

Road vehicles — Circuit breakers —

Part 2: ~~User's guide~~

Guidance for users

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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 document 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](http://www.iso.org/directives)).

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This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 32, *Electric and electronic components and general system aspects*.

This second edition cancels and replaces the first edition (ISO 10924-2:2014), which has been technically revised.

The main changes are as follows:

— ~~—~~ added [Clause 14](#)~~Clause 14,~~

A list of all parts in the ISO 10924 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).



# Road vehicles — Circuit breakers —

## Part 2: ~~—~~ **User's** ~~—~~ **guide** **Guidance for users**

### 1 Scope

This document provides guidance for the choice and application of automotive circuit breakers. It describes the various parameters that are taken into account when selecting circuit breakers.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. 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*

### 3 ~~—~~Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ~~—~~ ISO Online browsing platform: available at <https://www.iso.org/obp>

— ~~—~~ IEC Electropedia: available at <https://www.electropedia.org/>

<https://standards.iteh.ai/catalog/standards/iso/972c2c83-a407-4c39-b6ec-4980858ebf9d/iso-fdis-10924-2>

### 4 General

#### **4.1 Overview**

ISO 10924-1, ISO 10924-3, ISO 10924-4 and ISO 10924-5 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 which shall 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~~ power dissipation of the components comprising the system;
- ~~short-circuit~~ short-circuit parameters;
- ~~inrush~~ inrush parameters of devices;
- ~~operating mode~~ operating mode of the load;
- ~~operating of one or more electrical/electronic devices~~ operating of one or more electrical/electronic devices;
- ~~orientation and location of the circuit breakers, e.g. engine, passenger or luggage compartment~~ orientation and location of the circuit breakers, e.g. engine, passenger or luggage compartment;
- ~~different currents, voltages, and temperatures of the system and surroundings~~ different currents, voltages, and temperatures of the system and surroundings;
- ~~distances or clearances inside circuit breaker boxes or holders~~ distances or clearances inside circuit breaker boxes or holders;
- ~~different circuit breakers, circuit breaker holders and boxes (see Annex BAnnex B);~~ different circuit breakers, circuit breaker holders and boxes (see [Annex BAnnex B](#));
- ~~environmental conditions (mechanical loads, climatically loads, chemical loads)~~ environmental conditions (mechanical loads, climatically loads, chemical loads);
- ~~forced cooling of the circuit breakers~~ forced cooling of the circuit breakers.

NOTE Consult the manufacturers of the circuit-breaker, contacts and cables, because not all of the above points can be addressed in this document.

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 are considered in each vehicle ~~applications~~application.

#### 4.14.2 Circuit breaker nominal voltage

See ISO 10924-1:1:1:1 Clause 3.

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#### 4.24.3 Supply voltage maximum, $U_{Smax}$

See ISO 10924-1:1:1:1 Clause 3.

#### 4.34.4 Rated current, $I_R$ , and continuous current

The rated current,  $I_R$ , is the current used for identifying the circuit breaker.

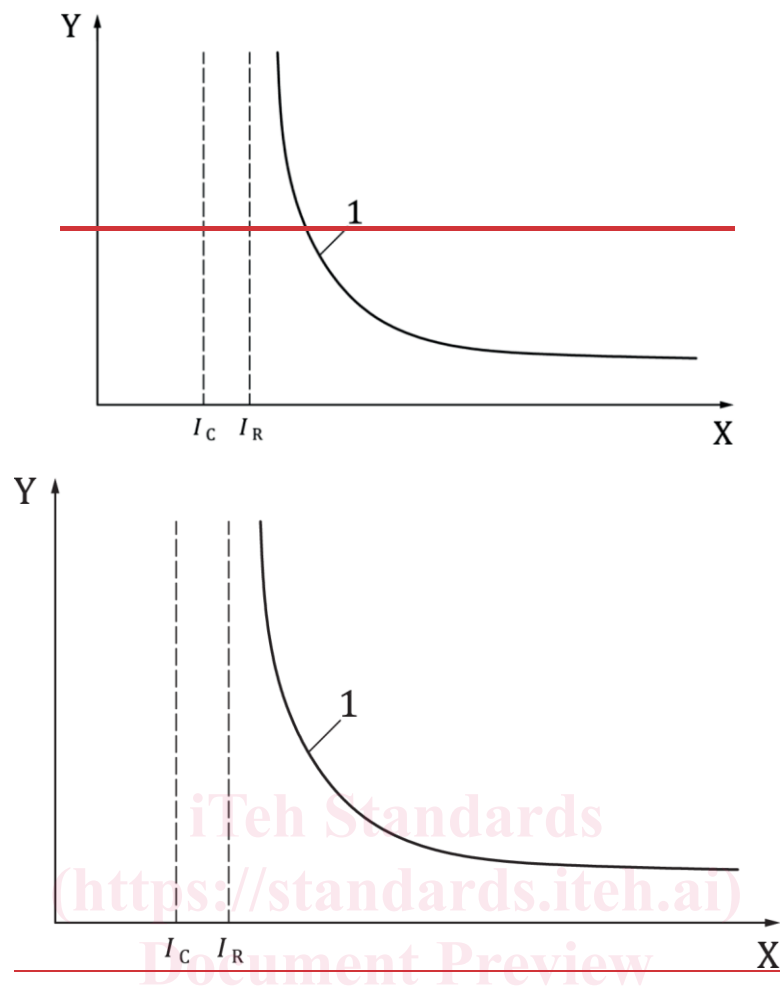
The continuous current,  $I_C$ , in [Figure 1Figure 1](#) is the maximum current which the circuit can continuously carry under specified conditions: room temperature (23 °C), duration maximum 1 h, standard test holder, cross sections of wires. The continuous current can be lower than the rated current,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

See  $I-t$  characteristics of the circuit breaker described in [A.2.2.3A.2.2.3](#).

<sup>1</sup> Third edition under preparation. Stage at the time of publication: ISO/FDIS 10924-1:2024.

<sup>1)</sup> Third edition under preparation. Stage at the time of publication: ISO/FDIS 10924-1:2024.





**Key**

- X current,  $I$
- Y operating time,  $t$
- $I_C$  continuous current
- $I_R$  rated current
- 1 time current characteristic

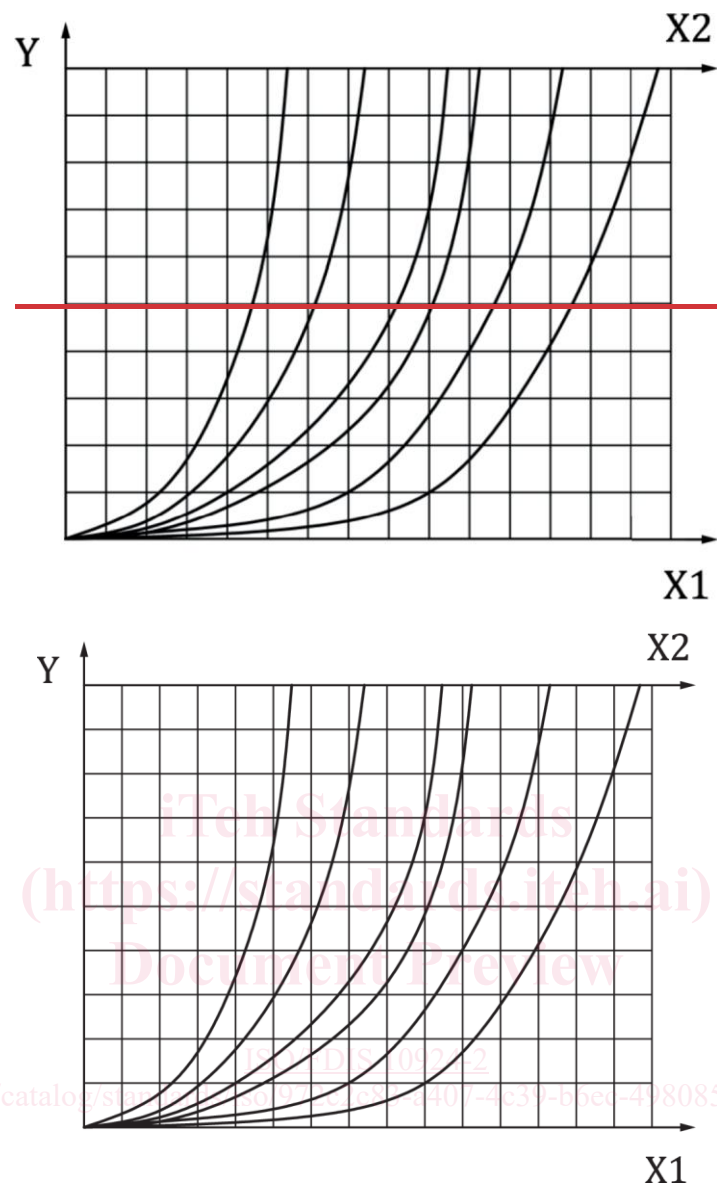
**Figure 1 — Rated current ( $I_R$ ), continuous current and time-current characteristic**

## 5 Current and conductors (cables)

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

See  $I$ - $t$  - characteristic of the insulated conductor (cable) in [A.2.2.4A.2.2.4.](#)

[Figure 2](#) shows stabilized temperature rise for various conductor cross sections at room temperature (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 room temperature**

**6 Current and contact resistance**

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

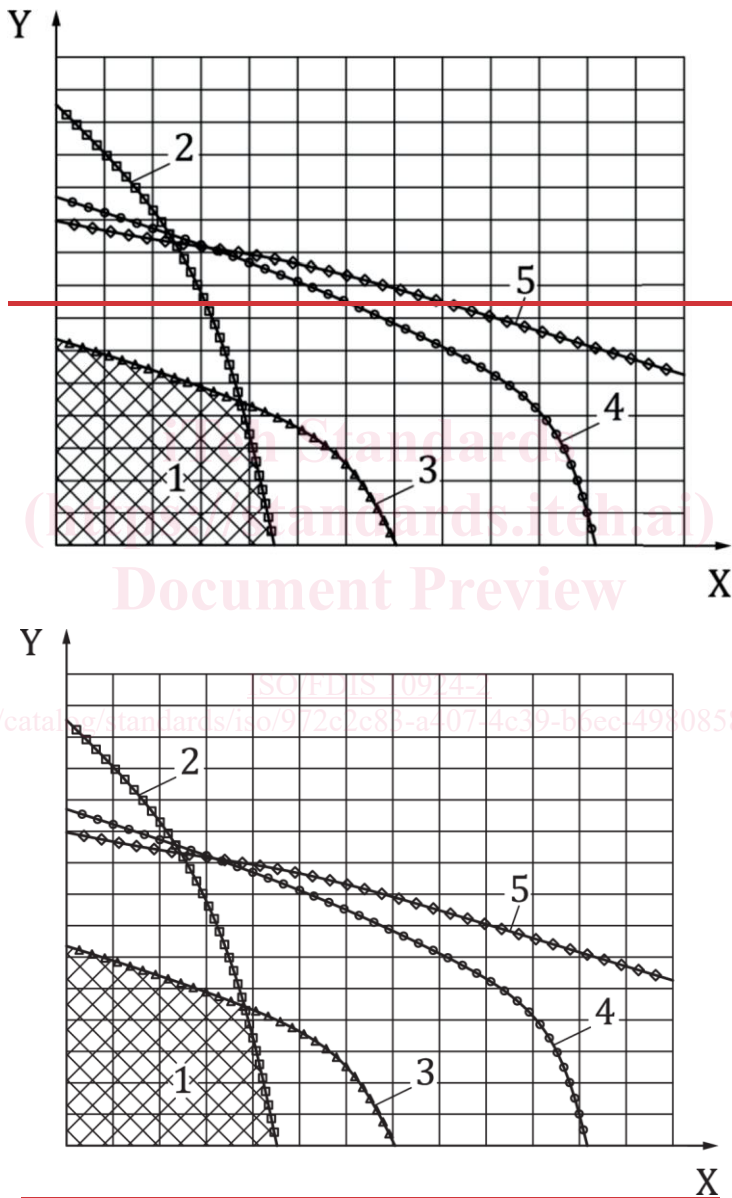
A temperature rise test can be conducted using circuit breakers, circuit breaker holders and connections as specified by the vehicle manufacturer. At a specified test current, the temperature of the connections shall be measured at the points, either tabs or bolt connection of the circuit breaker that protrude from the base of the circuit breaker body (specified in ISO 10924-1 according to the type of 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](#)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 *I-t* - characteristic of the insulated conductor (cable) [A.2.2.4](#)A.2.2.4 and rerating factor [Table C.1](#)Table C.1.



- Key**
- X room temperature,  $T$
  - Y current,  $I$
  - 1 application area
  - 2 cable
  - 3 connection
  - 4 insulator
  - 5 circuit breaker