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Road vehicles — Automotive cables —

Part 7: Dimensions and requirements for 30 V a.c. or 60 V d.c. round, sheathed, screened or unscreened multi or single core copper conductor cables

Véhicules routiers — Cables automobiles —

Partie 7: Dimensions et exigences des câbles en cuivre ronds, gainés, blindés, mono ou multi conducteurs de 30 V a.c ou 60 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).

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 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*.

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.

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.

Road vehicles — Automotive cables —

Part 7: Dimensions and requirements for 30 V a.c. or 60 V d.c. round, sheathed, screened or unscreened multi or 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 multi or single core cables intended for use in road vehicle applications where the nominal system voltage is 30 V a.c. or 60 V d.c.. It also applies to individual cores in multi core and single core 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.

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

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

ISO 19642-3, *Road vehicles — Automotive cables — Dimensions and requirements — 30 V a.c. or 60 V d.c. single core copper cables*

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 1.

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 rating

The voltage rating is established by the rating of the cores 30 V a.c. or 60 V d.c..

4.4 Temperature classes

The temperature class rating is established by the rating(s) of the cores and sheath.

The rating of the cable shall be equal to the lowest rating of the individual cores and sheath.

For details on temperature classes, see ISO 19642-1.

4.5 Conductor material

The conductor material shall be according to ISO 19642-3.

4.6 Conductors

The conductors of the core or cores shall be according to ISO 19642-3.

4.7 Sheath thickness

Two different sheath thicknesses are allowed in this document:

1. thin wall sheath;
2. thick wall sheath.

The insulation wall thickness of the core or cores shall be according to ISO 19642-3.

4.8 Core cable outside diameter

The maximum and minimum outside cable diameter for the core or cores shall be according to ISO 19642-3.

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

Additional production processes in a multi core cable (such as twisting, braiding, jacket extrusion) influence the properties of the cores in the finished cable. Thus for the dimensions and maximum conductor resistance of the used cores the requirements of ISO 19642-3 apply with the following additions:

The minimum wall thickness may follow the design guidelines in ISO 19642-1:—[1)], A.4.

1) Under preparation.

The maximum resistance of cores may follow the design guidelines in ISO 19642-1 :—, A.5.

The values for maximum conductor resistance and minimum wall thickness of the insulation should be documented in the data sheet of the supplier and are the basis for assessment.

Dimensions of preferred constructions for round, sheathed, screened or unscreened multi or single core copper conductor cables are presented in Annex A, Tables A.1 through A.6.

A complete definition of all possible multi core cables is not feasible. In addition to the preferred constructions other constructions are permissible using the calculation rules in ISO 19642-1:—, Annex A.

The diameter under sheath may be calculated according to ISO 19642-1:—, A.3.

The wall thickness of sheath and the bedding layer may be calculated according to ISO 19642-1:—, A.6.

The maximum and minimum outside cable diameter may be calculated according to ISO 19642-1:—, A.9.

The dimensions of all cables should be documented in the datasheet of the supplier and are the basis for assessment.

Table 1 provides a list of all relevant tests in ISO 19642-2:2019 for round, sheathed, screened or unscreened multi or single core cables.

Table 1 — Tests

Test description	Mandatory			If required[c]	
	In process[a]	Initial certification	Periodic[b]	Initial certification	Periodic[b]
6.1 **Dimensional tests**					
6.1.1 Cable outside and inner layer diameters	—	X	X	—	—
6.1.2 Ovality of sheath	—	—	—	X	X
6.1.3 Thickness of sheath	—	X	X	—	—
6.1.4 In-process cable outside diameter	X	—	—	—	—
6.2 **Electrical tests**					
6.2.1 Electrical continuity	—	X	X	—	—
6.2.2 Withstand voltage at final inspection	X	X	X	—	—
6.2.3 Screening effectiveness					
6.2.3.1 Purpose					
6.2.3.2 d.c. resistance of the screen	—	—	—	X	X
6.2.3.3 Surface transfer impedance — Tri-axial method	—	—	—	X	X

Key

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

—: Test is not required

a A test made on entire cable length 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 two abrasion tests has to be performed as to 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".

Table 1 *(continued)*

Test description	Mandatory			If required[c]	
	In process[a]	Initial certification	Periodic[b]	Initial certification	Periodic[b]
6.2.3.4 Screening attenuation — Absorbing clamp method	—	—	—	X	X
6.2.3.5 Screening attenuation — Tri-axial method	—	—	—	X	X
6.2.4 Sheath fault on screened cables	X	—	—	—	—
6.3 **Mechanical tests**					
6.3.1 Strip force of sheath	—	—	—	X	X
6.3.2 Cyclic bending	—	—	—	X	—
6.3.3 Flexibility	—	—	—	X	—
6.4 **Environmental tests**					
6.4.1 Test specimen preparation and winding tests[d]	—	—	—	—	—
6.4.2 Long term heat ageing, 3 000 h at temperature class rating	—	X	—	—	—
6.4.3 Short term heat ageing, 240 h at temperature class rating +25 °C	—	X	X	—	—
6.4.4 Thermal overload, 6 h at temperature class rating +50 °C	—	—	—	X	X
6.4.5 Pressure test at high temperature	—	X	X	—	—
6.4.6 Shrinkage by heat of sheath	—	X	X	—	—
6.4.7 Low temperature winding	—	X	X	—	—
6.4.8 Cold impact	—	—	—	X	X
6.4.9 Temperature and humidity cycling[f]		—	—	X	—
6.4.10 Resistance to liquid chemicals[f, g]	—	X	—	X	—
6.4.11 Durability of sheath marking[f]	—	—	—	X	X
6.4.12 Resistance to ozone[f]	—	—	—	X	—
6.4.13 Artificial weathering[f]	—	—	—	X	—
6.4.14 Resistance to flame propagation	—	X	X	—	—

Key

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

—: Test is not required

[a] A test made on entire cable length 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 two abrasion tests has to be performed as to 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 for single-core cables

Cores shall fulfill the requirements of ISO 19642-3 with thin or thick wall dimensions.

Any construction with inner conductors that do not match ISO 19642-3 due to additional protection by the sheath are considered special purpose cable and captured as an agreement between the customer and the supplier.

6 Requirements for round, sheathed, screened or unscreened multi or single core cables

6.1 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 1.

6.2 Dimensional tests

6.2.1 Cable outside and inner layer diameters

Measure the following parameters, if applicable:

— outside diameter of twisted cores;

— outside diameter of bedding layer;

— outside diameter of braid;

— outside diameter of foils;

— outside diameter of jacket.

Dimensions shall be within the limits established by agreement between the customer and the supplier.

6.2.2 Ovality of sheath

Ovality shall be less than 10 %, measured immediately after extrusion.

NOTE Ovality can be different after handling due to mechanical deformation.

6.2.3 Thickness of sheath

The thickness of sheath shall be within the limits established by agreement between the customer and the supplier.

The measuring should be without the inner covering (bedding layer).

6.2.4 In-process cable outside diameter

In-process cable outside diameter monitoring is mandatory.

The cable outside diameter measurement shall be within the specified limits.

6.3 Electrical tests

6.3.1 Electrical continuity

The indicator shall show continuity.

6.3.2 Withstand voltage at final inspection

This test is intended to be carried out directly after production on the total cable length as well as on specimens subjected to environmental tests.

Breakdown shall not occur between core(s) applying a voltage of 2 kV a.c. to be measured at the end of the test specimen for a minimum of 3 s.

If a screen is present, breakdown shall not occur between the core(s) and screen.

6.3.3 Screening effectiveness

6.3.3.1 General

These tests are only applicable to screened cables. The usage of these tests shall be established by agreement between the customer and the supplier.

6.3.3.2 D.C. resistance of the screen

The requirement for this test shall be established by agreement between the customer and the supplier.

6.3.3.3 Surface transfer impedance — Tri-axial method

The requirement for this test shall be established by agreement between the customer and the supplier.

6.3.3.4 Screening attenuation — Absorbing clamp method

The requirement for this test shall be established by agreement between the customer and the supplier.

6.3.3.5 Screening attenuation — Tri-axial method

The requirement for this test shall be established by agreement between the customer and the supplier.

6.3.4 Sheath fault on screened cables

A voltage of 3 kV a.c. shall be continuously applied.

Breakdown shall not occur.

6.4 Mechanical tests

6.4.1 Strip force of sheath

The undisturbed section of the sheath shall be able to be removed without damage to the screen (if present) and the interior cores.

The requirement for this test shall be established by agreement between the customer and the supplier.

6.4.2 Cyclic bending

The requirement for this test shall be established by agreement between the customer and the supplier.

6.4.3 Flexibility

This test is applicable to cables with an ISO conductor size greater than or equal to 8 mm^2.

The requirement for this test shall be established by agreement between the customer and the supplier.

6.5 Environmental tests

6.5.1 Test specimen preparation and winding tests

ISO 19642-2:2019, 6.4.1 describes the mandrel sizes used for preparation of specimens in different subsequent environmental tests.

It also describes the winding tests used to detect defects caused by environmental stresses.

6.5.2 Long term heat ageing, 3 000 h at temperature class rating

The specimen shall be aged for 3 000 h at the upper value of the temperature class rating.

After winding, the test specimen shall show no signs of cracks.

During withstand voltage at final inspection (6.3.2), breakdown shall not occur.

6.5.3 Short term heat ageing, 240 h at temperature class rating +25 °C

The specimen shall be aged for 240 h at the upper value of the temperature class rating plus 25 °C.

After winding, the test specimen shall show no signs of cracks.

During withstand voltage at final inspection (6.3.2), breakdown shall not occur.

6.5.4 Thermal overload, 6 h at temperature class rating +50 °C

The specimen shall be aged for 6 h at the upper value of the temperature class rating plus 50 °C.

After winding, the test specimen shall show no signs of cracks.

During withstand voltage at final inspection (6.3.2), breakdown shall not occur.

6.5.5 Pressure test at high temperature

The thickness within the area of the indentation shall not be less than 40 % of the mean of the other two values.

6.5.6 Shrinkage by heat of sheath

The requirement for this test shall be established by agreement between the customer and the supplier.

6.5.7 Low temperature winding

The test specimen shall be conditioned for 4 h at the lower value of the temperature class rating.

After winding, the test specimen shall show no signs of cracks.

During withstand voltage at final inspection (6.3.2), breakdown shall not occur.

6.5.8 Cold impact

Perform the test with a mass of the hammer according to Table 2.

After impact, the test specimen shall show no signs of cracks.

During withstand voltage at final inspection (6.3.2), breakdown shall not occur.

Table 2 — Cold impact

Cable outside diameter (D) mm	Mass of the hammer (g)
$D \leq 15$	300
$15 < D \leq 25$	400
$25 < D \leq 35$	500
$D > 35$	600

6.5.9 Temperature and humidity cycling

After unwinding, the test specimen shall show no signs of cracks.

6.5.10 Resistance to liquid chemicals

After winding, the test specimen shall show no signs of cracks.

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

6.5.11 Durability of sheath marking

The requirement for this test shall be established by agreement between the customer and the supplier.

6.5.12 Resistance to ozone

The visual examination of the sheath shall show no cracks.

6.5.13 Artificial weathering

After exposure to the artificial weathering, the elongation of the conditioned test specimen shall not be less than 50 % of the unconditioned specimen measured value.

6.5.14 Resistance to flame propagation

Any combustion flame of insulating or sheath material shall extinguish within 70 s from the end of ignition and a minimum of 50 mm of insulation and sheath at the top of the test specimen shall remain unburnt.

All 5 specimens shall pass the test.

Annex A
(informative)

Dimensions of preferred constructions

Table A.1 — Dimensions of unscreened multi core cables with thin wall sheath

Number of cores	ISO conductor size mm²	Conductor diameter mm maximum	Single core diameter mm maximum	Twisted core diameter mm		Wall thickness sheath mm nominal	Wall thickness sheath mm minimum	Cable outside diameter mm	
				maxi-mum	mini-mum			maxi-mum	mini-mum
2	1,5	1,8	2,4	4,8	4,3	0,6	0,46	5,9	5,4
3	1,5	1,8	2,4	5,2	4,6	0,6	0,47	6,4	5,8
4	1,5	1,8	2,4	5,8	5,2	0,6	0,50	7,0	6,5
2	2,5	2,2	3,0	6,0	5,4	0,6	0,51	7,3	6,7
3	2,5	2,2	3,0	6,5	5,8	0,7	0,53	7,8	7,2
4	2,5	2,2	3,0	7,2	6,5	0,7	0,56	8,6	8,0
2	4	2,8	3,7	7,4	6,7	0,7	0,56	8,8	8,1
3	4	2,8	3,7	8,0	7,2	0,7	0,58	9,4	8,7
4	4	2,8	3,7	8,9	8,1	0,8	0,61	10,4	9,7
2	6	3,4	4,3	8,6	7,8	0,7	0,60	10,1	9,4
3	6	3,4	4,3	9,3	8,4	0,8	0,61	10,8	10,1
4	6	3,4	4,3	10,4	9,4	0,8	0,64	12,0	11,2
2	10	4,5	6,0	12,0	10,9	0,8	0,68	13,7	12,8
3	10	4,5	6,0	12,9	11,8	0,9	0,69	14,7	13,8
2	16	6,3	7,2	14,4	13,1	0,9	0,72	16,2	15,3
3	16	6,3	7,2	15,5	14,1	0,9	0,74	17,4	16,4

NOTE These are the preferred constructions according to the calculation guidelines in ISO 19642-1:—, Annex A. Different constructions can be used as agreed between the customer and the supplier.

Table A.2 — Dimensions of unscreened multi core cables with thick wall sheath

Number of cores	ISO conductor size mm²	Conductor diameter mm maximum	Single core diameter mm maximum	Twisted core diameter mm		Wall thickness sheath mm nominal	Wall thickness sheath mm minimum	Cable outside diameter mm	
				maximum	minimum			maximum	minimum
2	1,5	1,8	3,0	6,0	5,4	1,1	0,91	8,3	7,7
3	1,5	1,8	3,0	6,5	5,8	1,2	0,94	8,8	8,2
4	1,5	1,8	3,0	7,2	6,5	1,2	0,98	9,7	9,0
2	2,5	2,2	3,6	7,2	6,5	1,2	0,98	9,7	9,0
3	2,5	2,2	3,6	7,8	7,0	1,3	1,01	10,3	9,6
4	2,5	2,2	3,6	8,7	7,9	1,3	1,05	11,3	10,6
2	4	2,8	4,4	8,8	8,0	1,3	1,06	11,4	10,7
3	4	2,8	4,4	9,5	8,6	1,4	1,09	12,2	11,4
4	4	2,8	4,4	10,6	9,6	1,4	1,13	13,4	12,6
2	6	3,4	5,0	10,0	9,1	1,4	1,11	12,8	12,0
3	6	3,4	5,0	10,8	9,8	1,4	1,13	13,6	12,8
4	6	3,4	5,0	12,1	11,0	1,5	1,18	15,0	14,1
2	10	4,5	6,5	13,0	11,8	1,5	1,20	16,0	15,1
3	10	4,5	6,5	14,0	12,8	1,5	1,23	17,1	16,1
2	16	6,3	8,3	16,6	15,2	1,6	1,30	19,8	18,7
3	16	6,3	8,3	17,9	16,3	1,7	1,32	21,2	20,0

NOTE These are the preferred constructions according to the calculation guidelines in ISO 19642-1: —, Annex A. Different constructions can be used as agreed between the customer and the supplier.

Table A.3 — Dimensions of screened single core cables with thin wall sheath

ISO conductor size mm²	Conductor diameter mm	Single core diameter mm		Strand diameter screen mm	Diameter under sheath mm	Wall thickness sheath mm		Cable outside diameter mm	
	maximum	maximum	minimum	maximum	maximum	nominal	minimum	maximum	minimum
1,5	1,8	2,4	2,2	0,13	2,9	0,4	0,32	3,7	3,3
2	2,0	2,8	2,5	0,13	3,3	0,4	0,32	4,1	3,7
2,5	2,2	3,0	2,7	0,13	3,5	0,4	0,32	4,3	3,9
3	2,4	3,4	3,1	0,16	4,0	0,4	0,32	4,8	4,2
4	2,8	3,7	3,4	0,16	4,3	0,4	0,32	5,1	4,5
5	3,1	4,2	3,9	0,16	4,8	0,6	0,48	6,0	5,4
6	3,4	4,3	4,0	0,16	4,9	0,6	0,48	6,1	5,5
8	4,3	5,0	4,6	0,19	5,8	0,65	0,52	7,1	6,5
10	4,5	6,0	5,3	0,19	6,8	0,65	0,52	8,1	7,5
12	5,4	6,5	5,8	0,19	7,3	0,65	0,52	8,6	8,0
16	6,3	7,2	6,4	0,19	8,0	0,8	0,64	9,6	9,0
20	6,9	7,8	7,0	0,19	8,6	0,8	0,64	10,2	9,6
25	7,8	8,7	7,9	0,21	9,5	0,9	0,72	11,3	10,7
30	8,3	9,6	8,7	0,21	10,4	0,9	0,72	12,2	11,6
35	9,0	10,4	9,4	0,21	11,2	1,0	0,80	13,2	12,6
40	9,6	11,1	10,0	0,21	11,9	1,0	0,80	13,9	13,3
50	10,5	12,2	11,0	0,21	13,0	1,1	0,88	15,2	14,6
60	11,6	13,3	12,0	0,21	14,1	1,1	0,88	16,3	15,5
70	12,5	14,4	13,0	0,21	15,2	1,1	0,88	17,4	16,6
85	13,6	15,8	14,4	0,26	16,8	1,1	0,88	19,0	18,2
95	14,8	16,7	15,3	0,26	17,7	1,1	0,88	19,9	19,1
120	16,5	19,7	17,7	0,26	20,7	X			

Key

X: Cable type does not exist

These are the preferred constructions according to the calculation guidelines in ISO 19642-1:—, Annex A. Different constructions can be used as agreed between the customer and the supplier.