

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	2 A	WC, WFT-D, WFT-E	50	12	580	4	6,1	57	
		4 A			20	370	9	17,3	164	
		6 A			25	200	10	36	340	
		10 A			46	55	7	161	1 530	
		16 A			60	37	13	250	2 270	
		20 A			80	31	15	430	3 750	
		25 A			105	24.5	20	650	5 500	
		32 A			130	18.2	28	1 120	10 100	
		40 A			178	13.2	33	2 270	18 100	
		50 A			220	8.5	26	6 270	31 300	
		63 A			270	7.0	43	10 200	50 800	
		80 A			360	5.2	50	18 700	93 500	
		100 A			540	4.6	66	38 000	197 000	
		125 A			610	3.4	101	61 500	319 000	
		160 A			810	2.7	135	102 200	528 000	
	292	292	6 A	WC, WFT-D, WFT-E	50	25	200	10	36	340
			10 A			46	55	7	161	1 530
			16 A			60	37	13	250	2 270
			20 A			80	31	15	430	3 750
			25 A			105	24.5	20	650	5 500
			32 A			130	18.2	28	1 120	10 100
			40 A			178	13.2	33	2 270	18 100
			50 A			220	8.5	26	6 270	31 300
			63 A			270	7.0	43	10 200	50 800
			80 A			360	5.2	50	18 700	93 500
			100 A			540	4.6	66	38 000	197 000
			125 A			610	3.4	101	61 500	319 000
			160 A			810	2.7	135	102 200	528 000
			200 A			1000	2.1	155	151 780	789 270
			250 A			1250	1.7	196	228 610	1 188 800
	442	442	63 A	WC, WFT-D, WFT-E	50	270	8.5	62	10 200	50 800
			80 A			360	6.5	77	18 700	93 500
			100 A			540	5.7	105	38 000	197 000
			125 A			610	4	115	61 500	319 000
			160 A			810	3.2	151	102 200	528 000
			200 A			1000	2.65	195	151 780	789 270
			250 A			1250	2.2	253	228 610	1 188 800
			315 A			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 A	VVC, VVT-D, VVT-E	50	12	980	6	6,1	57		
		4 A			20	650	15	17,3	164		
		6 A			27	400	21	36	340		
		10 A			50	87	8	161	1 530		
		16 A			80	60,5	19	250	2 270		
		20 A			100	47	22	430	3 750		
		25 A			125	37	34	650	5 500		
		32 A			160	27	43	1220	10 100		
		40 A			200	21	54	2 270	18 100		
		50 A			250	14	44	6 270	31 300		
	292	VVC, VVT-D, VVT-E	50	2 A	12	980	6	6,1	57		
				4 A	20	650	15	17,3	164		
				6 A	25	400	21	36	340		
				10 A	46	87	8	161	1 530		
				16 A	60	60,5	19	250	2 270		
				20 A	80	47	22	430	3 750		
				25 A	105	37	34	650	5 500		
				32 A	130	27	43	1220	10 100		
				40 A	178	21	54	2 270	18 100		
				50 A	220	14	44	6 270	31 300		
				63 A	270	10.5	65	10 200	50 800		
				80 A	360	8	73	18 700	93 500		
				100 A	540	7.3	109	38 000	197 000		
				125 A	610	5.1	137	61 500	319 000		
	160 A	810	4	189	102 200	528 000					
	442	VVC, VVT-D, VVT-E	50	2 A	12	980	6	6,1	57		
				4 A	20	650	15	17,3	164		
				6 A	25	400	21	36	340		
				10 A	46	87	8	161	1 530		
				16 A	60	60.5	19	250	2 270		
				20 A	80	47	22	430	3 750		
				25 A	105	37	34	650	5 500		
				32 A	130	27	43	1220	10 100		
				40 A	178	21	54	2 270	18 100		
				50 A	220	14	44	6 270	31 300		
				63 A	270	10.5	65	10 200	50 800		
				80 A	360	8	73	18 700	93 500		
				100 A	540	7.3	109	38 000	197 000		
				125 A	610	5.1	137	61 500	319 000		
				160 A	810	4	189	102 200	528 000		
				200 A	1000	3.3	238	151 780	789 270		
				537	VVC, VVT-D, VVT-E	50	160 A	810	4	189	102 200
200 A							1000	3.3	238	151 780	789 270
250 A							1250	2.65	305	228610	1 188 800

Technical data - VV

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 A	VVC, VVT-D, VVT-E	50	12	1400	8	6,1	57	
		4 A			20	900	17	17,3	164	
		6 A			27	670	35	36	340	
		10 A			50	100	11	161	1 530	
		16 A			80	82	28	250	2 270	
		20 A			100	65	38	430	3 750	
		25 A			125	54	45	650	5 500	
		32 A			160	38	61	1 220	10 100	
		40 A			200	29	69	2 270	18 100	
		50 A			250	19	63	6 270	31 300	
		63 A			283	15	91	10 200	50 800	
		80 A			400	11	118	18 700	93 500	
	367	367	2 A	VVC, VVT-D, VVT-E	50	12	1400	8	6,1	57
			4 A			20	900	17	17,3	164
			6 A			25	670	35	36	340
			10 A			46	100	11	161	1 530
			16 A			60	82	28	250	2 270
			20 A			80	65	38	430	3 750
			25 A			105	54	45	650	5 500
			32 A			130	38	61	1 220	10 100
			40 A			178	29	69	2 270	18 100
			50 A			220	19	63	6 270	31 300
			63 A			270	15	91	10 200	50 800
			80 A			360	11	118	18 700	93 500
	100 A	540	9.5	156	38 000	197 000				
	125 A	610	6.8	193	61 500	319 000				
	160 A	810	5.5	255	102 200	528 000				
	442	442	2 A	VVC, VVT-D, VVT-E	50	12	1400	8	6,1	57
			4 A			20	900	17	17,3	164
			6 A			25	670	35	36	340
			10 A			46	100	11	161	1 530
			16 A			60	82	28	250	2 270
			20 A			80	65	38	430	3 750
			25 A			105	54	45	650	5 500
			32 A			130	38	61	1 220	10 100
			40 A			178	29	69	2 270	18 100
50 A			220			19	63	6 270	31 300	
63 A			270			15	91	10 200	50 800	
80 A			360			11	118	18 700	93 500	
100 A	540	9.5	156	38 000	197 000					
125 A	610	6.8	193	61 500	319 000					

Technical data

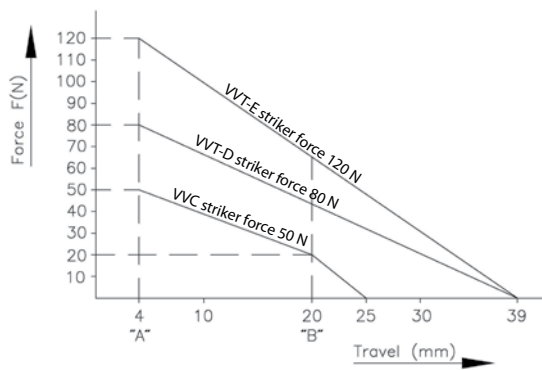
rated voltage	Dimension "e" according to DIN and IEC	rated current	Striker type	Rated breaking capacity	Rated minimum breaking current	cold resistance	power dissipation	pre-arcing I ² t value	total I ² t value
[kV]	(mm)	I _n [A]		(kA)	(A)	[mΩ]	[W]	[A ² s]	[A ² s]
10/24	292	2 A	VVC, VWT-D, VWT-E	31,5	12	2040	12	6,1	57
		4 A			20	1300	35	17,3	164
		6 A			27	900	56	36	340
		10 A			50	160	19	161	1 530
		16 A			80	106	35	250	2 270
		20 A			100	85	44	430	3 750
		25 A			125	67	58	650	5 500
		32 A			160	48	71	1220	10 100
		40 A			200	37.5	95	2 270	18 100
		50 A			250	25	81	6 270	31 300
		63 A			283	20	120	10 200	50 800
		442			VVC, VWT-D, VWT-E	50	2 A	12	2040
	4 A		20	1300			35	17,3	164
	6 A		25	900			56	36	340
	10 A		46	160			19	161	1 530
	16 A		60	106			35	250	2 270
	20 A		80	85			44	430	3 750
	25 A		105	67			58	650	5 500
	32 A		130	48			71	1220	10 100
	40 A		178	37.5			95	2 270	18 100
	50 A		220	25			81	6 270	31 300
	63 A		270	20			120	10 200	50 800
	80 A		360	15			157	18 700	93 500
	100 A		540	13.8			235	38 000	197 000
	125 A		610	9.6			304	61 500	319 000
	537	VVC, VWT-D, VWT-E	50	2 A	12	2040	12	6,1	57
				4 A	20	1300	35	17,3	164
				6 A	25	900	56	36	340
				10 A	46	160	19	161	1 530
				16 A	60	106	35	250	2 270
				20 A	80	85	44	430	3 750
				25 A	105	67	58	650	5 500
				32 A	130	48	71	1220	10 100
				40 A	178	37.5	95	2 270	18 100
				50 A	220	25	81	6 270	31 300
				63 A	270	20	120	10 200	50 800
80 A				360	15	157	18 700	93 500	
100 A				540	13.8	235	38 000	197 000	
125 A				610	9.6	304	61 500	319 000	
160 A	810	8	410	74 650	388 180				

Technical data - VV

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 A	WC, WVT-D, WVT-E	20	12	2900	17	6,1	57
		4 A			20	1870	45	17,3	164
		6 A			27	1390	73	36	340
		10 A			50	208	28	161	1 530
		16 A			80	150	53	250	2 270
	537	VVC, WVT-D, WVT-E	31,5	2 A	12	2900	17	6,1	57
				4 A	20	1870	45	17,3	164
				6 A	25	1390	73	36	340
				10 A	46	208	28	161	1 530
				16 A	60	150	53	250	2 270
				20 A	80	122	74	430	3 750
				25 A	105	95	87	650	5 500
				32 A	130	69	111	1 220	10 100
				40 A	178	52	139	2 270	18 100
				50 A	220	35	125	6 270	31 300
				63 A	270	28	185	10 200	50 800
				80 A**	360	21	213	18 700	93 500

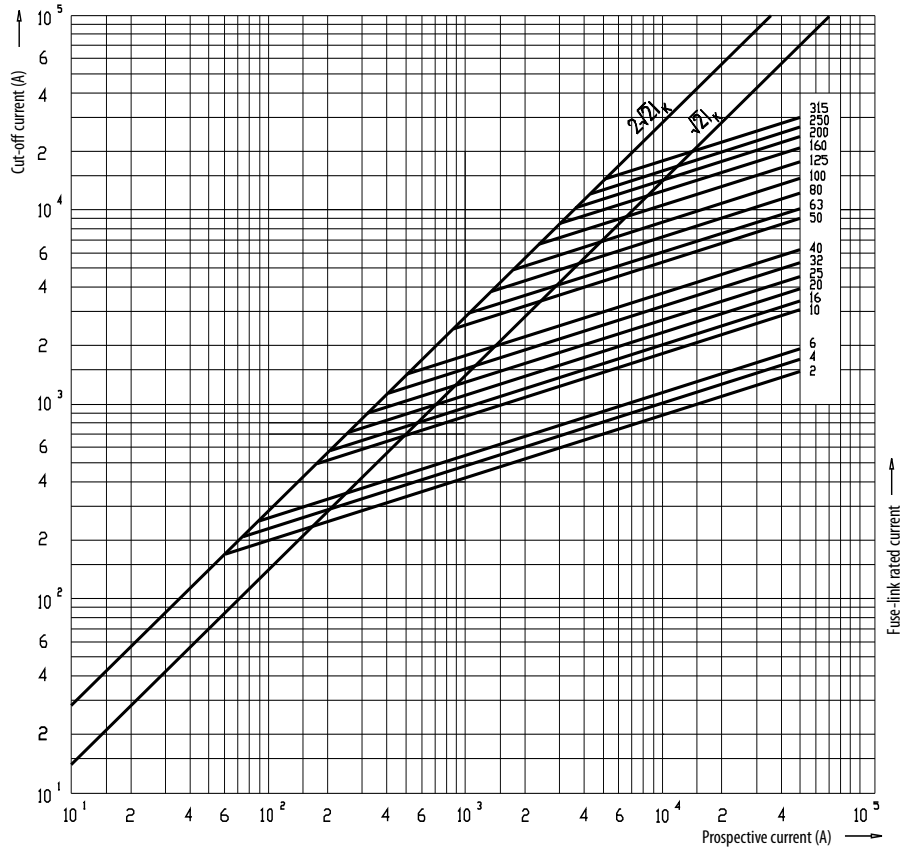
Force / travel striker pin diagram



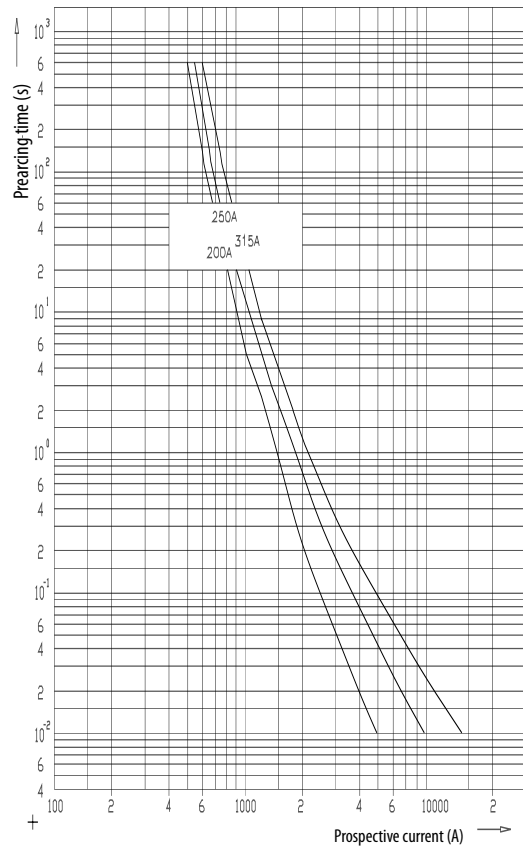
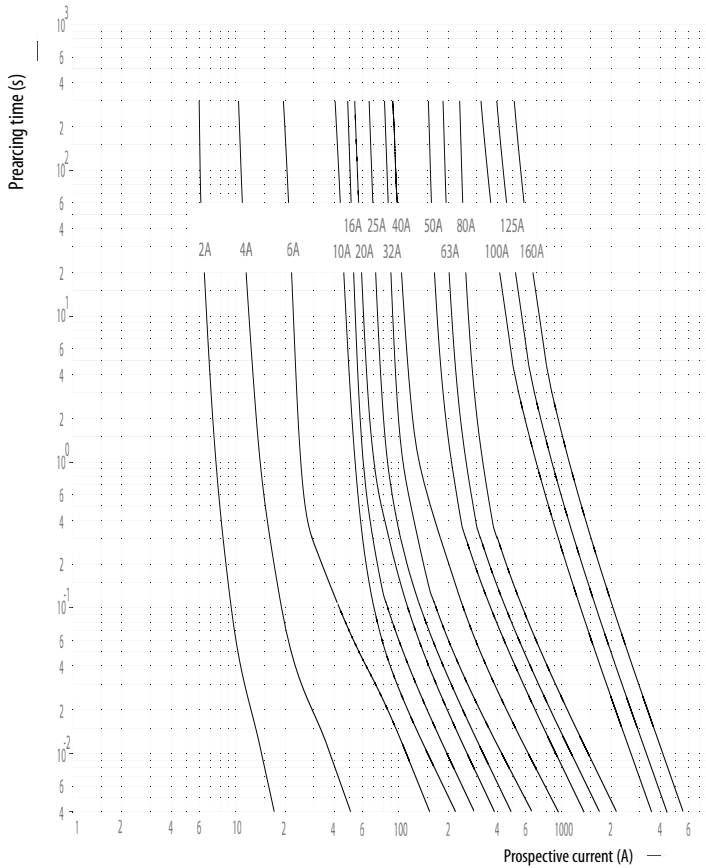
Connection in indoor switchgear, example:



Cut-off current diagram for VV-Thermo fuse links



Time-current characteristics for VV-thermo fuse links



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 2s ec or 3sec 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. $I_n \text{ FUSE} > 1.4 I_n \text{ TRAFO}$

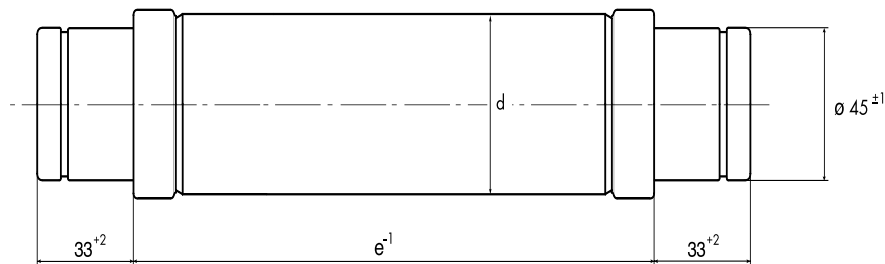
Selection table for VV - THERMO back-up fuse links

Pt (kVA)	6/7,2 kV					10/12 kV					15/17.5kV				
	Transformer rated primary current I_p (A) at 6 kV	Inrush current (A)	HV Fuse-link rated current		LV Fuse- Link NH gG	Transformer rated primary current I_p (A) at 10 kV	Inrush current (A)	HV Fuse-link rated current		LV Fuse- Link NH gG	Transformer rated primary current I_p (A) at 15 kV	Inrush current (A)	HV Fuse-link rated current		LV Fuse- Link NH gG
			I_{HV} min (A)	I_{HV} max (A)				I_{LV} (A)	I_{HV} min (A)				I_{HV} max (A)	I_{LV} (A)	
50	5	58	10	16	63	3	35	6	10	63	2	23	6	10	63
75	7	86	16	20	100	4	52	10	16	100	3	35	6	10	100
100	10	115	25	32	125	6	70	10	16	125	4	46	10	16	125
125	12	145	32	40	160	7	86	16	20	160	5	58	10	16	160
160	15	185	40	50	200	9	110	20	25	200	6	74	16	20	200
200	19	230	40	50	250	12	138	25	32	250	8	92	20	25	250
250	24	289	50	63	315	14	173	32	40	315	10	115	25	32	315
315	30	364	50	63	400	18	218	40	50	400	12	145	32	40	400
400	39	462	63	80	500	23	276	50	63	500	15	185	40	50	500
500	48	577	80	100	630	29	346	50	63	630	19	230	40	50	630
630	61	727	100	125	800	36	437	63	80	800	24	293	50	63	800
800	77	923	100	125	1000	46	554	80	100	1000	31	370	63	80	1000
1000	96	1154	125	160	1250	58	692	100	125	1250	38	462	80	100	1250
1250	120	1440	160	200*	1250	72	866	100	125	1250	48	577	100	125	1250
1600	154	1848	200*	250*	1500	92	1109	125	160	1500	62	739	125	160	1500
2000	192	2310	250*	315*	1600	115	1380	160	200*	1600					

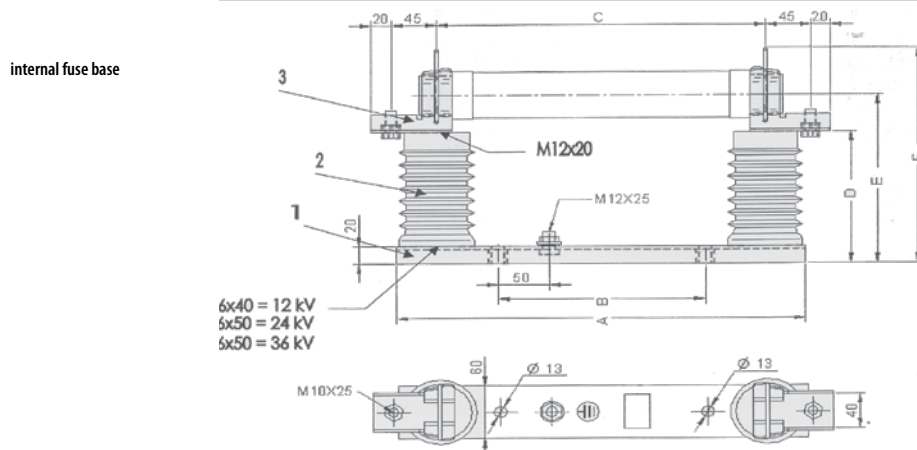
* Note: nonstandard tube dimension

Selection table for VV - THERMO back-up fuse links

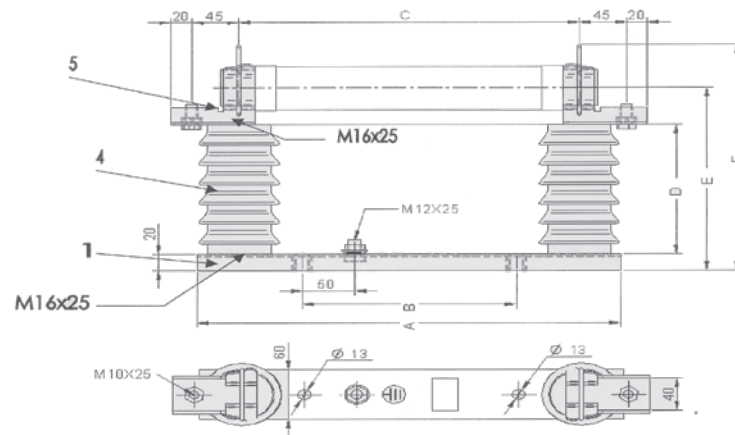
Pt (kVA)	20/24 kV					30/36 kV				
	Transformer rated pri- mary current Ip(A) at 20 kV	Inrush current (A)	HV Fuse-link rated current		LV Fuse- Link NH gG	Transformer rated pri- mary current Ip(A) at 30 kV	Inrush current (A)	HV Fuse-link rated current		LV Fuse- Link NH gG
			I _{HV} min (A)	I _{HV} max (A)	I _{LV} (A)			I _{HV} min (A)	I _{HV} max (A)	I _{LV} (A)
50	1	18	4	6	63	1	12	2	4	63
75	2	26	4	6	100	1	17	4	6	100
100	3	35	6	10	125	2	23	6	10	125
125	4	43	6	10	160	2	29	6	10	160
160	5	55	10	16	200	3	37	6	10	200
200	6	70	10	16	250	4	46	10	16	250
250	7	86	16	20	315	5	58	10	16	315
315	9	109	20	25	400	6	73	16	20	400
400	12	138	25	32	500	8	92	20	25	500
500	14	173	32	40	630	10	115	20	25	630
630	18	217	40	50	800	12	145	25	32	800
800	23	277	50	63	1000	15	185	40	50	1000
1000	29	346	50	63	1250	19	230	50	63	1250



1-pole fuse-base	Rated voltage [kV]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]
INDOOR MOUNTING	7,2 and 12	405	205	325	152	195	250
	17,5 and 24	555	335	475	252	295	350
	36	650	450	570	332	375	430
OUTDOOR MOUNTING	7,2 and 12	405	205	325	179	224	277
	17,5 and 24	555	335	475	252	295	350
	36	650	450	570	337	380	435



external fuse base



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.