

Technical data

High-voltage high-breaking capacity VV fuse-links

Technical data									
rated voltage	Dimension "e" according to DIN and IEC	rated current	Striker type	Rated breaking capacity	Rated minimum breaking current	cold resistance	power dissipation	pre-arcing I ² t value	total I ² t value
[kV]	(mm)	I _n [A]		(kA)	(A)	[mΩ]	[W]	[A ² s]	[A ² s]
3/7.2	192	1	C ₀	63	12	1170	3		
		2			12	580	4	6,1	57
		4			20	370	9	17,3	164
		6			25	260	10	36	340
		6,3			25	260	10	36	340
		10			43	75	9	165	1.450
		16			56	44	14	320	5.200
		20			70	27	12,5	450	7.000
		25			87	21	16	700	10.000
		31,5			110	18	23,5	1.400	15.000
		32			110	18	25	1.400	15.000
		40			140	13	28,5	3.200	27.000
		50			175	10,5	35,5	5.800	44.000
		63			220	7,5	42,5	12.000	70.000
		80			280	5,9	59	19.000	140.000
		100			360	4,8	73	35.000	202.000
		125			450	3,9	101	55.000	300.000
		160			600	3	144	94.000	580.000
3/7.2	292	2	C ₀	63	12	580	4	6,1	57
		4			20	370	9	17,3	164
		6			25	260	10	36	340
		6,3			25	260	10	36	340
		10			43	75	9	165	1.450
		16			56	44	14	320	5.200
		20			70	27	12,5	450	7.000
		25			87	21	16	700	10.000
		31,5			110	18	23,5	1.400	15.000
		32			110	18	25	1.400	15.000
		40			140	13	28,5	3.200	27.000
		50			175	10,5	35,5	5.800	44.000
		63			220	7,5	42,5	12.000	70.000
		80			280	5,9	59	19.000	140.000
		100			360	4,8	73	35.000	202.000
		125			450	3,9	101	55.000	300.000
		160			600	3	144	94.000	580.000
		200			1000	2,1	155	151.780	789.270
250	1250	1,7	196	228.610	1.188.800				
3/7.2	442	2	C ₀	63	12	840	4,7	6,1	57
		4			20	530	11,7	17,3	164
		6			25	270	13,4	36	340
		6,3			25	270	13,4	36	340
		10			43	90	11	165	1.450
		16			56	53	16	320	5.200
		20			70	32	15	450	7.000
		25			87	25	19	700	10.000
		31,5			110	21,5	28	1.400	15.000
		32			110	21,5	30	1.400	15.000
		40			140	15,5	34	3.200	27.000
		50			175	12,6	43	5.800	44.000
		63			220	9	51	12.000	70.000
		80			280	7,1	71	19.000	140.000
		100			360	5,8	88	35.000	202.000
		125			450	4,7	121	55.000	300.000
		160			600	3,6	173	94.000	580.000
		200			1000	2,65	195	151.780	789.270
		250			1250	2,2	253	228.610	1.188.800
		315			1575	1,75	320	368.640	1.916.930

Technical data

rated voltage	Dimension "e" according to DIN and IEC	rated current	Striker type	Rated breaking capacity	Rated minimum breaking current	cold resistance	power dissipation	pre-arcing I ² t value	total I ² t value		
[kV]	(mm)	I _n [A]		(kA)	(A)	[mΩ]	[W]	[A ² s]	[A ² s]		
6/12	192	2	C, D	50	12	980	6	6,1	57		
		4			20	650	15	17,3	164		
		6			27	435	21	36	340		
		6,3			27	435	21	36	340		
		10			42	130	15	165	1.450		
		16			64	70	24	320	5.200		
		20			80	44	21	450	7.000		
		25			100	33	28	700	10.000		
		31,5			126	29	40	1.400	15.000		
		32			126	29	43	1.400	15.000		
		40			160	21	48	3.200	27.000		
		50			200	16,5	58	5.800	44.000		
		292			C, D	63	1	12	1970	5	
	2		12	980			6	6,1	57		
	4		20	650			15	17,3	164		
	6		25	435			21	36	340		
	6,3		25	435			21	36	340		
	10		43	130			15	165	1.450		
	16		56	70			24	320	5.200		
	20		70	44			21	450	7.000		
	25		87	33			28	700	10.000		
	31,5		110	29			40	1.400	15.000		
	32		110	29			43	1.400	15.000		
	40		140	21			48	3.200	27.000		
	50		175	16,5			58	5.800	44.000		
	63		220	12			74	12.000	70.000		
	80		280	9			96	19.000	140.000		
	100		360	6,7			105	35.000	202.000		
	125		450	5,2			138	55.000	300.000		
	160	600	4,1	190	94.000	580.000					
	442	C, D	63	2	12	980	6	6,1	57		
				4	20	650	15	17,3	164		
				6	25	435	21	36	340		
6,3				25	435	21	36	340			
10				43	130	15	165	1.450			
16				56	70	24	320	5.200			
20				70	44	21	450	7.000			
25				87	33	28	700	10.000			
31,5				110	29	40	1.400	15.000			
32				110	29	43	1.400	15.000			
40				140	21,5	48	3.200	27.000			
50				175	16,5	58	5.800	44.000			
63				220	12	74	12.000	70.000			
80				280	9	96	19.000	140.000			
100				360	6,7	105	35.000	202.000			
125				450	5,2	138	55.000	300.000			
160				600	4,1	190	94.000	580.000			
200				1000	3,3	238	151.780	789.270			
537				C, D	63	160	600	4,1	179	94.000	580.000
						200	1000	3,3	238	151.780	789.270
						250	1250	2,65	305	228.610	1.188.800

Technical data

Technical data										
rated voltage	Dimension "e" according to DIN and IEC	rated current	Striker type	Rated breaking capacity	Rated minimum breaking current	cold resistance	power dissipation	pre-arcing I ² t value	total I ² t value	
[kV]	(mm)	I _n [A]		(kA)	(A)	[mΩ]	[W]	[A ² s]	[A ² s]	
10/17.5	292	2	C, D	50	12	1400	8	6,1	57	
		4			20	900	17	17,3	164	
		6			27	670	35	36	340	
		6,3			27	670	35	36	340	
		10			42	160	20	165	1.450	
		16			64	95	31	320	5.200	
		20			80	58	29	450	7.000	
		25			100	45	36	700	10.000	
		31,5			126	38	51	1.400	15.000	
		32			126	38	53	1.400	15.000	
		40			160	28	64	3.200	27.000	
		50			200	21,5	75	5.800	44.000	
		63			252	16,5	100	12.000	70.000	
		80			320	12,5	130	19.000	140.000	
		100			400	9	150	35.000	202.000	
	367	C, D	1	63	12	2800	6			
			2		12	1400	8	6,1	57	
			4		20	900	17	17,3	164	
			6		25	670	35	36	340	
			6,3		25	670	35	36	340	
			10		42	160	20	165	1.450	
			16		56	95	31	320	5.200	
			20		70	58	29	450	7.000	
			25		87	45	36	700	10.000	
			31,5		110	38	51	1.400	15.000	
			32		110	38	53	1.400	15.000	
			40		140	28	64	3.200	27.000	
			50		175	21,5	75	5.800	44.000	
			63		220	16,5	100	12.000	70.000	
			80		280	12,5	130	19.000	140.000	
	100	360	9	150	35.000	202.000				
	125	450	7,5	210	55.000	300.000				
	160	600	5,6	290	94.000	580.000				
	442	C, D	2	63	12	1400	8	6,1	57	
			4		20	900	17	17,3	164	
			6		25	670	35	36	340	
			6,3		25	670	35	36	340	
			10		42	160	20	165	1.450	
			16		56	95	31	320	5.200	
			20		70	58	29	450	7.000	
			25		87	45	36	700	10.000	
			31,5		110	38	51	1.400	15.000	
			32		110	38	53	1.400	15.000	
			40		140	28	64	3.200	27.000	
			50		175	21,5	75	5.800	44.000	
63			220		16,5	100	12.000	70.000		
80			280		12,5	130	19.000	140.000		
100			360		9	150	35.000	202.000		
125	450	7,5	210	55.000	300.000					
160	600	5,6	290	94.000	580.000					

Technical data

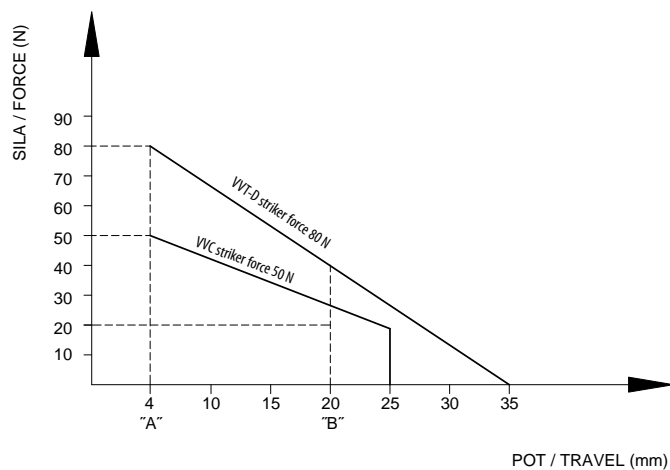
rated voltage	Dimension "e" according to DIN and IEC	rated current	Striker type	Rated breaking capacity	Rated minimum breaking current	cold resistance	power dissipation	pre-arcing I ² t value	total I ² t value	
[kV]	(mm)	I _n [A]		(kA)	(A)	[mΩ]	[W]	[A ² s]	[A ² s]	
10/24	292	2	C, D	31,5	12	2040	12	6,1	57	
		4			20	1300	35	17,3	164	
		6			27	900	56	36	340	
		6,3			27	900	56	36	340	
		10			42	230	25,5	165	1.450	
		16			64	125	42	320	5.200	
		20			80	76	39,5	450	7.000	
		25			100	59	49	700	10.000	
		31,5			126	52	75	1.400	15.000	
		32			126	52	79	1.400	15.000	
		40			160	38	94	3.200	27.000	
		50			200	29	110	5.800	44.000	
	63	252	21,5	137	12.000	70.000				
	442	442	1	C, D	63	12	3900	9		
			2			12	2040	12	6,1	57
			4			20	1300	35	17,3	164
			6			25	900	56	36	340
			6,3			25	900	56	36	340
			10			42	230	25,5	165	1.450
			16			56	125	42	320	5.200
			20			70	76	39,5	450	7.000
			25			87	59	49	700	10.000
			31,5			110	52	75	1.400	15.000
			32			110	52	79	1.400	15.000
			40			140	38	94	3.200	27.000
			50			175	29	110	5.800	44.000
			63			220	21,5	137	12.000	70.000
			80			280	16	174	19.000	140.000
			100			355	12,9	220	35.000	202.000
			125			473	11,9	365	49.000	220.000
			537			537	2	C, D	63	12
	4	20		1300	35		17,3			164
	6	25		900	56		36			340
	6,3	25		900	56		36			340
	10	42		230	25,5		165			1.450
	16	56		125	42		320			5.200
20	70	76		39,5	450		7.000			
25	87	59		49	700		10.000			
31,5	110	52		75	1.400		15.000			
32	110	52		79	1.400		15.000			
40	140	38		94	3.200		27.000			
50	175	29		110	5.800		44.000			
63	220	21,5		137	12.000		70.000			
80	280	16		174	19.000		140.000			
100	355	12,9		220	35.000		202.000			
125	473	11,9		365	49.000		220.000			
160	600	5,6	290	94.000	580.000					

Technical data

Technical data

rated voltage	Dimension "e" according to DIN and IEC	rated current	Striker type	Rated breaking capacity	Rated minimum breaking current	cold resistance	power dissipation	pre-arcing I ² t value	total I ² t value	
[kV]	(mm)	I _n [A]		(kA)	(A)	[mΩ]	[W]	[A ² s]	[A ² s]	
20/36	442	2	C, D	20	12	2900	17	6,1	57	
		4			20	1870	45	17,3	164	
		6			27	1300	73	36	340	
		6,3			27	1300	73	36	340	
		10			42	320	40	165	1.450	
		16			64	185	60	320	5.200	
		20			84	110	58	450	7.000	
		25			100	85	80	700	10.000	
	537	C, D	31,5	1	12	5800	14			
				2	12	2900	17	6,1	57	
				4	20	1870	45	17,3	164	
				6	25	1300	73	36	340	
				6,3	25	1300	73	36	340	
				10	45	320	40	165	1.450	
				16	56	185	60	320	5.200	
				20	84	110	58	450	7.000	
				25	87	90	77	700	10.000	
				31,5	116	75	115	1.400	15.000	
				32	116	75	120	1.400	15.000	
				40	149	57	145	3.200	27.000	
				50	175	47	145	5.800	44.000	
				63	220	34	200	12.000	70.000	
				80	280	25,5	270	19.000	140.000	

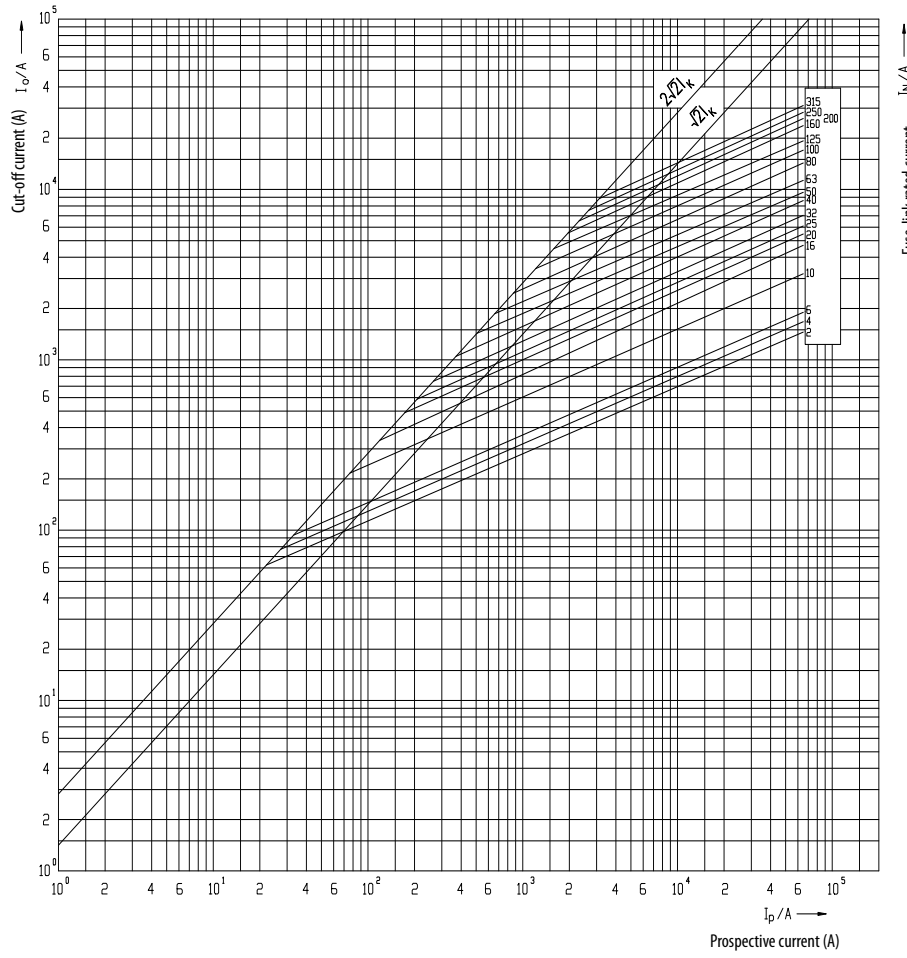
Force / travel striker pin diagram



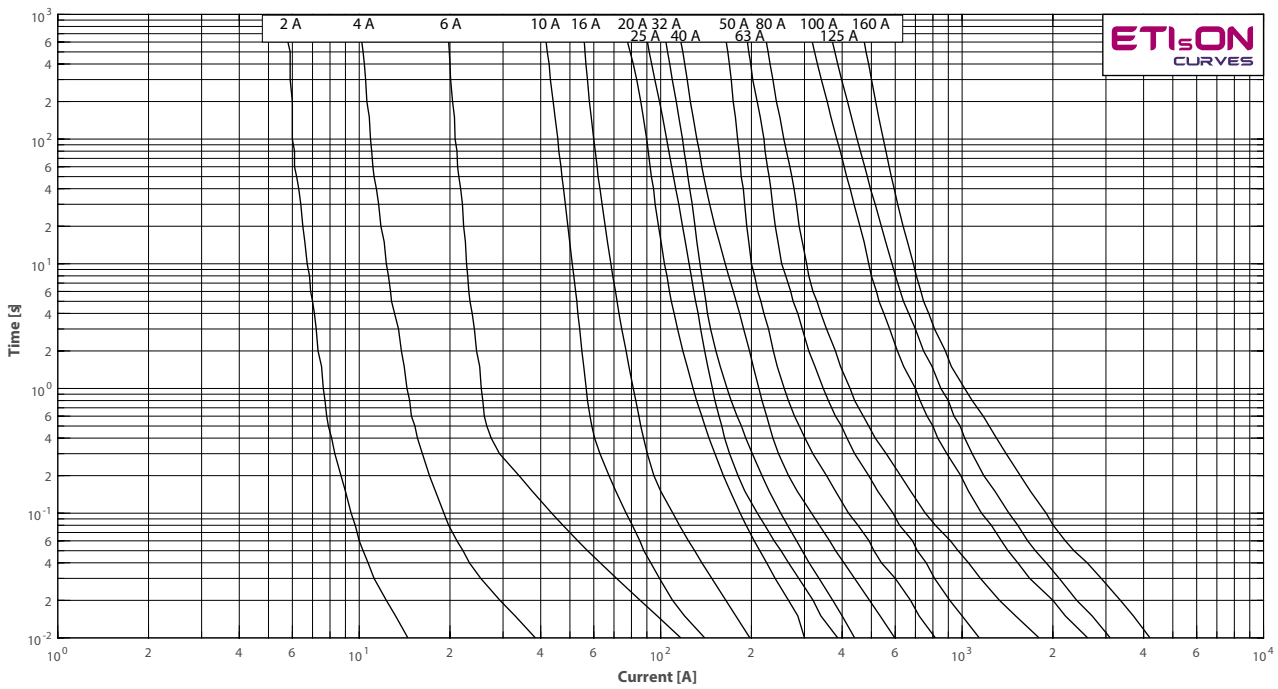
Connection in indoor switchgear, example:



Cut-off current diagram for VV-Thermo fuse links

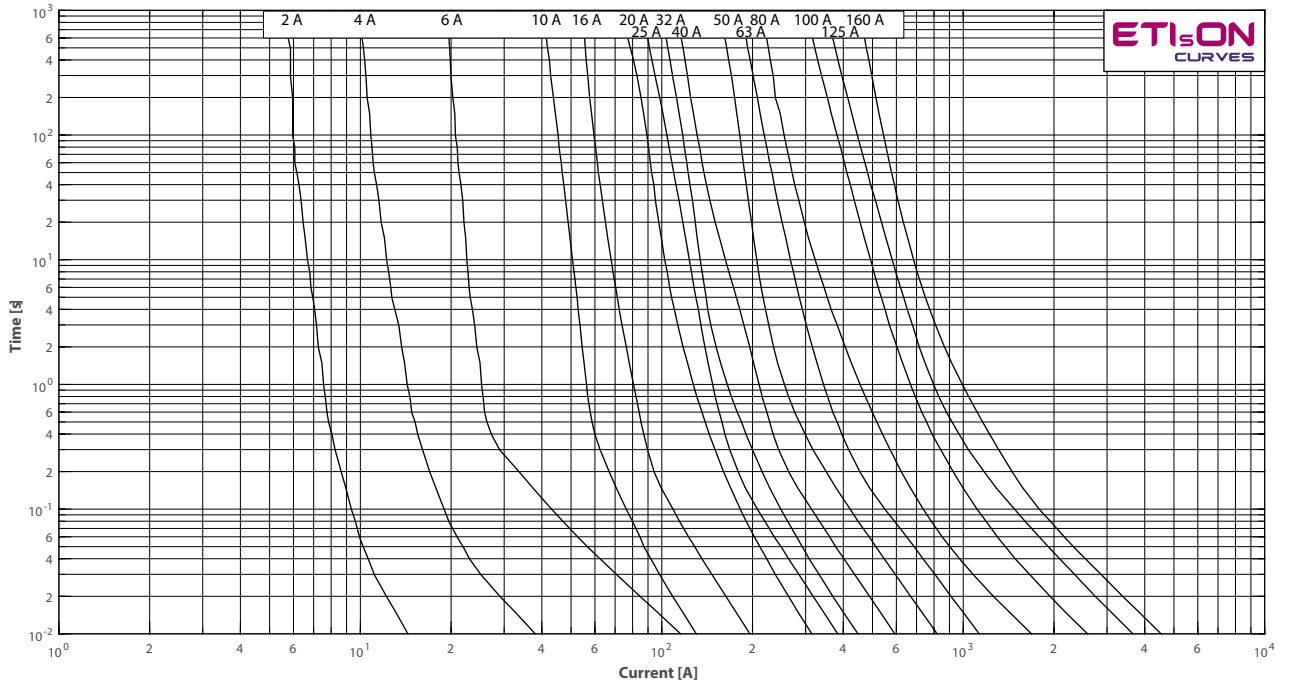


Time-current characteristics for VV-thermo fuse links
7,2 kV

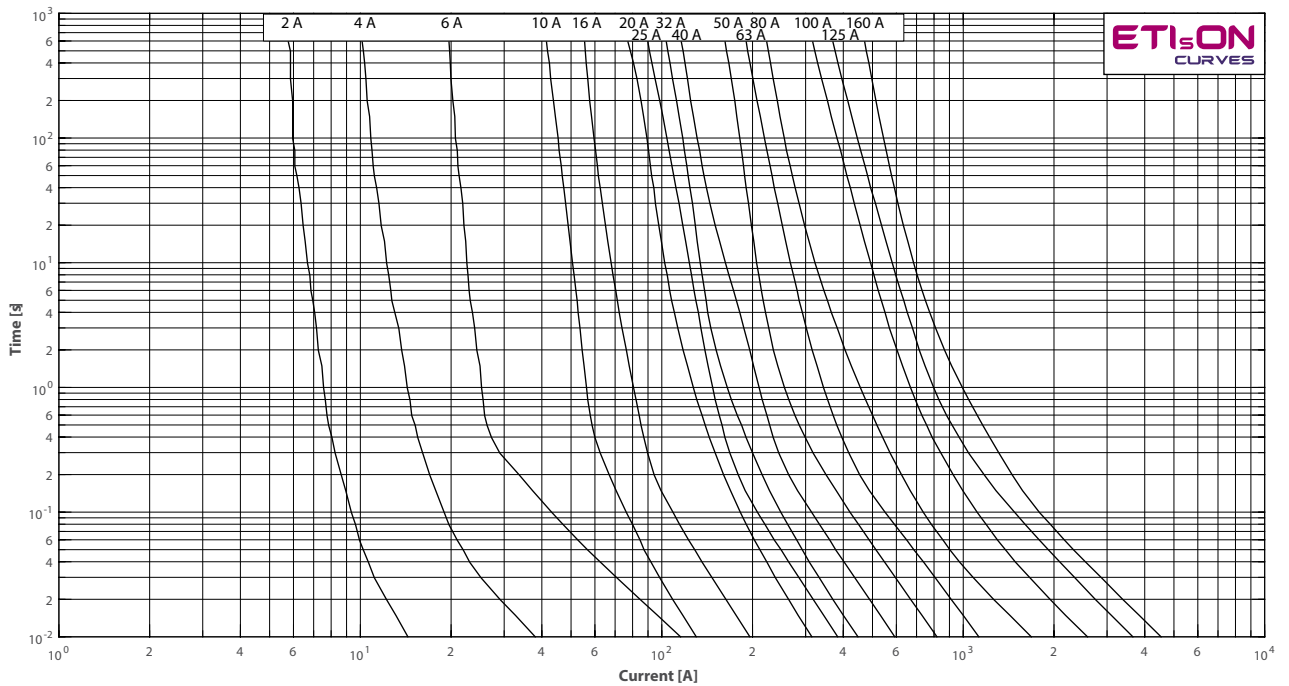


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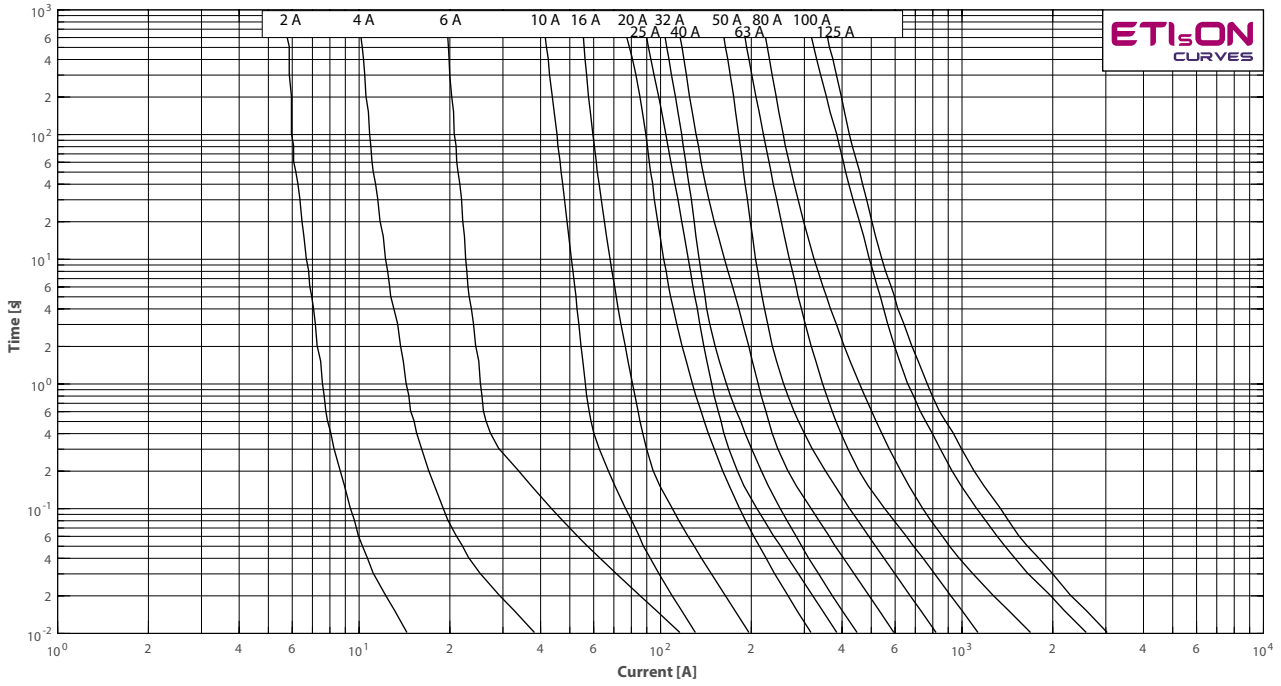
Time-current characteristics for VV-thermo
fuse links
12 kV



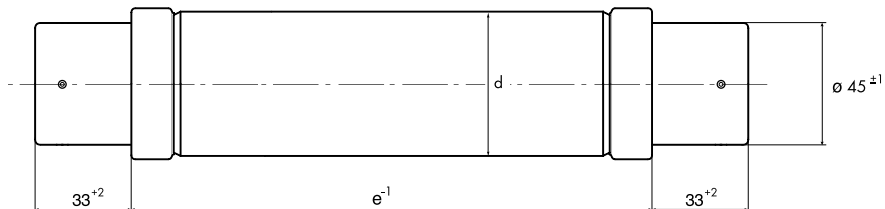
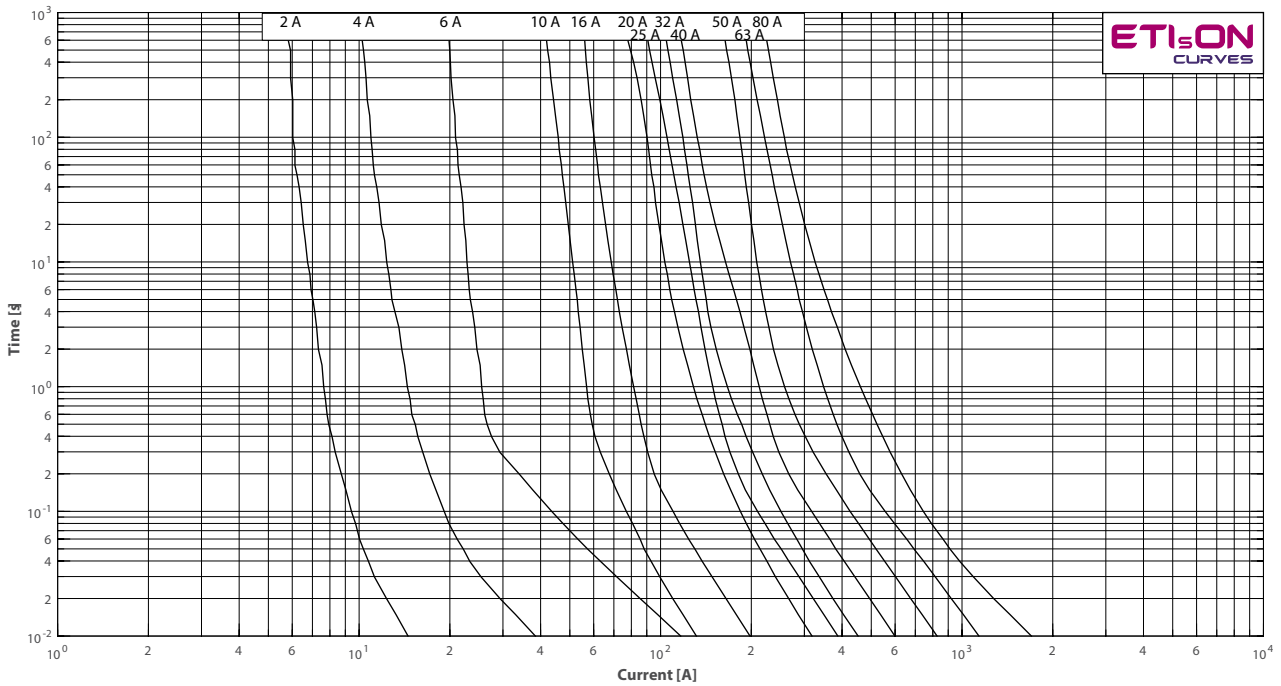
Time-current characteristics for VV-thermo
fuse links
17,5 kV



Time-current characteristics for VV-thermo fuse links
24 kV



Time-current characteristics for VV-thermo fuse links
36 kV



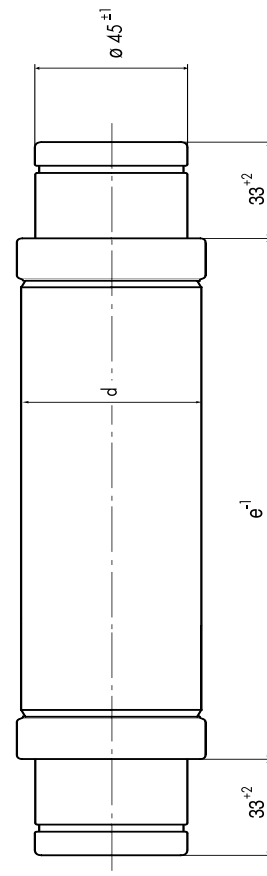
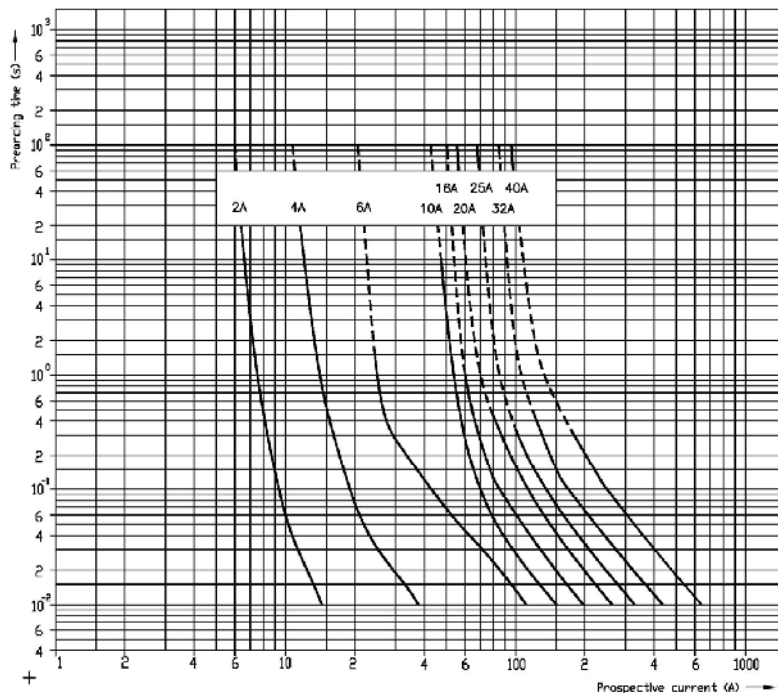
Technical data

High voltage fuse-links for liquid-immersed transformer protection

Technical data

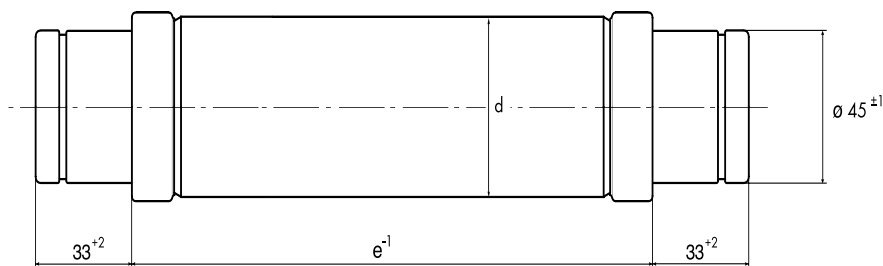
rated voltage	Dimension "e" according to DIN and IEC	rated current	Striker type	Rated breaking capacity	Rated minimum breaking current	cold resistance	power dissipation	pre-arcing I ² t value	total I ² t value
[kV]	(mm)	I _n [A]		(kA)	(A)	[mΩ]	[W]	[A ² s]	[A ² s]
6/12	292	2A	VVT-D	50	12	980	6	6,1	57
		4A			20	650	15	17,3	164
		6A			25	435	21	36	340
		10A			46	87	8	161	1530
		16A			60	60,5	19	250	2270
		20A			80	47	22	430	3750
		25A			105	37	34	650	5500
		32A			130	27	43	1220	10100
		40A			178	21	54	2270	18100
10/24	292	2A	VVT-D	50	12	2040	12	6,1	57
		4A			20	1300	35	17,3	164
		6A			25	900	56	36	340
		10A			46	160	19	161	1530
		16A			60	106	35	250	2270
		20A			80	85	44	430	3750
	442	VVT-D	50	2A	12	2040	12	6,1	57
				4A	20	1300	35	17,3	164
				6A	25	900	56	36	340
				10A	46	160	19	161	1530
				16A	60	106	35	250	2270
				20A	80	85	44	430	3750
		VVT-D	50	25A	105	67	58	650	5500
				32A	130	48	71	1220	10100
				40A	178	37,5	95	2270	18100

Time-current characteristics



High voltage fuses for protection of voltage transformers

Technical data									
rated voltage	Dimension "e" according to DIN and IEC	rated current	Striker type	Rated breaking capacity	Rated minimum breaking current	cold resistance	power dissipation	pre-arcing I ² t value	total I ² t value
[kV]	(mm)	I _n [A]		(kA)	(A)	[mΩ]	[W]	[A ² s]	[A ² s]
10/24	235	2A	/	20	12	2040	14	6,1	57
		4A			20	1300	38	17,3	164



Selection of fuses for transformer protection

For HV fuse-link rated current selection, following transformer technical features has to be known:

- Rated power P_n (kVA)
- Short-circuit voltage U_{cc} (%)
- Rated current I_{nt}
- Inrush current usually between $8-12 \times I_{nt}$
- Short-circuit current I_{cc}
- Overload current usually $1.4 I_{nt}$
- Maximum short-circuit duration. Standard 2 sec for transformers up to 630 kVA and 3 sec for higher rated powers

Following HV fuse-link technical features has to be known:

- Rated voltage U_n (kV)
- Rated current I_n (A)
- I/t Characteristics According to the curves
- Melting current (0.1 sec) $I_{f(0.1sec)}$
- Melting current at 2 sec or 3 sec melting time
- Minimum breaking current I_3 (A)
- Breaking capacity I_1 (kA)

General about transformer protection:

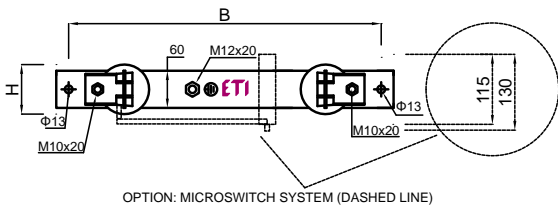
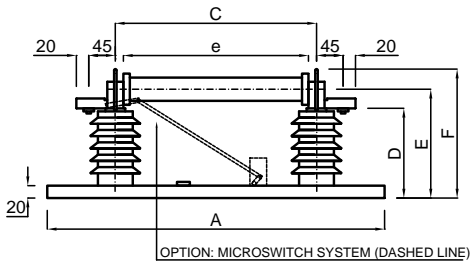
- Fuse-link rated voltage U_n must be higher then network voltage.
- Maximum fuse-link breaking current I_1 must be higher then short circuit-current I_{cc} .
- Inrush current should not melt the fuse-link. Melting current at 100 msec must be higher than 12 times transformer rated current
- Fuse-link has to operate before the expected short-circuit current damage the transformer $I_{cc} > I_f$ (2 sec) or $I_{cc} > I_f$ (3 sec)
- Fuse-link must be able to withstand possible short duration overloads. $I_n \text{ FUSE} > 1.4 I_n \text{ TRAFO}$

Technical data

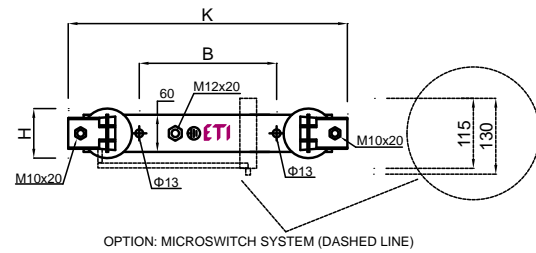
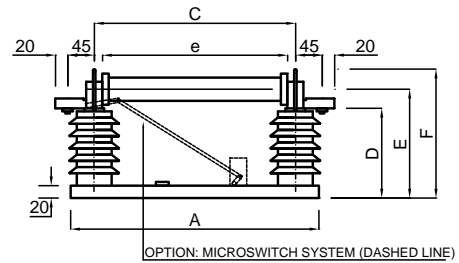
Transformer rated capacity Pt (kVA)	67,2 kV				10/12 kV				15/17,5kV				20/24 kV				30/36 kV			
	Transformer rated primary current Ip(A) at	HV Fuse-Link rated current		LV Fuse-Link g0 LV Fuse-Link g1	Transformer rated primary current Ip(A) at	HV Fuse-Link rated current		LV Fuse-Link g0 LV Fuse-Link g1	Transformer rated primary current Ip(A) at	HV Fuse-Link rated current		LV Fuse-Link g0 LV Fuse-Link g1	Transformer rated primary current Ip(A) at	HV Fuse-Link rated current		LV Fuse-Link g0 LV Fuse-Link g1	Transformer rated primary current Ip(A) at	HV Fuse-Link rated current		LV Fuse-Link g0 LV Fuse-Link g1
		6kV	hV			hV	hV/min			10kV	hV			hV/min	15kV			hV	hV/min	
50	4,8	10	50	72	2,9	6	50	72	1,9	6	50	72	1,4	4	50	72	1,0	4	50	72
75	7,2	16	80	108	4,3	10	80	108	2,9	6	80	108	2,2	6	80	108	1,4	4	80	108
100	9,6	20	100	144	5,8	10	100	144	3,8	10	100	144	2,9	6	100	144	1,9	6	100	144
125	12,0	20	125	180	7,2	16	125	180	4,8	10	125	180	3,6	10	125	180	2,4	6	125	180
160	15,3	25	160	231	9,2	20	160	231	6,2	16	160	231	4,6	10	160	231	3,1	6	160	231
200	19,2	32	200	289	11,5	20	200	289	7,7	16	200	289	5,8	10	200	289	3,8	10	200	289
250	24,0	40	250	361	14,4	25	250	361	9,6	20	250	361	7,2	16	250	361	4,8	10	250	361
315	30,3	50	315	455	18,2	32	315	455	12,1	20	315	455	9,1	16	315	455	6,0	16	315	455
400	38,5	63	400	577	23,1	40	400	577	15,4	25	400	577	11,5	20	400	577	7,7	16	400	577
500	48,1	80	500	722	28,8	50	500	722	19,2	32	500	722	14,4	20	500	722	9,6	20	500	722
630	60,6	100	630	909	36,4	63	630	909	24,2	40	630	909	18,2	25	630	909	12,1	20	630	909
800	77,0	100	800	1.155	46,2	80	800	1.155	30,8	50	800	1.155	23,1	40	800	1.155	15,4	25	800	1.155
1000	96,2	125	1.000	1.443	57,7	80	1.000	1.443	38,5	63	1.000	1.443	28,9	50	1.000	1.443	19,2	32	1.000	1.443
1250	120,0	160	1250	**	72,2	100	1250	**	48,1	80	1250	**	36,1	63	1250	**	24,0	40	1250	**
1600	154,0	200*	1600	**	92,4	125	1600	**	61,6	100	1600	**	46,2	63	1600	**	30,8	50	1600	**
2000	192,5	250*	**	**	115,5	160	**	**	77,0	100	**	**	57,7	80	**	**	38,5	63	**	**

1-pole fuse-base	microswitch	Un [kV]	A [mm]	B [mm]	C [mm]	K[mm]	D [mm]	E [mm]	F [mm]	H [mm]	"e" Fuse length	Version
INDOOR MOUNTING	×	7,2	445	405	225		150	202	259	83	192	1
	✓	7,2	445	405	225		147	190	220	80	192	1
	×	12	456	424	322		150	202	259	83	292	2
	✓	12	456	424	322		147	190	220	60	292	2
	×	17,5	480	280	397	528	245	297	354	80	367	2
	✓	17,5	480	280	397	528	197	240	270	80	367	2
	×	24	555	355	475	606	245	297	354	80	442	2
	✓	24	555	355	475	606	227	270	300	60	442	2
	×	36	670	350	570	701	330	382	439	80	537	2
	✓	36	670	350	570	701	327	370	400	80	537	2
OUTDOOR MOUNTING	×	7,2	445	405	225		306	358	415	127	192	1
	×	12	456	424	322		306	358	415	127	292	2
	×	17,5	480	280	397	528	306	358	415	127	367	2
	×	24	555	355	475	606	306	358	415	127	442	2
	×	36	670	350	570	701	509	561	618	120	537	2

VARIANT 1



VARIANT 2



Definitions and terms

Back-up fuse-links

According to standard IEC 60282-1 Fifth edition (2002-01), item 3.3.3, Back-up fuse is current-limiting fuse capable of breaking, under specified conditions of use and behaviour, all currents from the rated maximum breaking current (I_1) down to the rated minimum breaking current (I_3).

Back-up fuse links should not operate below their minimum breaking current. If the short-circuit current of the transformer is lower than the minimum breaking current, additional protection must be provided.

Rated voltage range voltages

ETI VV Thermo fuse-links must be operated at the rated voltage. At lower operating voltages without limitation provided, please contact ETI team.

Breaking capacity I_1

This value (sometimes named "rated maximum breaking current" of current indicates, that this is the maximum current which can be interrupted by the fuse-link. I_1 should be greater than the maximum expected short circuit current at the fuse-link site.

Minimum breaking current I_3

This value (sometimes named "rated minimum breaking current" is specified for Back-up fuse-links. Up from this current, fuse-link is capable to breaking fault current.

Power dissipation of a fuse-link P_n

The power dissipation of a VV Thermo fuse-link is specified at the rated current of the fuse-link. For calculations of protection with VV Thermo fuse-link, it should be noted, that operating current is normally below half of the rated current.

Time-current characteristics

I/t characteristics represents the correlation between current and time up to the melting of a silver fuse element. For coordination with other protection devices, melting integral must be referred for melting times below 100ms.

Current limitation

This is most significant advantage of fuse-links compared to mechanical switches. Contacts of that switches need much longer time as fuse-link to interrupt fault currents. VV fuse-link interrupt fault current within few milliseconds and sinusoidal current does not reach its peak value.

Switching voltages

Between current-limiting process, short circuit current must be limited and reduced as soon as possible. This require a switching voltage that exceed the normal system voltage and force the current to zero.

Permissible value of switching voltage is 2.2 times peak value of the maximum rated voltage.

