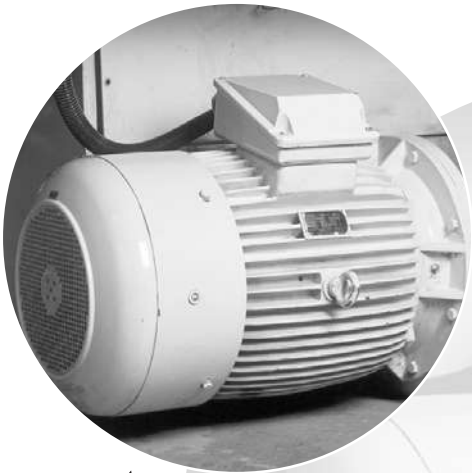
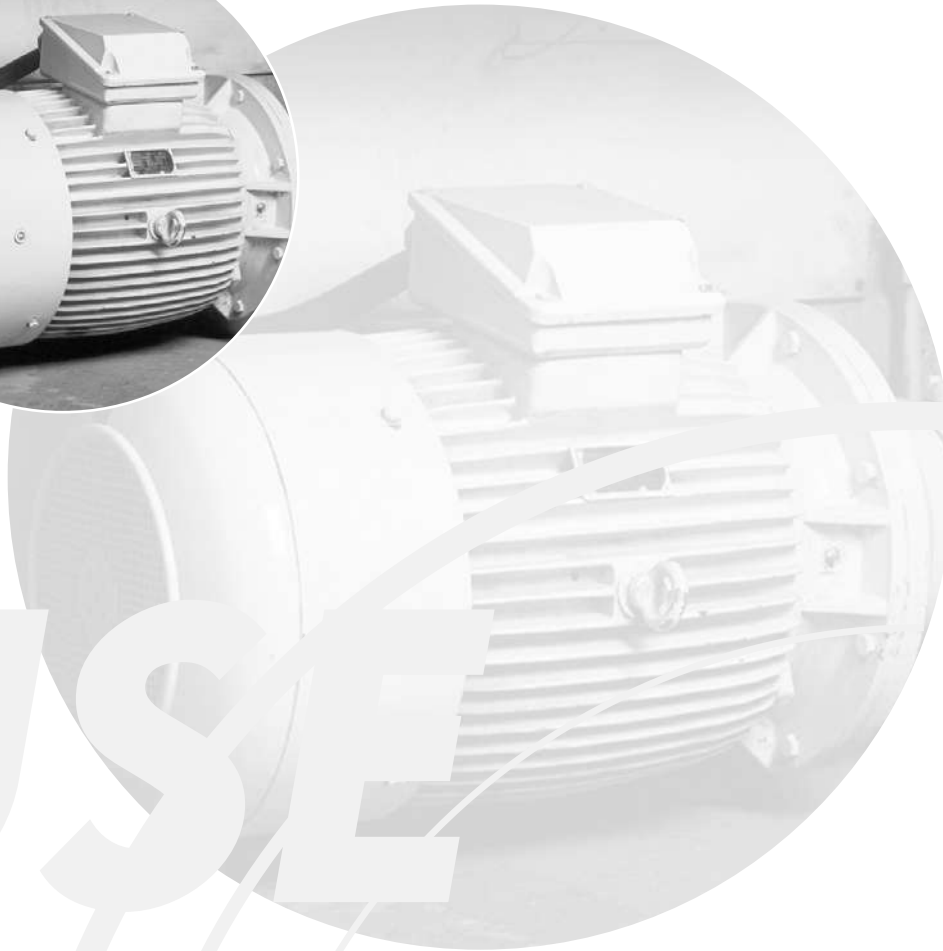


# Motor Circuit Protection ...using Medium Voltage fuses



Legend ▶



The use of MV current-limiting fuses as Back-Up protection for contactor operated motor control equipment provides more effective overall protection and at lower cost than many earlier forms of non-fused protection devices.

In particular, the current-limiting effect of the fuses limits possible damage under severe fault conditions and virtually eliminates risk of motor terminal box explosion. The current-limiting effect also makes it possible to size interconnecting cable on the basis of load current capability alone rather than necessary ability to survive short circuit faults.

Published by



## The intrinsic advantages of the fuse technology

Fuse protection is a proven technology for tomorrow's systems. It is a component of high technology, adaptable for numerous applications, in all areas of industry and at all levels of an installation. Fuselinks have many unique performance characteristics:

### Optimum Component Protection

They reduce short circuit currents that flow to a low value by "current limitation". There is no need for complex short circuit calculations and no concerns about costly future upgrades due to system expansion with increased fault currents. Their compact size offers low cost overcurrent protection for the highest short circuit levels.

### Safety

No emission of gas, flames, arcs or other materials when clearing any value of overcurrent up to the highest level of short circuit. In addition, the speed of operation on high short circuit currents limits significantly the flash hazard at the fault location.

### Reliability

No moving parts to wear out or become contaminated by dust, oil or corrosion and no nuisance tripping. If a fault occurs, the fuselink immediately operates in its predetermined manner or co-ordinates with other circuit components. The cause of the fault is then ascertained, corrected and a new fuselink fitted. Fuse replacement ensures protection is restored to its original state of integrity. It should be stressed that the time taken for the replacement is very small in relation to the fault correction.

### Simple Co-ordination

Standardised fuselink characteristics and a high degree of current limitation ensure that there is simple and effective co-ordination between fuselinks and with other devices.

## The state-of-the art solution

The control equipment will be designed such that low over-load currents are cleared by the relay and contactor while short circuit faults are cleared by the fuses alone. The contactor thus has no high breaking capacity requirements and can be designed for long life under repetitive starting conditions.

In some designs of equipment, tripping of the contactor can also be initiated by an instantaneous earth fault relay and/or by the action of striker pins fitted to the fuses. Because of the nature of their application, MV fuses normally have an appreciably higher current rating than the full load current of the motor in question.

The MV fuses designed for such applications are similar to those for more general use but are usually of higher current rating (up to 630A or more) and have lower voltage ratings (o.k. -7.2 kV) as compared to fuses for distribution system protection. Motor fuses thus have a larger number of thicker fuse elements in parallel and these are strung end-to-end within the fuse instead of being wound helically on a ceramic former.

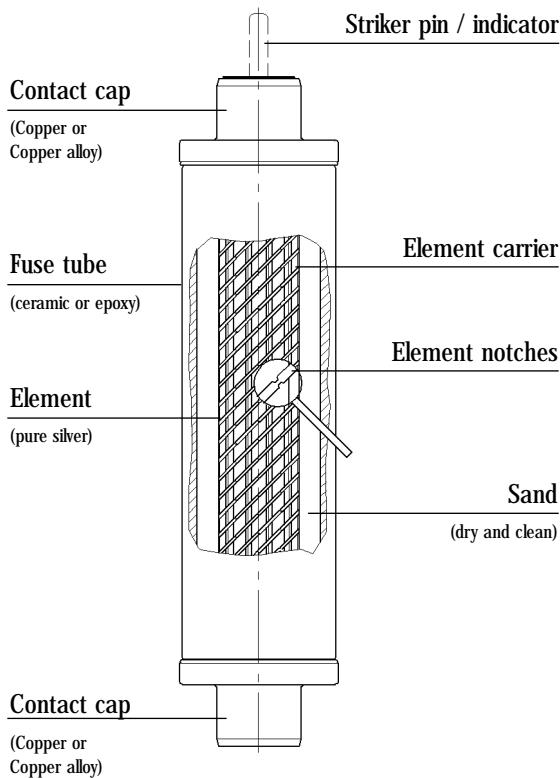
In order to cope safely with motor starting surge currents, these fuses have specially designed elements which have corrugations along their length to spread out any thermal stresses due to these surges.

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## Equipment & standards

Motor circuit MV fuses are available in standardised BS, DIN and North American dimensions. For protection of very large motors, it is common to parallel sets of two or even more fuses per phase where these can be accommodated within the control cubicle. Note that in such cases, due to proximity heating effects, the combined current rating of two or more fuses will be less than the sum of their individual ratings.

# Choosing the right fuse



The choice of correct fuse for a given motor starting duty is fairly straightforward:

- The size of motor and its control circuitry will have fixed the value of load current and the value and duration of the starting current.
- The time current characteristic of the required fuse must lie well to the right of the point represented by the motor starting current at its maximum run-up time. Most fuse manufacturers specify a substantial margin at this point to allow for manufacturing tolerances and repetitive starting duties
- The current corresponding to the point of intersection of the time-current characteristics of the fuse and over current relay should be less than the switching limit of the contactor.
- The rated minimum breaking current of the fuse should be less than the above value.
- The cut-off current and Joule integral energy values for the fuse should be lower than the relevant withstand values for the contactor.

- Check that the withstand curve for any cable connecting control cubicle and motor lies to the right of the combined time-current characteristic for fuse and over current relay. Where long run-up times and/or frequent starting duty necessitate a larger current rating of fuse, there may have to be an appropriate increase in cable size.
- Even where direct-on-line starting is not employed and surge currents are reduced, there should still be a reasonable margin between full load current and fuse current rating to allow for thermal de-rating in the control cubicle. In general, a margin of 125% may be considered appropriate.
- In applications where there is likely to be frequent starting and stopping of the motor (e.g. steel mills factory machinery) additional allowance may have to be made when sizing the fuse. This is to avoid cumulative heating effects on the fuse elements from closely spaced successive starts.

The electrical characteristics of MV motor circuit fuses are not standardised. However guidance on preferred characteristics are given in ICE standard 60644. Other relevant standards dealing with this type of equipment are:

- IEC 60282-1 high voltage current limiting fuses
- IEC 60470 high voltage AC contactors and motor starters

Most fuse manufacturers give detailed applications data for their own products. Again, there is no standardised method of displaying such information. Data may be in the form of formulae, graphs, histograms etc.

Where information on service conditions is lacking, the following rules of thumb may be applied:

- Starting current (direct on line): 6 x full load current
- Duration of starting current: 10 seconds.
- Frequency of starts: 2 starts per hour maximum.

Do you wish to know the european suppliers? To find the right product for your application? Do you need help from our experts? See page 4 ▶



PRO FUSE INTERNATIONAL is an association of renowned manufacturers of either fuses or fuse-based equipment. The association currently consists of more than twenty members from most European countries. The primary objective is to promote the use and value of a wide range of products, which use fuses as a protective device. Indeed, there are many aspects of a fuse which are of significant benefit to the user, and these may be grouped under the general headings of SAFETY, RELIABILITY and ECONOMY. It is the intention of the Association to expand upon each of these headings in the future publications. They will be relevant, educational and meaningful to all people, from students to consultants and from small contractors to end-users.

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The ProFuse International Website aims to be a key learning resource and information hub on fuse technology. It contributes to:

- Keeping users updated
- Advising and helping
- Informing and spreading information
- Sharing news of technical developments as they occur, highlighting the user benefits arising from these developments.

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