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Road vehicles — Circuit breakers —

Part 5: Circuit breakers with bolt with rated voltage of 450 V

Véhicules routiers — Coupe-circuits —

Partie 5: Coupe circuit moyen à boulon avec une tension nominale de 450 V

Reference number
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Contents

Page

Foreword ..... **iv**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **1**

4 Marking, labelling and colour coding **1**

5 Tests and requirements **2**

5.1 General 2
5.1.1 General test conditions 2
5.1.2 Test sequence plan 2
5.1.3 Test cable sizes 3
5.2 Voltage drop 4
5.2.1 Purpose 4
5.2.2 Tests 4
5.2.3 Requirements 4
5.3 Maximum housing temperature 5
5.4 Environmental conditions 5
5.5 Operating time-rating 5
5.5.1 Purpose 5
5.5.2 Tests 5
5.5.3 Requirements 5
5.6 Current steps 5
5.7 No current trip and reset temperature 5
5.8 Absolute breaking capacity 6
5.8.1 Tests 6
5.8.2 Requirements 6
5.9 Breaking capacity 6
5.9.1 Tests 6
5.9.2 Requirements 6
5.10 Strength of terminals 6
5.10.1 Tests 6
5.10.2 Requirements 7
5.11 Endurance 7
5.11.1 Tests 7
5.11.2 Requirements 7
5.12 Dielectric strength 7
5.12.1 Tests 7
5.12.2 Requirement 7
5.13 Pulse test 7
5.13.1 Purpose 7
5.13.2 Test 7
5.13.3 Requirement 8

6 Dimensions and designation example **9**

Bibliography **10**

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.

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 32, *Electrical and electronic components and general system aspects*.

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 3: Miniature circuit breakers with tabs (Blade type), Form CB11*

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

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

Road vehicles — Circuit breakers —

Part 5:
Circuit breakers with bolt with rated voltage of 450 V

1 Scope

This part of ISO 10924 specifies circuit breakers with rated voltage of 450 V for use in road vehicles. It establishes, for this circuit breaker type, the rated current, test procedures, performance requirements and dimensions.

This part of ISO 10924 is intended to be used in conjunction with ISO 10924-1 and with ISO 10924-2. The numbering of its clauses corresponds to that of ISO 10924-1 whose requirements are applicable, except where modified by requirements particular to this part of ISO 10924.

This part of ISO 10924 is applicable to circuit breakers with a rated voltage of 450 V d.c., a current rating of no greater than 300 A and a breaking capacity of 6 000 A.

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 6722–1, *Road vehicles — 60 V and 600 V single-core cables — Part 1: Dimensions, test methods and requirements for copper conductor cables*

ISO 8820–7, *Road vehicles — Fuse-links — Part 7: Fuse-links with tabs (Type G) with rated voltage of 450 V*

ISO 8820–8, *Road vehicles — Fuse-links — Part 8: Fuse-links with bolt-in contacts (Type H and J) with rated voltage of 450 V*

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

ISO 16750–4, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 4: Climatic loads*

3 Terms and definitions

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

4 Marking, labelling and colour coding

See ISO 10924-1 and Table 1.

Table 1 — Colour code

Rated current, I_R A	Colour code
15	blue
20	yellow
25	white (natural)
30	green
40	orange
50	red
60	blue
70	brown
80	black
100	blue
120	white
150	orange
200	blue
250	pink
300	grey

5 Tests and requirements

5.1 General

5.1.1 General test conditions

In addition to carrying out the test procedures in accordance with ISO 10924-1, the following criteria shall apply.

— Tests shall be performed following the test sequences in Table 2.

— The test fixture for electrical tests shall be designed in accordance with ISO 8820-7 and ISO 8820-8. The connection resistance shall be 1 mΩ max. to ensure the proper function of the test fixture. The ambient temperature range for circuit breakers according to this part of ISO 10924 shall be −40 °C to 85 °C, Code G (according to ISO 16750-4).

5.1.2 Test sequence plan

Table 2 — Test sequence plan

No	Test	Clause	Sample groups[a]							
			1	2	3	4	5	6	7	8
1	Dimensions	Clause 6	X	—	—	—	—	—	—	—
2	Marking, labelling and colour coding	Clause 4	X	—	—	—	—	—	—	—
3	Operating time rating 2,0 I_R	5.5	X	X	X	X	X	X	X	X
4	Current steps	5.6	—	—	—	—	X	—	—	—
5	Voltage drop	5.2	X	X	X	X	X	X	X	X
6	Maximum housing temperature	5.3	—	—	—	X	—	—	—	—

— Not required.

[a] Three circuit breakers for each rated current rating per sample group.

[b] 3 + 3 circuit breakers for each rated current rating, three circuit breakers with reversal voltage.

Table 2 *(continued)*

No	Test			Clause	Sample groups[a]							
					1	2	3	4	5	6	7	8
7	No current trip and reset temperature			5.7	—	—	—	—	X	—	—	—
8	Strength of terminals			5.10	X	X	X	—	—	—	—	—
9	Environmental conditions	Climatic loads		5.4	—	—	—	X	—	—	—	—
10		Chemical loads			—	—	—	—	X	—	—	—
11		Mechanical loads	Vibration		—	—	—	—	—	X	—	—
			Shock		—	—	—	—	—	X	—	—
			Free Fall		—	—	—	—	—	X	—	—
12	Absolute breaking capacity			5.8	X[b]	—	—	—	—	—	—	—
13	Breaking capacity			5.9	—	X[b]	—	—	—	—	—	—
14	Endurance			5.11	—	—	X[b]	—	—	X	—	—
15	Pulse test			5.13	—	—	—	—	—	—	—	X
16	Operating time rating		1,0 I_R	5.5	—	X	X	—	—	—	X	X
			1,35 I_R		—	—	—	X	—	X	X	—
			1,5 I_R		—	—	—	—	—	—	X	—
			2,0 I_R		—	X	X	X	X	X	X	X
			4,0 I_R		—	—	—	—	—	—	X	—
			6,0 I_R		—	X	—	X	—	X	X	—
17	Voltage drop			5.2	—	X	X	X	X	X	X	X
18	Maximum housing temperature			5.3	—	—	—	X	—	—	—	—
19	Dielectric strength			5.12	X	X	X	X	X	X	—	X
20	Strength of terminals			5.10	X	X	X	X	X	X	X	X
20	Marking, labelling and colour coding			Clause 4	X	X	X	X	X	X	X	X

— Not required.

[a] Three circuit breakers for each rated current rating per sample group.

[b] 3 + 3 circuit breakers for each rated current rating, three circuit breakers with reversal voltage.

5.1.3 Test cable sizes

Test cable sizes shall be as given in Table 3. All tests for a particular circuit breaker rating shall be performed using the same cable size.

Test cable sizes are specified to allow comparative circuit breaker tests to be carried out. The cable size specified herein does not necessarily indicate the size of cable to be used in the vehicle application.

Only thick wall cables as specified in ISO 6722-1 shall be used for testing.

Table 3 — Test cable sizes

Rated current, I_R A	**Conductor cross-sectional area**[a] mm^2	**Length** mm
15	1,5	500 ± 50
20	2,5	
25	2,5	
30	4	
40	6	
50	10	
60	10	
70	16	
80	16	
100	16	
120	16	
150	25	
200	35	
250	50	
300	70	

[a] Conductor material according ISO 6722-1 for copper cables.

5.2 Voltage drop

5.2.1 Purpose

See ISO 10924-1.

5.2.2 Tests

The circuit breaker voltage drop shall be measured at points A and B across the circuit breaker tabs at 1,0 × I_R as shown in ISO 8820-7 and ISO 8820-8.

5.2.3 Requirements

The requirements given in Table 4 shall apply.

Table 4 — Voltage drop

Rated current, I_R A	**Max. voltage drop,** U_D V
15	0,200
20	0,200
25	0,175
30	0,175
40	0,150
50	0,150
60	0,125
70	0,125
80	0,100
100	0,100
120	0,095

Table 4 *(continued)*

Rated current, I_R A	**Max. voltage drop**, U_D V
150	0,090
200	0,080
250	0,075
300	0,070

5.3 Maximum housing temperature

The tests and requirements specified in ISO 10924-1 shall apply. The subsequent tests in Table 2 have to be passed.

5.4 Environmental conditions

The tests of ISO 10924-1 shall apply.

5.5 Operating time-rating

5.5.1 Purpose

See ISO 10924-1.

5.5.2 Tests

The test of ISO 10924-1 shall apply.

5.5.3 Requirements

The requirements given in Table 5 shall apply.

Table 5 — Operating times

Test current A	**Operating time** s	
	min	max
I_R	3 600	∞
1,35 I_R	100	1 800
1,50 I_R	50	400
2,00 I_R	10	100
4,00 I_R	0,5	30
6,00 I_R	0,05	1

— Not required.

NOTE The values given here are the total time values, including pre-arcing time and arcing time.

5.6 Current steps

The test and requirements of ISO 10924-1 shall apply.

5.7 No current trip and reset temperature

The test and requirements of ISO 10924-1 shall apply.

5.8 Absolute breaking capacity

5.8.1 Tests

The tests as described in ISO 10924-1 shall apply. The circuit breakers shall be tested at 6 000 A, U_{Smax} = 480 V. The time constant of the circuit shall be adjusted with the variable resistor R and/or the inductor L to (0,5 ± 0,2) ms.

5.8.2 Requirements

The requirements as in ISO 10924-1 shall apply.

5.9 Breaking capacity

5.9.1 Tests

The tests given in ISO 10924-1 shall apply; the circuit breakers shall be tested to the values specified in Table 6, for U_{Smax} = 480 V.

Table 6 — Breaking capacity

Rated current, I_R A	**Breaking capacity** A
15	250
20	
25	
30	300
40	
50	400
60	
70	500
80	
100	
120	
150	600
200	
250	750
300	900

5.9.2 Requirements

The requirements of Table 2 and the tests specified in ISO 10924–1 shall apply.

5.10 Strength of terminals

5.10.1 Tests

Strength of terminals has to be agreed upon between circuit breaker manufacturer and vehicle manufacturer.

Tests shall be made with the appropriate type of conductor having the maximum cross section of wires.

5.10.2 Requirements

Terminals shall not work loose and there shall be no damage, such as breakage of screws or damage to the housing, threads, washers or stirrups that will impair the further use of the connections.

5.11 Endurance

5.11.1 Tests

The tests and cycling profiles as given in ISO 10924-1 (Type IV) shall apply; the minimum number of cycles is shown in Table 7.

Table 7 — Endurance

Endurance	Current	Current load time s	Operating time s	Resetting time s	Cycles
Electro-mechanical cycling (On < 5 s, Off > 20 s)	1 x I_R	5	—	20	5 000
Electro-mechanical cycling (On < 5 s, Off > 20 s)	2 x I_R	5	20	—	100
Mechanical cycling (6 cycles/min)	0 A	—	—	—	100 000
— Not required.					

5.11.2 Requirements

See ISO 10924-1.

5.12 Dielectric strength

5.12.1 Tests

The circuit breaker shall be measured in OFF-position at points A and B as shown ISO 8820-7 and ISO 8820-8. The test voltage amounts to (3 000 ± 50) VDC for $\left(60^{+6}_{0}\right)$ s.

5.12.2 Requirement

Flashover shall not occur and the leakage current shall not exceed 15 mA.

5.13 Pulse test

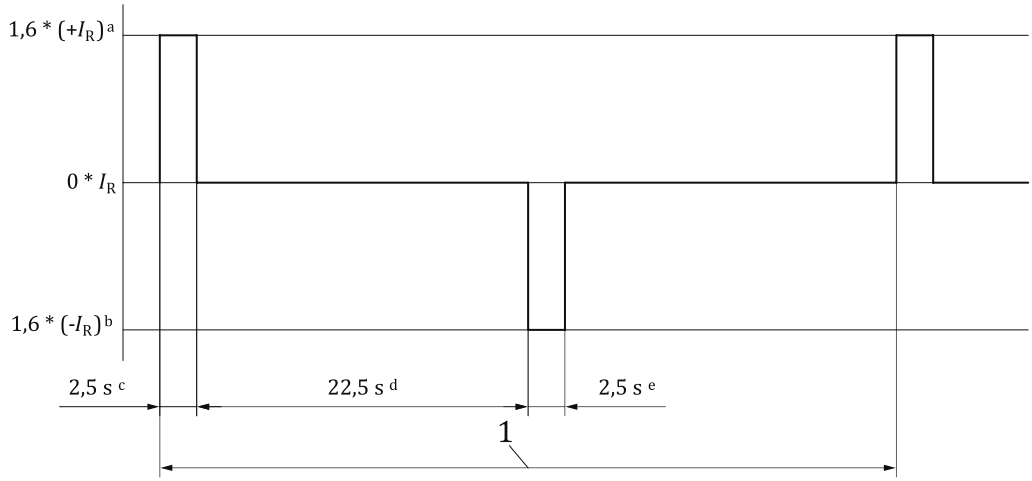
5.13.1 Purpose

To simulate the ability of the circuit breaker to withstand the duty cycles of the driving conditions (unload and recuperation) of an electric vehicle.

5.13.2 Test

The test shall be performed at $U_{\text{Smax}}\left(^{+2}_{0}\right)V$ with a (2,0 ± 0,5) ms time constant. The pulse test profile is shown in Figure 1. Perform this test at standard conditions and ambient temperature as specified in the appropriate part of ISO 10924. A multiple I_R shall be applied to the circuit breaker for a length of time allowing it to cycle continuously as specified in the appropriate part of ISO 10924. See Figure 1 for the pulse test profile

A multiple I_R (unload and recuperation) shall be applied to the circuit breaker for a length of time allowing it to cycle continuously as specified in Figure 1. The minimum number of cycles is 500 000.



Key

1 one cycle

a 1,6 × (+I_R) (unload).

b 1,6 × (-I_R) (recuperation).

c Load time = 2,5 s.

d No load time = 22,5 s.

e Recuperation time = 2,5 s.

Figure 1 — Pulse test profile

5.13.3 Requirement

After the test, the current through the circuit breaker shall not exceed the value as specified in the appropriate part of ISO 10924 at the voltage (U_R). The following shall not occur:

— permanent arcing;

— ruptures to the external surfaces shall not be visible to the naked eye;

— welding together of the contacts or terminals;

— circuit breaker shall be removable in one piece from the test fixture by its intended method.

6 Dimensions and designation example

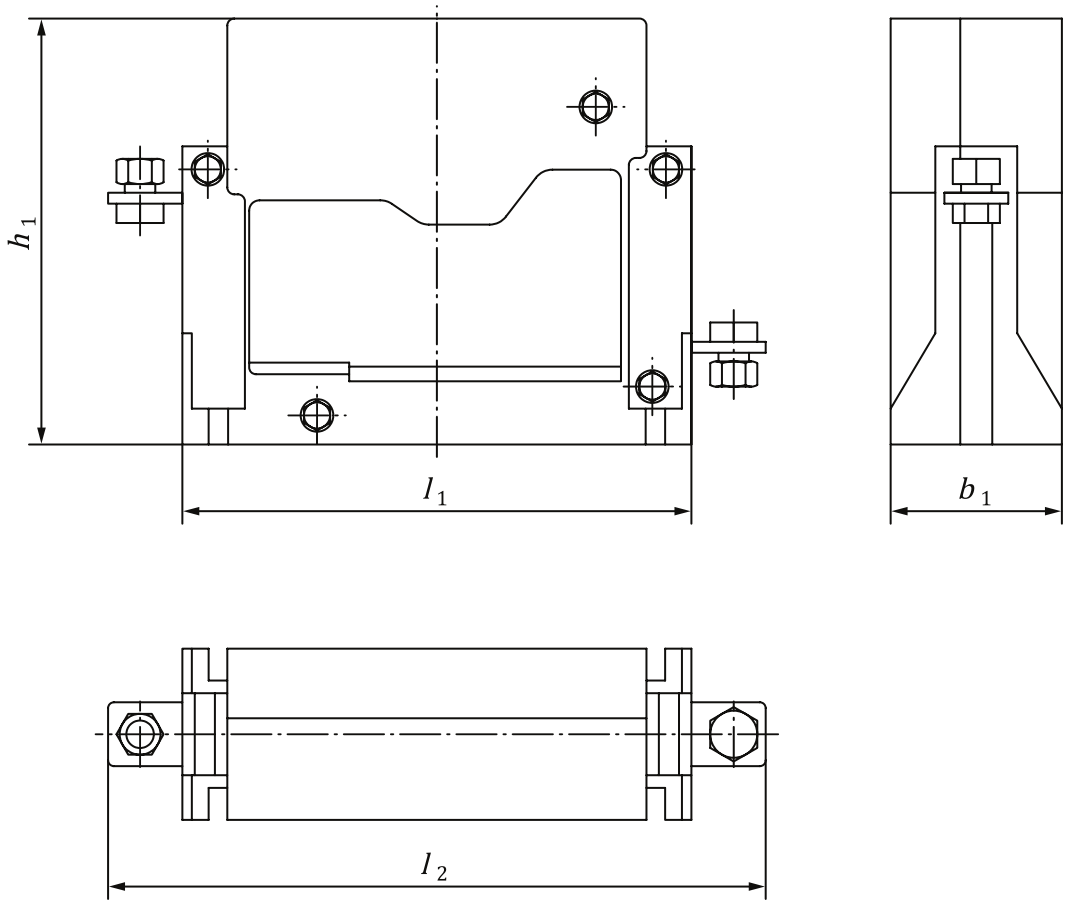


Figure 2 — Designation example

Table 8 — Dimensions

Dimension mm	Category		Tolerances mm
	ACD	BGH	
b_1	44,5	—	±0,5
h_1	112	—	
l_1	132	—	
l_2	170	—	
— Not required			

Bibliography

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

[2] ISO 10924–2, *Road vehicles — Circuit breakers — Part 2: User's guide*

[3] ISO 16750–1, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 1: General*

[4] ISO 16750–3, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 3: Mechanical loads*

[5] ISO 16750–5, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 5: Chemical loads*

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