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**Road vehicles — Automotive cables —  
Part 5:  
Dimensions and requirements for  
600 V a.c. or 900 V d.c. and 1 000 V  
a.c. or 1 500 V d.c. single core copper  
conductor cables**

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*Véhicules routiers — Câbles automobiles —*

*Partie 5: Dimensions et exigences des câbles de cuivre mono  
conducteurs de 600 V a.c. ou 900 V c.c. et 1 000 V a.c. ou 1 500 V c.c.*

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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](http://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](http://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 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](http://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*.

A list of all parts in the ISO 19642 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).

## Introduction

This document was prepared following a joint resolution to improve the general structure of the ISO Automotive Electric Cable standards. This new structure adds more clarity and, by defining a new standard family, opens up the standard for future amendments.

Many other standards currently refer to ISO 6722-1, ISO 6722-2 and ISO 14572. So these standards will stay valid at least until the next scheduled systematic review and will be replaced later on by the ISO 19642 series.

For new Automotive Cable Projects customers and suppliers are advised on using the ISO 19642 series.

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# Road vehicles — Automotive cables —

Part 5:

## Dimensions and requirements for 600 V a.c. or 900 V d.c. and 1 000 V a.c. or 1 500 V d.c. single core copper conductor cables

**WARNING** — The use of this document can involve hazardous materials, operations and equipment. This document does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this document to establish appropriate safety practices and determine the applicability of regulatory limitations prior to use.

### 1 Scope

This document specifies the dimensions and requirements for single core cables intended for use in general purpose road vehicle applications where the nominal system voltage is 600 V a.c. or 900 V d.c. and 1 000 V a.c. or 1 500 V d.c.. It also applies to the individual conductor cores used in multi core cables.

This document specifies requirements for copper conductor cables.

### 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.

EN 13602, *Copper and copper alloys — Drawn, round copper wire for the manufacture of electrical conductors*

ISO 19642-1, *Road vehicles — Automotive cables — Vocabulary and design guidelines*

ISO 19642-2, *Road vehicles — Automotive cables — Test methods*

ASTM B1, *Standard Specification for Hard-Drawn Copper Wire*

ASTM B3, *Standard Specification for Soft or Annealed Copper Wire*

ASTM B33, *Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes*

ASTM B298, *Standard Specification for Silver-Coated Soft or Annealed Copper Wire*

ASTM B355, *Standard Specification for Nickel-Coated Soft or Annealed Copper Wire*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19642-1 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 Specifications

### 4.1 General test conditions

The test conditions of ISO 19642-2 shall apply.

The cables shall be submitted to the tests as specified in [Table 2](#).

If suppliers and customers agree upon modifications or changes to the methods and requirements, all the changes and modifications shall be clearly documented.

### 4.2 Safety concerns

The precautions as described in the WARNING at the beginning of this document shall be followed.

### 4.3 Voltage ratings

The cables described in this document are limited to the voltage ratings shown below.

1. 600 V a.c. or 900 V d.c. maximum
2. 1 000 V a.c. or 1 500 V d.c. maximum

ISO conductor size 0,35 mm<sup>2</sup> shall not be used for 1 000 V a.c. or 1 500 V d.c. cables.

NOTE [Annex B](#) contains information regarding colouring for cables identified for the voltage ratings in this document.

### 4.4 Temperature classes

All temperature classes in [ISO 19642-1](#) are suitable for copper conductor cables.

### 4.5 Conductor material

The conductors shall consist of bare or coated copper strands as defined in [Table 1](#).

ISO conductor sizes greater than or equal to 0,5 mm<sup>2</sup> shall consist of soft annealed copper or annealed compressed wires.

ISO conductor sizes less than 0,5 mm<sup>2</sup> shall consist of soft annealed copper, soft annealed compressed copper, hard unannealed copper or a copper alloy.

The specifications for the conductors shall be completed by material specifications.

Elongation requirements shall be established by agreement between the customer and the supplier.

The finished cable shall meet the resistance and cross-sectional area (CSA) requirements of [Table 10](#) for all conductors except alloys. When an alloy is used, the resistance requirement shall be established by agreement between the customer and the supplier.

NOTE Examples for strands are shown in [Annex A](#).



**Table 1 — Conductor specifications**

Specification number	Description
ASTM B1	Hard-drawn copper wire
ASTM B3 or EN 13602	Soft or annealed copper wire
ASTM B33 or EN 13602	Tinned soft or annealed copper wire
ASTM B298	Silver-coated soft or annealed copper wire
ASTM B355	Nickel-coated soft or annealed copper wire
NOTE Silver and Nickel coated conductors are intended for use with temperature class ratings greater than 150 °C.	

#### 4.6 Conductors

The conductors in the finished cable shall meet the CSA and resistance requirements of [Table 10](#).

The maximum diameter of the conductors is standardized and presented [Table 11](#).

The configuration of the stranded conductor is not standardized.

NOTE 1 Existing stranding configurations for copper conductors are presented in [Table A.1](#).

NOTE 2 Preferred stranding configurations for copper conductors are presented in [Table A.2](#).

Other stranding configurations may be used for copper conductors provided they meet the above requirements and are agreed between the customer and the supplier.

#### 4.7 Insulation thickness

Two different insulation thicknesses are allowed in this document:

1. thick wall insulation;
2. thin wall insulation.

The minimum wall thickness requirements for the different ISO conductor sizes are standardized and specified in [Table 11](#).

The nominal wall thickness is derived from the minimum wall thickness in [Table 11](#) by the following formulae:

$$w_{\text{nom}} = 1,25 \times w_{\text{min}} \text{ or } w_{\text{nom}} = w_{\text{min}} / 0,8$$

where

$w_{\text{min}}$  is the minimum wall thickness;

$w_{\text{nom}}$  is the nominal wall thickness.

#### 4.8 Cable outside diameter

The cable outside diameter for each ISO conductor size and insulation thickness is standardized and specified in [Table 11](#).

#### 4.9 Representative conductor sizes for testing

When a test is required, all combinations of conductor size, insulation thickness and insulation formulation shall meet the specified requirements.

However, if testing of representative conductor sizes is permitted by agreement between the customer and the supplier, compliance for a cable family may be demonstrated by testing examples of large and small conductor sizes only.

**4.10 Reference and requirements for the tests according to ISO 19642-2**

Table 2 provides a list of all relevant tests in ISO 19642-2:2019 for single core copper conductor cables.

**Table 2 — Tests**

Test description	Mandatory			If required <sup>c</sup>	
	In process <sup>a</sup>	Initial certification	Periodic <sup>b</sup>	Initial certification	Periodic <sup>b</sup>
<b>5.1 Dimensional tests</b>					
5.1.2 Cable outside diameter	—	X	X	—	—
5.1.3 Insulation thickness	—	X	X	—	—
5.1.4 Conductor diameter	—	—	—	X	X
5.1.5 Cross sectional area	—	—	—	X	X
5.1.6 In-process cable outside diameter	X	—	—	—	—
<b>5.2 Electrical tests</b>					
5.2.1 Conductor resistance	—	X	X	—	—
5.2.2 Determination of temperature coefficients	—	X	—	—	—
5.2.3 Withstand voltage	—	X	X	—	—
5.2.4 Withstand voltage after environmental testing <sup>d</sup>	—	—	—	—	—
5.2.5 Insulation faults	—	—	—	—	—
5.2.6 Insulation volume resistivity	—	—	—	X	X
<b>5.3 Mechanical tests</b>					
5.3.1 Strip force	—	—	—	X	X
5.3.2 Abrasion <sup>e</sup>					
5.3.2.4 Sandpaper abrasion test	—	X	X	—	—
5.3.2.5 Scrape abrasion test	—	X	X	—	—
5.3.3 Breaking force of the finished cable	—	—	—	X	—
5.3.4 Cyclic bending	—	—	—	X	—
5.3.5 Flexibility	—	—	—	X	—
<b>5.4 Environmental tests</b>					
5.4.1 Specimen preparation and winding tests <sup>d</sup>	—	—	—	—	—
5.4.2 Long term heat ageing, 3 000 h at temperature class rating	—	X	—	—	—

**Key**

X: Test shall be performed according to ISO 19642-2.

—: Test is not required.

<sup>a</sup> A test made on the entire cable lot during or after manufacture.

<sup>b</sup> The frequency of periodic testing shall be established by agreement between the customer and the supplier.

<sup>c</sup> The usage of "If required" tests shall be established by agreement between the customer and the supplier.

<sup>d</sup> These tests are only used in preparation and after environmental endurance tests.

<sup>e</sup> Only one of the abrasion tests has to be performed by agreement between the customer and the supplier.

<sup>f</sup> Compliance for a cable family may be demonstrated by testing examples of large and small conductor sizes only.

<sup>g</sup> Some fluids are for "Initial certification" and others are "If required".

Table 2 (continued)

Test description	Mandatory			If required <sup>c</sup>	
	In process <sup>a</sup>	Initial certification	Periodic <sup>b</sup>	Initial certification	Periodic <sup>b</sup>
5.4.3 Short term heat ageing, 240 h at temperature class rating +25 °C	—	X	X	—	—
5.4.4 Thermal overload, 6 h at temperature class rating +50 °C	—	—	—	X	X
5.4.5 Pressure test at high temperature	—	X	X	—	—
5.4.6 Shrinkage by heat	—	X	X	—	—
5.4.7 Low temperature winding	—	X	X	—	—
5.4.8 Cold impact	—	—	—	X	X
5.4.9 Temperature and humidity cycling <sup>f</sup>	—	—	—	X	—
5.4.10 Resistance to hot water <sup>f</sup>	—	X	—	—	—
5.4.11 Resistance to liquid chemicals <sup>f, g</sup>	—	X	—	X	—
5.4.12 Durability of cable marking <sup>f</sup>	—	—	—	X	X
5.4.13 Stress cracking resistance <sup>f</sup>	—	—	—	X	—
5.4.14 Resistance to ozone <sup>f</sup>	—	—	—	X	—
5.4.15 Resistance to flame propagation	—	X	X	—	—
<b>Key</b> X: Test shall be performed according to ISO 19642-2. —: Test is not required. a A test made on the entire cable lot during or after manufacture. b The frequency of periodic testing shall be established by agreement between the customer and the supplier. c The usage of "If required" tests shall be established by agreement between the customer and the supplier. d These tests are only used in preparation and after environmental endurance tests. e Only one of the abrasion tests has to be performed by agreement between the customer and the supplier. f Compliance for a cable family may be demonstrated by testing examples of large and small conductor sizes only. g Some fluids are for "Initial certification" and others are "If required".					

## 5 Requirements

### 5.1 General

The cables shall be tested per ISO 19642-2 according to their temperature class rating.

The cables shall be tested as specified in [Table 2](#).

### 5.2 Dimensional tests

#### 5.2.1 Cable outside diameter

No single value shall be greater or less than the standardized values in [Table 11](#).

#### 5.2.2 Insulation thickness

No single value shall be less than the standardized minimum value in [Table 11](#).