1ZSE 2750-116 EN, REV. 5

Transformer bushings type GSA-OO

Technical guide

Original instruction

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, or its authorized representative.

We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail. ABB does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.

Table of contents

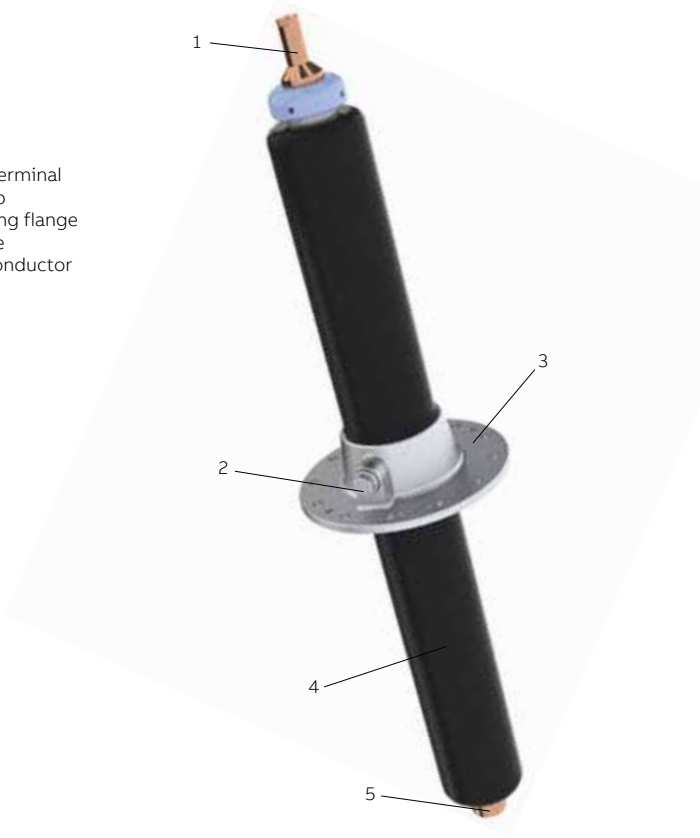
Design

The solid GSA-OO bushing is completely dry and based on a Resin Impregnated Paper (RIP) core. The connection system consists of either flexible or solid pull through conductors with the outer terminal integrated with the conductor/inner terminal. The bushings are fitted to the transformer by means of a cast aluminium flange with an integrated test tap.

The GSA bushings are produced by winding a crêped paper web onto a mandrel, with aluminium foil inserts for electrical stress control. The core is vacuum impregnated and cured giving a partial discharge free bushing with low tan δ (dissipation factor). After curing, the core is machined and the flange is fitted.

During the design work hard focus has been put into achieving a compact and lightweight bushing and to reduce the number of parts to a minimum in order to achieve highest possible reliability of the product. An example is that the fixing and sealing system for the terminal has been designed to integrate a shielding function. Thus it is not necessary to apply a separate shield at the top of the bushing, unless it is needed for shielding the connection to the terminal itself. With the outer and inner terminals integrated to one piece, the conventional current interface between these parts has been eliminated.

1. Outer terminal
2. Test tap
3. Mounting flange
4. RIP core
5. Solid conductor



— 01 Transformer bushing type GSA-OO.

Standards
The GSA bushing is designed and tested according to IEC 60137 and IEEE C57.19.00/01 in applicable parts.

Features and benefits
- Solid – Reduced risk for fire, any mounting angle possible, oil leakage from the bushing eliminated, no monitoring of pressure and oil level.
- Seals the transformer – Reduced risk for fire, risk for oil leakage from the transformer reduced.
- Non-shattering materials – Protection of personnell and equipment, easy handling, safe transport - also when mounted on the transformer, high seismic withstand
- Light weight, compact – Easy handling, small requirements on space inside transformer, low life cycle environmental impact.

Transportation and long term storage
The bushing is surrounded by a sealed moisture-proof wrapping material together with a drying agent upon delivery.

The supplied protective wrapping shall not be opened if the bushings are intended to be stored. After transformer test, it is also important to reseal the bushing with the supplied protective wrapping or a similar moisture-proof wrapping, together with a drying agent. The wrapping works as protection for transportation and storage (< 6 months). Note that bushings with standard wrapping shall be stored protected from precipitation.

For longer storage times (>6 months) a container have to be ordered separately.

Table 1. General specifications
For conditions exceeding the standard specification, please consult the supplier.

Application:	Transformers
Classification:	Resin impregnated paper, capacitance graded, completely immersed bushing
Ambient temperature:	Not applicable
Altitude of site:	Not applicable
Level of rain and humidity:	Not applicable
Pollution level:	Not applicable
Immersion medium:	Transformer oil or poly-buthylen. Max. daily mean oil temperature 90 °C. Max. normal load 100 °C, emergency duty 115 °C acc. to IEC 60137.
Oil level in transformer:	Not lower than 25 mm from the bushing flange
Max. pressure of medium:	100 kPa over pressure
Angle of mounting:	Horizontal to vertical
Test tap:	Test tap with 4 mm contact pin
Capacitance C_2 of test tap:	< 5 000 pF
Conductor:	Solid or flexible pull through conductor
Markings:	Conforming to IEC / IEEE

Testing

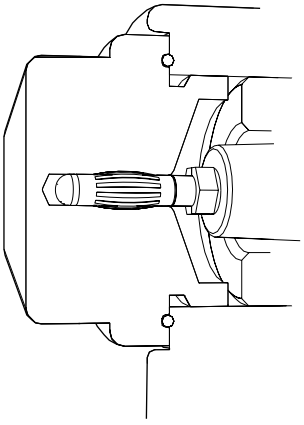
Routine testing
The bushing is routine tested according to applicable standards. The tests include measurement of partial discharge quantity, tan δ, capacitance, power frequency voltage withstand test. The flange is separately tightness tested, and the seal between flange and core is tested after mounting. A visual inspection is performed.

An individual routine test protocol is delivered with each bushing.

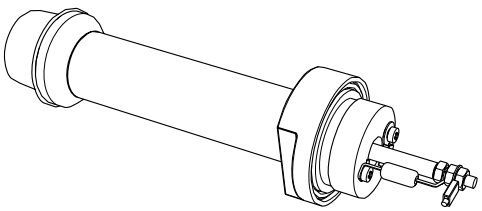
Type tests
Complete type tests have been performed and reports are available on request.

Special tests
A number of tests not specified by international standards have also been performed and reports are available on request.

Test tap
The outer conducting layer of the condenser core is connected to an insulated test tap on the flange. During operation the protective cap must be screwed on 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.



—
02 Test tap.



—
03 Test tap adapter, 1ZSC003881-AAE.

Electrical data

Table 2. Electrical data

Ratings GSA-OO	**73**	**123**	**145**	**170**	**245**
Rated voltage IEC (kV)	72.5	123-170	145-170	170	245
Rated phase-to-earth voltage IEC (kV)	42	98	98	98	141
Insulation class IEEE (kV)	69	115	138	161	196
Rated line-to-ground voltage IEEE (kV)	44	88	88	102	146
Basic Insulation Level (kV) (Equal to dry lightning impulse withstand voltage)	350	550	650	750	1050
Rated current (A)	2500	2000	2000	2000	1600
Draw lead current (A), 1200 mm²	1600	1600	1600	1600	1250
Rated frequency (Hz)	50/60	50/60	50/60	50/60	50/60
Temporary over voltage (kV)	73	170	170	170	196
Routine test 1 minute (kV)	160	260	310	365	505
Space for current transformer (mm)	0 / 300 / 500	0 / 300 / 500	100 / 300 / 500	100 / 300 / 500	100 / 300 / 600
Nominal capacitance C_1 ±10 % (pF)	176 / 411 / 567	141 / 266 / 348	212 / 295 / 379	243 / 327 / 409	204 / 268 / 363

—
04 Nameplate with marking example.

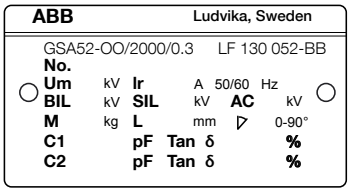
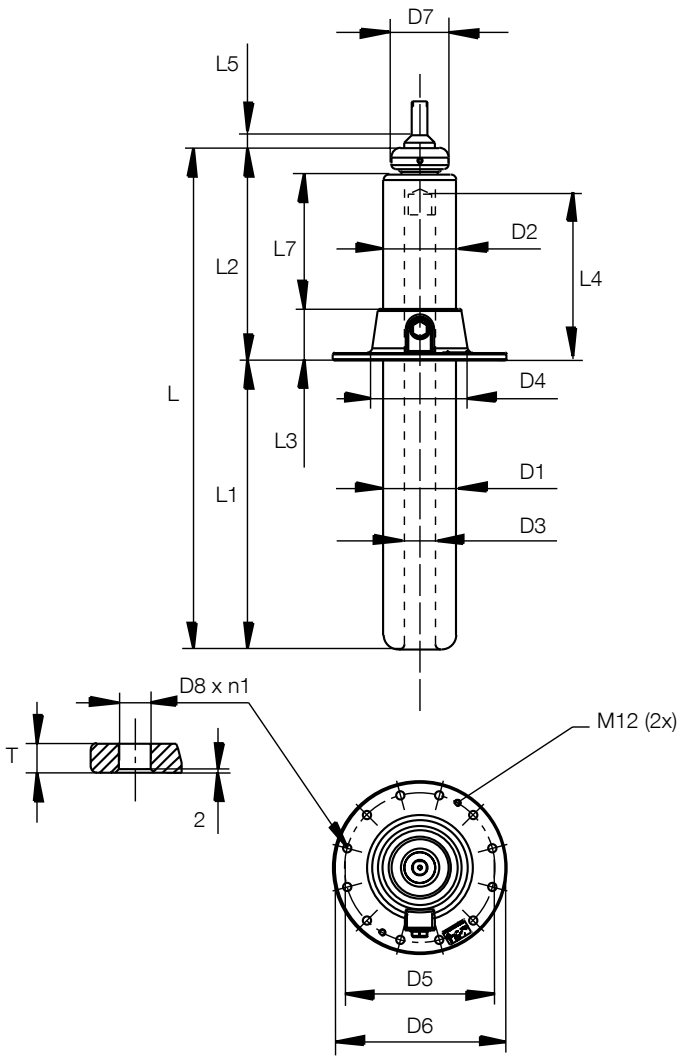


Table 3. Dimensions.
Dimensions are subject to modification without notice.

				Dimensions in mm								
Type GSA-OO	**Cat. No.**	**Space for current transformer (mm)**	**Net mass (kg)**	**Total L**	**Transformer side L1**	**Cable box side L2**	**Flange height L3**	**Draw lead L4**	**Top part L5**	**Cable box side L7**	**Condenser core outer D1**	**Condenser core inner D2**
73	LF 135 073-BA	0	7	532	180	352	100	257	25	200	103	103
	-BB	300	9	832	480							
	-BC	500	11	1032	680							
123	LF 135 123-CA	0	16	712	260	452	100	357	25	300	143	143
	-CB	300	21	1012	560							
	-CC	500	24	1212	760							
145	LF 135 145-FA	100	19	899	357	542	100	447	25	390	143	143
	-FB	300	23	1099	557							
	-FC	500	26	1299	757							
170	LF 135 170-DA	100	21	1042	410	632	100	537	25	480	143	143
	-DB	300	24	1242	610							
	-DC	500	28	1442	810							
245	LF 135 245-EA	100	42	1372	610	762	100	667	25	610	173	175
	-EB	300	47	1572	810							
	-EC	600	55	1872	1110							

Dimensions



—
05 Dimensions.

Center hole D3	Min. gasket surface inner diam. D4	Hole circle D5	Flange D6	Top nut diam. D7	Flange hole D8	Number of holes n1	Flange thickness T	Cantilever load Max. permitted loading perpendicular to the terminal	
								Operating load (N)	Test load (N)
60	115	250	290	110	16	8	15	3150	6300
60	155	290	335	110	16	12	15	3325	6650
60	155	290	335	110	16	12	15	3325	6650
60	155	290	335	110	16	12	15	3325	6650
60	190	350	400	110	20	8	15	3000	6000

Connection details

Solid rod is used for maximum current capacity and stranded cable for greater ease of assembly, when the required current capacity is lower. A mounting kit is used for fixing and sealing the terminal to the bushing.

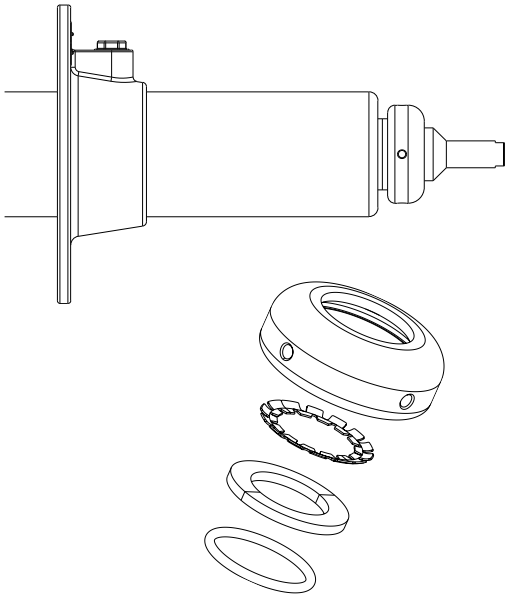
Mounting kit
The mounting kit, LF 170 087-A, is supplied with each bushing and consists of a divided ring, a divided spring washer, two O-rings and a top nut. One of the O-rings is intended for use at site installation.

Included in each packing for delivery are two lifting eye bolts M12, 2183 2001-3, and a hook spanner, 6896 743-1, intended for use at installation.

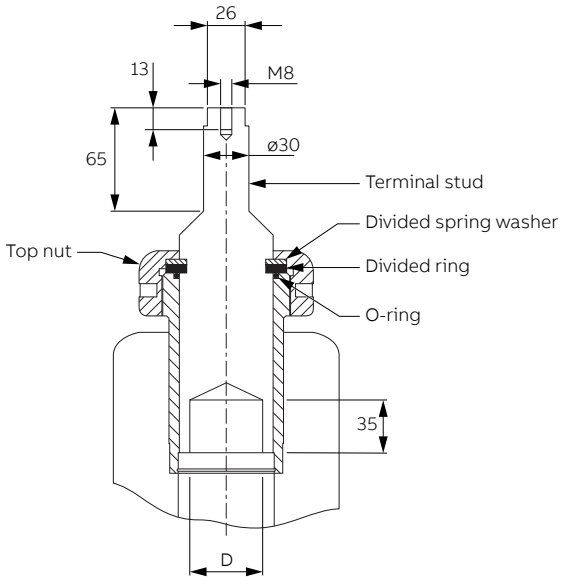
Integrated inner/outer terminal
The integrated inner and outer terminal is available with different inner diameters suited for different stranded cables. Other configurations can be supplied on request.

Table 4.

Material and design	Conductor diameter, D (mm)	Cat. No. LF 170 084	Mass (kg)
Copper for brazing	5	-A	4.1
	11	-B	4.1
	13	-C	4.1
	15	-D	4.0
	18	-E	4.0
	30	-F	3.9
	42	-G	3.6
	45	-H	3.6
	50	-I	3.4
	54	-J	3.3

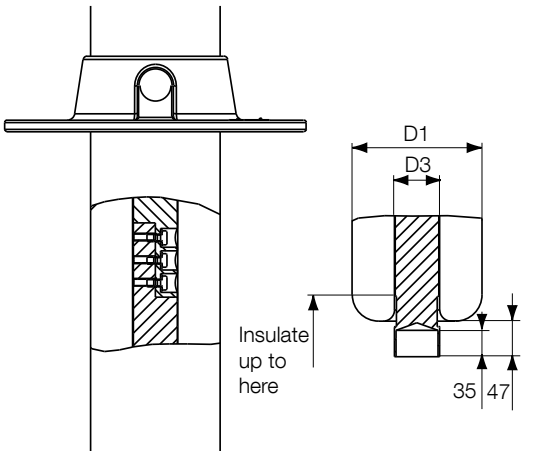


06 Mounting kit.



07 Inner/outer terminal.

Solid rod conductor
The solid rod is produced from electrolytical copper and divided into two parts for ease of assembly. The parts are joined together with a screw joint with undroppable screws. The lower part of the solid rod is designed to enable connection by brazing. The solid rod is available with two alternative dividing points, 20 mm below the bushing flange or 20 mm below the space for current transformer and is delivered without paper insulation.



—
08 Solid rod conductor.

Positioning of stranded cable
It is important that the stranded cable is positioned in the centre of the lower part of the condenser core. There is otherwise a certain risk that the electrical field affecting the lower end of the high voltage foil will be too high. The centre position of the stranded cable can be achieved by means of a thicker layer of insulating paper around the cable. Allowed deviation for the stranded cable from the centre of the bushing is ± 5 mm. It is however important to have a loose of a few mm between the paper and the bushing hole, in order to let oil enter the centre hole when filling the transformer.

Conductor insulation
Draw leads and solid rods must be insulated with vacuum oil-impregnated insulating paper or equivalent, to give sufficient insulation integrity. The paper insulation must be min. 2 mm thick.

Stranded cable: The paper insulation must be brought min. 50 mm inside the bushing centre hole.

Solid rod: The paper must fill the recess and cover the whole solid rod end downwards.

Table 5. Ordering particulars for solid rod conductor.

		Division at flange (at 100 mm flange extension for LF 135 170, LF 135 245 and LF 135 145)		Division at current transformer	
Bushing Cat. No.		**Upper part LF 170 085**	**Lower part LF 170 086**	**Upper part LF 170 085**	**Lower part LF 170 086**
LF 135 073	-BA	-A	-A	-	-
	-BB	-A	-B	-B	-A
	-BC	-A	-C	-C	-A
LF 135 123	-CA	-D	-D	-	-
	-CB	-D	-E	-E	-D
	-CC	-D	-F	-F	-D
LF 135 145	-FA	-N	-P	-	-
	-FB	-N	-R	-P	-P
	-FC	-N	-S	-R	-P
LF 135 170	-DA	-G	-G	-	-
	-DB	-G	-H	-H	-G
	-DC	-G	-I	-I	-G
LF 135 245	-EA	-J	-J	-	-
	-EB	-J	-K	-K	-J
	-EC	-J	-L	-L	-J

Conductor loading

The GSA-OO bushings is heat run tested with solid conductors and 1200 mm² stranded cable. The test currents together with calculated values for different stranded cables are given in the table below:

Table 6.

Bushing	Conductor	Tested permissible current IEC A	Tested permissible current IEEE A	Calculated permissible current A
LF 135 073	Solid rod ø 58 mm	2500	2500	
	Stranded cable			
	1200 mm²	2000	2000	
	900 mm²			1500
	450 mm²			1000
	150 mm²			500
LF 135 123	Solid rod ø 58 mm	2000	2000	
	Stranded cable			
	1200 mm²	1600	1600	
	900 mm²			1200
	450 mm²			850
	150 mm²			450
LF 135 145	Solid rod ø 58 mm	2000	2000	
	Stranded cable			
	1200 mm²	1600	1600	
	900 mm²			1200
	450 mm²			850
	150 mm²			450
LF 135 170	Solid rod ø 58 mm	2000	2000	
	Stranded cable			
	1200 mm²	1600	1600	
	900 mm²			1200
	450 mm²			850
	150 mm²			450
LF 135 245	Solid rod ø 58 mm	1600	1600	
	Stranded cable			
	1200 mm²	1250	1250	
	900 mm²			950
	450 mm²			650
	150 mm²			350

Overloading of bushings

If the conductor for the bushing is selected for 120 % of the rated current of the transformer, the bushing is considered to be able to withstand the overload conditions stated in IEC 60076-7 without further clarifications or tests, according to IEC 60137.

Short-time current

The rated thermal short-time current (I_{th}) is calculated according to IEC 60137.

Table 7.

Conductor	Rated current A	Area mm²	Short-time current (I_{th}) kA, rms 1 s	Short-time current (I_{th}) kA, rms 2 s	Dynamic current (I_d) kA, peak
Solid rod Ø 58 mm	2500.. 1600	2642	100	100	315
Stranded draw-lead	2000.. 1250	1200	89	63	157

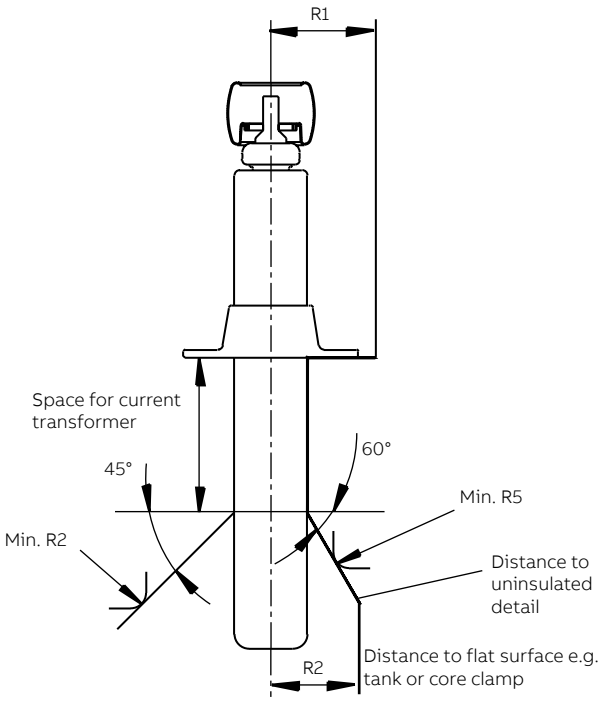
Recommendations for positioning

The maximum stresses in the oil at the surface of the shield insulation and the parts surrounding the bushing must be limited to those values normal for insulated conductors and other similar components in the same transformer.
The withstand voltage in a specific case depend upon many factors beyond control of the bushing manufacturer.
Therefore the configuration and distances given below are only intended as guidelines.

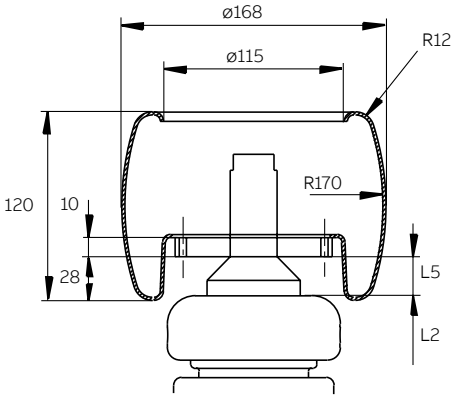
ABB can provide assistance with field calculations to confirm the compatibility between the transformer and the bushing.

Table 8.

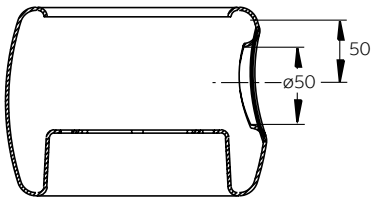
Type GSA-OO	Internal insulation level of transformer kV	Shield	Distance to earthed parts (with shield) R1 mm	Distance to earthed parts (without shield) R2 mm
73	350-140	LF 170 020-S	130	90
		LF 170 020-T		
123	550-230	LF 170 020-S	200	145
		LF 170 020-T		
145	650-275	LF 170 020-S	228	165
		LF 170 020-T		
170	750-325	LF 170 020-S	260	190
245	1050-460	LF 170 046-AT	400	270



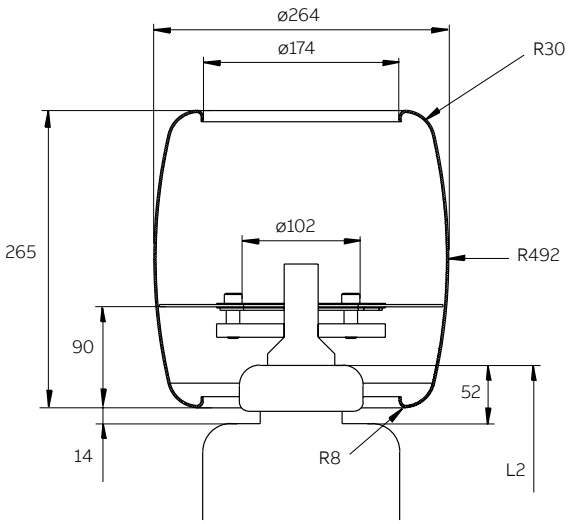
09 Recommendations for positioning.



LF 170 020-S



LF 170 020-T



LF 170 046-AT

—
10 Top end shields.

Ordering particulars

When ordering, please state:

- Type and catalog number for bushing.
- Catalog number for integrated inner/outer terminal or conductor, lower and upper part.
- Additional accessories or modifications.
- Test required, in addition to the normal routine tests.

ABB AB, Components
SE-771 80 Ludvika
Sweden
E-mail: sales@se.abb.com

www.abb.com/transformercomponents

1ZSE 2750-116 en, Rev. 5, 2018-10-15