



1ZSE 2750-111 en, Rev. 6

# Transformer bushings, type GSA-OA

## Technical guide

This Technical guide has been produced to allow transformer manufacturers, and their designers and engineers, access to all the technical information required to assist them in their selection of the appropriate transformer bushing. The guide should be used in conjunction with the *Selection guide* to allow the optimum selection to be made.

The technical information pertaining to bushings manufactured by ABB has been divided into 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, or its authorized representative.

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# Table of contents

Standards _____	5
Design _____	5
Test tap _____	6
Testing _____	6
Routine testing _____	6
Type tests _____	6
Special tests _____	6
Test tap adapter _____	7
Transportation and storage _____	7
Electrical data _____	7
Dimensions _____	8
Common specifications _____	9
Connection details _____	10
Outer terminal _____	10
Inner terminal _____	10
Ordering particulars for solid rod conductor _____	11
Separate terminal plate with bolts _____	11
Arcing horns _____	11
Conductor loading _____	12
Overloading of bushings _____	12
Short-time current _____	12
Ordering particulars _____	12
Recommendations for positioning _____	13



## Standards

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

## Design

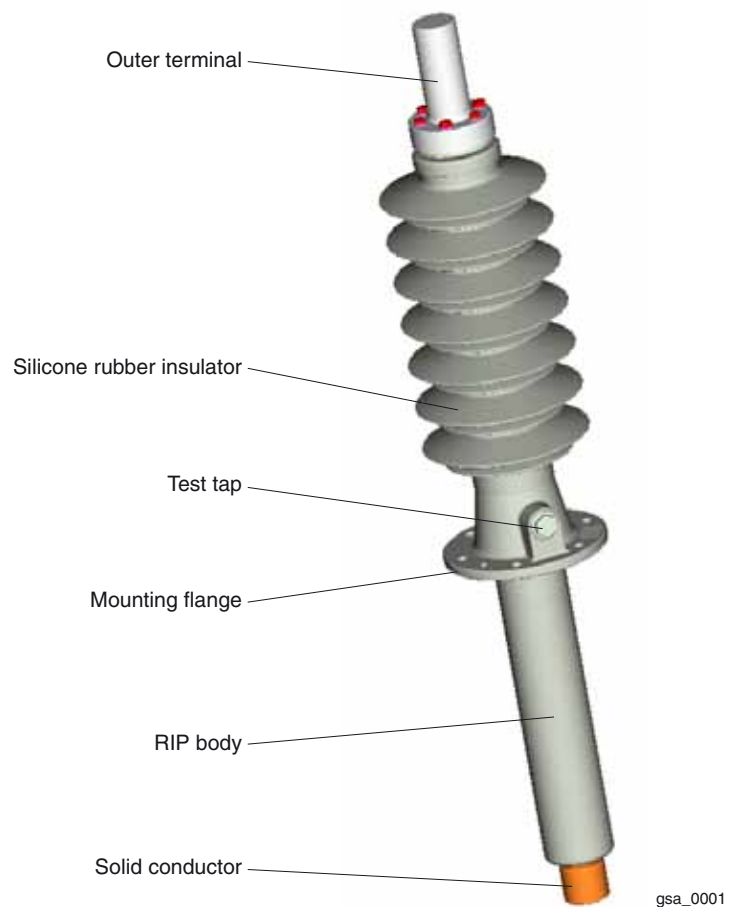
GSA-OA is a Resin Impregnated Paper (RIP) bushing with Silicone Rubber (SiR) insulator. The condenser body is bonded directly to the silicone rubber to give a compact and lightweight bushing, containing no gas, oil or other liquids.

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

The inner terminal is fixed to the top piece with a divided ring (patented by ABB) and can be connected to leads by brazing. For maximum current rating, a solid copper rod is used.

Outer terminals are available in a number of standard configurations in aluminium and copper, but can also be modified to suit any connection need.

The standard colour of the mounting flange and of the insulator is RAL 7035, light grey.



*Fig. 1. Transformer bushing type GSA-OA.*

## Test tap

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

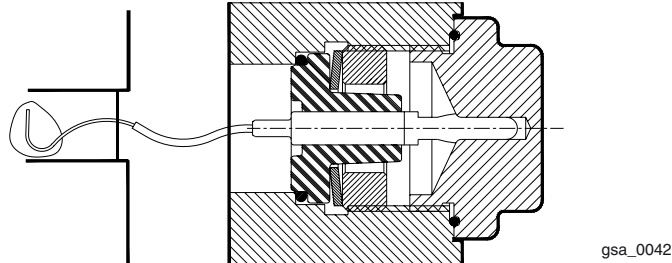


Fig. 2. Test tap.

Features	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.
Silicone rubber insulator	Superior electrical performance, cleaning normally not needed.

## Testing

### Routine testing

The bushing is routine tested according to applicable standards. The tests include measurement of partial discharge quantity,  $\tan \delta$ , capacitance, dry power frequency voltage withstand test. The flange is separately tightness tested with helium. A visual inspection is performed.

An individual routine test protocol is delivered with each bushing from ABB.

### Type tests

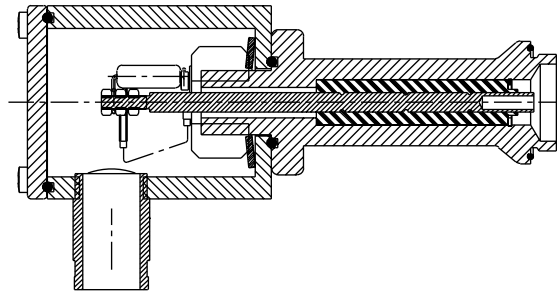
Complete type tests have been performed and reports are available on request.

### Special tests

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

## Test tap adapter

For testing, a special test adapter is required for permanent connection of the test tap to the measuring circuits.



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Fig. 3. Test tap adapter, 2769 531-D.

## Transportation and storage

The bushing shall be surrounded by a sealed moisture-proof wrapping material together with a drying agent during transportation and storage.

The supplied protective wrapping shall not be opened if the bushings are intended to be stored. The protective wrapping can be re-sealed, or a similar sealed moisture-proof wrapping can be used, together with a drying agent.

## Electrical data

Ratings GSA-OA	52	73	123	145	170
Rated voltage IEC (kV)	52	72.5	123-170	145-170	170
Rated phase-to-earth voltage IEC (kV)	30	42	98	98	98
Insulation class IEEE (kV)	46	69	115	138	161
Rated line-to-ground voltage IEEE (kV)	29	44	88	88	102
Basic Insulation Level (kV) (Equal to dry lightning impulse withstand voltage.)	250	350	550	650	750
Rated current (A)	2000	2000	1600	1600	1600
Draw lead current (A)	1250	1250	1250	1250	1250
Rated frequency (Hz)	50/60	50/60	50/60	50/60	50/60
Temporary over voltage (kV)	52	73	170	170	170
Wet power frequency AC (kV)	95	140	230	275	325
Routine test 1 minute dry (kV)	120	160	260	310	365
Nominal capacitance between conductor and test tap C1 ±10 % (pF)	224/430/559	351/546/682	213/314/380	251/314/380	301/395/465
Space for current transformer (mm) 0/300/500					

# Dimensions

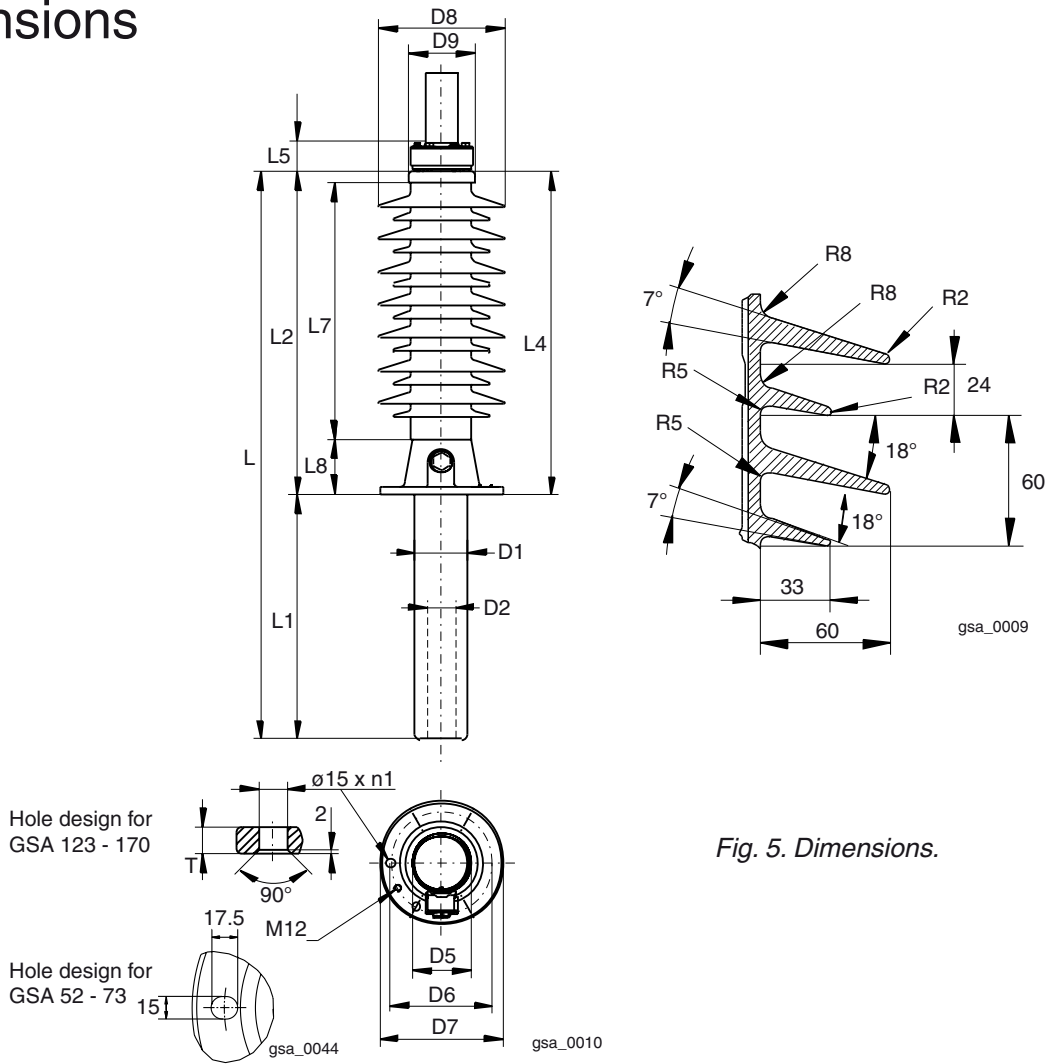


Fig. 5. Dimensions.

Dimensions are subject to modification without notice.

Dimensions in mm												
Type GSA	Rated current (A)	Cat. No.	Space for current transformer (mm)	Net mass (kg)	Total L	Oil side L1	Air side L2	Draw lead L4	Top part L5	Arcing distance L7	Flange height L8	Condenser body outer D1
52	2000	LF 130 052-BA	0	13	734	145	589	583	56	467	101	96
			-BB 300	16	1034	445						
			-BC 500	17	1234	645						
73	2000	LF 130 073-BA	0	18	1029	260	769	763	56	647	101	96
			-BB 300	20	1329	560						
			-BC 500	21	1529	760						
123	1600	LF 130 123-BA	0	45	1444	255	1189	1183	56	1067	101	136
			-BB 300	50	1744	555						
			-BC 500	53	1944	755						
145	1600	LF 130 145-BA	0	52	1731	362	1369	1363	56	1247	101	136
			-BB 300	57	2031	662						
			-BC 500	60	2231	862						
170	1600	LF 130 170-BA	0	61	2019	410	1609	1603	56	1487	101	136
			-BB 300	66	2319	710						
			-BC 500	69	2519	910						

## Common specifications

Application:	Transformers
Classification:	Resin impregnated paper, capacitance graded, outdoor immersed bushing
Ambient temperature:	+40 °C to -40 °C, minimum value acc. to temperature class 2 of IEC 60137
Altitude of site:	< 1000 m
Level of rain and humidity:	1-2 mm rain/min. horizontally and vertically, as per IEC 60060-1, and 5 mm/min. as per IEEE
Pollution level:	Acc. to specific creepage distance and IEC 60815 ("Guide for selection of insulators with respect to polluted conditions")
Immersion medium:	Transformer oil. Max oil temperature acc. to the Installation and Maintenance Guide.
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 male contact pin
Capacitance C2 of test tap:	< 5000 pF
Arcing horns:	Optional
Conductor:	Solid or flexible draw lead conductor
Markings:	Conforming to IEC/IEEE.

For conditions exceeding the standard specification above, please consult the supplier.

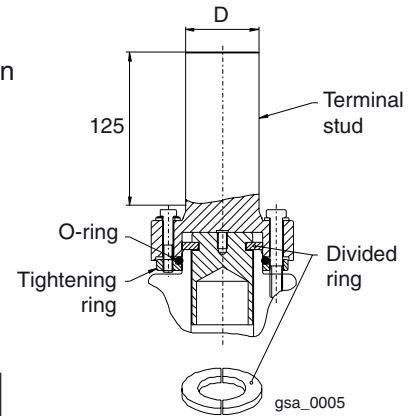
Centre hole D2	Min. gasket surface inner diameter D5	Hole circle D6	Flange D7	Insulator sheds D8	Top piece diameter D9	Number of holes n1	Flange thickness T	Creepage distance		Cantilever load Max. permitted loading perpendicular to the terminal	
								total (mm)	protected (mm)	(N)	Test (N)
51	110	185	225	230	120	6	15	1642	700	1250	2500
51	110	185	225	230	120	6	15	2323	1000	1575	3150
51	150	250	290	270	160	8	15	3913	1700	2000	4000
51	150	250	290	270	160	8	15	4595	2000	2000	4000
51	150	250	290	270	160	8	15	5504	2400	2000	4000

## Connection details

The outer terminal needs to be specified in each case. The outer terminal is then used together with either a solid rod, for maximum current capacity, or a flexible lead for greater ease of assembly, when the required current capacity is lower.

### Outer terminal

The outer terminal is available in a number of standard configurations. Other configurations can be supplied on request.

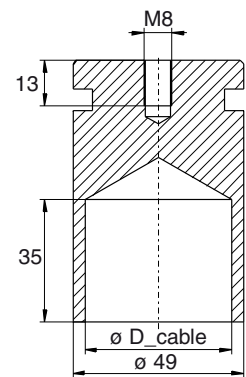


Material	Plating	Stud diameter (mm)	Cat. No. LF 170 079	Mass (kg)
Aluminium	-	60	-A (standard)	2.3
	-	30	-B (standard)	1.6
Copper	-	60	-C (standard)	6.2
	-	30	-D (standard)	3.6
	Tin	60	-E	6.2
	Tin	30	-F	3.6
	Silver	60	-G	6.2
	Silver	30	-H	3.6

### Inner terminal

The inner terminal is made of copper for connection of a draw lead.

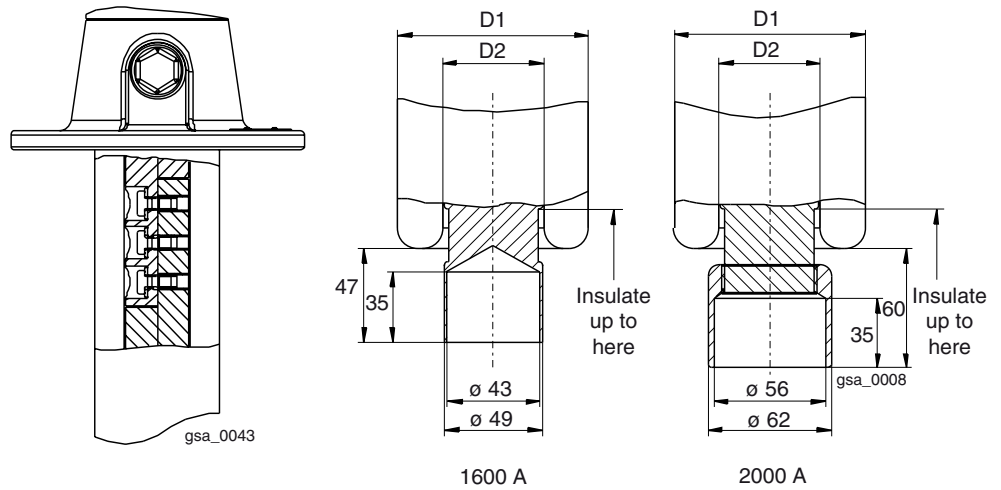
Material and design	Conductor diameter (mm)	Cat. No. LF 170 080	Mass (kg)
Copper for brazing	5 (pilot hole)	-A	1
	11	-B	1
	13	-C	1
	15	-D	1
	18	-E	1
	30	-F	1
	42	-G	1
	45	-H	1



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## Solid rod conductor

The rod is produced from electrolytical copper and divided into two parts for ease of assembly. The parts are joined 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. The solid rod is delivered without paper insulation.



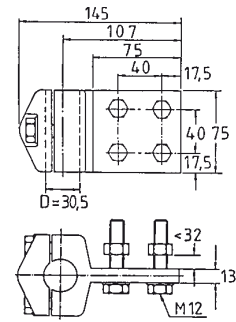
## Ordering particulars for solid rod conductor

Bushings Cat. No.	Division at flange			Division at current transformer			Mass (kg)	
	Upper part LF 170 081	1600 A Lower part LF 170 082	2000 A Lower part LF 170 082	Upper part LF 170 081	1600 A Lower part LF 170 082	2000 A Lower part LF 170 082	1600 A	2000 A
LF 130 052	-BA	-ABA	-DABA	-ABA	-	-	13	13.5
	-BB	-BABA	-DABB	-ABB	-ABB	-DBABA	18	18.5
	-BC	-CABA	-DABC	-ABC	-ABC	-DCABA	21.5	22
LF 130 073	-BA	-BBA	-DBBA	-BBA	-	-	18	18.5
	-BB	-BBBA	-DBBB	-BBB	-BBB	-DBBBA	23	23.5
	-BC	-CBBA	-DBBC	-BBC	-BBC	-DCBBA	26	26.5
LF 130 123	-BA	-DBA	-DADBA	-	-	-	25	-
	-BB	-BDBA	-DDBB	-	-DBB	-DBDBA	30	-
	-BC	-CDBA	-DDBC	-	-DBC	-DDBA	33	-
LF 130 145	-BA	-EBA	-DEBA	-	-	-	29.5	-
	-BB	-BEBA	-DEBB	-	-EBB	-DBEBA	33.7	-
	-BC	-CEBA	-DEBC	-	-EBC	-DCEBA	37.1	-
LF 130 170	-BA	-FBA	-DAFBA	-	-	-	34.5	-
	-BB	-BFBA	-DFBB	-	-FBB	-DBFBA	39.5	-
	-BC	-CFBA	-DFBC	-	-FBC	-DFBA	42.5	-

## Separate terminal plate with bolts

The separate terminal plate is available for stud with  $\varnothing$  30 mm, and used for connecting the bushing to the line conductor.

Material	Cat. No.
Aluminium	LF 170 014-A
Nickel plated copper	LF 170 021-A



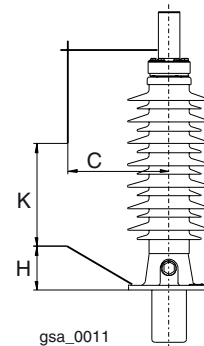
## Arcing horns

Arcing horns made of galvanised steel can be mounted on the bushing. The arcing horns are available for stud with  $\varnothing$  30 mm.

The lower rod is fastened onto the flange with one of the fixing screws and the upper rod by means of a bracket on the outer terminal.

The gap distances for standard arcing horns are shown in the table. Other gap distances on request.

Bushing type	K (mm)	C (mm)	H (mm)
GSA 52	230–440	315	112
GSA 73	400–620	315	112
GSA 123	620–960	315	114
GSA 145	700–1080	380	224
GSA 170	820–1290	380	224



## Conductor loading

The GSA bushings fulfil the temperature rise test requirements according to IEC and IEEE for the currents below:

Bushing type GSA-OA	Conductor	Permissible current	
		IEC (A)	IEEE (A)
52-73 kV	Solid rod	2000	2000
123-170 kV	Solid rod	1600	1600
All types	Stranded cable		
	185 mm <sup>2</sup>	400	400
	740 mm <sup>2</sup>	1250	1250

## Overloading of bushings

If the conductor for the bushing is selected with 120 % of the rated current of the transformer, the bushing is considered to be able to withstand the overload conditions stated in IEC 60354 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.

Conductor	Rated current A	Area mm <sup>2</sup>	Short-time current ( $I_{th}$ ) kA, rms		Dynamic current ( $I_d$ ) kA, peak
			1 s	2 s	
Solid rod Ø 49 mm Cu	2000.. 1600	1886	100	96	240
Stranded draw-lead	1250	740	61	43	107

## Ordering particulars

When ordering, please state:

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

ABB	Ludvika, Sweden
GSA52-OA/2000/0.3	LF 130 052-BB
No.	
Ur/Uy	52/46 kV Ir 2000 A 50/60 Hz
LI / SI / AC	250 / - / 120 kV
M	16 kg L 445 mm ✓ 0-90 °
C1	pF Tan δ %
C2	pF Tan δ %

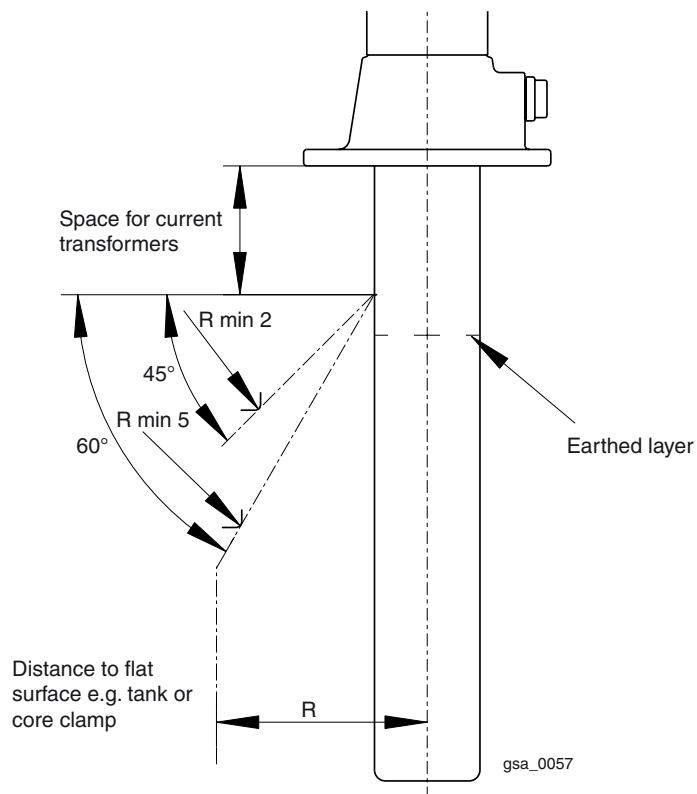
Nameplate with marking example.

## Recommendations for positioning

The maximum stresses in the oil at the surface of the conductor insulation must be limited to those values normal for insulated conductors and similar components in the same transformer.

The adjacent recommendations are intended as guide lines when complete calculations are not carried out.

Type GSA	Internal insulation level of transformer (kV)	Distance to earthed parts R (mm)
52	250-95	75
73	350-140	90
123	550-230	145
145	650-275	165
170	750-325	190





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