
**Road vehicles — Connection interface
for pyrotechnic devices, two-way and
three-way connections —**

**Part 2:
Test methods and general
performance requirements**

*Véhicules routiers — Interface de raccordement pour dispositifs
pyrotechniques, deux voies et trois voies —*

Partie 2: Méthodes d'essai et exigences des performances générales



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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*.

This third edition cancels and replaces the second edition (ISO 19072-2:2013), which has been technically revised.

The main changes compared to the previous edition are as follows:

- [4.4.2.1 Table 1](#), force and torque requirements for straight connectors;
- [4.4.2.2 Table 2](#), force and torque requirements for right angle connectors;
- [4.9.1.2 Figure 8](#) including key, signal contact resistance;
- [4.9.2.1 Table 5](#), maximum signal contact resistance;
- [4.9.2.2 Table 6](#), maximum contact resistance between ground and squib holder.

A list of all parts in the ISO 19072 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

Road vehicles integrate an increasing number of pyrotechnic devices contributing to occupant safety in vehicles (for example, frontal and side air bags, safety belt pretensioner, etc.).

To build the complete system providing the function requires a supply of various components from several different equipment makers. Vehicle manufacturers need to define a common specification to ensure that connectors designed and produced by the various equipment makers meet the same performance criteria and requirements.

In the current design of this vehicle equipment, three areas of connection have been identified:

- between the pyrotechnic device (e.g. initiator) and the harness connector;
- between the tab holder and the clip holder of the harness connector;
- between the harness connector and the electronic control module.

The connection between the pyrotechnic device and the harness connector is the only connection that can be standardized and forms the subject of this document. Due to the location of the safety device in the vehicle, the connector design could be a right angle or straight.

A sealed variant of the pyrotechnic device/initiator harness connector assembly is defined in [Annex A](#).

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Road vehicles — Connection interface for pyrotechnic devices, two-way and three-way connections —

Part 2: Test methods and general performance requirements

1 Scope

This document specifies the performance criteria and requirements of a three-way connection interface, including ground connection, linking the pyrotechnic device and harness connector built into a road vehicle.

Performance criteria and requirements are defined for a sealed variant of the pyrotechnic device/initiator harness connector assembly (see [Annex A](#)).

Performance criteria and requirements are defined for a two-way (without ground) variant of the pyrotechnic device/initiator harness connector assembly (see [Annex B](#)).

Performance criteria and requirements are defined for a variant without a retainer of the pyrotechnic device/initiator harness connector assembly is defined (see [Annex C](#)).

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 8092-2, *Road vehicles — Connections for on-board electrical wiring harnesses — Part 2: Definitions, test methods and general performance requirements*

ISO 20653, *Road vehicles — Degrees of protection (IP code) — Protection of electrical equipment against foreign objects, water and access*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/>

3.1

connector

assembly used to connect several conductors together or a single conductor to an appliance

Note 1 to entry: A male (female) connector is a *housing* (3.2) containing male (female) contacts and accessory items. A male connector may be permanently fixed to a wiring harness or to an appliance [an electronic control unit (ECU) for example]. A female connector is generally permanently fixed to a wiring harness.

[SOURCE: ISO 19072-1:2019, 3.1]

3.2

housing

connector (3.1) without its contacts

[SOURCE: ISO 19072-1:2019, 3.2]

3.3

retainer

ring holding an optional shorting clip (shunt) and providing coding and electrical insulation, generally made of plastic

Note 1 to entry: The shorting clip (shunt) may be omitted by decision between manufacturer and supplier.

[SOURCE: ISO 19072-1:2019, 3.5]

3.4

short-circuited initiator

inert *initiator* (3.6) with two male contacts internally short-circuited with a shunt, used for testing

3.5

squib holder

part of the pyrotechnic device, holding the *initiator* (3.6) and the *retainer* (3.3)

3.6

initiator

part of the pyrotechnical device with two male contacts

4 Functional characteristics of mated connectors

4.1 General

Mated connectors shall meet the requirements specified in 4.2 to 4.16.

Unless other specifications are given, the temperature class to be taken into account for these tests (see ISO 8092-2) is class 2.

4.2 Visual examination

The test and corresponding requirements shall comply with ISO 8092-2.

4.3 Mating and unmating

The test shall be carried out in compliance with ISO 8092-2 by measuring the force applied on the connector.

The connector shall not be locked during the mating and unmating process unless otherwise specified.

The mating/unmating sequence shall comply with the one described in Table 7.

The maximum connecting and disconnecting force measured on the connector shall be less than 40 N.

NOTE The movements of the mating sequence (Table 7) can be carried out simultaneously with the same force.

4.4 Resistance to tensile and compressive force between the connector and squib holder equipped with initiator and retainer

4.4.1 Test

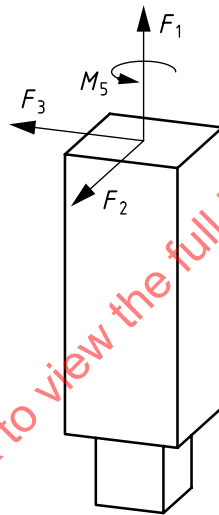
4.4.1.1 General

The connector shall be locked for testing.

This test is a destructive test carried out on an assembly comprising a squib holder, an initiator with male contacts, and a retainer.

4.4.1.2 Straight connectors

The test is carried out on a new sample, applying the forces in the directions shown in [Figure 1](#) on the straight connector without its cable.



Key

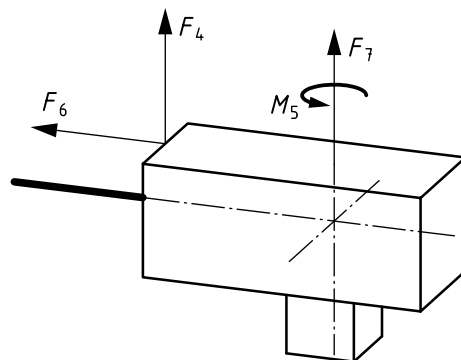
- F_1 tensile force
- F_2 tensile and compressive forces
- F_3 tensile and compressive forces
- M_5 torque

Figure 1 — Direction of forces applied on straight connectors

4.4.1.3 Right-angle connectors

The test is carried out on a new sample, applying the forces F_4 and F_6 on the connector body where the cable exits the connector in the directions shown in [Figure 2](#).

Apply the force F_7 in the central axis of the connector as shown in [Figure 2](#).

**Key**

- F_4 tensile and compressive forces
 F_5 tensile and compressive forces
 F_7 tensile force
 M_5 torque

Figure 2 — Direction of forces applied on right-angle connectors

4.4.2 Requirements

4.4.2.1 Straight connectors

Mated straight connectors shall be able to withstand minimum forces and torque indicated in [Table 1](#).

Table 1 — Minimum tensile and compressive force values for straight connectors

Forces/torque applied to straight connectors	Minimum values of tensile/compressive forces or torque for straight connectors	ISO	Variant
F_1	120 N ^a		
F_2	80 N		
F_3	80 N		
M_5	1,0 Nm	ISO 19072-4	Two-way connections
	0,6 Nm		Three-way (with ground) connections (Annex A)
	1,5 Nm	ISO/TS 19072-5	Two-way connections

^a For the test carried out with force F_1 , after 10 cycles, the value of the minimum force is 100 N.

4.4.2.2 Right-angle connectors

Mated right-angle connectors shall be able to withstand minimum forces and torque indicated in [Table 2](#).

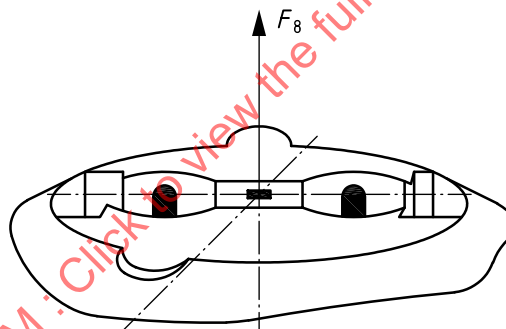
Table 2 — Minimum values of tensile/compressive forces or torque for right-angle connectors

Forces/torque applied to right-angle connectors	Minimum values of tensile/compressive forces or torque for right-angle connectors	ISO	Variant
F_4	70 N		
M_5	1,0 Nm	ISO 19072-4	Two-way connections
	0,6 Nm		Three-way (with ground) connections (Annex A)
	1,5 Nm	ISO/TS 19072-5	Two-way connections
F_6	80 N		
F_7	100 N		

4.5 Mechanical strength of the retainer in the squib holder

4.5.1 Test

The test is carried out on a new sample by applying the force in the direction shown in [Figure 3](#) on the retainer installed in the squib holder.



Key

F_8 force applied to retainer installed in squib holder

Figure 3 — Direction of force applied to the retainer installed in the squib holder

4.5.2 Requirements

The retainer installed in the squib holder without mated connector shall withstand minimum force F_8 indicated in [Table 3](#).

Table 3 — Minimum force applied to the retainer installed in the squib holder

Force applied to the retainer installed in the squib holder	Minimum value of force applied to the retainer installed in the squib holder
F_8	10 N

4.6 Combination of temperature/humidity/vibration

4.6.1 Test

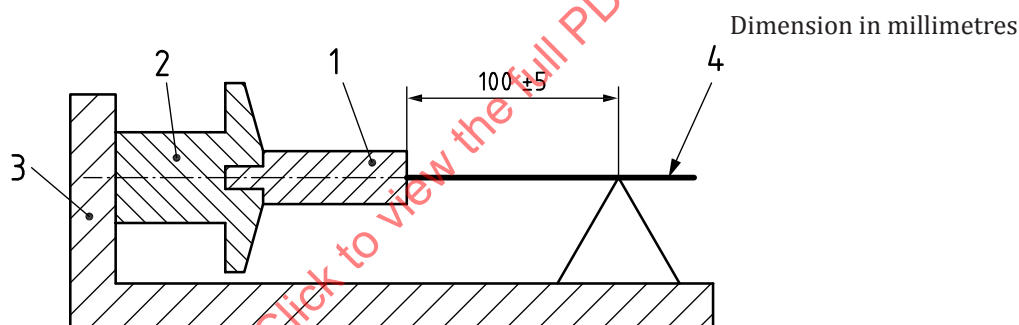
Samples from a series application are assembled with a cable, mated, and preconditioned for 48 h in a ventilated heat chamber at $(65 \pm 2) ^\circ\text{C}$.

The mated connectors are then secured to a vibrating table with the male contacts connected in series on the short-circuited initiator side and connected to a direct current source delivering an intensity of 50 mA, so that the variation in contact resistance can be determined throughout the test. Apply the frequency variations indicated in Table 4 to the connection by logarithmic modulation of 1 octave/min for 48 h per axis (i.e. 144 h in total) using the test setup described in Figures 4 and 5.

Table 4 — Test parameters for combined temperature/humidity/vibration test

Frequency f Hz	Displacement/ acceleration
$5 \leq f \leq 25$	$\pm 1,2 \text{ mm}$
$25 < f \leq 200$	3 g ^a
$200 < f \leq 2\,000$	1 g

^a The conventional value for acceleration due to gravity is 9,806 65 m/s².

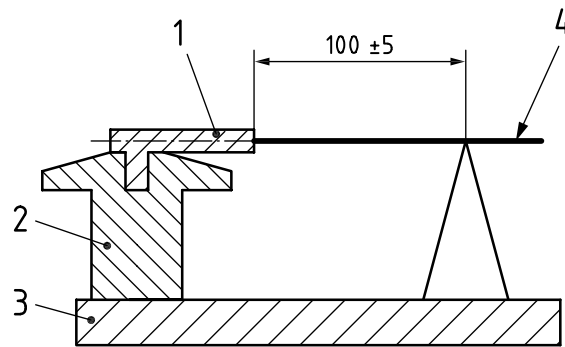


Key

- 1 straight connector being tested
- 2 short-circuited initiator
- 3 vibrating table
- 4 cable fixed without tension force on connector

Figure 4 — Straight connector mounting for combined temperature/humidity/vibration test

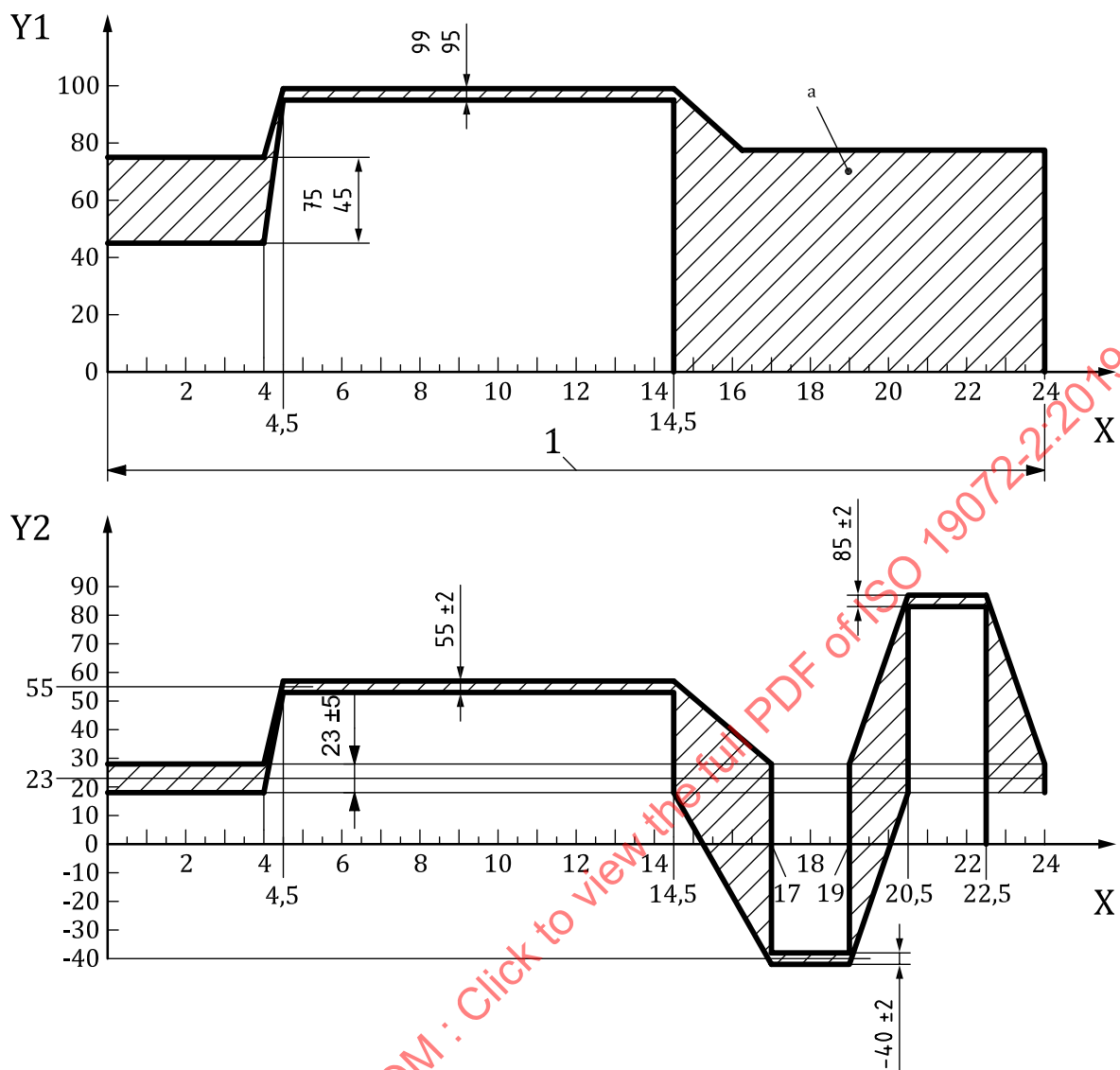
Dimension in millimetres

**Key**

- 1 right-angle connector being tested
- 2 short-circuited initiator
- 3 vibrating table
- 4 cable fixed without tension force on connector

Figure 5 — Right-angle connector mounting for combined temperature/humidity/vibration test

This test is carried out in a heat chamber in which the relative humidity and temperature variation cycle, applied at the same time as the vibration cycle, shall comply with [Figure 6](#).



Key

1 1 cycle

Y1 relative humidity as percentage

Y2 temperature of the test chamber in °C

X time in hours

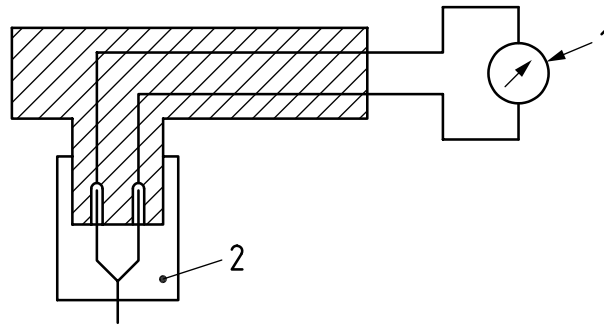
a Relative humidity is not monitored in this range for temperatures of less than 0 °C.

Figure 6 — Temperature cycle for the combined temperature/humidity/vibration test

4.6.2 Requirements

Variation of contact resistance is measured continuously during the test. It shall never exceed 50 mΩ. The minimum recording threshold is set at 25 mΩ.

Contact resistance shall be measured using the test setup shown in [Figure 7](#). The resistance of the wires and the male contacts, except the contact resistance, shall be subtracted from the measurement.

**Key**

- 1 resistance monitoring unit according to ISO 8092-2
- 2 short-circuited initiator

Figure 7 — Test setup used to measure contact resistance

4.7 Coding

4.7.1 Test

The test consists in carrying out a mating test (see [4.3](#)) between a connector and all combinations of alternate retainer codes.

4.7.2 Requirements

It shall be impossible to make electrical connection with a force less than or equal to 100 N.

It shall be impossible to open the shorting bar with a force less than or equal to 150 N.

4.8 Polarisation

4.8.1 Test

The test consists in carrying out a mating test (see [4.3](#)) between a connector and a counterpart in all positions other than the correct position.

4.8.2 Requirements

It shall be impossible to make electrical connection with a force less than or equal to 100 N.

It shall be impossible to open the shorting bar with a force less than or equal to 200 N.

4.9 Contact resistance (voltage drop), millivolt test

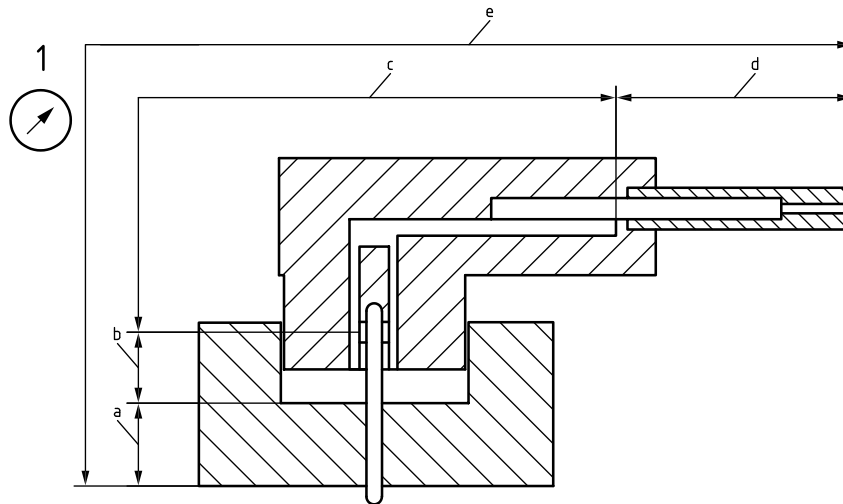
4.9.1 Test

4.9.1.1 General

The test voltage shall not exceed 20 mV under direct current or 20 mV peak voltage under alternating current in open circuit. The intensity of the test current shall not exceed 100 mA.

4.9.1.2 Signal contact resistance

Signal contact resistance shall be measured using the test setup shown in [Figure 8](#).



Key

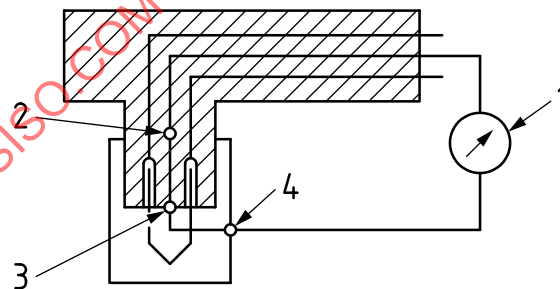
- 1 resistance monitoring unit 1 in accordance with ISO 8092-2
- a Resistance R_{device}
- b Resistance R_{pin}
- c Terminal resistance R_c (bulk resistance terminal + contact resistance to pin + connection resistance to cable).
- d Resistance R_{cable}
- e Resistance R_{measured}

Figure 8 — Test setup used to measure signal contact resistance (millivolt test)

4.9.1.3 Ground contact resistance

Ground contact resistance shall be measured using the test setup shown in [Figure 9](#).

Ground contact resistance does not include internal resistance of the squib holder and cable.



Key

- 1 resistance monitoring unit 1 according to ISO 8092-2
- 2 retainer – connector third-way contact
- 3 retainer – squib holder contact
- 4 measurement point on squib holder outer surface

Figure 9 — Test setup used to measure ground contact resistance (millivolt test)

4.9.2 Requirements

4.9.2.1 Maximum signal contact resistance

The initial, delta and final values shall be documented accordingly in the test report.

Maximum signal contact resistance shall conform to the values given in [Table 5](#).

Signal contact resistance does not include a, b and d.

$$R_c = R_{\text{measured}} - R_{\text{device}} - R_{\text{pin}} - R_{\text{cable}}$$

Table 5 — Maximum signal contact resistance

Pin category	Signal contact resistance	
	Delta between Initial – after test	Maximum value
Ø 1 mm	$\Delta R_c < 6 \text{ m}\Omega$	$R_c < 15 \text{ m}\Omega$

4.9.2.2 Maximum contact resistance between ground and squib holder

Maximum contact resistance between ground and squib holder shall comply with the values given in [Table 6](#).

Table 6 — Maximum contact resistance between ground and squib holder

Maximum contact resistance between ground and squib holder	
Initial maximum value	Maximum value after tests
100 mΩ	1 Ω

4.10 Insulation resistance

The test and corresponding requirements shall comply with ISO 8092-2.

4.11 Withstand voltage

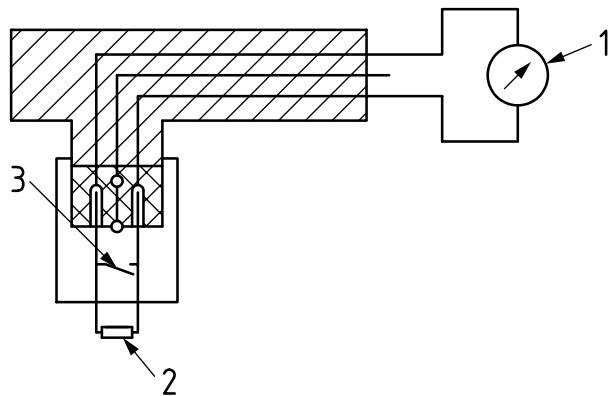
The test and corresponding requirements shall comply with ISO 8092-2, except for the test measurement voltage which is set at 750 V for alternating current and 1 000 V for direct current.

4.12 Thermal ageing

The test and corresponding requirements shall comply with ISO 8092-2.

4.13 Opening and closing of the short-circuit

The test setup used to detect ground and short-circuit is shown in [Figure 10](#).



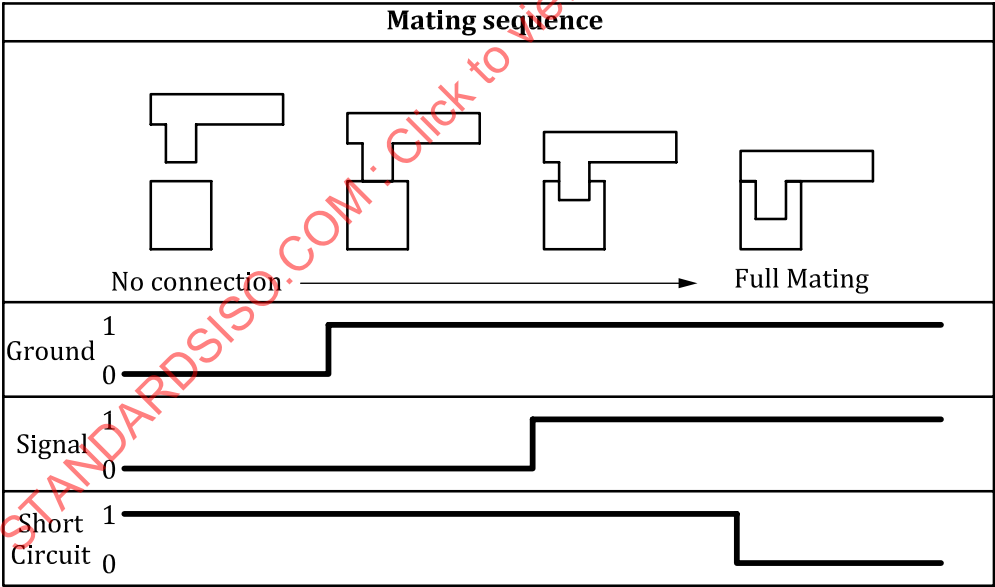
- Key**
- 1 resistance monitoring unit 1 according to ISO 8092-2
 - 2 test resistance of $(10 \pm 0,1) \Omega$
 - 3 retainer short-circuit

Figure 10 — Test setup used to detect ground and short-circuit

Functional sequence requirements for opening and closing of the short-circuit are explained in [Table 7](#). This sequence shall be observed regardless of the connector orientation.

Connector mating phases 1 and 2 may be realized in one or two operations.

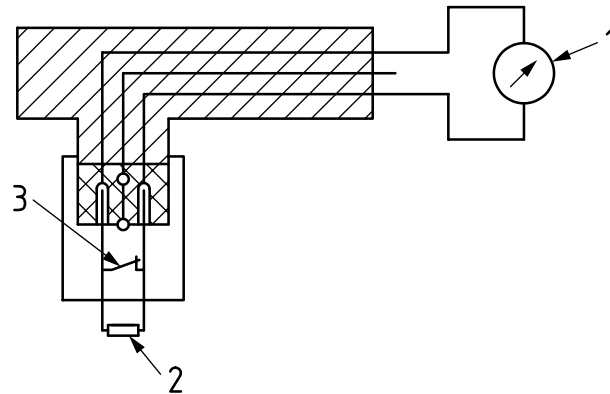
Table 7 — Mating sequence



4.14 Short-circuit resistance

4.14.1 Test

The test setup shown in [Figure 11](#) shall be used to create the short-circuit and measure electrical resistance on the resistance monitoring unit.

**Key**

- 1 resistance monitoring unit according to ISO 8092-2
- 2 opened initiator (R_1)
- 3 short-circuit electrical connection (R_2)

NOTE $R_1 > R_2$.

Figure 11 — Test setup used to measure short-circuit resistance

4.14.2 Requirements

Before and after environment tests, the resistance shall be measured as no more than 300 mΩ.

4.15 Rapid change of temperature (thermal shock)

The test and corresponding requirements shall comply with ISO 8092-2.

4.16 Chemical fluids

The test and corresponding requirements shall comply with ISO 8092-2.

5 Test sequences

The test sequences for each group of samples are shown in [Table 8](#).

Each group shall contain at least 10 samples.

Unless other specifications are given, all the samples in a test group shall be used for the test.

For a sealed variant of the pyrotechnic device/initiator harness connector assembly the test sequence specified in [Annex A](#) shall be followed.

For a two-way (without ground) variant of the pyrotechnic device/initiator harness connector assembly the test sequence specified in [Annex B](#) shall be followed.

For a variant without a retainer variant of the pyrotechnic device/initiator harness connector assembly the test sequence specified in [Annex C](#) shall be followed.

Table 8 — Test sequences and requirements

Test		Group of test samples												Requirement				
Title	Subclause	A		B		C		D		E		F		G		H		Subclause
Visual examination	4.2	1 ^a	3	1	6	1	5	1	9	1	3	1	6	1	6	1	6	4.2
Mating and unmating (first operation)	4.3			2												3		4.3
Mating and unmating (tenth operation)	4.3							3						2		4		4.3
Resistance to tensile and compressive force between the connector and squib holder equipped with initiator and retainer	4.4.1			5														4.4.2
Mechanical strength of the retainer in the squib holder	4.5.1													5				4.5.2
Combination of temperature/humidity/vibration	4.6.1					3						3						4.6.2
Coding	4.7.1	2																4.7.2
Polarisation	4.8.1									2								4.8.2
Contact resistance (voltage drop), milli-volt test Signal contact Ground contact	4.9.1			3				2	4	6		2	4					4.9.2
Insulation resistance	4.10							7										4.10
Withstand voltage	4.11							8				5				5		4.11
Thermal ageing	4.12													4				4.12
Opening and closing of the short-circuit	4.13													3				4.13
Short-circuit resistance	4.14.1			4		2	4											4.14.2
Rapid change of temperature (thermal shock)	4.15							5										4.15
Chemical fluids	4.16															2		4.16

^a Order in which the tests shall be carried out (1, 2, 3, etc.).

^a Order in which the tests shall be carried out (1, 2, 3, etc.).

Annex A

(normative)

Sealed variant of the pyrotechnic device/initiator harness connector assembly

A.1 Functional characteristics of mated connectors

A.1.1 General

All contents of the main document are applicable for the sealed design except [Table 8](#) which is replaced by [Table A.1](#).

Unless otherwise agreed between customer and supplier, the temperature class to be taken into account for these tests (see ISO 8092-2) is class 3.

A.1.2 Mating and unmating

Maximum connecting and disconnecting force measured on the connector shall be less than 60 N.

A.2 Validation tests

Test IPX9K as described in ISO 20653 shall be used.

A.3 Test sequences

The test sequences for each group of samples are shown in [Table A.1](#).

Each group shall contain at least 10 samples.

Unless other specifications are given, all the samples in a test group shall be used for the test.

Table A.1 — Test sequences and requirements

Test		Group of test samples																Requirement
Title	Subclause	A	B	C	D	E	F	G	H	I	Subclause							
Visual examination	4.2	1 ^a 3	1 6	1 5	1 9	1 3	1 6	1 5	1 8	1 6	4.2							
Mating and unmating (first operation)	4.3		2							3	4.3							
Mating and unmating (tenth operation)	4.3				3			2		4	4.3							
Resistance to tensile and compressive force between the connector and squib holder equipped with initiator and retainer	4.4.1		5								4.4.2							
Mechanical strength of the retainer in the squib holder	4.5.1							4			4.5.2							
Water tightness	A.2								5		A.3							
Combination of temperature/humidity/vibration	4.6.1			3			3				4.6.2							
Coding	4.7.1	2									4.7.2							
Polarisation	4.8.1					2					4.8.2							
Contact resistance (voltage drop), millivolt test Signal contact Ground contact	4.9.1		3		2 4 6		2 4		2 7		4.9.2							
Insulation resistance	4.10				7				3 6		4.10							
Withstand voltage	4.11				8		5			5	4.11							
Thermal ageing	4.12								4		4.12							
Opening and closing of the short-circuit	4.13							3			4.13							
Short-circuit resistance	4.14.1		4 2 4								4.14.2							
Rapid change of temperature (thermal shock)	4.15				5						4.15							
Chemical fluids	4.16									2	4.16							

^a Order in which the tests shall be carried out (1, 2, 3, etc.).

^a Order in which the tests shall be carried out (1, 2, 3, etc.).