1ZSC000563-AAA EN, REV. 7

Transformer bushings type GSBK

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.

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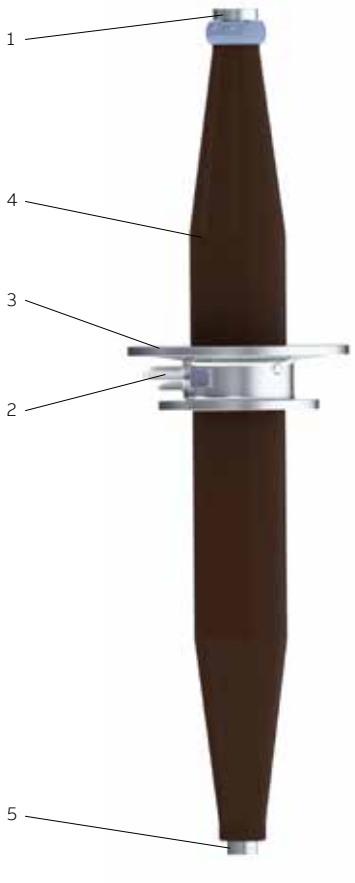
Design

GSBK is a Resin Impregnated Paper (RIP) bushing intended for immersed oil – SF_6 service. The bushing can be mounted in any direction from vertical to horizontal.

The insulation core of the GSBK is produced by winding crepe paper onto a center tube, with aluminium foil insert for electrical stress control. The manufacturing process is optimized to give a partial discharge free bushing with low dielectric losses.

As a current conductor, GSBK uses the center tube, which is moulded into the RIP core. The outer terminal is fit to the center tube by a bolted joint. The bottom contact on the transformer side is mounted by a draw rod system or by a bolted joint.



1. Outer terminal
2. Test tap
3. Mounting flange
4. RIP core
5. Center tube

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01 Transformer bushing type GSBK oil – SF_6 connection.

Standards
The GSBK bushing is designed and tested according to IEC 60137 and IEC 62271-211.

RIPCOAT
Water uptake on the RIP bushings during transport, handling and storage leads to increased dielectric losses. At site this means that the bushings might need to be dried before assembling leading to delays. A water barrier “RIPCOAT” has been developed to solve this problem. The time to reach critical dissipation factor has been stretched by a factor of up to 80 by using RIPCOAT compared to bushings with an unprotected oil-side. Actual time depends highly on level of relative humidity and temperature.

Features and benefits
- Solid – Reduced risk of fire. No restriction in mounting angle. Oil leakage from the bushing eliminated.
- Seals the transformer – Reduced risk of fire. Risk of oil leakage from the transformer reduced..
- Non-brittle materials – Protection of people and equipment. Easy handling. Safe transport - even when mounted on the transformer. High earthquake withstand.
- Light weight, compact – Easy handling, small space requirements 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, temperature class E (120 °C) according to IEC 60137
Ambient temperature:	+40 °C to -40 °C, minimum value acc. to temperature class 3 of IEC 60137
Immersion medium on switchgear side:	SF_6 gas. Max daily mean temperature +75 °C.
Max pressure of medium on switchgear side:	750 kPa (over pressure)
Immersion medium on transformer side:	Transformer oil. Max daily mean oil temperature +90 °C. Max temporary oil temperature +115 °C.
Oil level in transformer:	Not lower than 30 mm from the bushing flange.
Max. pressure of medium:	100 kPa (over pressure)
Angle of mounting:	Horizontal to vertical
Test tap:	Dimensions according to IEEE, Type A. Max. service voltage 600 V.
Voltage tap:	Dimensions according to IEEE, Type A. Max. service voltage 6 kV.
Capacitance C_2 of test tap:	< 5000 pF
Conductor:	Integrated tube conductor
Markings:	Conforming to IEC

Testing

Routine testing
The bushing is routine tested according to IEC 60137 and IEC 62271-211. The tests include measurement of partial discharge quantity, tan δ, capacitance and power frequency voltage withstand test. On each bushing, an external pressure test is performed and the tightness between the gas side and the oil side is confirmed.

An individual routine test report is issued with each bushing. The routine test is carried out at room temperature with the bushing immersed in transformer oil.

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02 Test tap.

Type tests
Type tests have been performed according to above standards and are available on request.

Special tests
A number of tests not specified by the above standards have also been performed and summaries are available on request.

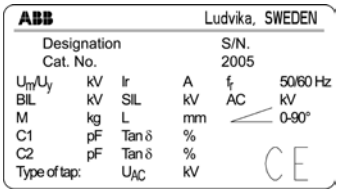
Test tap
The outer conducting layer of the condenser core is connected to an insulated test tap on the flange. During operation the protective cap must be fitted in order to ground the outer layer to the flange. The maximum test voltage is 2 kV, 50 Hz for 1 minute. The maximum service voltage is 600 V.

Voltage tap is available as on request. The maximum test voltage is 20 kV, 50 Hz for 1 minute. The maximum service voltage is 6 kV. The test tap and voltage tap have dimensions according to IEEE, potential tap type A.

Electrical data

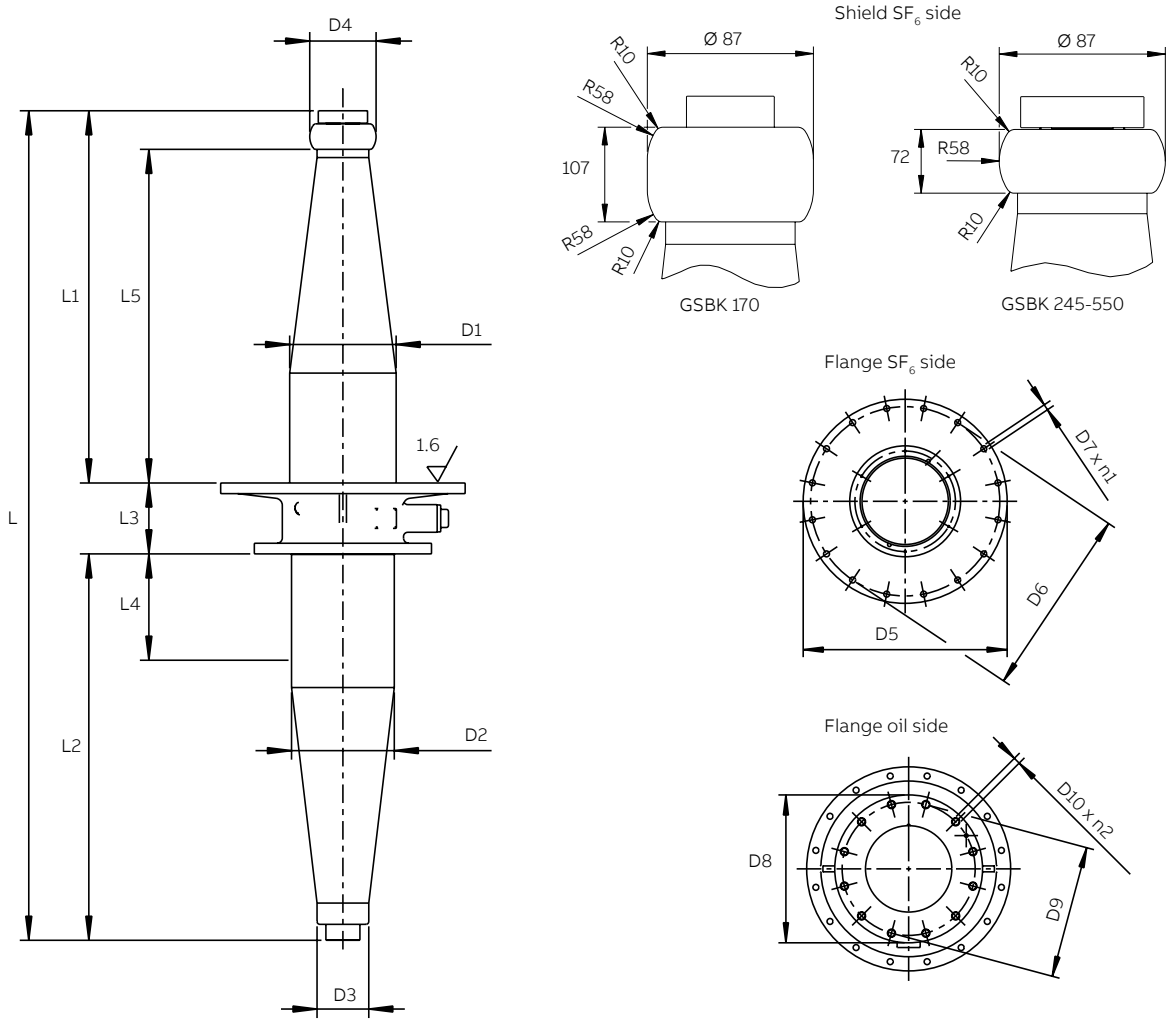
Table 2. Electrical data.

Ratings GSBK	**170**	**245**	**362**	**420**	**550**
Rated voltage IEC (kV), U_m	170	245	362	420	550
Rated phase-to-ground voltage IEC (kV)	98	141	209	242	317
Basic Insulation Level (kV) (Equal to dry lightning impulse withstand voltage.)	750	1050	1300	1550	1675
Dry switching impulse level (kV), SI	N.A.	850	1050	1175	1300
Dry power frequency. Routine test 1 minute (kV)	365	506	630	695	750
Rated current (A), I_r Note! Higher current ratings are available on request.					
Al conductor	1600	1600	1600	1600	1250
Cu conductor	2500	2500	2500	2500	2500
Rated frequency (Hz), fr	50/60	50/60	50/60	50/60	50/60
Temporary over voltage (kV) IEC (phase-to-ground voltage)	170	196	290	336	440
Space for current transformer (mm)	300/600	300/600	300/600	300/600	300/600
Nominal capacitance between conductor and test tap C_1 ±10 % (pF)	496/656	500/622	405/494	346/424	286/352



06 Nameplate with marking example.

Dimensions



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03 Dimensions.

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

		Cat. No. 1ZSC...		Dimensions in mm							
Type GSBK	Rated current (A)	Test tap	Voltage tap 6 kV	L	L1	L2	L3	L4	L5	D1	D2
170	1600	900170-AAA	900170-ABA	1470	520	750	200	300	378	188	180
		-AAB	-ABB	1770	520	1050	200	600	378	188	180
170	2500	900170-ACA	900170-ADA	1470	520	750	200	300	378	188	180
		-ACB	-ADB	1770	520	1050	200	600	378	188	180
245	1600	900245-AAA	900245-ABA	1890	770	920	200	300	663	214	206
		-AAB	-ABB	2190	770	1220	200	600	663	214	206
245	2500	900245-ACA	900245-ADA	1890	770	920	200	300	663	214	206
		-ACB	-ADB	2190	770	1220	200	600	663	214	206
362	1600	900362-AAA	900362-ABA	2285	1050	1035	200	300	943	266	256
		-AAB	-ABB	2585	1050	1335	200	600	943	266	256
362	2500	900362-ACA	900362-ADA	2285	1050	1035	200	300	943	266	256
		-ACB	ADB	2585	1050	1335	200	600	943	266	256
420	1600	900420-AAA	900420-ABA	2340	1050	1090	200	300	943	301	290
		-AAB	-ABB	2640	1050	1390	200	600	943	301	290
420	2500	900420-ACA	900420-ADA	2340	1050	1090	200	300	943	301	290
		-ACB	-ADB	2640	1050	1390	200	600	943	301	290
550	1250	900550-AAA	900550-ABA	2535	1050	1285	200	300	943	355	342
		-AAB	-ABB	2835	1050	1585	200	600	943	355	342
550	2500	900550-ACA	900550-ADA	2535	1050	1285	200	300	943	355	342
		-ACB	-ADB	2835	1050	1585	200	600	943	355	342

										Cantilever load	
D3	**D4**	**D5**	**D6**	**D7 x n1**	**D8**	**D9**	**D10 x n2**	**Space for current transformer (mm)**	**Net mass (kg)**	**Max operating load (kN)**	**Test load (kN)**
146	187	335	305	16 x 8	335	290	15 x 12	300	68	2	4
146	187	335	305	16 x 8	335	290	15 x 12	600	78	2	4
146	187	335	305	16 x 8	335	290	15 x 12	300	96	2	4
146	187	335	305	16 x 8	335	290	15 x 12	600	113	2	4
146	187	565	535	16 x 16	450	400	23 x 12	300	114	2	4
146	187	565	535	16 x 16	450	400	23 x 12	600	128	2	4
146	187	565	535	16 x 16	450	400	23 x 12	300	152	2	4
146	187	565	535	16 x 16	450	400	23 x 12	600	171	2	4
146	187	690	640	20 x 16	500	400	23 x 12	300	178	2	4
146	187	690	640	20 x 16	500	400	23 x 12	600	198	2	4
146	187	690	640	20 x 16	500	400	23 x 12	300	227	2	4
146	187	690	640	20 x 16	500	400	23 x 12	600	253	2	4
146	187	690	640	20 x 16	500	450	23 x 12	300	204	2	4
146	187	690	640	20 x 16	500	450	23 x 12	600	231	2	4
146	187	690	640	20 x 16	500	450	23 x 12	300	250	2	4
146	187	690	640	20 x 16	500	450	23 x 12	600	280	2	4
146	187	690	640	20 x 16	550	500	23 x 12	300	258	2	4
146	187	690	640	20 x 16	550	500	23 x 12	600	294	2	4
146	187	690	640	20 x 16	550	500	23 x 12	300	312	2	4
146	187	690	640	20 x 16	550	500	23 x 12	600	354	2	4

Connection details

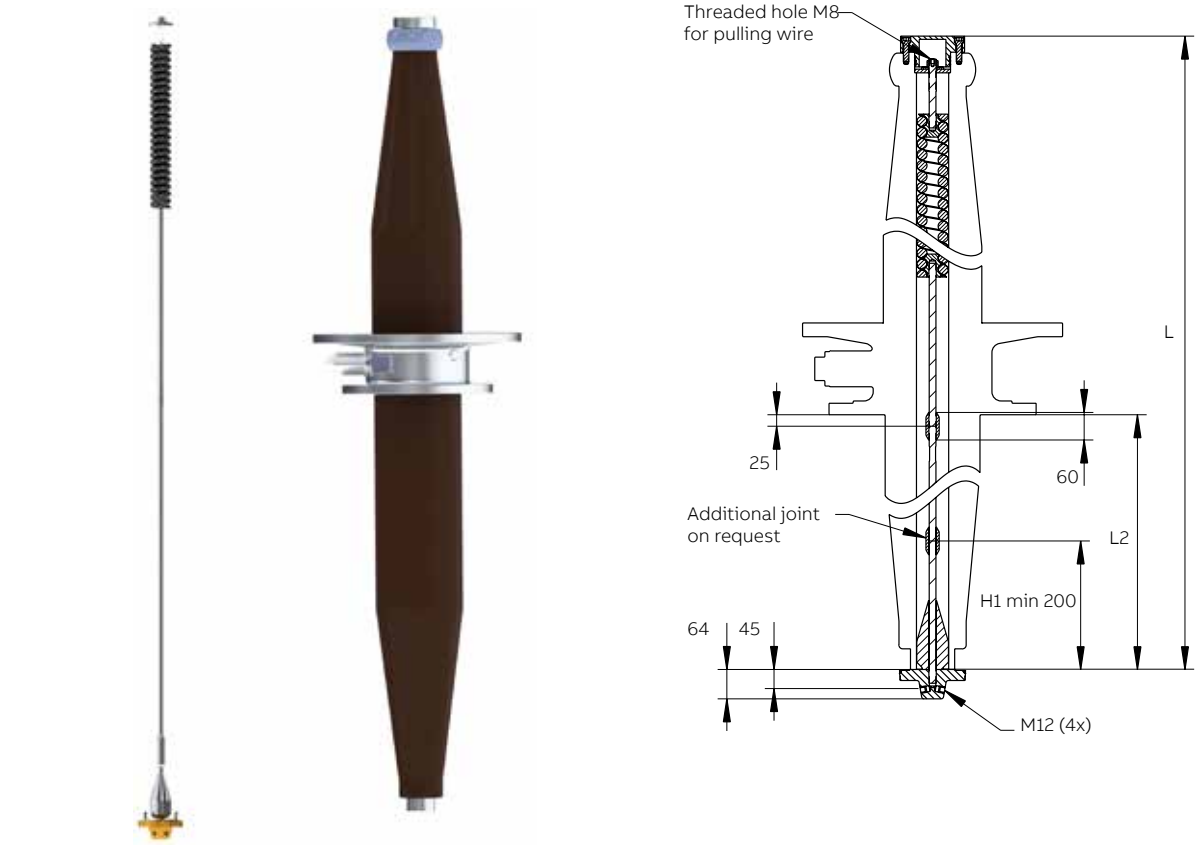
Draw rod system
The draw rod system offers the following advantages compared to other connection systems:

- No hand holes required in the transformer tank.
- Easy bushing installation and removal – no connection work inside the transformer at site.
- No special supports required in the transformer as is the case with plug contacts.
- Perfect guiding of the bushing into the transformer.
- The lower end shield may be fixed to the contact and will thus be correctly positioned with respect to the lower end plate of the bushing.

The center tube of the bushing is used as current conductor. The transformer leads are fitted with cable lugs, which are bolted to a bottom contact. This contact is pressed against the bottom end of the bushing tube by a steel draw rod. The upper end of this rod is bolted to a compensating device, which consists of a spring and is so designed that it gives the required contact pressure at all temperatures. The draw rod is divided at the level of the flange. If required by the transport conditions, an additional joint can be positioned below the flange. This must be stated in the order. The lower part with contact end shield can then be secured to the cover during transport and storage of the transformer.

Bottom contacts with 4 threaded holes for cable lugs are available. The bottom contacts are made of copper in one piece. To this bottom contact there is a suitable end shield, cat. No. 1ZSC999003. Special bottom contacts are available on request.

Catalogue number for draw rod: 1ZSC999004. The draw rod consists of bottom contact, rods, compensating device, joints, washers and nut.



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04 Draw rod system.

Fixed bottom contact

The fixed bottom contact (Cat. No. 1ZSC999002-AAE) uses the same bottom contact as in the draw rod system, i.e. it is made of copper in one piece and has 4 threaded holes for cable lugs. The fixed bottom contact system also uses the center tube as a current conductor but it is secured to the center tube with a pulling ring instead of the draw rod. The pulling ring is made of aluminum and is threaded on to the center tube. The bottom contact is then fastened to the ring with six M10 bolts. Standard end-shields with Cat. No. 1ZSC999003, is suitable for the bottom contact.

SF_6 side terminal

The dimensions on the SF_6 side terminal fully comply to IEC 62271-211 and include 4 threaded holes for GIS connection. The terminal is fitted to the top end of the conductor tube by means of bolts, screwed into a pulling ring. The terminal surface for GIS connection is silver plated. Special terminals are available on request.

Standard end-shield

The end-shield is made of aluminum and coated with insulating epoxy paint or 3 mm of pressboard. The design enables easy installation and should be used with standard draw rod bottom contact, or with the fixed bottom contact system.

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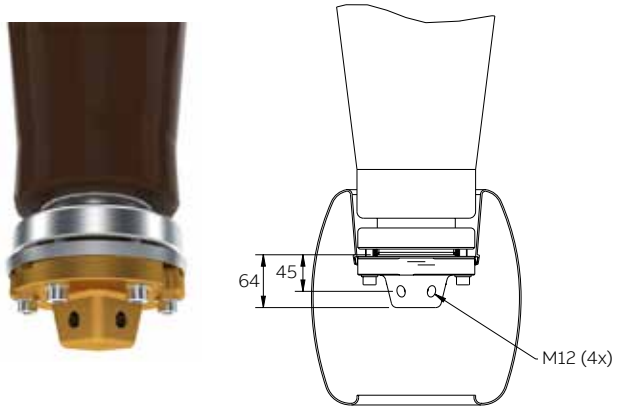
Table 4. Standard end-shield.

Cat. No.	Coating
1ZSC999003-AEA	Epoxy paint
1ZSC999003-AEB	3 mm pressboard



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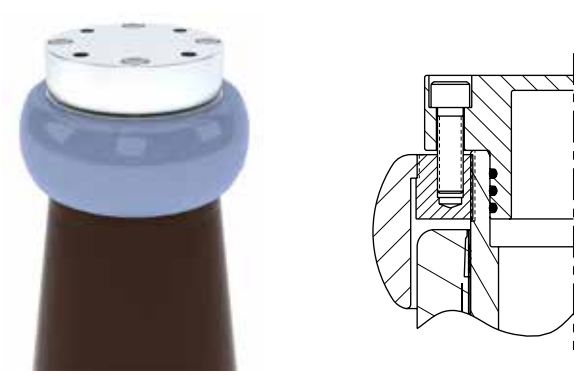
05 Fixed bottom contact.



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06 SF_6 side terminal.

Conductor loading

The GSBK bushings fulfill the temperature rise test requirements according to IEC for the currents in the table below. The rated thermal short-time current (I_{th}) is calculated according to IEC 60137. Contact the supplier for current ratings for GSBK in oil - oil applications.

Table 5. Conductor loading.

Bushing GSBK	Rated current A	Short-time current (I_{th}) kA, rms		Dynamic current (I_d) kA, peak
		1 s	2 s	
170	1600	57	40	100
	2500	88	63	156
245	1600	57	40	100
	2500	88	63	156
362	1600	57	40	100
	2500	88	63	156
420	1600	57	40	100
	2500	88	63	156
550	1250	57	40	100
	2500	88	63	156

Overloading of bushings according to IEC
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 600076-7 when following the directions: for long time and short time emergency loading the oil temperature must be 115 °C max. and the daily mean oil temperature must be 90 °C max.

For overload conditions other than the above-mentioned IEC overload, contact the supplier for permissible currents and temperatures.

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

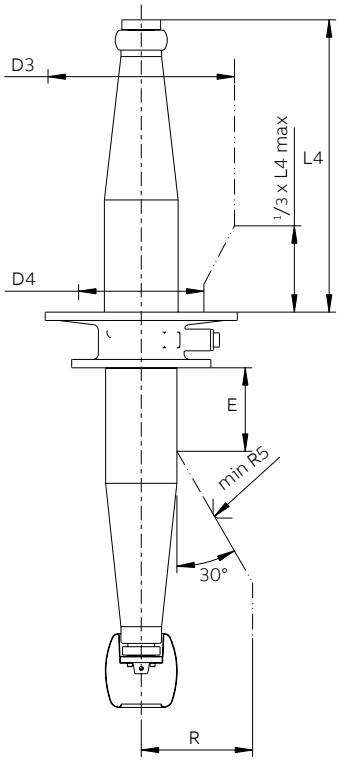
Recommendations for positioning

The maximum stresses in the oil at the surface of the shield and the parts surrounding the bushing must be limited to the normal values for insulated conductors and other similar components in the same transformer.

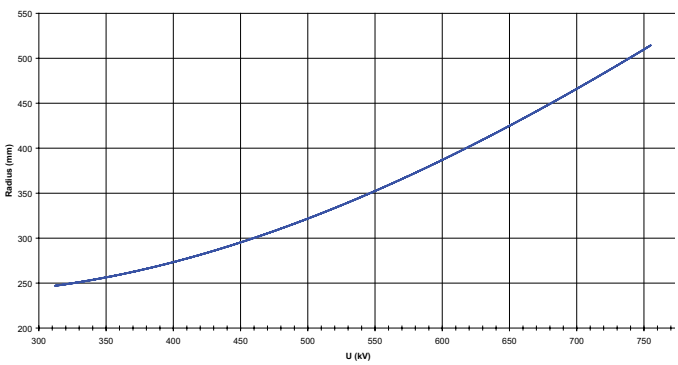
The withstand voltages in a specific case depend upon many factors beyond the control of the bushing manufacturer. Therefore the configurations and distances given in the table and figures are only intended as guidelines.

Table 6. Recommendations for positioning.

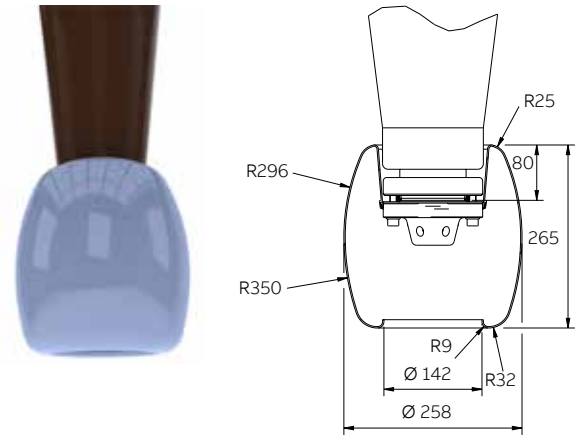
Type GSBK	E (mm)	BIL	L4 (mm)	d3 (mm)	d4 (mm)
170	300	750	520±1	300	220 +3 0
	600	750	520±1	300	220 +3 0
245	300	1050	770±2	450	450 +5 0
	600	1050	770±2	450	450 +5 0
362	300	1175	1050±2	540	540 +5 0
	600	1175	1050±2	540	540 +5 0
420	300	1550	1050±2	540	540 +5 0
	600	1550	1050±2	540	540 +5 0
550	300	1550	1050±2	540	540 +5 0
	300	1675	1050±2	580	540 +5 0
	600	1550	1050±2	540	540 +5 0
	600	1675	1050±2	580	540 +5 0



07 Recommendations for positioning.



08 Recommended minimum distance R, for standard shield at 1 minute power frequency (rms) test.



09 End shield.

Ordering particulars

When ordering, please state:

- Type and catalogue number for bushing
- Connection details: fixed bottom contact or draw rod
- Catalogue number for shield on oil side
- Additional accessories or modifications
- Test required, in addition to the normal routine tests

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