OIP Transformer Outdoor Bushings
Type COT(C) 125…COT (C) 1800
24kV to 550kV
up to 5000A
IEC 60137-2008




TRENCH

Features

If you need any transformer bushing proven in operation conditions around the world, Trench has it !

Transformer Bushings Type COT(C) 125 to COT(C) 1800

- experience in manufacturing of bushings for more than 100 years
- capacitive fine graded oil-paper insulation with long experience
- computer optimized electrical field distribution
- proven high electrical withstand against transient or impulse stresses
- excellent long term stability due to extremely low partial discharge and power loss factor
- oil immersed part covered by epoxy resin tube providing high impact resistance
- electrode embedded in the lower epoxy resin part
  - avoids external shielding
  - reduces distance to ground
  - lower transformer costs
- porcelain cemented into flange provides higher mechanical strength than level II of IEC
- available with porcelain or composite insulator on air side
- inclination in service up to 30° from vertical.
  For COT(C) 125 and COT(C) 170 even horizontal operation is possible
- horizontal transport for all types possible
- tan α and PD-values more than twice as good as requested by IEC 60137
- current rating can easily be increased by exchanging the cable bolt with a removable split conductor on existing bushing

To preserve our environment the free oil volume in COT-bushings is minimized

Certified ISO 9001

Design

1 Top terminal

Terminal (Aluminium or Copper) for connection of overhead lines or bus bars and arcing horns. Trench design provides a maintenance free termination and ensures that the connection will not become loose in service.

2 Assembly

The whole bushing is tightened together by the central tube or conductor.

3 Head

Al-casted head with oil expansion chamber and oil level indicator. The chamber is hermetically sealed against several environmental conditions.

4 Oil filling

COT bushings are filled with dried, degassed insulating mineral oil.

5 Insulator

Porcelain insulator made of high grade electrotechnical porcelain according to IEC 60815. The insulator is connected to the mounting flange using cement and sealed with O-ring gasket. instead of porcelain a composite insulator is also available.

6 Active part

The active part is made of oil-impregnated wide band paper with layers of aluminium foil to control the electrical field radially and axially. Depending on the current rating, the paper and foil are wound on either a central tube or solid conductor

7 Flange

Mounting flange with integrated test tap made of corrosion free aluminium alloy, machined to ensure an excellent seal between the bushing and the transformer.

8 CT-Pocket

If current transformers are required on the bushing, the ground sleeve can be extended.

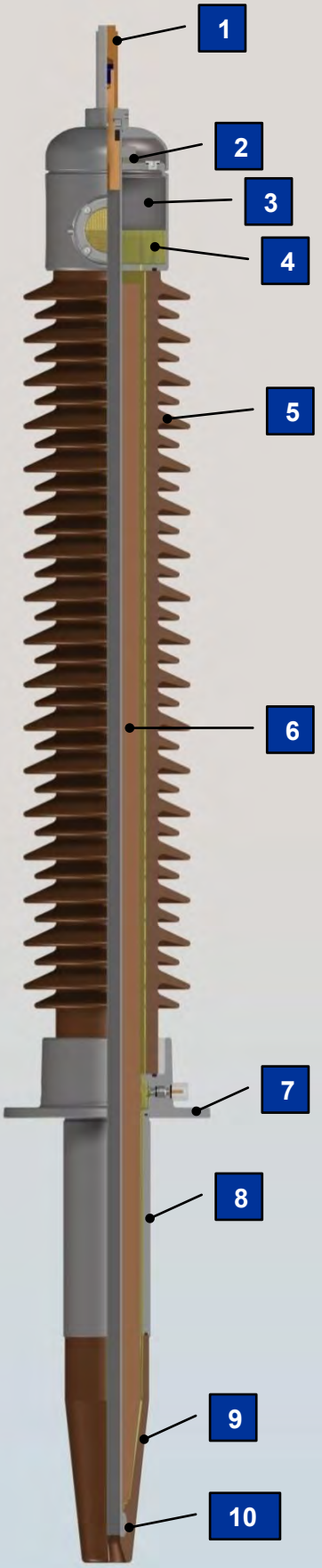
9 Oil side end

The insulator on the oil side is made of an epoxy resin tube. It is designed to stay installed during the in-tank drying process of the transformer and can withstand temperatures up to 130°C.

10 End-shielding

For voltages starting between 52kV & 300kV a special aluminium electrode is casted into the end of the epoxy resin tube. This end shielding controls the electrical field strength in this area to ground.

Cut view
General design



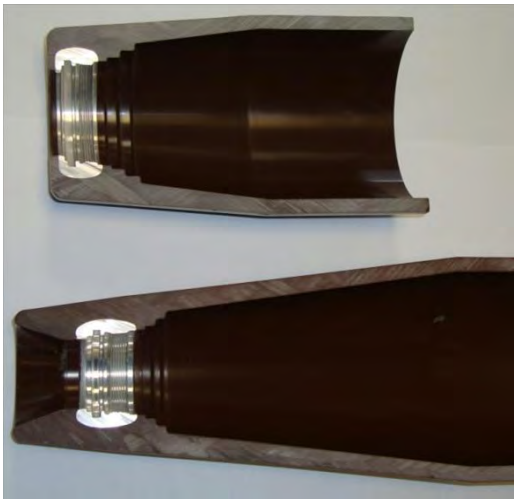
One of several TRENCH winding machines

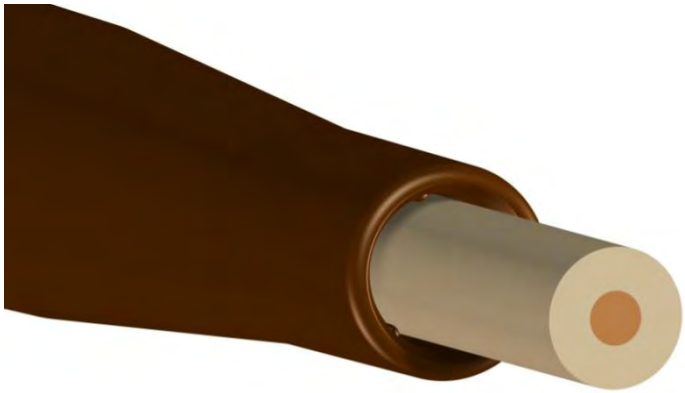
Test tap for C and tan δ measurement

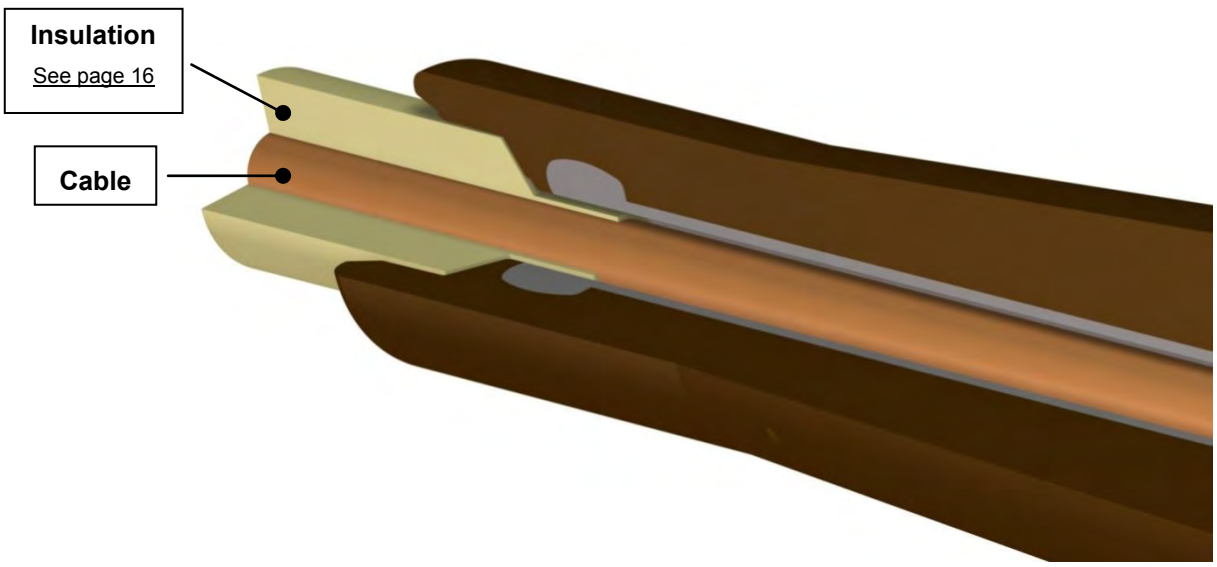
High voltage test laboratory

Epoxy insulator with embedded end shield

Cut view







Type COT 125……450

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
N°	Type	Highest voltage (Um)	Maximum phase to earth voltage	Bushing Dry Power frequency voltage withstand (AC)	Transformer Power frequency voltage withstand (AC)	Lightning Impulse withstand voltage (BIL)	Switching Impulse wet (SIL): 250/2500µs	Rated current (Ir)	Connection to Transformer	Cable cross section Conductor	CT Space L4 see fig.3 page 12	AD Arcing distance (min.)	Standard creepage distance	Mass Approx.	Cantilever test load (min)
		kV	kV	kV	kV	kV	kV	A		mm² mm	mm	mm	mm	kg	N
01	COT 125	24	14	55	50	125	/	800	cable	400	Standard: 0, 300, 500	235	600	22	2000
02								1000	cable [1])	400				22	2000
03								1250	rem.Co-cond.[2])	35				28	2000
04								1600	fixed Co-cond.	-				29	2000
05								2500	fixed Co-cond.	-				32	2000
06								3150	fixed Co-cond.	-				36	3150
07	COT 170	36	21	77	70	170	/	800	cable	400		340	*1116	31	2000
08								1000	cable [1])	400			*1116	31	2000
09								1250	rem.Co-cond.[2])	35			*1116	38	2000
10								1600	fixed Co-cond.	-			*1116	44	2000
11								2500	fixed Co-cond.	-			*1116	49	2000
12								3150	fixed Co-cond.	-			*1116	53	3150
13	COT 250	52	30	105	95	250	/	800	cable	400		465	1300	26	2000
14								1000	cable [1])	400				26	2000
15								1250	rem.Co-cond.[2])	35				35	2000
16								1600	fixed Co-cond.	-				36	2000
17								2500	fixed Co-cond.	-				54	3150
18								3150	fixed Co-cond.	-				75	4000
19	COT 325	72,5	42	155	140	325	/	800	cable	400		600	1820	31	2000
20								1000	cable [1])	400				31	2000
21								1250	rem.Co-cond.[2])	35				40	2000
22								1600	fixed Co-cond.	-				44	2000
23								2500	fixed Co-cond.	-				62	3150
24								3150	fixed Co-cond.	-				88	4000
25	COT 450	100	58	205	185	450	/	800	cable	400		820	2540	40	2000
26								1000	cable [1])	400				40	2000
27								1250	rem.Co-cond.[2])	35				52	2000
28								1600	fixed Co-cond.	-				56	2000
29								2500	fixed Co-cond.	-				80	3150
30								3150	fixed Co-cond.	-				106	4000

25 mm / kV

25 mm/kV

Comments related to columns 1…33:

04: Bushings test voltage at 50Hz 60 sec.

09: [1]) Class F insulation

[2]) Removable solid rod copper conductor

Connection system see pages 17 to 23

11: Extension for current transformer (other extensions on request)

13: * 31mm/kV in standard

Type COT 125……450

08	16	17	18	19	20	21	22	24	25	26	27	28	29	30	31	32	33
Rated current (Ir)	L	L_1	L_2	L_3	L_6	L_7	D	D_2	D_3	D_4	D_5	D_6	D_7 min	øt	n	e	see fig.
A	mm															mm	
800	761	140	621	452	80	60	80	184	240	210	190	30	40	24	4	12	19
1000	761	140	621	452	80	60	80	184	240	210	190	30	40	24	4	12	19
1250	761	140	621	-	80	60	80	184	240	210	190	30	-	24	4	12	20
1600	729	140	589	-	125	60	80	184	240	210	190	40	-	24	4	12	21
2500	729	140	589	-	125	60	80	184	240	210	190	40	-	24	4	12	21
3150	729	140	589	-	125	60	80	184	240	210	190	40	-	24	4	12	21
800	895	169	726	557	80	60	80	184	240	230	190	30	40	24	4	12	19
1000	895	169	726	557	80	60	80	184	240	230	190	30	40	24	4	12	19
1250	895	169	726	-	80	60	80	184	240	230	190	30	-	24	4	12	20
1600	863	169	694	-	125	60	80	184	240	230	190	40	-	24	4	12	21
2500	863	169	694	-	125	60	80	184	240	230	190	40	-	24	4	12	21
3150	863	169	694	-	125	60	80	184	240	230	190	40	-	24	4	12	21
800	1090	140	950	760	80	100	100	185	225	200	170	30	35	16	6	14	22
1000	1090	140	950	760	80	100	100	185	225	200	170	30	35	16	6	14	22
1250	1090	140	950	-	80	100	100	185	225	200	170	30	-	16	6	14	23
1600	1135	140	995	-	125	100	100	185	225	200	170	40	-	16	6	14	24
2500	1095	140	955	-	125	110	120	200	240	231	170	60	-	22	6	15	25
3150	1105	140	965	-	125	110	130	290	335	242	170	60	-	16	12	16	26
800	1210	175	1035	845	80	100	100	185	225	210	170	30	35	16	6	14	22
1000	1210	175	1035	845	80	100	100	185	225	210	170	30	35	16	6	14	22
1250	1210	175	1035	-	80	100	100	185	225	210	170	30	-	16	6	14	23
1600	1255	175	1080	-	125	100	100	185	225	210	170	40	-	16	6	14	24
2500	1275	175	1100	-	125	110	120	200	240	231	170	60	-	22	6	15	25
3150	1285	175	1110	-	125	110	130	290	335	242	170	60	-	16	12	16	26
800	1503	230	1273	1085	80	100	100	185	225	210	170	30	35	16	6	14	22
1000	1503	230	1273	1085	80	100	100	185	225	210	170	30	35	16	6	14	22
1250	1503	230	1273	-	80	100	100	185	225	210	170	30	-	16	6	14	23
1600	1548	230	1318	-	125	100	100	185	225	210	170	40	-	16	6	14	24
2500	1543	230	1313	-	125	110	120	200	240	231	170	60	-	22	6	15	25
3150	1553	230	1323	-	125	110	130	290	335	242	170	60	-	16	12	16	26

12, 13: Brown glazed porcelain, other colours and Other creepage distances upon request

15: According to IEC 137 level II or better

16, 17: L_1 depends on L_4. The values in the table are valid for L_4= 0mm. If L_4>0mm add L_4 to L_1 and L.

24, 25, 29, 32: Other dimensions on request.

Type COT 550……1050

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
N°	Type	Highest voltage (Um)	Maximum phase to earth voltage	Bushing Dry Power frequency voltage withstand (AC)	Transformer Power frequency voltage withstand (AC)	Lightning Impulse withstand voltage (BIL)	Switching Impulse wet (SIL): 250/2500µs	Rated current (Ir)	Connection to Transformer	Cable cross section Conductor	CT Space L4 see fig.3 page 12	AD Arcing distance (min.)	Standard creepage distance	Mass Approx.	Cantilever test load (min.)
		kV	kV	kV	kV	kV	kV	A		mm² mm	mm	mm	mm	kg	N
01	COT 550	123	71	255	230	550	/	800	cable	400	Standard: 0, 300, 500	1050	3100	62	3150
02								1000	cable [1])	400				62	3150
03								1250	rem.Co-cond.[2])	35				74	3150
04								1600	fixed Co-cond.	-				79	3150
05								2500	fixed Co-cond.	-				165	4000
06								3150	fixed Co-cond.	-				173	4000
07	COT 650	145	84	305	275	650	/	800	cable	400		1250	3625	81	3150
08								1000	cable [1])	400				81	3150
09								1250	rem.Co-cond.[2])	35				98	3150
10								1600	fixed Co-cond.	-				101	3150
11								2500	fixed Co-cond.	-				190	4000
12								3150	fixed Co-cond.	-				198	4000
13	COT 750	170	98	355	325	750	/	800	cable	400		1460	4250	92	4000
14								1000	cable [1])	500				92	4000
15								1250	rem.Co-cond.[2])	35				111	4000
16								1600	fixed Co-cond.	-				117	4000
17								2500	fixed Co-cond.	-			*5270	315	5000
18								3150	fixed Co-cond.	-				223	5000
19	COT 1050	245	142	505	460	1050	750	800	cable	400		2150	6125	236	4000
20							750	1000	cable [1])	500				236	4000
21							750	1250	rem.Co-cond.[2])	38				266	4000
22							750	1600	fixed Co-cond.	-				285	4000
23							750	2500	fixed Co-cond.	-				328	5000
24							750	3150	fixed Co-cond.	-				332	5000
25	COT 1050	300	173	560	510	1050	850	1000	Cable	630		2400	7500	350	5000
26							850	1600	fixed Co-cond.	-				440	5000
27							850	2500	fixed Co-cond.	-				445	5000

25mm / kV

Comments related to columns 1…33:

04: Bushings test voltage at 50Hz 60 sec.

09: [1]) Class F insulation

[2]) Removable solid rod copper conductor

11: Extension for current transformer (other extensions on request)

Connection system see pages 17 to 23

13: * 31mm/kV in standard

Type COT 550……1050

08	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Rated current (Ir)	L	L_1	L_2	L_3	L_6	L_7	D	D_1	D_2	D_3	D_4	D_5	D_6	D_7 min	øt	n	e	see fig.
A	mm																mm	
800	1805	310	1495	1306	80	110	120	-	250	290	231	170	30	35	16	8	15	27
1000	1805	310	1495	1306	80	110	120	-	250	290	231	170	30	35	16	8	15	27
1250	1805	310	1495	-	80	110	120	-	250	290	231	170	30	-	16	8	15	28
1600	1850	310	1540	-	125	110	120	-	250	290	231	170	40	-	16	8	15	29
2500	2089	310	1779	-	125	195	175	-	290	290	295	300	60	-	20	12	20	30
3150	2052	310	1742	-	125	195	175	-	400	450	295	300	60	-	22	12	22	31
800	2055	360	1695	1506	80	110	130	-	290	335	242	170	30	35	16	12	16	27
1000	2055	360	1695	1506	80	110	130	-	290	335	242	170	30	35	16	12	16	27
1250	2055	360	1695	-	80	110	130	-	290	335	242	170	30	-	16	12	16	28
1600	2100	360	1740	-	125	110	130	-	290	335	242	170	40	-	16	12	16	29
2500	2339	360	1979	-	125	195	175	-	290	335	295	300	60	-	20	12	20	30
3150	2302	360	1942	-	125	195	175	-	400	450	295	300	60	-	22	12	22	31
800	2325	420	1905	1716	80	110	130	-	290	335	242	170	30	35	16	12	16	27
1000	2325	420	1905	1716	80	110	130	-	290	335	242	170	30	35	16	12	16	27
1250	2325	420	1905	-	80	110	130	-	290	335	242	170	30	-	16	12	16	28
1600	2370	420	1950	-	125	110	130	-	290	335	242	170	40	-	16	12	16	29
2500	2609	420	2189	-	125	195	175	-	290	335	335	300	60	-	20	12	20	30
3150	2572	420	2152	-	125	195	175	-	400	450	295	300	60	-	22	12	22	31
800	3518	684	2834	2500	80	195	175	-	400	450	295	300	30	40	22	12	22	32
1000	3518	684	2834	2500	80	195	175	-	400	450	295	300	30	40	22	12	22	32
1250	3518	684	2834	-	80	195	175	-	400	450	295	300	30	-	22	12	22	33
1600	3563	684	2879	-	125	195	175	-	400	450	295	300	40	-	22	12	22	34
2500	3563	684	2879	-	125	195	200	-	400	450	340	300	60	-	22	12	22	35
3150	3407	684	2842	-	125	195	200	-	400	450	340	300	60	-	22	12	22	36
1000	3813	684	3129	2750	80	195	200	-	400	450	350	300	40	55	22	12	22	37
1600	3813	684	3129	-	125	195	200	-	400	450	350	300	40	-	22	12	22	38
2500	3742	650	3092	-	125	195	200	-	400	450	350	300	50	-	22	12	22	39

12, 13: Brown glazed porcelain, other colours and Other creepage distances upon request

15: According to IEC 137 level II or better

16, 17: L_1 depends on L_4. The values in the table are valid for L_4= 0mm. If L_4>0mm add L_4 to L_1 and L.

24, 25, 29, 32: Other dimensions on request.

Type COT 1175……1800

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
N°	Type	Highest voltage (Um)	Maximum phase to earth voltage	Bushing Dry Power frequency voltage withstand (AC)	Transformer Power frequency voltage withstand (AC)	Lightning Impulse withstand voltage (BIL)	Switching Impulse wet (SIL): 250/2500µs	Rated current (Ir)	Connection to Transformer	Cable cross section Conductor	CT Space L4 see fig.3 page 12	AD Arcing distance (min.)	Standard creepage distance	Mass Approx.	Cantilever test load (min)
		kV	kV	kV	kV	kV	kV	A		mm² mm	mm	mm	mm	kg	N
01	COT 1175	362	209	560	510	1175	950	1000	cable	630	Standard: 0, 300, 500	2800	9115	480	5000
02								1600	Fixed cond.	-		2800			5000
03								2500	Fixed cond.	-		2800		540	5000
04	COT 1300	362	209	625	570	1300	950	1000	cable	630		2800	9115	500	5000
05								1600	Fixed cond.	-		2800		530	5000
06								2500	Fixed cond.	-		2800		560	5000
07	COT 1425	420	243	695	630	1425	1050	1000	cable	630		3300	*13750	865	5000
08								1600	Fixed cond.	-		3300	*13750	930	5000
09								2500	Fixed cond.	-		3300	*13750	990	5000
10	COT 1550	550	318	750	680	1550	1175	1000	cable	630		3800	14350	940	5000
11								1600	Fixed cond.	-		3800		1000	5000
12								2500	Fixed cond.	-		3800		1030	5000
13	COT 1675	550	318	750	680	1675	1175	1000	cable	630		3800	14350	980	5000
14								1600	Fixed cond.	-		3800		1060	5000
15								2500	Fixed cond.	-		3800		1100	5000
16	COT 1800	550	318	870	790	1800		1000	cable	630		4200	14350	1050	5000
17								1600	Fixed cond.	-		4200		1150	5000
18								2500	Fixed cond.	-		4200		1200	5000

25 mm / kV

Comments related to columns 1…33:

04: Bushings test voltage at 50Hz 60 sec.
Connection system see pages 17 to 23

11: Extension for current transformer (other extensions on request)

13: * 31mm/kV in standard for Type COT 1425

Type COT 1175……1800

08	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Rated current (Ir)	L	L_1	L_2	L_3	L_6	L_7	D	D_1	D_2	D_3	D_4	D_5	D_6	D_7	øt	n	e	see fig.
A	mm																mm	
1000	4270	720	3550	3240	125	250	235	-	400	450	390	330	40	55	22	12	22	40
1600	4230	720	3510	-	125	250	235	-	400	450	390	330	40	-	22	12	22	41
2500	4230	720	3510	-	125	250	235	-	400	450	390	330	40	-	22	12	22	41
1000	4270	720	3550	3240	125	250	235	-	400	450	390	330	40	55	22	12	22	40
1600	4230	720	3510	-	125	250	235	-	400	450	390	330	40	-	22	12	22	41
2500	4230	720	3510	-	125	250	235	-	400	450	390	330	40	-	22	12	22	41
1000	5055	820	4235	3995	125	280	291	380	530	590	477	400	40	68	23	12	25	42
1600	4965	820	4145	-	125	280	291	380	530	590	477	400	40	-	23	12	25	43
2500	4965	820	4145	-	125	280	291	380	530	590	477	400	50	-	23	12	25	43
1000	5790	1055	4735	4495	125	280	291	380	530	590	455	500	40	68	23	12	25	42
1600	5700	1055	4645	-	125	280	291	380	530	590	455	500	40	-	23	12	25	43
2500	5700	1055	4645	-	125	280	291	380	530	590	455	500	50	-	23	12	25	43
1000	5935	1200	4735	4495	125	280	291	380	530	590	455	500	40	68	23	12	25	42
1600	5845	1200	4645	-	125	280	291	380	530	590	455	500	40	-	23	12	25	43
2500	5845	1200	4645	-	125	280	291	380	530	590	455	500	50	-	23	12	25	43
1000	6345	1200	5145	4895	125	280	291	380	530	590	455	500	40	68	23	12	25	42
1600	6245	1200	5045	-	125	280	291	380	530	590	455	500	40	-	23	12	25	43
2500	6255	1200	5055	-	125	280	291	380	530	590	455	500	50	-	23	12	25	43

12, 13: Brown glazed porcelain, other colours and Other creepage distances upon request

15: According to IEC 137 level II or better

16, 17: L_1 depends on L_4. The values in the table are valid for L_4= 0mm. If L_4>0mm add L_4 to L_1 and L.

24, 25, 29, 32: Other dimensions on request.

Dimensional Drawing

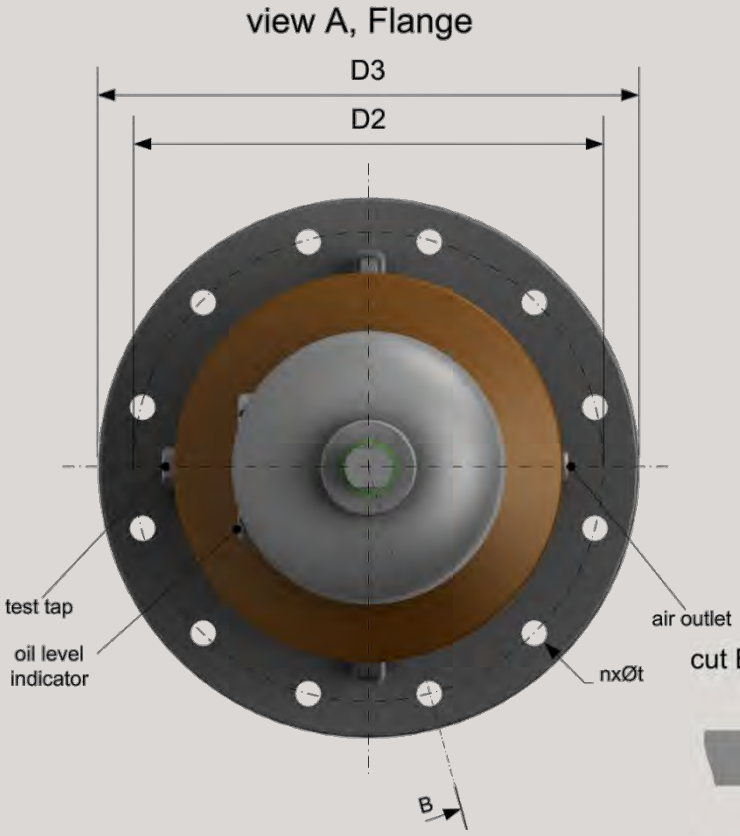


Fig. 1

Fig. 2

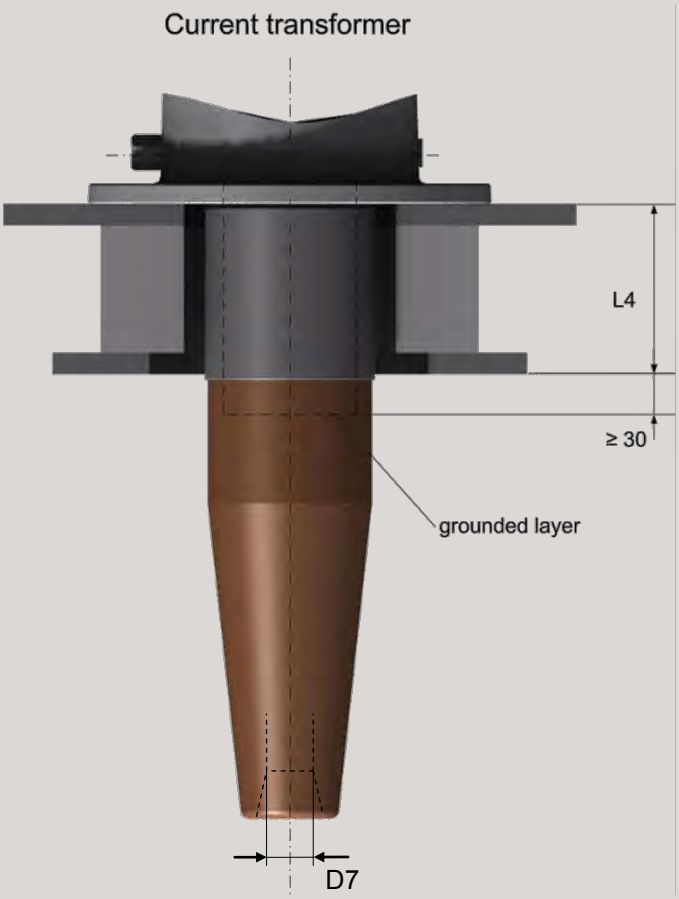


Fig. 3

COT 550…1050 (Um =245kV), 3150 A

COT 1050 (Um=300kV), 2500A

COT 1175 … 1800

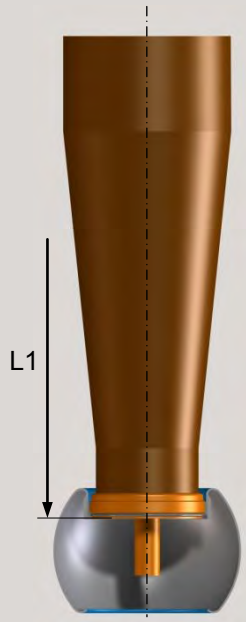


Fig. 4

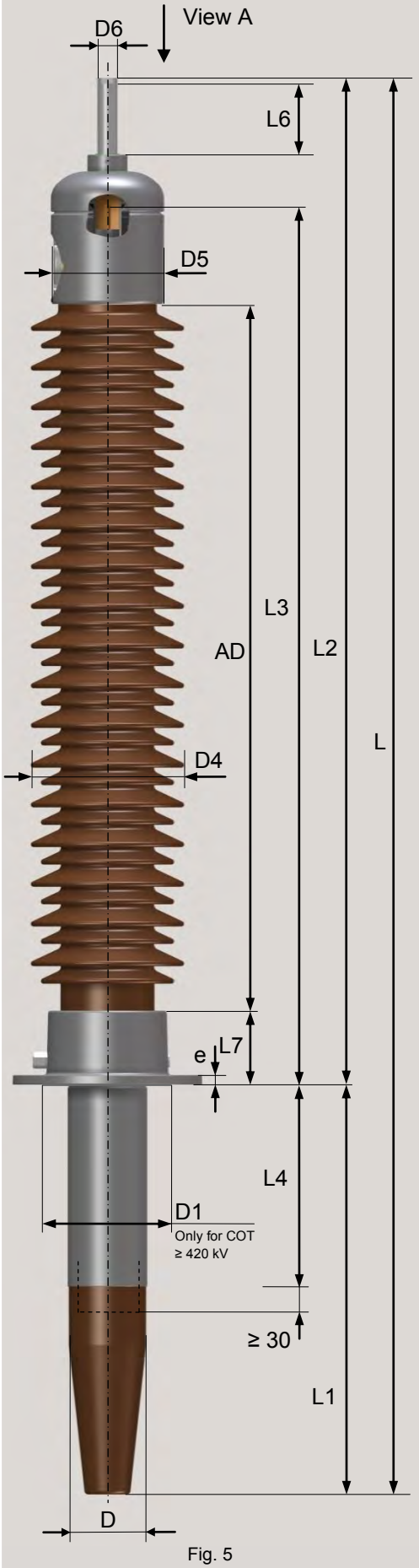
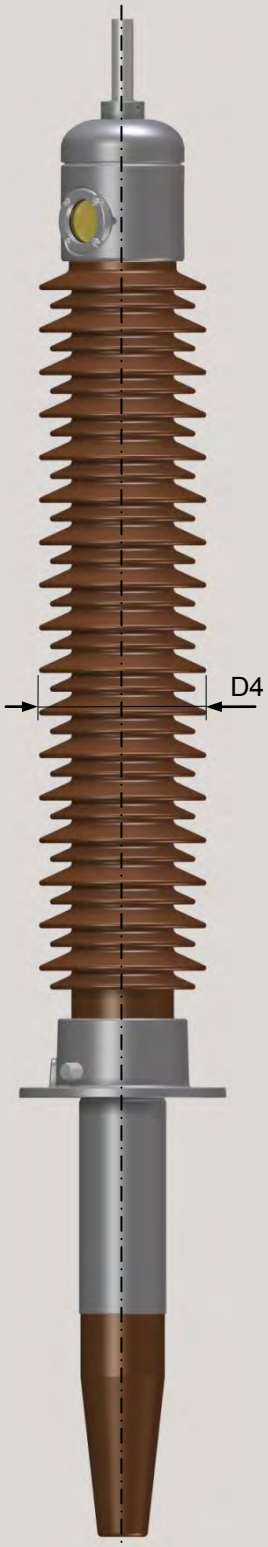


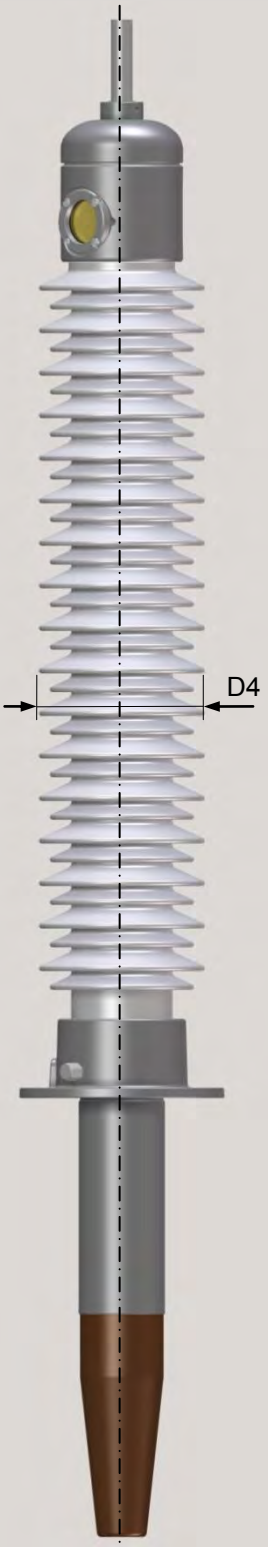
Fig. 5

Porcelain Insulator (Type COT)

Brown color (RAL 8016)

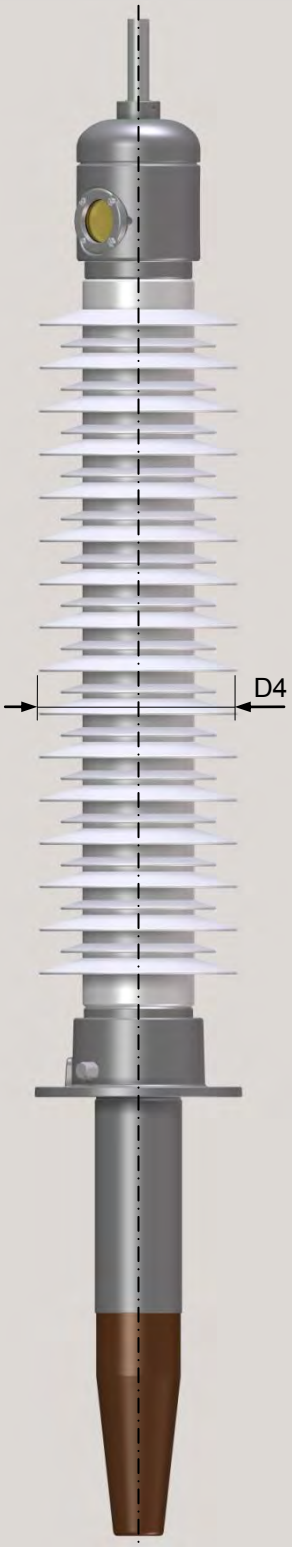


Gray color (ANSI gray N70)

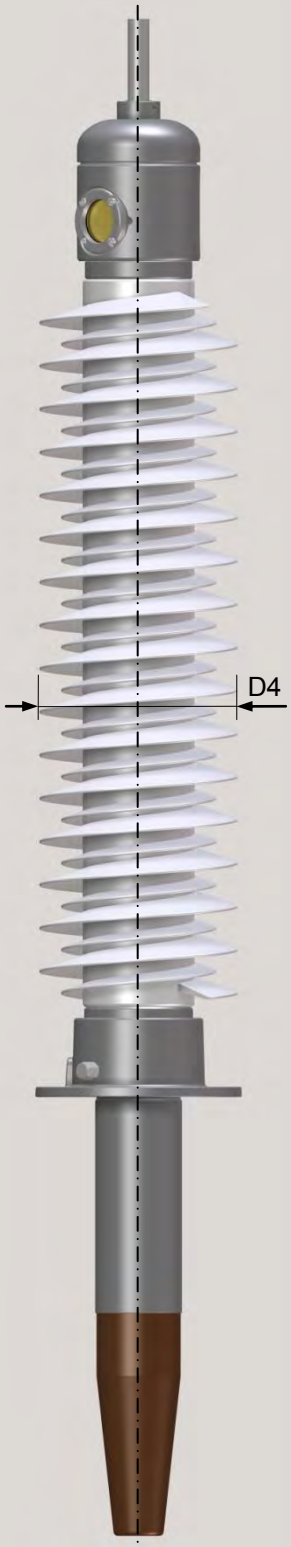


Composite Insulator (Type COTC)

Alternate sheds (ANSI gray N70)



Helicoil sheds (ANSI gray N70)



All COT(C) can be equipped with silicone rubber insulators upon request without affecting dimensions except D4

Oil level indicator
COT 125, COT 170

Fig. 6

Oil level indicator
COT 250 … COT 1050

Fig. 7

Test tap (2kV)

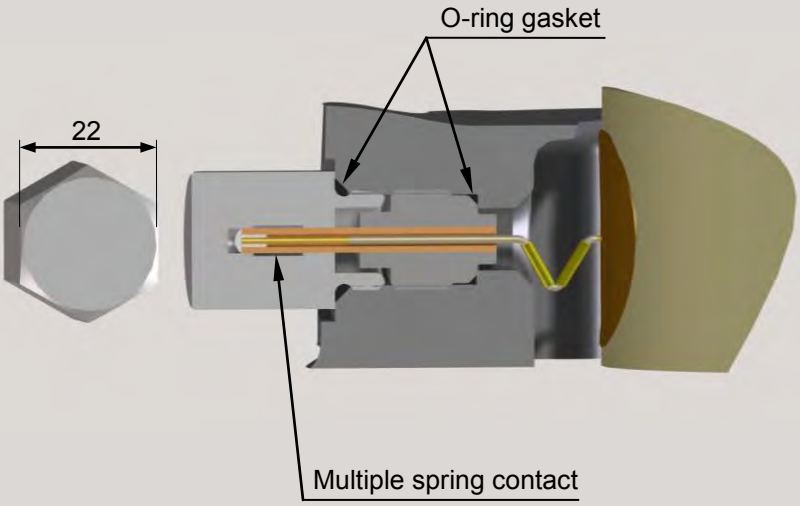


Fig. 8

Air escape screw

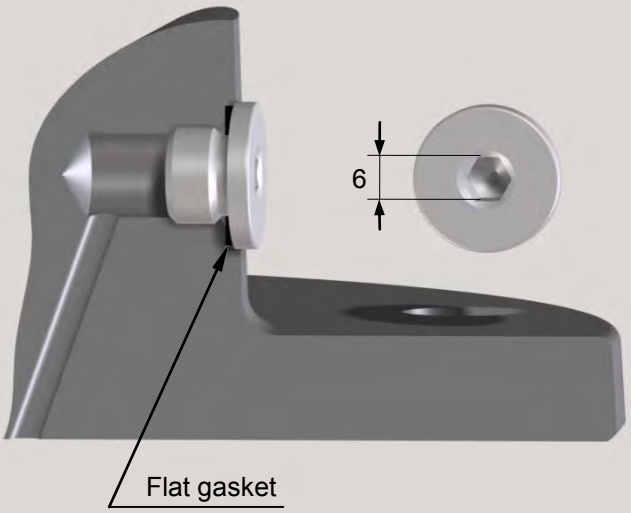


Fig. 9

Magnetic oil level indicator (Ø95)
COT 250 … COT 1800

Fig. 10

Arcing horns

Type	S	
	min	max
	mm	
COT 125	-	-
COT 170	-	-
COT 250	220	270
COT 325	300	390
COT 450	430	520
COT 550	420	650
COT 650	500	750
COT 750	500	850
COT 1050	750	1200

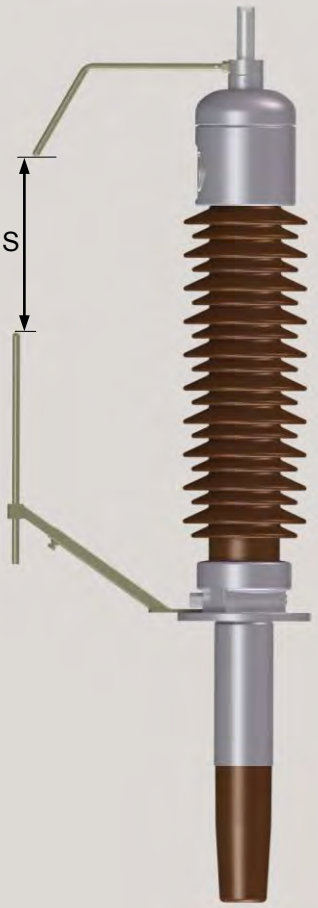


Fig. 11

Voltage tap according to ANSI/IEEE (20kV)

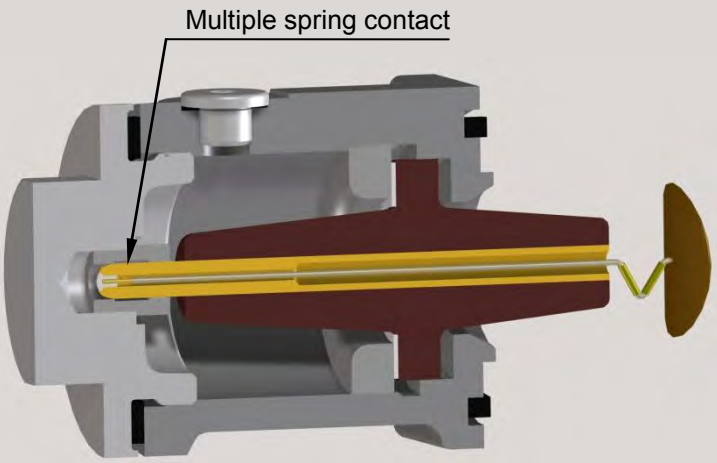


Fig. 12

Oil sampling device

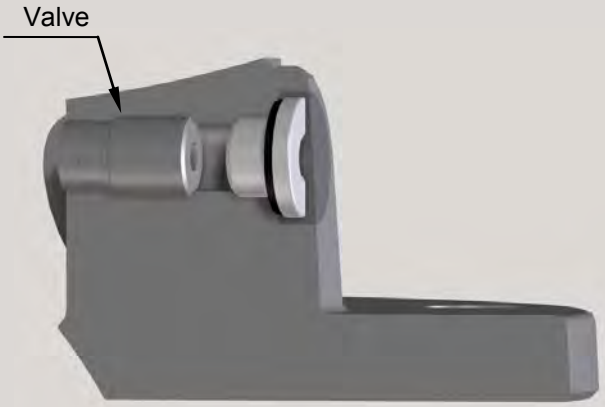
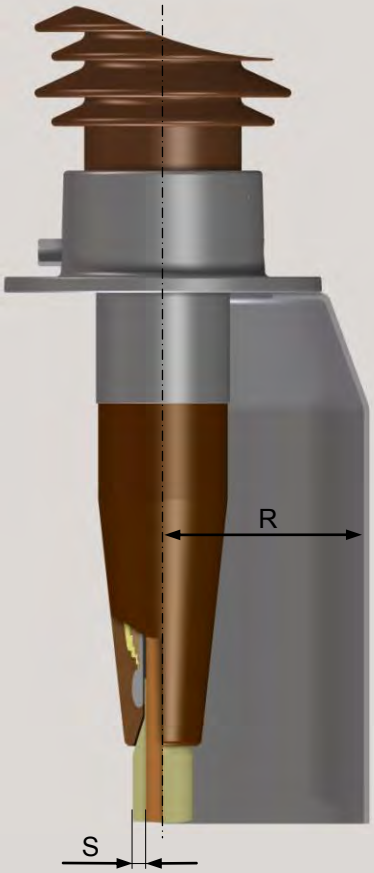


Fig. 13

Recommendations for lead out arrangement

Embedded shield



These bushings are equipped on the lower end with a cone shaped epoxy resin tube and an embedded electrode. Therefore, additional barriers or electrodes may be omitted and distance to ground is reduced

Oil conditions:

Mineral oil with less than 10ppm water content and dielectric strength higher than 60kV (acc. to IEC 60156)

Fig. 14

External shield

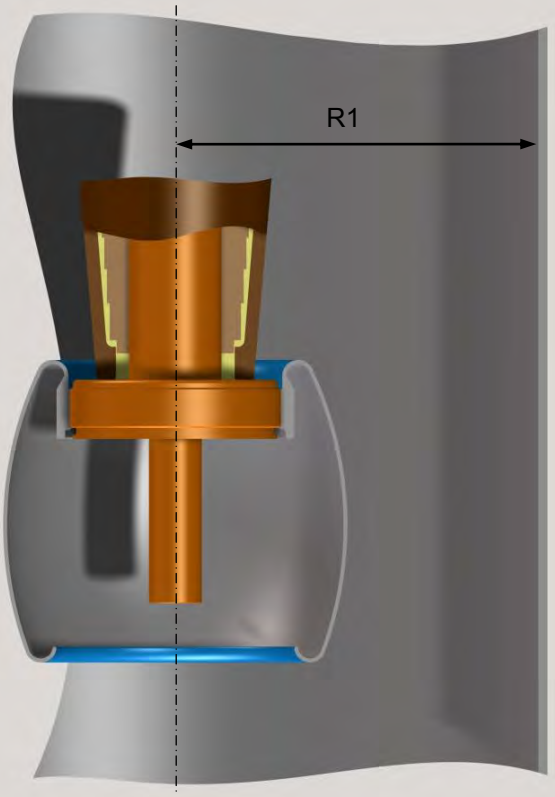


Fig. 15

Draw lead insulation

COT 550…750

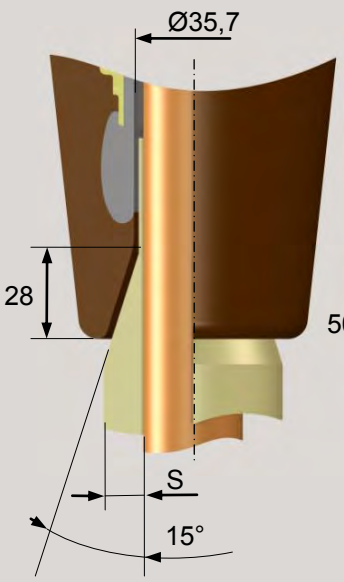


Fig. 16

COT 1050

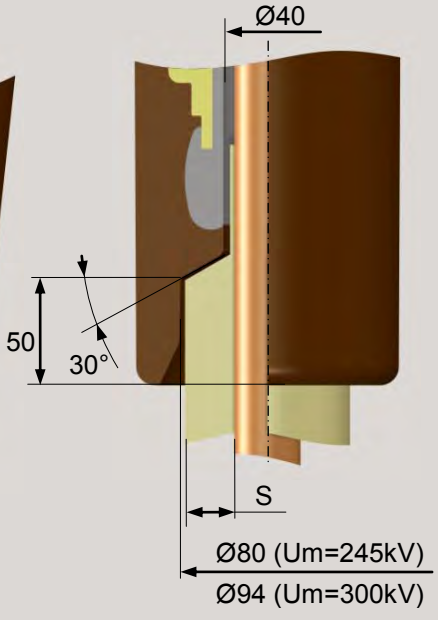


Fig. 17

Cable insulation and distance to grounded parts			
Type	**Min. insulation thickness**	**Min. distance to grounded parts**	
	S	**R**	**R1**
	mm		
COT 125	5	65	-
COT 170	5	75	-
COT 250	10	85	-
COT 325	10	120	-
COT 450	12	135	-
COT 550	12	145	250
COT 650	15	180	275
COT 750	15	225	300
COT 1050	20	300	375
COT 1175 to COT 1800	-	-	See spec 40497124

Removable split conductor

COT 125 … COT 1175
1250 A

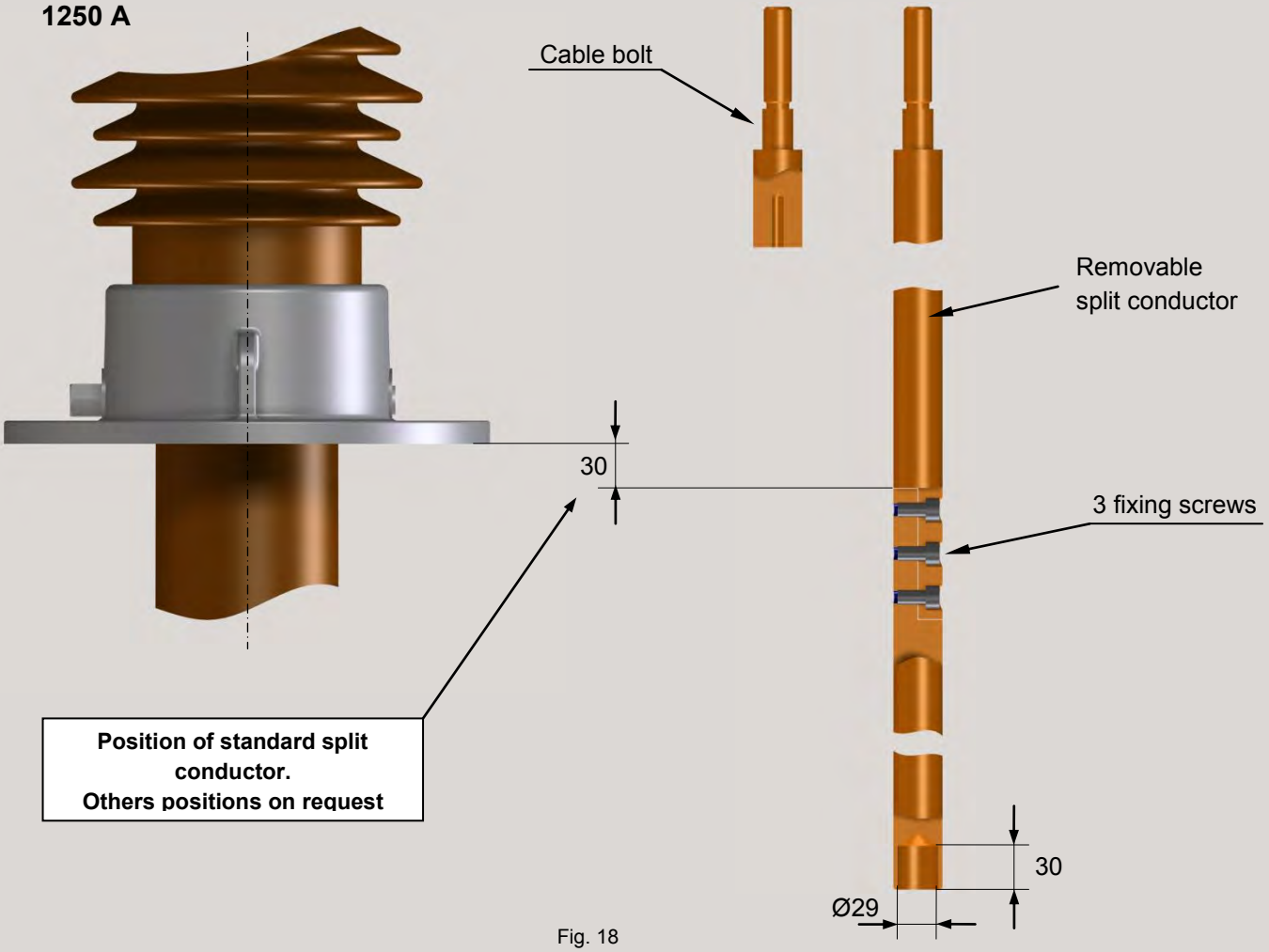
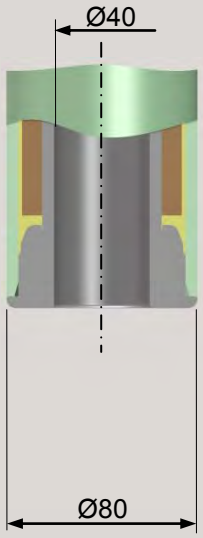


Fig. 18

Oil side end

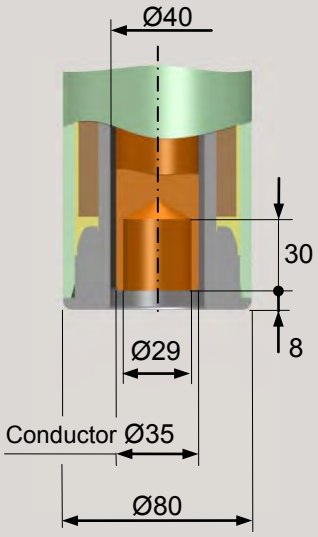
COT 125, COT 170

… 1000A



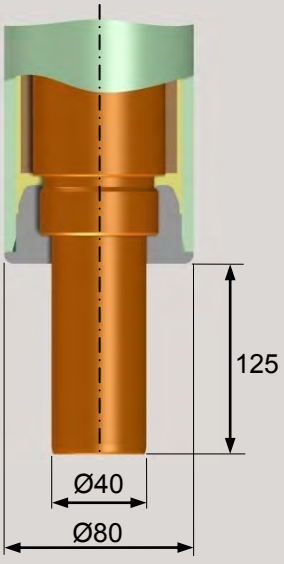
Cable Fig. 19

… 1250A



Removable copper conductor Fig. 20

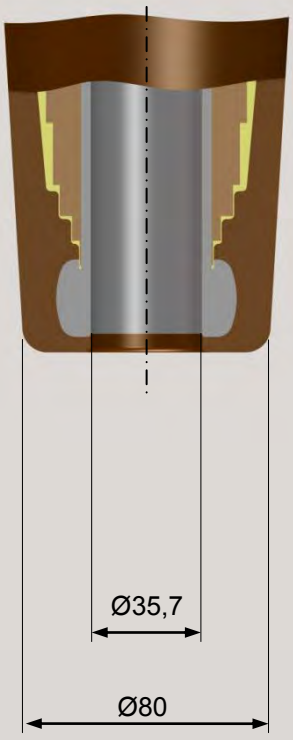
1600 … 3150A



Fixed copper-conductor Fig. 21

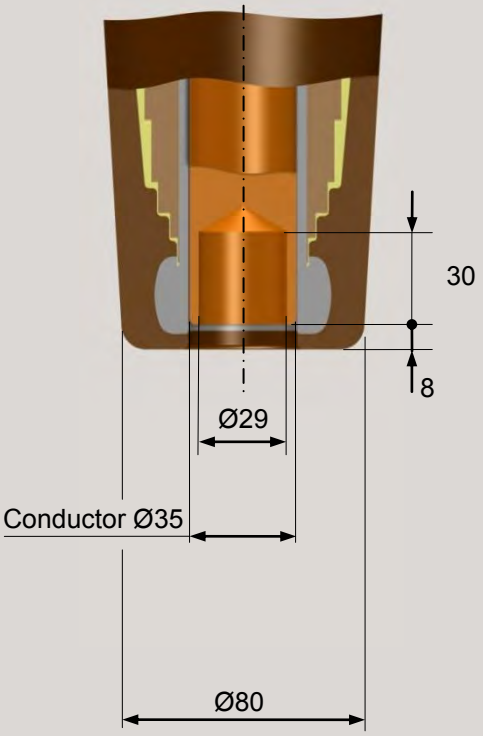
COT 250 … COT 450

… 1000A



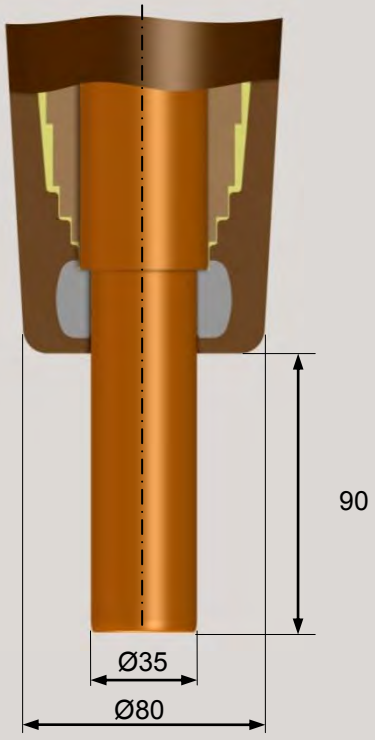
Cable Fig. 22

… 1250A



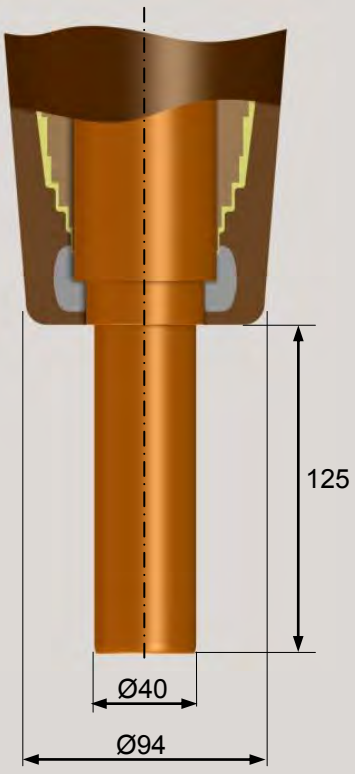
Removable copper conductor Fig. 23

… 1600 A



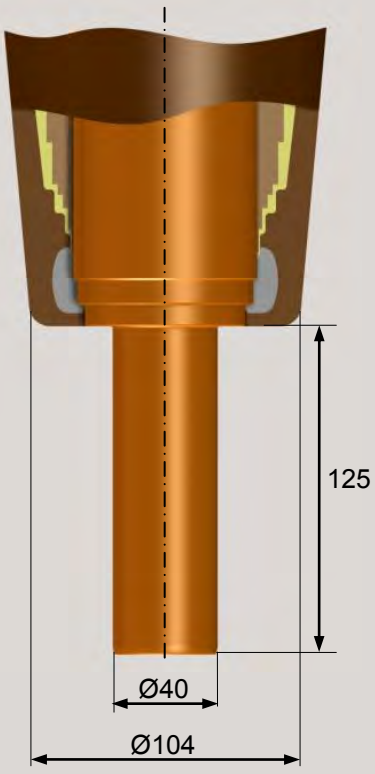
Fixed copper-conductor Fig. 24

… 2500A



Fixed copper-conductor Fig. 25

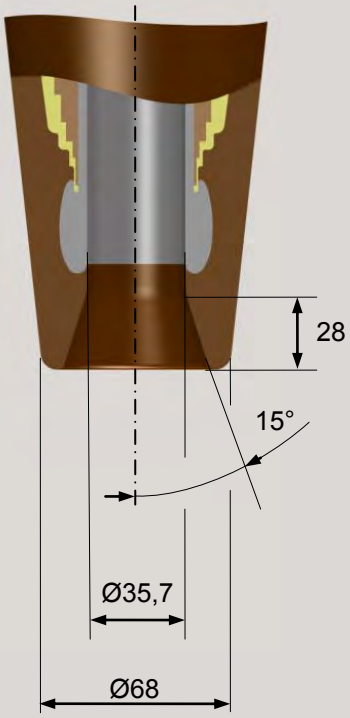
… 3150A



Fixed copper-conductor Fig. 26

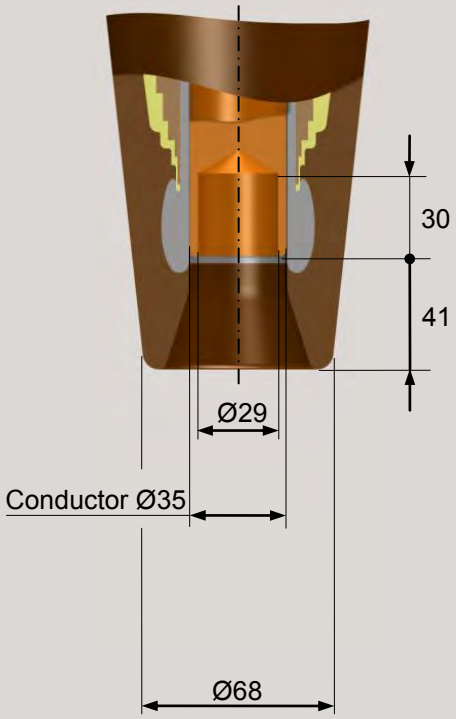
COT 550 … COT 750

… 1000A



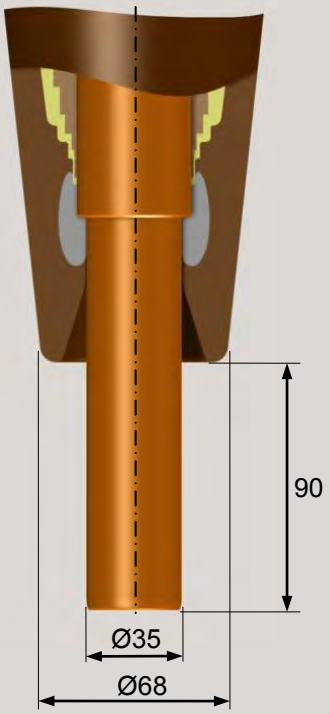
Cable Fig. 27

… 1250A



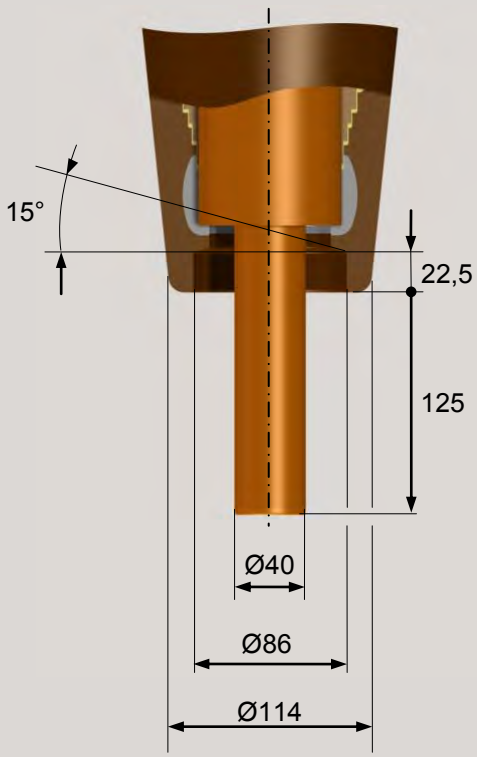
Removable copper conductor Fig. 28

… 1600 A



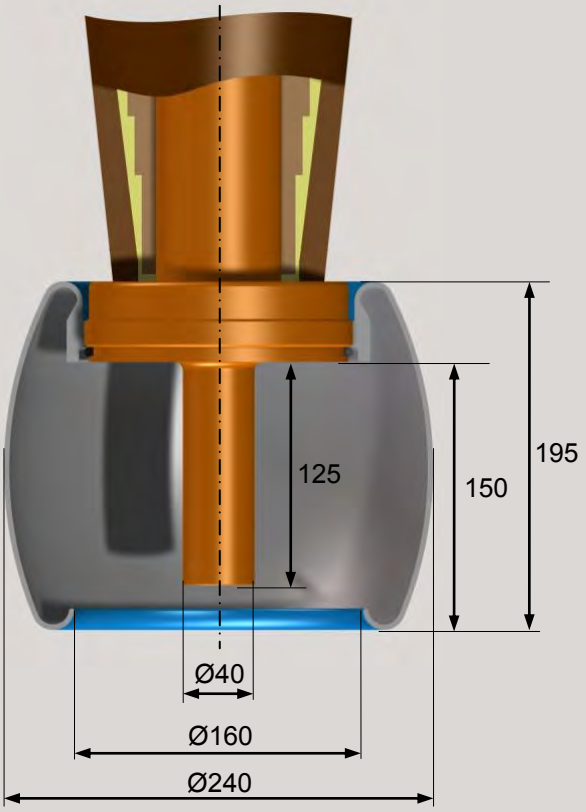
Fixed copper-conductor Fig. 29

… 2500A



Fixed copper-conductor Fig. 30

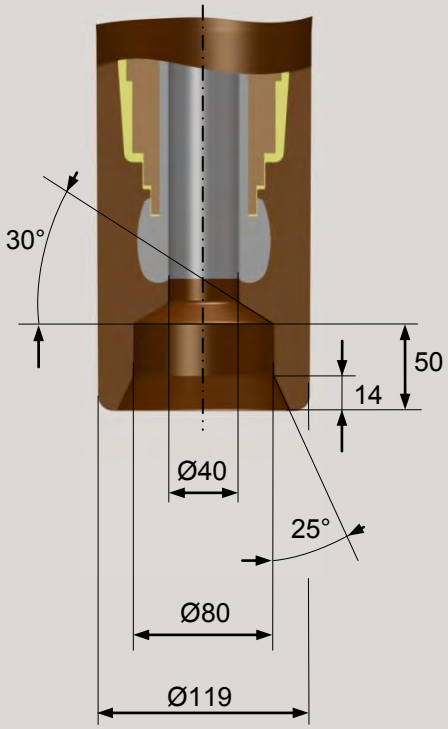
… 3150A



Fixed copper-conductor with removable screwed shield Fig. 31

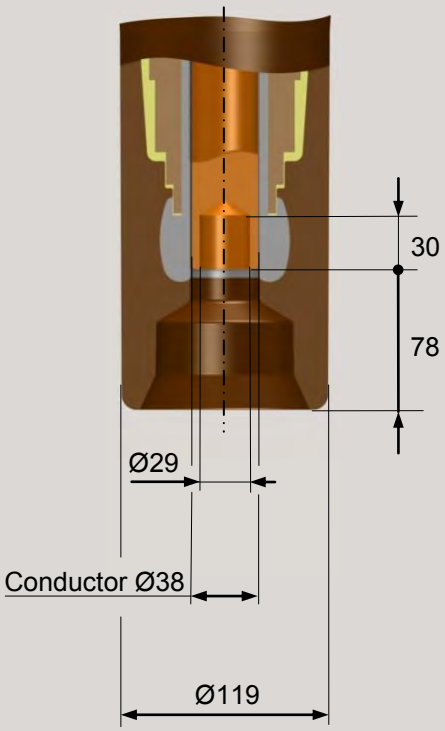
COT 1050, Um = 245 kV

… 1000A



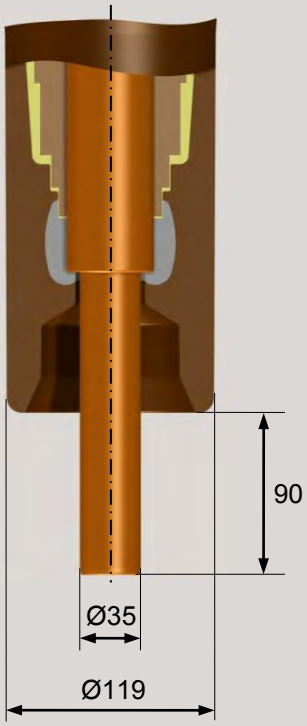
Cable Fig. 32

… 1250A



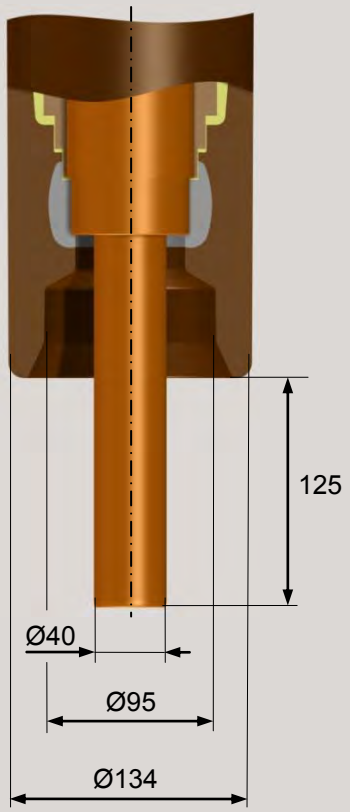
Removable copper conductor Fig. 33

… 1600 A



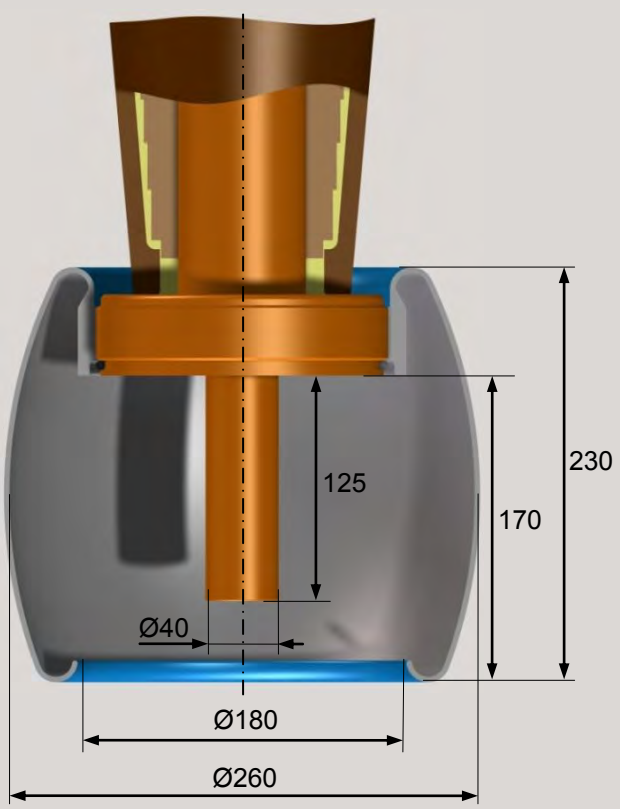
Fixed copper-conductor Fig. 34

… 2500A



Fixed copper-conductor Fig. 35

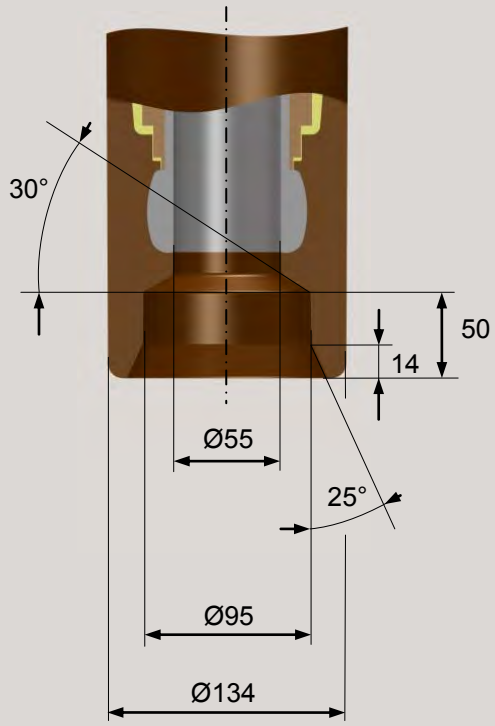
… 3150A



Fixed copper-conductor with removable screwed shield Fig. 36

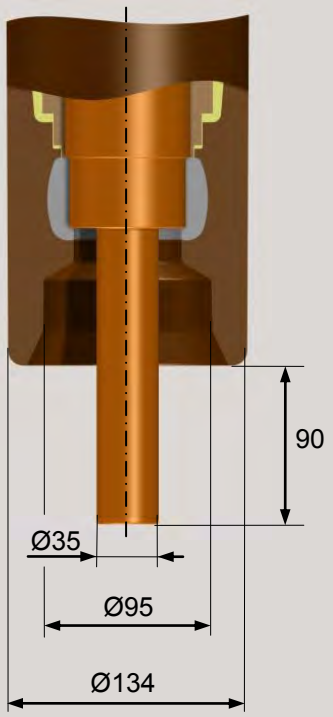
COT 1050, Um = 300 kV

… 1000A



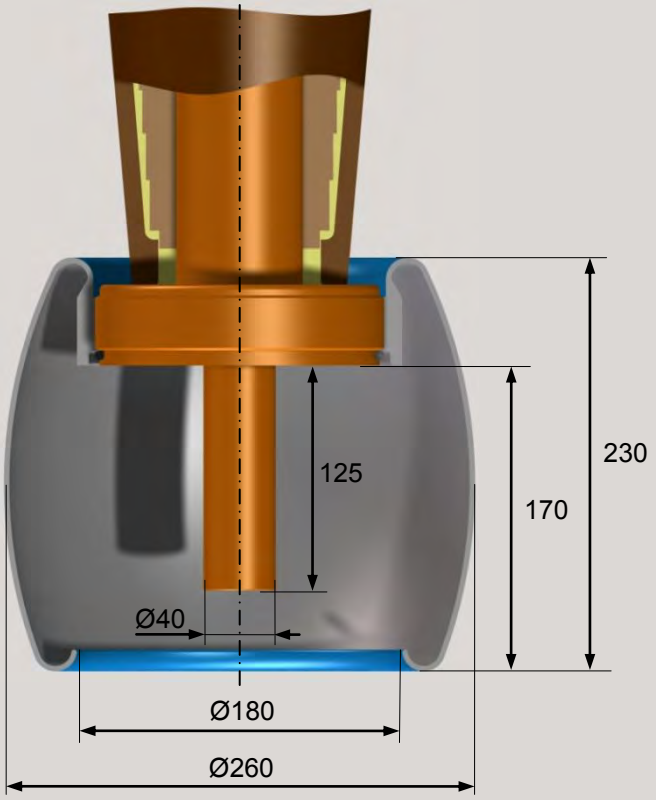
Cable Fig. 37

… 1600A



Fixed copper-conductor Fig. 38

… 2500A

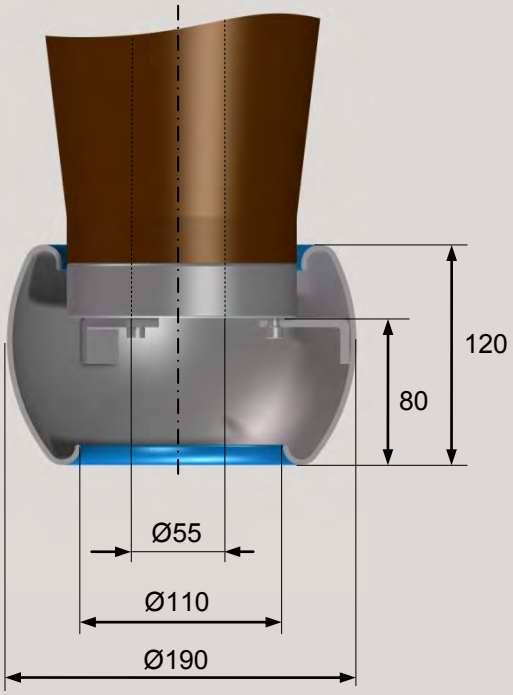


Fixed copper-conductor with removable screwed shield Fig. 39

Oil side end

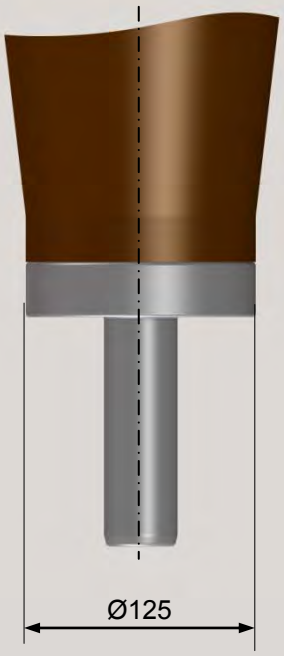
COT 1175 … 1300

… 1000A



Cable with fixed shield Fig. 40

… 1600A

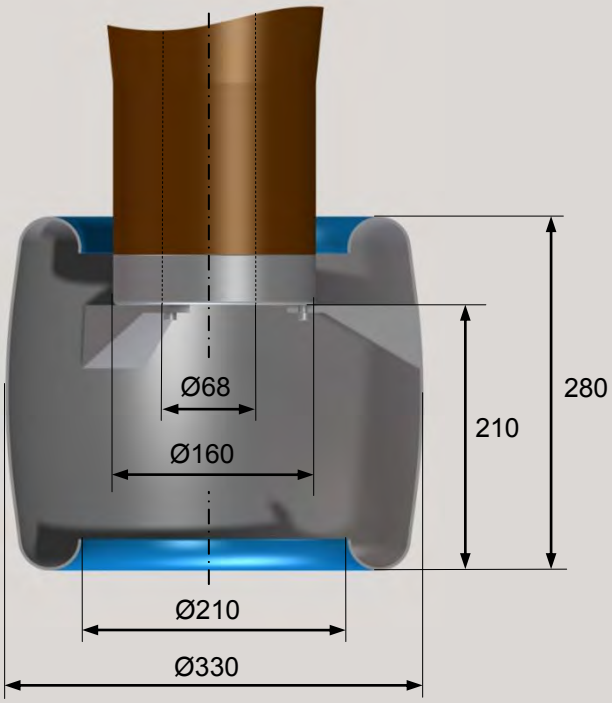


Oil side connector according to customer request

Fixed conductor Fig. 41

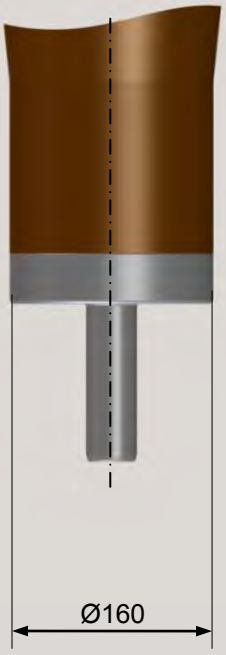
COT 1425 … 1800

… 1000A



Cable with fixed shield Fig. 42

… 1600A



Oil side connector according to customer request

Fixed conductor Fig. 43

FIXED SHIELD

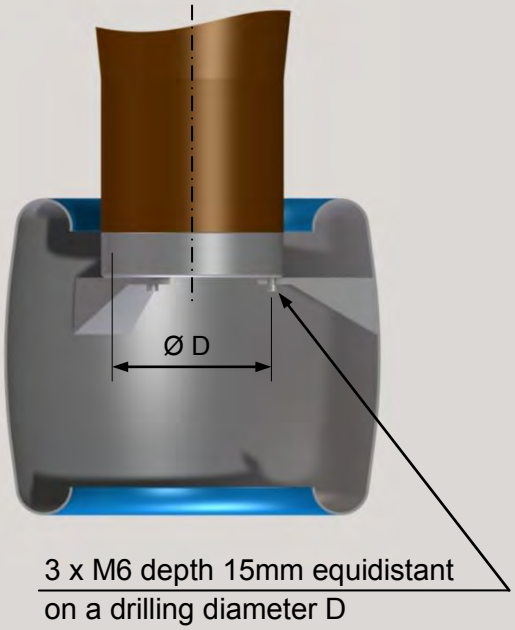


Fig. 44

SCREWED SHIELD

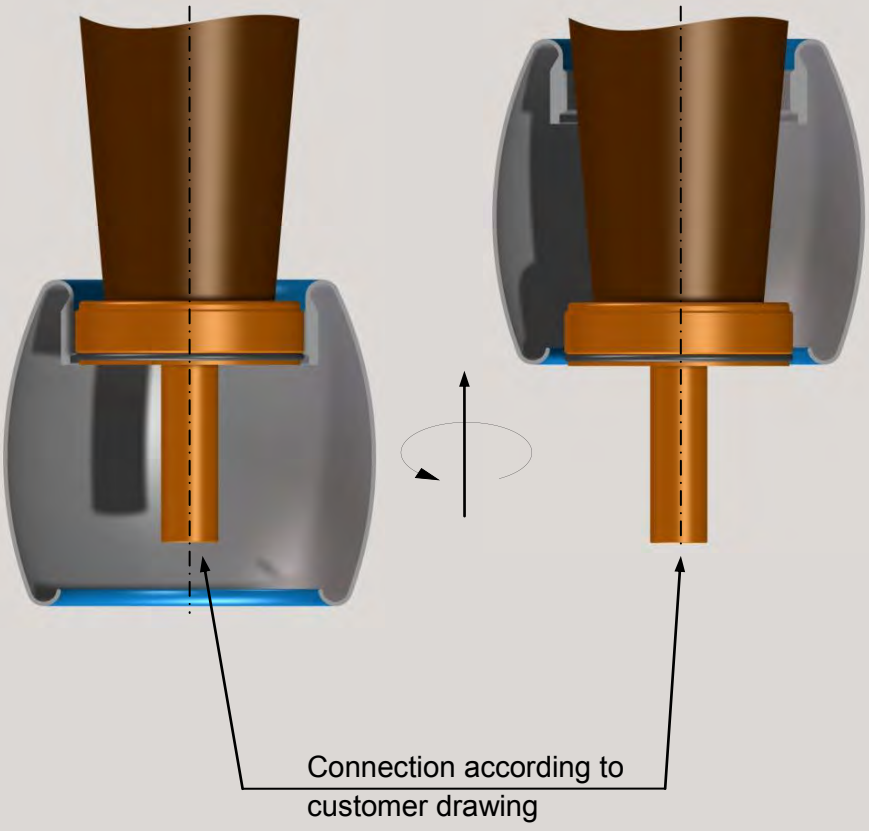


Fig. 45

SHIELD WITH BAYONET SYSTEM

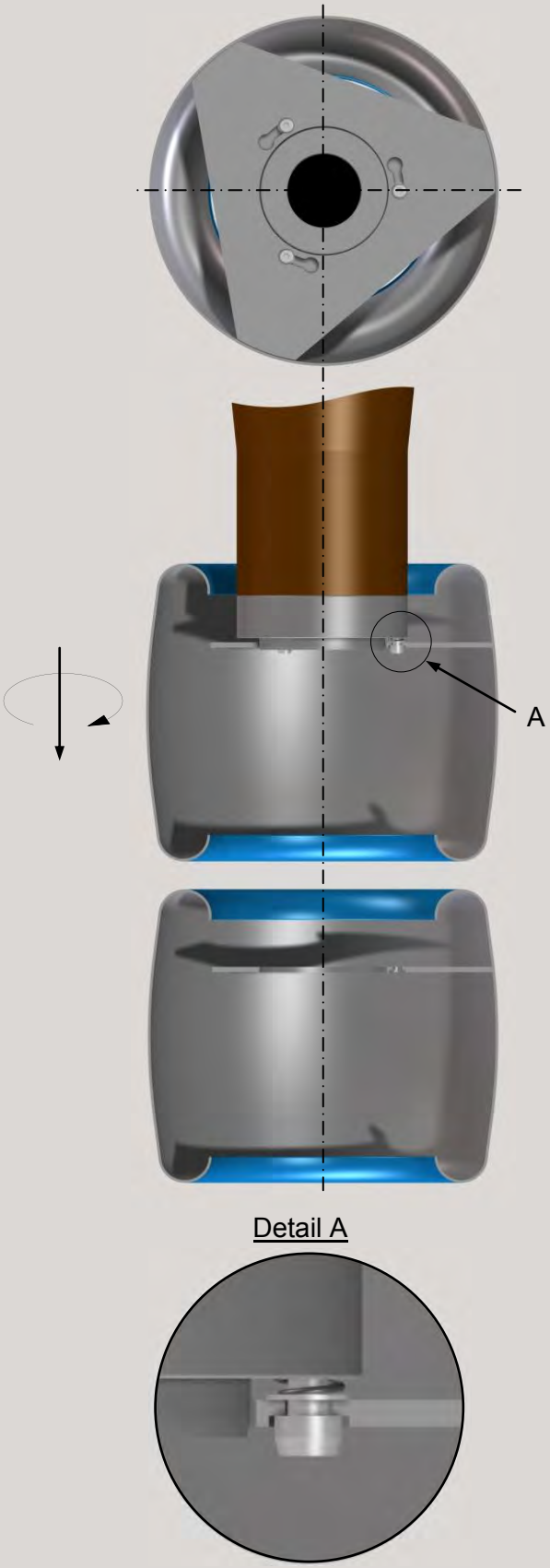


Fig. 46