INTERNATIONAL STANDARD

ISO 8820-2

Third edition
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Road vehicles — Fuse-links —

Part 2:
User guidelines

Véhicules routiers — Liaisons fusibles —

Partie 2: Guide de l'utilisateur

Reference number
ISO 8820-2:2014(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This third edition cancels and replaces the second edition (ISO 8820-2:2005), which has been technically revised.

ISO 8820 consists of the following parts, under the general title *Road vehicles — Fuse-links*:

— *Part 1: Definitions and general test requirements*

— *Part 2: User guidelines*

— *Part 3: Fuse-links with tabs (blade type) Type C (medium), Type E (high currents) and Type F (miniature)*

— *Part 4: Fuse-links with female contacts (Type A) and bolt-in contacts (Type B) and their test fixtures*

— *Part 5: Fuse-links with axial terminals (Strip fuse-links) Types SF30 and SF51 and test fixtures*

— *Part 6: Single-bolt fuse-links*

— *Part 7: Fuse-links with tabs (Type G) with rated voltage of 450 V*

— *Part 8: Fuse-links with bolt-in contacts (Types H and J) with a rated voltage of 450 V*

— *Part 9: Fuse-links miniature low profile (Type K)*

— *Part 10: Road vehicles — Fuse — Part 10: Fuse-links with tabs Type L (high current miniature)*[1)]

1) To be published.

Road vehicles — Fuse-links —

Part 2:
User guidelines

1 Scope

This part of ISO 8820 gives guidance for the choice and application of automotive fuse-links which are defined in the other parts of this International Standard. It describes the various parameters which have to be taken into account when selecting fuse-links.

Fuse-links according to ISO 8820 are intended for electrical cable protection. If these types of fuse-links are to be used for electrical component protection, it should be agreed between customer and supplier.

It is intended to be used in conjunction with the other parts of ISO 8820.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8820-1, *Road vehicles — Fuse-links — Part 1: Definitions and general test requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions in ISO 8820-1 apply.

4 Rated voltage and system voltage

The fuse rated voltage shall always be higher than the nominal voltage of the electrical system of the vehicle to allow for possible overvoltage conditions.

5 Rated current and continuous current

The rated current (I_R) is the current used for identifying the fuse-link.

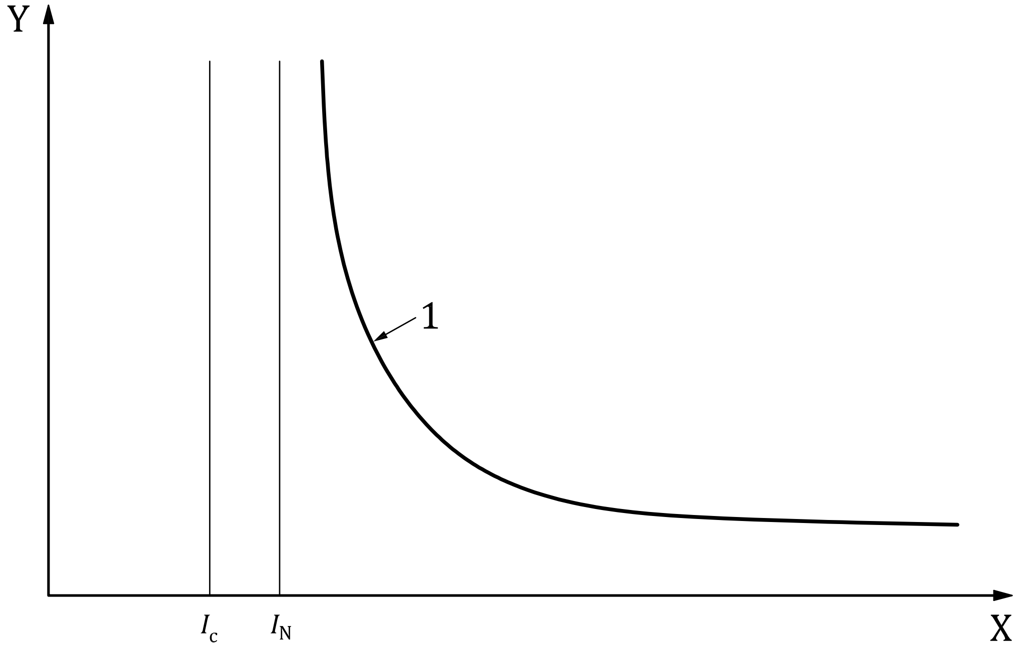
The continuous current (I_C) in Figure 1 is the maximum current flowing continuously through the circuit (fuse-link, terminals, holder, and cables) at a maximum ambient temperature. The continuous current is lower than the rated current.

6 Cold resistance

The cold resistance is the resistance of a fuse-link without self-heating at room temperature (RT). It can be calculated by the drop voltage measured, between the measuring points of the fuse-link (specified in the appropriate part of ISO 8820 according to the type of the fuse), at a certain current, typically measured at 10 % of fuse rated current.

The spread of fuse-link cold resistance due to volume production results in a spread in power dissipation and a spread in time-current characteristic (see Figure 2).

Figures 2 and 3 show the variation of operating time and voltage drop versus cold resistance for a given test current.



Key

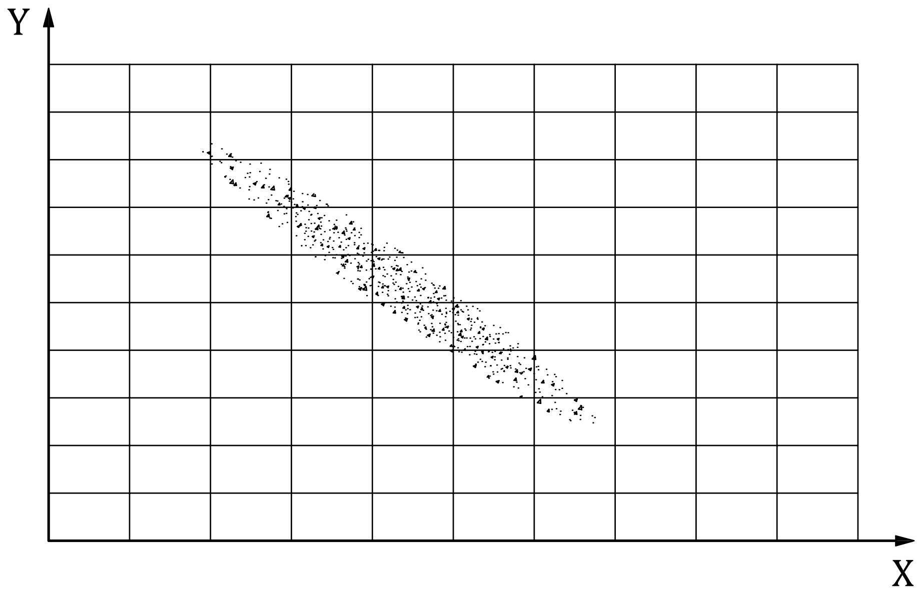
Y operating time (t)

X current (I)

1 time-current characteristic

Figure 1 — Rated current, continuous current, and time-current characteristic

The rise of the temperature in the circuit depends on the current and time.

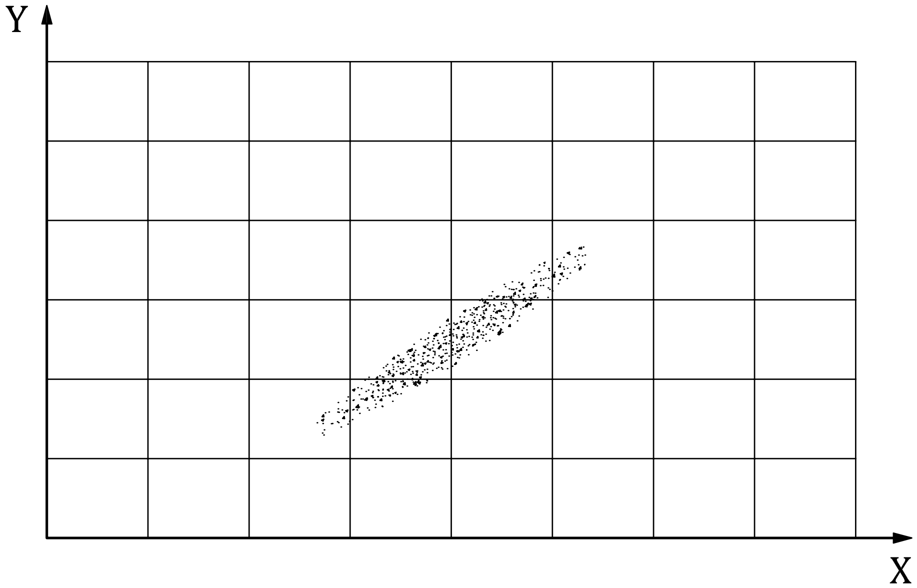


Key

Y operating time

X cold resistance

Figure 2 — Cold resistance versus operating time



Key

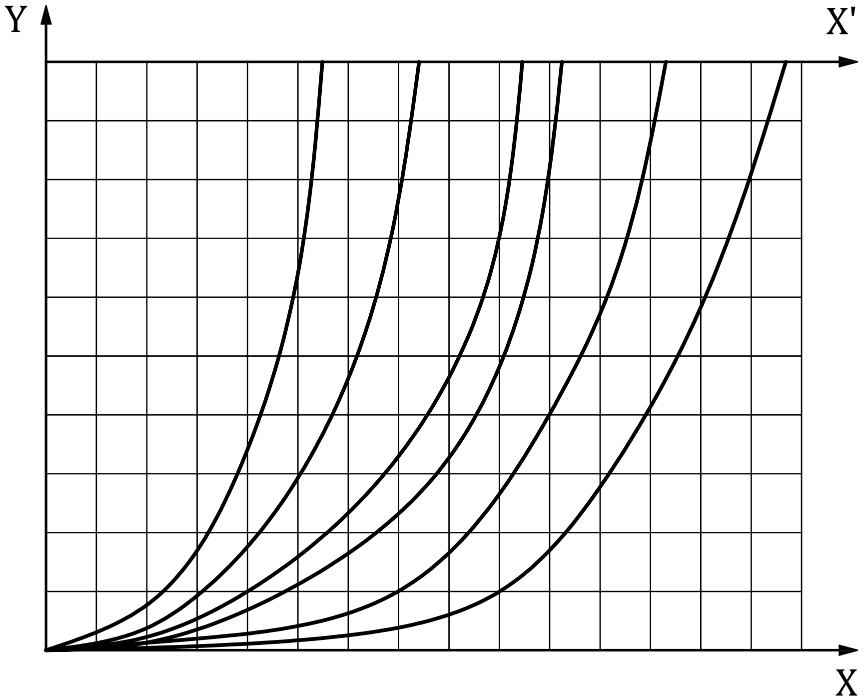
Y voltage drop

X cold resistance

Figure 3 — Cold resistance versus voltage drop

7 Current and conductors

The temperature rise of a conductor is a function of current, conductor cross section, and time duration. For system application, other influences, e.g. ambient temperature, conducting and isolating material, strands, have to be taken into account also. Figure 4 shows stabilized temperature rise for various conductor cross sections.



Key

Y conductor temperature

X’ conductor session section

X current (*I*)

Figure 4 — Conductor temperatures for different conductor cross sections versus current

8 Current and contact resistance

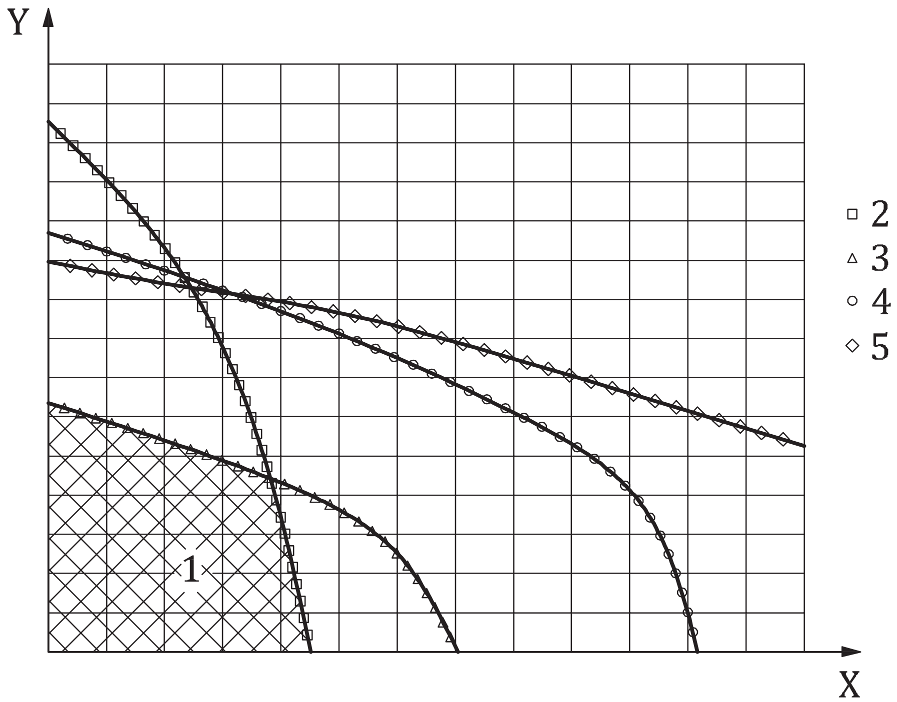
A higher contact resistance of mated terminals leads to a temperature rise and reduced thermal conduction from the fuse-link. The temperature of the fuse-link terminal will increase and the continuous current for the application has to be derated.

A temperature rise test can be conducted using fuse-links, fuse holders, and connections as specified by the vehicle manufacturer. At a specified test current, the temperature of the connections shall be measured at the points specified in the appropriate part of the ISO 8820 according to the type of the fuse. After thermal equilibrium has been achieved, the temperature rise of the connection shall not exceed the limits as specified for terminals and cable.

9 Current and ambient temperature

All components of a circuit and their parts have their own characteristic thermal curve as shown in Figure 5.

Each component in a circuit has an upper temperature limit. An increase of temperature beyond this limit can result in increased resistance, which can by itself increase the temperature. As a result, the fuse-link can open.



Key

Y current

X ambient temperature

1 application area of the system

2 cable

3 connection

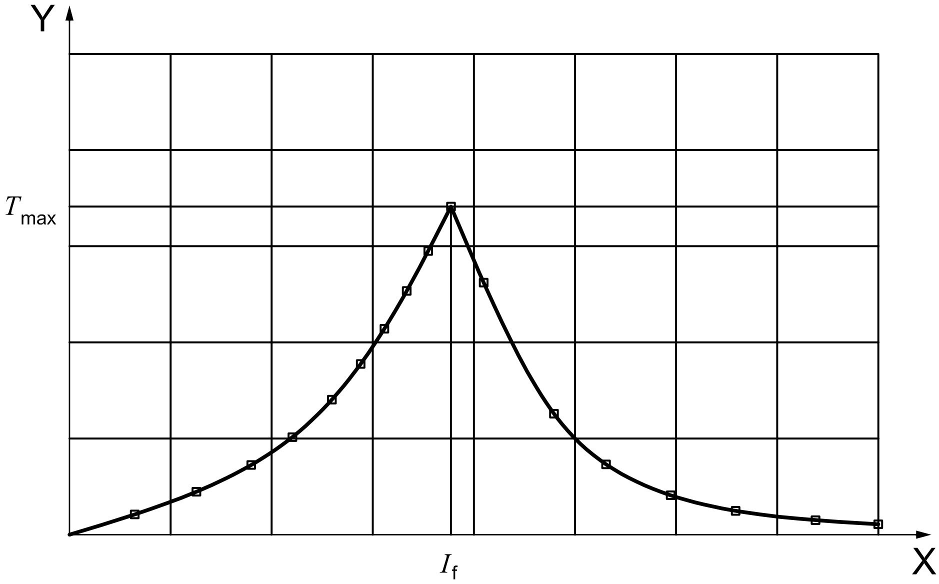
4 insulator

5 fuse element

Figure 5 — Maximum continuous currents of circuit components versus ambient temperature

10 Cable protection versus time-current characteristics

To ensure satisfactory cable protection, fuse-links shall be chosen such that they will always open before the maximum allowed cable temperature T_{max} is exceeded. Figure 6 shows the correct fuse-link selection. The maximum allowed temperature is never exceeded because above a certain minimal fusing current (I_f), the fuse-link will open the circuit before the maximum permitted temperature of the cable is exceeded.



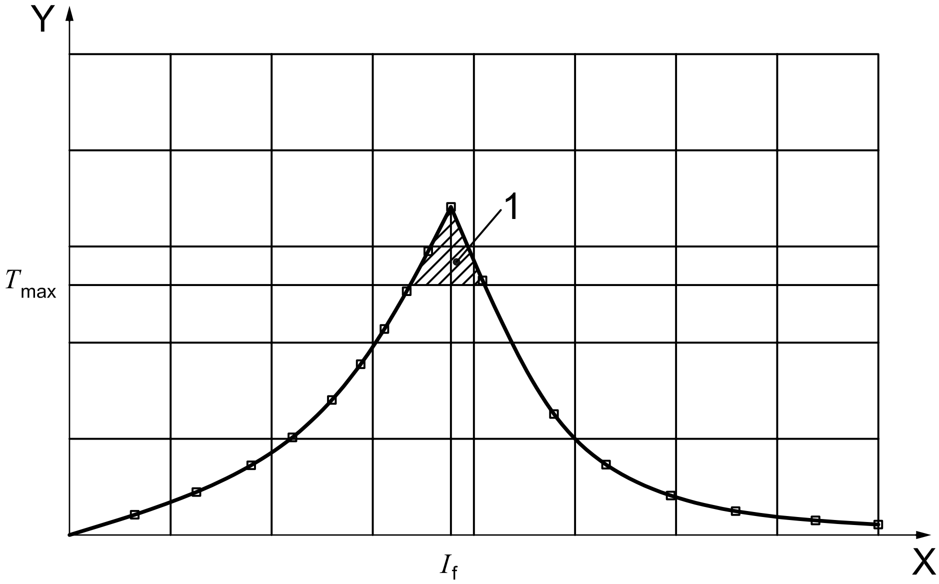
Key

Y cable temperature

X current (I)

Figure 6 — Correct fuse selection

Figure 7 shows incorrect fuse selection. The fuse-link allows some potentially damaging current to flow for too long, causing the cable to overheat.



Key

Y cable temperature

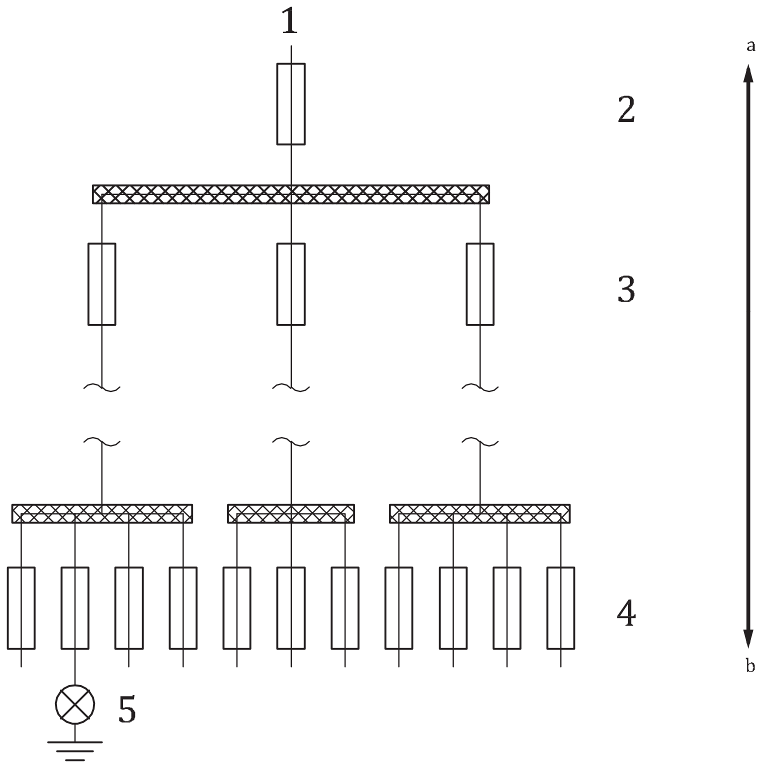
X current (I)

1 unprotected region

Figure 7 — Incorrect fuse selection

11 Selectivity

It shall be ensured that higher level fuse-links do not open when lower level fuse-links are opening (see Figure 8).



Key

1 battery

2 fuse-link level 1

3 fuse-link level 2

4 fuse-link level n

5 load

a higher level

b lower level

NOTE Fuse-link level 1 is the highest level.

Figure 8 — Example for selectivity

12 Replacement of fuse-links

The replacement of fuse-links in a circuit shall be performed with the circuit de-energised.

13 Voltage peaks during opening of fuse-links

When a fuse-link opens, voltage peaks can occur. The peaks can approach 10 times the rated voltage, depending on the load and the supply.

14 Inrush withstand characteristics of fuse-links

In selecting a fuse-link, not only the continuous current and the rated current are to be considered but also the inrush characteristics of electrical devices.

The inrush characteristic describes the time-current behaviour of electrical devices until the stabilized continuous current has been attained.

It is important to consider the inrush characteristic as there are different requirements on the fuse-link depending on the type of load. The fuse-link shall withstand the energy pulse caused by inrush without opening.

15 Electromagnetic compatibility (EMC)

EMC tests for fuse-links are not required by this International Standard.

Annex A
(informative)

Parameters for the selection of fuse-links in road vehicles

The various parts of ISO 8820 define basic requirements and test methods for rated voltage, rated current, and time/current characteristics to give comparable and reproducible results of the fuse-links.

In practice, however, there are other parameters to be considered for the correct selection of fuse-links in road vehicles, for example:

— continuous current and operating time,

— fusing of one or more electrical/electronic devices,

— connection resistance,

— types of cables, e.g. different cross section, length, insulation, bundling,

— internal resistances of the fuse-links, terminals, cables, and devices,

— power dissipation of the components comprising the system,

— short-circuit parameters,

— inrush parameters of devices,

— stall current (of motors with locked rotors),

— different currents, voltages, and temperatures of the system and surroundings,

— fuse-link holders and boxes,

— orientation and location of the fuse-links, e.g. engine, passenger, luggage compartment,

— distances between the fuse-links in fuse boxes,

— environmental conditions (mechanical loads, climatic loads, chemical loads),

— cooling of fuse-links, e.g. by fan or through heat sink, and

— other aspects.

NOTE Users are advised to consult the manufacturers of fuse-links, terminals, and cables because not all of the above points can be addressed in this guide.

Annex B
(normative)

Selection criteria for fuse-links and cables

B.1 Introduction

In any given application, the characteristics of load, connecting cable, and fuse-link shall be carefully matched. This is necessary if the fuse-link is to provide the expected degree of protection in the event of an overcurrent in the circuit and to maintain that level of protection throughout the lifetime of the vehicle. The procedure that follows gives guidelines for selecting the correct size of cable and rated current of fuse-link.

B.2 Selecting the correct connecting cable and fuse-link

B.2.1 Selection process

Figure B.1 shows a flow chart illustrating the various stages that make up the selection process.

A relationship between the rated current of fuse-links and the size of connecting cable can be determined as described in B.2.2 and B.2.3.

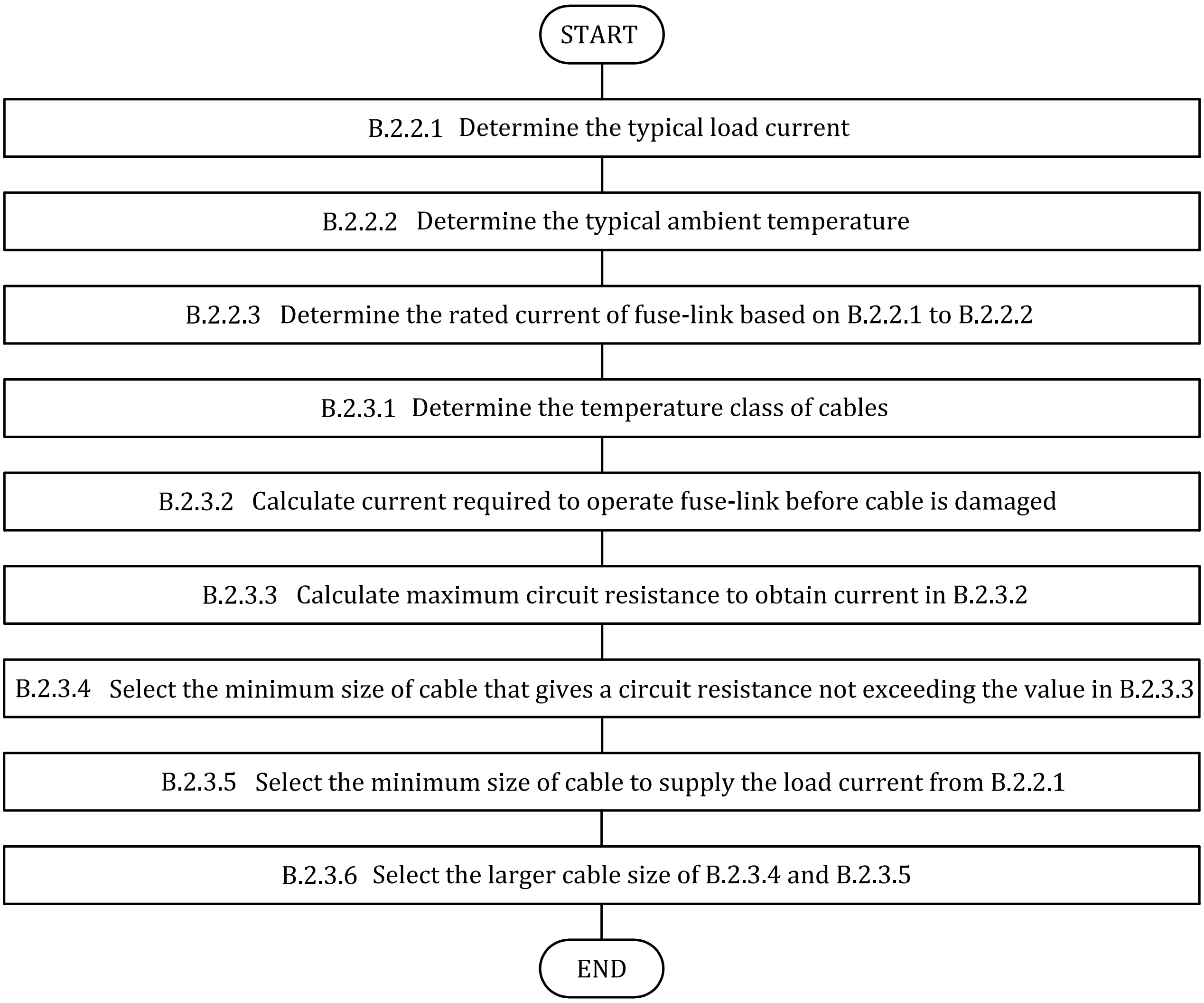


Figure B.1 — Selection process

After this selection process, practical tests shall be used to validate the calculation.

B.2.2 Procedure for selecting the rated current of fuse-links

B.2.2.1 Determination of the typical load current

The rated current of the fuse-link shall always be greater than the load current. As a first approximation, use the following guidelines:

— For example: For a first approximation, the rated current of the fuse-link should be chosen so that the load current does not exceed 70 % of the rated current at room temperature.

— There are various factors that should be taken into consideration when determining the value of load current to be used for selection of fuse-link and cable. These factors should be discussed between fuse-link manufacturer and customer.

EXAMPLE Is the load current continuous or pulsed? Is there a high current surge during switch-on? During vehicle operation, does the load current have to be supplied for a short period or continuously?

B.2.2.2 Determination of the typical ambient temperature

Having determined the load current, the next step is to consider the ambient temperature where the fuse-link is to be operated. Because fuse-links are essentially thermal devices, their operating characteristics will be affected by ambient temperature. Their rated current and published characteristics are usually related to RT. When the ambient temperature is significantly different, the rating of the fuse-link has to be recalculated based upon the fuse manufacturer's characteristic curves.

B.2.2.3 Determination of the rated current of the fuse-link based on B.2.2.1 and B.2.2.2

Using the information derived from B.2.2.1 and B.2.2.2, it is possible to select a fuse-link of the correct rated current.

The following criteria shall be known prior to calculation selection procedure:

Table B.1 — Known criteria in an electrical circuit of a vehicle

Term	Acronym	Value
Nominal voltage	U_n	12 V
Load power at nominal voltage	P	95 W
Supply voltage	U_s	14 V
Room temperature	RT	23 °C
Cable length in the current	l	15 m

Determine the typical load current (I_l).

$$I_{12\ \mathrm{V}} = P / U_N = (95\ \mathrm{W} / 12\ \mathrm{V}) = 7{,}92\ \mathrm{A}$$

$$P_{14\ \mathrm{V}} = U_s \times I_{12\ \mathrm{V}} = 14\ \mathrm{V} \times 7{,}92\ \mathrm{A} = 110{,}9\ \mathrm{W}$$

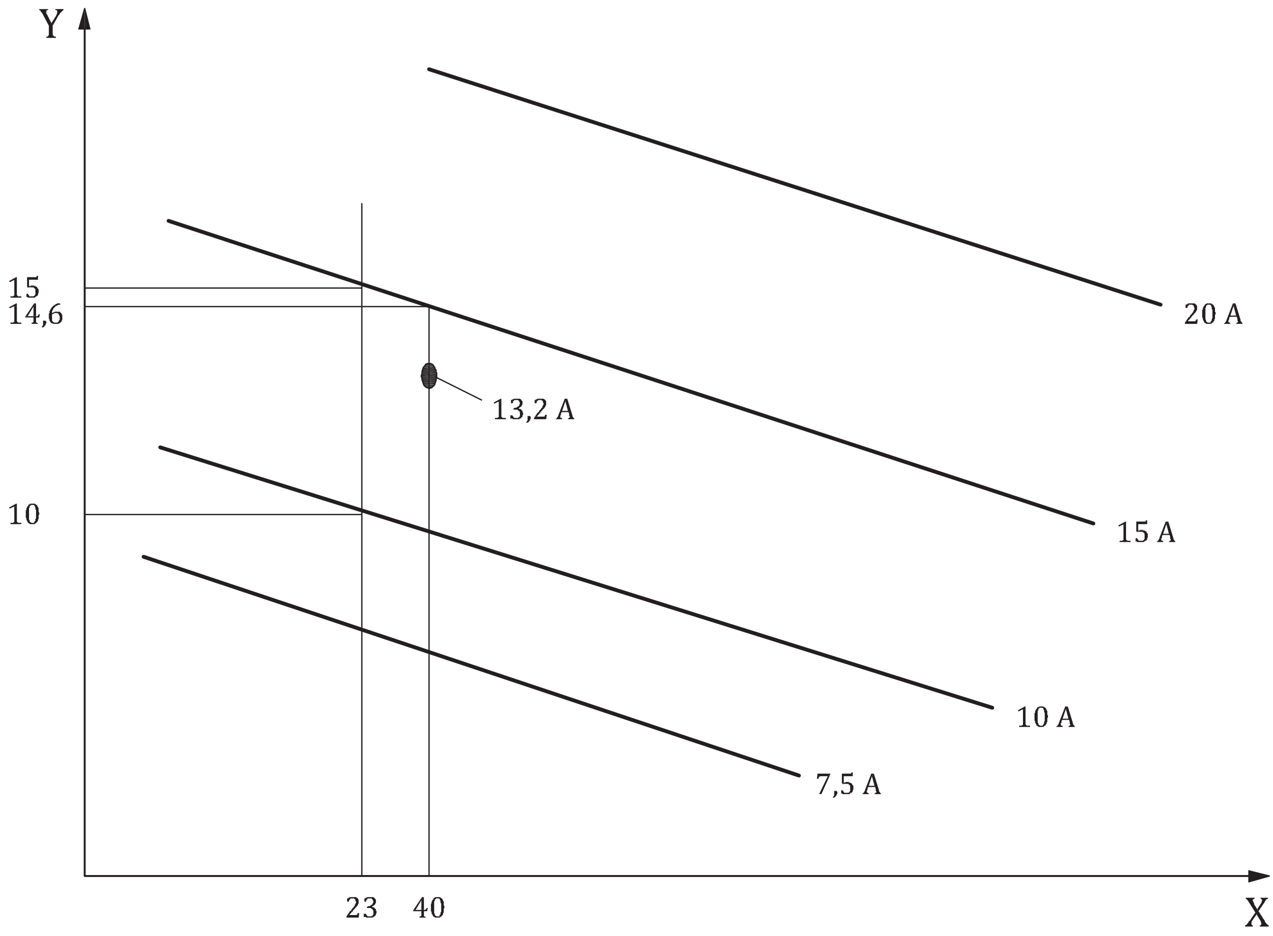
$$I_l = P_{14} / U_N = 110{,}9\ \mathrm{W} / 12\ \mathrm{V} = 9{,}24\ \mathrm{A}$$

Determine the theoretical rating current of the circuit breaker (I_{RT}).

$$I_{RT} = I_l / 70\ \% = 9{,}24\ \mathrm{A} / 0{,}7 = 13{,}2\ \mathrm{A}$$

(0,7 because the load current should not exceed 70 % of the rated current)

By referring to Figure B.2 (typical temperature characteristic curves for medium fuse-links with tabs), it can be seen that at 40 °C, a current of 13,2 A falls between the curves of the 10 A and 15 A ratings. Therefore, 15 A is chosen as the correct rated fuse-link.



Key

Y theoretical rated current

X temperature

Figure B.2 — Typical temperature rerating curves for medium fuse-links with tab

NOTE In this example, if a selection had been made based on the simple assessment of load current alone (9,24 A), a fuse-link with a rated current of only 10 A would have been chosen, with adverse consequences for long-term reliability.

B.2.3 Procedure for selecting the correct size and temperature class of connecting cable

B.2.3.1 Determination of the temperature class of cables

Determine the temperature classes of cables according to the ambient temperature where the cables are installed.

B.2.3.2 Calculation of the current required to operate fuse-link before cable is damaged

If the fuse-link is to protect the cable against overheating, it shall operate before an over current can cause thermal damage. Calculate the current value required to cause the fuse-link to operate in a short time. This shall be 2 × I_R (rated current I_R) for miniature and medium tab fuse-links and 6 × I_R (rated current I_R) for high-current fuse-links.

The value of rated current I_R used in this calculation is adjusted based on the temperature characteristic curve. In our example, the adjusted rating of a 15 A medium fuse-link with tabs at 40 °C is about 14,6 A according to Figure B.2. Therefore, the operating current I_O will be:

$I_O = 2 \times I_R = 2 \times 14{,}6\ A = 29{,}2\ A$

B.2.3.3 Calculate the maximum circuit resistance to obtain current in B.2.3.2

Calculate the maximum value of circuit resistance required to guarantee this operating current by correcting for the ambient temperature of the cable. If the cable is at 40 °C, the circuit resistance will be:

$$R_{max40\ °C} = U_S / I_O = 14\ V / 29{,}2\ A = 0{,}479\ \Omega$$

Correcting this result to room temperature and using the coefficient of resistance of copper gives:

$$R_{max} = 0{,}479\ \Omega \times [1 + 0{,}003\ 93 \times (23\ °C - 40\ °C)] = 0{,}447\ \Omega$$

B.2.3.4 Selection of the minimum size of cable that gives a circuit resistance not exceeding the value in B.2.3.3

Using the required cable length, determine its resistance per unit length. If the cable is 15 m long, the resistance per unit length will be:

$$R_{max} = R_{max} / m = (0{,}447\ \Omega\ /15\ m) = 0{,}029\ 8\ \Omega/m$$

By consulting tables of copper cable unit resistance (as per ISO 6722), it can be determined that a 0,75 mm^2 cable is the minimum size that will give this maximum value of resistance.

B.2.3.5 Selection of the minimum size of cable to supply the load current from B.2.2.1

By reference to the cable manufacturers' data, determine the minimum cable size necessary to carry the load current, taking the ambient temperature of the cable into account. A cable of 0,5 mm^2 is needed to carry load current I_l = 9,24 A at 40 °C.

B.2.3.6 Selection of the larger cable size of B.2.3.4 and B.2.3.5

Select the larger of the sizes as calculated in B.2.3.4 and B.2.3.5, i.e. 0,75 mm^2.

B.2.3.7 Summary

Table B.2 — Summary for selecting connecting cable and the rated current I_R of fuse-link

I_l	Load of the fuse-link in % of rated current I_R	I_{RT}	I_R	I_O	R_{max}	A at *RT* according to operating current
9,24 A	70 % × I_R = 10,5 A	13,2 A	15 A	29,2 A	0,447 Ω	0,75 mm^2

In this calculation, figures like inrush current, overload, and short current are only considered statically. Voltage drop of the conductor is not considered.

ICS 43.040.10

Price based on 14 pages