INTERNATIONAL STANDARD

ISO 20934

First edition
2019-04

Road vehicles — Fuse-links with axial terminals for use in 48V networks — Types SF36-70V, SF51-70V and SF56-70V

Véhicules routiers — Liaisons fusibles avec languettes axiales pour réseaux 48V — Types SF36-70V, SF51-70V et SF56-70V

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Reference number
ISO 20934:2019(E)

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Contents

Page

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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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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

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Road vehicles — Fuse-links with axial terminals for use in 48V networks — Types SF36-70V, SF51-70V and SF56-70V

1 Scope

This document specifies fuse-links with axial terminals (Strip fuse-links) Types SF36-70V, SF51-70V and SF56-70V used in road vehicles. It establishes, for these fuse-link types, the rated current, test procedures, performance requirements, and dimensions.

This document is applicable to fuse-links with a rated voltage of 70 V DC, a rated current of 30 A to 500 A, and a breaking capacity of 2 500 A intended for use in the electrical system of road vehicles with a nominal voltage of 48 V DC.

This document is intended to be used in conjunction with ISO 8820-1 and with ISO 8820-2. The numbering of its clauses corresponds to that of ISO 8820-1, whose requirements are applicable, except where modified by requirements particular to this document.

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

ISO 8820-1:2014, *Road vehicles — Fuse-links — Part 1: Definitions and general test requirements*

ISO 16750-3:2012, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 3: Mechanical loads*

ISO 16750-5:2010, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 5: Chemical loads*

IEC 60068-2-14:2009, *Environmental testing — Part 2-14: Tests — Test N: Change of temperature*

3 Terms and definitions

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

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

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

— IEC Electropedia: available at http://www.electropedia.org/

4 Marking, labelling and colour coding

See ISO 8820-1. The fuse-link shall be additionally marked with U_R “70 V”, the colour coding given in Table 1 shall apply.

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Table 1 — Fuse-link colour coding

Fuse-link rated current A	Fuse-link type SF36-70V	Fuse-link types SF51-70V and SF56-70V
30	orange	—
40	green	
50	red	
60	yellow	light blue
70	brown	dark grey
80	white	red
100	blue	yellow
125	pink	green
150	grey	orange
175	light brown (tan)	white
200	violet	blue
225	—	light brown (tan)
250		pink
300		light grey
350		dark green
400		violet
450		gold/dark yellow
500		brown

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5 Design and test requirements

5.1 General

5.1.1 General test conditions

See ISO 8820-1 and the following:

— Install the fuse-link in the test fixture with a torque of 9 Nm ± 1 Nm for M6 bolts and a torque of 20 Nm ± 1 Nm for M8 bolts. For a method to conduct retightening torque and setting behaviour, see Annex A.

— The bolt-down fuse-link validation shall apply to the clinchable version.

— If clinchable fuse-links need to be tested on the test fixtures shown in Figures 10, 11, or 12 for the tests, then a hole should be produced into the clinch-terminal to fit the bolt-down test fixture.

Perform the tests according to the test sequence in Table 2.

Fuse-link types SF51-70V and SF56-70V with a rated current between 300 A and 500 A shall only be used for short circuit protection.

5.1.2 General performance requirements

See ISO 8820-1 and the following:

— After the tests, the insulator shall be intact, visible cracks are not permitted.

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5.1.3 General fuse-link requirements

The general fuse-link requirements are as follows:

— The terminals shall be made out of a copper material.

— The surface of the terminals shall be tin coated with a thickness of 0,5 µm to 6 µm.

— The insulator shall enclose the fuse-element completely.

5.1.4 Test sequence

Table 2 — Test sequence

No.	Test		Clause	Breaking capacity, I^2t-value	Operating time rating	Current steps	Current cycling	Chemical loads	Climatic loads	Temperature shock	Shock, &Vibration	Derating (optional)	Mechanical stability	Dimensions
	Sample group			A	B	C	D	E	F	G	H	J	K	L
	Number of samples			6	[a]	6	12	6	12	12	12	6	12	10
1	Dimensions		6											X
2	Marking		4					X	X	X				
3	Cold resistance		5.10	X	X	X	X		X	X	X	Z	X	
4	Retightening torque		A.1				Z		Z	Z	Z	Z		
5	Temperature shock		5.4.5							X				
6	Climatic loads		5.4.2						X					
7	Chemical loads		5.4.3					X						
8	Shock & Vibration		5.4.4								X			
9	Current cycling		5.3				X							
10	Derating		A.3									Z		
11	Current steps		5.6			X								
12	Breaking capacity		5.7	X										
13	Mechanical stability		5.8										X	
14	Cold resistance		5.10				X		X	X	X		X	
15	Retightening torque		A.1							Z				
16	Overload test	1,35 I_R[b]	5.11				Y		Y	Y	Y		Y	
		2,0 I_R					Y		Y	Y	Y		Y	
17	Operating time rating	0,75 I_R or I_R (with voltage drop measurement)	5.5 5.2		Y									
		1,35 I_R[b]	5.5		Y									
		1,5 I_R [b]			Y									
		2,0 I_R			Y									
		3,0 I_R or 3,5 I_R			Y									
		5,0 I_R[b]			Y									
		6,0 I_R[b]			Y									
18	I^2t-value		A.2	Z										
19	Insulation resistance		5.9	X	X	X	X		X	X	X			
20	Retightening torque		A.1				Z		Z		Z	Z		
21	Marking		4	X				X	X	X	X			

[a] Use at least 6 samples for each test current in the overload test.

[b] If applicable.

Y Each rated current shall be divided equally on these tests. The fuses are intended for a single operation only.

Z These tests are optional.

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5.1.5 Test cable size

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

Use thin-wall cables, temperature class C, according to ISO 6722-1, silicone insulation is not permitted.

Use a tubular cable lug, Cu-HCP with Sn coating and hexagonal or W-crimp style.

Table 3 — Test cable sizes

I_R **A**	**Conductor cross sectional area** **mm²**
30	2,5
40	4,0
50	6,0
60	
70	10,0
80	
100	
125	16,0
150	25,0
175	
200	35,0
225	
250	50,0
300	
350	
400	70,0
450	
500	

5.2 Voltage drop

5.2.1 Purpose

This test defines and measures the energy consumption of the fuse-link which creates a temperature rise.

5.2.2 Test

This test shall be performed at rated current. For SF51-70V and SF56-70V rated 300 A to 500 A fuse-links the test shall be performed at 0,75 I_R.

Record the voltage drop after the values are stabilized, i.e., the values do not change more than 2 % within a 10 min period. Measure at the points indicated (see Figure 3 to Figure 5) using the test fixtures of Clause 7.

NOTE This test can be performed during the operating time rating.

5.2.3 Requirement

The requirements given in Table 4 shall apply.

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Table 4 — Voltage drop

Rated current A	Maximum voltage drop mV	
	for fuse-link type SF36-70V	for fuse-link types SF51-70V and SF56-70V
30	120	—
40		
50		
60	110	110
70		
80		
100	100	
125		
150		
175		
200		
225	—	80
250		
300		
350		
400		
450		
500		

5.3 Current cycling

5.3.1 Purpose

This test evaluates the ability of the fuse-link to withstand the energy volume of transient pulses.

5.3.2 Test

Apply a cyclic current as displayed in Figure 1 to the fuse-link, perform 10 000 cycles. The rectangular current shall have a rise time of <0,01 s.

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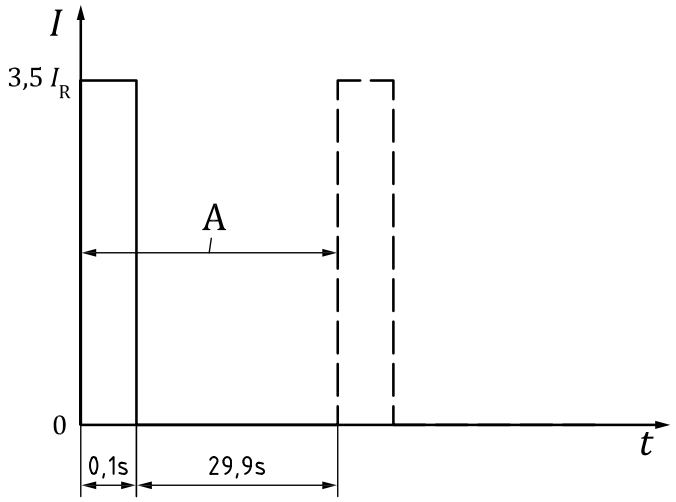

Key

I current
t time in s
A one cycle

Figure 1 — Current cycling

This test does not apply to fuse-links types SF51-70V and SF56-70V rated 300 A and above. For those fuse-links, agreements shall be taken between supplier and customer.

5.3.3 Requirement

After the current cycling, the fuse-links shall meet the requirements of the subsequent tests according to Table 2.

5.4 Environmental conditions

5.4.1 Purpose

These tests evaluate the ability of the fuse-links to function under environmental stresses.

5.4.2 Mechanical Shock and Vibration test

Perform a shock test according to ISO 16750-3:2012, 4.2.2.

Afterwards, perform a vibration test according to ISO 16750-3:2012, 4.1.2.4, with the modification according to Table 5.

Table 5 — Vibration test

T_{min}	−40 °C	
T_{max}	125 °C	
Acceleration rms value	30,8 m/s^2	
Vibration profile	Frequency Hz	Power spectral density (m/s^2)^2/Hz
	5	0,884
	10	20
	55	6,5

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Table 5 *(continued)*

	180	0,25
	300	0,25
	360	0,14
	1 000	0,14
	2 000	0,14

Perform this test with the fuse-links mounted in the test fixtures without attached test cables.

The subsequent tests shall be passed.

5.4.3 Climatic loads

Perform the tests according to ISO 8820-1.

5.4.4 Chemical loads

Perform the test as specified in ISO 16750-5:2010, Table B.1, for the mounting location "engine compartment", use the application method "wiping". Further testing can be agreed on between supplier and customer.

5.4.5 Temperature shock

Perform this test according to IEC 60068-2-14:2009 "Test Na", with the parameters indicated in Table 6. The fuse-links shall be mounted in the test fixtures.

Table 6 — Temperature shock

T_{min}	−40 °C
T_{max}	130 °C
Soak time	15 min
Number of cycles	600
Transition time	≤10 s

5.4.6 Requirement

After the test, the fuse-links shall remain physically intact, the marking shall remain legible, and the fuse-links shall meet the requirements of the subsequent tests according to Table 2.

5.5 Operating time rating

5.5.1 Purpose

See ISO 8820-1.

5.5.2 Test

See ISO 8820-1.

5.5.3 Requirement

The requirements given in Table 7 and Table 8 shall apply.

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Table 7 — Operating times type SF36-70V

Test currents	Minimum s	Maximum s
I_R	360 000	—
1,35 I_R	300	3 600
1,5 I_R	90	500
2,0 I_R	1	50
3,0 I_R	0,3	4
5,0 I_R	0,1	1
6,0 I_R	0,07	0,7

Table 8 — Operating times types SF51-70V and SF56-70V

Test currents	<300 A		≥300 A	
	Minimum s	Maximum s	Minimum s	Maximum s
0,75 I_R	—	—	14 400	—
I_R	14 400	—	—	—
1,35 I_R	120	1 800	—	—
1,5 I_R	20	450	—	—
2,0 I_R	1	15	1	15
3,5 I_R	0,3	5	0,5	5
6,0 I_R	0,1	1	—	—

5.6 Current steps

5.6.1 Purpose

See ISO 8820-1.

5.6.2 Test

See ISO 8820-5. This test does not apply for fuse-link types SF51-70V and SF56-70V rated 300 A to 500 A.

5.6.3 Requirement

The subsequent tests according to Table 2 shall be passed.

After these tests, the fuse-link shall be removable from the test fixture by its intended method, after returning to RT.

5.7 Breaking capacity

5.7.1 Purpose

See ISO 8820-1.

5.7.2 Test

See ISO 8820-1 with the following modifications.

The test shall be performed at ≥U_R (≥70 V), and a prospective current ≥2 500 A. The actual values shall be documented.

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The recovery voltage shall at least be ≥95 % of U_R. The recovery voltage 2 ms to 3 ms after current-zero shall not be less than 95 % of U_R and shall be maintained for not less than 30 s.

If the current cannot be reached, a different test cable diameter may be used.

If the test is performed using a rectified transformer, the voltage may never drop below U_R (70 V). The usage of an electronic load in constant-current mode is not permitted.

5.7.3 Requirement

The subsequent tests according to Table 2 shall be passed.

After these tests, the fuse-link shall be removable from the test fixture by its intended method, after returning to RT.

5.8 Mechanical stability

5.8.1 Purpose

This test evaluates the ability of the fuse-link to withstand forces caused e.g. by the thermal expansion of a fuse-box.

5.8.2 Test

Apply a force F of 150 N for the fuse-link type SF36-70V and 300 N for types SF51-70V and SF56-70V onto the fuse-link's terminal as shown in Figure 2 for a period of 2 s minimum. The fuse-link shall not be damaged, the cold resistance shall be measured during the test and documented.

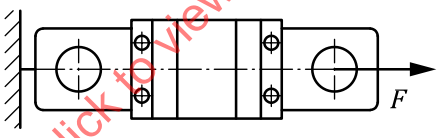

Figure 2 — Pull-test

5.8.3 Requirement

After the test, the fuse-link shall remain physically intact and meet the requirements of the subsequent tests according to Table 2.

5.9 Insulation resistance

5.9.1 Purpose

This test evaluates the ability of the fuse-link to properly disconnect and insulate the circuit after operation.

5.9.2 Test

The resistance shall be measured in the used test fixture. The fuse-link shall not be moved before the test.

Perform the test between 1 min and 5 min after the breaking capacity test or the operating times test. The megohmmeter shall be set to 100 V, the test voltage shall be applied for 60 s to the terminals.

5.9.3 Requirement

The fuse-link's insulation resistance shall be ≥200 kΩ.

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5.10 Cold resistance

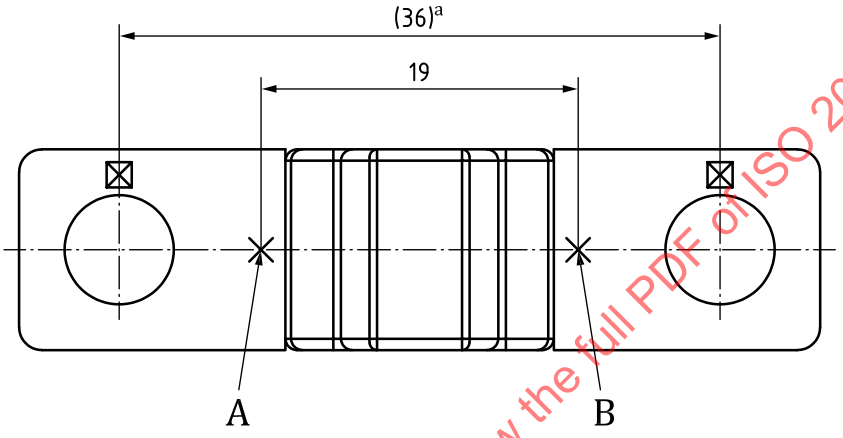
5.10.1 Purpose

The cold resistance measurement is a quick and easy way to measure the resistance of the fuse-link and detect changes which might point to defects of the fuse element.

5.10.2 Test

The cold resistance shall be measured using a four-wire-ohmmeter and shall be documented. The current during measurement shall be <0,1 I_R.

Measure the resistance at the points shown in Figure 3, Figure 4, and Figure 5.



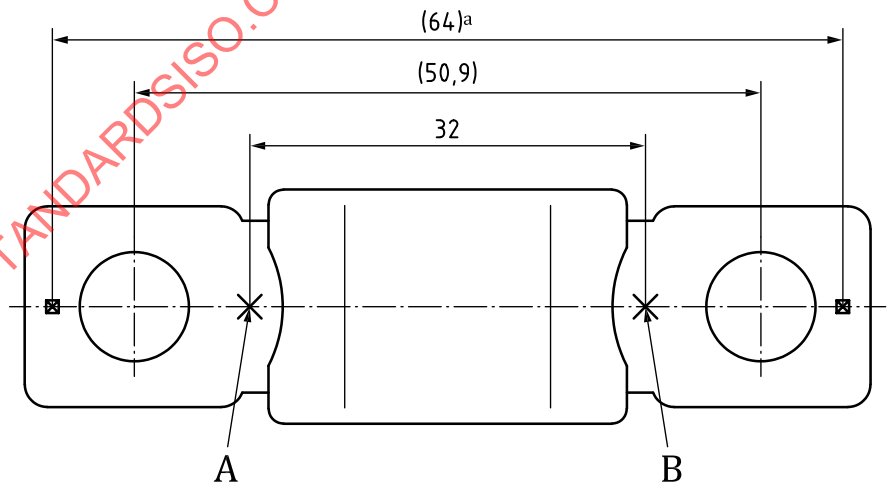
Key

A, B voltage drop measuring points

a Recommendation for current input.

Figure 3 — Measurement points SF36-70V

Dimensions in millimetres



Key

A, B voltage drop measuring points

a Recommendation for current input.

Figure 4 — Measurement points SF51-70V

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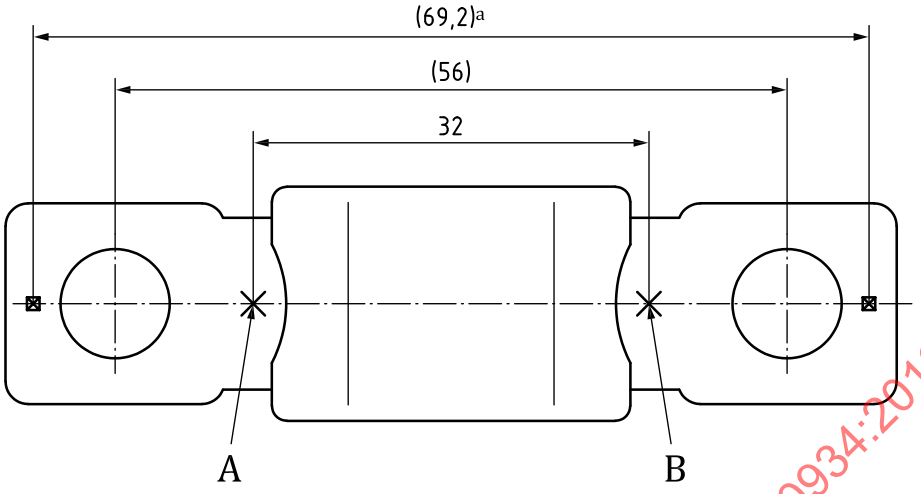
Dimensions in millimetres



Key

A, B voltage drop measuring points

a Recommendation for current input.

Figure 5 — Measurement points SF56-70V

5.10.3 Requirement

After the test sequence, the cold resistance of the fuse-link shall not differ more than 10 % compared to the beginning of the test. A change in cold resistance might point to a defect or ageing of the fuse link.

5.11 Overload test

5.11.1 Purpose

The purpose of this test is to show that the fuse-link disconnects properly during an overload.

5.11.2 Test

See ISO 8820-1:2014, 5.5, with the following modifications:

During testing, maintain a testing voltage of $\geq U_R$ (≥70 V).

If the test is performed using a rectified transformer, the voltage may never drop below U_R (70 V). The usage of an electronic load in constant-current mode is not permitted.

5.11.3 Requirement

The requirements of 5.5.3 and 5.1.2 shall be fulfilled.

6 Dimensions and examples of designation

6.1 Type SF36-70V

6.1.1 Dimensions bolt-down

Dimensions bolt-down see Figure 6.

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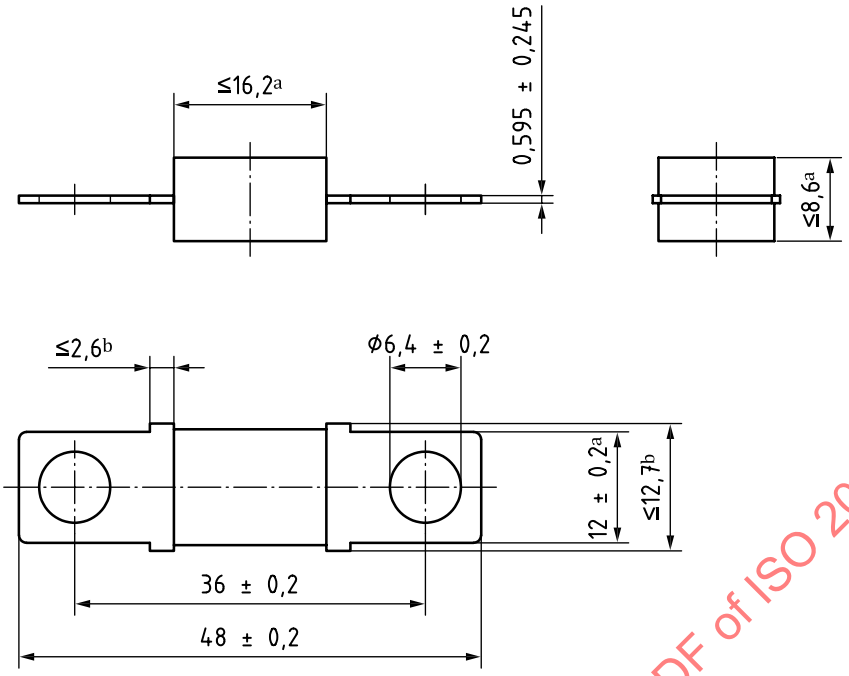
Dimensions in millimetres



a Insulator may be any shape within given dimensions.

b A support with these dimensions is permitted.

Figure 6 — Fuse-link type SF36-70V

6.1.2 Dimensions clinchable

Dimensions clinchable see Figure 7.

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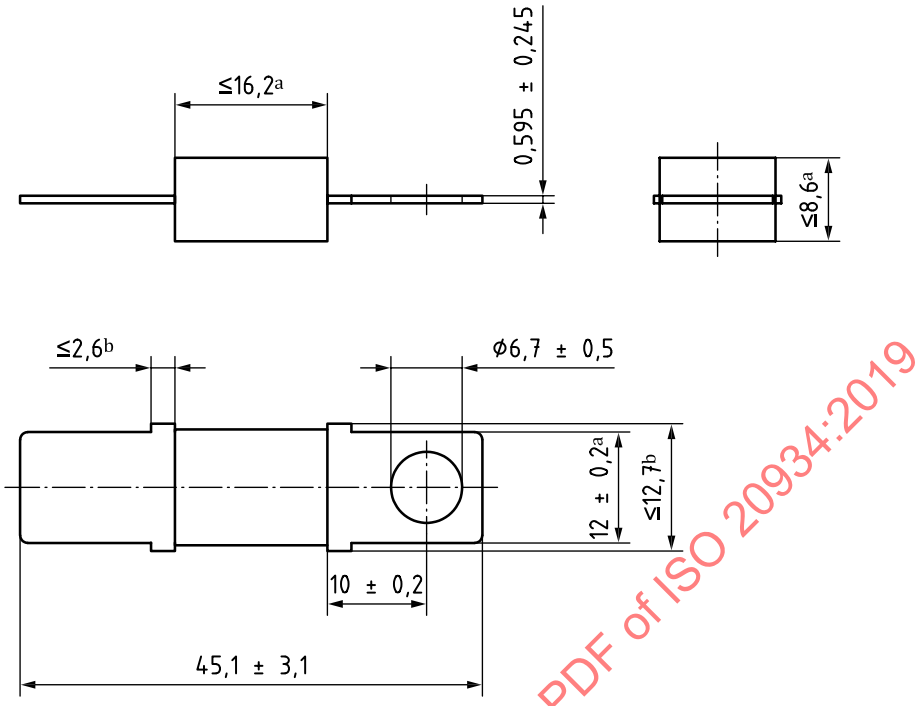
Dimensions in millimetres



a Insulator may be any shape within given dimensions.

b A support with these dimensions is permitted.

Figure 7 — Fuse-link type SF36-70V, clinchable

6.2 Type SF51-70V

For clinchable fuse-links, one through-hole shall be omitted (see Figure 8).

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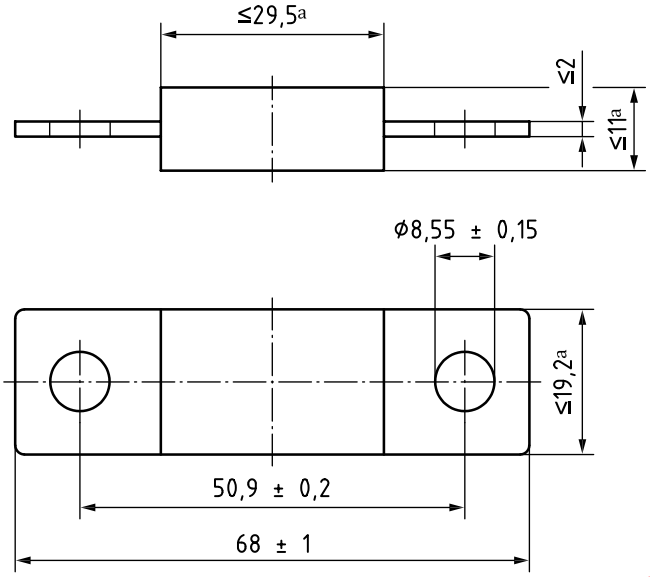
Dimensions in millimetres



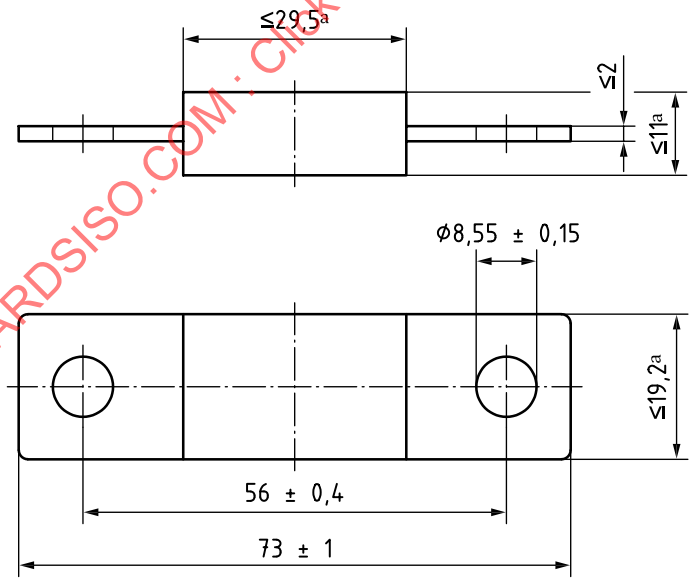
a Insulator may be any shape within given dimensions.

Figure 8 — Fuse-link type SF51-70V

6.3 Type SF56-70V

For clinchable fuse-links, one through-hole shall be omitted (see Figure 9).

Dimensions in millimetres



a Insulator may be any shape within given dimensions.

Figure 9 — Fuse-link type SF56-70V

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6.4 Designation example

An example of the designation of a fuse-link type SF36-70V for a rated current of 100 A is:

Fuse-link ISO 20934, SF36-70V-100.

An example of the designation of a clinchable fuse-link type SF51-70V for a rated current of 150 A is:

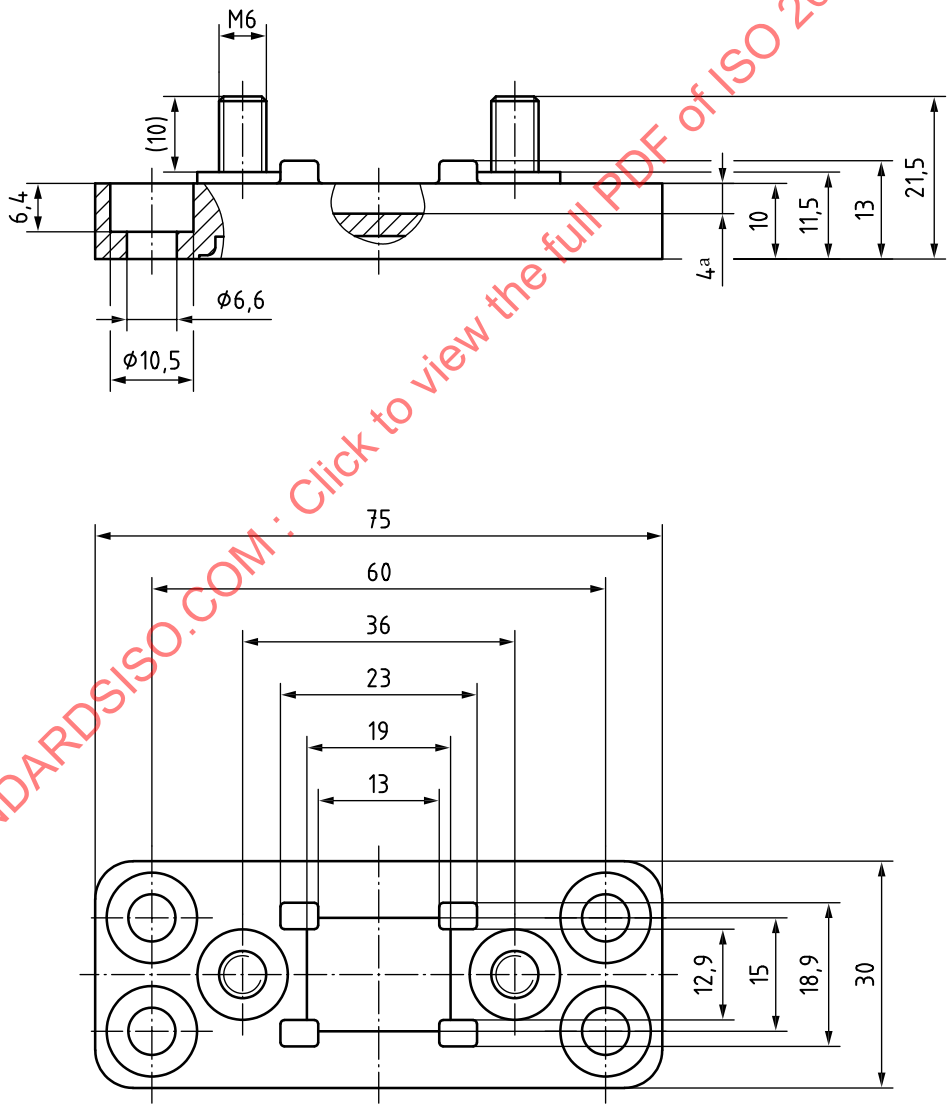
Fuse-link ISO 20934, SF51-70V-150-clinch.

7 Test fixture

7.1 SF36-70V

Dimensions see Figure 10.

Dimensions in millimetres



NOTE Fixture prevents bolt from rotating during torqueing.

Figure 10 — Test fixture — SF36-70 V

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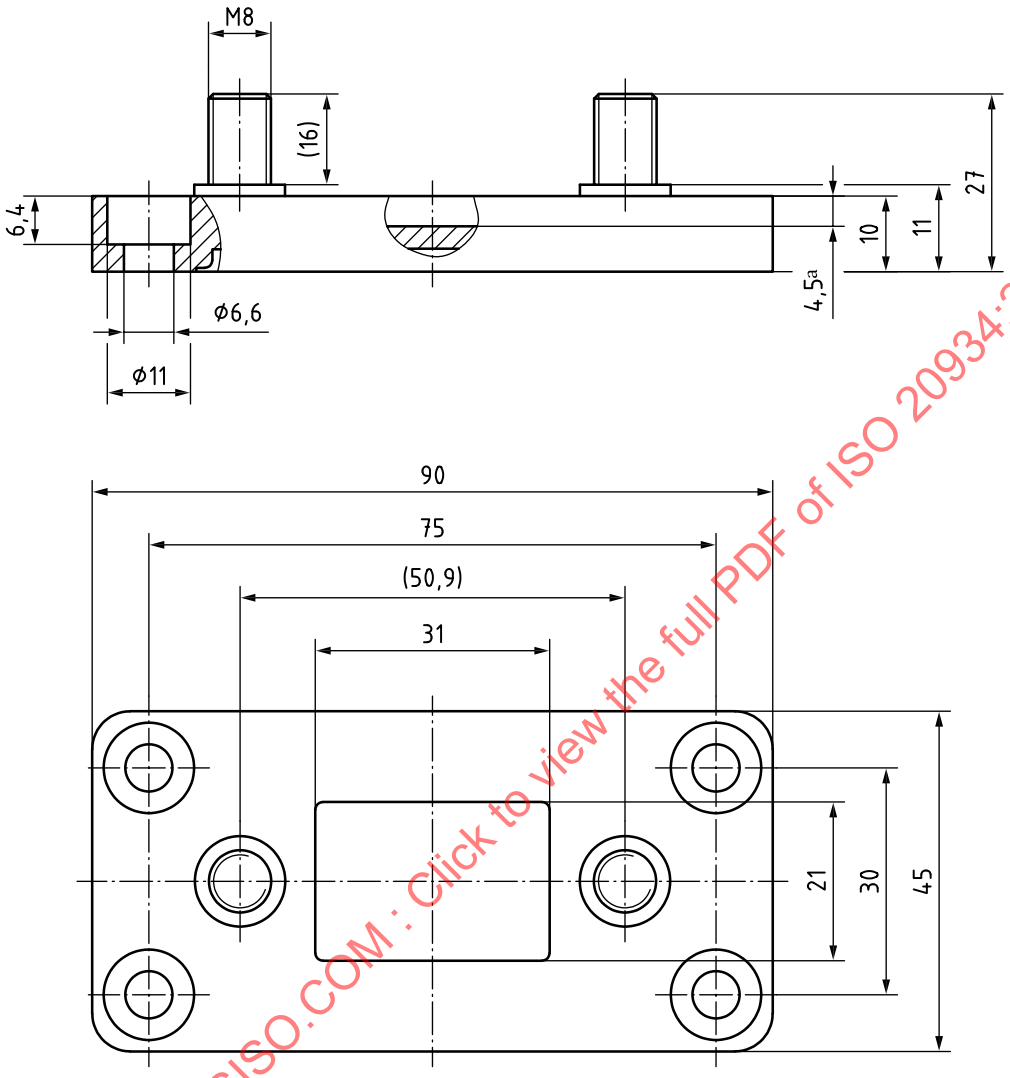
7.2 SF51-70V

Dimensions see Figure 10.

Dimensions in millimetres



NOTE Fixture prevents bolt from rotating during torqueing.

Figure 11 — Test fixture — SF51-70V

7.3 SF56-70V

Dimensions see Figure 10.

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