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

Part 4:

**Test methods and requirements for coiled  
cable assemblies**

*Véhicules routiers — Câbles de raccordement multiconducteurs —*

*Partie 4: Méthodes d'essai et exigences pour les câbles spiralés  
assemblés*

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4141-4 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This second edition cancels and replaces the first edition (ISO 4141-4:2001), which has been technically revised.

ISO 4141 consists of the following parts, under the general title *Road vehicles — Multi-core connecting cables*:

- *Part 1: Test methods and requirements for basic performance sheathed cables*
- *Part 2: Test methods and requirements for high performance sheathed cables*
- *Part 3: Construction, dimensions and marking of unscreened sheathed low-voltage cables*
- *Part 4: Test methods and requirements for coiled cable assemblies*

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# Road vehicles — Multi-core connecting cables —

## Part 4: Test methods and requirements for coiled cable assemblies

### 1 Scope

This part of ISO 4141 specifies test method and performance requirements for electrical coiled cable assemblies for the connection of towing and towed road vehicles equipped with nominal 12 V or 24 V systems.

### 2 Normative references

The following referenced documents are indispensable for the application 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 1185, *Road vehicles — Connectors for the electrical connection of towing and towed vehicles — 7-pole connector type 24 N (normal) for vehicles with 24 V nominal supply voltage*

ISO 1724, *Road vehicles — Connectors for the electrical connection of towing and towed vehicles — 7-pole connector type 12 N (normal) for vehicles with 12 V nominal supply voltage*

ISO 3731, *Road vehicles — Connectors for the electrical connection of towing and towed vehicles — 7-pole connector type 24 S (supplementary) for vehicles with 24 V nominal supply voltage*

ISO 3732, *Road vehicles — Connectors for the electrical connection of towing and towed vehicles — 7-pole connector type 12 S (supplementary) for vehicles with 12 V nominal supply voltage*

ISO 4141-3:2006, *Road vehicles — Multi-core connecting cables — Part 3: Construction, dimensions and marking of unscreened sheathed low-voltage cables*

ISO 7638-1, *Road vehicles — Connectors for the electrical connection of towing and towed vehicles — Part 1: Connectors for braking systems and running gear of vehicles with 24 V nominal supply voltage*

ISO 7638-2, *Road vehicles — Connectors for the electrical connection of towing and towed vehicles — Part 2: Connectors for braking systems and running gear of vehicles with 12 V nominal supply voltage*

ISO 11446, *Road vehicles — Connectors for the electrical connection of towing and towed vehicles — 13-pole connectors for vehicles with 12 V nominal supply voltage*

ISO 12098, *Road vehicles — Connectors for the electrical connection of towing and towed vehicles — 15-pole connector for vehicles with 24 V nominal supply voltage*

ISO 25981, *Road vehicles — Connectors for the electrical connection of towing and towed vehicles — Connectors for electronically monitored charging systems with 12 V or 24 V nominal supply voltage*

### 3 Preconditioning

This test shall be performed in accordance with ISO 4141-3 on coiled cables assembled with appropriate connectors in accordance with ISO 1185, ISO 1724, ISO 3731, ISO 3732, ISO 7638-1, ISO 7638-2, ISO 11446, ISO 12098 or ISO 25981, along with their anti-kink protection (if any).

The following preconditioning shall be performed prior to testing:

- a) conditioning for 2 h at a temperature of  $(-40 \pm 2)$  °C, one extension once to its maximum admitted extension length in accordance with ISO 4141-3 within 15 s after being removed from the temperature chamber, and subsequently resting for 120 s in restored conditions at room temperature;
- b) the same as in step a), but conditioning for 2 h at  $(80 \pm 2)$  °C;
- c) cooling down at room temperature for another 2 h.

### 4 Articulation test

#### 4.1 Purpose

The purpose of the articulation test is to specify the strength of the complete plug and cable assembly and the effect of anti-kink protection against bending, in order to replicate extreme angles occurring between vehicle and trailer whilst manoeuvring.

#### 4.2 Test method

Both plugs shall be inserted in sockets in a test arrangement in accordance with Figure 1. The fixing of at least one socket shall permit rotation around axis A.

Conductor breakage shall be monitored by applying a current of  $(5 \pm 0,5)$  A to all pins and connected conductors of the coiled assembly during the entire test phase (see Figure B.2). Conductor breakage occurs if the applied current drops by more than 1,0 A for more than 10 ms. In such cases, the test procedure shall stop automatically.

#### 4.3 Test description

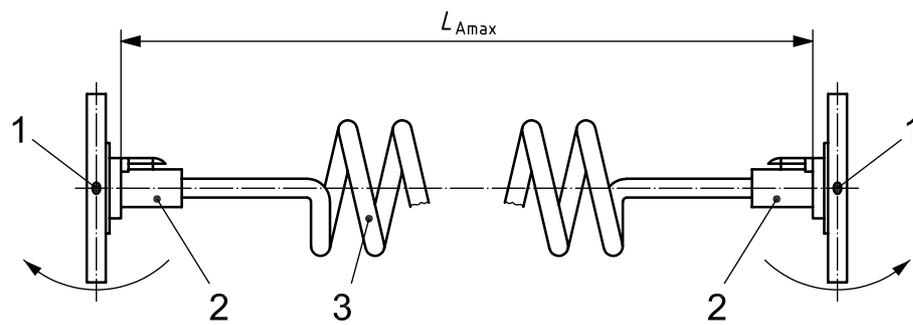
One of the connectors shall be articulated 90° each way to the longitudinal axis of the closed coil. Rotate the connector around axis A.

The test shall be carried out at a frequency of 15 cycles per minute and shall comprise the following steps:

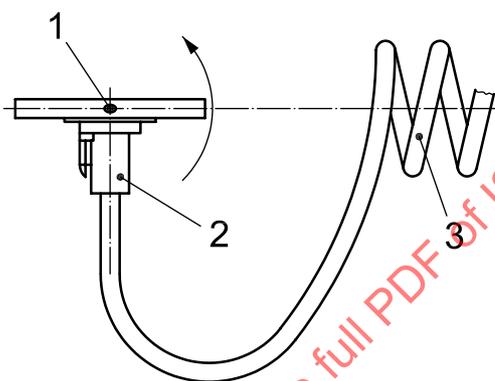
- a) position 1 – functionally important datum plane;
- b) rotation around axis A by 180° to position 2;
- c) rotation back to position 1 completes the cycle;
- d) check fulfilment of the requirements in 4.4;
- e) perform steps a) to d) with the opposite cable assembly side.

NOTE If both connectors are tested simultaneously, step e) can be omitted.

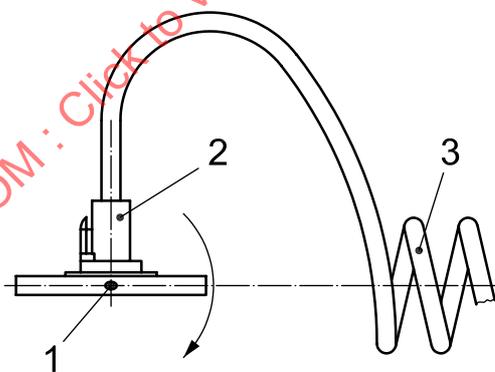
Figure 1 shows the test arrangement and the positions of one cycle of the articulation test. Axis A is perpendicular to the plane of the paper.



a) Complete assembly



b) Position 1



c) Position 2

**Key**

- 1 rotating axis A
- 2 connector
- 3 coiled cable
- $L_{Amax}$  maximum admitted extension length

**Figure 1 — Test arrangement for articulation test — Top view**

#### 4.4 Requirements

The sample shall be subjected to at least 20 000 continuous cycles and shall show no signs of cable cracking or displacement of the anti-kink protection (if any).

NOTE A higher number of continuous cycles can be agreed between customer and supplier.

If no breakage occurs, perform the following withstand voltage test.

Apply a test voltage of 1 kV RMS, 50 Hz or 60 Hz, or 1 600 V d.c. for 1 min between each conductor and the remaining conductors connected together. Breakdown shall not occur.

### 5 Torsion strain (mechanical strength of plug/cable assembly)

#### 5.1 Purpose

The purpose of the torsion strain test is to specify the strength of the complete plug and cable assembly against torsion occurring due to rotated connection.

#### 5.2 Test method

At least one plug shall be inserted in a socket in a test arrangement in accordance with Figure 2 or Figure 3. The fixing of the cable at the fasten point shall permit rotation around the longitudinal axis. The cable shall be fastened in accordance with Figure 2 or Figure 3.

Conductor breakage shall be monitored by applying a current of  $(5 \pm 0,5)$  A to all pins and connected conductors of the coiled assembly during the entire test phase (see Figure B.2). Conductor breakage occurs if the applied current drops by more than 1,0 A for more than 10 ms. In such cases, the test procedure shall be stopped.

#### 5.3 Test description

Fasten down the cable as shown in Figure 2 or Figure 3. Rotate the cable around the rotating axis B with a maximum torque of 20 Nm up to 360° or stop rotation at the required value, whichever occurs first, denoted by end position.

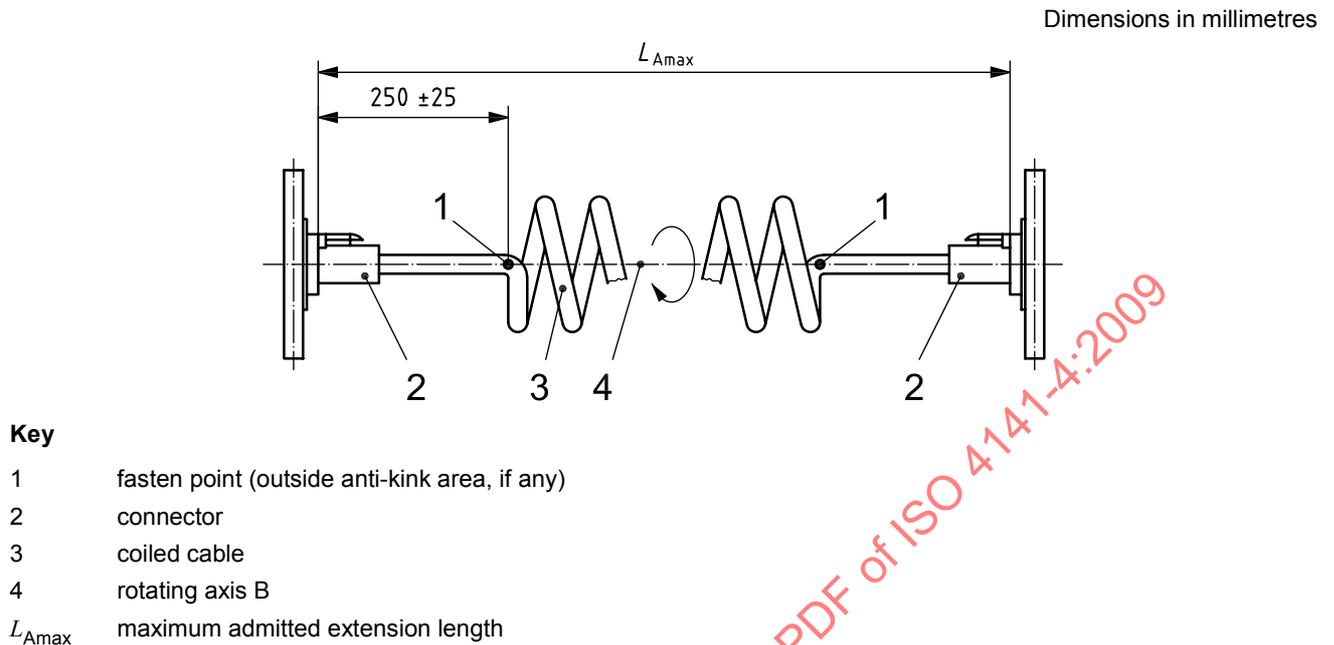
Perform the test in each rotational direction at a speed of  $15^\circ \pm 5^\circ$  per second.

One test cycle shall comprise the following steps:

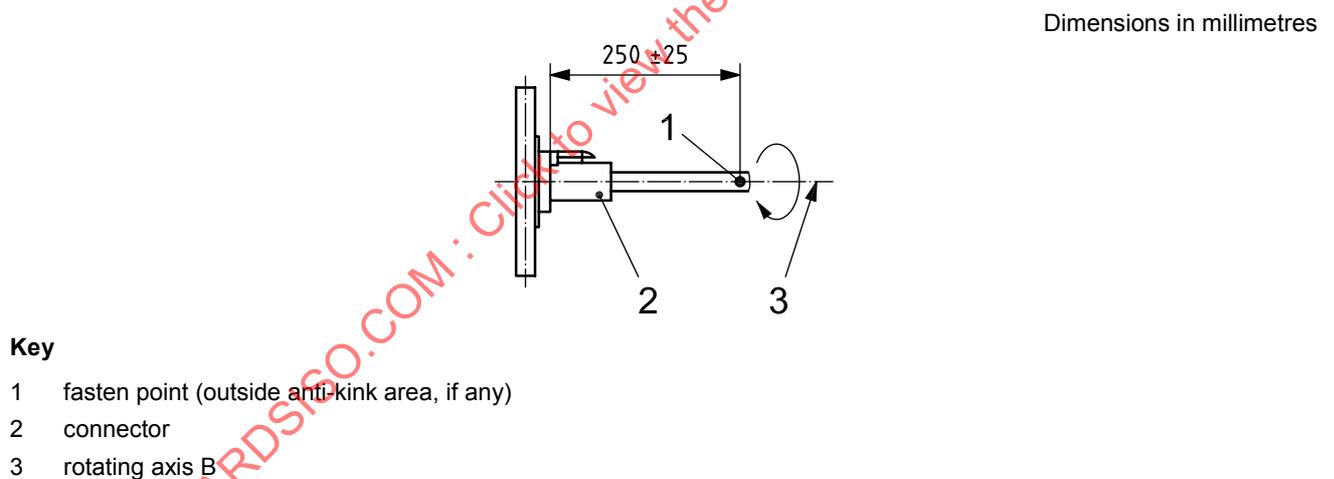
- a) position 1 – datum: apply one mark between the cable, its anti-kink protection (if any) and the connector;
- b) rotate the cable at the fasten point clockwise around the longitudinal axis;
- c) check fulfilment of the requirements in 5.4.2;
- d) rotate the cable at the fasten point back to datum position;
- e) rotate the cable at the fasten point as described in step b), but anti-clockwise;
- f) check fulfilment of the requirements in 5.4.2;
- g) rotate the cable at the fasten point back to datum position;
- h) perform steps a) to g) with the opposite cable assembly side.

NOTE If both ends are tested simultaneously, step h) can be omitted.

Alternatively, the test may be carried out with a plug and a straight piece of cable as shown in Figure 3, performing only steps a) to g).



**Figure 2 — Test arrangement for torsion strain**



**Figure 3 — Alternative test arrangement for torsion strain**

## 5.4 Requirements

**5.4.1** The sample shall be subjected to at least 1 cycle (mechanical cycle) without displacement of mark between cable and connector, and 1 000 cycles (electrical cycles) for electrical breakdown.

**5.4.2** The cable assembly shall not show any signs of cracking or displacement on the cable or displacement of the anti-kink protection (if any) at the end position: there shall be no displacement of mark between cable and connector.

NOTE A higher number of continuous cycles can be agreed between customer and supplier.

**5.4.3** If no breakage occurs, perform the following withstand voltage test.

Apply a test voltage of 1 kV RMS, 50 Hz or 60 Hz, or 1 600 V d.c. for 1 min between each conductor and the remaining conductors connected together. Breakdown shall not occur.

## Annex A (informative)

### Designation of coiled cable assembly

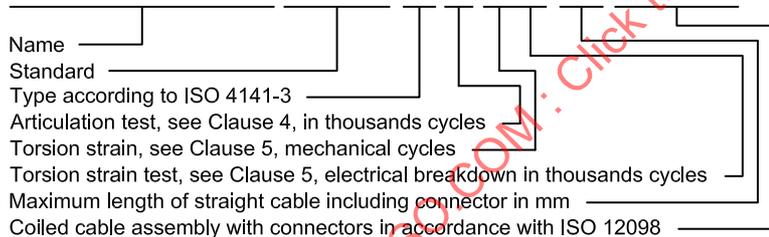
The designation of coiled cable assembly in accordance with ISO 4141-3 is defined as follows:

#### Coiled cable assembly ISO 4141-WW-XX-YY-ZZ- $L_C$ -Plug definition

- WW** Type of coiled multi-core cable in accordance with ISO 4141-3:2006, 4.3 and Table 2 (e.g. **2A**)
- XX** Articulation test cycles in accordance with ISO 4141-3:2006, Clause 4, in thousands (e.g. **20** = 20 000 cycles)
- YY** Torsion strain test cycles in accordance with ISO 4141-3:2006, 5.5, mechanical cycles (e.g. **01** = 1 cycle)
- ZZ** Torsion strain test cycles in accordance with ISO 4141-3:2006, 5.5, electrical breakdown cycles, in thousands (e.g. **01** = 1 000 cycles)
- $L_C$  Maximum length of straight cable end including connector, in millimetres (e.g. **250**) (see Figure B.1)
- Plug** assembled with 2 connectors in accordance with ISO xxxxx (e.g. **ISO 12098**)

EXAMPLE

Coiled cable assembly ISO 4141-2A-20-01-01-250-ISO 12098

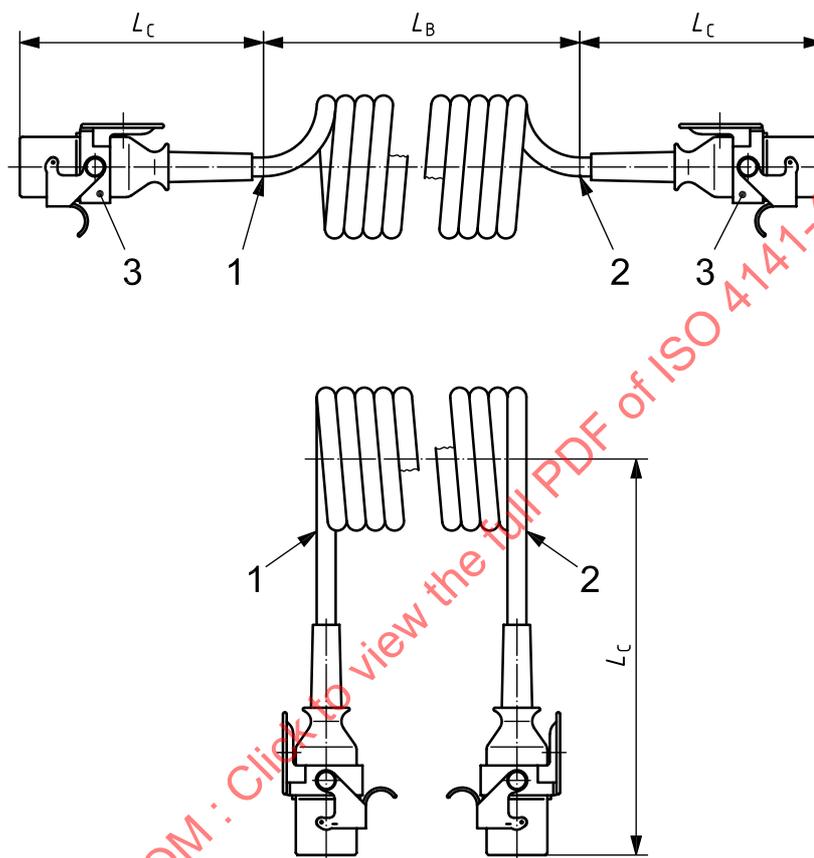


The above example describes cable assembly with the following characteristics:

- coil dimensions in accordance with ISO 4141-3:2006, Type 2 a);
- test requirements as follows:
  - 20 000 cycles, in accordance with 4.4 of this part of ISO 4141;
  - 1 mechanical cycle and 1 000 electrical cycles, in accordance with 5.4 of this part of ISO 4141;
  - length  $L_C \leq 250$  mm;
- assembled with connectors in accordance with ISO 12098.

## Annex B (informative)

### Dimensions of the assembled coiled cable



#### Key

- 1 fasten point of first torsion strain twist test (outside anti-kink area, if any) (side 1 of coiled cable assembly)
- 2 fasten point of second torsion strain twist test (outside anti-kink area, if any) (side 2 of coiled cable assembly)
- 3 plug in accordance with ISO 1185, ISO 1724, ISO 3731, ISO 3732, ISO 7638-1, ISO 7638-2, ISO 11446, ISO 12098 or ISO 25981

$L_B$  block length (see ISO 4141-3)

$L_C$  maximum dimension admitted (if less than 300 mm, as agreed between customer and supplier)

Figure B.1 — Types