Medium Voltage Distribution

Fuses

from 3.6 to 36 kV

Catalogue
2010

Schneider Electric

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Applications

Fuse range selection

058579N

Public distribution

058580N

Motor protection

Our Fusarc CF, Soléfuse, Tépéfuse and MGK fuses make up a broad, consistent and uniform range of high breaking capacity fuses and current limitors.
They are all of combined type and are manufactured so that they can be installed both indoors and outdoors (depending on the type).

Schneider Electric fuses provide protection to medium voltage distribution devices (from 3 to 36 kV) from both the dynamic and thermal effects of short-circuit currents greater than the fuse's minimum breaking current.
Considering their low cost and their lack of required maintenance, medium voltage fuses are an excellent solution to protect various types of distribution devices:

- Medium voltage current consumers (transformers, motors, capacitors, etc.)
- Public and industrial electrical distribution networks.

They offer dependable protection against major faults that can occur either on medium or low voltage circuits.
This protection can be further enhanced by combining the fuses with low voltage protection systems or with an overcurrent relay.

Selection table

Depending on the equipment to be protected and its voltage rating, the table below gives the range of fuses which are best suited to the protection application.

Voltage (kV)	Motors	Power transformers	Capacitors	Voltage transformers
3.6	Fusarc CF MGK	Fusarc CF	Fusarc CF	Fusarc CF
7.2	Fusarc CF MGK	Fusarc CF Soléfuse	Fusarc CF Soléfuse	Fusarc CF
12	Fusarc CF	Fusarc CF Soléfuse	Fusarc CF Soléfuse	Tépéfuse Fusarc CF
17.5		Fusarc CF Soléfuse	Fusarc CF Soléfuse	Tépéfuse Fusarc CF
24		Fusarc CF	Fusarc CF Soléfuse	Tépéfuse Fusarc CF Soléfuse
36		Fusarc CF Soléfuse	Fusarc CF Soléfuse	Tépéfuse Fusarc CF

Soléfuse
(UTE standard;
transformer protection)

MGK
(UTE standard;
motor protection)

Fusarc CF
(DIN standard;
transformer, motor and
capacitor protection)

Tépéfuse
(UTE standard;
voltage transformer protection)

PE56922

Main characteristics

PE55711

Key characteristics

The most significant features provided by our range of fuses are as follows:

- High breaking capacity
- High current limitation
- Low I^2t values
- Dependable breaking of critical currents
- Low breaking overvoltage
- Low dissipated power
- No maintenance or ageing
- For indoor and outdoor applications
- With a thermal striker
- Low minimum breaking current values.

Standards

Our fuses are designed and manufactured according to the following standards:

- IEC 60282-1, IEC 60787 (Fusarc CF, Soléfuse,Tépéfuse, MGK)
- DIN 43625 (Fusarc CF)
- VDE 0670-402 (Fusarc CF)
- UTE C64200, C64210 (Soléfuse, Tépéfuse).

Quality assurance system

In addition to being tested in our own laboratories as well as in official laboratories such as the CESI, Les Renardiers and Labein, with their own respective certificates, our fuses are manufactured according to quality guidelines within the framework of the ISO 9001 and ISO 14001 Quality System Certification awarded by AENOR (IQ-NET) which provides an additional guarantee for Schneider Electric products.

Routine testing

During manufacture, each fuse is subject to systematic routine testing, with the aim of checking its quality and conformity:

- **Dimensional control** and weight control
- **Visual control** of markings, labelling and external appearance
- **Electrical resistance measurement:** a key point to ensure that fuses have the required performance levels at the end of the production process and to check that no damage has occurred during assembly.

Measurement of the room temperature resistance of each fuse is therefore carried out in order to check that they are in line with values, according to their rated voltage and rated current.

Certified quality: ISO 9001 and ISO 14001

A major advantage

Schneider Electric has a functional organisation whose main mission is to check quality and monitor compliance with standards in each of its production units. MESA, the only company in Schneider Electric that makes fuses, is certified by AENOR (The Spanish Standards Association), and is certified to ISO 9001 and ISO 14001 (IQ-NET).

Furthermore, Schneider Electric annually carries out internal type-testing and breaking testing in order to comply with our annual quality assurance plan, which is available on request to our customers.

- **Seal testing:** in order to test the sealing of our Fusarc CF fuses, they are immersed for 5 minutes in a hot water bath (80°C), in accordance with standard IEC 60282-1.

Main characteristics

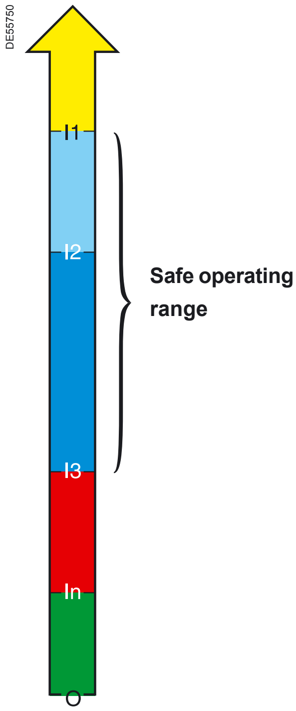


Figure 1: definition of a fuse's operating zone.

Key definitions

Un: rated voltage
This is the highest voltage between phases (expressed in kV) for the network on which the fuse might be installed.
In the medium voltage range, the preferred rated voltages have been set at: 3.6 - 7.2 - 12 - 17.5 - 24 and 36 kV.

In: rated current
This is the current value that the fuse can withstand on a constant basis without any abnormal temperature rise (generally 65 Kelvin for the contacts).

I3: minimum rated breaking current
This is the minimum current value which causes the fuse to blow and break the current. For our fuses, these values are between 3 and 5 times the In value.
Comment: it is not enough for a fuse to blow in order to interrupt the flow of current. For current values less than I3 , the fuse will blow, but may not break the current. Arcing continues until an external event interrupts the current. It is therefore essential to avoid using a fuse in the range between In and I3.
Overcurrents in this range may irreversibly damage fuse elements, whilst still maintaining the risk of an arc which is not broken, and of them being destroyed.
Figure 1 shows the operating ranges of combined type fuses.

I2: critical currents (currents giving similar conditions to the maximum arcing energy). This current subjects the fuse to greater thermal and mechanical stresses. The value of I2 varies between 20 and 100 times the In value, depending on the design of the fuse element. If the fuse can break this current, it can also break currents between I3 and I1.

I1: maximum rated breaking current
This is the presumed fault current that the fuse can interrupt. This value is very high for our fuses ranging from 20 to 63 kA.
Comment: it is necessary to ensure that the network short circuit current is at least equal to the I1 current of the fuse that is used.

Fusarc CF, Soléfuse, Tépéfuse, MGK
Construction

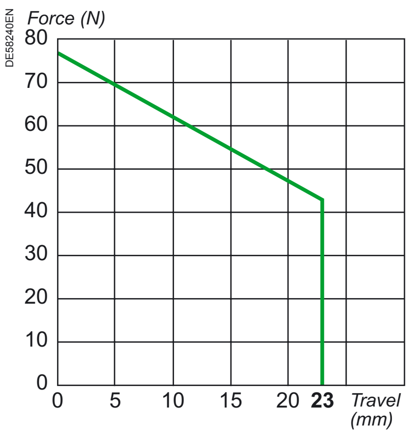


Figure 2: this graph shows the value of the force provided by the striker according to its length of travel.

End contact caps (1)
Together with the enclosure, they form an assembly which must remain intact before, during and after breaking the current. This is why they have to withstand mechanical stresses and sealing stresses due to overpressure caused by arcing. The stability of the internal components must also be ensured over time.

Enclosure (2)
This part of the fuse must withstand certain specific stresses (related to what has already been mentioned):
- Thermal stresses: the enclosure has to withstand the rapid temperature rise that occurs when the arc is extinguished
- Electrical stresses: the enclosure has to withstand the restoring of current after breaking
- Mechanical stresses: the enclosure has to withstand the increase in pressure caused by the expansion of the sand when breaking occurs.

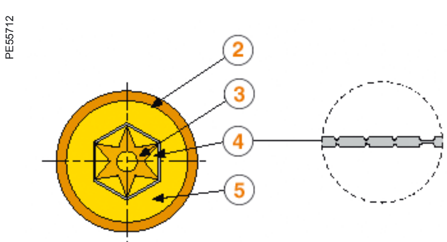
Core (3)
This is a cylinder surrounded by ceramic fins onto which the fuse element is wound. The striker control wire together with the latter are fitted in the cyclinder. They are insulated from the fuse elements.

Fuse element (4)
This is the main component of the fuse. It is made from materials with very low resistance and which do not wear over time. Our fuse elements are carefully configured following a lot of testing, to enable us to achieve the required results.

Extinction powder (5)
The extinction powder is made up of high purity quartzite sand (over 99.7%), which is free from any metal compounds and moisture.
When it vitrifies, the sand absorbs the energy produced by the arc and forms an insulating compound called *fulgurite* with the fuse element.

Thermal striker (6)
This is a mechanical device which indicates correct fuse operation.
It also provides the energy required to actuate a combined breaking device.
The striker is controlled by a heavy duty wire which, once the fuse element has blown, also melts and releases the striker. It is very important that the control wire does not cause premature tripping of the striker, nor must it interfere with the breaking process.
The Schneider Electric limiting fuse, with its thermal striker, is not only capable of indicating and breaking short circuits. It is also capable of this for prolonged overcurrents, and currents causing significant temperature rises in the devices combined with the fuses and the fuses themselves.
The thermal strikers installed in our fuses are of “medium type” and their force/travel characteristics (approximately 1 joule according to standard IEC-60282-1) are shown in figure 2.

1 Contact caps
2 Enclosure
3 Core
4 Fuse element
5 Extinction powder
6 Thermal striker



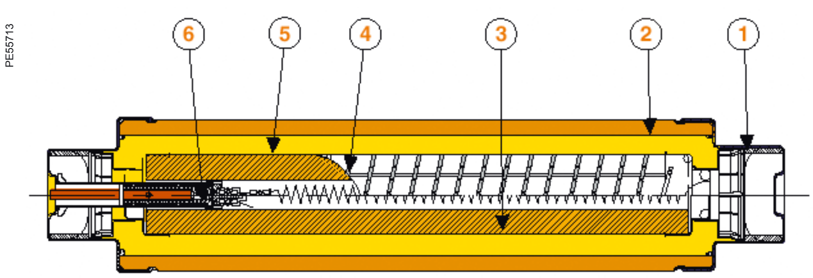


Figure 3: cross sectional diagram of a fuse

MV limiting fuses with thermal striker
Construction

PE56923

Fusarc CF fuses installed in a CAS 36 cubicle

All Schneider Electric fuses (type Fusarc CF) are provided of a thermal protection device. In the case of permanent overcurrents lower than I3 and superior to the rated current (In), the fuse mechanical striker acts opening the device associated and avoiding any incidents due to overheatings.
In this way, the fuse not only works as a current limiter but also as a temperature limiter when combined with an external breaking device.

These types of fuses, which integrate a thermal striker, are fully compatible with standard Back UP type fuses.
Figure 1.1 shows thermal protection action zone.

Technical / economic / safety advantages:

The use of a thermal protector in our fuses provides the following advantages:

- Protecting the fuses and their environment from unacceptable temperature rises in installations equipped with a disconnecting switch with the possibility of automatic opening
- Providing a response to unexpected operating conditions, to frequent or longlasting overloads, or to mistakes in selecting the fuse rating, or even concerning restricted ventilation conditions within the installation
- Indicating and protecting against overloads caused by overcurrents below the minimum breaking current (I3) of the installed fuse and which can cause dangerous operating temperatures
- Reducing operating costs due to destruction of equipment or excess costs caused by loss of quality of service (repair time, staff, etc.).

This thermal protector safety feature, significantly reduces the risk of damage and accidents in installations and therefore increases the power distribution quality of service.

The characteristics of the thermal striker fuse (breaking capacity, fuse curves, limiting values, striker force, etc.) do not vary relative to our fuses without thermal protection.

DE55754

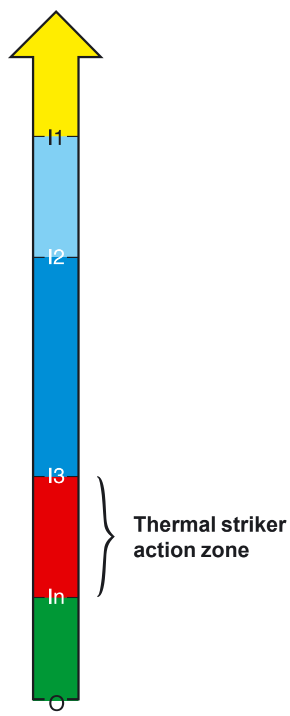
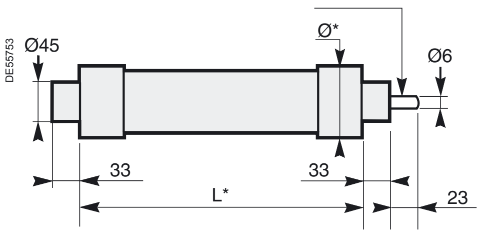


Figure 1.1: thermal protection

Fusarc CF
Characteristics and dimensions

Dimensions (mm)

Figure 4



** The following page gives the diameter and length of the fuse according to its rating.*

Fusarc CF

This is Schneider Electric's DIN standard fuse range.
When designing this range, we paid particular attention to minimise power dissipation.
It is increasingly common to use RMU units with SF6 gas as the insulating material.
In view of these operating conditions, in which the fuse is inserted inside a hermetically sealed fuse chamber, with virtually no ventilation, these fuses avoid premature ageing of themselves and of the whole device which would otherwise be caused by a non-optimised fuse.
The enclosure in the Fusarc CF range up to 100 A (rated current) is made from crystallised brown porcelain which withstands ultra-violet radiation and can therefore be installed both outdoors and indoors.
Fuses with rated current values greater than 100 A have glass fibre enclosures and are only for indoor installations.
You will find the full list of the Fusarc CF range in the table given on the following page.
With rated voltages ranging from 3 to 36 kV and rated currents of up to 250 A, they meet customers' exact requirements in terms of switchgear short-circuit protection.

Time/current fuse curves

These curves show the virtual fusion or pre-arcing time, as a function of the value of the symmetrical component of the intended current. Careful selection and design of fuse elements, together with meticulous industrial control, provides Schneider Electric customers with precise time-current curves, well above the tolerance limits provided for in standard IEC 60282-1.
When designing our Fusarc CF fuses, we focused on a relatively high fusion current at 0.1 s in order to withstand transformer making currents and at the same time a low fusion current at 10 s in order to achieve quick breaking in the case of a fault.
On page 10, we give the time/current characteristics of Fusarc CF fuses.

Current limitation curves

Schneider Electric fuses are current limiting. Consequently, short circuit currents are limited without reaching their maximum value. These diagrams show the relationship between the presumed short-circuit current and the peak value of the current broken by the fuse. The intersection of these lines with straight lines for Imax symmetrical and Imax asymmetrical give the presumed breaking current, below which fuses no longer have their limiting capacity.
For example, as shown in the limitation curves on page 10, for a short-circuit whose presumed current is 5 kA, in an unprotected installation, the maximum current value would be 7 kA for symmetrical flow and 13 kA for an asymmetrical case.
If we had used a Fusarc CF fuse with a rated current of 16 A, the maximum value reached would have been 1.5 kA.

Fusarc CF
References and characteristics

Table no. 1

Reference	Rated voltage (kV)	Operating voltage (kV)	Rated current (A)	Max. breaking current I1 (kA)	Min. breaking current I3 (A)	Cold resistance* (mΩ)	Dissipated power (W)	Length (mm)	Diameter (mm)	Weight (kg)
757372AR	3.6	3/3.6	250	50	2000	0.626	58	292	86	3.4
51311006M0	7.2	3/7.2	4	63	20	796	20	192	50.5	1
51006500M0			6.3		36	186.4	12			
51006501M0			10		39	110.5	14			
51006502M0			16		50	68.5	26			
51006503M0			20		62	53.5	32			
51006504M0			25		91	36.4	35			
51006505M0			31.5		106	26	42			
51006506M0			40		150	18	46			
51006507M0			50		180	12.4	44		76	2.1
51006508M0			63		265	9.9	52			
51006509M0			80		280	7.4	68			
51006510M0			100		380	6.2	85			
757352BN			125	50	650	3.4	88	292	86	3.4
757352BP			160		1000	2.2	87			
757352BQ			200		1400	1.8	95			
757374BR			250		2200	0.96	95	442		5
51311007M0	12	6/12	4	63	20	1177	27	292	50.5	1.2
51006511M0			6.3		36	283.4	16			
51006512M0			10		39	105.5	18			
51006513M0			16		50	106	37			
51006514M0			20		62	82	42			
51006515M0			25		91	56	52			
51006516M0			31.5		106	40	59			
51006517M0			40		150	28	74			
51006518M0			50		180	18.5	70		76	3.2
51006519M0			63		265	14.8	82			
51006520M0			80		280	11.1	102			
51006521M0			100		380	8.9	120			
757364CN			125	40	650	5.3	143	442	86	5
757354CP			160		1000	3.5	127			
757354CQ			200		1400	2.7	172			
51006522M0	17.5	10/17.5	10	40	39	233.4	23	292	50.5	1.2
51006523M0			16		50	146	47			
51006524M0			25		91	78.7	72		76	3.2
51006525M0			31.5		106	56.6	78			
51006526M0			40		150	39.2	90			
51311008M0			4		20	1487	34	367	50.5	1.5
51006527M0			6.3		36	369.3	21			
51006528M0			10		39	212.2	25			
51006529M0			16		50	132	46			
51006530M0			20		62	103	52			
51006531M0			25		91	71	66			
51006532M0			31.5		106	51	74			
51006533M0			40		150	35	94			
51006534M0			50	31.5	180	23.4	93		76	3.9
51006535M0			63		265	19.4	121			
51006536M0			80		330	13.5	145			
51006537M0			100		450	11	192		86	4.6

** Resistances are given at ±10% for a temperature of 20°C. Fuses > 100 A rated current, are manufactured in glass fibre (for indoor use).*

Fusarc CF
References and characteristics

Table no. 1 (continued)

Reference	Rated voltage (kV)	Operating voltage (kV)	Rated current (A)	Max. breaking current I1 (kA)	Min. breaking current I3 (A)	Cold resistance* (mΩ)	Dissipated power (W)	Length (mm)	Diameter (mm)	Weight (kg)
51108915M0			6.3		38	484	26			
51108916M0			10		40	248	35		50.5	1.2
51108917M0			16		60	158	64			
51108918M0			20		73	123	84			
51108919M0			25	31.5	100	88	79	292	76	3.2
51108920M0			31.5		112	61	90			
51108921M0			40		164	45	120			
51108922M0			50		233	30	157		86	5
51108923M0			63		247	23	177			
51108807M0			6.3		36	455	26			
51108808M0			16		50	158	58		50.5	1.5
51108813M0			20		62	123	67	367		
51108814M0			25		91	88	76			
51108809M0	24	10/24	31.5		106	61	93		76	3.9
51108810M0			40		150	44.5	115			
51311009M0			4	40	20	1505	34			
51006538M0			6.3		36	455	25			
51006539M0			10		39	257.5	31			
51006540M0			16		50	158	58	442	50.5	1.7
51006541M0			20		62	123	67			
51006542M0			25		91	88	79			
51006543M0			31.5		106	61	96			
51006544M0			40		150	44.5	119			
51006545M0			50		180	33.6	136			
51006546M0			63	31.5	265	25.2	144		76	4.5
51006547M0			80		330	18	200			
51006548M0			100		450	13.5	240		86	5.7
51311010M0			4	20	20	2209	51			
51006549M0			6.3		36	714	39			
51006550M0			10		39	392.2	50		50.5	1.9
51006551M0			16		50	252	98			
51006552M0	36	20/36	20	40	62	197	120	537		
51006553M0			25		91	133	133			
51006554M0			31.5		106	103	171		76	5.4
51006555M0			40		150	70	207			
51006556M0			50	20	200	47	198		86	6.5
51006557M0			63		250	35	240			

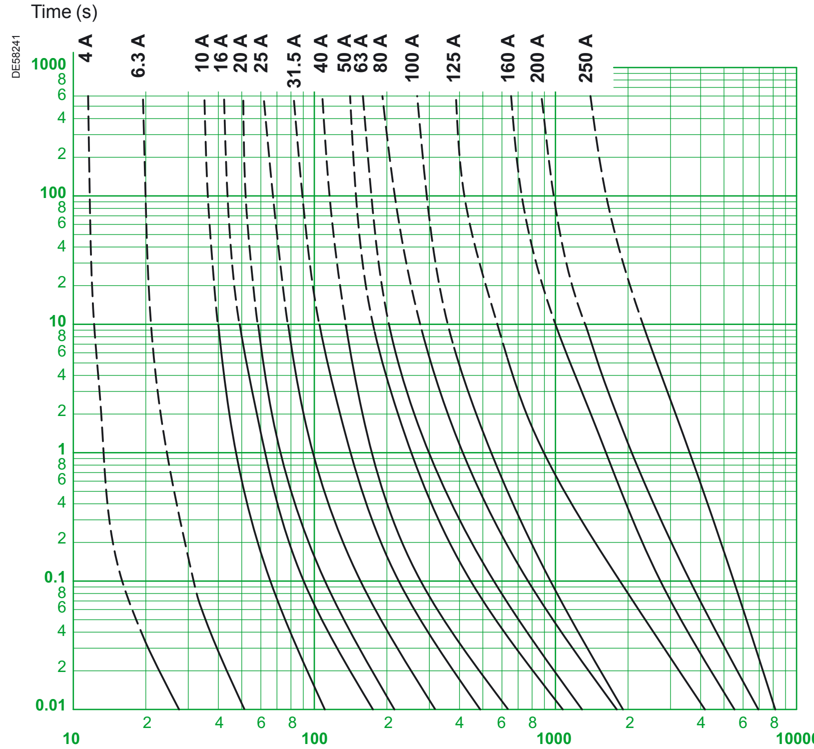
** Resistances are given at ±10% for a temperature of 20 °C. Fuses > 100 A rated current, are manufactured in glass fibre (for indoor use).*

Fusarc CF

Fuse and limitation curves

Time/current characteristics curves
3.6 - 7.2 - 12 - 17.5 - 24 - 36 kV

Time (s)

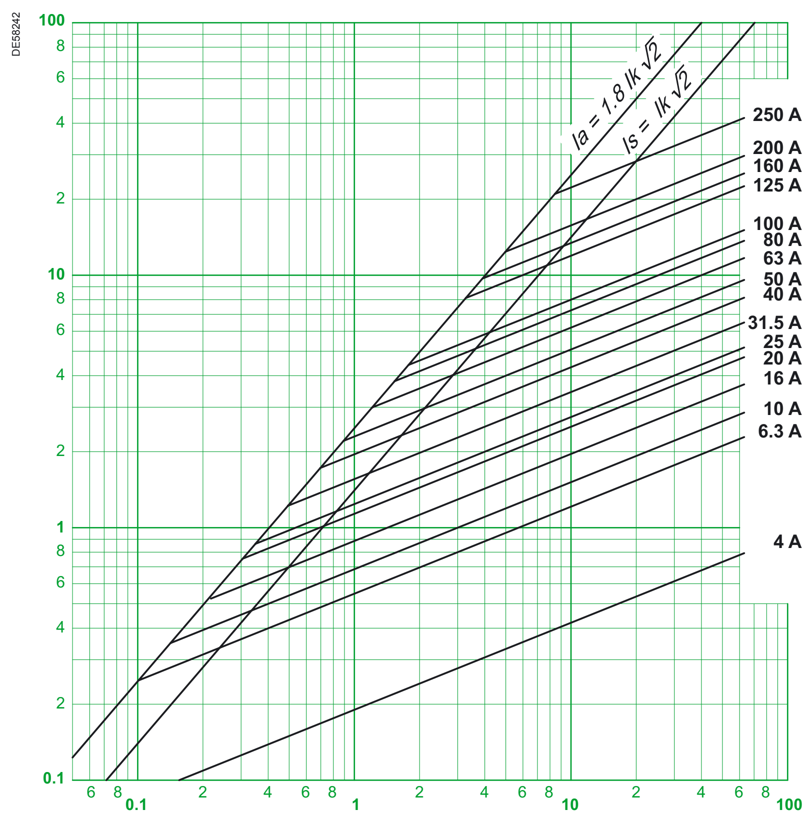


Current (A)

Current limitation curves 3.6 - 7.2 - 12 - 17.5 - 24 - 36 kV

Maximum value of cut-off current (kA peak)

The diagram shows the maximum limited broken current value as a function of the rms current value which could have occurred in the absence of a fuse.



Rms value of the presumed broken current (kA)

Soléfuse

References and characteristics

The Soléfuse range of fuses is manufactured according to UTE standard C64200. The rated voltage varies from 7.2 to 36 kV. They can be supplied with or without a striker and their weight is of around 2 kg.
They are mainly intended to protect power transformers and distribution networks, and are solely for indoor installations (glass fibre enclosure).

Electrical characteristics

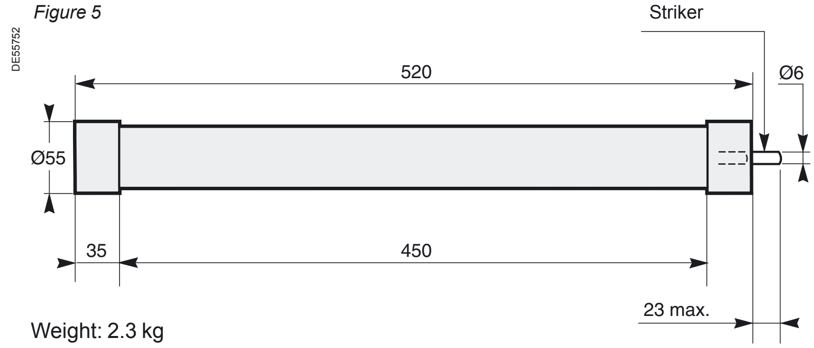
Table no. 2

Reference	Rated voltage (kV)	Operating voltage (kV)	Rated current (A)	Min. breaking current I3 (A)	Max. breaking current I1 (kA)	Cold resistance * (mΩ)
757328BC			6.3	35		192.7
757328BE			16	80		51.7
757328BH	7.2	3/7.2	31.5	157.5	50	24.5
757328BK			63	315		11.3
757328BN			125	625		4.8
757328CM	7.2/12	3/12	100	500	50	7.7
757328DL	7.2/17.5	3/17.5	80	400	40	15.1
757328EC			6.3	35		454.3
757328EE			16	80		95.6
757328EH	12/24	10/24	31.5	157.5	30	45.8
757328EJ			43	215		33.6
757328EK			63	315		19.9
757331GC**			6.3	35		463
757331GE**			16	80		96
757331GH**	12/24	10/24	31.5	157.5	30	46.2
757331GJ**			43	215		34.3
757331GK**			63	315		19.9
757328FC			6.3	35		762.6
757328FD			10	50		252.9
757328FE	36	30/36	16	80	20	207.8
757328FF			20	100		133.2
757328FG			25	125		124
757328FH			31.5	157.5		93

** Resistances are given at ±10% for a temperature of 20°C.*
*** Without striker.*

Dimensions (mm)

Figure 5

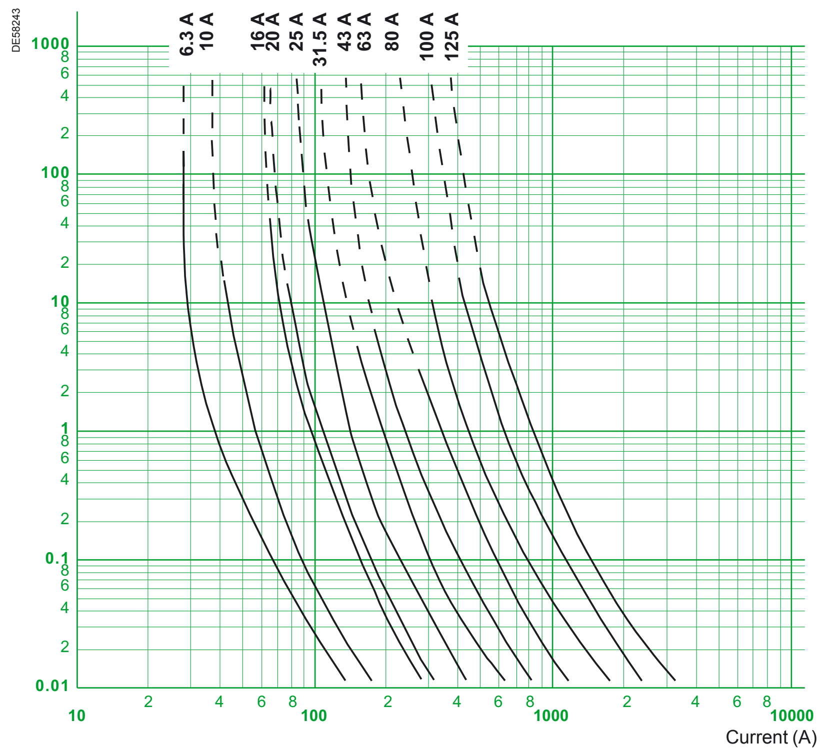


Weight: 2.3 kg

Soléfuse

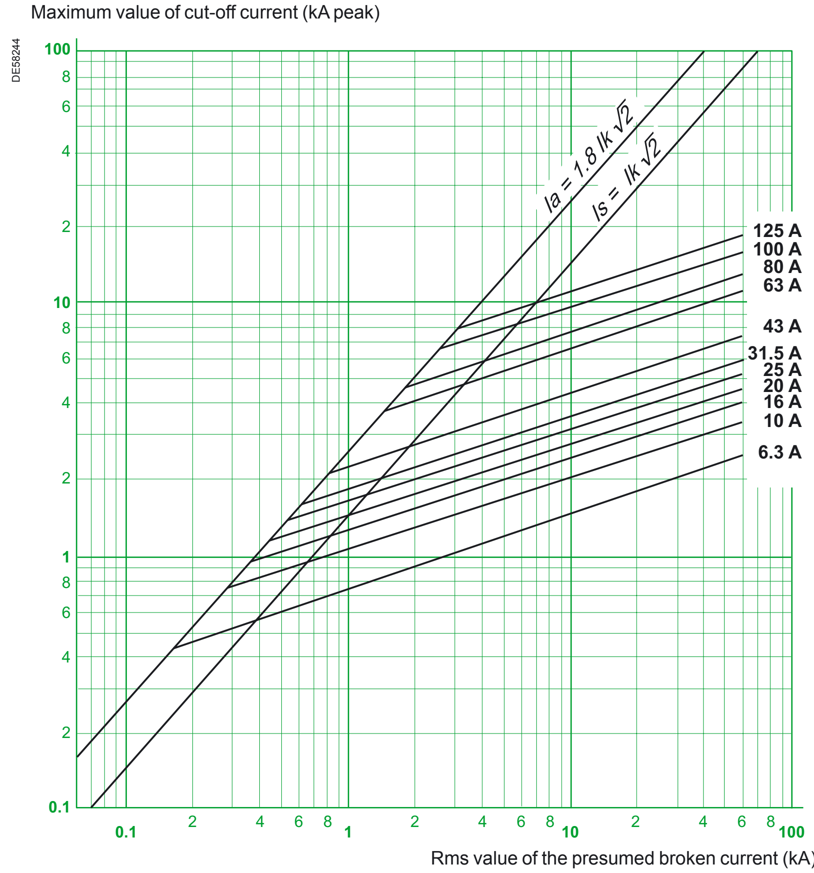
Fuse and limitation curves

Time/current characteristic curves 7.2 - 12 - 17.5 - 24 - 36 kV



Current limitation curves 7.2 - 12 - 17.5 - 24 - 36 kV

The diagram shows the maximum limited broken current value as a function of the rms current value which could have occurred in the absence of a fuse.



Tépéfuse, Fusarc CF
(metering transformer protection)
References, characteristics and curves

We manufacture Tépéfuse and Fusarc CF type fuses intended for metering transformer protection which have the following references and characteristics:

Characteristics

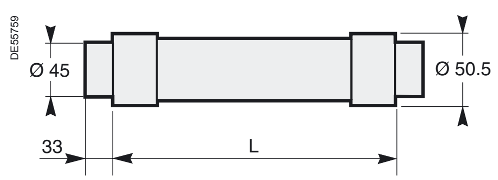
Table no. 3

Type	Reference	Rated voltage (kV)	Operating voltage (kV)	Rated current (A)	Max. breaking current I1 (kA)	Min. breaking current I3 (A)	Cold resistance * (mΩ)	Length (mm)	Diameter (mm)	Weight (kg)
Tépéfuse	781825A	12	< 12	0.3	40	40	6.1	301	27.5	0.4
	781825B	24	13.8/24				11.6			
Fusarc CF	51311002M0	7.2	3/7.2	2.5			1278	192		0.9
	51311000M0	12	6/12	1	63		3834	292		1.2
	51311003M0			2.5			1917			
	51311011M0	17.5	10/17.5	2.5		9.5	2407	367	50.5	1.5
	51311001M0	24	10/24	1	40		4815	442		1.6
	51311004M0			2.5			2407			
	51311005M0	36	20/36	2.5	20		3537	537		1.8

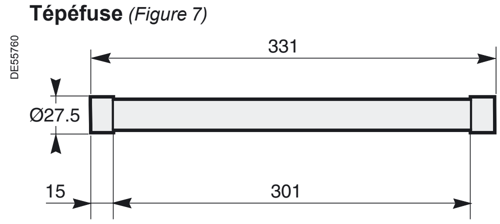
** Resistances are given at ±10% for a temperature of 20°C.*
Tépéfuse fuses are only made in glass fibre when intended for indoor usage.
Fuses for metering transformer protection are made without strikers, according to figures 6 and 7.

Dimensions (mm)

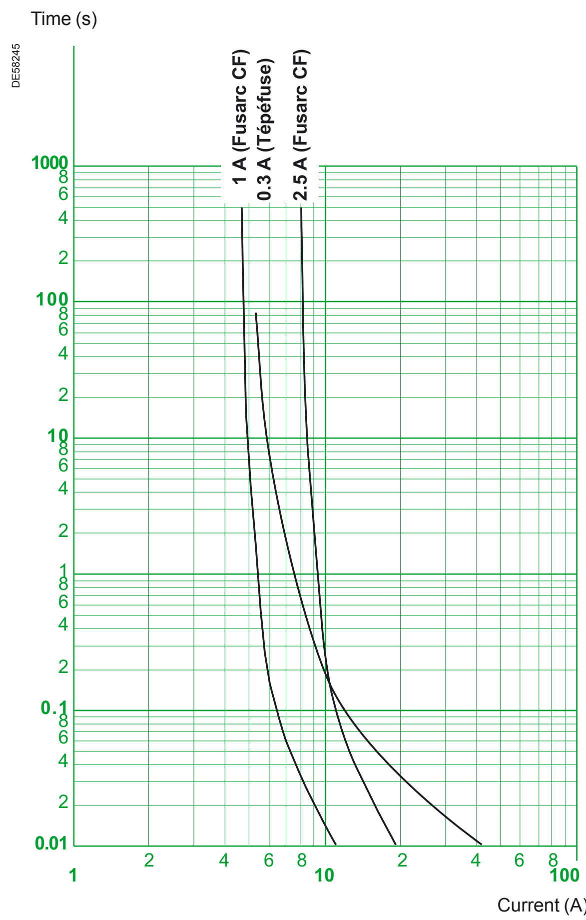
Fusarc CF *(Figure 6)*



Tépéfuse *(Figure 7)*



Fuse curve 7.2 - 12 - 24 - 36 kV

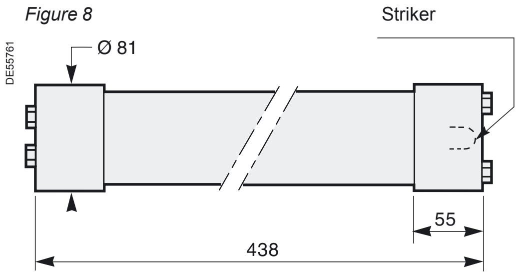


MGK

References, characteristics and curves

Dimensions (mm)

Figure 8



Weight: 4.1 kg

MGK fuses are intended to protect medium voltage motors at 7.2 kV (indoor application).

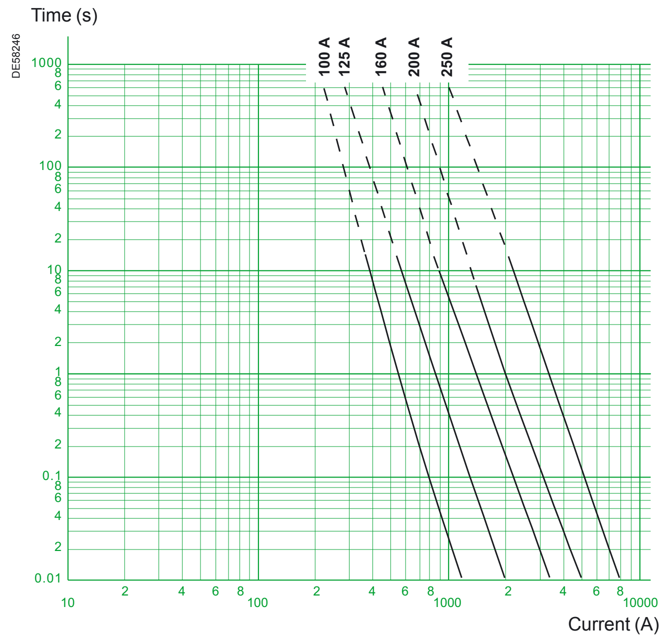
Electrical characteristics

Table no. 4

Reference	Rated voltage (kV)	Operating voltage (kV)	Rated current (A)	Min. breaking current I3 (A)	Max. breaking current I1 (kA)	Cold resistance * (mΩ)
757314			100	360	50	6.4
757315			125	570	50	4.6
757316	7.2	⩽ 7.2	160	900	50	2.4
757317			200	1400	50	1.53
757318			250	2200	50	0.98

** Resistances are given at ±10% for a temperature of 20°C.*

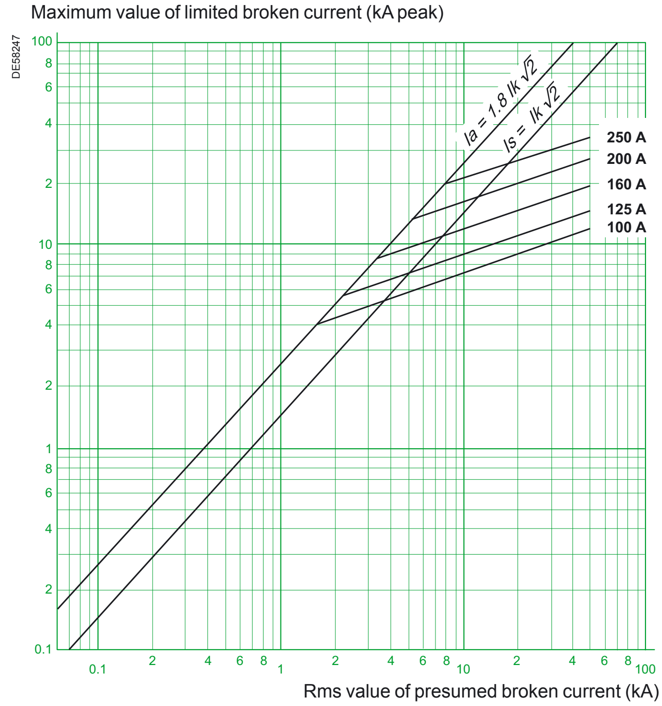
Fuse curve 7.2 kV



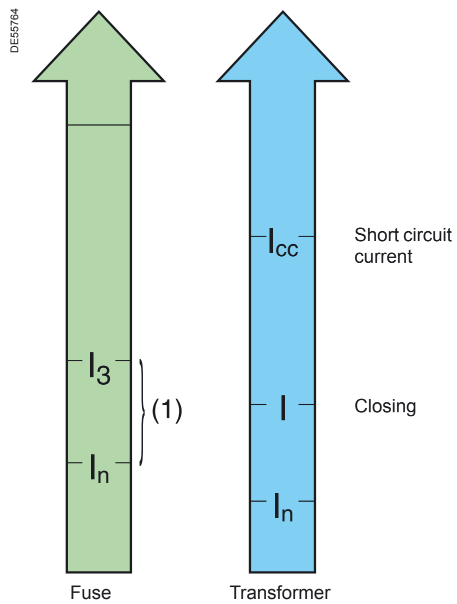
Current limitation curve 7.2 kV

Maximum value of limited broken current (kA peak)

The diagram shows the maximum limited broken current value as a function of the rms current value which could have occurred in the absence of a fuse.



Selection and usage guide
General
Transformer protection



(1) In this current zone, any overloads must be eliminated by LV protection devices or by a MV switch equipped with an overcurrent relay.

General
According to their specific characteristics, the various types of fuses (Fusarc CF, Soléfuse, Tépéfuse and MGK) provide real protection for a wide variety of medium and high voltage equipment (transformers, motors, capacitors).
It is of the utmost importance to always remember the following points:
- **Un** of the fuse must be greater than or equal to the network voltage
- **I1** of a fuse must be greater than or equal to the network short circuit current
- The characteristics of the equipment to be protected must always be taken into consideration.

Transformer protection
A transformer imposes three main stresses on a fuse. This is why the fuses must be capable of:

- **… Withstanding the peak start-up current which accompanies transformer closing**

The fuses' fusion current at 0.1 s must be more than 12 times the transformer's rated current.

If(0.1 s) > 12 x In transfo.

- **… Breaking fault currents across the terminals of the transformer secondary**

A fuse intended to protect a transformer has to break its rated short circuit current (Isc) before it can damage the transformer.

Isc > If(2 s)

- **… Withstanding the continuous operating current together with possible overloads**

In order to achieve this, the fuse's rated current must be over 1.4 times the transformer's rated current.

In fuse > 1.4 In transfo.

Choice of rating
In order to correctly select the fuse's rated current to protect a transformer, we have to know and take account of:
- **The transformer characteristics:**
  - power (P in kVA)
  - short circuit voltage (Usc in %)
  - rated current.
- **The fuse characteristics:**
  - time/current characteristics (If 0.1 s and If 2 s)
  - the minimum rated breaking current (I3).
- **The installation and operating conditions:**
  - open air, cubicle or fuse chamber
  - presence or otherwise of permanent overload
  - short circuit current in the installation
  - indoor or outdoor usage.

Comment: whether used in Schneider Electric's SM6, RM6, CAS 36 or in a device from another manufacturer, the equipment manufacturer's own user's instructions must be referred to when choosing the fuse.

Selection and usage guide
Transformer protection
Selection table

Fusarc CF fuses DIN standard for transformer protection (rating in A) (1) (2) (3)
Table no. 6

Operating voltage (kV)	Rated voltage (kV)	Transformer power (kVA)																
		25	**50**	**75**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**
3	7.2	16 **20** 25	25 **31.5** 40	31.5 **40** 50	40 **50** 63	50 **63** 80	63 **80** 100	63 **80** 100	80 **100**	**100** 125	**125** 160	**125** 160	**160**	**200**	**250**			
5	7.2	**10** 16	16 **20** 25	25 **31.5** 40	31.5 **40** 50	31.5 **40** 50	40 **50** 63	50 **63** 80	63 **80** 100	63 **80** 100	80 **100**	**100** 125	**125** 160	**125** 160	**160**	**200**	**250**	
6	7.2	6.3 **10**	16 **20** 25	20 **25** 31.5	25 **31.5** 40	31.5 **40** 50	40 **50** 63	40 **50** 63	50 **63** 80	63 **80** 100	63 **80** 100	80 **100**	**100** 125	**125**	**125**	**160**	**200**	**250**
6.6	7.2	6.3 **10**	16 **20** 25	20 **25** 31.5	25 **31.5** 40	25 **31.5** 40	31.5 **40** 50	40 **50** 63	50 **63** 80	50 **63** 80	63 **80** 100	80 **100**	**100** 125	**125**	**125**	**160**	**200**	**250**
10	12	**6.3**	**10** 16	**16** 20	16 **20** 25	20 **25** 31.5	25 **31.5** 40	31.5 **40** 50	31.5 **40** 50	40 **50** 63	50 **63** 80	63 **80** 100	63 **80** 100	**80** 100	**100** 125	**125**	**125**	**160**
11	12	**6.3**	**10**	10 **16** 20	16 **20** 25	20 **25** 31.5	25 **31.5** 40	25 **31.5** 40	31.5 **40** 50	40 **50** 63	50 **63** 80	50 **63** 80	63 **80** 100	**80** 100	**100** 125	**125**	**125**	**160**
13.2	17.5	**4**	6.3 **10**	10 **16**	16 **20** 25	16 **20** 25	20 **25** 31.5	25 **31.5** 40	25 **31.5** 40	31.5 **40** 50	40 **50** 63	50 **63** 80	50 **63** 80	63 **80** 100	**80** 100	**100**		
13.8	17.5	**4**	6.3 **10**	10 **16**	10 **16** 20	16 **20** 25	20 **25** 31.5	25 **31.5** 40	25 **31.5** 40	31.5 **40** 50	40 **50** 63	50 **63** 80	50 **63** 80	63 **80** 100	**80** 100	**100**	**100**	
15	17.5	**4**	**6.3** 10	**10** 16	10 **16** 20	16 **20** 25	16 **20** 25	**25** 31.5	25 **31.5** 40	31.5 **40** 50	40 **50** 63	40 **50** 63	50 **63** 80	63 **80**	63 **80** 100	80 **100**	**100**	**100**
20	24		**6.3**	6.3 **10**	**10** 16	10 **16** 20	16 **20** 25	16 **20** 25	20 **25** 31.5	25 **31.5** 40	31.5 **40** 50	31.5 **40** 50	40 **50** 63	50 **63**	**63** 80	63 **80** 100	**80** 100	**100**
22	24		**6.3**	**6.3** 10	**10**	10 **16**	10 **16** 20	16 **20** 25	20 **25** 31.5	25 **31.5** 40	25 **31.5** 40	31.5 **40** 50	40 **50** 63	40 **50** 63	50 **63** 80	63 **80** 100	**80** 100	**100**
25	36		**4**	**6.3**	6.3 **10**	**10** 10	10 **16** 20	16 **20** 25	16 **20** 25	**25** 31.5	25 **31.5** 40	31.5 **40** 50	40 **50** 63	40 **50** 63	50 **63**	**63**	**63**	
30	36		**4**	**6.3**	**6.3** 10	6.3 **10**	**10** 16	10 **16** 20	16 **20** 25	16 **20** 25	**25** 31.5	25 **31.5** 40	31.5 **40** 50	31.5 **40** 50	40 **50** 63	50 **63**	**63**	**63**

Soléfuse fuses UTE standard for transformer protection (rating in A) (1) (2) (3)
Table no. 7

Operating voltage (kV)	Rated voltage (kV)	Transformer power (kVA)														
		25	**50**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**
3	7.2	**16**	**16**	**31.5**	**63**	**63**	**63**	**80**	**100**	**100**	**125**					
3.3	7.2	**16**	**16**	**31.5**	**31.5**	**63**	**63**	**80**	**80**	**100**	**125**					
4.16	7.2	**6.3**	**16**	**31.5**	**31.5**	**31.5**	**63**	**63**	**80**	**80**	**100**	**125**				
5.5	7.2	**6.3**	**16**	**16**	**31.5**	**31.5**	**31.5**	**63**	**63**	**63**	**80**	**100**	**125**			
6	7.2	**6.3**	**16**	**16**	**31.5**	**31.5**	**31.5**	**63**	**63**	**63**	**80**	**100**	**100**	**125**		
6.6	7.2	**6.3**	**16**	**16**	**16**	**31.5**	**31.5**	**31.5**	**63**	**63**	**80**	**80**	**100**	**125**		
10	12	**6.3**	**6.3**	**16**	**16**	**16**	**31.5**	**31.5**	**31.5**	**43**	**43**	**63**	**80**	**80**	**100**	
11	12	**6.3**	**6.3**	**16**	**16**	**16**	**16**	**31.5**	**31.5**	**31.5**	**43**	**63**	**63**	**80**	**100**	
13.8	17.5/24	**6.3**	**6.3**	**16**	**16**	**16**	**16**	**16**	**31.5**	**31.5**	**31.5**	**43**	**63**	**63**	**80**	
15	17.5/24	**6.3**	**6.3**	**16**	**16**	**16**	**16**	**16**	**31.5**	**31.5**	**31.5**	**43**	**43**	**63**	**80**	**80**
20	24	**6.3**	**6.3**	**6.3**	**6.3**	**16**	**16**	**16**	**16**	**31.5**	**31.5**	**43**	**43**	**43**	**63**	
22	24	**6.3**	**6.3**	**6.3**	**6.3**	**16**	**16**	**16**	**16**	**16**	**31.5**	**31.5**	**31.5**	**43**	**43**	**63**
30	36			**6.3**	**6.3**	**6.3**	**16**	**16**	**16**	**16**	**16**	**31.5**	**31.5**	**31.5**		

(1) Fuse ratings correspond to open air installation with a transformer overload of 30%. or to an indoor installation without transformer overload.
(2) If the fuse is incorporated in a distribution switchboard. please refer to the selection table provided by the manufacturer of this device.
(3) although the ratings shown in bold type are the most appropriate. the others also protect transformers in a satisfactory manner.

Selection and usage guide
Motor protection

Fusarc CF selection for motor protection
Table no. 8

Maximum operating voltage (kV)	Start-up current (A)	Start-up time (s) 5		10		20	
		Number of start-ups per hour 6	12	6	12	6	12
3.3	1410	250					
	1290	250	250	250			
	1140	250	250	250	250	250	250
	1030	250	250	250	250	250	250
	890	250	250	250	250	250	250
	790	200	250	250	250	250	250
	710	200	200	200	250	250	250
	640	200	200	200	200	200	250
6.6	610	200	200	200	200	200	200
	540	160	160	160	200	200	200
	480	160	160	160	200	200	200
	440	160	160	160	160	160	200
	310	160	160	160	160	160	160
	280	125	160	160	160	160	160
	250	125	125	125	160	160	160
	240	125	125	125	125	125	160
	230	125	125	125	125	125	125
	210	100	125	125	125	125	125
	180	100	100	100	100	100	125
11	170	100	100	100	100	100	100
	160	100	100	100	100	100	100
	148	80	100	100	100	100	100
	133	80	80	80	100	100	100
	120	80	80	80	80	80	100
	110	80	80	80	80	80	80
	98	63	80	80	80	80	80
	88	63	63	63	63	80	80
	83	63	63	63	63	63	80
	73	50	63	63	63	63	63
	67	50	50	50	63	63	63
	62	50	50	50	50	50	63
	57	50	50	50	50	50	50

Motor protection
When combined with a contactor, fuses provide a particularly effective protection system for an MV motor.
The specific stresses that fuses have to withstand are due to:
- The motor to be protected
- The network on which it is placed.

Stresses due to the motor
- The start-up current (Id).
- The start-up duration (Td).
- The number of successive start-ups.
- When the motor is energised, and throughout the start-up period, the impedance of a motor is such that it consumes a current Id which is significantly greater than the rated load current In. Normally, this current Id is around 6 times the rated current, (Id/In = 6).
- The start-up duration Td depends on the type of load that is being driven by the motor. It is of around ten seconds.
- We also have to take account of the possibility of several successive start-ups in choosing the fuse rating.

Stresses related to the network
- The rated voltage: the rated voltage for MV motors is at most equal to 11 kV.
- The limited broken current: networks with MV motors are generally high installed power networks with very high short circuit currents.

Choice of rating
The fuse rating chosen depends on three parameters:
- The start-up current
- The duration
- The start-up frequency.

Selection and usage guide
Motor protection
Selection charts

η = motor efficiency

Ua = rated motor voltage

Id = start up current

Td = start up time

The three charts given below enable the fuse rating to be determined when we know the motor power (P in kW) and its rated voltage (Ua in kV).
Chart 1: this gives the rated current In (A) according to P and Ua.
Chart 2: this gives the start-up current Id (A) according to In (A).
Chart 3: this gives the appropriate rating according Id and the start-up duration time td (s).

Comments
Chart 1 is plotted for a power factor of 0.92 and an efficiency of 0.94.
For values different to this, use the following equation: $In = \frac{P}{n\sqrt{3}\,Ua\,.\,p.f.}$

- chart 3 is given in the case of 6 start-ups spread over an hour or 2 successive startups .
- For n successive start-ups (n > 6), multiply td by $\frac{n}{6}$

For p successive start-ups (p > 2), multiply td by $\frac{p}{2}$ (see selection table)
In the absence of any information, take td = 10 s.
- if the motor start-up is not direct, the rating obtained using the charts below may be less than the full load current of the motor. In this case, we have to choose a rating 20% over the value of this current, to take account of the cubicle installation.

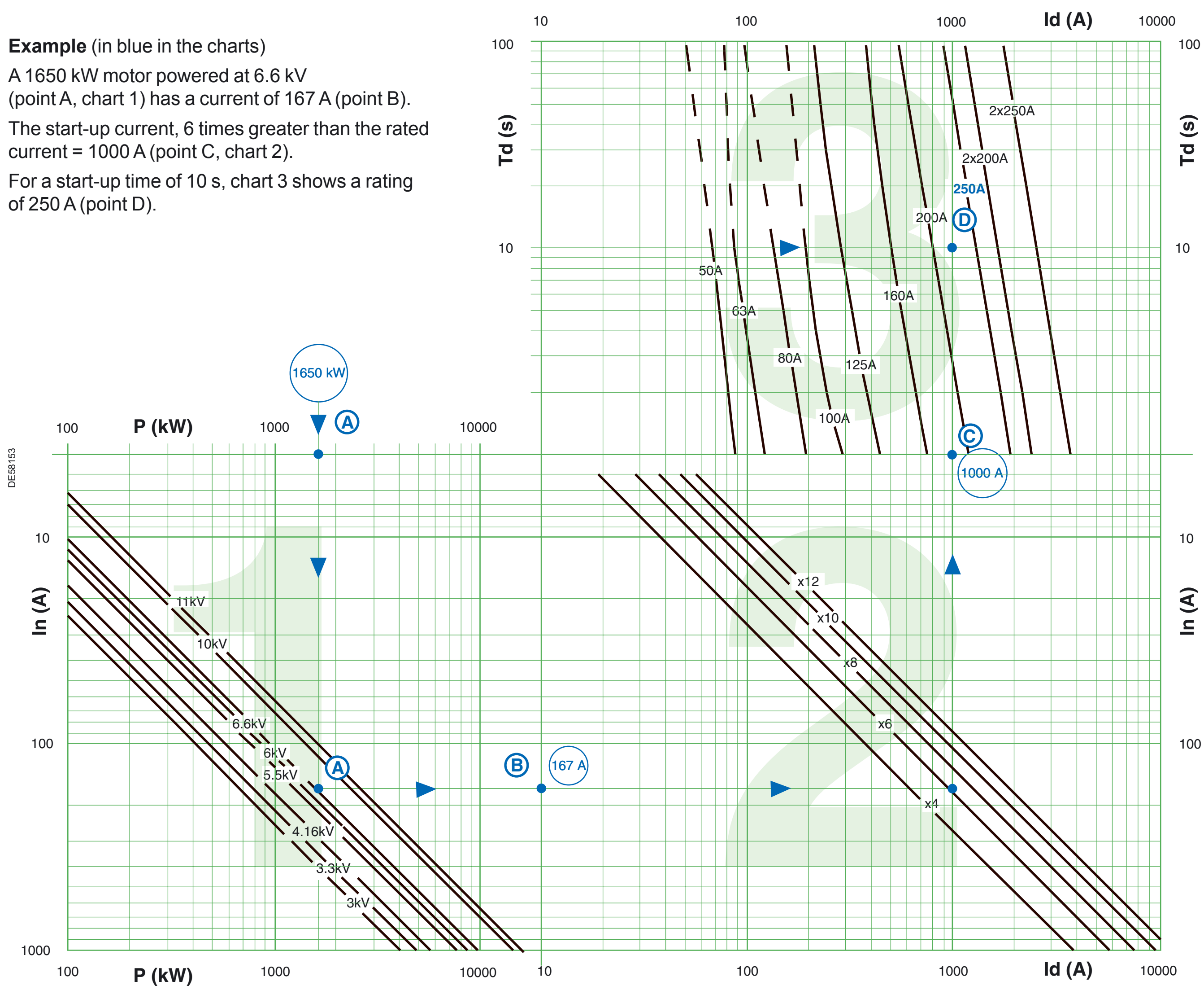
Fuses with a rating chosen using these charts will satisfy fuse ageing tests according to recommendations in IEC 60644.

Example (in blue in the charts)

A 1650 kW motor powered at 6.6 kV (point A, chart 1) has a current of 167 A (point B).

The start-up current, 6 times greater than the rated current = 1000 A (point C, chart 2).

For a start-up time of 10 s, chart 3 shows a rating of 250 A (point D).



Capacitor bank protection

Fuses intended to protect capacitor banks have to withstand special voltages:
- When the bank is energised, the inrush current is very high and can lead to premature ageing or fusion of the fuse element
- In service, the presence of harmonics can lead to excessive temperature rise.

Choice of rating
A common rule applied to any switchgear in the presence of capacitor banks is to derate the rated current by 30 to 40% due to the harmonics which cause additional temperature rise.
It is recommended to apply a coefficient of between 1.7 and 1.9 to the capacitive current in order to obtain the appropriate fuse rating, i.e. 1.7 or 1.9 times the rated current of the bank.
As for transformers, it is necessary to know the rms inrush current value and its duration.

Comments on substituting fuses

In accordance with recommendation in IEC 60282-1 (Application guide):
« it is recommended to replace all three fuses in a three-phase circuit when one of them has already blown, unless we are certain that there has been no overcurrent in the fuses which have not blown ».

Moreover, in this guide, we can find several basic recommendations for the correct use of this type of fuse.

It is important to take account of the fact that the striker only acts when all of the fuse elements have blown. However, if the striker has not been activated, this does not mean that the fuses have not been subject to an overcurrent.

Order form

Only one of the boxes (ticked [X] or filled [ ] by the needed value) have to be considered between each horizontal line.

Fuses

Quantity [ ]

Electrical characteristics

Rated voltage		**(kV)**	[ ]
Operating voltage		**(kV)**	[ ]
Rated current		**(A)**	[ ]
Power	Transformer [ ] Motor [ ]	**(kVA)**	[ ]

Dimensions

Fuse length	**(mm)**	[ ]
Cap diameter	**(mm)**	[ ]

Other characteristics

Operating conditions

Open air [ ] Cubicle [ ] Fuse chamber [ ] Other [ ]

Standards	[ ]
Reference	[ ]

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