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

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 tripfree 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.

General charateristics

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 I3). Their operating range is from I3 to the maximum rated breaking current (I1).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 theHV back-up fuse-link than I3 (IKmin > I3).
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 I1

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. I1 of the fuse-link must be greater than the maximum short circuit current at the site of the fuse-link (I1 > IKmax).

Minimum breaking current I3

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 I3 can occur at the site of the fuse-link (due to the system parameters or other protective devices).

Power dissipation of a fuse-link Pwarm

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 Pwarm 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 (tvs) 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 I2t must be referred to for melting times below 100ms.

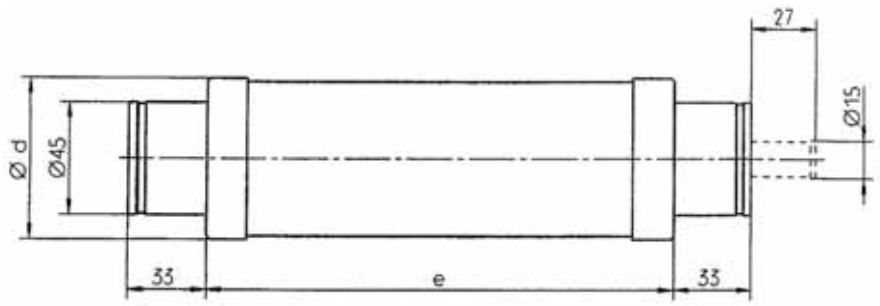
Current limitation

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.

Dimension



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

Current (A)	Voltage (kV)	Cat.Number	Ref. number	Pack.
2	3/7,2	**45DB72V2P**	N1000098A	1
4	3/7,2	**45DB72V4P**	P1000099A	1
6,3	3/7,2	**45DB72V6,3PD**	S209293A	1
10	3/7,2	**45DB72V10PD**	T209294A	1
16	3/7,2	**45DB72V16PD**	V209295A	1
20	3/7,2	**45DB72V20PD**	W209296A	1
25	3/7,2	**45DB72V25PD**	X209297A	1
31,5	3/7,2	**45DB72V32PD**	Y209298A	1
40	3/7,2	**45DB72V40PD**	Z209299A	1
50	3/7,2	**45DB72V50PD**	A209300A	1
63	3/7,2	**45DB72V63P**	B209301A	1
80	3/7,2	**45DB72V80P**	C209302A	1
100	3/7,2	**45DB72V100P**	D209303A	1
125	3/7,2	**45DB72V125PD**	Q1000100A	1
160	3/7,2	**45DB72V160P**	R1000101A	1
200	3/7,2	**45DB72V200P**	S1000102A	1
1	6/12	**45DB120V1P**	T1000103A	1
2	6/12	**45DB120V2P**	V1000104A	1
4	6/12	**45DB120V4P**	W1000105A	1
6,3	6/12	**45DB120V6,3P**	F209305A	1
10	6/12	**45DB120V10P**	G209306A	1
16	6/12	**45DB120V16P**	H209307A	1
20	6/12	**45DB120V20P**	J209308A	1
25	6/12	**45DB120V25P**	K209309A	1
31,5	6/12	**45DB120V32P**	L209310A	1
40	6/12	**45DB120V40P**	M209311A	1
50	6/12	**45DB120V50P**	N209312A	1
63	6/12	**45DB120V63P**	P209313A	1
80	6/12	**45DB120V80P**	Q209314A	1
100	6/12	**45DB120V100P**	R209315A	1
125	6/12	**45DB120V125P**	X1000106A	1
160	6/12	**45DB120V160P**	Y1000107A	1
200	6/12	**45DB120V200P**	Z1000108A	1
6,3	10/17,5	**45DB175V6,3P**	T209317A	1
10	10/17,5	**45DB175V10P**	V209318A	1
16	10/17,5	**45DB175V16P**	W209319A	1
20	10/17,5	**45DB175V20P**	X209320A	1
25	10/17,5	**45DB175V25P**	Y209321A	1
31,5	10/17,5	**45DB175V32P**	Z209322A	1
40	10/17,5	**45DB175V40P**	A209323A	1
50	10/17,5	**45DB175V50P**	B209324A	1
63	10/17,5	**45DB175V63P**	C209325A	1
80	10/17,5	**45DB175V80P**	D209326A	1
100	10/17,5	**45DB175V100P**	E209327A	1
1	10/24	**45DB240V1P**	A1000109A	1
2	10/24	**45DB240V2P**	B1000110A	1
4	10/24	**45DB240V4P**	C1000111A	1
6,3	10/24	**45DB240V6,3P**	S209339A	1
10	10/24	**45DB240V10P**	T209340A	1
16	10/24	**45DB240V16P**	V209341A	1
20	10/24	**45DB240V20P**	W209342A	1
25	10/24	**45DB240V25P**	X209343A	1
31,5	10/24	**45DB240V32P**	Y209344A	1
40	10/24	**45DB240V40P**	Z209345A	1
50	10/24	**45DB240V50P**	A209346A	1
63	10/24	**45DB240V63P**	B209347A	1
80	10/24	**45DB240V80P**	C209348A	1
100	10/24	**45DB240V100P**	D209349A	1
125	10/24	**45DB240V125P**	D1000112A	1
160	10/24	**45DB240V160P**	E1000113A	1
200	10/24	**45DB240V200P**	F1000114A	1
2	20/36	**45DB360V2P**	G1000115A	1
4	20/36	**45DB360V4P**	H1000116A	1
6,3	20/36	**45DB360V6,3PD**	S209362A	1
10	20/36	**45DB360V10PD**	T209363A	1
16	20/36	**45DB360V16PD**	V209364A	1
20	20/36	**45DB360V20PD**	W209365A	1
25	20/36	**45DB360V25PD**	X209366A	1
31,5	20/36	**45DB360V32PD**	Y209367A	1
40	20/36	**45DB360V40PD**	Z209368A	1
50	20/36	**45DB360V50PD**	J1000117A	1
63	20/36	**45DB360V63PD**	K1000118A	1

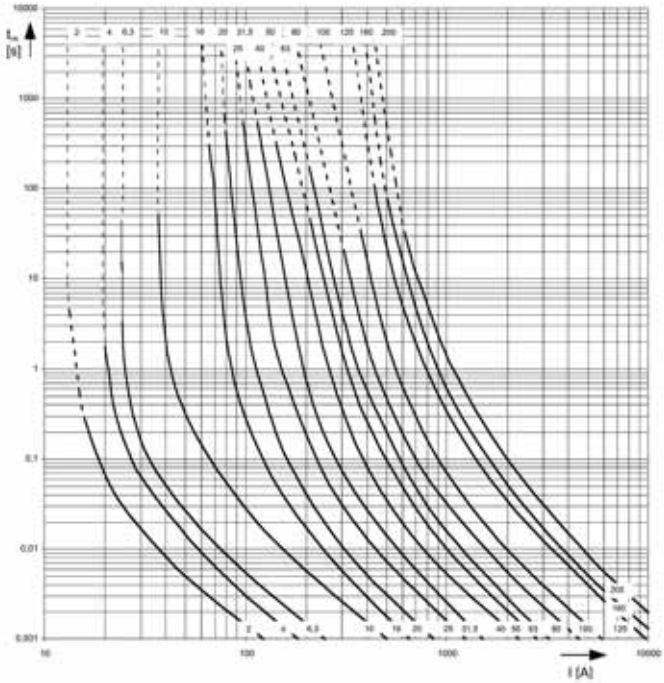
HV back-up fuse-links acc. to IEC 60282-1 with controlled power dissipation

Current (A)	Voltage (kV)	Cat.Number	Ref. number	Pack.
1	6/12	**45DB120V1PT**	L1000119A	1
2	6/12	**45DB120V2PT**	M1000120A	1
4	6/12	**45DB120V4PT**	N1000121A	1
6,3	6/12	**45DB120V6,3PT**	P1000122A	1
10	6/12	**45DB120V10PT**	Q1000123A	1
16	6/12	**45DB120V16PT**	R1000124A	1
20	6/12	**45DB120V20PT**	S1000125A	1
25	6/12	**45DB120V25PT**	T1000126A	1
31,5	6/12	**45DB120V32PT**	V1000127A	1
40	6/12	**45DB120V40PT**	W1000128A	1
50	6/12	**45DB120V50PT**	X1000129A	1
63	6/12	**45DB120V63PT**	Y1000130A	1
80	6/12	**45DB120V80PT**	Z1000131A	1
100	6/12	**45DB120V100PT**	A1000132A	1
125	6/12	**45DB120V125PT**	B1000133A	1
160	6/12	**45DB120V160PT**	C1000134A	1
200	6/12	**45DB120V200PT**	D1000135A	1
1	10/24	**45DB240V1PT**	E1000136A	1
2	10/24	**45DB240V2PT**	F1000137A	1
4	10/24	**45DB240V4PT**	G1000138A	1
6,3	10/24	**45DB240V6,3PT**	H1000139A	1
10	10/24	**45DB240V10PT**	J1000140A	1
16	10/24	**45DB240V16PT**	K1000141A	1
20	10/24	**45DB240V20PT**	L1000142A	1
25	10/24	**45DB240V25PT**	M1000143A	1
31,5	10/24	**45DB240V32PT**	N1000144A	1
40	10/24	**45DB240V40PT**	P1000145A	1
50	10/24	**45DB240V50PT**	Q1000146A	1
63	10/24	**45DB240V63PT**	R1000147A	1
80	10/24	**45DB240V80PT**	S1000148A	1
100	10/24	**45DB240V100PT**	T1000149A	1
125	10/24	**45DB240V125PT**	V1000150A	1

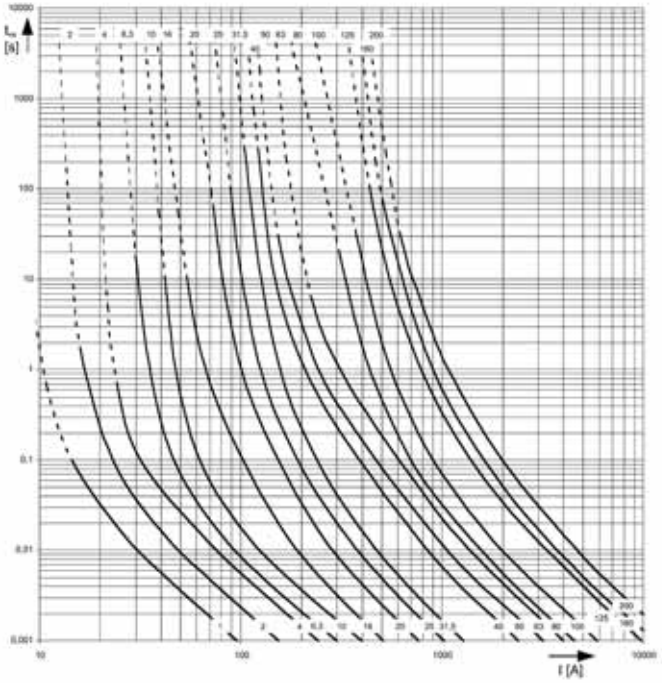
HV General Purpose fuse-links acc. to IEC 60282-1

Current (A)	Voltage (kV)	Cat.Number	Ref. number	Pack.
6,3	6/12	**45DG120V6,3P**	W1000151A	1
10	6/12	**45DG120V10P**	X1000152A	1
16	6/12	**45DG120V16P**	Y1000153A	1
25	6/12	**45DG120V25P**	Z1000154A	1
40	6/12	**45DG120V40P**	A1000155A	1
50	6/12	**45DG120V50P**	B1000156A	1
4	10/24	**45DG240V4P**	C1000157A	1
6,3	10/24	**45DG240V6,3P**	D1000158A	1
10	10/24	**45DG240V10P**	E1000159A	1
16	10/24	**45DG240V16P**	F1000160A	1
25	10/24	**45DG240V25P**	G1000161A	1

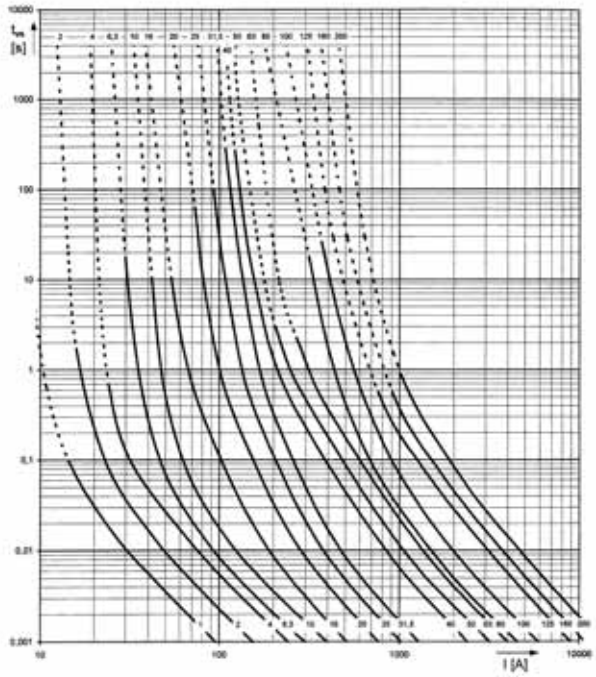
Time current characteristics



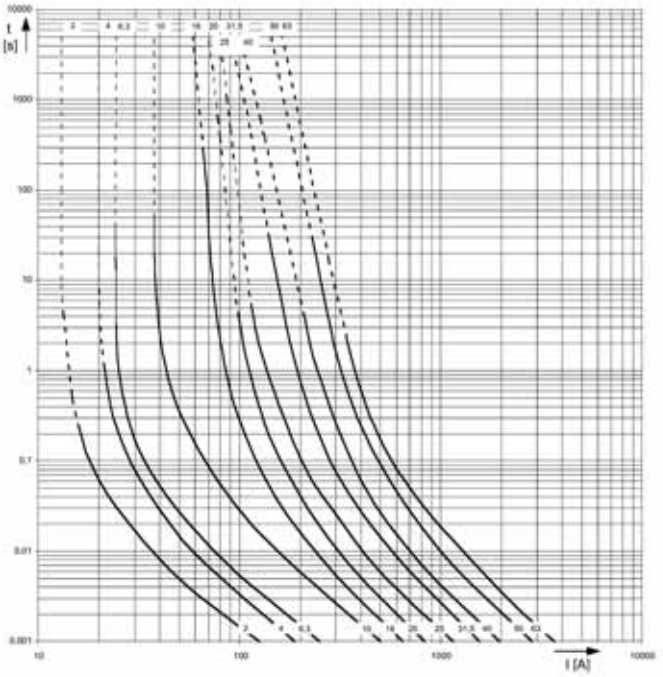
3/7,2 kV



6/12 kV



10/24 kV



20/36 kV

Application

Limitor 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.

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 (ltransfer)
– Fuse-initiated opening time of the switch (t0)
Fig. 9 shows the rated transfer current (ltransfer) as a vertical line.
The fuse-initiated opening time (t0) 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.

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 IB 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).

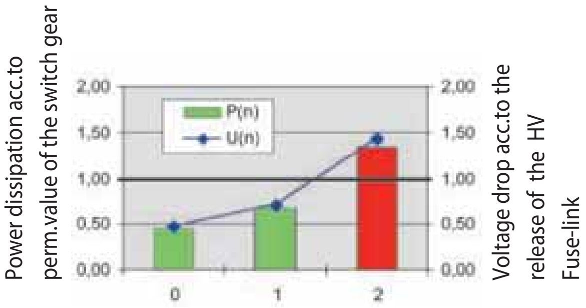


Fig. 8: Controlled power dissipation

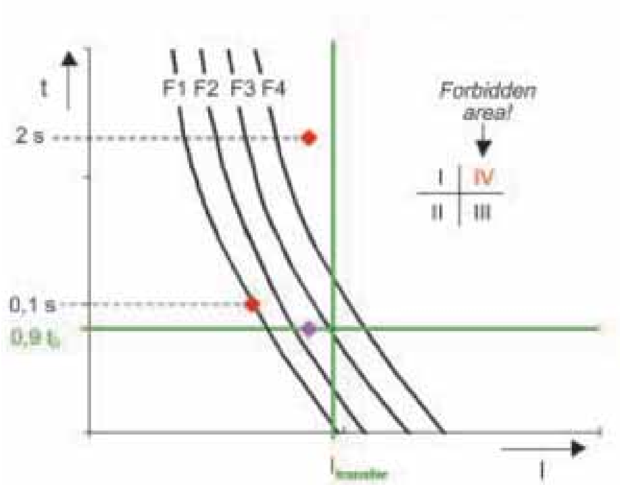


Fig. 9 : Selection of HV fuse-links acc. to IEC 62 271-105

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.

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Clips

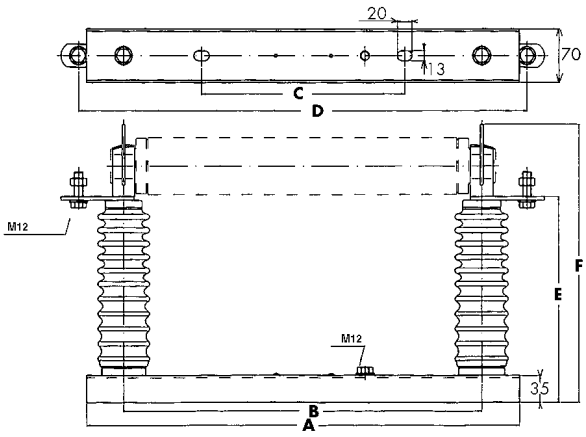
Size	Reference.Number	Catalog Number	Packaging
MR 45 + spring	L096472A	MR45R	1
MR 45 without connection lug	S210236B	MR55R	2

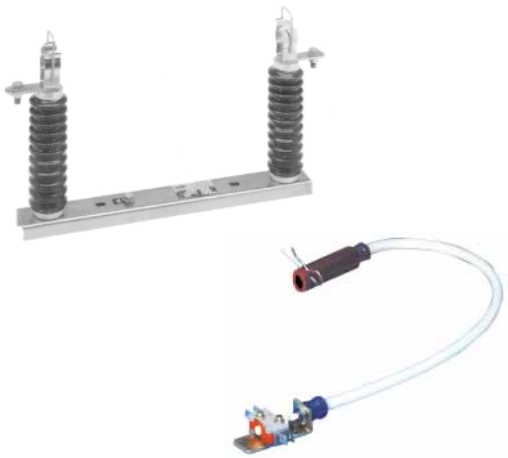
Bases

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) 50Hz-1mn Kv Rms	Dielectric withstand (phase to ground) 1,2/50µs peak voltage	Dimensions (mm) A	B	C	D	E	F	Weight (kg)
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