases, ABB has other draw-lead connectors. If you cannot use the standard draw-lead connector, please contact ABB for other options.

5.2 Bottom Connected

The standard 34.5 kV and 69 kV Type O Plus C II bushing has the IEEE Std C57.19.01-2000 lower end configuration. Connection is made directly to the lower support of the bushing. Figure 5 shows the various lower support configurations for this line of bushings.

5.3 Draw-rod Connected

Draw-rod configurations of 34.5 kV and 69 kV Type O Plus C II bushings are available. Figure 6 shows a typical draw-rod configuration. Bushings that are suitable for draw-rod applications have an opening through the main axis of the bushing conductor and a special bottom end configuration. The draw-rod is pulled through this opening and secured at the top of the bushing. This makes it possible to remove/install bushings without draining the apparatus on which it is applied. With this application, the current is not carried by the rod but is transferred to the bushing conductor at the lower end of the bushing. The bushing’s current rating with draw rod is the same as the bushing’s current rating when bottom connected.

5.4 Top Terminal Connections

The standard 34.5 kV and 69 kV Type O Plus C II bushings have IEEE Std C57.19.01 top terminals (see Figure 4). The purchaser can order bushings with other terminals if desired. Note that the terminal thread size is: 1.50 - 12 thread for the 400/1200 A and 2000 A bushing and it is 2.00 – 12 thread for the 3000 A bushing.
6 Drawings: Bushing Top End and Bottom End

All dimensions are inches unless otherwise noted.
Figure 6

Transformer Mounting Flange

Flats for wrench

0.312 – 18 UN Female Thread - 0.500 Deep

1.25

Fixing Hardware

Upper & Lower Rods Thread Together

Upper Rod       Lower Rod

Bushing Flange

Transfer of Current to the Bushing

Note: drawing is rotated 90° CCW to fit publication
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