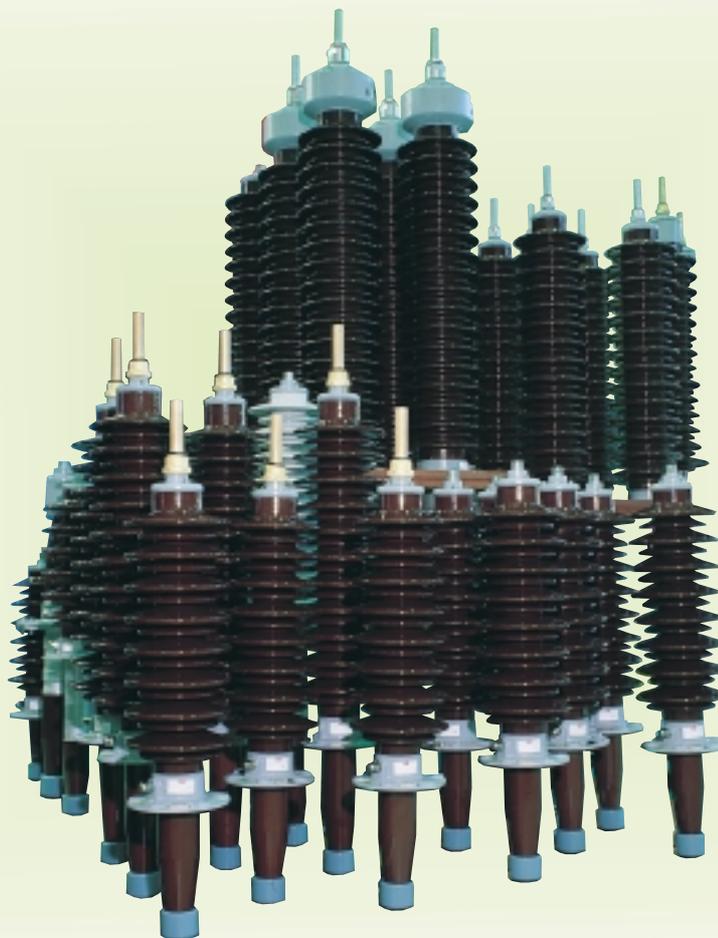


Bushings for High Voltage AC Applications

Selection guide



During selection of bushings for high voltage applications several important factors have to be considered to ensure that the correct equipment is chosen. This Selection Guide has been produced to simplify the selection process and to ensure that sufficient information exists to allow the correct selection to be made.

The technical information pertaining to bushings manufactured by ABB Components has been divided in separate documents, with one document for each type.

The information provided in this document is intended to be general and does not cover all possible applications. Any specific application not covered should be referred directly to ABB Components AB, or its authorized representative.

ABB Components AB makes no warranty or representation and assumes no liability for the accuracy of the information in this document or for the use of such information. All information in this document is subject to change without notice.

ABB Components also manufactures the following products:

- On-load tap-changers
- Motor-drive mechanisms

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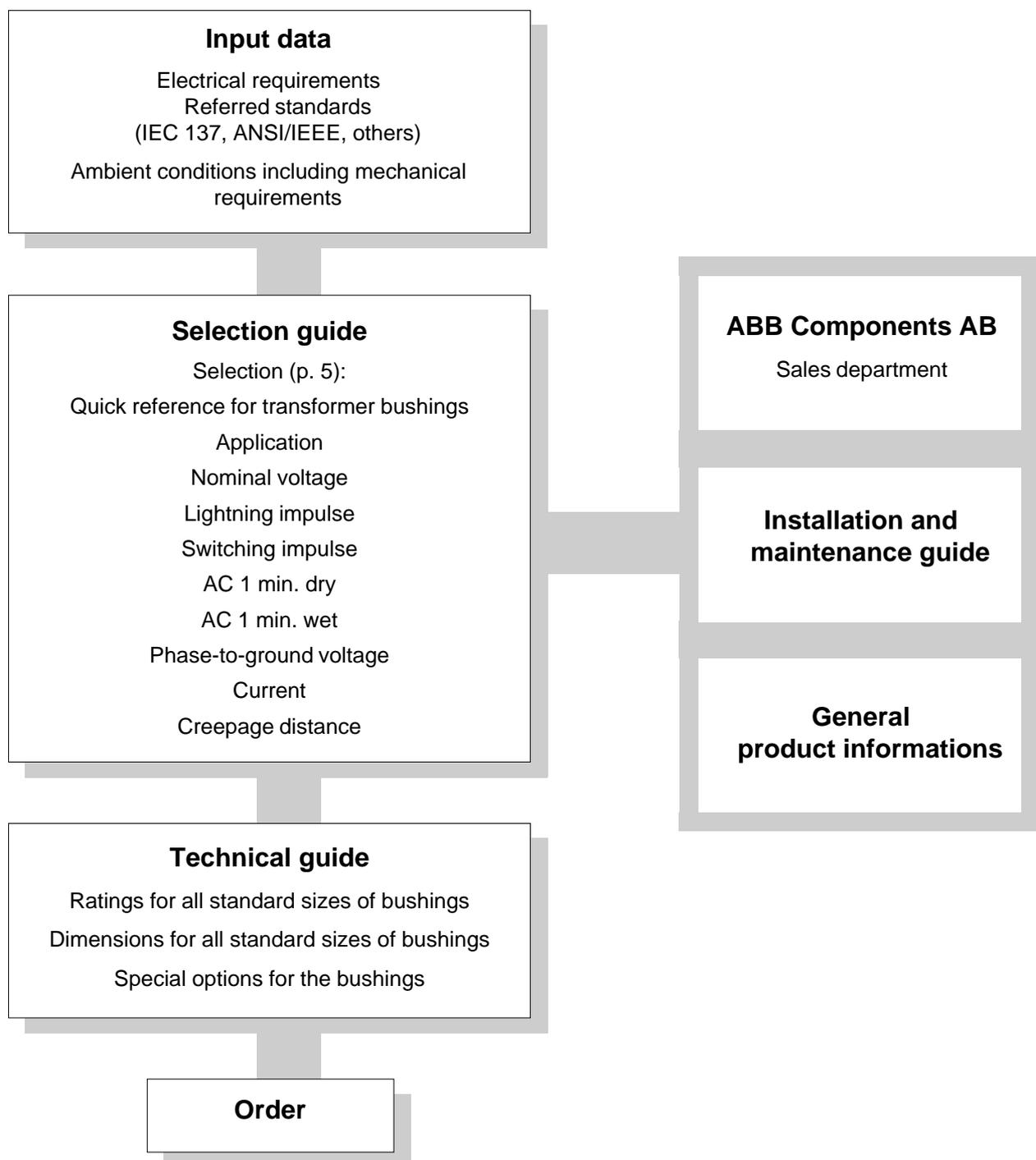
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The selection process for AC bushings

Below is a schematic plan, showing the selection process. Before the selection can start, a number of different input data have to be collected. After that the selection guide can be used to select the most suitable bushing for the application in question. When the type of bushing is identified, the selection of the right size is made in the applicable *Technical Guide*. In the Technical Guide, the special features, such as connection details, oil level indicator, inclination of the bushing etc. are chosen.

Information about mounting and service is given in the *Installation and Maintenance Guide*, available for all types.

For special questions, product informations giving more detailed information are available upon request. For any further assistance, please do not hesitate to contact ABB Components.



Input data

Type of application

ABB Components AC bushings are made for five different applications:

Air to Oil
Oil to Oil
Oil to SF₆
Air to Air
Air to SF₆

For DC application, please contact ABB Components for further information.

	IEC	ANSI
Air temperature	30 °C	40 °C
Transformer oil temperature rise above ambient	60 K	55 K
Maximum hot spot in OIP bushings	105 °C	105 °C
Maximum hot spot in RIP bushings	120 °C	120 °C

Electrical requirements

The following electrical data must be known prior to commencing the selection process:

Referred standard

Generally ABB Components bushings fulfil the electrical requirements according to IEC (IEC 137) and ANSI (IEEE C57.19.00-1991 and IEEE C57.19.01-2000). If any other standard is required, please contact ABB Components.

Rated voltage

Normally the phase-to-phase voltage for the system where the bushing is intended to be used.

Required lightning impulse level

Normally the same lightning impulse level as for the transformer. The lightning impulse test is a routine test for bushings with a rated voltage equal to or above 300 kV.

Required switching impulse level

Normally the same switching impulse level as for the transformer. This is a type test and is made during wet conditions for bushings for outdoor application.

Required test level for the dry 1 minute AC test

Normally about 10% above the test level of the induced test for the transformer. This test is made as a routine test on all bushings.

Test voltage for the wet 1 minute AC test

This is a type test for bushings with a rated voltage below 300 kV.

Phase-to-ground voltage

This is the actual continuous AC voltage that the bushing is subjected to.

Nominal current

This is the maximum continuous AC current the bushing can carry at a certain air temperature and a certain oil temperature with the hot spot of the bushing at maximum 105 °C (120 °C for RIP). The following temperatures applies for IEC and ANSI:

Required power factor if standards other than IEC or ANSI are referred to

This is made as a routine test on all bushings. IEC requires the bushing to have a power factor below 0.7 %. ANSI requires the bushing to have a power factor below 0.55 %.

Ambient conditions including mechanical requirements

Referred standard

ABB Components bushings fulfil the ambient and mechanical requirements according to IEC (IEC 137). ANSI (IEEE C57.19.01-2000) specify certain dimension requirements which deviate from ABB Components bushings. Please check in our bushing Technical Guides or directly with ABB Components for further information. If any other standard is required, please contact ABB Components.

Required specific creepage distance

IEC defines the specific creepage distance as the total creepage distance divided with the rated voltage whereas ANSI defines it as the total creepage distance divided by the line-to-ground voltage. This means that there is a conversion factor of $\sqrt{3}$ between IEC and ANSI.

IEC defines four different classes depending on the degree of pollutions in the area where the bushing is intended to be used:

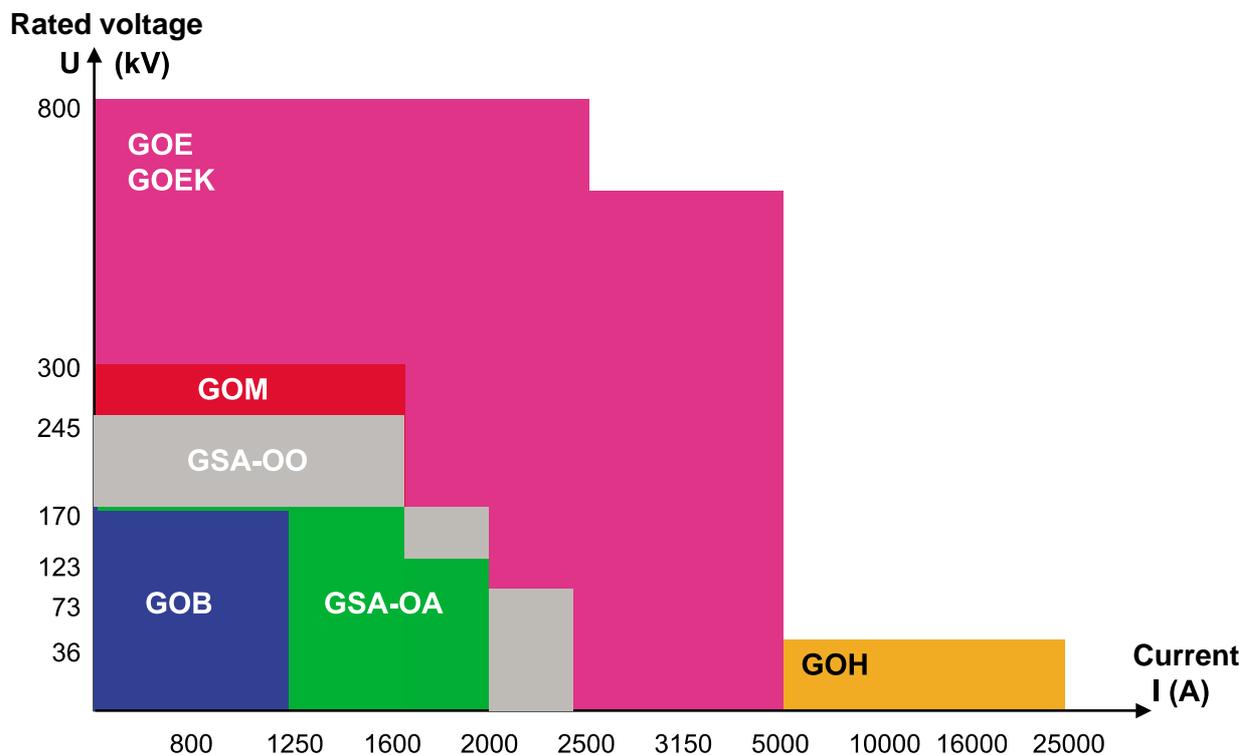
Class 1 16 mm/kV for lightly polluted atmospheres
Class 2: 20 mm/kV for medium polluted atmospheres
Class 3: 25 mm/kV for heavily polluted atmospheres
Class 4: 31 mm/kV for very heavily polluted atmospheres

The most common classes are 20 and 25 mm/kV.

Required cantilever load

Both IEC and ANSI have specified values for the required cantilever load. In the new revision of IEC 137 two different levels for the cantilever load are given: Level 1 for normal application and Level 2 for special applications with severe mechanical loads. Level 1 corresponds to the level in the previous revision of IEC 137.

Selection



Quick reference for transformer bushings.

	Rated voltage (kV)	Lightning impulse (kV)	Switching impulse, wet (kV)	Routine AC 1 min. dry (kV)	AC 1 min. wet (kV)	Phase-to-ground voltage (kV)	Current (A)	Creepage distance (mm)
Air to Oil:								
GOB	170	750	N.A.	365	325	170	1250	4800
GSA-OA	170	750	N.A.	365	325	100	2000	5504*)
GOM	300	1175	850	505	550	200	1600	7550
GOE	800	2550	1600	1000	1000	485	5000	20000
GOH	36	200	N.A.	80	75	36	25000	760
Oil to Oil:								
GSA-OO	245	1050	N.A.	505	N.A.	141	2500	N.A.
Oil to SF₆:								
GOEK	800	2550	N.A.	1000	N.A.	485	5000	N.A.
Air to Air:								
GOBL	145	650	N.A.	300	275	145	1250	4080
GSA-AA	170	550	N.A.	260	230	100	2000	3913*)
GOEL	800	2100	1600	1000	1000	485	5000	20000
GGAL	550	1675	1300	750	750	485	5000	17500*)
Air to SF₆:								
GGA	550	1800	1360	800	800	318	4000	13750*)

Maximum ratings for different types of ABB Components bushings. See also quick reference above.

*) Silicone rubber sheds.

Bushings - p



L 33152

L 36531

L 35702

L 33150

L 37060

L 37062

Type

GOB

GOM

GOE

GOH

GOEK

GOBL

Technical Guide

1ZSE 2750-102

1ZSE 2750-108

1ZSE 2750-105

1ZSE 2750-107

1ZSE 2750-106

1ZSE 2750-104

**Installation and
Maintenance Guide**

2750 515-12

2750 515-41

2750 515-1

2750 515-85

2750 515-116

2750 515-117

product scope



L 26836

GOEL

-

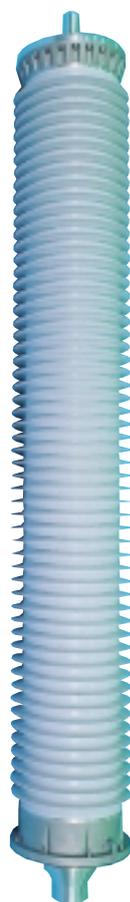
2750 515-132



GGAL

-

-



L 36697

GGA

1ZSE 2770-100

2770 501-2



GSA-OA

1ZSE 2750-111

2750 515-115



GSA-AA

1ZSE 2750-112

2750 515-133



GSA-OO

1ZSE 2750-116

2750 515-138

Product documentation

Technical guide

The Technical guide provides ratings and dimensions for all standard sizes of a particular bushing. Several design options are also given.

Colour of air side insulator

Brown and light grey porcelains are available as standard for most of our bushings with brown as the most common one.

Silicone rubber sheds are only available in light grey RAL 7035.

Type of connection

Draw lead: This type of connection is the most common one for low currents. The current is carried by a stranded cable pulled through the bushing. The inner terminal can be connected to the cable either by brazing or crimping. Guidance for the needed area of the cable is also given in the Technical Guide.

Solid rod: This type of connection is used when the current becomes too large to be carried by a stranded cable. The current is carried by a solid rod pulled through the bushing.

Draw rod: This type of connection is used for the GOE and GOEK on higher currents to get a simple design of the transformer together with an easy mounting of the bushing on the transformer. The current is carried by a conductor tube, included in the bushing. As the draw rod solution simplifies the transformer design it is used quite frequently also at lower currents.

Outer terminal: Aluminium and copper alloy are available as standard for most of our bushings. Other materials and dimensions are available upon request.

Type of shielding

Shield for the transformer side of the bushing is normally available as standard. Depending on voltage level and type of bushing the shield is epoxy coated or insulated with press board. Guidance for the design of the position of the bushing in the transformer is also given in the Technical Guide. If other bottom end shields are used, ABB Components can assist with field calculations to confirm the compatibility between the bushing, the shield and the transformer. Type tests as well as routine tests are performed with our standard shields mounted on the bushings oil side.

Oil level indicator

Oil level indicators are normally requested on oil-filled bushings. This is an option for smaller bushings. The indicator comprises a sight glass or is of a magnetic type, depending on the type of bushing.

Pressure monitoring

Pressure monitoring equipment is an option on bushings for connection between SF₆ and the transformer oil. This gives the advantage of continuous monitoring including alarm and trip functions.

Installation and maintenance guide

The Installation and maintenance guide provides information on how to handle the bushing. Detailed information about inner and outer connections and maintenance are also important parts of this document. Each product type has its own Installation and maintenance guide.

Product informations

Product informations are available to answer general questions that are not covered in the Technical guides or the Installation and maintenance guides. These questions include the following:

Gasket in ABB oil impregnated bushings (2152 4016-3)
Gives a short description about the gasket system used in ABB Components' bushings.

Repair of damaged porcelain insulator (2750 514-23)
Describes how to repair small damages in porcelains.

Bushing diagnostics and conditioning (2750 515-142)
Guidelines for diagnostics and conditioning of bushings.

Bushing oil (2750 515-84) General information about the oil used in ABB Components' bushings.

Seismic calculation on ABB bushings mounted on a transformer tank cover (2750 515-88) Guide how to calculate seismic withstand on ABB Components' bushings.

Resin impregnated paper bushings (2750 515-130)
Comprehensive information about the RIP technology used in ABB Components' bushings type GSA.

Silicone rubber (2750 515-131) Comprehensive information about the silicone rubber insulators used on ABB Components' bushings type GSA.

Difference between RIP and OIP bushings (2750 515-136) Particular features of RIP and OIP bushings from ABB Components.



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