

High-voltage high-breaking capacity VV fuse-link

Technical data, dimensions							
rated voltage U_n [kV]	rated current I_n [A]	dimensions		electrical parameters			
		d [mm]	e [mm]	cold resistance R_c [mΩ]	power dissipation P_n [W]	minimum pre-arcing I^2t_{min} [A ² s]	maximum total clearing I^2t_{max} [A ² s]
3/7.2	2 A	53	192	580	3.5	6,1	57
	4 A			370	8.9	17,3	164
	6 A			200	10.0	50	200
	10 A			55	6.6	161	1 530
	16 A			37	11.8	250	2 270
	20 A			31	15.3	430	3750
	25 A			24.5	22.1	650	5500
	32 A			18.2	30.1	1220	10 100
	40 A			13.2	36.9	2 270	18 100
	50 A			8.5	25.9	6 270	31 300
	63 A			7.0	42.8	10 200	50 800
	80 A			5.2	50.3	18 700	93 500
	100 A	4.6	66.4	38 000	197 000		
	125 A	3.4	101	61 500	319 000		
	160 A	2.7	135	102 200	528 000		
	3/7.2	2 A	53	192	580	3.5	6,1
4 A		370			8.9	17,3	164
6 A		200			10.0	50	200
10 A		55			6.6	161	1 530
16 A		37			11.8	250	2 270
20 A		31			15.3	430	3750
25 A		24.5			22.1	650	5500
32 A		18.2			30.1	1220	10 100
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Technical data - VV

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6/12	2 A	53	292	980	5.9	6,1	57
	4 A			650	15.1	17,3	164
	6 A			309	15.4	50	200
	10 A			87	10.4	161	1 530
	16 A			61	19.4	250	2 270
	20 A			47	23.2	430	3 750
	25 A			37	33.5	650	5 500
	32 A			27.5	45.6	1 220	10 100
	40 A			20	55.9	2 270	18 100
	50 A			14.3	43.6	6 270	31 300
	63 A			10.6	64.8	10 200	50 800
	80 A			8.0	77.3	18 700	93 500
	100 A			7.2	104	38 000	197 000
	125 A			5.1	152	61 500	319 000
	160 A			4.0	200	102 200	528 000
	6/12			2 A	53	292	980
4 A		650	15.1	17,3			164
6 A		309	15.4	50			200
10 A		87	10.4	161			1 530
16 A		61	19.4	250			2 270
20 A		47	23.2	430			3 750
25 A		37	33.5	650			5 500
32 A		27.5	45.6	1 220			10 100
40 A		20	55.9	2 270			18 100
50 A		14.3	43.6	6 270			31 300
63 A		10.6	64.8	10 200			50 800
80 A		8.0	77.3	18 700			93 500
100 A		7.2	104	38 000			197 000
125 A		5.1	152	61 500			319 000
160 A		4.0	200	102 200			528 000
6/12		2 A	53	292			980
	4 A	650			15.1	17,3	164
	6 A	309			15.4	50	200
	10 A	87			10.4	161	1 530
	16 A	61			19.4	250	2 270
	20 A	47			23.2	430	3 750
	25 A	37			33.5	650	5 500
	32 A	27.5			45.6	1 220	10 100
	40 A	20			55.9	2 270	18 100
	50 A	14.3			43.6	6 270	31 300
	63 A	10.6			64.8	10 200	50 800
	80 A	8.0			77.3	18 700	93 500
	100 A	7.2			104	38 000	197 000
	125 A	5.1			152	61 500	319 000
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10/17.5	2 A	53	367	1400	8,4	6,1	57
	4 A			900	21,6	17,3	164
	6 A			445	23.4	50	200
	10 A			131	15.6	161	1 530
	16 A			82.6	26.4	250	2 270
	20 A			68.6	37.9	430	3750
	25 A			54.3	49.2	650	5500
	32 A			38.9	65.7	1220	10 100
	40 A			29.5	78.1	2 270	18 100
	50 A			19.8	65.2	6 270	31 300
	63 A			15.8	101	10 200	50 800
	80 A			12.0	122	18 700	93 500
	100 A			9.8	166	38 000	197 000
	125 A			7.2	219	61 500	319 000
160 A	6.1	339	102 200	528 000			
10/17.5	2 A	53	367	1400	8,4	6,1	57
	4 A			900	21,6	17,3	164
	6 A			445	23.4	50	200
	10 A			131	15.6	161	1 530
	16 A			82.6	26.4	250	2 270
	20 A			68.6	37.9	430	3750
	25 A			54.3	49.2	650	5500
	32 A			38.9	65.7	1220	10 100
	40 A			29.5	78.1	2 270	18 100
	50 A			19.8	65.2	6 270	31 300
	63 A			15.8	101	10 200	50 800
	80 A			12.0	122	18 700	93 500
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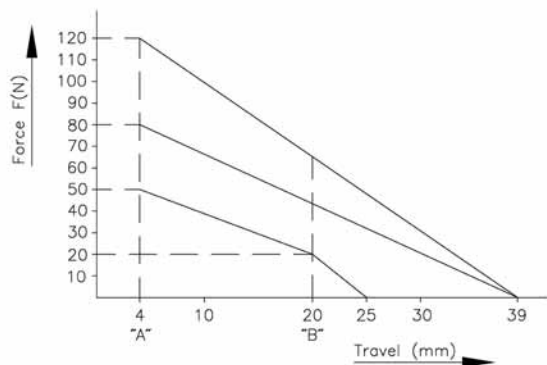
Technical data - VV

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10/24	2 A	53	442	2040	11.8	6,1	57
	4 A			1300	30	17,3	164
	6 A			550	28.9	50	200
	10 A			162	19.2	161	1 530
	16 A			102	32.6	250	2 270
	20 A			85	46.9	430	3 750
	25 A			67	60.7	650	5 500
	32 A			48.0	81.1	1 220	10 100
	40 A			36.4	96.4	2 270	18 100
	50 A			24.5	80.5	6 270	31 300
	63 A	68	442	19.5	125	10 200	50 800
	80 A			14.8	151	18 700	93 500
	100 A			13.5	228	38 000	197 000
	125 A			9.9	301	61 500	319 000
10/24	2 A	53	442	2040	11.8	6,1	57
	4 A			1300	30	17,3	164
	6 A			550	28.9	50	200
	10 A			162	19.2	161	1 530
	16 A			102	32.6	250	2 270
	20 A			85	46.9	430	3 750
	25 A			67	60.7	650	5 500
	32 A			48.0	81.1	1 220	10 100
	40 A			36.4	96.4	2 270	18 100
	50 A			24.5	80.5	6 270	31 300
	63 A	68	442	19.5	125	10 200	50 800
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	50 A			24.5	80.5	6 270	31 300
	63 A	68	442	19.5	125	10 200	50 800
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	100 A			13.5	228	38 000	197 000
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Technical data, dimensions

rated voltage U_n [kV]	rated current I_n [A]	dimensions		electrical parameters			
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20/36	2 A	53	537	2900	17.4	6,1	57
	4 A			1870	44.9	17,3	164
	6 A			770	40.5	50	200
	10 A			226	26.9	161	1 530
	16 A			142	45.6	250	2 270
	20 A	119		65.7	430	3750	
	25 A	93.8		84.9	650	5500	
	32 A	68		67.2	113	1220	10 100
	40 A	50.9		134	2 270	18 100	
	50 A	34.3		112	6 270	31 300	
	63 A	85		27.3	175	10 200	50 800
20/36	2 A	53	537	2900	17.4	6,1	57
	4 A			1870	44.9	17,3	164
	6 A			770	40.5	50	200
	10 A			226	26.9	161	1 530
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	40 A	50.9		134	2 270	18 100	
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Force-travel characteristic

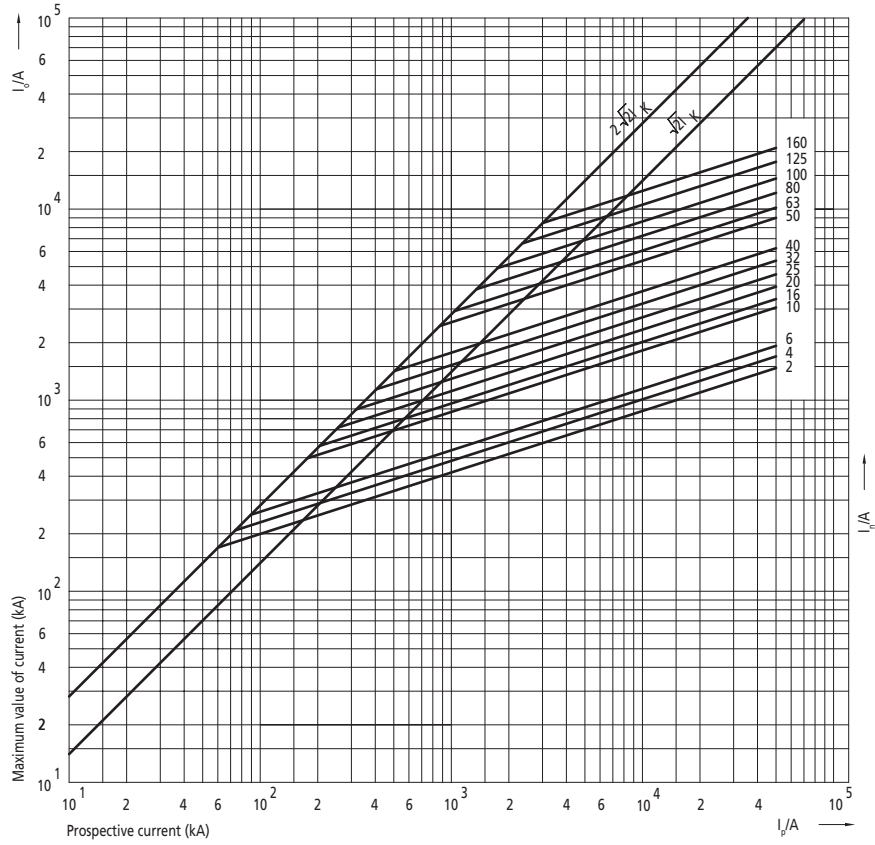


Connection in indoor switchgear, example:

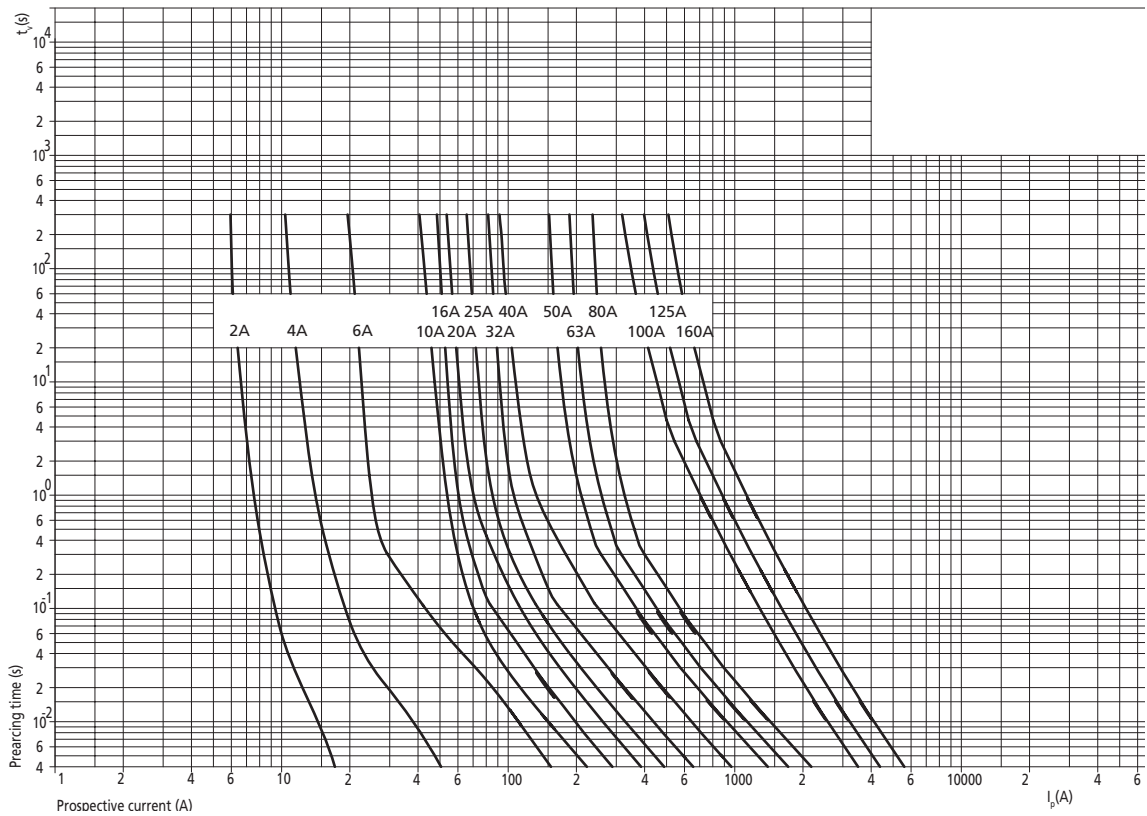


Technical data - VV

Cut-off current diagram for VV-Thermo Back-up fuse links I/t



Time-current characteristics for VV-Thermo Back-up fuse links I/t



Application recommendation for transformer protection

At rated current of the fuse-link choosing for protection of main transformer, the following information should be observed:

TRANSFORMER CHARACTERISTICS

- Rated power P_n (kVA)
- Short-circuit voltage U_{cc} (%)
- Rated current I_{nt}
- Inrush current usually between 8-12x I_{nt}
- Short-circuit current I_{cc}
- Current while overload usually 1,2 to 1.4 I_{nt}
- Maximum time withstood under short-circuit conditions on the transformers.

Standard values:

- 2 sec for transformers up to 630 kVA
- 3 sec for transformers with higher rated powers

FUSE CHARACTERISTICS

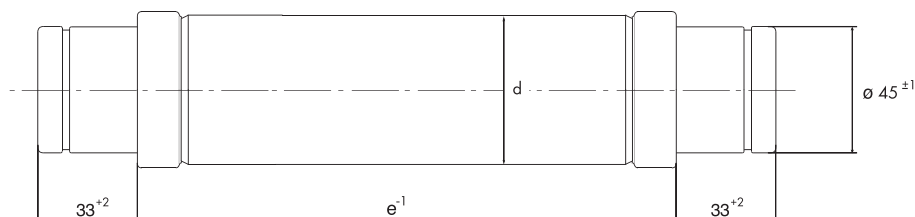
- Rated voltage U_n (kV)
- Rated current I_n (A)
- I/t Characteristics According to the curves
- Melting current (0.1sec) $I_{f(0.1sec)}$
- Melting current (2 or 3sec) $I_{f(2sec)}$ or $I_{f(3sec)}$
- Minimum cut-off current I_3 (A)
- Maximum cut-off current I_1 (kA)

GENERAL REQUIREMENTS

- The fuse rated voltage to be upper or equal to the line voltage.
- Inrush current should not melt the fuse-link. The transformer must be designed to withstand this current for 2 seconds.
- Fuse-link must withstand the rated current I_{nt} and the possible overloads, usually 1,3 to 1,4 I_{nt} of the transformer
- If installation and working conditions are not well known, the fuse rated current chosen will be the one immediately above to 1.5 I_{nt} .
- To break the short-circuit current of the installation, should be $I_1 > I_{cc}$.
- To break the short-circuit current of the transformer I_{cc} (fault in the secondary terminals), that is $I_{cc} \geq I_3$.

Selection table for VV-THERMO back-up fuse-links

transformer rated capacity P_t (kVA)	6/7,2 kV				10/12 kV				20/24 kV				30/36 kV			
	transformer rated primary current I_p [A]		HV fuse-link rated current I_f		transformer rated primary current I_p [A]		HV fuse-link rated current I_f		transformer rated primary current I_p [A]		HV fuse-link rated current I_f		transformer rated primary current I_p [A]		HV fuse-link rated current I_f	
	at 6 kV	at 7,2 kV	I_{fmin} [A]	I_{fmax} [A]	at 10 kV	at 12 kV	I_{fmin} [A]	I_{fmax} [A]	at 20 kV	at 24 kV	I_{fmin} [A]	I_{fmax} [A]	at 30 kV	at 36 kV	I_{fmin} [A]	I_{fmax} [A]
50	4.8	4.1	10	16	2.9	2.4	6	10	1.5	1.2	4	6	0.96	0.8	2	4
75	7.2	6.2	16	20	4.3	3.6	10	16	2.2	1.8	4	6	1.4	1.2	4	6
100	9.6	8.2	25	32	5.8	4.8	10	16	2.9	2.4	6	10	1.9	1.6	6	10
125	12.1	10.3	32	40	7.2	6	16	20	3.6	3.0	6	10	2.4	2.0	6	10
160	15.4	13.2	40	50	9.2	7.7	20	25	4.6	3.8	10	16	3.1	2.6	6	10
200	19.2	16.4	40	50	11.5	9.6	25	32	5.8	4.8	10	16	3.8	3.2	10	16
250	24.1	20.6	50	63	14.4	12	32	40	7.2	6.0	16	20	4.8	4.0	10	16
315	30.3	26	50	63	18.2	15.2	40	50	9.1	7.6	20	25	6.1	5.1	16	20
400	38.5	33	63	80	23	19.2	50	63	11.5	9.6	25	32	7.7	6.4	20	25
500	48.1	41.2	80	100	28.8	24	50	63	14.4	12	32	40	9.6	8.0	20	25
630	60.6	51.9	100	125	36.4	30.3	63	80	18.1	15.2	40	50	12.1	10.1	25	32
800	76.9	66	100	125	46.2	38.5	80	100	23.1	19.2	50	63	15.4	12.8	40	50
1000	96.2	82.5	125	160	57.7	48.1	100	125	28.8	24.1	50	63	19.2	16.0	50	63



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 (I1) down to the rated minimum breaking current (I3).

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 I1

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

This is very important parameter, described in standard IEC 60282-1 Fifth edition (2002-01). Between current-limiting process, short circuit current must be limited and reduced as soon as possible. This require a switching voltage that exceed de 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.

