



Bowthorpe EMP

Transmission Line Surge Arresters (IEEE)

TRANSMISSION LINE SURGE ARRESTERS

Numerous technical publications have stated that lightning is responsible for approximately 65% of all of the non-scheduled outages occurring on transmission lines, thus creating many issues for power supply utilities.

Power supply utilities themselves have verified the load losses due to voltage sags on their systems from transitory outages caused by lightning activity, and in some regions they have found serious permanent damage caused to the system itself due to these transitory disturbances occurring on important lines.

The effect of these transitory disturbances on transmission lines can also be more critical in areas with high ground resistivity when associated with high lightning activity.

Most non-scheduled outages are transitory in nature, with a fault time shorter than 1 minute. In many cases this is still deemed by power supply utilities and their customers, to be unacceptable. This loss of supply is critical for all modern industries now so reliant on sophisticated electronic equipment and especially production processes sensitive to momentary disturbances on the system.

In order to reduce the number of non-scheduled outages in electrical systems, power companies and industrial consumers have been studying and promoting improvements to transmission lines thereby increasing their reliability.

There are different methods to improve transmission line performance due to lightning:

- a) Increase the dry arcing distance from the insulators strings.
- b) Install shield wires on lines without shield wires.
- c) Improve the shield wire performance.
- d) Improve the grounding system performance of surges by improving the tower footing resistance.
- e) Installation of transmission line arresters to counteract the effects of lightning or switching activity.

Cases have shown transmission line surge arresters, when electrically connected in parallel with the insulator string, are considered as an effective method to improve transmission line performance, especially when associated with improvements to the grounding system. This will demonstrate a best benefit versus cost relationship in reducing flashovers of the insulator string due to excessive voltages. Once transmission line arresters (TLA) are introduced to a transmission line the voltage is controlled due to the bipolar operation of the ZnO elements within the surge arrester.

Key Features

- TLA suspended from a transmission line giving enhanced transmission line performance
- TLA installed on the tower depending on geometry and clearance

Standard

- IEEE C62.11-2012 for Metal-oxide surge arresters

UTILITY

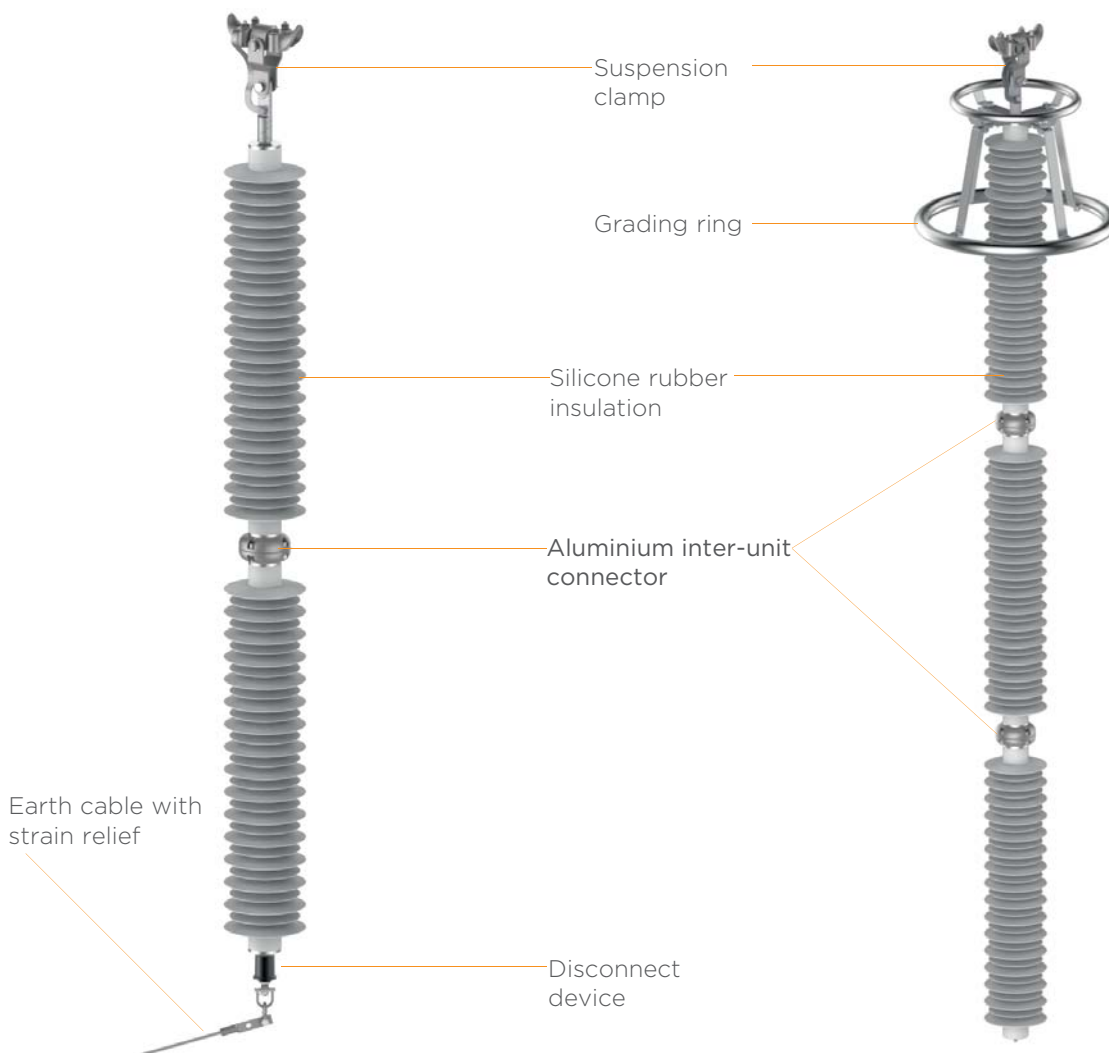
- Utilities are required by statutory demand to increase availability and reliability of transmission systems. Therefore, eliminating operational high cost outages and mandatory penalties is high on the agenda.

BENEFITS OF BOWTHORPE EMP TRANSMISSION LINE SURGE ARRESTER INSTALLATIONS

- Minimizing circuit breaker operation with possible system outage, resulting from back flashover on the shielded transmission line
- Lightning overvoltages are absorbed over the length of the line, thus reducing the severity of surge at the substation
- Transmission systems can be operated even where sub-soil gives poor tower footing resistance
- Eliminating interrupted power supply for sensitive industrial processes
- Installing transmission line surge arresters on a standard 3 phase voltage system along the line at calculated intervals, allows for optimum performance of the transmission line surge arrester, thus giving increased system line voltage. This eliminates the need to increase the standard insulation level required on conventional system upgrade (typically requires a full system study).

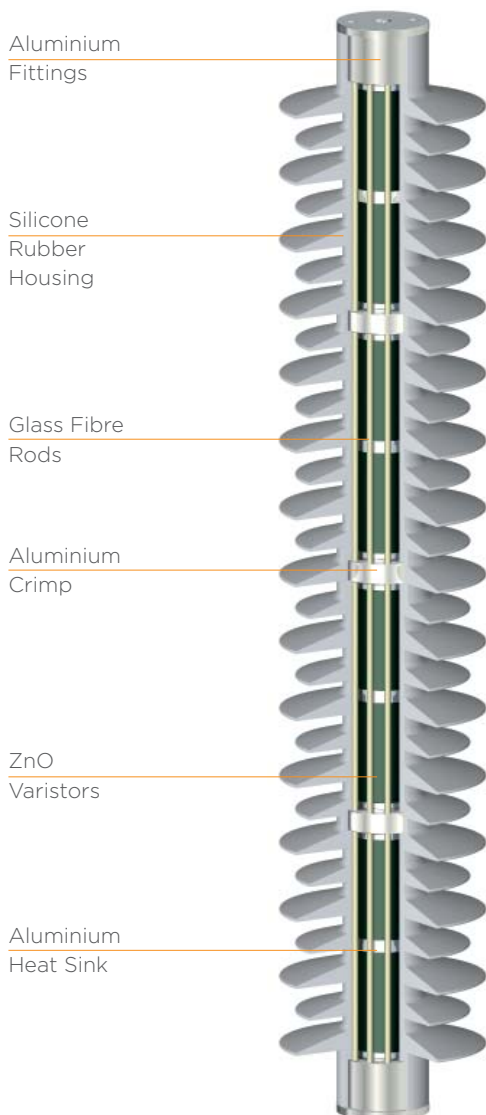
APPLICATION

Since the late 90's TE Connectivity (TE) has been supplying transmission line arresters, installed on different transmission line networks around the world. Transmission line arresters are largely being considered as an optimum solution for transmission line reliability, from lightning strikes and back flashovers. Lightning causes back flashovers which cause outages and therefore loss of productivity and potential penalties for the utilities.



GENERIC TECHNICAL DATA

		Surge arrester type		
		TLPAA	TLPBA	TLPCA
System voltage U_{max}	kV	245	300	550
System voltage U_{nom}	kV	230	275	500
Lightning impulse classifying current	kA	5	10	10
High current impulse (4/10 μs)	kA	65	65	65
Arrester class designation		Intermediate	Station	Station
Single impulse withstand rating	C	1.4	1.6	2.2
Energy class		B	D	E
Switching surge energy rating	kJ/kV MCOV	5.2	8.0	9.7
Low-current Long-duration Current Withstand	A @2ms	450	680	910
Rated short circuit voltage	kA	40	65	65



Qualification testing:

Decades of design and development experience have been used to produce today's TE Connectivity transmission line surge arresters. The construction comprises of a number of ZnO elements, assembled within an open cage construction, which has a silicone rubber moulded shed profile chemically bonded to the surface of the core.

TE Connectivity transmission line surge arresters are designed and manufactured to the current IEEE C62.11 December 2012 standard and the following tests have been successfully performed.

• Test performed on metal oxide blocks:

- IEEE clause 8.2 - Discharge voltage characteristic test
- IEEE Clause 8.4 - Accelerated ageing test for varistors
- IEEE Clause 8.17 - TOV test
- IEEE Clause 8.16 - Duty-cycle test
- IEEE Clause 8.15 - Single-impulse energy rating test

• Test performed on complete surge arresters:

- IEEE Clause 7.2.2.3 - Cooling test
- IEEE Clause 8.7 - Accelerated aging test for polymer-housed arresters with exposure to salt fog
- IEEE Clause 8.8 - Contamination test
- IEEE Clause 8.11 - RIV test
- IEEE Clause 8.18 - Short circuit test
- IEEE Clause 8.22 - Maximum design cantilever load (MDCL) and moisture ingress test for polymer-housed arresters

• Insulation withstand tests on surge arrester housing:

- IEEE Clause 8.1.2.4 - Arrester insulation withstand test
- Dry lightning impulse
- Wet power frequency
- Wet switching impulse

ELECTRICAL PERFORMANCE

Maximum system voltage U_m	Duty cycle rating U_r	Arrester classification	Long duration current (2000 μ s)	Lightning impulse classifying current	High current impulse 4/10 μ s	Switching surge energy rating	Arrester type
(kV)	(kV)		(A)	(kA)	(kA)	(kJ/kV)	
24	18 - 30	Intermediate	500	5	65	5.2	TLPAA
	18 - 30	Station	680	10	65	8.0	TLPBA
	18 - 30	Station	910	10	65	9.7	TLPCA
36	27 - 54	Intermediate	500	5	65	5.2	TLPAA
	27 - 54	Station	680	10	65	8.0	TLPBA
	27 - 54	Station	910	10	65	9.7	TLPCA
52	42 - 54	Intermediate	500	5	65	5.2	TLPAA
	42 - 54	Station	680	10	65	8.0	TLPBA
	42 - 54	Station	910	10	65	9.7	TLPCA
72.5	60 - 75	Intermediate	500	5	65	5.2	TLPAA
	60 - 75	Station	680	10	65	8.0	TLPBA
	60 - 75	Station	910	10	65	9.7	TLPCA
123	96 - 120	Intermediate	500	5	65	5.2	TLPAA
	96 - 120	Station	680	10	65	8.0	TLPBA
	96 - 120	Station	910	10	65	9.7	TLPCA
145	108 - 144	Intermediate	500	5	65	5.2	TLPAA
	108 - 144	Station	680	10	65	8.0	TLPBA
	108 - 144	Station	910	10	65	9.7	TLPCA
170	138 - 150	Intermediate	500	5	65	5.2	TLPAA
	138 - 150	Station	680	10	65	8.0	TLPBA
	138 - 150	Station	910	10	65	9.7	TLPCA
245	180 - 228	Intermediate	500	5	65	5.2	TLPAA
	180 - 228	Station	680	10	65	8.0	TLPBA
	180 - 228	Station	910	10	65	9.7	TLPCA
300	240 - 312	Station	680	10	65	8.0	TLPBA
	240 - 312	Station	910	10	65	9.7	TLPCA
420	312 - 372	Station	910	10	65	9.7	TLPCA
500	396 - 468	Station	910	10	65	9.7	TLPCA

ELECTRICAL CHARACTERISTICS

Maximum System Voltage U_m	Rated Voltage U_r	MCOV	Max. Ures tested with current wave								Normalizes FOW discharge voltage (1/20 μ s)	
			Switching Current discharge voltage (30/60 μ s)				Lightning impulse discharge voltage (8/20 μ s)					
			250 A	500 A	1000 A	2000 A	5 kA	10 kA	20 kA	40 kA	10 kA	20 kA
kV	kV	kV	kV	kV	kV	kV	kV	kV	kV	kV	kV	
24	18	15.3	37.9	39.1	40.5		46.0	49.5	54.5		55.1	
	21	17.0	40.7	42.0	43.6		49.4	53.2	58.5		59.2	
	24	19.5	50.5	52.1	54.1		61.3	66.0	72.6		73.5	
	27	22.0	53.3	55.0	57.1		64.8	69.7	76.7		77.6	
	30	24.4	60.8	62.7	65.1		73.9	79.5	87.5		88.5	
	18	15.3	35.5	36.6	37.8	39.6	42.7	45.5	50.0	56.1	47.7	52.3
	21	17.0	46.9	48.3	49.9	52.3	56.4	60.0	63.6	66.0	63.0	69.0
	24	19.5	47.4	48.8	50.4	52.8	57.0	60.6	66.7	74.8	63.6	69.7
	27	22.0	57.9	59.6	61.6	64.5	69.6	74.0	81.4	91.4	77.7	85.1
	30	24.4	59.2	61.0	63.0	66.0	71.2	75.8	83.3	93.6	79.5	87.1
	18	15.3	34.6	35.4	36.7	38.1	41.0	43.2	46.7	51.8	45.4	48.7
	21	17.0	45.6	46.7	48.5	50.3	54.2	57.0	61.6	68.4	59.9	64.2
	24	19.5	46.1	47.2	49.0	50.8	54.7	57.6	62.2	69.1	60.5	64.9
27	22.0	57.4	58.9	61.0	63.3	68.2	71.8	77.5	86.2	75.4	80.9	
30	24.4	57.6	59.0	61.2	63.5	68.4	72.0	77.8	86.4	75.6	81.1	
36	30	24.4	60.8	62.7	65.1		73.9	79.5	87.5		88.5	
	36	29.0	70.8	73.1	75.8		86.0	92.6	102		103	
	42	33.6	86.1	88.8	92.1		105	113	124		125	
	45	36.5	88.4	91.1	94.6		107	116	127		129	
	54	42.0	101	104	108		123	132	145		147	
	30	24.4	59.2	61.0	63.0	66.0	71.2	75.8	83.3	93.6	79.5	87.1
	36	29.0	71.1	73.2	75.6	79.2	85.4	90.9	100	112	95.4	104
	42	33.6	82.9	85.4	88.2	92.4	99.7	106	117	131	111	122
	45	26.5	88.9	91.5	94.5	99.0	107	114	125	140	119	131
	54	42.0	107	110	113	119	128	136	150	168	143	157
	30	24.4	57.6	59.0	61.2	63.5	68.4	72.0	77.8	86.4	75.6	81.1
	36	29.0	69.1	70.8	73.4	76.2	82.1	86.4	93.3	104	90.7	97.4
	42	33.6	80.6	82.7	85.7	88.9	95.8	101	109	121	106	114
45	36.5	86.4	88.6	91.8	95.3	103	108	117	130	113	122	
54	42.0	104	106	110	114	123	130	140	156	136	146	

Surge arresters with other ratings are available on request

MECHANICAL CHARACTERISTICS

TOV Capability (without prior energy)		Dry impulse voltage 1,2/50 µs	Wet power frequency voltage	Wet switching impulse 250/2500 µs	Leakage distance	Overall length	Weight	Drawing Reference	Product code
1 sec* T _r	10 sec* T _r								
kV	kV								
22.6	21.9	252	102		38.19	13.19	11.0	BOW-38-012	TLPAA1-18
25.2	24.3	252	102		38.19	13.19	11.0	BOW-38-012	TLPAA1-21
28.9	27.9	252	102		38.19	13.19	11.0	BOW-38-012	TLPAA1-24
32.6	31.5	267	112		44.29	14.76	12.1	BOW-38-013	TLPAA2-27
36.1	34.9	267	112		44.29	14.76	12.1	BOW-38-013	TLPAA2-30
22.3	21.3	321	122		52.76	17.68	15.4	BOW-39-011	TLPBA1-18
24.8	23.7	321	122		52.76	17.68	15.4	BOW-39-011	TLPBA1-21
28.4	27.2	321	122		52.76	17.68	15.4	BOW-39-011	TLPBA1-24
32.1	30.7	321	122		52.76	17.68	15.4	BOW-39-011	TLPBA1-27
35.6	34.0	321	122		52.76	17.68	15.4	BOW-39-011	TLPBA1-30
22.6	21.4	275	101		43.31	15.75	22.1	BOW-30-032	TLPCA1-18
25.2	23.8	275	101		43.31	15.75	22.1	BOW-30-032	TLPCA1-21
28.9	27.3	275	101		43.31	15.75	22.1	BOW-30-032	TLPCA1-24
32.6	30.8	275	101		43.31	15.75	22.1	BOW-30-032	TLPCA1-27
36.1	34.2	275	101		43.31	15.75	22.1	BOW-30-032	TLPCA1-30
36.1	34.9	267	112		44.29	14.76	12.1	BOW-38-013	TLPAA2-30
42.9	41.5	267	112		44.29	14.76	12.1	BOW-38-013	TLPAA2-36
51.8	50.1	267	112		44.29	14.76	12.1	BOW-38-013	TLPAA2-42
54.0	52.2	267	112		44.29	14.76	12.1	BOW-38-013	TLPAA2-45
63.6	61.5	352	184		88.58	23.94	18.7	BOW-38-009	TLPAA4-54
35.6	34.0	321	122		52.76	17.68	15.4	BOW-39-011	TLPBA1-30
42.3	40.4	321	122		52.76	17.68	15.4	BOW-39-011	TLPBA1-36
49.0	46.8	321	122		52.76	17.68	15.4	BOW-39-011	TLPBA1-42
53.2	50.9	354	184		76.69	23.78	22.1	BOW-39-012	TLPBA2-45
61.2	58.5	354	184		76.69	23.78	22.1	BOW-39-012	TLPBA2-54
36.1	34.2	275	101		43.31	15.75	22.1	BOW-30-032	TLPCA1-30
42.9	40.6	275	101		43.31	15.75	22.1	BOW-30-032	TLPCA1-36
49.7	47.0	275	101		43.31	15.75	22.1	BOW-30-032	TLPCA1-42
54.0	51.1	337	173		88.58	23.23	33.1	BOW-30-033	TLPCA2E-45
62.2	58.8	337	173		88.58	23.23	33.1	BOW-30-033	TLPCA2E-54

* TOV curves are given on technical data sheets for selected surge arrester (on request)

ELECTRICAL CHARACTERISTICS

Maximum System Voltage U_m	Rated Voltage U_r	MCOV	Max. Ures tested with current wave								Normalizes FOW discharge voltage (1/20 μ s)	
			Switching Current discharge voltage (30/60 μ s)				Lightning impulse discharge voltage (8/20 μ s)					
			250 A	500 A	1000 A	2000 A	5 kA	10 kA	20 kA	40 kA	10 kA	20 kA
kV	kV	kV	kV	kV	kV	kV	kV	kV	kV	kV	kV	
52	42	33.6	86.1	88.8	92.1		105	113	124		125	
	45	36.5	88.4	91.1	94.6		107	116	127		129	
	48	39.0	96.1	99.1	103		117	126	138		140	
	54	42.0	101	104	108		123	132	145		147	
	42	33.6	82.9	85.4	88.2	92.4	99.7	106	117	131	111	122
	45	36.5	88.9	91.5	94.5	99.0	107	114	125	140	119	131
	48	39.0	94.8	97.6	101	106	114	121	133	150	127	139
	54	42.0	107	110	113	119	128	136	150	168	143	157
	42	33.6	80.6	82.7	85.7	88.9	95.8	101	109	121	106	114
	45	36.5	86.4	88.6	91.8	95.3	103	108	117	130	113	122
48	39.0	92.2	94.5	97.9	102	109	115	124	138	121	130	
54	42.0	104	106	110	114	123	130	140	156	136	146	
72.5	60	48.0	121	125	130		147	159	174		177	
	72	57.0	147	151	157		178	192	211		213	
	75	60.0	151	156	162		184	198	218		220	
	60	48.0	118	122	126	132	142	152	167	187	159	174
	72	57.0	142	146	151	158	171	182	200	225	191	209
	75	60.0	148	152	158	165	178	189	208	234	199	218
	60	48.0	115	118	122	127	137	144	156	173	151	162
	72	57.0	138	142	147	152	164	173	187	207	181	195
	75	60.0	150	153	159	165	178	187	202	224	196	211
123	96	76.0	195	201	209		237	255	280		283	
	108	84.0	227	234	243		276	297	327		331	
	96	76.0	190	195	202	211	228	242	267	299	255	279
	108	84.0	213	220	227	238	256	273	300	337	286	314
	96	76.0	184	189	196	203	219	230	249	276	242	260
	108	84.0	207	213	220	229	246	259	280	311	272	292

Surge arresters with other ratings are available on request

MECHANICAL CHARACTERISTICS

TOV Capability (without prior energy)		Dry impulse voltage 1,2/50 μ s	Wet power frequency voltage	Wet switching impulse 250/2500 μ s	Leakage distance	Overall length	Weight	Drawing Reference	Product code
1 sec* T _r	10 sec* T _r								
kV	kV				in.	in.	lbs.		
51.8	50.1	352	184		88.58	23.94	18.7	BOW-38-009	TLPAA4-42
54.0	52.2	352	184		88.58	23.94	18.7	BOW-38-009	TLPAA4-45
57.7	55.8	352	184		88.58	23.94	18.7	BOW-38-009	TLPAA4-48
63.6	61.5	352	184		88.58	23.94	18.7	BOW-38-009	TLPAA4-54
49.0	46.8	321	122		52.76	17.68	15.4	BOW-39-011	TLPBA1-42
53.2	50.9	354	184		76.69	23.78	22.1	BOW-39-012	TLPBA2-45
56.8	54.4	354	184		76.69	23.78	22.1	BOW-39-012	TLPBA2-48
61.2	58.5	354	184		76.69	23.78	22.1	BOW-39-012	TLPBA2-54
49.7	47.0	275	101		43.31	15.75	22.1	BOW-30-032	TLPCA1-42
54.0	51.1	337	173		88.58	23.23	33.1	BOW-30-033	TLPCA2E-45
57.7	54.6	337	173		88.58	23.23	33.1	BOW-30-033	TLPCA2E-48
62.2	58.8	337	173		88.58	23.23	33.1	BOW-30-033	TLPCA2E-54
71.0	68.6	352	184		88.58	23.94	18.7	BOW-38-009	TLPAA4-60
84.4	81.5	352	184		88.58	23.94	18.7	BOW-38-009	TLPAA4-72
88.8	85.8	352	184		88.58	23.94	18.7	BOW-38-009	TLPAA4-75
69.9	66.9	354	184		76.69	23.78	22.1	BOW-39-012	TLPBA2-60
83.0	79.5	663	350		152.4	43.15	40.8	BOW-39-012	TLPBA3-72
87.4	83.6	663	350		152.4	43.15	40.8	BOW-39-013	TLPBA3-75
71.0	67.2	337	173		88.58	23.23	33.1	BOW-30-033	TLPCA2E-60
84.4	79.8	672	358		177.2	42.72	60.6	BOW-30-034	TLPCA3E-72
88.8	84.0				177.2	42.72	60.6	BOW-30-034	TLPCA3E-75
112	109	709	367		175.2	47.87	39.6	BOW-38-010	TL2PAA4-96
124	120	709	367		175.2	47.87	39.6	BOW-38-010	TL2PAA4-108
111	106	663	350		152.4	43.15	40.8	BOW-39-013	TLPBA3-96
122	117	663	350		152.4	43.15	40.8	BOW-39-013	TLPBA3-108
112	106	672	358		177.2	42.72	60.6	BOW-30-034	TLPCA3E-96
124	118	672	358		177.2	42.72	60.6	BOW-30-034	TLPCA3E-108

* TOV curves are given on technical data sheets for selected surge arrester (on request)

ELECTRICAL CHARACTERISTICS

Maximum System Voltage U_m kV	Rated Voltage U_r kV	MCOV kV	Max. Ures tested with current wave								Normalizes FOW discharge voltage (1/20 μ s)	
			Switching Current discharge voltage (30/60 μ s)				Lightning impulse discharge voltage (8/20 μ s)				10 kA	20 kA
			250 A	500 A	1000 A	2000 A	5 kA	10 kA	20 kA	40 kA	10 kA	20 kA
145	120	98.0	243	250	260		295	317	349		353	
	132	106	268	276	287		325	350	385		390	
	144	115	293	302	314		356	383	422		427	
	120	98.0	237	244	252	264	285	303	333	374	318	348
	132	106	261	268	277	290	313	333	367	412	350	383
	144	114	284	293	303	317	342	364	400	449	382	418
	120	98.0	230	236	245	254	274	288	311	346	302	325
	132	106	253	260	269	279	301	317	342	380	333	357
	144	114	276	283	294	305	328	346	373	415	363	389
170	138	110	281	289	300		341	367	403		408	
	144	115	293	302	314		356	383	422		427	
	150	120	353	365	378		429	462	508		514	
	138	110	272	281	290	303	328	348	383	430	366	401
	144	115	284	293	303	317	342	364	400	449	382	418
	150	120	296	305	315	330	356	379	417	468	398	436
	138	110	265	272	282	292	315	331	358	397	348	373
	144	115	276	283	294	305	328	346	373	415	363	389
	150	120	288	295	306	318	342	360	389	432	378	406
245	192	152	404	417	432		491	528	581		588	
	198	158	417	430	446		506	545	599		606	
	216	172	442	456	473		536	578	635		643	
	228	180	454	469	486		536	578	635		643	
	192	152	379	390	403	422	456	485	533	599	509	558
	198	158	391	402	416	435	470	500	550	617	525	575
	216	172	427	439	454	475	513	545	600	674	573	627
	228	180	450	463	479	501	541	576	633	711	604	662
	192	152	369	378	392	406	438	461	498	553	484	519
	198	158	380	390	404	419	451	475	513	570	499	536
	216	172	415	425	441	457	492	518	560	622	544	584
	228	180	438	449	465	483	520	547	591	657	575	617

Surge arresters with other ratings are available on request

MECHANICAL CHARACTERISTICS

TOV Capability (without prior energy)		Dry impulse voltage 1.2/50 μ s	Wet power frequency voltage	Wet switching impulse 250/2500 μ s	Leakage distance	Overall length	Weight	Drawing Reference	Product code
1 sec* T _v	10 sec* T _v								
kV	kV				in.	in.	lbs.		
145	140	709	367		175.2	47.87	39.6	BOW-38-010	TL2PAA4-120
157	152	709	367		175.2	47.87	39.6	BOW-38-010	TL2PAA4-132
170	165	709	367		175.2	47.87	39.6	BOW-38-010	TL2PAA4-144
143	137	663	350		152.4	43.15	40.8	BOW-39-013	TLPBA3-120
154	148	642	337		205.2	63.58	58.2	BOW-39-014	TLPBA31-132
168	160				205.2	63.58	58.2	BOW-39-014	TLPBA31-144
145	137	672	358		177.2	42.72	60.6	BOW-30-034	TLPCA3E-120
157	148	672	358		177.2	42.72	60.6	BOW-30-034	TLPCA3E-132
170	161				220.4	61.85	84.9	BOW-30-035	TLPCA3E-144
163	157	709	367		175.2	47.87	39.6	BOW-38-010	TL2PAA4-138
170	165	709	367		175.2	47.87	39.6	BOW-38-010	TL2PAA4-144
178	172	709	367		175.2	47.87	39.6	BOW-38-010	TL2PAA4-150
160	153	642	337		205.2	63.58	58.2	BOW-39-014	TLPBA31-138
168	160	642	337		205.2	63.58	58.2	BOW-39-014	TLPBA31-144
175	167	642	337		205.2	63.58	58.2	BOW-39-014	TLPBA31-150
163	154	672	358		177.2	42.72	60.6	BOW-30-034	TLPCA3E-138
170	161	609	349		220.4	61.85	84.9	BOW-30-035	TLPCA3E-144
178	168	609	349		220.4	61.85	84.9	BOW-30-035	TLPCA3E-150
225	217				265.7	74.7	57.2	BOW-38-014	TL3PAA4-192
234	226				265.7	74.7	57.2	BOW-38-014	TL3PAA4-198
256	247				265.7	74.7	57.2	BOW-38-014	TL3PAA4-216
266	257				265.7	74.7	57.2	BOW-38-014	TL3PAA4-228
221	212	989	553		304.9	89.06	81.6	BOW-39-015	TLPBA33-192
230	220	989	553		304.9	89.06	81.6	BOW-39-015	TLPBA33-198
252	241	989	553		304.9	89.06	81.6	BOW-39-015	TLPBA33-216
262	251	989	553		304.9	89.06	81.6	BOW-39-015	TLPBA33-228
225	213	933	490		354.3	88.82	121.3	BOW-30-036	TLPCA33E-192
234	221	933	490		354.3	88.82	121.3	BOW-30-036	TLPCA33E-198
256	242	933	490		354.3	88.82	121.3	BOW-30-036	TLPCA33E-216
266	252	933	490		354.3	88.82	121.3	BOW-30-036	TLPCA33E-228

* TOV curves are given on technical data sheets for selected surge arrester (on request)

ELECTRICAL CHARACTERISTICS

Maximum System Voltage U_m kV	Rated Voltage U_r kV	MCOV kV	Max. Ures tested with current wave								Normalizes FOW discharge voltage (1/20 μ s) kV	
			Switching Current discharge voltage (30/60 μ s)				Lightning impulse discharge voltage (8/20 μ s)					
			250 A kV	500 A kV	1000 A kV	2000 A kV	5 kA kV	10 kA kV	20 kA kV	40 kA kV	10 kA kV	20 kA kV
300	252	201	498	512	529	554	598	636	700	786	668	732
	258	209	509	524	542	567	612	651	717	805	684	749
	264	212	521	537	555	581	627	667	733	823	700	767
	276	220	545	561	580	607	655	697	767	861	732	801
	288	230	569	585	605	633	684	727	800	898	764	836
	300	240	592	610	630	660	712	758	833	936	795	871
	312	245	616	634	655	686	741	788	867	973	827	906
	252	201	484	496	514	533	575	605	653	726	635	682
	258	209	495	508	526	546	588	619	669	743	650	698
	264	212	507	520	539	559	602	634	684	760	665	714
	276	220	530	543	563	584	629	662	715	795	696	747
	288	230	553	567	588	610	657	691	746	829	726	779
	300	240	576	590	612	635	684	720	778	864	756	811
	312	245	599	614	636	660	711	749	809	899	786	844
420	336	268	645	661	685	711	766	806	871	968	847	909
	360	288	691	708	734	762	821	864	933	1037	907	974
	372	297	714	732	759	787	848	893	964	1071	937	1006
550	420	335	806	827	857	889	958	1008	1089	1210	1058	1136
	444	353	852	874	906	940	1012	1066	1151	1279	1119	1201

Surge arresters with other ratings are available on request

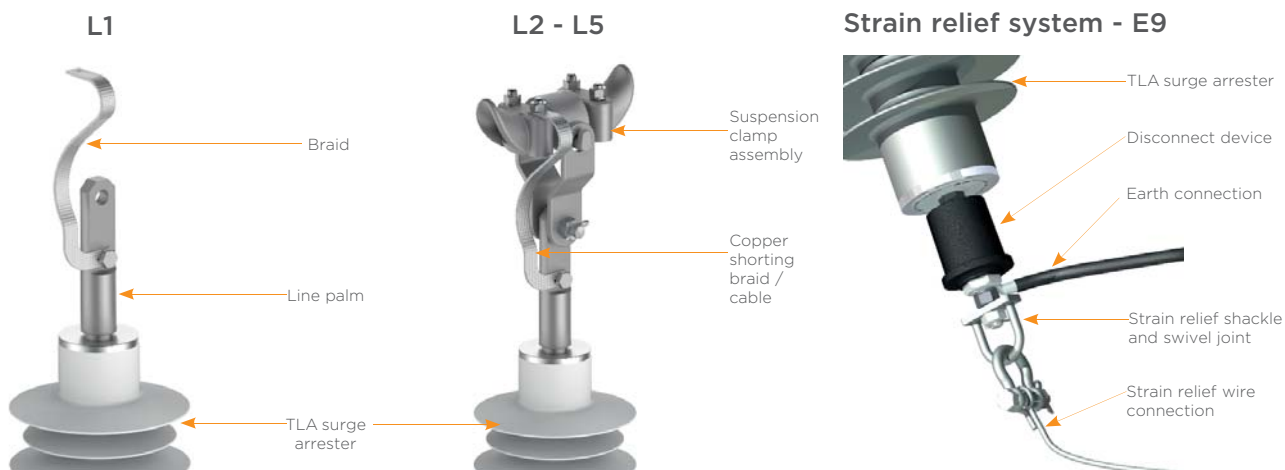
MECHANICAL CHARACTERISTICS

TOV Capability (without prior energy)		Dry impulse voltage 1,2/50 μ s	Wet power frequency voltage	Wet switching impulse 250/2500 μ s	Leakage distance	Overall length	Weight	Drawing Reference	Product code
1 sec* T _r	10 sec* T _r								
kV	kV				in.	in.	lbs.		
294	282				357.6	115.7	96.8	BOW-39-016	TLPBA331-252
305	291				357.6	115.7	96.8	BOW-39-016	TLPBA331-258
309	296				357.6	115.7	96.8	BOW-39-016	TLPBA331-264
321	307				357.6	115.7	96.8	BOW-39-016	TLPBA331-276
335	321	1220	626		381.5	116.2	105.6	BOW-39-017	TLPBA332-288
350	335	1220		1072	457.3	135.5	124.3	BOW-39-018	TLPBA333-300
357	342	1220		1072	457.3	135.5	124.3	BOW-39-018	TLPBA333-312
299	283	1079	558		397.6	110.1	147.4	BOW-30-037	TLPCA331E-252
309	293	1079	558		397.6	110.1	147.4	BOW-30-037	TLPCA331E-258
314	297	1079	558		397.6	110.1	147.4	BOW-30-037	TLPCA331E-264
326	308	1079	558		397.6	110.1	147.4	BOW-30-037	TLPCA331E-276
340	322				442.9	117.6	156.2	BOW-30-038	TLPCA332E-288
355	336	1372		1113	531.5	137.1	183.7	BOW-30-039	TLPCA333E-300
363	343	1372		1113	531.5	137.1	183.7	BOW-30-039	TLPCA333E-312
398	377	1372		1113	531.5	137.1	183.7	BOW-30-039	TLPCA333E-336
426	403	1372		1113	531.5	137.1	183.7	BOW-30-039	TLPCA333E-360
441	417	1372		1113	531.5	137.1	183.7	BOW-30-039	TLPCA333E-372
496	469				574.8	152.7	205.7	BOW-30-040	TLPCA3331E-420
522	494				708.6	179.7	244.2	BOW-30-041	TLPCA3333E-444

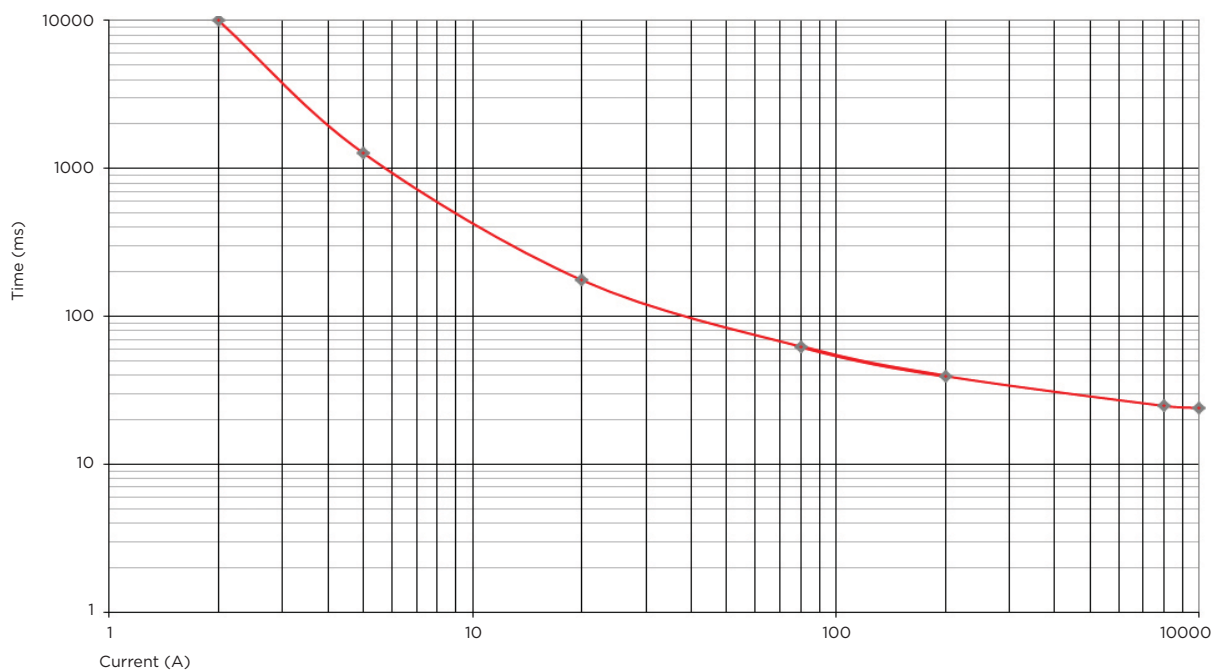
* TOV curves are given on technical data sheets for selected surge arrester (on request)

Line and Earth configurations

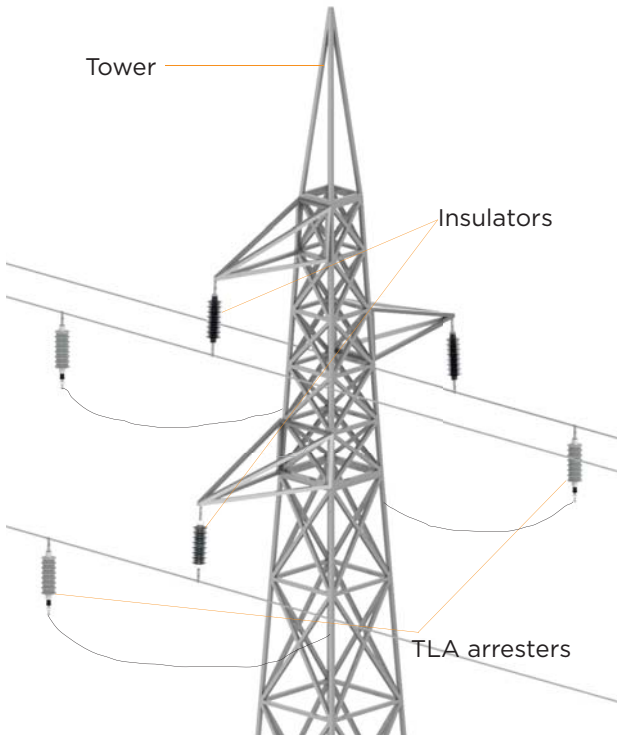
Clamp	Drawing Reference	Conductor	Palm	"U" Bolt
		Range Dia.		Torque
L1	BOW-30-029			
L2	BOW-30-030	0.37 - 0.75 in.	L1	398 lbf in
L3		0.71 - 1.18 in.	L1	398 lbf in
L4		1.18 - 1.77 in.	L6	663 lbf in
L5		1.77 - 2.56 in.	L6	663 lbf in
L6	BOW-30-031			



Time vs current curve for DD5 disconnect device



Tower installation configuration



The number of surge arresters installed on the tower depends on the tower geometry, configuration, and type of tower (Suspension or tension) as well as the earthing impedance.

For towers with a horizontal conductor configuration, normal practice is to install a surge arrester on both of the two outside phase conductors.

For towers with a vertical or triangular conductor configuration, the resultant transient voltage across the insulators string sets is usually higher on the bottom phase, which presents a lower distance to the soil and lowest coupling with the shield wire. Therefore, only one surge arrester is necessary on the bottom phase for transmission lines with a vertical configuration and low tower footing impedance. For higher footing impedances it may be necessary to install two or three surge arresters subject to the line analysis.

A direct lightning strike to the transmission line without a shield wire will cause discharge current $I(t)$ to divide into two current waves travelling in opposite directions along the line with a magnitude of $I(t)/2$ (it is valid when we consider the impedance of the discharge channel as infinite). This current also produces a voltage wave $v(t)$ in both directions. As a first approach we can consider the transmission line is without losses and distortions, therefore the voltage along the line can be estimated by:

$$V(t) = Z_0 \cdot i(t) / 2$$

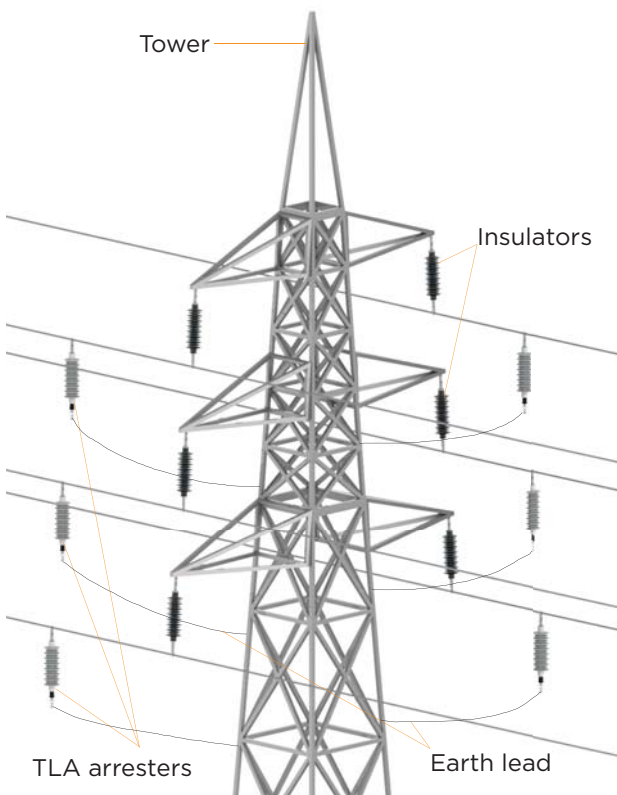
(Where Z_0 is the surge impedance of the transmission line)

Shield wires on transmission lines are installed to attract lightning strikes and subsequently the overvoltages magnitude and frequency will be significantly lower than a tower without shield wires however it will also depend on the earthing transient behaviour and also the lightning strike point and tower impedance.

We are able to carry out a computational study to set where transmission line surge arresters are to be installed for optimum line performance.

Consideration to clearances is very important when installing TLA's either on the transmission line or the tower. Another consideration would be the lead length when operation of the disconnect occurs and whether installation of the disconnect is on the phase or the surge arrester earth.

A data sheet is available to collate line information.



Other product ranges available



Porcelain surge arresters

Porcelain surge arresters

- For system voltages up to 800 kV
- Standard: IEC60099-4, 2014 and IEEE C62.11: 2012
- Designation class: SL, SM, SH (IEC) and Station class (IEEE)
- High Current short circuit up to 65 kA
- Application: Transmission and sub-station overvoltage protection



Polymeric surge arresters

Polymeric surge arresters

- For system voltages up to 400 kV
- Standard: IEC60099-4, 2014 and IEEE C62.11:2012
- Designation class: SL, SM (IEC) and Intermediate, Station class (IEEE)
- Short Circuit rating up to 65 kA
- Application: Transmission and sub-station overvoltage protection



Cable sheath arresters

Cable sheath surge arresters

- For cable sheath protection up to 12 kV rating
- Standard: IEC60099-4
- Designation class: SL (IEC)
- Application: Cable sheath protection



Cable spiker kit

Cable spiker kit

- Safety device for cables
- Cable to BS6622 & BS EN/IEC60228
- Suitable for cable up to 102 mm diameter
- Hydraulic pump - no explosive cartridge required
- Application: To determine if 11 kV cable is dead or alive



Airfield lighting box

Airfield lighting box type 2DCAFL4

- Suitable for 4 kV DC lighting systems
- Standard: IEC60099-4
- Designation class: DH
- Robust design to IP65
- Application: Protection of airfield lighting

Brighton High Power Laboratory



Impulse generator 1.65 MV



500 kV power transformer with PD testing



High energy surge arrester test system



HV varistor block ageing test system with AC and DC supply



TE Connectivity (NYSE: TEL) is a \$12 billion global technology leader. Our connectivity and sensor solutions are essential in today's increasingly connected world. We collaborate with engineers to transform their concepts into creations - redefining what's possible using intelligent, efficient and high-performing TE products and solutions proven in harsh environments. Our 72,000 people, including over 7,000 engineers, partner with customers in close to 150 countries across a wide range of industries. We believe EVERY CONNECTION COUNTS - www.TE.com.

Generation

- Conventional Power
- Nuclear Power
- Wind/Solar
- Hydro-electric

Transmission & Distribution

- Substation
- Underground
- Overhead
- Street Lighting

Industry

- Mining
- Petrochemical
- Railway
- Shipbuilding

WHEREVER ELECTRICITY FLOWS, YOU'LL FIND TE ENERGY



te.com/energy

FOR MORE INFORMATION:

EMAIL: hvsa@te.com

TE Technical Support Centers

AMERICAS

USA/Canada: +1 (800) 327-6996
 Mexico: +52 0-55-1106-0800
 Brazil: +55 11-2103-6023
 South America: +57 1-319-8962

ASIA-PACIFIC

Australia: +61 29-554-2695
 New Zealand: +64 9-634-4580
 China: +86 (0) 400-820-6015

EUROPE-MIDDLE EAST-AFRICA

France: +33 (0) 38-058-3200
 Germany/Switzerland: +49 (0) 89-608-9903
 UK: +44 08708-707-500
 Spain/Portugal: +34 912-681-885
 Italy: +39 335-834-3453
 Benelux: +32 16-351-731
 Poland/Baltics: +48 224-576-753
 Czech Republic: +42 (0) 272-011-105
 Sweden/Norway: +46 850 725 000
 Middle East: +971 4-211-7020

te.com/powertransmission

© 2016 TE Connectivity Ltd. family of companies. All Rights Reserved. EPP-2869-11/16

Bowthorpe EMP, TE Connectivity, TE and the TE connectivity (logo) are trademarks of the TE Connectivity Ltd. family of companies. Other logos, product and/or Company names mentioned herein may be trademarks of their respective owners. While TE has made every reasonable effort to ensure the accuracy of the information in this brochure, TE does not guarantee that it is error-free, nor does TE make any other representation, warranty or guarantee that the information is accurate, correct, reliable or current. TE reserves the right to make any adjustments to the information contained herein at any time without notice. TE expressly disclaims all implied warranties regarding the information contained herein, including, but not limited to, any implied warranties of merchantability or fitness for a particular purpose. The dimensions in this brochure are for reference purposes only and are subject to change without notice. Specifications are subject to change without notice. Consult TE for the latest dimensions and design specifications.