R&D Engineering Note: Recommendations for Circuit Breakers and Fuses

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Author	G.Zammit
Checked	C.Camilleri
Approved	G. Zammit
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1) Recommended Protective Devices

All Seifert units have a recommended fuse rating specified on the instruction manual and on the type plate. This fuse rating is valid for the following types of protective devices:

1. Time-Lag Fuses according to IEC 60127, IEC 60269 or UL 248
2. Circuit Breakers with tripping characteristic D according to IEC 60898-1
3. Circuit Breakers with tripping characteristic K according to IEC 60947-2

Any other type of protective device might cause nuisance tripping during operation. In such cases the recommendations in this document must be adhered to limit such scenarios.

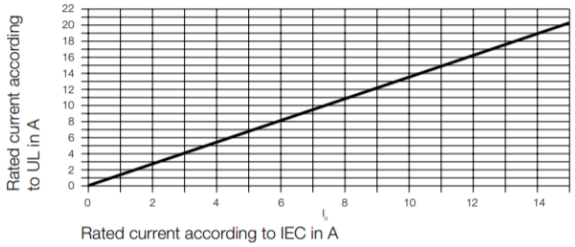
2) Selection Criteria

The parameters to consider for the selection of a protective device are the following:

a) Nominal Current

The nominal current (I_n) of the protective device must correspond to the operating current of the equipment to be protected. The nominal current is defined as follows:

1. On fuse-links according to IEC the nominal current corresponds to the current, which the fuse-link can be exposed to continually, according to the standardized regulations, without interrupting the fuse-link.
2. On fuse-links according to UL 248 however, the nominal current corresponds to the current, which would interrupt the fuse-link already after a few hours. The current, which according to IEC, can flow constantly without interrupting the fuse-link, is approx. 0.7 I_n.



When selecting a protective device, the nominal current as defined in IEC standards should be equal to or more (but not exceeding 175% of the stated maximum current) than the recommended fuse rating. In general Seifert Systems recommends fuses 167% larger than the maximum current of the unit. In case where a protective device with the exact nominal current rating cannot be found, then the next larger one can be used if within the allowed range. If this is also not available or if it is deemed to be unsuitable (for installation purposes) the next smaller size can be used. The protective device must also be rated to operate at the unit's voltage.

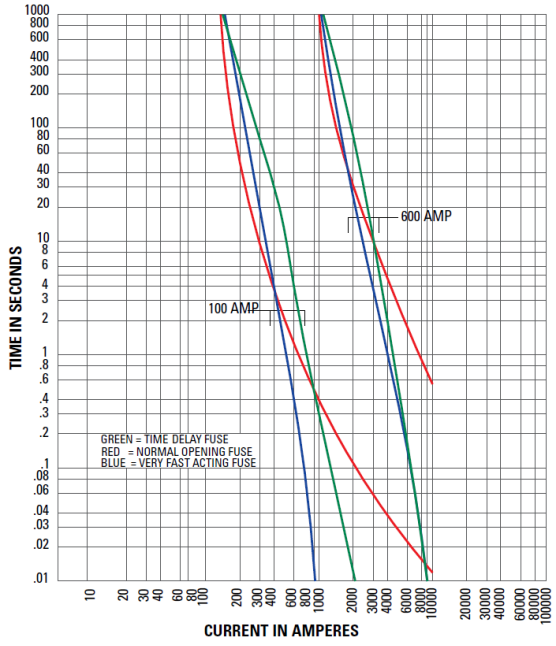
b) Instantaneous and Delayed Trip Curve

The standards for fuses and for circuit breakers define the instantaneous tripping current range and the allowed delay range to trip expressed as multiples of the nominal rated current.

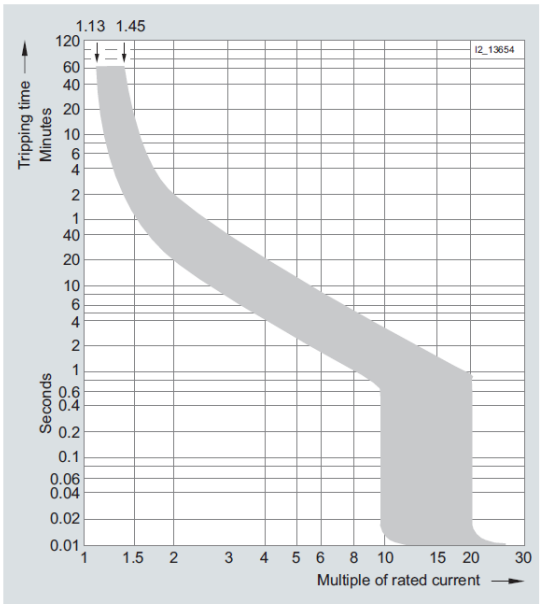
To avoid nuisance tripping the selected protective device must meet the following criteria:

- Instantaneous tripping current: >12 x I_n, where I_n is the nominal current rating, for units without transformer (refer to the unit's circuit diagram).
- Instantaneous tripping current: >120 A and >12 x I_n, where I_n is the nominal current rating, for units having a transformer (refer to the unit's circuit diagram).
- Time delay for tripping current: >12sec @ 2 x I_n

This information is provided by the device manufacturer in the form of a time-current chart as shown below. The instantaneous trip current is that at which the curve meets the horizontal axis at time zero. In the case of a circuit breaker a tripping range is given within which tripping can occur. On the chart this is either depicted as a shaded area or by a minimum and maximum border line.



Fuse Tripping Curve



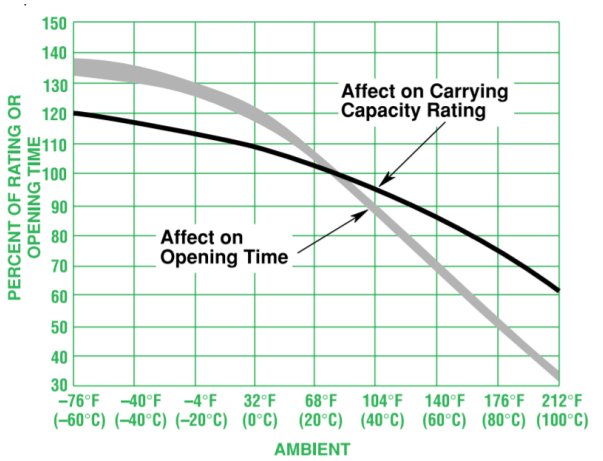
Tripping characteristic D

Circuit Breaker Tripping Curve

NOTE on US type fuses: Generally, class CC fuses can be used for units without transformers. For units with transformers (check unit's circuit diagram) class CC fuses can trip on first power up due to high transformer in-rush current, hence class RK5 fuses are recommended.

c) Operating Temperature and de-rating

The manufacturer of a protective device will provide a temperature de-rating curve/table so that the proper corrections are made when selecting the device, an example of such a chart is shown below.



The device's corrected nominal current rating must match (as described above) the recommended fuse rating at the temperature it would be operating at. Generally, manufacturers rate the device at an ambient temperature of 25°C/77°F. If the ambient air temperature in which the device is installed is lower than the rating temperature, then a device with a lower nominal current rating could be used while if the temperature will be higher a device with a higher rating would be needed.

Also important to considerer is that fuse characteristics might change by time after many operating cycles, especially at high levels of current, voltage and temperature. Hence a fuse that worked perfectly for a prolonged period of time and for a high number of on-off compressor cycles might blow without any apparent reason.

In case of doubt consult the device manufacturer to apply the proper correction factors.