TECHNICAL GUIDE

CONDENSER OIL TRANSFORMER BUSHINGS

FOR POWER TRANSFORMERS

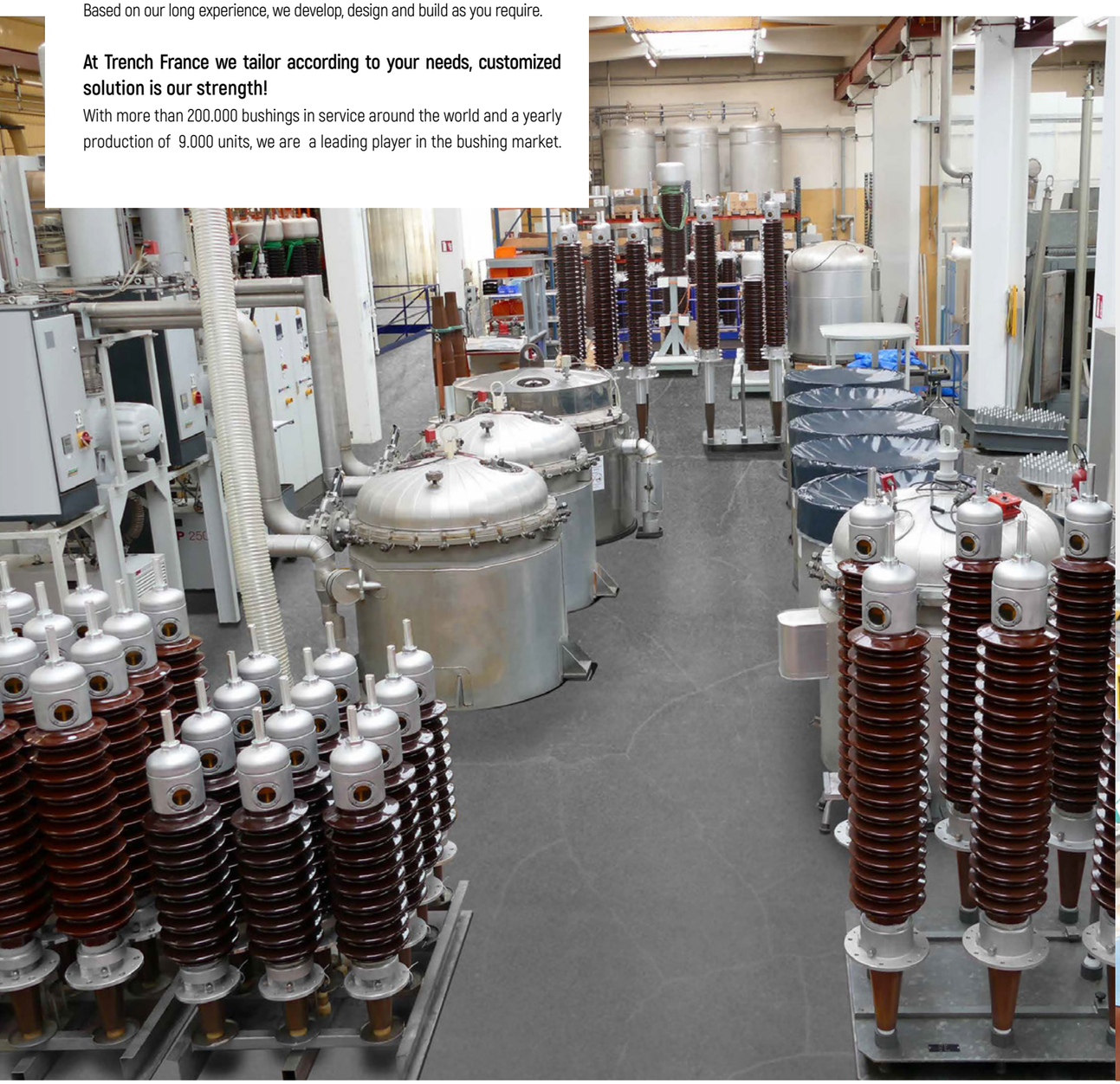
TRENCH

Trench is a recognized world leader in the design and manufacture of high voltage equipment for application on electric utility and high energy industrial systems.

The Trench Group is your partner of choice for electrical power transmission and distribution solutions today and for the development of your new technology solutions of tomorrow.

Trench France factory is offering you a full product portfolio of transformer bushings, high current bushings, generator bushings and wall bushings.
Based on our long experience, we develop, design and build as you require.

At Trench France we tailor according to your needs, customized solution is our strength!
With more than 200.000 bushings in service around the world and a yearly production of 9.000 units, we are a leading player in the bushing market.



MAIN FEATURES

General

Experience for more than **50 years**

Meet all IEC, NFC, IEEE, CAN standards, fully type tested

Portfolio available from **24 to 550kV**

Current up to **3150A (higher value on request)**

Standard CT extension 0, 300, 500mm

Flexibility in design, interchangeability, adaptability to match your transformer design

Oil sampling device as standard accessory

High seismic qualification (see page 5)

Standard altitude < 1000m, higher on request

Standard temperature : -30°C to +40°C (see page 14)

Product Design

OIP condenser bushing made of **fine graded capacitive oil paper insulation**

Impregnation with mineral oil or **Ester** (see page 23)

Air-side insulator available in **composite** or porcelain

Connection via **draw lead cable, removable split conductor or fixed conductor**

Casted parts out of aluminum

Hermetically sealed

Embedded shield in the lower **epoxy resin insulator**, **reducing distance to grounded parts**

High mechanical strength

High electrical withstand against transient or impulse stresses

Oil sampling on the flange to avoid air or humidity ingress

Voltage tap on request

Test tap

Product process

Computer optimized electrical field distribution

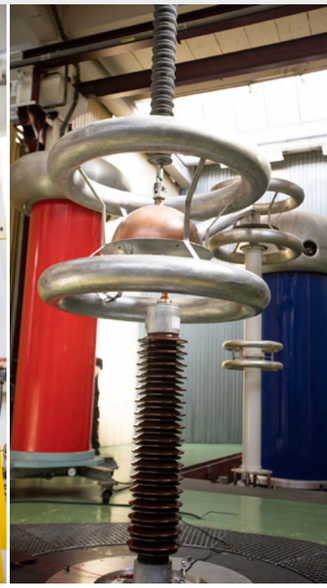
Lean manufacturing concept applied to the whole supply chain

Short lead time for standard products

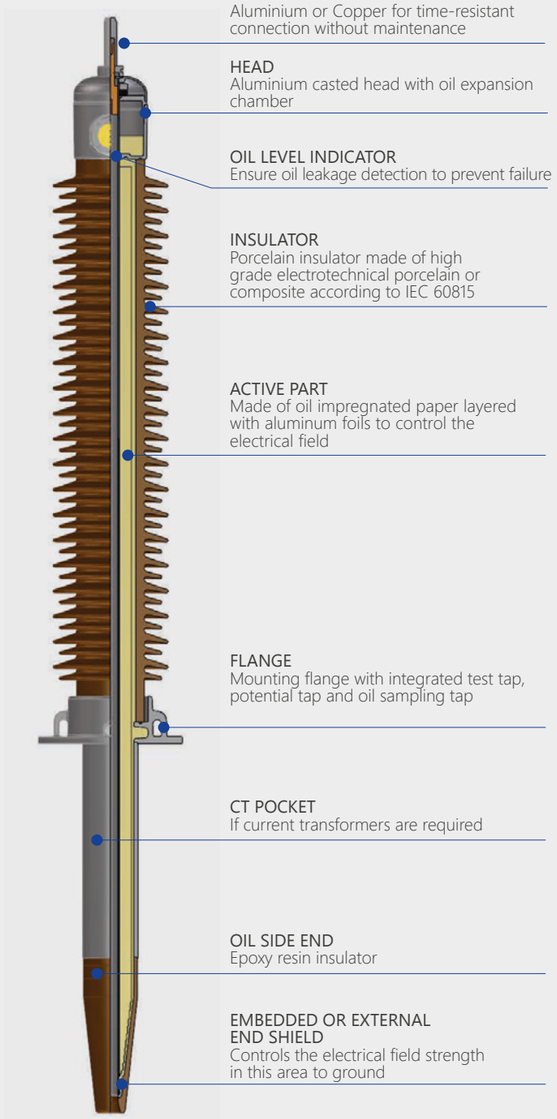
Automatic winding process

Fully equipped laboratories to perform dielectric tests on all manufactured bushings (routine & type tests)

Trench management system has been certified
ISO 9001
ISO 14001
ISO 45001



PRODUCT STRUCTURE



Choice of insulator

Air-side insulators are made of material with mechanical, electrical and thermal characteristics according to IEC 62155 and 60815 standards and have been used for decades all around the world.

TYPES

- Porcelain in grey or brown color for standard application
- Composite in grey color

CREEPAGE DISTANCES

All types of insulation are made respecting :
- SCD (Specific Creepage Distance) 31mm/kV
- USCD (Unified Specific Creepage Distance) 53,7mm/kV

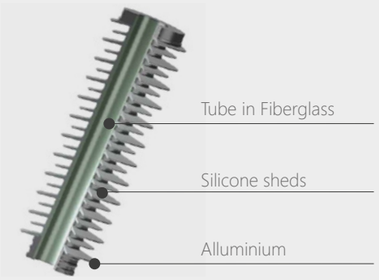
according to high pollution requirements.

COMPOSITE

Composite insulator is available from 24kV up to 550kV for our transformer bushings

It brings the following advantages:

- **Earthquake resistant**: particularly suitable in regions where severe earthquakes may be expected
- Outstanding performance for **heavy polluted application**
- **Maintenance free:** seldom cleaning operation even if running in severe conditions
- **Easy to use:** lower weight, easier handling and installation, damaged sheds can be repaired on-site
- **Hydrophobicity:** leakage current and surface discharge activities are significantly reduced
- **Higher safety:** flashover resistant, resistant against vandalism, low risk of damage
- Fully **interchangeable** with existing units



BASIC STRUCTURE OF HOLLOW COMPOSITE INSULATORS

SEISMIC QUALIFICATION

The methodology for demonstration of bushing seismic performance varies with the standard applied:
- IEC 61463-2016 allows either static calculation, dynamic analysis or vibration test
- IEEE 693-2018 specifies time history shake table test for voltage class greater than 138 kV, static pull test for voltage class greater than 34.5 kV to 138 kV, and inherently acceptable for voltage class less than or equal to 34.5 kV

The standard requested for seismic performance can differ from the standard used for bushing design: for areas with prevalent seismic problematics, customers may use IEC-type bushings with seismic requirements as per IEEE standard, which are more demanding than IEC requirements.

Product Line	Bushing Std	Seismic Std	Qualification Methodology
COT(C)	IEC 60137	IEC 61463	Static calculation
		IEEE 693	Shake table test for Um>138 kV

Trench France has validated two COTC (IEC) transformer bushing designs through shake table test at IEEE high performance level*, with an inclination angle of 30° from vertical:
- Transformer bushing **300kV type COTC 1050-1000** with composite insulator
- Transformer bushing **550kV type COTC 1550-2500** with composite insulator

They have successfully passed the shake table test and subsequent electrical tests.

These results are also applicable to similar designs with shorter arcing distance

*High performance level = 2.0 g Peak Ground Acceleration

ELECTRICAL VALUES & MECHANICAL VALUES | COT = CONDENSER OIL TRANSFORMER | 125 TO 250

TYPE DESIGNATION	ELECTRICAL DATA									INSULATOR & MECHANICAL DATA			
CLICK HERE AND SEE TECHNICAL SCHEME COT = Porcelain Insulator COTC = Composite Insulator	Highest voltage for equipement (Um)	Maximum phase to earth voltage (Um/√3)	Rated lightning impulse withstand voltage (BIL)	Rated switching impulse withstand voltage (SIL)	Bushing Power frequency withstand voltage (AC dry)	Bushing Power frequency withstand voltage (AC wet)	Rated current (Ir)	Rated short-time current (Ith/2s)	CLICK HERE AND SEE TECHNICAL SCHEME Conductor Type	Arcing distance (min.) (AD)	Creepage distance (min.) (CD) 31 mm/Kv	Cantilever test load (min.)	Bushing length (mm)
	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[A]	[kA/2s]		[mm]	[mm]	N	L
COT(C) 125-800	24	14	125	n.a.	55	50	800	20	Cable	235	744	2000	810 1110 1310
COT(C) 125-1000	24	14	125	n.a.	55	50	1000	25	Cable	235	744	2000	810 1110 1310
COT(C) 125-1250	24	14	125	n.a.	55	50	1250	31,5	Removable split conductor	235	744	2000	810 1110 1310
COT(C) 125-1600	24	14	125	n.a.	55	50	1600	40	Fixed conductor	235	744	2000	855 1155 1355
COT(C) 125-2500	24	14	125	n.a.	55	50	2500	63	Fixed conductor	235	744	2000	865 1165 1365
COT(C) 125-3150	24	14	125	n.a.	55	50	3150	79	Fixed conductor	235	744	3150	729 1029 1229
COT(C) 170-800	36	21	170	n.a.	77	70	800	20	Cable	340	1116	2000	915 1215 1415
COT(C) 170-1000	36	21	170	n.a.	77	70	1000	25	Cable	340	1116	2000	915 1215 1416
COT(C) 170-1250	36	21	170	n.a.	77	70	1250	31,5	Removable split conductor	340	1116	2000	915 1215 1417
COT(C) 170-1600	36	21	170	n.a.	77	70	1600	40	Fixed conductor	340	1116	2000	960 1260 1460
COT(C) 170-2500	36	21	170	n.a.	77	70	2500	63	Fixed conductor	340	1116	2000	970 1270 1470
COT(C) 170-3150	36	21	170	n.a.	77	70	3150	79	Fixed conductor	340	1190	3150	863 1163 1363
COT(C) 250-800	52	30	250	n.a.	105	95	800	20	Cable	515	1612	2000	1090 1390 1590
COT(C) 250-1000	52	30	250	n.a.	105	95	1000	25	Cable	515	1612	2000	1090 1390 1590
COT(C) 250-1250	52	30	250	n.a.	105	95	1250	31,5	Removable split conductor	515	1612	2000	1090 1390 1590
COT(C) 250-1600	52	30	250	n.a.	105	95	1600	40	Fixed conductor	515	1612	2000	1135 1435 1635
COT(C) 250-2500	52	30	250	n.a.	105	95	2500	63	Fixed conductor	465	1612	3150	1095 1395 1595
COT(C) 250-3150	52	30	250	n.a.	105	95	3150	79	Fixed conductor	475	1612	4000	1105 1405 1605

OIL SIDE DIMENSIONS [MM]					FLANGE DIMENSIONS [MM]							AIR SIDE DIMENSIONS [MM]					
CT Space standard	Length under flange	External diameter under flange	Inside diameter under flange (min.)	Oil side end CLICK ON EACH CELL BELOW AND SEE TECHNICAL SCHEMES	Only for COT ≥ 420kV	Bolt circle diameter (BCD)	Flange external diameter	Flange length	number of holes	Flange hole diameter	Flange plate thickness	Air side length	Drawlead length from flange Lemb	External Insulator diameter	Head external diameter	Terminal diameter	Terminal length
L4	L1	D	D7	Fig.	D1	D2	D3	L7	n	Øt	e	L2	L3	D4	D5	D6	L6
0 300 500	140 440 640	80	40	9	-	184	240	100	4	24	14	670	480	220	170	30	105
0 300 500	140 440 640	80	40	9	-	184	240	100	4	24	14	670	480	220	170	30	105
0 300 500	140 440 640	80	-	10	-	184	240	100	4	24	14	670	-	220	170	30	105
0 300 500	140 440 640	80	-	11	-	184	240	100	4	24	14	715	-	220	170	40	150
0 300 500	140 440 640	80	-	12	-	184	240	110	4	24	15	725	-	220	170	60	150
0 300 500	140 440 640	80	-	14	-	184	240	60	4	24	12	589	-	240	190	40	125
0 300 500	140 440 640	80	40	9	-	184	240	100	4	24	14	775	585	220	170	30	105
0 300 500	140 440 640	80	40	9	-	184	240	100	4	24	14	775	585	220	170	30	105
0 300 500	140 440 640	80	-	10	-	184	240	100	4	24	14	775	-	220	170	30	105
0 300 500	140 440 640	80	-	11	-	184	240	100	4	24	14	820	-	220	170	40	125
0 300 500	140 440 640	80	-	12	-	184	240	110	4	24	15	830	-	220	170	60	150
0 300 500	169 469 669	80	-	14	-	184	240	60	4	24	12	694	-	230	190	40	125
0 300 500	140 440 640	100	35	9	-	185	225	100	6	16	14	950	760	225	170	30	105
0 300 500	140 440 640	100	35	9	-	185	225	100	6	16	14	950	760	225	170	30	105
0 300 500	140 440 640	100	-	10	-	185	225	100	6	16	14	950	-	225	170	30	105
0 300 500	140 440 640	100	-	11	-	185	225	100	6	16	14	995	-	225	170	40	150
0 300 500	140 440 640	120	-	12	-	200	240	110	6	22	15	955	-	240	170	60	150
0 300 500	140 440 640	130	-	13	-	290	335	110	12	16	16	965	-	335	170	60	150

ELECTRICAL VALUES & MECHANICAL VALUES | COT = CONDENSER OIL TRANSFORMER | 325 TO 650

TYPE DESIGNATION	ELECTRICAL DATA									INSULATOR & MECHANICAL DATA			
CLICK HERE AND SEE TECHNICAL SCHEME COT = Porcelain Insulator COTC = Composite Insulator	Highest voltage for equipement (Um)	Maximum phase to earth voltage (Um/√3)	Rated lightning impulse withstand voltage (BIL)	Rated switching impulse withstand voltage (SIL)	Bushing Power frequency withstand voltage (AC dry)	Bushing Power frequency withstand voltage (AC wet)	Rated current (Ir)	Rated short-time current (Ith/2s)	CLICK HERE AND SEE TECHNICAL SCHEME Conductor Type	Arcing distance (min.) (AD)	Creepage distance (min.) (CD) 31 mm/Kv	Cantilever test load (min.)	Bushing length [mm]
	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[A]	[kA/2s]		[mm]	[mm]	N	L
COT(C) 325-800	72,5	42	325	n.a.	155	140	800	20	Cable	600	2248	2000	1210 1510 1710
COT(C) 325-1000	72,5	42	325	n.a.	155	140	1000	25	Cable	600	2248	2000	1210 1510 1710
COT(C) 325-1250	72,5	42	325	n.a.	155	140	1250	31,5	Removable split conductor	600	2248	2000	1210 1510 1710
COT(C) 325-1600	72,5	42	325	n.a.	155	140	1600	40	Fixed conductor	600	2248	2000	1255 1555 1755
COT(C) 325-2500	72,5	42	325	n.a.	155	140	2500	63	Fixed conductor	610	2248	3150	1275 1575 1775
COT(C) 325-3150	72,5	42	325	n.a.	155	140	3150	79	Fixed conductor	620	2248	4000	1285 1585 1785
COT(C) 450-800	100	58	450	n.a.	205	185	800	20	Cable	838	3100	2000	1503 1803 2003
COT(C) 450-1000	100	58	450	n.a.	205	185	1000	25	Cable	838	3100	2000	1503 1803 2003
COT(C) 450-1250	100	58	450	n.a.	205	185	1250	31,5	Removable split conductor	838	3100	2000	1503 1803 2003
COT(C) 450-1600	100	58	450	n.a.	205	185	1600	40	Fixed conductor	838	3100	2000	1548 1848 2048
COT(C) 450-2500	100	58	450	n.a.	205	185	2500	63	Fixed conductor	823	3100	3150	1543 1843 2043
COT(C) 450-3150	100	58	450	n.a.	205	185	3150	79	Fixed conductor	833	3100	4000	1553 1853 2053
COT(C) 550-800	123	71	550	n.a.	255	230	800	20	Cable	1050	3813	3150	1805 2105 2305
COT(C) 550-1000	123	71	550	n.a.	255	230	1000	25	Cable	1050	3813	3150	1805 2105 2305
COT(C) 550-1250	123	71	550	n.a.	255	230	1250	31,5	Removable split conductor	1050	3813	3150	1805 2105 2305
COT(C) 550-1600	123	71	550	n.a.	255	230	1600	40	Fixed conductor	1050	3813	3150	1850 2150 2350
COT(C) 550-2500	123	71	550	n.a.	255	230	2500	63	Fixed conductor	1050	3813	3150	2089 2389 2589
COT(C) 550-3150	123	71	550	n.a.	255	230	3150	79	Fixed conductor	1050	3813	4000	2052 2352 2552
COT(C) 650-800	145	84	650	n.a.	305	275	800	20	Cable	1250	4495	3150	2055 2355 2555
COT(C) 650-1000	145	84	650	n.a.	305	275	1000	25	Cable	1250	4495	3150	2055 2355 2555
COT(C) 650-1250	145	84	650	n.a.	305	275	1250	31,5	Removable split conductor	1250	4495	3150	2055 2355 2555
COT(C) 650-1600	145	84	650	n.a.	305	275	1600	40	Fixed conductor	1250	4495	3150	2100 2400 2600
COT(C) 650-2500	145	84	650	n.a.	305	275	2500	63	Fixed conductor	1250	4495	4000	2339 2639 2839
COT(C) 650-3150	145	84	650	n.a.	305	275	3150	79	Fixed conductor	1250	4495	4000	2302 2602 2802

OIL SIDE DIMENSIONS [MM]					FLANGE DIMENSIONS [MM]							AIR SIDE DIMENSIONS [MM]					
CT Space standard	Length under flange	External diameter under flange	Inside diameter under flange (min.)	Oil side end CLICK ON EACH CELL BELOW AND SEE TECHNICAL SCHEMES	Only for COT ≥ 420kV	Bolt circle diameter (BCD)	Flange external diameter	Flange length	number of holes	Flange hole diameter	Flange plate thickness	Air side length	Drawlead length from flange Lemb	External Insulator diameter	Head external diameter	Terminal diameter	Terminal length
L4	L1	D	D7	Fig.	D1	D2	D3	L7	n	Øt	e	L2	L3	D4	D5	D6	L6
0 300 500	175 475 675	100	35	9	-	185	225	100	6	16	14	1035	845	225	170	30	105
0 300 500	175 475 675	100	35	9	-	185	225	100	6	16	14	1035	845	225	170	30	105
0 300 500	175 475 675	100	-	10	-	185	225	100	6	16	14	1035	-	225	170	30	105
0 300 500	175 475 675	100	-	11	-	185	225	100	6	16	14	1080	-	225	170	40	150
0 300 500	175 475 675	120	-	12	-	200	240	110	6	22	15	1100	-	240	170	60	150
0 300 500	175 475 675	130	-	13	-	290	335	110	12	16	16	1110	-	335	170	60	150
0 300 500	230 530 730	100	35	9	-	185	225	100	6	16	14	1273	1085	225	170	30	105
0 300 500	230 530 730	100	35	9	-	185	225	100	6	16	14	1273	1085	225	170	30	105
0 300 500	230 530 730	100	-	10	-	185	225	100	6	16	14	1273	-	225	170	30	105
0 300 500	230 530 730	100	-	11	-	185	225	100	6	16	14	1318	-	225	170	40	150
0 300 500	230 530 730	120	-	12	-	200	240	110	6	22	15	1313	-	240	170	60	150
0 300 500	230 530 730	130	-	13	-	290	335	110	12	16	16	1323	-	335	170	60	150
0 300 500	310 610 810	120	35	15	-	250	290	110	8	16	15	1495	1306	231	170	30	105
0 300 500	310 610 810	120	35	15	-	250	290	110	8	16	15	1495	1306	231	170	30	105
0 300 500	310 610 810	120	-	16	-	250	290	110	8	16	15	1495	-	231	170	30	105
0 300 500	310 610 810	120	-	17	-	250	290	110	8	16	15	1540	-	231	170	40	150
0 300 500	310 610 810	175	-	18	-	290	335	195	12	20	20	1779	-	295	300	60	125
0 300 500	310 610 810	175	-	19	-	400	450	195	12	22	22	1742	-	295	300	60	125
0 300 500	360 660 860	130	35	15	-	290	335	110	12	16	16	1695	1506	242	170	30	105
0 300 500	360 660 860	130	35	15	-	290	335	110	12	16	16	1695	1506	242	170	30	105
0 300 500	360 660 860	130	-	16	-	290	335	110	12	16	16	1695	-	242	170	30	105
0 300 500	360 660 860	130	-	17	-	290	335	110	12	16	16	1740	-	242	170	40	150
0 300 500	360 660 860	175	-	18	-	290	335	195	12	20	20	1979	-	295	300	60	125
0 300 500	360 660 860	175	-	19	-	400	450	195	12	22	22	1942	-	295	300	60	125

ELECTRICAL VALUES & MECHANICAL VALUES | COT = CONDENSER OIL TRANSFORMER | 750 TO 1175

TYPE DESIGNATION	ELECTRICAL DATA									INSULATOR & MECHANICAL DATA			
CLICK HERE AND SEE TECHNICAL SCHEME COT = Porcelain Insulator COTC = Composite Insulator	Highest voltage for equipement (Um)	Maximum phase to earth voltage (Um/√3)	Rated lightning impulse withstand voltage (BIL)	Rated switching impulse withstand voltage (SIL)	Bushing Power frequency withstand voltage (AC dry)	Bushing Power frequency withstand voltage (AC wet)	Rated current (Ir)	Rated short-time current (Ith/2s)	CLICK HERE AND SEE TECHNICAL SCHEME Conductor Type	Arcing distance (min.) (AD)	Creepage distance (min.) (CD) 31 mm/Kv	Cantilever test load (min.)	Bushing length (mm)
	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[A]	[kA/2s]		[mm]	[mm]	N	L
COT(C) 750-800	170	98	750	n.a.	355	325	800	20	Cable	1460	5270	4000	2325 2625 2825
COT(C) 750-1000	170	98	750	n.a.	355	325	1000	25	Cable	1460	5270	4000	2325 2625 2825
COT(C) 750-1250	170	98	750	n.a.	355	325	1250	31,5	Removable split conductor	1460	5270	4000	2325 2625 2825
COT(C) 750-1600	170	98	750	n.a.	355	325	1600	40	Fixed conductor	1460	5270	4000	2370 2670 2870
COT(C) 750-2500	170	98	750	n.a.	355	325	2500	63	Fixed conductor	1460	5270	5000	2609 2909 3109
COT(C) 750-3150	170	98	750	n.a.	355	325	3150	79	Fixed conductor	1460	5270	5000	2572 2872 3072
COT(C) 1050-800	245	142	1050	850	505	460	800	20	Cable	2150	7595	4000	3518 3818 4018
COT(C) 1050-1000	245	142	1050	850	505	460	1000	25	Cable	2150	7595	4000	3518 3818 4018
COT(C) 1050-1250	245	142	1050	850	505	460	1250	31,5	Removable split conductor	2150	7595	4000	3518 3818 4018
COT(C) 1050-1600	245	142	1050	850	505	460	1600	40	Fixed conductor	2150	7595	4000	3733 4033 4233
COT(C) 1050-2500	245	142	1050	850	505	460	2500	63	Fixed conductor	2150	7595	5000	3733 4033 4233
COT(C) 1050-3150	245	142	1050	850	505	460	3150	79	Fixed conductor	2150	7595	5000	3396 3996 4196
COT(C) 1050-1000	300	173	1050	850	505	n/a	1000	25	Cable	2400	9300	5000	3813 4113 4313
COT(C) 1050-1250	300	173	1050	850	505	n/a	1250	31,5	Removable split conductor	2400	9300	5000	3813 4113 4313
COT(C) 1050-1600	300	173	1050	850	505	n/a	1600	40	Fixed conductor	2400	9300	5000	3983 4283 4583
COT(C) 1050-2500	300	173	1050	850	505	n/a	2500	63	Fixed conductor	2400	9300	5000	3946 4246 4446
COT(C) 1050-3150	300	173	1050	850	505	n/a	3150	79	Fixed conductor	2400	9300	5000	3946 4246 4446
COT(C) 1175-1000	362	209	1175	950	560	n/a	1000	25	Cable	2800	11337	5000	4270 4570 4770
COT(C) 1175-1600	362	209	1175	950	560	n/a	1600	40	Fixed conductor	2800	11337	5000	4230 4530 4730
COT(C) 1175-2500	362	209	1175	950	560	n/a	2500	63	Fixed conductor	2800	11337	5000	4230 4530 4730
COT(C) 1175-3150	362	209	1175	950	560	n/a	3150	79	Fixed conductor	2800	11337	5000	4230 4530 4730

OIL SIDE DIMENSIONS [MM]					FLANGE DIMENSIONS [MM]							AIR SIDE DIMENSIONS [MM]					
CT Space standard	Length under flange	External diameter under flange	Inside diameter under flange (min.)	Oil side end CLICK ON EACH CELL BELOW AND SEE TECHNICAL SCHEMES	Only for COT ≥ 420kV	Bolt circle diameter (BCD)	Flange external diameter	Flange length	number of holes	Flange hole diameter	Flange plate thickness	Air side length	Drawlead length from flange Lemb	External Insulator diameter	Head external diameter	Terminal diameter	Terminal length
L4	L1	D	D7	Fig.	D1	D2	D3	L7	n	Øt	e	L2	L3	D4	D5	D6	L6
0 300 500	477 720 920	130	35	15	-	290	335	110	12	16	16	1905	1716	242	170	30	105
0 300 500	477 720 920	130	35	15	-	290	335	110	12	16	16	1905	1716	242	170	30	105
0 300 500	477 720 920	130	-	16	-	290	335	110	12	16	16	1905	-	242	170	30	105
0 300 500	477 720 920	130	-	17	-	290	335	110	12	16	16	1950	-	242	170	40	150
0 300 500	420 720 920	175	-	18	-	290	335	195	12	20	20	2189	-	335	300	60	125
0 300 500	420 720 920	175	-	19	-	400	450	195	12	22	22	2152	-	295	300	60	125
0 300 500	684 984 1184	175	40	20	-	400	450	195	12	22	22	2834	2500	295	300	30	80
0 300 500	684 984 1184	175	40	20	-	400	450	195	12	22	22	2834	2500	295	300	30	80
0 300 500	684 984 1184	175	-	21	-	400	450	195	12	22	22	2834	-	295	300	30	80
0 300 500	684 984 1184	175	-	22	-	400	450	195	12	22	22	2879	-	295	300	40	125
0 300 500	684 984 1184	200	-	23	-	400	450	195	12	22	22	2879	-	340	300	50	125
0 300 500	684 984 1184	200	-	24	-	400	450	195	12	22	22	2842	-	340	300	60	125
0 300 500	684 984 1184	200	55	25	-	400	450	195	12	22	22	3129	2750	350	300	40	125
0 300 500	684 984 1184	200	-	26	-	400	450	195	12	22	22	3129	-	350	300	40	125
0 300 500	684 984 1184	200	-	27	-	400	450	195	12	22	22	3129	-	350	300	40	125
0 300 500	684 984 1184	200	-	28	-	400	450	195	12	22	22	3092	-	350	300	50	125
0 300 500	684 984 1184	200	-	29	-	400	450	195	12	22	22	3092	-	350	300	60	125
0 300 500	720 1020 1220	235	55	30	-	400	450	250	12	22	22	3550	3240	402	330	40	125
0 300 500	720 1020 1220	235	-	31	-	400	450	250	12	22	22	3510	-	402	330	40	125
0 300 500	720 1020 1220	235	-	31	-	400	450	250	12	22	22	3510	-	414	330	50	125
0 300 500	720 1020 1220	235	-	32	-	400	450	250	12	22	22	3510	-	414	330	60	125

ELECTRICAL VALUES & MECHANICAL VALUES | COT = CONDENSER OIL TRANSFORMER | 1300 TO 1800

TYPE DESIGNATION	ELECTRICAL DATA									INSULATOR & MECHANICAL DATA			
CLICK HERE AND SEE TECHNICAL SCHEME COT = Porcelain Insulator COTC = Composite Insulator	Highest voltage for equipement (Um)	Maximum phase to earth voltage (Um/√3)	Rated lightning impulse withstand voltage (BIL)	Rated switching impulse withstand voltage (SIL)	Bushing Power frequency withstand voltage (AC dry)	Bushing Power frequency withstand voltage (AC wet)	Rated current (Ir)	Rated short-time current (Ith/2s)	CLICK HERE AND SEE TECHNICAL SCHEME Conductor Type	Arcing distance (min.) (AD)	Creepage distance (min.) (CD) 31 mm/Kv	Cantilever test load (min.)	Bushing length (mm)
	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[A]	[kA/2s]		[mm]	[mm]	N	L
COT(C) 1300-1000	362	209	1300	950	625	n/a	1000	25	Cable	2800	11337	5000	4270 4570 4770
COT(C) 1300-1600	362	209	1300	950	625	n/a	1600	40	Fixed conductor	2800	11337	5000	4230 4530 4730
COT(C) 1300-2500	362	209	1300	950	625	n/a	2500	63	Fixed conductor	2800	11337	5000	4230 4530 4730
COT(C) 1300-3150	362	209	1300	950	625	n/a	3150	79	Fixed conductor	2800	11337	5000	4230 4530 4730
COT(C) 1300-1000	420	243	1300	1050	625	n/a	1000	25	Cable	3300	13750	5000	5055 5355 5555
COT(C) 1300-1600	420	243	1300	1050	625	n/a	1600	40	Fixed conductor	3300	13750	5000	4265 5265 5465
COT(C) 1300-2500	420	243	1300	1050	625	n/a	2500	63	Fixed conductor	3300	13750	5000	4265 5265 5465
COT(C) 1300-3150	420	243	1300	1050	625	n/a	3150	79	Fixed conductor	3300	13750	5000	4265 5265 5465
COT(C) 1425-1000	420	243	1425	1050	695	n/a	1000	25	Cable	3300	13750	5000	5055 5355 5555
COT(C) 1425-1600	420	243	1425	1050	695	n/a	1600	40	Fixed conductor	3300	13750	5000	4965 5265 5465
COT(C) 1425-2500	420	243	1425	1050	695	n/a	2500	63	Fixed conductor	3300	13750	5000	4965 5265 5465
COT(C) 1425-3150	420	243	1425	1050	695	n/a	3150	79	Fixed conductor	3300	13750	5000	4965 5265 5465
COT(C) 1550-1000	550	318	1550	1175	750	n/a	1000	25	Cable	3800	17864	5000	6000 6300 6500
COT(C) 1550-1600	550	318	1550	1175	750	n/a	1600	40	Fixed conductor	3800	17864	5000	5700 6000 6200
COT(C) 1550-2500	550	318	1550	1175	750	n/a	2500	63	Fixed conductor	3800	17864	5000	5700 6000 6200
COT(C) 1550-3150	550	318	1550	1175	750	n/a	3150	79	Fixed conductor	3800	17864	5000	5700 6000 6200
COT(C) 1675-1000	550	318	1675	1175	750	n/a	1000	25	Cable	3800	17864	5000	6145 6445 6645
COT(C) 1675-1600	550	318	1675	1175	750	n/a	1600	40	Fixed conductor	3800	17864	5000	5845 6145 6345
COT(C) 1675-2500	550	318	1675	1175	750	n/a	2500	63	Fixed conductor	3800	17864	5000	5845 6145 6345
COT(C) 1675-3150	550	318	1675	1175	750	n/a	3150	79	Fixed conductor	3800	17864	5000	5845 6145 6345
COT(C) 1800-1000	550	318	1800	1300	870	n/a	1000	25	Cable	4200	17822	5000	6555 6855 7055
COT(C) 1800-1600	550	318	1800	1300	870	n/a	1600	40	Fixed conductor	4200	17822	5000	6245 6545 6745
COT(C) 1800-2500	550	318	1800	1300	870	n/a	2500	63	Fixed conductor	4200	17822	5000	6245 6545 6745
COT(C) 1800-3150	550	318	1800	1300	870	n/a	3150	79	Fixed conductor	4200	17822	5000	6245 6545 6745

OIL SIDE DIMENSIONS [MM]					FLANGE DIMENSIONS [MM]							AIR SIDE DIMENSIONS [MM]					
CT Space standard	Length under flange	External diameter under flange	Inside diameter under flange (min.)	Oil side end CLICK ON EACH CELL BELOW AND SEE TECHNICAL SCHEMES	Only for COT ≥ 420kV	Bolt circle diameter (BCD)	Flange external diameter	Flange length	number of holes	Flange hole diameter	Flange plate thickness	Air side length	Drawlead length from flange Lemb	External Insulator diameter	Head external diameter	Terminal diameter	Terminal length
L4	L1	D	D7	Fig.	D1	D2	D3	L7	n	Øt	e	L2	L3	D4	D5	D6	L6
0 300 500	720 1020 1220	235	55	30	-	400	450	250	12	23	22	3550	3240	402	330	40	125
0 300 500	720 1020 1220	235	-	31	-	400	450	250	12	23	22	3510	-	402	330	40	125
0 300 500	720 1020 1220	235	-	31	-	400	450	250	12	23	22	3510	-	414	330	50	125
0 300 500	720 1020 1220	235	-	32	-	400	450	250	12	23	22	3510	-	414	330	60	125
0 300 500	820 1120 1320	291	55	30	-	530	590	280	12	22	25	4235	3995	477	400	40	125
0 300 500	820 1120 1320	291	-	31	-	530	590	280	12	22	25	4235	-	477	400	40	125
0 300 500	820 1120 1320	291	-	31	-	530	590	280	12	22	25	4235	-	525	400	50	125
0 300 500	820 1120 1320	291	-	32	-	530	590	280	12	22	25	4235	-	525	330	60	125
0 300 500	820 1120 1320	291	68	33	380	530	590	280	12	23	25	4235	3995	477	400	40	125
0 300 500	820 1120 1320	291	-	34	380	530	590	280	12	23	25	4145	-	477	400	40	125
0 300 500	820 1120 1320	291	-	34	380	530	590	280	12	23	25	4145	-	525	400	50	125
0 300 500	820 1120 1320	291	-	35	380	530	590	280	12	23	25	4145	-	525	400	60	125
0 300 500	1055 1355 1555	291	68	33	380	530	590	280	12	23	25	4735	4495	481	500	40	125
0 300 500	1055 1355 1555	291	-	34	380	530	590	280	12	23	25	4645	-	481	500	40	125
0 300 500	1055 1355 1555	291	-	34	380	530	590	280	12	23	25	4645	-	481	500	50	125
0 300 500	1055 1355 1555	291	-	35	380	530	590	280	12	23	25	4645	-	481	500	60	125
0 300 500	1200 1500 1700	291	68	33	380	530	590	280	12	23	25	4735	4495	481	500	40	125
0 300 500	1200 1500 1700	291	-	34	380	530	590	280	12	23	25	4645	-	481	500	40	125
0 300 500	1200 1500 1700	291	-	34	380	530	590	280	12	23	25	4645	-	481	500	50	125
0 300 500	1200 1500 1700	291	-	35	380	530	590	280	12	23	25	4645	-	481	500	60	125
0 300 500	1200 1500 1700	291	68	33	380	530	590	280	12	23	25	5145	4895	471	500	40	125
0 300 500	1200 1500 1700	291	-	34	380	530	590	280	12	23	25	5055	-	471	500	40	125
0 300 500	1200 1500 1700	291	-	34	380	530	590	280	12	23	25	5055	-	471	500	50	125
0 300 500	1200 1500 1700	291	-	35	380	530	590	280	12	23	25	5055	-	471	500	60	125

OPTIONS

SPARK GAP

STANDARD
Only on request. It protects the bushing from power surges. Available on all bushings.
Spherical spark gap devices with Um > 300kV (in option).

SPECIAL ADJUSTEMENT
Special distance adjustment between the horns on request

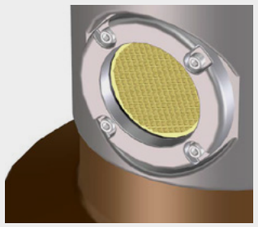
INSULATED
Insulated spark gap on request

STAINLESS STEEL
Stainless steel spark gap on request

OIL LEVEL INDICATOR

OPTICAL
Prismatic oil level indicator installed as standard on all bushings with Um ≤300kV.

MAGNETIC
Magnetic oil level indicator with magnetic needle.
Green color shows an optimal oil level, red color an insufficient oil level.
This method facilitates the oil level control.
Fitted as standard on all bushings with Um >300kV
Available on request on other bushings.



INSTALLATION

Inclination in service up to 30° from vertical
(other configurations on request)

TEMPERATURE

STANDARD
The standard ambient air temperature range of the bushings is -30 to +40°C.

LOW TEMPERATURE
On request, it is possible to adapt the bushings at a temperature to -55°C.

EXTREME COLD
On request, it is possible to use a special oil that allows the bushings to operate at a temperature down to -60°C.

ABOVE +40°C
On request, the bushings can be adapted to operate up to +55°C.

PACKAGING, MARKING & STORAGE

Bushings are packed in wooden crates, treated INMP15, oil level facing down and in horizontal position. To protect them, they are lying on foams and are wedged, bottom parts packed with plastic bags fixed with large tape. Product information, operation and maintenance instructions can be found into the crate.
Marking of the crate with general information of the order, special demand on request
Bushings should be stored horizontally in their original packaging, ideally in a closed, covered shelter.

AIR SIDE END OPTIONS

CYLINDRICAL TOP TERMINAL

MATERIAL
Top terminal available in :
- Aluminium (Al)
- Silver plated aluminium (Al/Ag)
- Tin plated aluminium (Al/Sn)
- Silver plated copper (Cu/Ag)
- Tin plated copper (Cu/Sn)
- Silver plated copper alloy (Lt/Ag)
- Tin plated copper alloy (Lt/Sn)

DIMENSIONS
Diameter and length can be adapted on request.
Threaded connections also available.

PLATE TOP TERMINAL

2, 4, 6 - or 8 - holes type adapters
available on request (NEMA or DIN)

SPREADER BAR (2 top terminals)

Spreader bar type adapter available on request.

CORONA RING

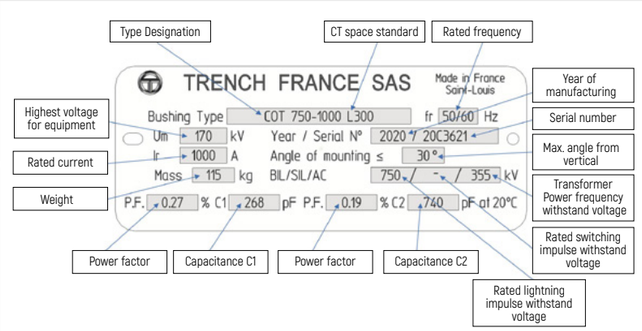
Corona rings are available on request for bushings with Um >245 kV.

PAINTS

Protective coating on aluminium parts for corrosive environment (C5-M).
Color paint on head or flange on request.

ELECTRICAL DATA PLATE

Aluminum > Black tinted aluminium plate. Standard on all bushings.
Stainless steel > On request.



OIL SIDE END OPTIONS

EXTERNAL SHIELDS

SHIELD WITH BAYONNET SYSTEM

Electrode provided with a bayonnet system to ease the connection of the bushing as it can be assembled and dismantled by the bottom after connection.

FIXED SHIELD

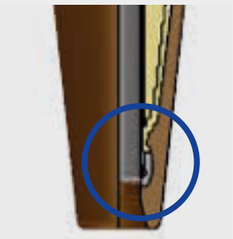
Shield with screws fixation

SCREWED SHIELD

Electrode mounted on a screw thread allowing the connection of the bushing as it can be assembled and disassembled from the top after connection.

EMBEDDED SHIELDS

Epoxy insulator with embedded end shield



OIL SIDE END OPTIONS

DISTANCE TO GROUNDED PARTS FOR BUSHINGS TYPE COT & COS 125 TO 1800

The following schemes represent the bushings' implementation in the transformer, therefore all values are given for transformer side.
- The maximal electrical stresses applied on the bottom shield should not be higher than the stresses applied on similar transformer components.
- The electrical withstand of bushings in operation depends on several parameters related to the transformer design and not under control of the bushing manufacturer
- The values indicated in the table are only given for information

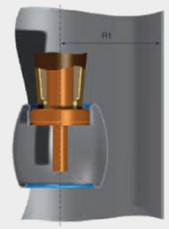
NOTE: On customer request we can provide assistance for electrical field calculation.

Type	Up(kV) acc. to IEC 60156	Type of shield	R* (mm)	R1* (mm) with epoxy coated shield	R1* (mm) with 4mm paper coated shield
COT/S 125	50	Embedded	65	-	-
COT/S 170	70	Embedded	75	-	-
COT/S 250	95	Embedded	85	-	-
COT/S 325	140	Embedded	120	-	-
COT/S 450	185	Embedded	135	-	-
COT/S 550	230	Embedded	145	-	-
		External	-	250	-
COT/S 650	275	Embedded	180	-	-
		External	-	275	-
COT/S 750	325	Embedded	225	-	-
		External	-	300	-
COT/S 1050	460	Embedded	300		-
		External	-	375	-
COT/S 1175	510	External	-	350	300
COT/S 1300	570	External	-		
COT/S 1425	630	External	-	400	350
COT/S 1550	680	External	-	425	375
COT/S 1675	680	External	-	450	400
COT/S 1800	790	External	-	550	440

* The Values of R and R1 are applicable for standard catalog designs only

EMBEDDED SHIELD

EXTERNAL SHIELD



OIL CONDITIONS

Liquid insulation: Mineral or ester
Water: < 10 ppm for mineral
< 30 ppm for Ester
Oil strength: > higher than 60 kV (acc. To IEC 60156)

BOTTOM TERMINAL OPTIONS

CYLINDRICAL

Standard solution for fixed conductor, variable dimensions on request.

SQUARE

4 or 8 tapping holes.
Other configurations on request.

SPADE

2, 3 or 4 holes.
Other configurations on request.

HEXAGONAL

6 tapping holes.
Other configurations on request.

HALF ROUND

2 or 3 tapping holes.
Other configurations on request.

OCTOGONAL

8 tapping holes.
Other configurations on request.

FLAT PAD

1, 2 or 4 holes.
Other configurations on request.

PLATE

All configurations on request.

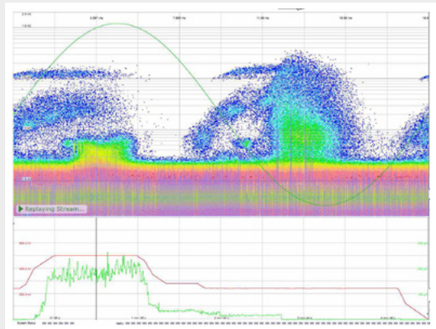
SERVICES & TEAM OF EXPERTS

TEST FIELDS

We have a set of four high voltage laboratories fully equipped and regularly kept upgraded and calibrated. Three laboratories are dedicated to workflow support and to type tests for new development as well. The fourth is used to perform special tests and research tests such as accelerated aging tests.

Every single produced bushing is routine tested (capacitance C1 & C2, the power factor of C1 & C2, partial discharges, AC withstand test and impulses) according to IEC or IEEE standard depending on customer request.

Up to 2400 kV Imulses generator @Trench France



Example of a PD measurement on a defective unit

INSTALLATIONS & FEATURES

TEST FIELD	INSTALLATION		FEATURES
	AC source	Impulses generator	
GP	· Test Voltage: 900 kV · Measured Capa up to 20 nF · Ground level < 1 pC	· Impulse max: 2400 kV · BIL / CW up to 2400 kV · SIL up to 1300 kV	· 600 m² Faraday cage · Variable frequency HV source for instrument transformers testing · High accuracy partial discharge measurement · Equipped for all bushing type tests (wet testing, thermal stability, etc.) · Over 1500 tested bushings / year BIL > 1050 kV
PJ1	· Test Voltage: 400 kV · Measured Capa up to 20 nF · Ground level < 2 pC	· Impulse max: 1100 kV · BIL / CW up to 1100 kV	· Low PD level · Can perform all routine tests up to BIL 750 kV · Over 4500 tested bushings / year BIL up to 750 kV
PJ2	· Test Voltage: 300 kV · Measured Capa up to 20 nF · Ground level < 2 pC	· Impulse max: 700 kV · BIL / CW up to 650 kV	· High accuracy for dry bushing testing including RBP and RIF · OIP testing up to BIL 550kV · Use biodegradable insulation liquid for bushing testing · Over 2600 tested bushings / year including OIP & dry bushings
PC1	· Test Voltage: 300 kV · Measured Capa up to 20 nF · Ground level < 2 pC	n.a	· Equipped for R&D basic tests · Dedicated for long duration/aging tests

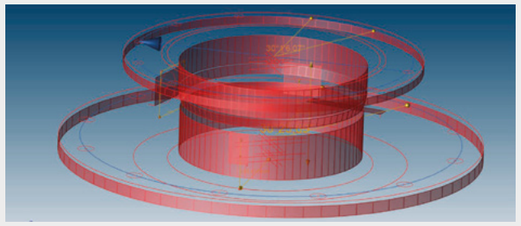
SERVICES
& TEAM OF EXPERTS

QUALITY LABORATORIES

To ensure top quality products to our customers, we check all incoming goods through our different quality laboratories:

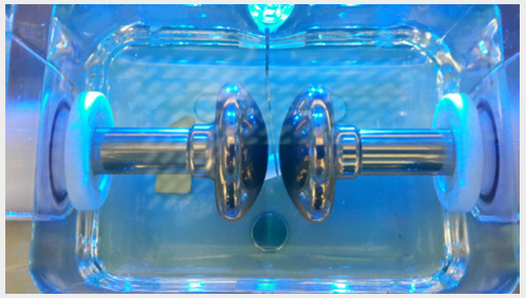
Incoming control phase

- Dimensional characteristics using tools from the standard caliper to a 3D arm
- Material characteristics like roughness, hardness or composition by an X-Ray fluorescence



Dimensional investigations can easily be performed
Chemistry laboratory is the place to reveal hidden characteristics of insulation:

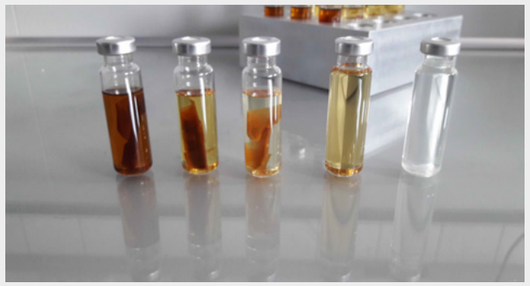
- OIL CHARACTERISTICS:
  - Water content (acc.to IEC 60814)
  - Dissipation factor (acc. to IEC 60247)
  - Breakdown voltage (acc to IEC 60156)
  - Acidity, interfacial tension, etc....



- PAPER CHARACTERISTICS

- MATERIAL COMPATIBILITY TEST WITH INSULATION

All those analyses can be completed by a dissolved gases analysis (acc. to IEC 60567) which identifies the gas signature of a standard ageing or other potential default.



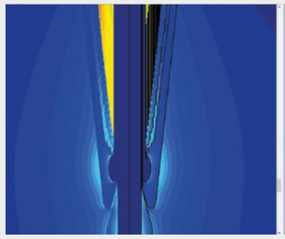
SERVICES
& TEAM OF EXPERTS

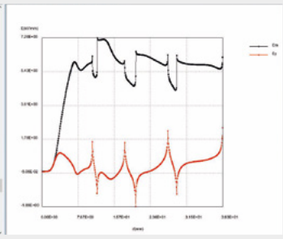
ENGINEERING

- Offers training either on site or by webinar

- Support for the implementation of the bushings within your transformers
  - Electrical field calculation
  - Seismic calculation
  - Mechanical calculation

- Special tests to fulfill specific requirements (thermic, mechanical, electrical)
- Answer to questions in a short period of time





ORDER CENTER

Complete supply chain value with a dedicated contact
- Customer-focused business
- 48 hours response time
- Worldwide experiences
- Reliable delivery time
- Shorter lead-time through supply agreement

SAFETY & ENVIRONMENT

We develop and promote the "Zero Harm Culture" . Safety is our first concern and is everyone's responsibility. We are committed to drive safety every day with training, workshops, daily discussions in order to ensure prevention.

We are very much focused on environment matters. We develop an environmental friendly product & reduce our carbon footprint by more than 20% from last years with digitalization, transport optimization, water & electricity consumption.

AFTER-SALES SERVICE

We are a team of experts available to determine the conditions of the bushings, to plan the maintenance, repair or replacement.
Supporting the end user to assest his bushing fleet and determine what would be the best way to manage it.
To achieve this goal, we set up a dedicated customer service team.

OUR TRENCH FRANCE AFTER-SALES SERVICE PORTFOLIO INCLUDES:

OIL ANALYSIS

- Oil sampling on the field
  The oil sampling on Trench bushing is performed at the flange with special tools.
  This solution unique in the market allows to make a safe oil sampling in grounded parts and to prevent any humidity or air ingress since the sampling device is totally immersed in oil.
- Oil analysis
  (e.g.: water content, electrical rigidity, dissolved gas) and recommendations

DEDICATED TRAINING

- Best knowledge of Trench products for crews (maintenance or technical)
- Know-how for doing better maintenance operations
- Prevention of potentially damaging actions

TECHNICAL EXPERTISE AND ADVICE

- Failure investigation and cause analysis
- Measurement of Capacitance and Tan delta
- Recommending repair

GENUINE SPART PARTS

- Supply of standard spare parts
- Supply of specific spare parts on demand

REPAIR, RECONSTRUCTION OR REFURBISHMENT

- Interchangeable reconstruction
- Refurbishment in our workshop as a brand-new bushing
- Repair after damages (e.g.: oil leakage, porcelain crack, etc.) in site or preferably in our workshop

CHECK TEST / ROUTINE OR SPECIAL TEST

- Check electrical test made internally in our test field labs, even if not originally made by Trench
- Specific test arrangement (type test, sealing test, mechanical test, etc....)

WORLDWIDE MAINTENANCE SERVICE

- On-site repairs depending on the damage level
- Highly qualified Trench service specialists

OUR NEW CET ESTER TRANFORMER BUSHINGS

Ester is a chemical compound families derived from an acid in which at least one -OH group is replaced by an-O-alky group.
They are naturally present in the nature such as tryglycerides or fragrances.

Synthetic esters are used in transformers where **fire safety** and **environmental protection** are a major concern or where demanding conditions are experienced.

Our concept is to offer an alternative bushing technology with **reduced costs** and **leatime**, therefore we developed the Ester Impregnated transformer bushings. Derived from our COT bushings they provide the same main features and options.

General

Developped at a steady pace, our new Ester filled bushing is the perfect answer to increasing eco sustainable high voltage equipment.

Portfolio available from **25kV** to **420kV**

Current up to 3150A (higher value on request)

Standard CT extension 0, 300, 500mm

Meet all IEC, NFC, IEEE, CAN standards,
fully type tested

Design adaption no changes inside the transformer

Flexibility in design

Adaptibility to match your transformer design

High seismic qualification

Standard temperature : -30°C to +40°C (see page 14)

Cost effective solution

Product Design

OIP condenser bushing made of kraft paper impregnated with liquid insulation

ECO- FRIENDLY SOLUTION
Using CET bushings reduces the risk of environmental damage in case of leaks.
The insulation liquid is classified as readily and fully **biodegradable**

ENHANCED SAFETY
Synthetic esters have a high fire point, significantly increasing the fire safety of the equipment

EXTENDED LIFE-TIME
CET products offer the characteristic of higher load capabilities at higher ntemperatures without reducing the insulation life expectancy.
Based on ageing tests, kraft paper has shown improved lifespan when combined with ester liquid.

COMPATIBLE with conventional transformers

Air-side insulator available in **composite** or porcelain

INTERCHANGEABILITY with COT bushings

Excellent **LONG TERM STABILITY** due to extremely pow partial discharge and power loss factor

EMBEDDED SHIELD in the low epoxy resin insulator

Product process

Filled with a synthetic ester that is readily biodegradable

Dedicated production equipment fully separated from mineral oil production line

Process similar to mineral oil impregnated bushings

CA - 2021-10 | We retain the right to make modifications without obligation to inform

Trench France SAS
16 rue du Général Cassagnou
68300 SAINT-LOUIS - France
+33 3 89 70 23 23
tf-sales@trench-group.com

www.trenchgroup.com

TRENCH