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Road vehicles — Circuit breakers —

Part 2: User's guide

Véhicules routiers — Coupe-circuits —

Partie 2: Guide de l'utilisateur

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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/TC 22, *Road vehicles*, Subcommittee SC 3, *Electric and electronic equipment*.

ISO 10924 consists of the following parts, under the general title *Road vehicles — Circuit breakers*:

— *Part 1: Definitions and general test requirements*

— *Part 2: User's guide*

— *Part 4: Medium circuit breakers with tabs (Blade type), Form CB15*

The following parts are under preparation:

— *Part 3: Miniature circuit breakers*

— *Part 5: Circuit breakers with tabs with rated voltage of 450 V*

Road vehicles — Circuit breakers —

Part 2:
User's guide

1 Scope

This part of ISO 10924 gives guidance for the choice and application of automotive circuit breakers. It describes the various parameters which have to be taken into account when selecting circuit breakers.

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*

ISO 10924-1, *Road vehicles — Circuit breakers — Part 1: Definitions and general test requirements*

ISO 16750-1, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 1: General*

ISO 16750-2, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 2: Electrical loads*

3 Terms and definitions

For the purposes of this document, the terms and definitions in ISO 8820-1 and ISO 10924-1 and the following apply.

4 General

The various parts of ISO 10924 define basic requirements and test methods for nominal voltage, rated current, I_R, and time/current characteristics to give comparable and reproducible results of circuit breakers.

In practice, however, there are other parameters to be considered for the correct selection of circuit breakers in road vehicles, such as

— continuous current,

— operating time,

— overload protection of one or more electrical/electronic devices,

— connection resistance,

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

— internal resistances (voltage drop) of the circuit breakers, contacts, cables, and devices,

— power dissipation of the components comprising the system,

— short-circuit parameters,

— inrush parameters of devices,

— operating mode of the load,

— operating of one or more electrical/electronic devices,

— orientation and location of the circuit breakers, e.g. engine, passenger or luggage compartment,

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

— distances or clearances inside circuit breaker boxes or holders,

— different circuit breakers, circuit breaker holders and boxes (see Annex B),

— environmental conditions (mechanical loads, climatically loads, chemical loads), and

— forced cooling of the circuit breakers.

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

The parameters listed are not intended to cover all the possible parameters that need to be taken into consideration for circuit breaker selection nor is it intended that all parameters will need to be considered in each vehicle applications.

4.1 Circuit breaker nominal voltage

See ISO 16750-1

4.2 Supply voltage maximum (U_{smax})

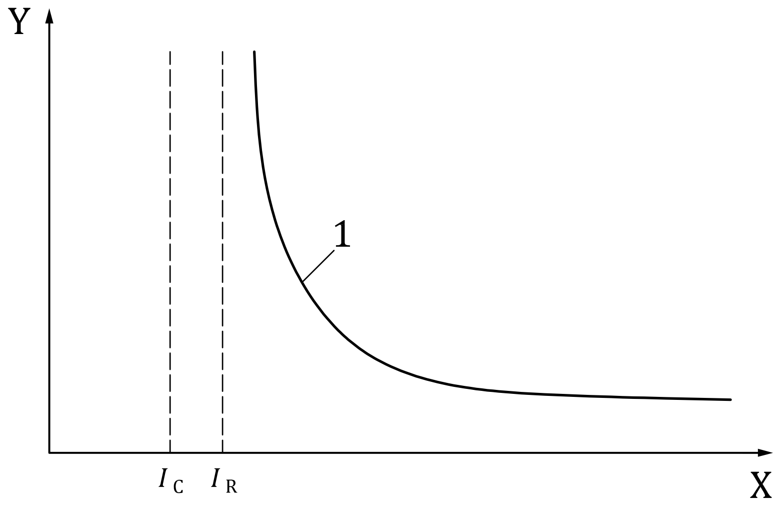
See ISO 16750-2

4.3 Rated current (I_R) and continuous current

The rated current (I_R) is the current used for identifying the circuit breaker.

The continuous current (I_C) in Figure 1 is the maximum current which the circuit can continuously carry under specified conditions: ambient temperature (23 °C), duration maximum 1 h, standard test holder, cross sections of wires. The continuous current can be lower than the rated current, I_R.

See A.2.2.3



Key

X current, I

Y operating time, t

I_C continuous current

I_R rated current

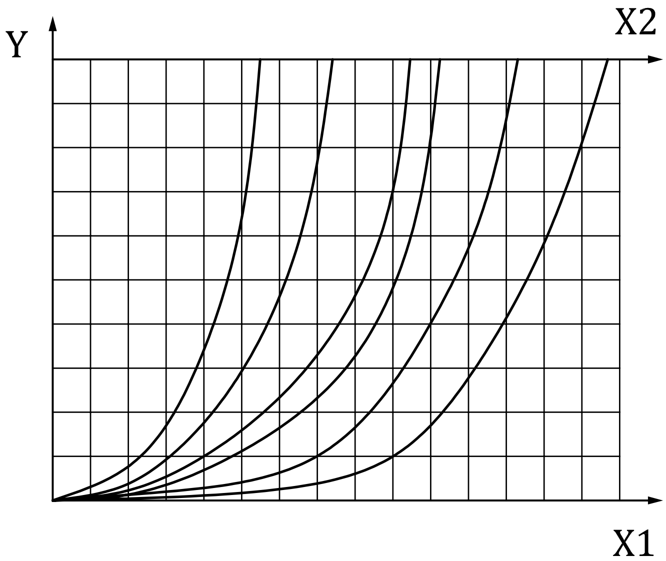
Figure 1 — Rated current (I_R), continuous current, and time-current characteristic

5 Current and conductors (cables)

The temperature rise of a cable is a function of current, conductor cross-section, strands, insolating materials time duration, and ambient temperature.

See A.2.2.4

Figure 2 shows stabilized temperature rise for various conductor cross sections at *RT*.



Key

X1 current, *I*

X2 conductor cross section

Y conductor temperature, *T*

Figure 2 — Conductor temperatures for different conductor cross sections vs. current at *RT*

6 Current and contact resistance

A higher resistance of mated terminals will result in a temperature rise and reduced thermal conduction away from the circuit breaker. Hence, the temperature of the circuit breaker terminal will be higher and the continuous current for the application lower.

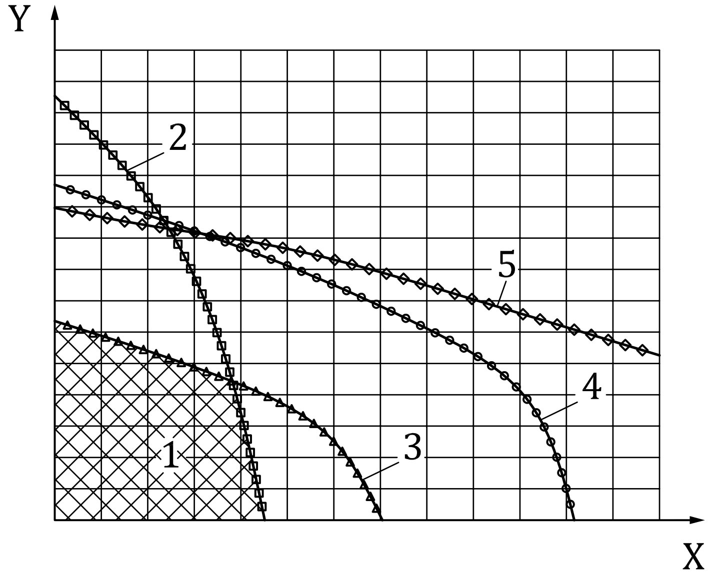
A temperature rise test can be conducted using circuit breakers, circuit breaker holders and connections as specified by the vehicle manufacturer. At a specified test current, the temperature of the connections shall be measured at the points, either tabs or bolt connection of the circuit breaker that protrude from the base of the circuit breaker body (specified in the appropriate part of the ISO 10924 according to the type of the circuit breaker). After thermal equilibrium has been achieved, the temperature rise of the connection shall not exceed the limits specified for terminals and cable.

7 Current and ambient temperature

All components of a circuit and their parts have their own characteristic curve as shown in Figure 3.

Each component in a circuit has an upper temperature limit. An increase of temperature results in increased resistance, which can increase the temperature by itself. As a result, the circuit breaker can trip. It is always recommended to consult with specific manufacturers of circuit breakers for current versus temperature curves as both design and thermal materials used result in different curve characteristics.

See A.2.2.4 and Annex C



Key

X ambient temperature, *T*

Y current, *I*

1 application area

2 cable

3 connection

4 insulator

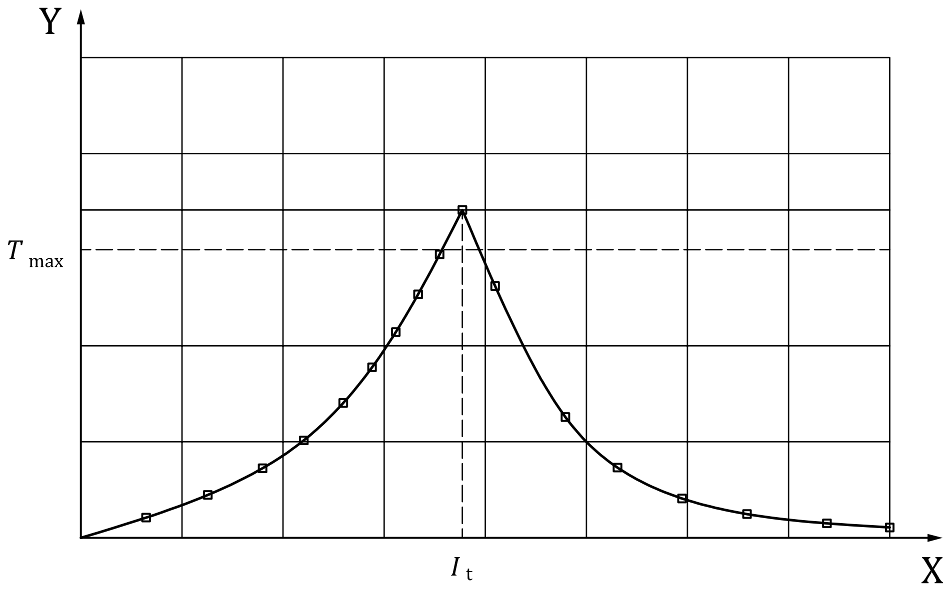
5 circuit breaker

Figure 3 — Maximum continuous currents of circuit components vs. ambient temperature

8 Cable protection: temperature versus current characteristics

To ensure satisfactory cable protection, circuit breakers shall be chosen such that they will always open before the maximum allowed cable temperature, T_{max}, exceeds. Figure 4 shows the correct circuit breaker selection. The maximum allowed temperature never exceeds, because above a certain minimal operating current (I_f), the circuit breaker will trip before the maximum permitted temperature of the cable exceeds.

See Annex A



Key

X times rated current

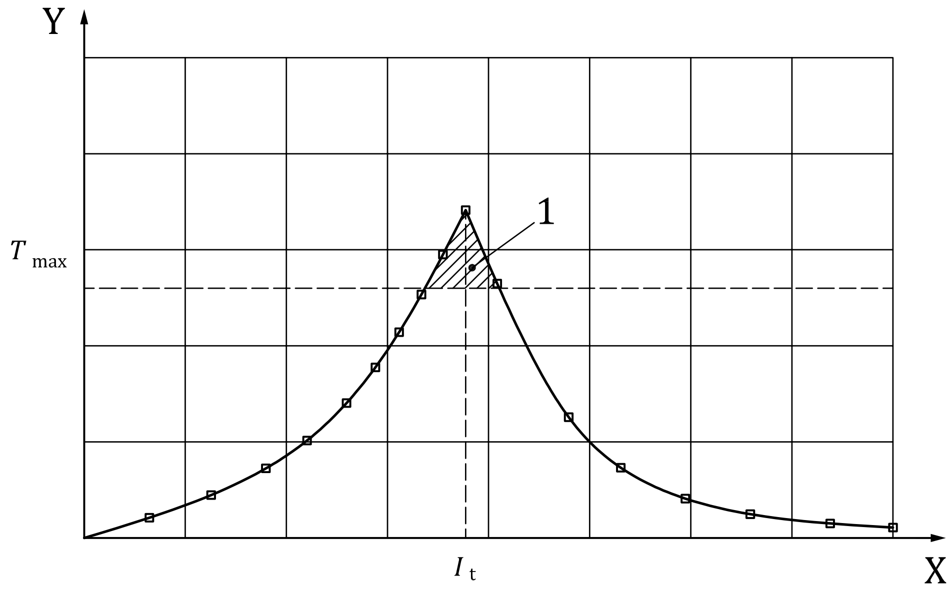
Y cable temperature, T

I_t trip current

T_{max} maximum allowed cable temperature

Figure 4 — Correct circuit breaker selection

Figure 5 shows incorrect circuit breaker selection. The circuit breaker allows some potentially damaging current to flow for too long, causing the cable to overheat.



Key

X times rated current

Y cable temperature, T

I_t trip current

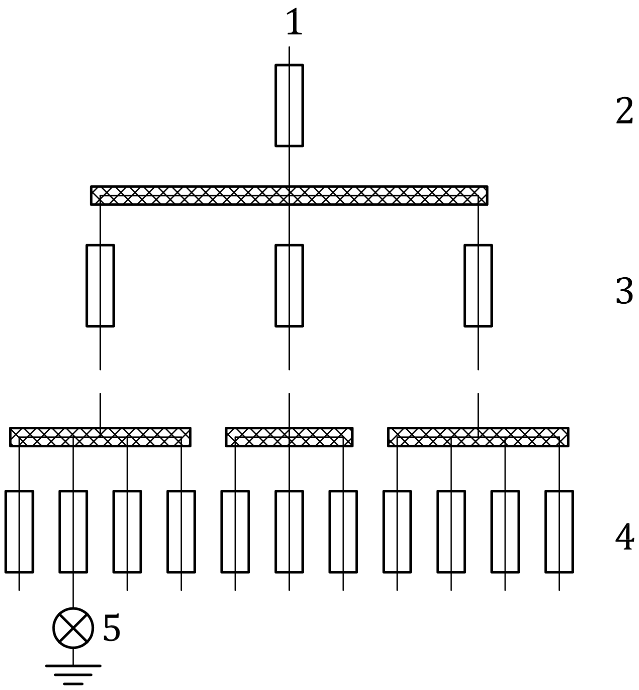
T_{max} maximum allowed cable temperature

1 unprotected region

Figure 5 — Incorrect circuit breaker selection

9 Selectivity

It shall be ensured that higher level circuit breakers do not trip when lower level circuit breakers are opening (see Figure 6).



Key

1 battery
2 circuit breaker level 1
3 circuit breaker level 2
4 circuit breaker level n
5 load

Figure 6 — Example for a structure hierarchy

10 Replacement of circuit breakers

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

11 Voltage peaks during opening of circuit breakers

During the opening process of the circuit breaker, voltage peaks can occur. The peaks can achieve six times the rated voltage, depending on the load and the supply.

12 Inrush withstand characteristics of circuit breakers

In selecting a circuit breaker, not only the continuous current and the rated current, I_R, 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 withstand characteristics as there are different requirements on the circuit breaker depending on the type of load. The circuit breaker shall withstand the inrush energy without opening. If the inrush energy is either too high or too long, or a combination thereof, it can be necessary to select a higher rated circuit breaker to eliminate nuisance openings.

See A.2.2.5

