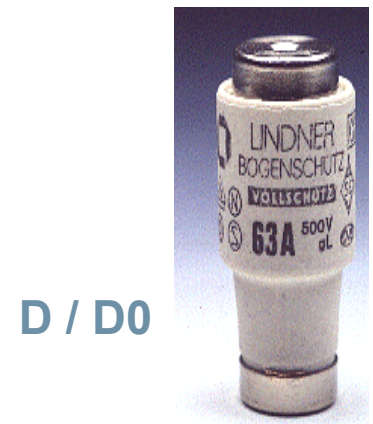
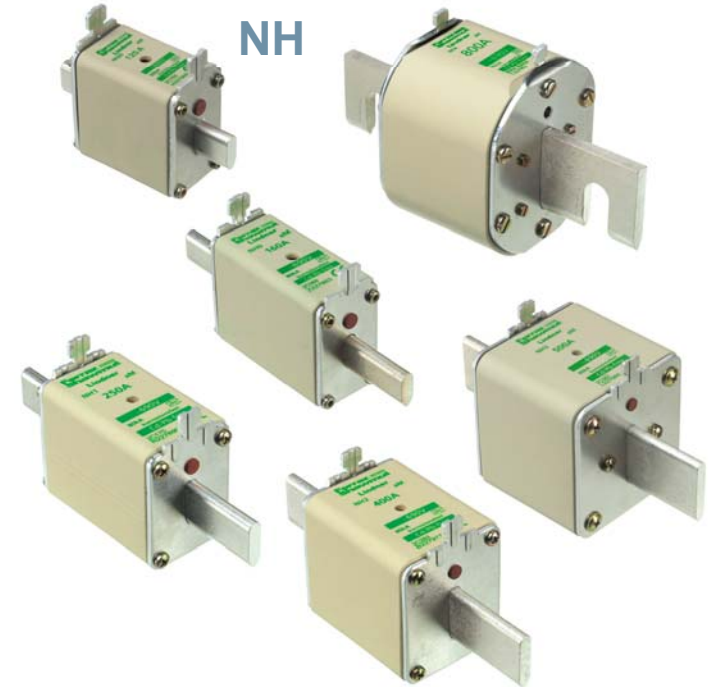
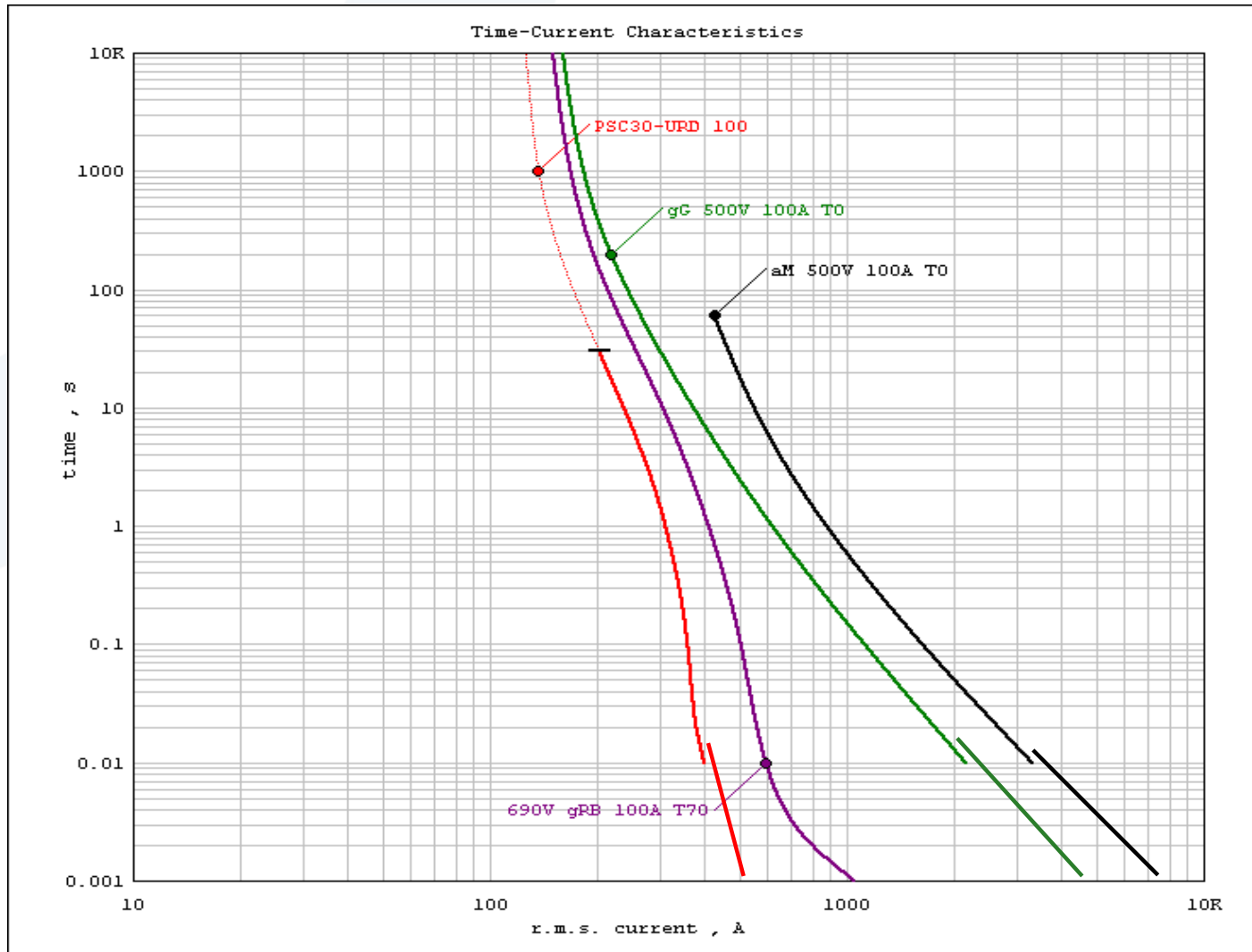


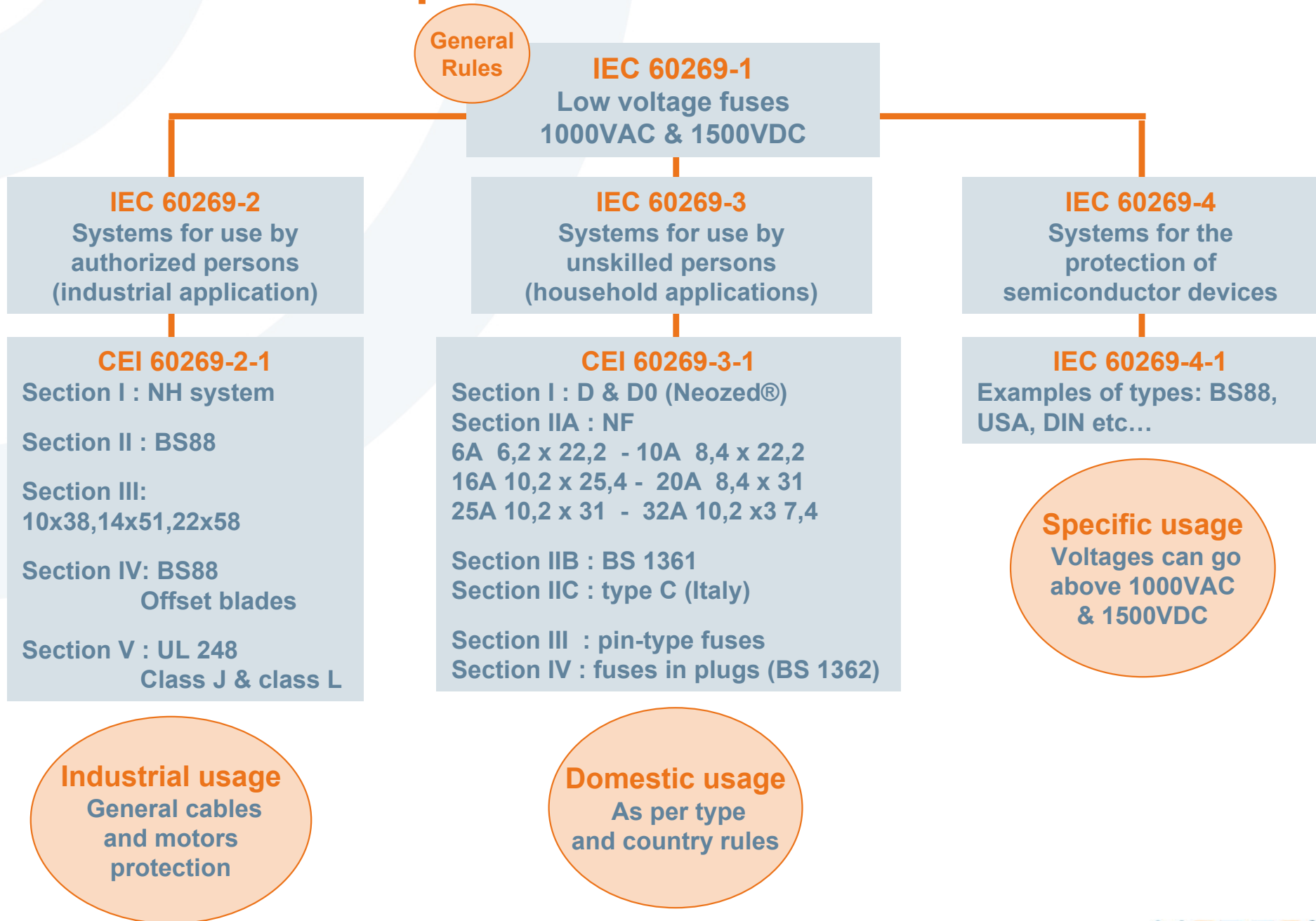
IEC 60269 gG & aM standard Low Voltage Fuses



Comparison of fuse type URD, gRB, gG, aM



Interruption to IEC 60269 standard



Fuse application

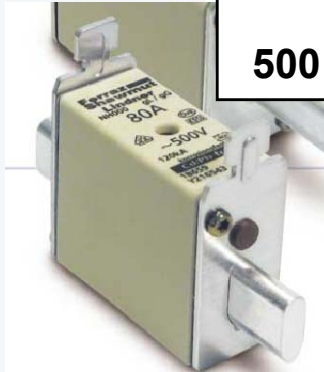
Type	Applications	Breaking Range
aM	Short circuit protection of motor circuits	Partial range (back-up)
aR	Semiconductor protection	
gG	General purpose: mainly conductor protection	Full range
gM	Motor circuit protection	
gN	North American general purpose for conductor protection	
gD	North American general purpose time-delay	
gR, gS	Semiconductor protection	
gTr	Transformer protection	
gL, gF, gI, gII	Former type of fuses replaced by gG type	

Fuse application

BS 88
415 V gG 63 A



NH
500 V gG 63 A



D Type (DIAZED)
500 V gG 63 A



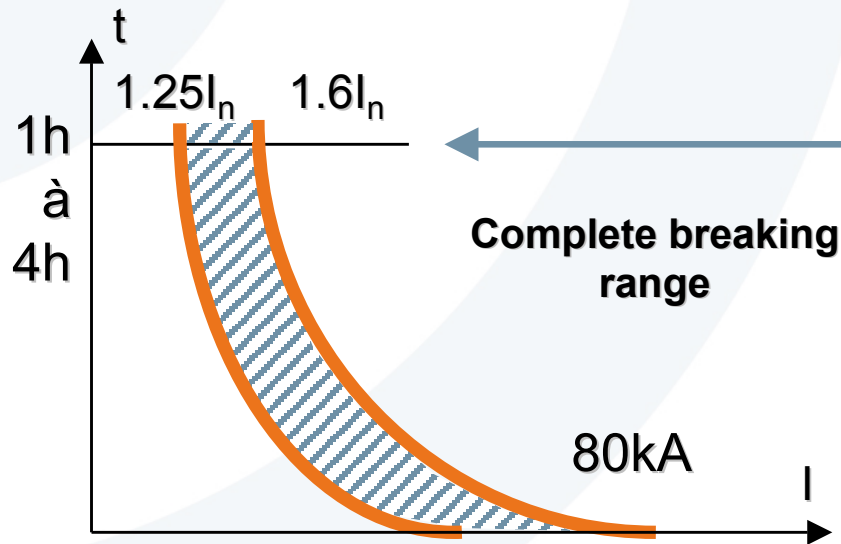
A gG fuse made in any technology can be replaced by another gG fuse from another technology because they have the **same electrical data**:

Time current curve must go between gates **defined by IEC60269** (see next slides)

Max I^2t is **defined by IEC 60269** etc...

However it is absolutely necessary to check the voltage and the breaking capacity of the new fuse are not lower than the values of the other fuses or at least fit with the circuit requirement.

gG Time current curves as per IEC 60269 definition



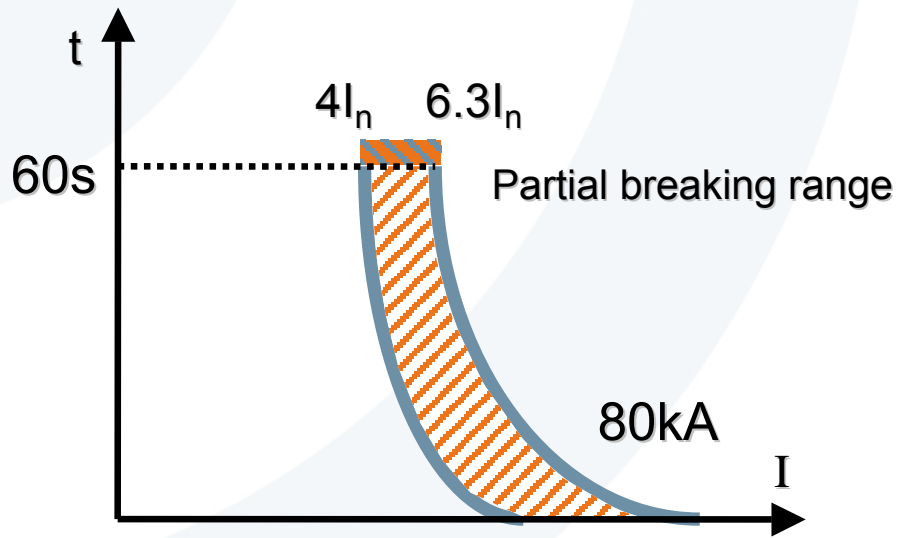
Conventional time: 1h to 4h (values versus fuse rating)

“gG”: Protection against all overloads.

Gates (for some ratings) defined by IEC 60269:

Fuse rating (A)	I _{mini} at 10s (A)	I _{max} at 5s (A)	I _{mini} at 0.1s (A)	I _{max} at 0.1s (A)
25	52	110	150	260
80	215	425	610	1100
250	750	1650	2590	4500
800	3060	7000	10600	19000
1250	5000	13000	19000	35000

aM Time current curves as per IEC 60269 definition



“aM”: Protection against short circuit current.

Gates for any current rating I_n

Current	tmini (s)	tmax (s)
4 I_n	60	
6.3 I_n		60
8 I_n	0.5	
10 I_n	0.2	
12.5 I_n		0.5
19 I_n		0.1

Protection level

Protection coordination IEC 60947

IEC 60947- 4 - 1 belongs to:

- Contactors et motor-starters
- Electromechanical contactors et motor-starters § 8.2.5.1.: Performance under short circuits conditions

In this paragraph coordination types are defined as follows:

- **Type 1 coordination:**

type 1 coordination requires that, under short circuit conditions, the contactor or starter shall cause no danger to persons or installations and may not be suitable for further service without repair and replacement of parts.

- **Type 2 coordination:**

type 2 coordination requires that, under short circuit conditions, the contactor or starter shall cause no danger to persons or installations and shall be suitable for further use. The risk of contact welding is recognized, in which case the manufacturer shall indicate the measures to be taken as regards the maintenance of the equipment.

Selection of the fuse voltage rating U_N For conductor and motor protection

Voltage is the most critical parameter. Any fuse selection must start by the choice of the voltage rating V_N of the fuse. The maximum voltage of the circuit $V_{\text{circuit max}}$ (this is the rated voltage + variation) must be lower than the maximal operational voltage of the fuse $V_{\text{fuse max}}$ given in the table.

$$U_{\text{fuse max}} > V_{\text{circuit max}}$$

Example: a circuit is rated 400V \pm 15% then $V_{\text{circuit max}} = 460\text{V}$ consequently the fuse rated 500V must be used.

Fuse type	Rated Voltage U_N (V)	Maximum operational voltage (V)
gG, gM, aR, aM	230	253
	400	440
	500	550
	690	725
gN, gD (american ranges)	600	600

gG and aM fuse selection

Influence of temperature and air cooling

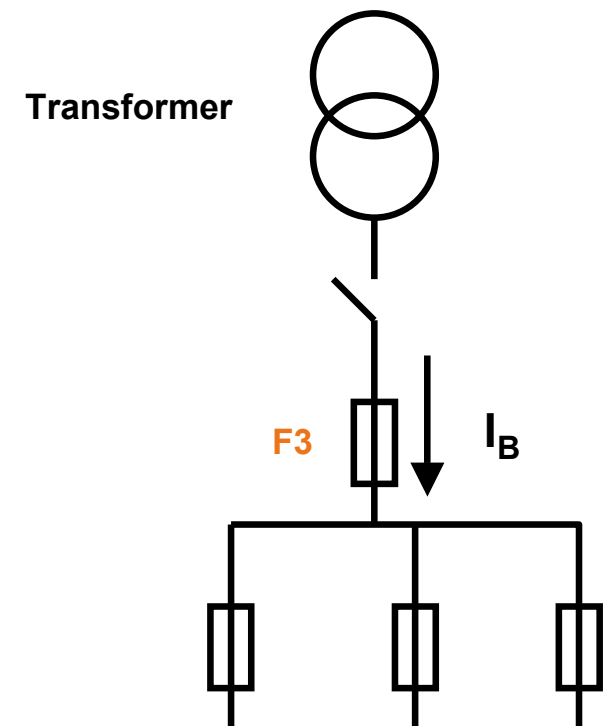
When the temperature θ_A is higher than 40°C and when there is an air cooling with air velocity V on the fuse current rating I_B is obtained from the operating current I_N as follows:

$$I_N = I_B \frac{K_\theta}{K_V}$$

The 2 coefficients are given by the 2 following tables

θ_A (°C)	K_θ
40	1
45	1.03
50	1.07
55	1.11
60	1.16
65	1.21
70	1.27

V (m / s)	K_V
0	1
1	1.05
2	1.10
3	1.15
4	1.20
5	1.25
> 5	1.25



gG fuse selection

Cables overload protection

The protection of the cable is checked with the following parameters:

I_B : working current of the cable

I_Z : maximum current carrying capacity of the cable

I_N : rated current of the fuse

I_F : conventional fusing current of the fuse

The cable is protected when the 2 following conditions are fulfilled:

$$I_B \leq I_N \leq I_Z$$

$$I_F \leq 1.45 I_Z$$

gG fuse selection

Selectivity

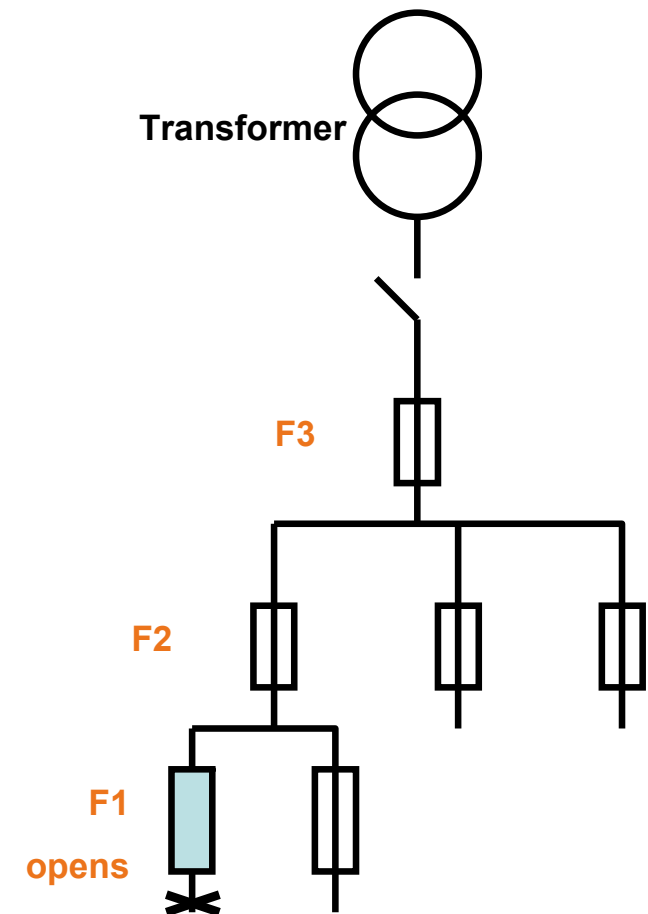
Selectivity: selectivity between gG fuse is achieved when the ratio between 2 ratings is about 1.60

Example:

F1 = 200 A

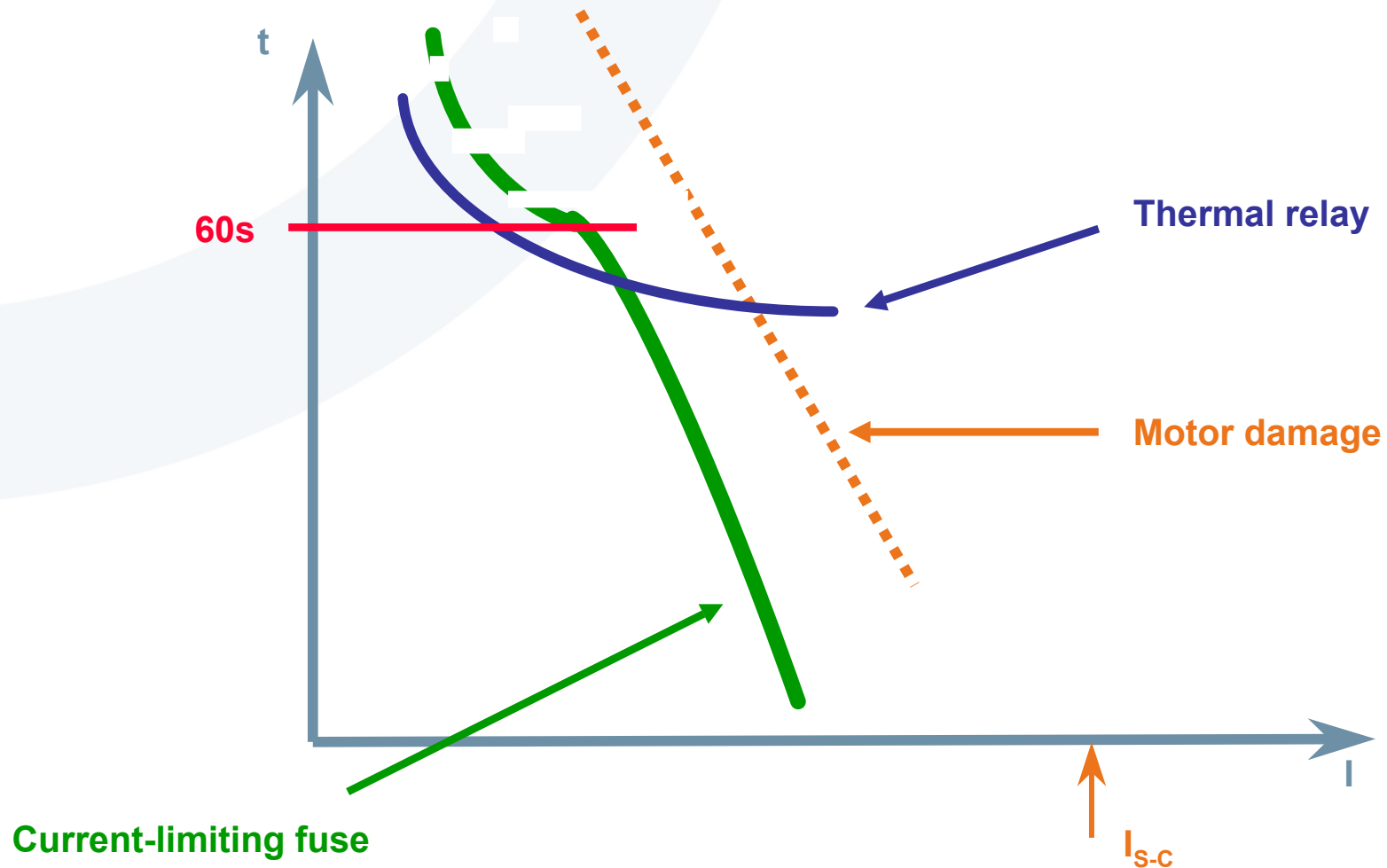
F2 = 315 A does not melt when F1 melts because $315 / 200 = 1.575$

F3 = 550 A does not melt when F2 melts because $550 / 315 = 1.746$



Motor circuit protection

The aM fuse must be associated to other protective devices because it must not operate for times above 60 seconds.



Motor circuit protection

The choice of the fuse current rating is function of:

- The rated current I_{FLA} of the motor
- The starting current of the motor and the number of starts expected during the life time of the equipment

Tables and short rules are provided to obtain easily the suitable fuse.

General recommendations for capacitor protection

The fuse selection must take into account:

- The inrush current occurring when the capacitor is switched on.
- The harmonic currents during the normal operation of the network.
- The recovery voltage across the fuse terminals after a fault interruption.