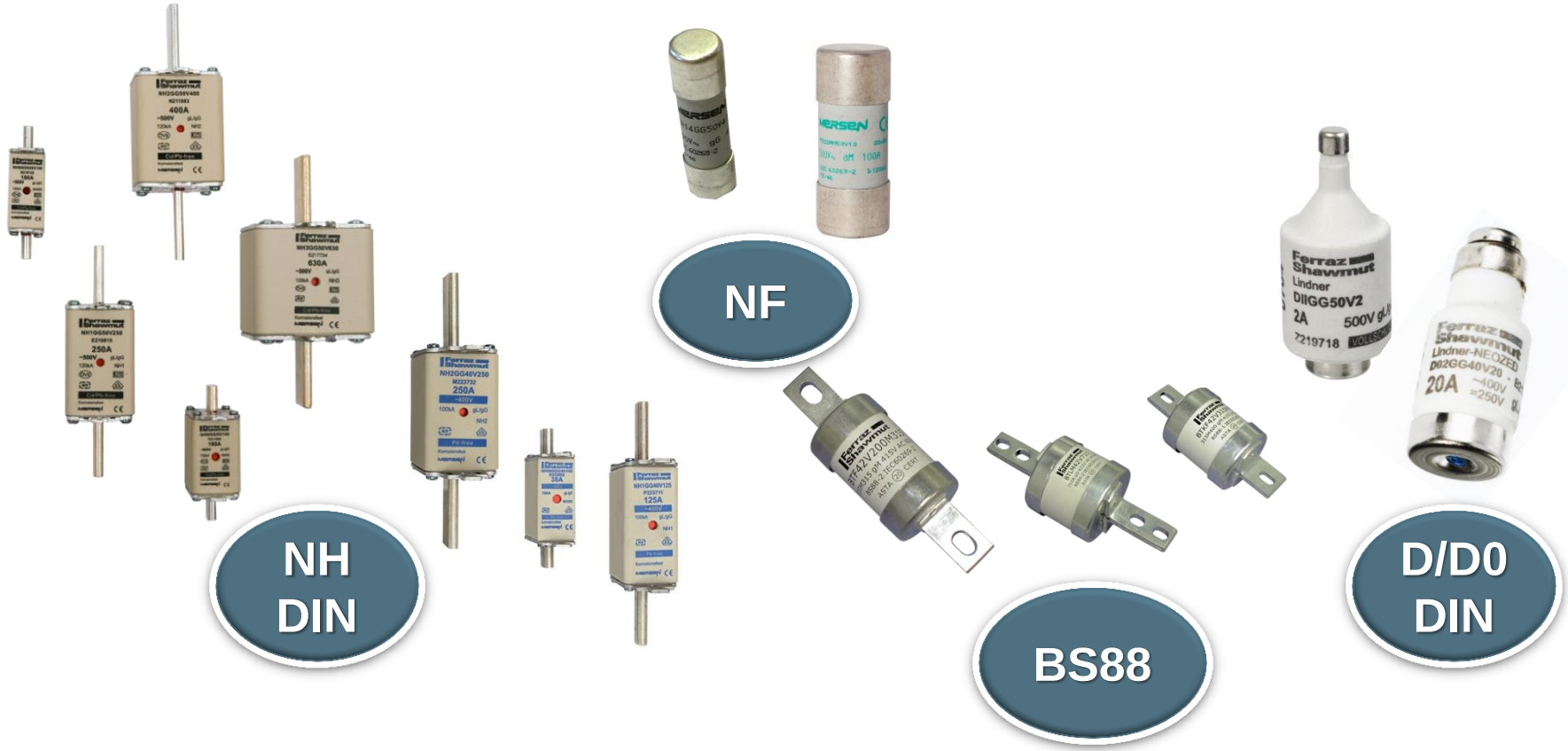
IEC 60269 gG & aM Standard

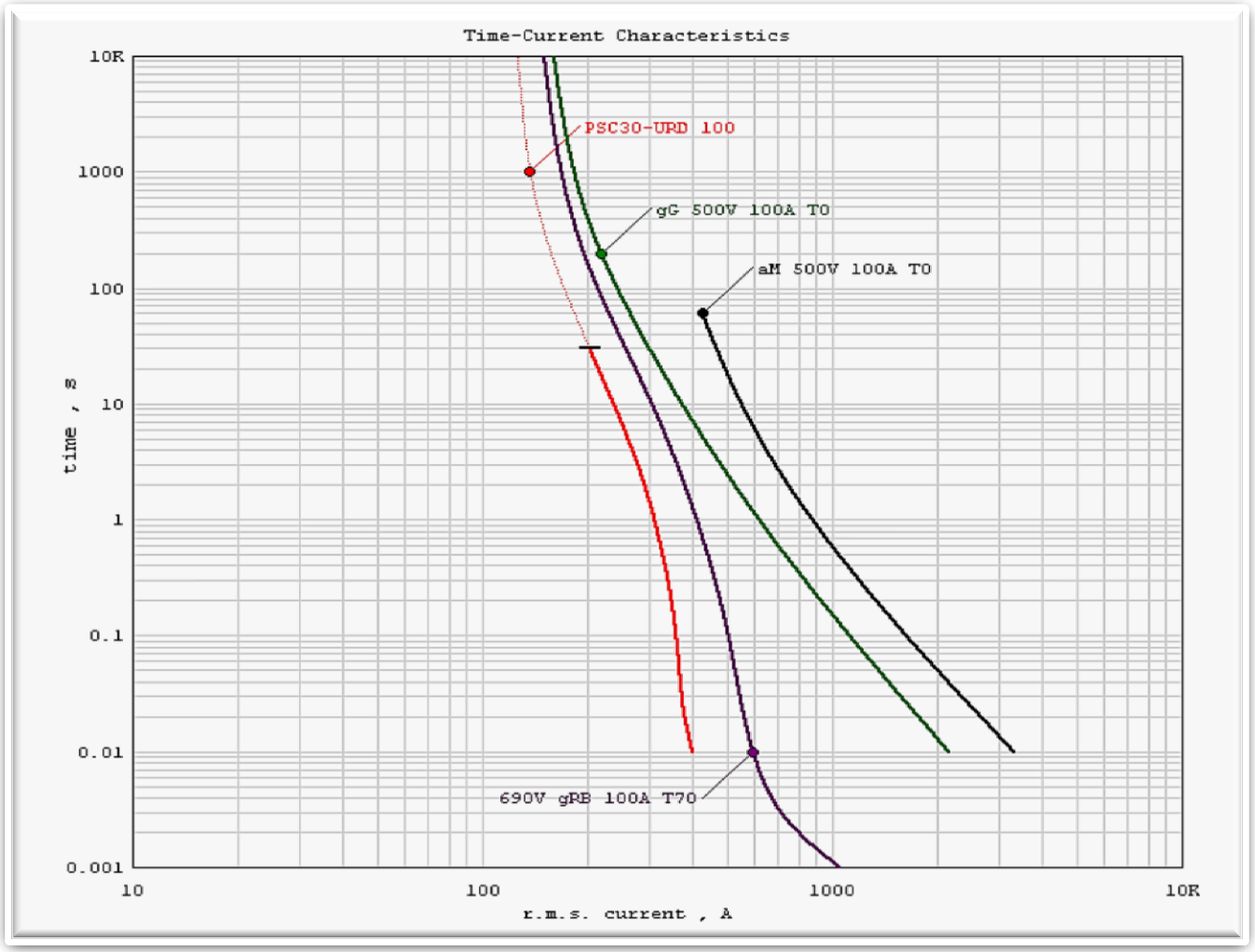
Low Voltage Fuses

EduPack Training Module

2012



COMPARISON OF FUSE TYPE GG, AM, URD, GRB



INTRODUCTION TO IEC 60269 STANDARD

IEC 60269-1
Low Voltage Fuses
1000 VAC & 1500 VDC

→ General rules

IEC60269-2
Systems for use by authorized persons (industrial applications)

IEC 60269-3
Systems for use by unskilled persons (household applications)

IEC 60269-4
Systems for the protection of semiconductor devices

IEC 60269-4-1
Examples of types: BS88, USA, DIN etc…

IEC 60269-2-1

Section I : NH system

Section II : BS88

Section III :10x38,14x51,22x58

Section IV: BS88
Couteaux déportés

Section V : UL 248
Classes J & L

IEC60269-3-1

Section I : Neozed (D0) & D
Section IIA : NF
6A 6.2 x 22,2 - 10A 8.4 x 22.2
16A 10.2 x 25,4 - 20A 8.4 x 31
25A 10.2 x 31 - 32A 10.2 x 37.4

Section IIB : BS 1361
Section IIC : type C (Italia)

Section III : pin-type fuses
Section IV : fuses in plugs
(BS 1362)

Specific usage with ratings higher than1000 VAC & 1500VDC

Domestic usage as per type and country rules

Industrial usage – general cables and motor protection

FUSE APPLICATION

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

FUSE APPLICATION

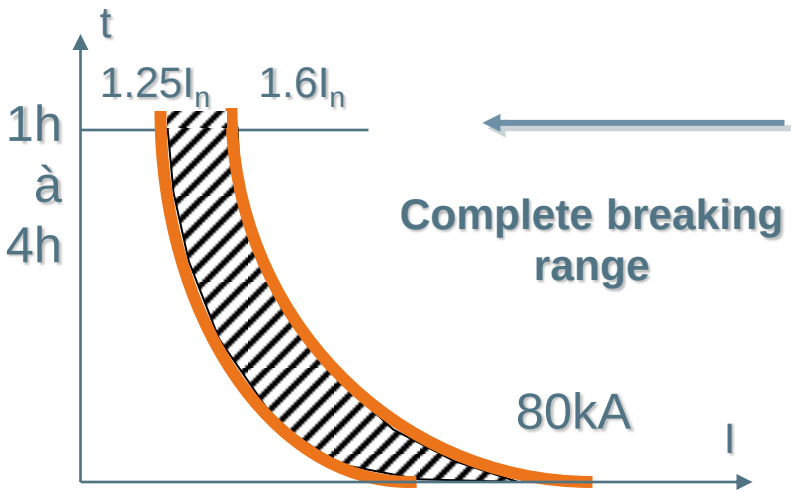
A gG fuse made in any technology can be replaced by another gG fuse from another technology because they have the same electrical data:

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

Max I^2t is defined by IEC60269 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

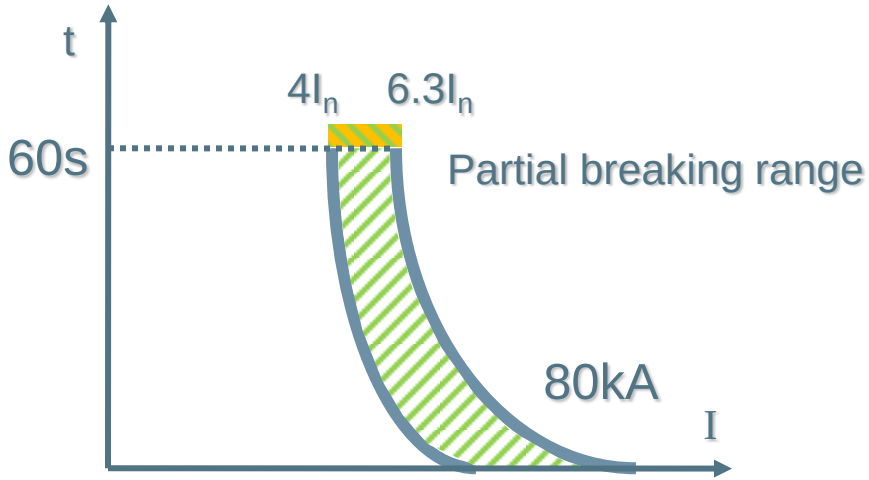


Conventional time: 1h to 4h (values versus fuse rating)

"gG": Protection against all overloads.

Gates for some ratings as per IEC 60269				
Fuse rating (A)	I_{mini} @ 10s (A)	I_{max} @ 5s (A)	I_{mini} @ 0.1s (A)	I_{max} @ 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 6026



“aM”: Protection against short circuit current.

Gates for any current rating In		
Current	T_{mini} (s)	T_{max} (s)
4 In	60	
6.3 In		60
8 In	0.5	
10 In	0.2	
12.5 In		0.5
19 In		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: GG & AM FUSES

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 $V_{circuit\ max}$ (this is the rated voltage + variation) must be lower than the maximal operational voltage of the fuse $V_{fuse\ max}$ given in the table.

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

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

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

gG & aM FUSE SELECTION

INFLUENCE OF TEMPERATURE AND AIR COOLING

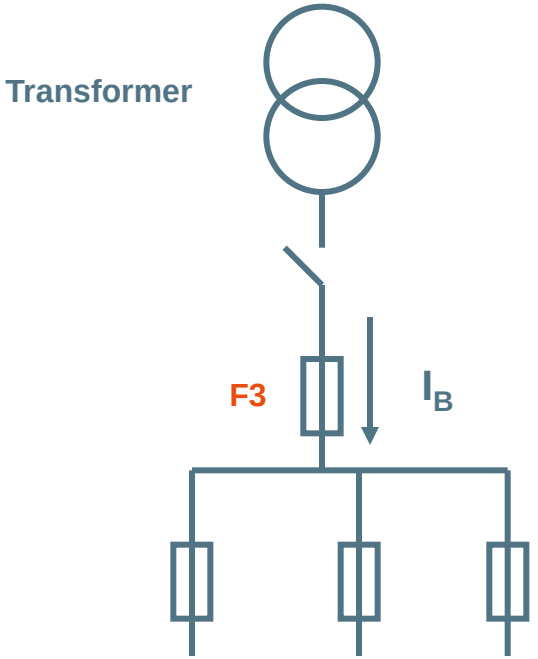
When the temperature θ_A is higher than 40°C and when there is an air cooling with air velocity V on the fuse current rating I_N is obtained from the operating current I_B as follows:

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

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
CABLE 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

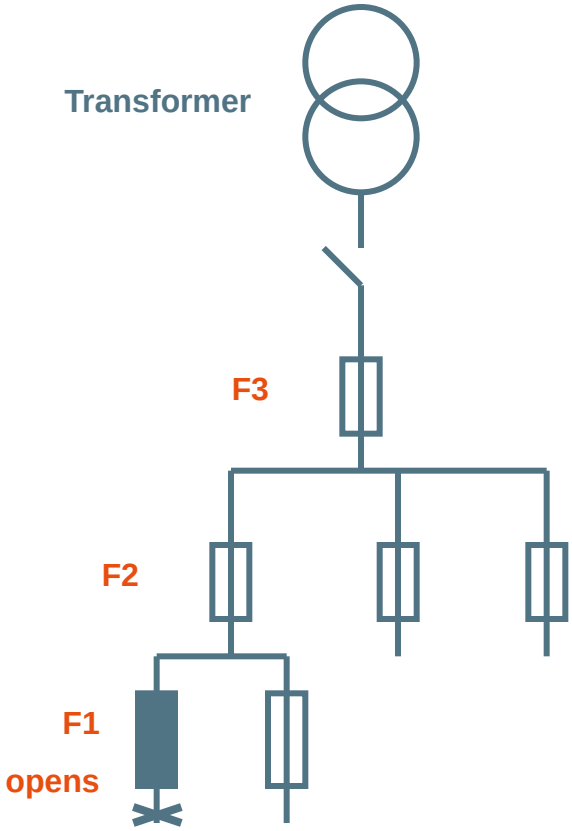
Selectivity: selectivity between gG fuse is achieved when the ratio between 2 ratings is about 1.60

Example:

F1 = 200 A

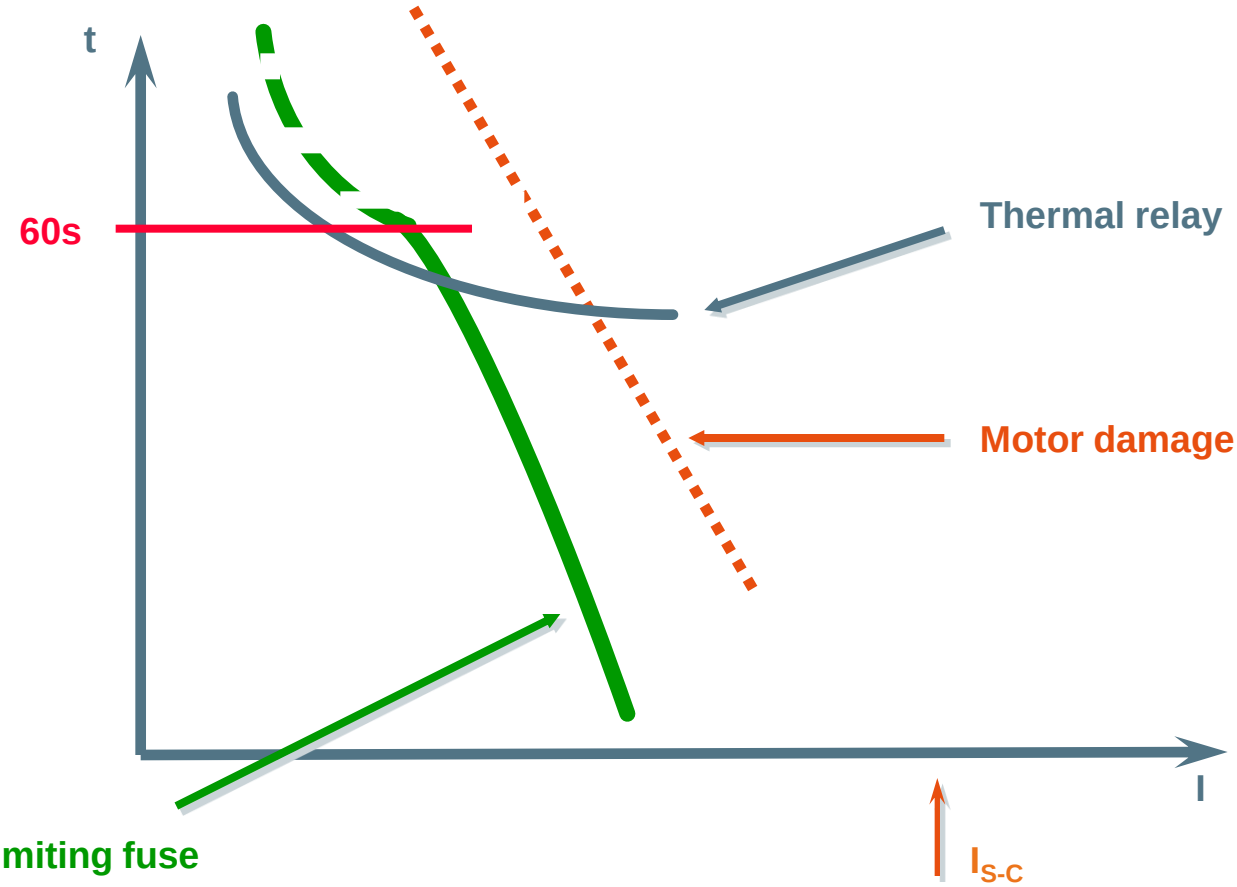
F2 = 315 A does not melt when F1 melts because 315 / 200 = 1.575

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.**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