
**Road vehicles — Multi-core connecting
cables —**

**Part 2:
Test methods and requirements for
high performance sheathed cables**

Véhicules routiers — Câbles de raccordement multiconducteurs —

Partie 2: Méthodes d'essai et exigences pour les câbles gainés à hautes performances



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Published in Switzerland

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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).

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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*.

This third edition cancels and replaces the second edition (ISO 4141-2:2006), which has been technically revised. The main changes compared to the previous edition are as follows:

- temperature range of cable defined as Class A and Class B in [6.4.2](#), [6.5.1](#), [6.5.2](#);
- test [6.6](#) added.

A list of all parts in the ISO 4141-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.

Road vehicles — Multi-core connecting cables —

Part 2:

Test methods and requirements for high performance sheathed cables

1 Scope

This document specifies the test methods and requirements for high performance sheathed multi-core cables for the connection of towing and towed vehicles, suitable for a temperature range of class A and class B, defined in ISO 6722-1:2011, Table 1.

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 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 4141-1, *Road vehicles — Multi-core connecting cables — Part 1: Test methods and requirements for basic performance sheathed cables*

ISO 4141-3, *Road vehicles — Multi-core connecting cables — Part 3: Construction, dimensions and marking of unscreened sheathed low-voltage cables*

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 14572, *Road vehicles — Round, sheathed, 60 V and 600 V screened and unscreened single- or multi-core cables — Test methods and requirements for basic- and high-performance cables*

3 Terms and definitions

No terms and definitions are listed in this document.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

4 General requirements

High performance sheathed multi-core cables shall be in accordance with ISO 4141-1 and shall meet the additional test and requirements or modified test conditions specified in [Clause 5](#).

Coiled multi-core cables shall in addition meet the tests and requirements specified in [Clause 6](#).

5 Tests and requirements

5.1 Impact

According to ISO 4141-1 but use a freezing temperature of $(-20 \pm 2) ^\circ\text{C}$.

5.2 Pressure at high temperature

According to ISO 14572 and apply the requirements for high performance cables.

5.3 Cyclic bending

According to ISO 4141-1 but use 10 000 cycles.

5.4 Fluid compatibility of the sheath

5.4.1 General

For each test, use three samples, each of 300 mm minimum length, at least 1 m apart on the cable.

Bend each test sample 180° min. to a radius of five times the outside diameter and secure it.

5.4.2 Tests

5.4.2.1 Resistance against ethanol

According to ISO 6722-1 but use a time frame of 168 hours.

5.4.2.2 Resistance against sulphuric acid

Immerse the bent test samples for 48 hours in dilute battery acid of density $1,275 \text{ g/cm}^3$ at a temperature of $(23 \pm 5) ^\circ\text{C}$.

Remove the test samples from the test liquid, rinse and wipe them thoroughly, straighten them, and then examine them visually.

5.4.2.3 Resistance against lubrication oil

Immerse the bent test samples for 168 hours in lubrication oil No. 1 as specified in ISO 1817 at a temperature of $(23 \pm 5) ^\circ\text{C}$.

Remove the test samples from the test liquid, wipe them thoroughly, straighten them, and then examine them visually.

5.4.2.4 Resistance against zinc chloride

Immerse the bent test samples in an aqueous solution of zinc chloride, 50 % mass fraction, for 168 hours at a temperature of $(23 \pm 5) ^\circ\text{C}$.

Remove the test samples from the test liquid, wipe them thoroughly, straighten them and then examine them visually.

5.4.3 Requirement

The sheath shall show no evidence of fracture or cracking.

6 Specific tests and requirements for coiled multi-core cables

6.1 Elongation by cable weight

6.1.1 Test

Measure the initial block length L_B of the complete coil at rest and in horizontal position. Then hang the cable vertically. After at least 60 seconds, measure the extended coil length.

6.1.2 Requirement

The extended coil length shall not be more than twice the initial block length.

6.2 Resistance against cyclic extension

6.2.1 Test

This test may be performed with the sample used in 6.1. Position the sample horizontally in a test apparatus and subject it to two test sequences specified in Table 1.

Table 1 — Cyclic extension test, number of cycles

Test sequence	Extension	Number of cycles ^a
1	To maximum value of working length (L_W) ^b	200 000
2	to max. admitted extension length (L_{Emax}) ^b	20 000
^a One cycle consists of — extension of the sample to its working length (test sequence 1) or to its maximum admitted extension length (test sequence 2); — contraction to its original block length including the uncoiled cable lengths.		
^b According to ISO 4141-3.		

The test shall be carried out at a frequency of (10 ± 5) cycles/min.

Conductor breakage shall be monitored by applying a current $(5 \pm 0,5)$ A to all conductors during the entire test phase. If breakage occurs, the test procedure shall stop automatically.

6.2.2 Requirement

No conductor shall break during the test. At the end, under visual examination, the sheath shall show no evidence of fracture or cracking.

6.3 Restoring force

6.3.1 Test

Precondition the cable:

- by one extension to its max. admitted extension length L_{Emax} ;
- 5 minutes rest, unstretched, at room temperature;
- rest for 4 hours in a freezing chamber at (-40 ± 2) °C.

Then within 60 seconds of removing the sample from the freezing chamber, measure the restoring force of the cable when extended to its max. admitted extension length.

6.3.2 Requirement

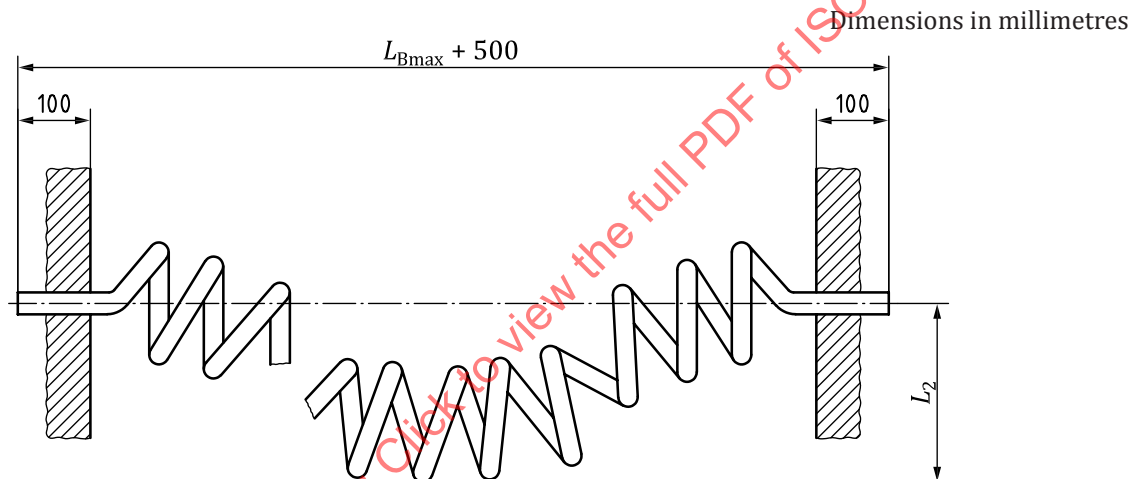
The restoring force shall not exceed 250 N.

6.4 Cable sag

6.4.1 Test

Mount one cable as shown in [Figure 1](#) and measure its sag successively after each of the following conditions:

- one extension to its max. admitted extension length, and subsequently 60 seconds rest unstretched,
- 2 hours conditioning in a heating chamber at $(80 \pm 2) ^\circ\text{C}$, one extension to its max. admitted extension length within 15 seconds after removing from the heating chamber, and subsequently 60 seconds rest at room temperature, unstretched,
- the cyclic extension test in [6.2](#), and subsequently 5 minutes rest, unstretched.



Key

L_2 cable sag

L_{Bmax} maximal block length, see ISO 4141-3

Figure 1 — Measurement of cable sag

6.4.2 Requirement

The measured cable sag shall not exceed the values specified in [Table 2](#).

Table 2 — Maximum cable sag

Measurement taken with cable at rest after conditioning according to	Class A Cable sag L_2 mm max.	Class B Cable sag L_2 mm max.
6.4.1 a)	400	400
6.4.1 b)	450	550
6.4.1 c)	650	650

6.5 Permanent elongation

6.5.1 Test

Measure the block length L_B of the cable as delivered and after each of the following conditioning procedures:

- one extension to its max. admitted extension length $L_{E\max}$ and subsequently 30 seconds rest in restored condition at room temperature;
- two hours conditioning at a temperature of $(-40 \pm 2)^\circ\text{C}$, one extension to its max. admitted extension length within 15 seconds after removing from the temperature chamber, and subsequently 120 seconds rest in restored condition at room temperature;
- as b), but 2 hours conditioning at $(60 \pm 2)^\circ\text{C}$;
- as b), but 2 hours conditioning for class A $(85 \pm 2)^\circ\text{C}$ and for class B $(100 \pm 2)^\circ\text{C}$.

Measurement shall be taken with a sample positioned horizontally on a plane surface of low friction. The released sample may be lifted and allowed to fall, to reduce the effect of friction.

6.5.2 Requirement

The measured change of block lengths shall not exceed the values specified in [Table 3](#).

Table 3 — Extension of block length

Measurements taken after conditioning as in	Class A Change of $L_{B\max}$ % max.	Class B Change of $L_{B\max}$ % max.
6.5.1 a)	30	30
6.5.1 b)	35	40
6.5.1 c)	40	50
6.5.1 d)	50	65

6.6 Class B — Cable sag at peak temperature

6.6.1 Purpose

This test is intended to confirm cable sag at peak temperature on class B (ISO 6722-1:2011, Table 13).

6.6.2 Test

The test shall be performed as follows:

One cycle:

- 15 minutes conditioning in a heating chamber at peak temperature for class B,
- within 30 seconds after removing from the heating chamber mount the cable as shown in [Figure 1](#) and extend to its max. admitted extension length,
- subsequently allow 60 seconds rest at room temperature, unstretched, measure the cable sag,
- restoring time between each cycle shall be 60 minutes.

3 cycles are required.