



# High-Voltage Fuse Links

according to IEC 60282-1

*We introduce this brand-new complete line of Limitor high voltage fuse-links to increase the safety of high voltage distribution networks and industrial installations.*



# Ferraz Shawmut

Ferraz Shawmut serves the Power Production& Distribution market with :

- Limitor®-branded high voltage fuse-links
- Nortroll®- branded fault indicators

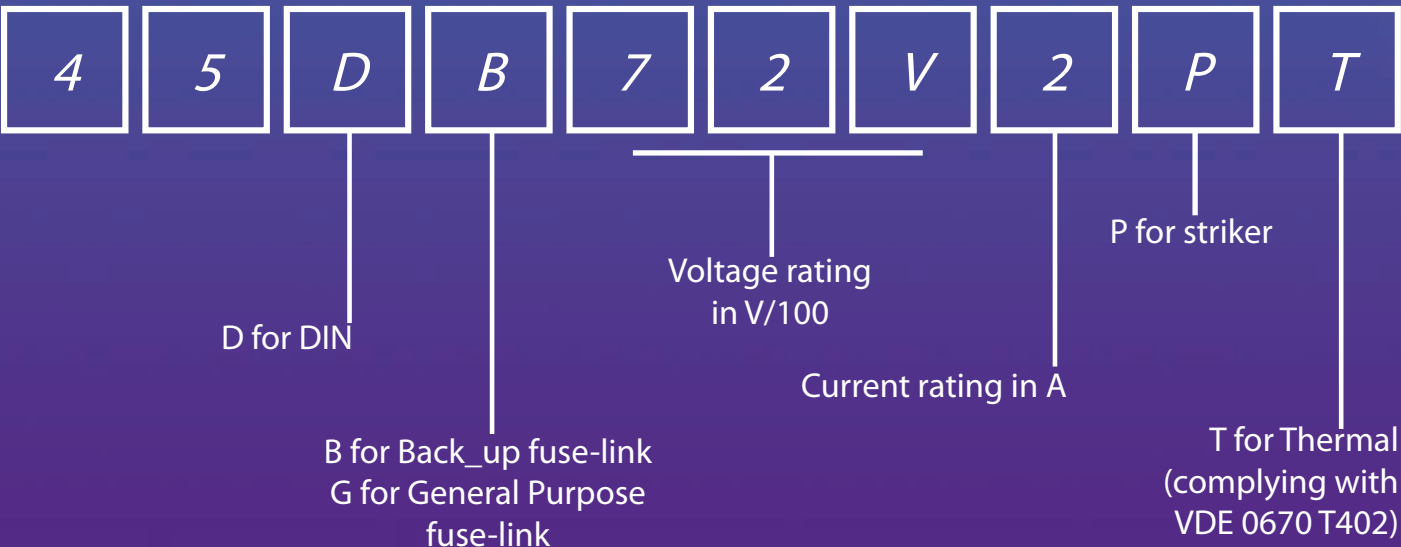
The combination of these two latter provides the utility market with well fitted protection against disastrous effects, electrical and mechanical, of short-circuits (Limitor®) and easier maintenance via very fast location of short-circuits and earth faults (Nortroll®). Ferraz Shawmut is involved in the utility market from awhile and is able to provide any support required by this market.

Among Limitor® solutions we introduce our brand-new line of high-voltage fuse-links complying with IEC 60282-1 International Standard (High-voltage fuses “current limiting fuse-links”). This international standard is identical to the German standard VDE 0670 T4. This line is designed, manufactured and tested as per our Quality Management System which is certified to the ISO 9001:2000 International standard.

Ferraz Shawmut high-voltage fuse-links have parallel connected pure silver fuse-link elements. The design and method of production of the elements ensures narrow tolerances of time-current characteristics. The fuse-link elements are wound on a ceramic support and are attached to contact carriers by means of spot-welding. The contact carriers are fitted inside the silver plated copper end caps by spot welding. The copper end caps themselves are fitted onto the porcelain tube which is glazed inside and outside. The end caps are furthermore mechanically fixed to the porcelain tube in a way that tightness against ingress of humidity is guaranteed. The tightness of each single Ferraz Shawmut high-voltage fuse-link is assured by a low-pressure test in a water bath.

This brand-new Limitor fuse-links line is intended to outdoor use. It encompasses three product ranges:

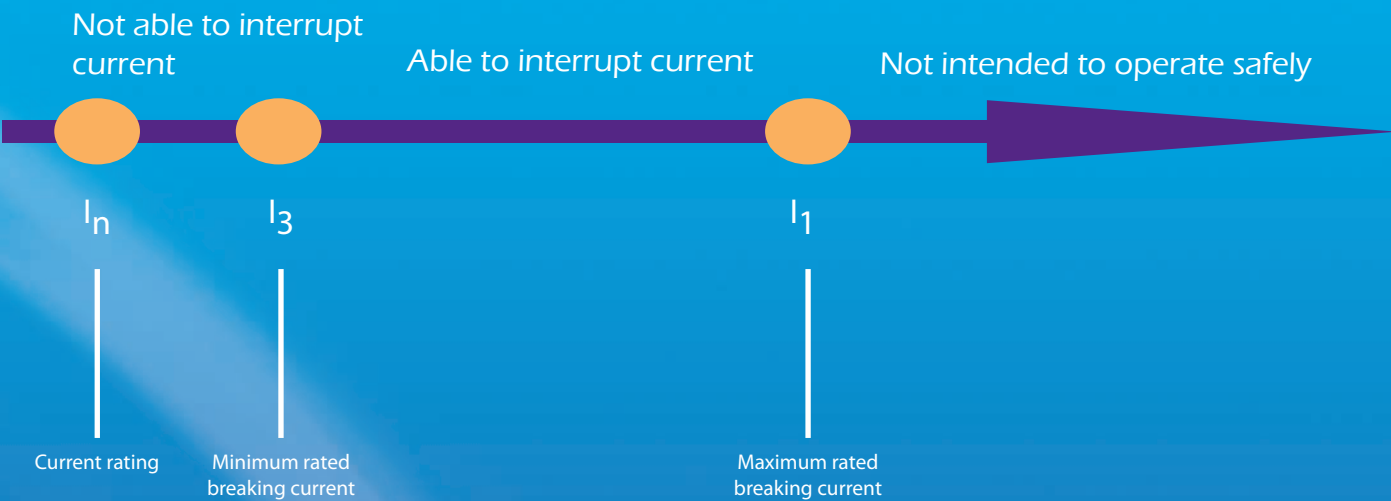
- The back-up fuse-link range with striker
- The back-up fuse-link range with striker and internal thermal protection
- The general purpose fuse-link range with striker





Technical Overview

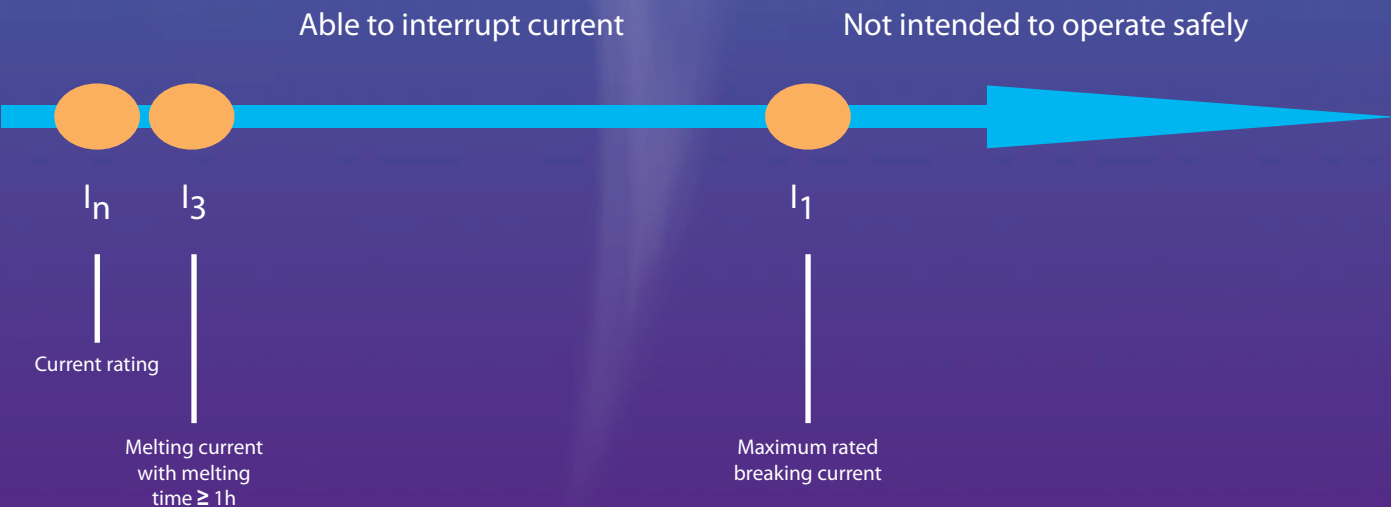
Back-up fuses range



Back-up fuse-links range with CPD (Controlled Power Dissipation)

The CPD designed by Ferraz Shawmut controls the power dissipation of the fuse-link according to Ohm's law. The striker of all the Limitor® high voltage fuse-links published here are of medium-type (80N class) as per the IEC 60282-1 standard (strikers are ranked as per the energy they release between two specified points during their trip). As the back-up fuse-link is combined with a transformer switch the CPD releases the switch before a too high power level is dissipated by the fuse-link.

General Purpose Fuse-links



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## General information

HV fuse-links have been used for reliable protection in medium-voltage switchgear and controlgear and systems for decades. They protect apparatus and equipment against the thermal and dynamic effects of short-circuits. The outstanding features of Limitor HV fuse-links from Ferraz Shawmut are:

- High breaking capacity
- High current limitation
- Low switching voltage
- Quick breaking
- Non-ageing

Limitor HV fuse-links conform to the following standards:

- IEC 60 282-1: High-voltage fuse-links “current limiting fuse-links”. This international standard is identical to the German standard VDE 0670 T4.
- IEC 60 787: Application guide for the selection of fuse-links of high-voltage fuse-links for transformer circuit applications
- VDE 0670 T303/IEC 60 420: High-voltage alternating current switch-fuse combinations
- DIN 43 625: High-voltage fuse-links, rated voltages 3,6 to 36kV (fuse-link dimensions)
- DIN 43 624: High-voltage fuse-links, rated voltages 3/3,6 to 30/36kV (single-pole fuse-link bases)

The quality management system of Ferraz Shawmut is certified to the international standard DIN ISO 9001 (EN 29001).

Ferraz Shawmut operates a certified environment management system. Ferraz Shawmut manufactures HV fuse-links with dimensions conforming to DIN 43 625 with striker for indoor and outdoor use, where the striker serves for actuating a trip-free mechanism as well as an indicator due to its red colour. In addition to the HV fuse-links shown in this brochure, Ferraz Shawmut also manufactures a wide range of special fuse-links in special dimensions. If you have a particular application that requires special fuse-link protection problems, simply ask the Ferraz Shawmut team, we are there for you.

## Terms and definitions

### Back-up fuse-links

Back-up fuse-links have a “rated minimum breaking current” from which the fuse-links are able to interrupt current. Backup fuse-links are not supposed to operate below their “minimum breaking current” (below  $I_3$ ). Their operating range is from  $I_3$  to the maximum rated breaking current ( $I_1$ ). For the assignment of back-up fuse-links, it is important to note that the lowest short circuit current is higher at the site of the HV back-up fuse-link than  $I_3$  ( $I_{kmin} > I_3$ ).

If the short circuit current is lower than the minimum breaking current, additional protection must be provided.

### Striker

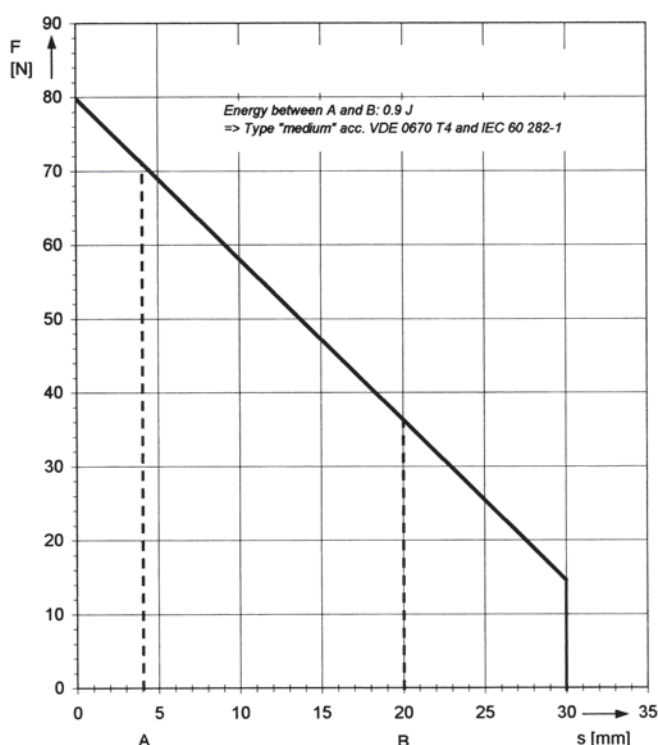
The striker of HV fuse-links in this product list has an effective length of 30 mm and is a «medium» type. This classification results from the energy released by the striker between the points A and B (within the first 20 mm of the operating distance. The initial force is about 80N, the force at the end of free movement is about 15N.

The striker serves for actuation of the trip-free mechanism of the switch

### Rated voltage range

It is important for HV fuse-links that they must be operated at the voltage for which they have been rated. Accordingly, the operating voltage corresponds to the maximum rated voltage of the fuse-link. Owing to the switching voltage occurring during arcing, the fuse-link cannot be used at lower voltages without limitation. A lower operating voltage at which the fuselink can still be used without exceeding the system insulation level during extinction must therefore be taken into account.

From these two values results the permissible voltage range of the fuse-link, which is shown on the fuse-links or in the technical data, e.g. 10/24kV.



## Breaking capacity $I_1$

The breaking capacity is also referred to as the “rated maximum breaking current”. This clearly indicates that this is the maximum current which can be interrupted by the fuselink.  $I_1$  of the fuse-link must be greater than the maximum short circuit current at the site of the fuse-link ( $I_1 > I_{kmax}$ ).

## Minimum breaking current $I_3$

The minimum breaking current is referred to as the “rated minimum breaking current”. This value must be specified for back-up fuse-links. From this current, back-up fuse-links are capable to breaking fault currents. The fuse-links must be assigned to the system so that no fault current below  $I_3$  can occur at the site of the fuse-link (due to the system parameters or other protective devices).

## Power dissipation of a fuse-link $P_{warm}$

The power dissipation of a HV fuse-link is specified at the rated current of the fuse-link. For protection with HV fuse-links, it should be noted that the operating current is normally half the rated current. Because of the physical relationships, the actual power dissipation is less than a quarter of the value  $P_{warm}$  for HV fuse-links shown in the technical data table.

## Time-current characteristic ( $I/t$ characteristic)

The time-current characteristic shows the correlation between current and time up to the melting of a fuse-element. The virtual time ( $t_{vs}$ ) is specified to enable a comparison of the  $I/t$  characteristics of fuse-links below 100ms. For co-ordination with other protective devices, e.g. load interrupter switches or circuit breakers, the melting integral  $I^2t$  must be referred to for melting times below 100ms.

## Current limitation

At high short circuit currents, HV fuse-links interrupt current within several milliseconds that means, the sinusoidal current does not reach its peak value and that HV fuse-links are current limiting devices. This is a significant advantage compared to mechanical switches whose contacts take longer to open and interrupt currents at natural zero. During this time, the peak short-circuit current is able to freely develop its dynamic force. By using HV fuse-links, this surge current is limited within several ms to a fraction of its peak value and the design of the subsequent system can be reduced in terms of dynamic forces.

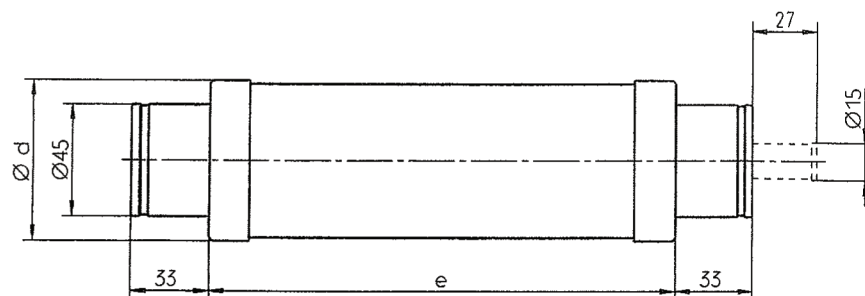
## Switching voltage

So that HV fuse-links perform a current-limiting action, the short circuit current must be limited and reduced as it increases. This requires a switching voltage that exceeds the driving system voltage and forces the current to zero. This switching voltage must not exceed the specified permissible value of 2.2 times the peak value of the maximum rated voltage. Limitor HV fuse-links are within this limit.

## Dimensions

HV fuse-links in this product list conform to DIN 43 625. The contact cap dimensions defined in this standard are shown in Fig. 2. The dimension "e" varies depending on the rated voltage of HV fuse-links, which is shown as a dimension for fuse-links in the technical data tables. The diameter "d" also varies with the rated current, whereby this dimension is also shown in the tables.

Fig. 2



Dimensions acc. to DIN 43 625 in mm

## Protection of transformers

The following should be observed for HV fuse-link selection:

- Transformer ratings
  - Service voltage (U)
  - Rated output (S)
  - Relative short-circuit voltage ( $U_k \%$ )
  - Inrush current (factor  $8 \dots 12 I_N$ )
- Time-current characteristic of HV fuse-links
- Secondary devices/selectivity

## Procedure based on an example:

A 630kVA transformer has a transformer rated current of 18,2A at a service voltage of 20kV. The relative short-circuit voltage is 4% and the inrush current is  $12 \times I_N$ . The short-circuit current on secondary terminal short-circuit is given from the relative short-circuit voltage. The transformer must be designed to withstand this current for 2 seconds. This condition results in point b) in Fig. 3. HV fuse-links must interrupt this current within 2 seconds. In Fig. 3, the fuse link F4 must not be used for this transformer, as the fuse-link will require longer than 2 seconds to melt at this short-circuit current.

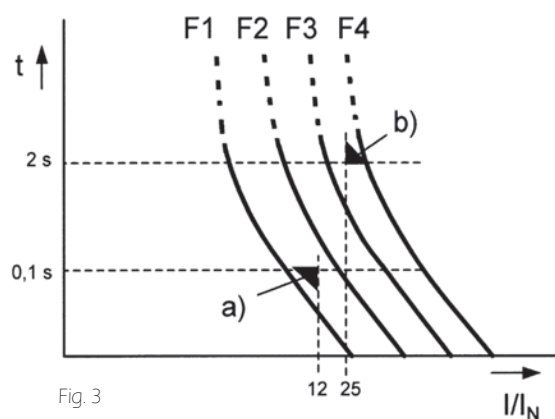


Fig. 3

F1 – F4) Time-current characteristics of HV fuse-links

a) Inrush current

b) lowest short-circuit current of transformer

The inrush current is plotted for a duration of 0,1 seconds, resulting in point a). This inrush current must not melt the fuse-link, for which reason the fuse-link F1 cannot be used for this transformer. The fuse-links F2 and F3 can be used for this transformer, since their time-current characteristics are between the points a) and b). A transformer can thus be assigned several HV fuse-links for various rated currents. Decisive for selection of the correct fuse is the time-current characteristic and not the rated current of the HV fuse-link.



# Selection table for HV back-up fuse-links acc. to IEC 60282-1

Rated voltage range of fuse-link [kV]		3/7,2		6/12		10/24		20/36	
Service voltage of transformer [kV]		6		10		20		30	
rel. short-circuit voltage	Transformer output [kVA]	Transformer rated current [A]	Rated current of fuse-link [A]	Transformer rated current [A]	Rated current of fuse-link [A]	Transformer rated current [A]	Rated current of fuse-link [A]	Transformer rated current [A]	Rated current of fuse-link [A]
U <sub>K</sub> = 4%	50	4,8	<b>16</b> –20	2,9	10	1,5	4	0,96	<b>2</b> –6,3
	100	9,6	<b>20</b> –31,5	5,8	<b>16</b> –20	2,9	10	1,9	<b>6,3</b> –10
	125	12	<b>25</b> –40	7,2	<b>20</b> –25	3,6	<b>10</b> –16	2,4	10
	160	15,4	<b>31,5</b> –50	9,2	<b>20</b> –31,5	4,6	<b>16</b> –20	3,1	10
	200	19,2	<b>40</b> –63	11,5	<b>25</b> –40	5,8	<b>16</b> –20	3,8	<b>10</b> –16
	250	24,1	<b>40</b> –80	14,4	<b>31,5</b> –50	7,2	<b>20</b> –25	4,8	<b>16</b> –20
	315	30,3	<b>50</b> –100	18,2	<b>40</b> –63	9,1	<b>20</b> –31,5	6,1	<b>16</b> –25
	400	38,5	<b>63</b> –125	23,1	<b>40</b> –80	11,5	<b>25</b> –40	7,7	<b>20</b> –25
	500	8,1	<b>80</b> –160	28,9	<b>50</b> –100	14,4	<b>31,5</b> –50	9,6	<b>20</b> –31,5
	630	60,6	<b>100</b> –200	36,4	<b>63</b> –100	18,2	<b>40</b> –63	12,1	<b>25</b> –40
U <sub>K</sub> = 5%	800	77,1	<b>125</b> –200	46,2	<b>80</b> –125	23,1	<b>40</b> –63	15,4	<b>31,5</b> –40
	1000	96,3	<b>125</b> –160	57,7	<b>100</b> –160	28,9	<b>50</b> –80	19,2	<b>40</b> –50
	1250	120,3	<b>160</b> –200	72,2	<b>125</b> –200	36,1	<b>63</b> –100	24,1	<b>40</b> –50
U <sub>K</sub> = 6%	1600	154	200	92,4	<b>125</b> –200	46,2	<b>80</b> –100	30,8	<b>50</b> –63

Table 1

Bold typed figures are preferred values

HV Back-up Fuse-Links according to IEC 60 282-1

Catalogue No.	Reference N°	Range	U <sub>N</sub> (kV)	I <sub>N</sub> (A)	L (mm)	D (mm)	I <sub>1</sub> (kA)	I <sub>3</sub> (A)	R (mΩ)	P (W)	I <sup>2</sup> t (kA²s)	Weight (kg)
45DB72V2P	N1000098A	Back-up with striker	3/7,2	2	192	56	63	15	256	1,8	0,6	1,1
45DB72V4P	P1000099A	Back-up with striker	3/7,2	4	192	56	63	20	256	5	0,8	1,1
45DB72V6,3PD	S209293A	Back-up with striker	3/7,2	6,3	192	56	63	20	256	11	0,8	1,1
45DB72V10PD	T209294A	Back-up with striker	3/7,2	10	192	56	63	35	144	19	3	1,1
45DB72V16PD	V209295A	Back-up with striker	3/7,2	16	192	56	63	64	41	13	2,34	1,1
45DB72V20PD	W209296A	Back-up with striker	3/7,2	20	192	56	63	80	32	14,5	3,9	1,1
45DB72V25PD	X209297A	Back-up with striker	3/7,2	25	192	56	63	95	25	20	4,9	1,1
45DB72V32PD	Y209298A	Back-up with striker	3/7,2	31,5	192	56	63	110	19	23	7	1,1
45DB72V40PD	Z209299A	Back-up with striker	3/7,2	40	192	56	63	134	12,5	30	14	1,1
45DB72V50PD	A209300A	Back-up with striker	3/7,2	50	192	56	63	190	9,25	35	25,3	1,1
45DB72V63P	B209301A	Back-up with striker	3/7,2	63	192	65	63	220	8,75	60	41,2	1,4
45DB72V80P	C209302A	Back-up with striker	3/7,2	80	192	65	63	300	6,25	85	84	1,4
45DB72V100P	D209303A	Back-up with striker	3/7,2	100	192	65	63	350	5	96	93,6	1,4
45DB72V125PD	Q1000100A	Back-up with striker	3/7,2	125	192	88	63	435	3	75	440	2,4
45DB72V160P	R1000101A	Back-up with striker	3/7,2	160	192	88	63	500	2,9	120	500	2,4
45DB72V200P	S1000102A	Back-up with striker	3/7,2	200	192	88	63	610	2,5	200	654	2,4
45DB120V1P	T1000103A	Back-up with striker	6/12	1	292	56	63	14	1400	1,6	0,2	1,7
45DB120V2P	V1000104A	Back-up with striker	6/12	2	292	56	63	16	500	2,2	0,4	1,7
45DB120V4P	W1000105A	Back-up with striker	6/12	4	292	56	63	22	340	6	0,7	1,7
45DB120V6,3P	F209305A	Back-up with striker	6/12	6,3	292	56	63	30	185	9	1	1,7
45DB120V10P	G209306A	Back-up with striker	6/12	10	292	56	63	42	138	17	1,5	1,7
45DB120V16P	H209307A	Back-up with striker	6/12	16	292	56	63	54	107	38	2	1,7
45DB120V20P	J209308A	Back-up with striker	6/12	20	292	56	63	73	71	38	4	1,7
45DB120V25P	K209309A	Back-up with striker	6/12	25	292	56	63	93	52	46	6	1,7
45DB120V32P	L209310A	Back-up with striker	6/12	31,5	292	56	63	105	42	65	10	1,7
45DB120V40P	M209311A	Back-up with striker	6/12	40	292	56	63	125	22,5	54	30	1,7
45DB120V50P	N209312A	Back-up with striker	6/12	50	292	56	63	160	18	70	50	1,7
45DB120V63P	P209313A	Back-up with striker	6/12	63	292	56	63	230	12,8	85	100	1,7
45DB120V80P	Q209314A	Back-up with striker	6/12	80	292	65	63	350	10,6	115	150	2,1
45DB120V100P	R209315A	Back-up with striker	6/12	100	292	65	63	500	8,5	156	200	3,1
45DB120V125P	X1000106A	Back-up with striker	6/12	125	292	88	63	480	4,75	117	440	3,7
45DB120V160P	Y1000107A	Back-up with striker	6/12	160	292	88	63	560	4,25	217	500	3,7
45DB120V200P	Z1000108A	Back-up with striker	6/12	200	292	88	63	610	3,75	333	654	3,7
45DB175V6,3P	V1000564A	Back-up with striker	10/17,5	6,3	367	56	63	30	245	11	1	2,1
45DB175V10P	W1000565A	Back-up with striker	10/17,5	10	367	56	63	43	180	22	1,5	2,1
45DB175V16P	X1000566A	Back-up with striker	10/17,5	16	367	56	63	54	150	53	2	2,1
45DB175V20P	Y1000567A	Back-up with striker	10/17,5	20	367	56	63	73	102	56	4	2,1
45DB175V25P	Z1000568A	Back-up with striker	10/17,5	25	367	56	63	93	78	73	6	2,1
45DB175V32P	A1000569A	Back-up with striker	10/17,5	31,5	367	56	63	105	59	95	10	2,1
45DB175V40P	B1000570A	Back-up with striker	10/17,5	40	367	56	63	125	33,8	79	30	2,1
45DB175V50P	C1000571A	Back-up with striker	10/17,5	50	367	56	63	205	26	106	50	2,1
45DB175V63P	D1000572A	Back-up with striker	10/17,5	63	367	56	63	280	18,4	130	100	2,1
45DB175V80P	E1000573A	Back-up with striker	10/17,5	80	367	65	63	350	15	180	150	2,6
45DB175V100P	F1000574A	Back-up with striker	10/17,5	100	367	88	63	500	13	280	200	3,5
45DB240V1P	A1000109A	Back-up with striker	10/24	1	442	56	63	14	2170	2,2	0,2	2,5
45DB240V2P	B1000110A	Back-up with striker	10/24	2	442	56	63	16	800	3,4	0,4	2,5
45DB240V4P	C1000111A	Back-up with striker	10/24	4	442	56	63	23	545	10	0,7	2,5
45DB240V6,3P	S209339A	Back-up with striker	10/24	6,3	442	56	63	30	297	13	1	2,5
45DB240V10P	T209340A	Back-up with striker	10/24	10	442	56	63	43	220	26	1,5	2,5
45DB240V16P	V209341A	Back-up with striker	10/24	16	442	56	63	54	197	73	2	2,5
45DB240V20P	W209342A	Back-up with striker	10/24	20	442	56	63	73	132	76	4	2,5
45DB240V25P	X209343A	Back-up with striker	10/24	25	442	56	63	93	96	89	6	2,5
45DB240V32P	Y209344A	Back-up with striker	10/24	31,5	442	56	63	105	78	127	10	2,5
45DB240V40P	Z209345A	Back-up with striker	10/24	40	442	56	63	125	45	114	30	2,5
45DB240V50P	A209346A	Back-up with striker	10/24	50	442	56	63	205	35	147	50	2,5
45DB240V63P	B209347A	Back-up with striker	10/24	63	442	56	63	280	24	170	100	2,5
45DB240V80P	C209348A	Back-up with striker	10/24	80	442	65	63	310	20	233	150	3,1
45DB240V100P	D209349A	Back-up with striker	10/24	100	442	78	63	430	18	400	200	4,2
45DB240V125P	D1000112A	Back-up with striker	10/24	125	442	88	40	760	11,7	117	350	5,9
45DB240V160P	E1000113A	Back-up with striker	10/24	160	442	88	31,5	900	9,45	217	500	5,9
45DB240V200P	F1000114A	Back-up with striker	10/24	200	442	88	31,5	1050	7	333	730	5,9
45DB360V2P	G1000115A	Back-up with striker	20/36	2	537	56	31,5	15	755	9	0,6	2,7
45DB360V4P	H1000116A	Back-up with striker	20/36	4	537	56	31,5	20	755	32	0,8	2,7
45DB360V6,3PD	S209362A	Back-up with striker	20/36	6,3	537	56	31,5	20	827	39	0,6	2,7
45DB360V10PD	T209363A	Back-up with striker	20/36	10	537	56	31,5	33	463	65	2	2,7
45DB360V16PD	V209364A	Back-up with striker	20/36	16	537	56	31,5	66	210	67	2,34	2,7
45DB360V20PD	W209365A	Back-up with striker	20/36	20	537	56	31,5	95	147	84	3,9	2,7
45DB360V25PD	X209366A	Back-up with striker	20/36	25	537	56	31,5	110	125	100	6,5	2,7
45DB360V32PD	Y209367A	Back-up with striker	20/36	31,5	537	65	31,5	135	85	119	7	3,7
45DB360V40PD	Z209368A	Back-up with striker	20/36	40	537	65	20	200	65	176	14,2	3,7
45DB360V50PD	J1000117A	Back-up with striker	20/36	50	537	88	20	220	42	183	40	6,5
45DB360V63PD	K1000118A	Back-up with striker	20/36	63	537	88	20	280	35	271	61,7	6,5

# HV back-up fuse-links acc. to IEC 60282-1 with and without controlled power dissipation

## Time current characteristics

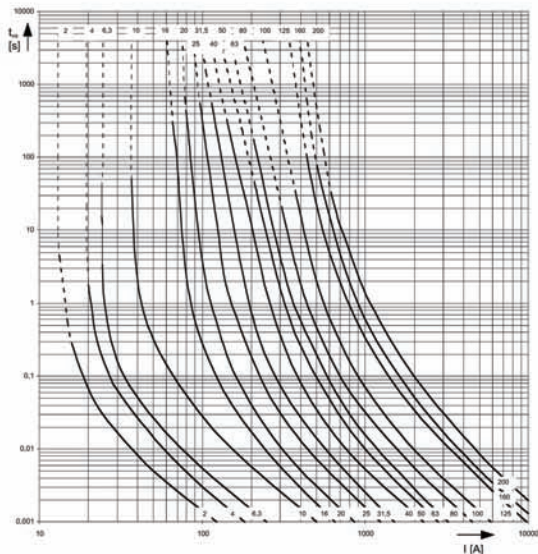


Fig.4  
3/7,2 kV

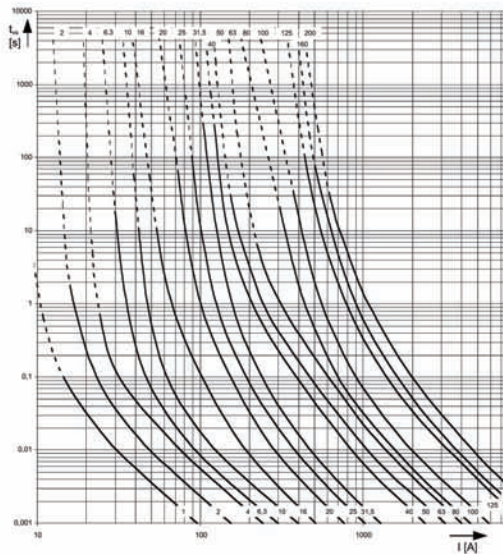


Fig.5  
6/12 kV

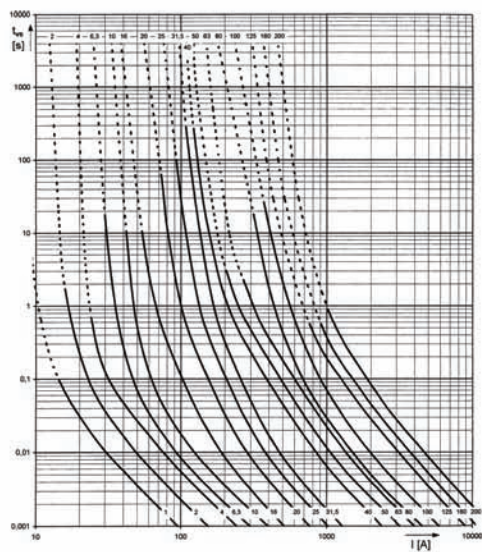


Fig.6  
10/24 kV

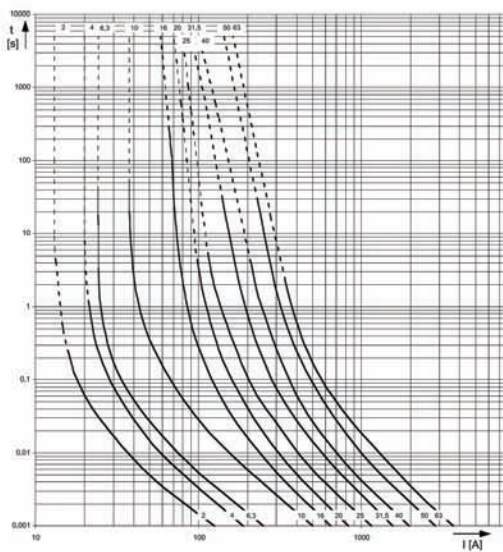


Fig.7  
20/36 kV

## HV back-up fuse-links meet the requirements of IEC 60282-1 with controlled power dissipation CPD

### Application

Limiter HV fuse-links type CPD meet the requirements of IEC 60282-1 and were specifically developed to be installed in compact sized enclosed SF6 insulated substations. In these substations HV fuse-links are enclosed in narrow fuse compartments which on the one hand prevent efficient cooling of the fuse-links and on the other hand have a limited thermal power acceptance themselves. Overheating of fuse compartments in such enclosures is, however, not to be expected, if the fuse-links have been properly selected by their rated current according to the transformer to be protected (see table 3) and if the melting elements of the fuselins are in faultless condition (Fig. 8).

One or more of the melting elements connected in parallel may, however, be interrupted by transient currents caused by transformer inrush or lightning strikes. Fuse-links having one or more of the paralleled melting elements interrupted, dissipate significantly more heat than faultless fuse-links. There is a certain risk that the limited power acceptance of fuse compartments may be exceeded at or even below rated transformer current. HV back-up fuse-links type CPD prevent such potential overheating when installed in conjunction with a transformer switch having trip-free mechanism.

### Function mode

The CPD striker system controls the power dissipation of the fuse according to Ohm's law (CPD means controlled power dissipation). The striker pin is released depending on the voltage drop across the fuse and, therefore depending on the power dissipation. The release voltage of the CPD striker system has been selected so that the fuse carrying the operating current  $I_B$  does not exceed the limiting value. The CPD striker system controls the power dissipation of the fuse and releases the transformer switch before the permissible power acceptance of the fuse compartment will be exceeded (Fig. 8).

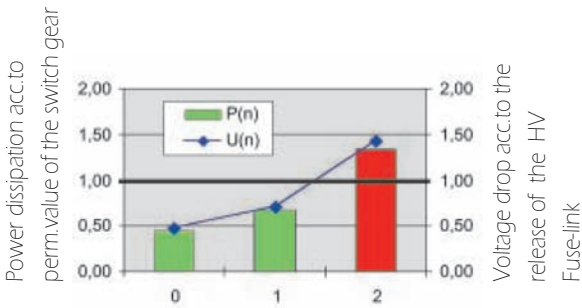


Fig. 8: Controlled power dissipation

## Selection table HV back-up fuse-links acc. to IEC 60282-1 with controlled power dissipation CPD

Rated voltage range of fuse-link [kV]		6/12		10/24	
Service voltage of transformer [kV]		10		20	
rel. short-circuit voltage	Transformer output [kVA]	Transformer rated current [A]	Rated current of fuse-link [A]	Transformer rated current [A]	Rated current of fuse-link [A]
$U_K = 4\%$	50	2,9	10	1,5	4
	100	5,8	<b>16</b> -20	2,9	10
	125	7,2	<b>20</b> -25	3,6	<b>10</b> -16
	160	9,2	<b>20</b> -31,5	4,6	<b>16</b> -20
	200	11,5	<b>25</b> -40	5,8	<b>16</b> -20
	250	14,4	<b>31,5</b> -50	7,2	<b>20</b> -25
	315	18,2	<b>40</b> -63	9,1	<b>20</b> -31,5
	400	23,1	<b>40</b> -80	11,5	<b>25</b> -40
	500	28,9	<b>50</b> -100	14,4	<b>31,5</b> -50
	630	36,4	<b>63</b> -100	18,2	<b>40</b> -63
$U_K = 5\%$	800	46,2	<b>80</b> -125	23,1	<b>40</b> -63
	1000	57,7	<b>100</b> -160	28,9	<b>50</b> -80
	1250	72,2	<b>125</b> -200	36,1	<b>63</b> -100
$U_K = 6\%$	1600	92,4	<b>125</b> -200	46,2	<b>80</b> -100-63

Table 3  
 Bold typed figures are preferred values



## HV back-up fuse-links acc. to IEC 60282-1 with controlled power dissipation

Catalogue No.	Reference N°	Range	U <sub>N</sub> (kV)	I <sub>N</sub> (A)	L (mm)	D (mm)	I <sub>1</sub> (kA)	I <sub>3</sub> (A)	R (mΩ)	P (W)	I <sup>2</sup> t (kA <sup>2</sup> s)	Weight (kg)
45DB120V1PT	L1000119A	Back-up, striker, CPD	6/12	1	292	56	63	14	1500	1,6	0,09	1,6
45DB120V2PT	M1000120A	Back-up, striker, CPD	6/12	2	292	56	63	16	510	2	0,28	1,6
45DB120V4PT	N1000121A	Back-up, striker, CPD	6/12	4	292	56	63	22	338	6	0,5	1,6
45DB120V6,3PT	P1000122A	Back-up, striker, CPD	6/12	6,3	292	56	63	30	190	8	0,6	1,6
45DB120V10PT	Q1000123A	Back-up, striker, CPD	6/12	10	292	56	63	42	139	16	1,15	1,6
45DB120V16PT	R1000124A	Back-up, striker, CPD	6/12	16	292	56	63	54	107	38	1,29	1,6
45DB120V20PT	S1000125A	Back-up, striker, CPD	6/12	20	292	56	63	73	71	38	3,2	1,6
45DB120V25PT	T1000126A	Back-up, striker, CPD	6/12	25	292	56	63	93	52	46	5,2	1,6
45DB120V32PT	V1000127A	Back-up, striker, CPD	6/12	31,5	292	56	63	105	43	65	7,2	1,6
45DB120V40PT	W1000128A	Back-up, striker, CPD	6/12	40	292	56	63	125	23	54	23,3	1,6
45DB120V50PT	X1000129A	Back-up, striker, CPD	6/12	50	292	56	63	160	18	70	34,9	1,6
45DB120V63PT	Y1000130A	Back-up, striker, CPD	6/12	63	292	56	63	230	12	85	58,3	1,6
45DB120V80PT	Z1000131A	Back-up, striker, CPD	6/12	80	292	65	63	350	10,6	114	90	2,1
45DB120V100PT	A1000132A	Back-up, striker, CPD	6/12	100	292	65	63	500	8,5	156	140	2,1
45DB120V125PT	B1000133A	Back-up, striker, CPD	6/12	125	292	88	63	480	4	117	440	3,7
45DB120V160PT	C1000134A	Back-up, striker, CPD	6/12	160	292	88	63	560	4,3	217	500	3,7
45DB120V200PT	D1000135A	Back-up, striker, CPD	6/12	200	292	88	63	610	3,8	333	654	3,7
45DB240V1PT	E1000136A	Back-up, striker, CPD	10/24	1	442	56	63	14	2100	2	0,09	2,3
45DB240V2PT	F1000137A	Back-up, striker, CPD	10/24	2	442	56	63	16	800	3	0,34	2,3
45DB240V4PT	G1000138A	Back-up, striker, CPD	10/24	4	442	56	63	23	550	10	0,45	2,3
45DB240V6,3PT	H1000139A	Back-up, striker, CPD	10/24	6,3	442	56	63	30	300	13	0,53	2,3
45DB240V10PT	J1000140A	Back-up, striker, CPD	10/24	10	442	56	63	43	220	26	0,94	2,3
45DB240V16PT	K1000141A	Back-up, striker, CPD	10/24	16	442	56	63	54	197	73	1,4	2,3
45DB240V20PT	L1000142A	Back-up, striker, CPD	10/24	20	442	56	63	73	134	76	3,1	2,3
45DB240V25PT	M1000143A	Back-up, striker, CPD	10/24	25	442	56	63	93	96	89	4,5	2,3
45DB240V32PT	N1000144A	Back-up, striker, CPD	10/24	31,5	442	56	63	105	79	127	5,9	2,3
45DB240V40PT	P1000145A	Back-up, striker, CPD	10/24	40	442	56	63	125	45	114	18,8	2,3
45DB240V50PT	Q1000146A	Back-up, striker, CPD	10/24	50	442	56	63	205	35	147	33,5	2,3
45DB240V63PT	R1000147A	Back-up, striker, CPD	10/24	63	442	56	63	280	24	170	59,6	2,3
45DB240V80PT	S1000148A	Back-up, striker, CPD	10/24	80	442	65	63	310	20,5	233	84	3,1
45DB240V100PT	T1000149A	Back-up, striker, CPD	10/24	100	442	78	63	430	18	400	93,6	4,1
45DB240V125PT	V1000150A	Back-up, striker, CPD	10/24	125	442	88	40	760	11,7	117	350	5,9

## HV General Purpose fuse-links acc. to IEC 60282-1

Catalogue No.	Reference N°	Range	U <sub>N</sub> (kV)	I <sub>N</sub> (A)	L (mm)	D (mm)	I <sub>1</sub> (kA)	I <sub>3</sub> (A)	R (mΩ)	P (W)	I <sup>2</sup> t (kA <sup>2</sup> s)	Weight (kg)
45DG120V6,3P	W1000151A	General Purpose, striker	6/12	6,3	292	65	40	0	128	6	2	2,3
45DG120V10P	X1000152A	General Purpose, striker	6/12	10	292	65	40	0	70	8	3,8	2,3
45DG120V16P	Y1000153A	General Purpose, striker	6/12	16	292	65	40	0	35	10	14	2,3
45DG120V25P	Z1000154A	General Purpose, striker	6/12	25	292	65	40	0	20,5	15	36	2,3
45DG120V40P	A1000155A	General Purpose, striker	6/12	40	292	78	40	0	12,2	24	110	3,1
45DG120V50P	B1000156A	General Purpose, striker	6/12	50	292	88	40	0	9,9	31	150	3,7
45DG240V4P	C1000157A	General Purpose, striker	10/24	4	442	78	40	0	280	5	1,8	4,1
45DG240V6,3P	D1000158A	General Purpose, striker	10/24	6,3	442	78	40	0	256,5	11	2	4,1
45DG240V10P	E1000159A	General Purpose, striker	10/24	10	442	78	40	0	135	15	3,6	4,1
45DG240V16P	F1000160A	General Purpose, striker	10/24	16	442	78	40	0	70,3	21	14	4,1
45DG240V25P	G1000161A	General Purpose, striker	10/24	25	442	88	40	0	41,2	31	39	4,5



# High-voltage alternating current switch-fuse combinations acc. to IEC 62 271-105

In order to increase the utilization range of a switch, it is combined with current limiting HV fuse-links. This combination unit offers short-circuit protection in addition to load switching capacity. HV fuse-links provide short-circuit protection, while the switch interrupts the currents below the take-over current of the combination unit.

In addition to the inrush current, short-circuit current on secondary terminal short-circuits and low voltage selectivity, the following switch characteristics should be taken into account:

- Rated transfer current ( $I_{transfer}$ )
- Fuse-initiated opening time of the switch ( $t_0$ )

Fig. 9 shows the rated transfer current ( $I_{transfer}$ ) as a vertical line. The fuse-initiated opening time ( $t_0$ ) must be multiplied by 0,9 (procedure according to IEC 62 271-105) and a horizontal line be drawn. This results in an intersection that is characteristic to the switch and must be established for each switch individually.

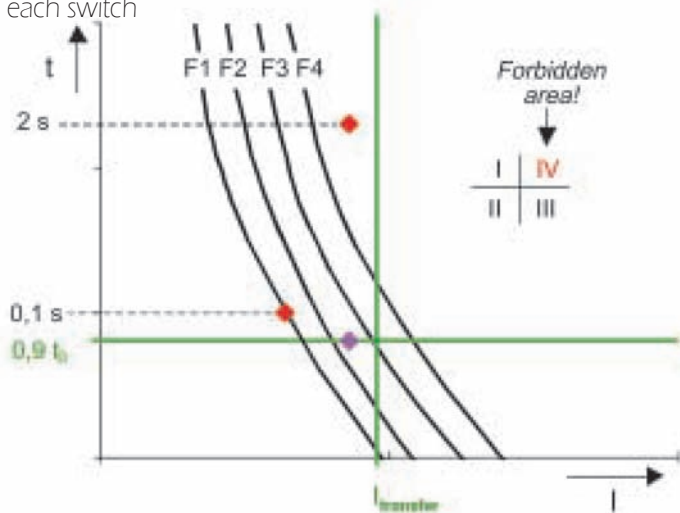


Fig. 9 : Selection of HV fuse-links acc. to IEC 62 271-105

This switch intersection divides the sheet into four quadrants (see Fig. 9).

Suitable for the switch-fuse combination are HV fuse-links only with a time-current characteristic that does not pass through quadrant IV ("forbidden area").

Generally suitable for use in switch-fuse combinations according to IEC 62 271-105 are all HV fuse-links with striker which meet this criterion.

Ferraz Shawmut has assigned HV fuse-links to the switch-fuse combination and the transformers of all major manufactures. These documents are available on request.

## Clips

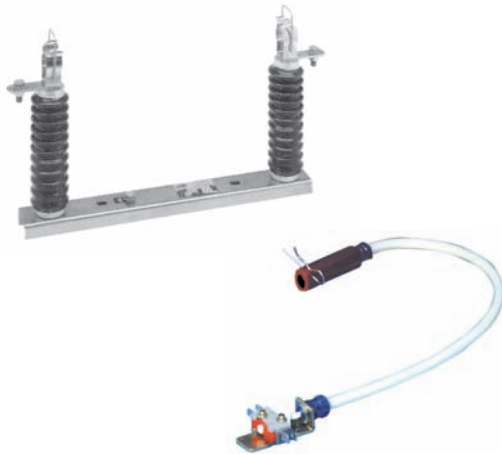
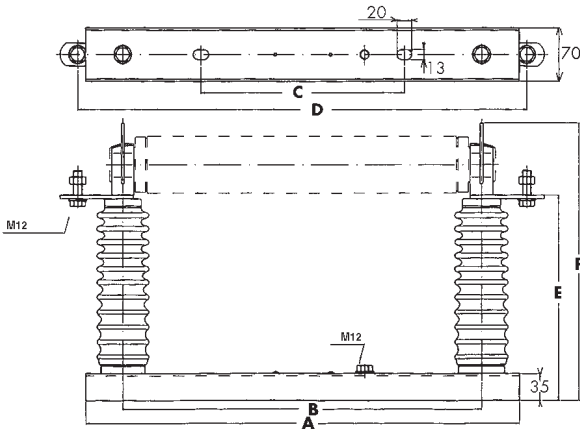
Size	Reference.Number	Catalog Number	Packaging
MR 45 + spring	L096472A	MR45R	1
MR 45 without connection lug	S210236B	MR55R	2

## Bases

Voltage (kV)	Size	Use	Reference.Number	Catalog Number	Packaging
7,2	SI 7,2/192	Indoor	G209421A	SI72V192	1
12	SI 12/292	Indoor	H209422A	SI120V292	1
17,5	SI 17,5/292	Indoor	J209423A	SI175V292	1
24	SI 24/442	Indoor	K209424A	SI 240V442	1
36	SI 36/537	Indoor	M209426A	SI360V537	1
12	SE 12/292	Outdoor	S210328A	SE120V292	1
17,5	SE 17,5/292	Outdoor	T210329A	SE175V292	1
24	SE 24/442	Outdoor	V210330A	SE240V442	1
36	SE 36/537	Outdoor	W210331A	SE360V537	1

## Bases with signalling

Voltage (kV)	Number of contacts	Reference.Number	Catalog Number	Packaging
12/36	1 NO/NF	E092855A	MC1-5NFLEXQS500	1
12/36	2 NO/NF	F092856A	MC1-9NFLEXQS500	1



Voltage (kV)	Length of fuse L (mm)	Size	Dielectric withstand (phase to ground)		Dimensions (mm)						Weight (kg)
			50Hz-1mn Kv Rms	1,2/50µs peak voltage	A	B	C	D	E	F	
7,2	192	SI 7,2/192	20	60	400	226	322	347	175	270	3,8
12	292	SI 12/292	28	75	424	324	200	445	175	270	4,1
17,5	292	SI 17,5/292	38	95	424	324	200	445	220	315	5,1
24	442	SI 24/442	50	125	576	476	270	597	270	365	5,5
36	537	SI 36/537	70	170	670	570	350	691	354	449	7,7
12	292	SE 12/292	28	75	424	324	200	445	261	356	7,5
17,5	292	SE 17,5/292	38	95	424	324	200	445	261	356	7,5
24	442	SE 24/442	50	125	576	476	270	597	309	404	8,8
36	537	SE 36/537	70	170	670	570	350	691	381	476	13,2



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