INTERNATIONAL STANDARD

ISO 6722

First edition
2002-04-15

Corrected version
2002-12-15

Road vehicles — 60 V and 600 V single-core cables — Dimensions, test methods and requirements

Véhicules routiers — Câbles monoconducteurs de 60 V et 600 V — Dimensions, méthodes d'essai et exigences

Reference number
ISO 6722:2002(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 6722 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 6722 cancels and replaces ISO 6722-1:1996, ISO 6722-2:1996, ISO 6722-3:1993 and ISO 6722-4:1993, which have been technically revised.

Annexes A and B of this International Standard are for information only.

This corrected version of ISO 6722:2002 now includes reference to the fact that this International Standard incorporates parts 1 to 4 as previously published.

Road vehicles — 60 V and 600 V single-core cables — Dimensions, test methods and requirements

1 Scope

This International Standard specifies dimensions, test methods and requirements for the following single-core cables:

— 60 V cables intended for use in road vehicle applications where the nominal system voltage is ⩽ 60 V d.c.;

— 600 V cables intended for use in road vehicle applications where the nominal system voltage is in the range of from 60 V d.c. to 600 V d.c. inclusive.

It also covers individual cores of multi-core cables falling within these parameters.

It is applicable to eight temperature classes, each with its own temperature range, as follows:

Class A – 40 °C to 85 °C;

Class B – 40 °C to 100 °C;

Class C – 40 °C to 125 °C;

Class D – 40 °C to 150 °C;

Class E – 40 °C to 175 °C;

Class F – 40 °C to 200 °C;

Class G – 40 °C to 225 °C;

Class H – 40 °C to 250 °C.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 1817, *Rubber, vulcanized — Determination of the effect of liquids*

ISO 8458-2, *Steel wire for mechanical springs — Part 2: Patented cold-drawn non-alloy steel wire*

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 Term and definition

For the purposes of this International Standard, the following term and definition apply.

3.1
nominal value
suitable approximate value used to designate or identify a component

4 General

CAUTION — Special care shall be taken for cables used with voltages above 60 V d.c. to protect them from mechanical stress in order to avoid shock hazard.

4.1 Conductors

The conductors shall consist of plain or coated copper strands as given in Table 1.

Table 1 — Conductor specifications

Conductor	Description
ASTM B1	Hard-drawn copper wire
ASTM B3	Soft or annealed copper wire
ASTM B33	Tinned soft or annealed copper wire
ASTM B298	Silver-coated soft or annealed copper wire[a]
ASTM B355	Nickel-coated soft or annealed copper wire[a]
[a] Silver- and nickel-coated wires are intended for use with high temperature class ratings.	

Conductors with conductor sizes $\geqslant 0{,}5\ mm^2$ shall consist of soft annealed copper or annealed compressed/compacted wires. Wires in conductors $< 0{,}5\ mm^2$ shall consist of soft annealed copper, soft annealed compressed/compacted copper, hard unannealed copper, or a copper alloy. The specifications for the conductors are to be completed by material specifications. Elongation requirements are to be established by agreement between the customer and the supplier. The finished cable shall meet the resistance requirements of clause 6.1 for all conductors except alloys. When an alloy is used, the resistance requirement is to be established by agreement between the customer and the supplier.

See annex A for strandings that highlight examples of conceptual configurations and which are not intended to reflect any preferred constructions. Other strandings' configurations may be used provided they meet the requirements shown above and are agreed between customer and supplier.

4.2 Tests

The cables shall be submitted to the tests given in Table 2.

Table 2 — Tests

Clause Subclause	Test description	In-process tests[a]	Certification		If required[c]	
			Initial	Periodic[b]	Initial	Periodic[b]
5	**Dimensions**					
5.1	Outside cable diameter		X	X		
5.2	Insulation thickness		X	X		
5.3	Conductor diameter				X	X
6	**Electrical characteristics**					
6.1	Conductor resistance		X	X		
6.2	Withstand voltage		d	d		
6.3	Insulation faults	d				
6.4	Insulation volume resistivity				X	X
7	**Mechanical characteristics**					
7.1	Pressure test at high temperature		X	X		
7.2	Strip Force				X	X
8	**Low temperature characteristics**					
8.1	Winding		X	X		
8.2	Impact				X	X
9	**Resistance to abrasion**		e	e		
9.1	Sandpaper abrasion					
9.2	Scrape abrasion					
10	**Heat ageing**					
10.1	Short term ageing 240 h		X	X		
10.2	Long term ageing, 3 000 h		X			
10.3	Thermal overload				X	X
10.4	Shrinkage by heat		X	X		
11	**Chemical resistance**					
11.1	Fluid compatibility		f		f	
11.2	Durability of cable marking				X	X
11.3	Resistance to ozone				X	
11.4	Resistance to hot water				X	
11.5	Environmental cycling				X	
12	**Resistance to flame propagation**		X	X		

[a] These are tests of all cable during or after manufacture carried out in order to check that the cables comply with the requirements of the standard concerned or the criteria specified.

[b] The frequency of periodic testing is to be established by agreement between the customer and the supplier.

[c] The usage of “If required” tests is to be established by agreement between customer and supplier.

[d] Some cables are rated at 60 V and others at 600 V. See 6.2 and 6.3 for details.

[e] See clause 9.

[f] Some fluids are for certification and others “If required”. See 11.1 for details.

4.3 General test conditions

Test samples for all tests except those given in clause 5 and in 6.1 and 6.3 shall be preconditioned for at least 16 h at a room temperature of (23 ± 5) °C. Unless otherwise specified, all tests other than “in-process” tests shall be conducted at this temperature. Where no tolerance is specified, all values are to be considered to be approximate.

4.4 Ovens

When an oven is required, unless otherwise specified it shall be a hot air oven. The air contained in the oven shall be completely changed a minimum of eight times and a maximum of twenty times per hour at the specified temperature.

5 Dimensions

5.1 Outside cable diameter

5.1.1 Test sample

Prepare a test sample of 3 m length.

5.1.2 Apparatus

Use a measuring device that does not cause deformation.

5.1.3 Procedure

Determine the maximum outside cable diameter by taking three sets of measurements at 1 m intervals, and recording the greatest outside diameter at each point to within an accuracy of ± 0,01 mm.

5.1.4 Requirement

The outside cable diameter shall be in accordance with Table 3.

5.2 Insulation thickness

5.2.1 Test samples

Prepare three test samples, each consisting of a thin cross-section of insulation, taken at 1 m intervals from a cable sample 3 m in length. Strip the insulation from the cable. Take care not to deform the test samples during the preparation process. If cable marking causes indentation of the insulation, take the first test sample through this indentation.

5.2.2 Apparatus

Use a measuring device that does not cause deformation.

5.2.3 Procedure

Place the test sample under the measuring equipment, with the plane of the cut perpendicular to the optical axis. The measurement accuracy shall be ± 0,01 mm.

5.2.4 Requirement

The insulation thickness shall be in accordance with Table 3.

Table 3 — Dimensions

ISO conductor size	Conductor maximum diameter	Thick wall			Thin wall			Ultra thin wall		
		Insulation thickness		Outside cable diameter	Insulation thickness		Outside cable diameter	Insulation thickness		Outside cable diameter
		nom.	min.	max.	nom.	min.	max.	nom.	min.	max.
mm^2	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
0,13	0,55	—	—	—	0,25	0,20	1,05	0,20	0,16	0,95
0,22	0,70	—	—	—	0,25	0,20	1,20	0,20	0,16	1,05
0,35	0,90	—	—	—	0,25	0,20	1,40	0,20	0,16	1,20
0,50	1,10	0,60	0,48	2,30	0,28	0,22	1,70	0,20	0,16	1,40
0,75	1,30	0,60	0,48	2,50	0,30	0,24	1,90	0,20	0,16	1,60
1	1,50	0,60	0,48	2,70	0,30	0,24	2,10	0,20	0,16	1,75
1,5	1,80	0,60	0,48	3,00	0,30	0,24	2,40	0,20	0,16	2,10
2	2,00	0,60	0,48	3,30	0,35	0,28	2,80	0,25	0,20	2,40
2,5	2,20	0,70	0,56	3,60	0,35	0,28	3,00	0,25	0,20	2,70
3	2,40	0,70	0,56	4,10	0,40	0,32	3,40	—	—	—
4	2,80	0,80	0,64	4,40	0,40	0,32	3,80	—	—	—
5	3,10	0,80	0,64	4,90	0,40	0,32	4,20	—	—	—
6	3,40	0,80	0,64	5,00	0,40	0,32	4,30	—	—	—
10	4,50	1,00	0,80	6,50	0,60	0,48	6,00	—	—	—
16	6,30	1,00	0,80	8,30	0,65	0,52	7,90	—	—	—
25	7,80	1,30	1,04	10,40	0,65	0,52	9,40	—	—	—
35	9,00	1,30	1,04	11,60	—	—	—	—	—	—
50	10,50	1,50	1,20	13,50	—	—	—	—	—	—
70	12,50	1,50	1,20	15,50	—	—	—	—	—	—
95	14,80	1,60	1,28	18,00	—	—	—	—	—	—
120	16,50	1,60	1,28	19,70	—	—	—	—	—	—

5.3 Conductor diameter

5.3.1 General

The usage of this test is to be established by agreement between customer and supplier. For cases where results are disputed, a referee method is provided in 5.3.2.2, 5.3.3.2 and 5.3.4.2.

5.3.2 Test samples

5.3.2.1 Under normal circumstances

Carry out this test on the same samples used for the measurement of the insulation thickness (see 5.2).

5.3.2.2 Referee test samples

In case of dispute, prepare three test samples, each 20 mm in length, taken at intervals of 1 m from a cable sample 3 m in length. Take care not to deform the test samples.

Immerse the test samples in a casting resin. After hardening, take a section perpendicular to the axis of the test sample.

5.3.3 Apparatus

5.3.3.1 Under normal circumstances

Carry out this test on the same apparatus used for the measurement of the insulation thickness (see 5.2).

5.3.3.2 Referee apparatus

In case of dispute, the measuring device shall be capable of at least 10 times linear magnification.

5.3.4 Procedure

5.3.4.1 Under normal circumstances

Check the conductor diameter by measuring the inside diameter of the samples used in 5.2 and recording the maximum inside diameter for each test sample.

5.3.4.2 Referee procedure

In case of dispute, measure the conductor diameter using the referee test samples and the referee apparatus. Record the maximum conductor diameter for each test sample.

5.3.5 Requirement

The conductor diameter shall be in accordance with Table 3.

NOTE This measured value is also a requirement of 6.4.

6 Electrical characteristics

6.1 Conductor resistance

6.1.1 Test sample

Prepare a test sample of 1 m length plus the length necessary for connections. Other lengths may be used providing that the resistance reading is adjusted using the method given in 6.1.3. The ends of the test sample may be soldered.

6.1.2 Apparatus

Use a resistance-measuring device with an accuracy to within ± 0,5 % of the measured value and a thermometer with an accuracy of ± 0,5 °C.

6.1.3 Procedure

Measure the temperature of the test sample and the unsoldered length. Take care to ensure that connections are secure. Measure the resistance of the test sample. Correct the measured value using the following equation:

$$R_{20} = \frac{R_t}{L\left[1 + 0{,}003\,93\left(t - 20°\right)\right]}$$

where

R_{20} is the corrected conductor resistance at the reference temperature of 20 °C, expressed in milliohms per metre;

R_t is the conductor resistance measured at the conductor temperature in milliohms;

L is the unsoldered conductor length, expressed in metres;

t is the conductor temperature at the time of measuring, expressed in degrees Celsius.

The value of 0,003 93 is the temperature coefficient for copper with 100 % conductivity at temperatures near 20 °C. For coated wires or alloys, the correction factor shall be established by agreement between the supplier and customer.

6.1.4 Requirement

The corrected value of the conductor resistance shall be in accordance with Table 4.