INTERNATIONAL STANDARD

ISO 4091

Third edition
2003-11-01

Road vehicles — Connectors for the electrical connection of towing and towed vehicles — Definitions, tests and requirements

Véhicules routiers — Connecteurs pour liaisons électriques entre véhicules tracteurs et véhicules tractés — Définitions, essais et exigences

Reference number
ISO 4091:2003(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 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 4091 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This third edition cancels and replaces the second edition (ISO 4091:1992), which has been technically revised.

Road vehicles — Connectors for the electrical connection of towing and towed vehicles — Definitions, tests and requirements

1 Scope

This International Standard gives definitions and specifies tests and requirements for connectors used for the electrical connection of towing and towed road vehicles. It is applicable to connectors of all types used for this purpose, as specified in ISO 1185, ISO 1724, ISO 3731, ISO 3732, ISO 7638-1, ISO 7638-2, ISO 11446 and ISO 12098.

NOTE Dimensions and particular requirements related to the design of the connector are given in separate International Standards.

2 Normative references

The following referenced documents are indispensable for 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 1817, *Rubber, vulcanized — Determination of the effect of liquids*

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 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 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 11446[1)], *Road vehicles — Connectors for the electrical connection of towing and towed vehicles — 13-pole connectors for vehicles with 12 V nominal supply voltage*

1) To be published. (Revision of ISO 11446:1995)

ISO 12098[2)], *Road vehicles — Connectors for the electrical connection of towing and towed vehicles — 15-pole connector for vehicles with 24 V nominal supply voltage*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
connection
two mated connectors or contacts

3.2
connector
assembly of contacts and housing which terminates conductors for the purpose of providing connection and disconnection to a suitable mating connector

3.3
contact
conductive element in a connector (including means for cable attachment) which mates with a corresponding element to provide an electrical path

3.4
contact area
area in contact between two mated contacts, which provides an electrical path

3.5
female contact
electrical contact (including means for cable attachment) intended to make electrical engagement on its inner surface and to accept entry of a male contact, thus forming an electrical connection

EXAMPLE Receptacle, sleeve.

3.6
male contact
electrical contact (including means for cable attachment) intended to make electrical engagement on its outer surface and to enter a female contact, thus forming an electrical connection

EXAMPLE Tab, pin, blade.

3.7
plug
free connector intended to mate with a socket

3.8
socket
connector intended to mate with a plug-in device

3.9
park socket
socket for storing the plug when it is disconnected

2) To be published. (Revision of ISO 12098:1994)

3.10
ejector
part of the socket (but not of the park socket) provided to disengage the plug automatically if the locking device is not operative

4 General requirements

4.1 Explanations

Tests and requirements are specified in the following clauses, with the generally applicable test sequences given in 4.2. Alternative tests, requirements and test sequences are as specified in the International Standards directly applicable to individual connection designs.

4.2 Test sequences

Where no test sequence is given in the International Standard that specifies the type of the connector under test, the test sequence followed shall be as given in Table 1.

Table 1 — Test sequences

Subclause	Test title	Sample group					
		A	B	C	D	E	F
5.1	Visual examination	1, 7, 9, 14	1, 12	1, 6, 12	1, 6	1, 14	1, 7
5.2	Dimensional check	2					
5.3	Connection	3	2	2		12	
5.3	Disconnection	12	11	10		13	
5.4	Locking device operation	4, 11	3, 10	3, 9		2, 10	
5.5	Ejector force	13				11	
5.6	Locking device and cable retention strength	6					
5.7	Lateral strength at low temperature	8					
5.8	Current carrying capacity				3		
5.9	Connection resistance		4, 7	4, 8	2, 5	3, 7	2, 5
5.10	Current cycling				4		
5.11	Withstand voltage		5, 9	7		4, 9	3, 6
5.12	Influence of water		8	11		8	
5.13	Static load	5					
5.14	Protection against dust					5	
5.15	Endurance					6	
5.16	Vibration						4
5.17	Drop	10					
5.18	Temperature/humidity cycling		6				
5.19	Salt spray			5			

The test sequence shall be carried out in the order of the running numbers given in Table 1 under the particular sample group. A test sequence shall be continued only if the sample meets the applicable requirements.

All test sequences shall

— be preceded by conditioning of all samples of connectors, cables and test rods at 23 °C ± 5 °C and 45 % to 75 % relative humidity for a minimum of 24 h,

— start with unused, dry and clean connectors, with plug and socket of the same manufacture and type, and

— be carried out at an ambient temperature of 23 °C ± 5 °C unless otherwise specified.

During the entire test sequence, no lubrication or other additional aid to reaching better results is permitted. However, production-related remains of lubricants may be used.

4.3 Sample requirement

Cables shall be attached as appropriate.

If the connector is not equipped with the full complement of contacts, the remaining holes shall be covered.

5 Tests and requirements

5.1 Visual examination

5.1.1 Test

Carry out the visual examination with the naked eye, corrected, if necessary, to give normal strength of vision and normal colour perception, at the most favourable viewing distance and with suitable illumination.

5.1.2 Requirement

Visual examination in accordance with 5.1.1 shall allow identification, appearance, workmanship and finish of the item to be checked against the relevant specification.

During visual examination of the connector or connectors after tests involving the test sample groups (for test sequences, see Table 1), special care shall be taken to ensure that, as a minimum requirement, no cracking, significant discoloration, deformation, and — where applicable — no ingress of water is in evidence.

5.2 Dimensional check

5.2.1 Test

Check all the dimensions given in the International Standard that specifies the type of connector under test.

5.2.2 Requirement

All dimensions checked shall be within the tolerances given in the International Standard that specifies the type of the connector under test. Failure of any of these dimensions entails the failure of the sample.

5.3 Connection and disconnection

5.3.1 Test

Perform connection and disconnection using suitable test apparatus at a constant speed between 25 mm/min and 100 mm/min.

Disable the ejector, if the socket to be tested is equipped with one.

Measure the force required axially to the connector with the locking device disengaged and the cover not resting on the plug.

5.3.2 Requirement

The force measured according to 5.3.1 shall meet the requirements of the International Standard that specifies the type of connector under test.

5.4 Locking device operation

5.4.1 Application

The following applies to connectors equipped with a locking device.

5.4.2 Test

5.4.2.1 Locking lever operation

Measure the force required to operate the locking lever at the centre point of the locking device operational area and in the direction specified by the manufacturer.

5.4.2.2 Twist-lock operation

Measure the torque required to engage, disengage and lock the twist-lock.

5.4.3 Requirements

5.4.3.1 The force measured for operating the locking lever according to 5.4.2.1 shall not exceed 120 N.

5.4.3.2 The torque measured on the coupling ring of the twist lock according to 5.4.2.2 shall not exceed 3,5 N·m.

5.5 Ejector force

5.5.1 Application

The following applies to sockets equipped with a physical means of ejecting the plug when the locking device is not engaged.

5.5.2 Test

Measure the force of the ejector in the socket along its moving direction over the full travel range.

5.5.3 Requirement

The ejector tested according to 5.5.2 shall produce a force within the range of 35 N to 75 N, including any force variation over the ejector spring travel.

5.6 Locking device and cable retention strength

5.6.1 Test

Carry out the test using a mated plug and socket and a plug assembled with a 5 mm ± 0,5 mm diameter metal rod coated with cable-quality PVC to give an outside diameter of 12 mm ± 0,5 mm for the connectors. The exception to this requirement is the connector according to ISO 12098, for which a test rod of 15 mm ± 0,5 mm diameter shall be used, fixed as if it were a cable. Apply a force increasing linearly within 10 s from 0 N to 1 000 N to the test rod in the withdrawal direction. Maintain the value of 1 000 N $^{+10}_{0}$ N for 10 s $^{+2}_{0}$ s.

5.6.2 Requirement

No cracks or permanent deformation shall be visible after the test according to 5.6.1.

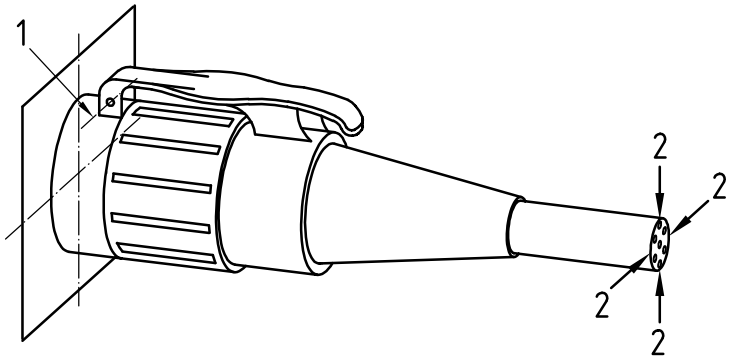
The test rod shall not have moved more than 2 mm after this test, measured on the PVC surface.

Connectors tested according to 5.6.1 shall fulfil subsequently performed tests in accordance with Table 1 or the International Standard that specifies the type of the connector under test.

5.7 Lateral strength at low temperature

5.7.1 Test

Carry out the lateral strength test in a test chamber at −40 °C ± 2 °C, socket- and plug-mated and mounted as designed. Assemble the plug with a test rod in accordance with 5.6.1. Ensure that the test sample has reached −40 °C ± 2 °C. Apply a test torque of 25 ·m in four directions perpendicular to each other (see Figure 1), for 1 min in each direction, starting parallel to the socket cover hinge.



Key

1 socket cover hinge
2 force (for torque)

Figure 1 — Application of torque

5.7.2 Requirement

No cracks or permanent deformation shall be visible after the test according to 5.7.1.

Connectors tested according to 5.7.1 shall fulfil subsequently performed tests in accordance with Table 1 or the International Standard that specifies the type of the connector under test.

5.8 Current carrying capacity

5.8.1 Test

Carry out the test, successively, on one contact pair (pin and tube) in the housings of mated connectors for each nominal cable cross-sectional area that the cable attachment of the contacts tested allows. The remaining contact cavities in the housings shall be left free.

Connect insulated test cables of 500 mm ± 5 mm length and a cross-sectional area in accordance with Table 2 to the male and female contacts to be tested.

Apply a test current in accordance with Table 2 for 1 h and monitor the contact temperatures, measured at the contacts as shown in Figure 2.

Table 2 — Current carrying capacity test values

Nominal cross-sectional area of cable admissible at contact mm^2	Test cable nominal cross-sectional area mm^2	Test current A
6	6	30
2 × 2,5	6	30
4	4	25
2,5	2,5	20
2 × 1,5	2,5	20
1,5	1,5	15

5.8.2 Requirements

The temperature rise of each contact, tested in accordance with 5.8.1, shall not exceed 40 °C, where the temperature rise equals the measured contact temperature minus the test ambient temperature.

This current carrying capacity shall not be used as guide to the capability of the connection to operate at elevated ambient temperatures.

Connectors tested according to 5.8.1 shall fulfil subsequently performed tests in accordance with Table 1 or the International Standard that specifies the type of the connector under test.