
**Road vehicles — Unscreened high-voltage
ignition cables — General specifications,
test methods and requirements**

*Véhicules routiers — Câbles d'allumage haute tension non blindés —
Spécifications générales, méthodes d'essai et exigences*



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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 3.

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.

International Standard ISO 3808 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 1, *Ignition equipment*.

This first edition of ISO 3808 cancels and replaces ISO 3808-1:1979 and ISO 3808-2:1980, which have been technically revised.

Annex A forms a normative part of this International Standard.

Road vehicles — Unscreened high-voltage ignition cables — General specifications, test methods and requirements

1 Scope

This International Standard specifies the classes, types and dimensions of, and test methods and requirements for, unscreened high-voltage ignition cables used in spark-ignited engines for road vehicles.

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 1817:1999, *Rubber, vulcanized — Determination of the effect of liquids*

ISO 4926:1978, *Road vehicles — Hydraulic brake systems — Non-petroleum base reference fluids*

3 General cable specifications

3.1 Cable classes

Depending on the test temperature for the thermal overload test (see 4.9) six cable classes are specified. See Table 1.

Table 1 — Cable classes and thermal overload test temperatures

Cable class	A	B	C	D	E	F
Thermal overload test temperature, °C	105	120	155	180	220	250

3.2 Cable types

The type of cable depends on the conductor used. See Table 2.

Table 2 — Cable types

Cable type	Conductor
1	Stranded copper
2	Other stranded metal
3A	Resistive
3B	
4	Reactive

3.3 Cable outside diameter

The outside diameter of the finished cable shall be

- $(5^{+0,3}_0)$ mm,
- $(7 \pm 0,3)$ mm, or
- $(8 \pm 0,3)$ mm.

4 Tests and requirements

4.1 General test conditions

Unless otherwise specified:

- all tests shall be performed at an ambient temperature (room temperature) of $(23 \pm 5)^\circ\text{C}$;
- each test shall be started with an unused sample.

Samples for all tests shall be preconditioned for at least 16 h at room temperature.

When an oven is required, it shall be a hot air oven. The air contained in the oven shall be completely changed at least eight times per hour, but not more than 20 times per hour, at the specified temperature.

4.2 Cable dimensions

4.2.1 Measurements

The outside diameter of the cable shall be determined by taking five sets of measurements along a 1 m length of the cable. Each set of measurements shall consist of the determination of the maximum and minimum diameters at the point of measurement.

4.2.2 Requirement

No single value shall be outside the tolerance given in 3.3.

4.3 Cable resistance

4.3.1 Measurement

The standard sample shall be 1 m in length, plus a stripped length necessary for connections. Other lengths may be used, provided that the resistance reading is adjusted using the procedure given in 4.3.3.

4.3.2 Resistance measuring device

The accuracy of the resistance measuring device shall be $\pm 0,5 \%$ of the measured value.

4.3.3 Procedure

Measure the length of the sample, plus a stripped length necessary for connections. Connect the resistance measuring device to the cable ends. Care should be taken to ensure the connections are secure. Measure the resistance of the sample and then calculate to express the result in ohms per metre.

4.3.4 Requirement

The resistance of the applicable cable types shall be in accordance with Table 3.

Table 3 — Cable resistance

Cable type	Resistance per length
2	1 Ω /m max.
3A	3 000 Ω /m to 9 000 Ω /m
3B	9 000 Ω /m to 23 000 Ω /m
4	Nominal resistance $\pm$ 20 %

4.4 Insulation faults

4.4.1 General

This test is not a qualification test, but an in-process test carried out on cable types 1 and 2 under production conditions.

4.4.2 Apparatus

For high-voltage tests, a sinusoidal voltage source 50 Hz or 60 Hz shall be used. A voltage meter, a fault indicator and a pulse counter shall be available. The test electrode may consist of metal ball chains, metal brushes or any other type of suitable electrodes.

4.4.3 Procedure

The test voltage shall be equal to

- for 5 mm cable, 20 kV (r.m.s.),
- for 7 mm cable, 30 kV (r.m.s.), and
- for 8 mm cable, 30 kV (r.m.s.).

Check before applying the test voltage that the conductor of the cable under test has continuity throughout its full length. The electrode length shall be chosen considering the speed of the cable running through the field of the electrode so that each point of the cable is loaded by at least nine voltage cycles.

Other test methods may be used, provided that insulation faults are detected with the same certainty.

For an existing application, a 7 mm cable of 25 kV (r.m.s.) may be used where agreed between supplier and user¹⁾.

4.4.4 Requirement

No insulation fault is permitted over the full length.

4.5 Thirty minute test voltage and breakdown voltage

4.5.1 Sample length

This shall be approximately 1 500 mm.

1) This situation is to be reviewed at the next periodical revision of this International Standard.

4.5.2 Apparatus

See annex A.

4.5.3 Thirty minute test voltage

4.5.3.1 Procedure

Soak the sample in salt solution [3 % (mass fraction) of NaCl in water] for 4 h at room temperature with each end of the cable emerging from the solution, then immediately apply the test voltage of 20 kV (r.m.s.) for 30 min between the conductor and the solution.

4.5.3.2 Requirement

During the test, there shall be no breakdown of the cable.

4.5.4 Breakdown voltage

4.5.4.1 Procedure

After the test in 4.5.3, increase the voltage at a rate of 500 V/s until breakdown occurs.

4.5.4.2 Requirement

Breakdown voltage shall be not less than

- for 5 mm cable, 25 kV (r.m.s.),
- for 7 mm cable, 35 kV (r.m.s.), and
- for 8 mm cable, 35 kV (r.m.s.).

For an existing application, a 7 mm cable of 30 kV (r.m.s.) minimum breakdown voltage may be used when agreed between manufacturer and supplier²⁾.

4.6 Capacitance

4.6.1 Sample length

This shall be a minimum of 1 200 mm.

4.6.2 Measuring frequency

The measuring frequency shall be 1 000 Hz.

4.6.3 Procedure

Soak the sample in salt solution [3 % (mass fraction) of NaCl in water] at $(70 \pm 2) ^\circ\text{C}$ for 24 h, with each end of the cable emerging 100 mm from the solution. Measure the cable capacitance between the conductor and the solution. Remove the sample from the salt solution and immerse it in a bath containing tap water at a temperature of

2) This situation is to be reviewed at the next periodical revision of this International Standard.

(23 ± 2) °C for 1 h, with each end of the cable emerging 100 mm from the water. Again, measure the cable capacitance between conductor and water.

4.6.4 Requirement

The cable capacitances shall not exceed 250 pF by metre of cable for any cable type.

4.7 Resistance to corona effect

4.7.1 Sample length

This shall be approximately 1 200 mm.

4.7.2 Apparatus

See annex A.

4.7.3 Procedure

Fix the sample, at room temperature, between mandrel and sleeve (see A.2) and apply a voltage increased from 0 at a rate of 500 V/s until the following value is reached:

- for 5 mm cable, 15 kV (r.m.s.);
- for 7 mm cable, 18 kV (r.m.s.);
- for 8 mm cable, 18 kV (r.m.s.).

Maintain this voltage for 8 h.

4.7.4 Requirement

No breakdown shall occur during the test. After the test, the sample shall show no cracks, fractures or other defects.

For an existing application, a 7 mm cable of 15 kV (r.m.s.) may be used where agreed between supplier and user³⁾.

4.8 Pressure at high temperature

4.8.1 Sample length

This shall be approximately 100 mm.

4.8.2 Apparatus

See annex A.

³⁾ This situation is to be reviewed at the next periodical revision of this International Standard.

4.8.3 Procedure

Mount the sample in the test apparatus (see A.3) and apply the specified force. Place the apparatus with sample mounted for 4 h in an oven maintained at a temperature in accordance with Table 4.

Table 4 — Test temperatures

Cable class	A	B	C	D	E	F
Test temperature, °C	± 2	70	105	120	Not applicable	

The apparatus shall be free from vibration. Remove the sample from the test apparatus and cool it within 10 s by immersing it in cold water. Then measure the depth of the indentation at a cross- or length-section in the area of application of the load, using a measuring microscope.

4.8.4 Test forces

These shall be as follows:

- for 5 mm cable, 3,1 N (force exerted by the mass);
- for 7 mm cable, 4,5 N (force exerted by the mass);
- for 8 mm cable, 5,1 N (force exerted by the mass).

4.8.5 Requirement

The depth of the indentation shall not exceed 50 % of the average wall thickness, determined by six measurements distributed around the circumference of the sample at a suitable distance from the area of the indentation.

4.9 Thermal overload

4.9.1 Sample length

This shall be approximately 500 mm.

4.9.2 Apparatus

See annex A.

4.9.3 Procedure

Suspend the sample vertically for 48 h in an oven at a temperature in accordance with Table 1.

Cool the sample to room temperature, then wind it in accordance with A.4.

4.9.4 Requirements

For all cable types, after this test, the sample shall show neither cracks, fractures nor other defects.

Additionally, for types 3A and 3B, the resistance — measured before and after the test with the same sample — shall not have changed by more than + 50 % or – 30 %.

4.10 Shrinkage by heat

4.10.1 General

This test is applicable to cable classes A and B, and shall be performed wherever shrinkage of the insulation relative to the connector attachment is important.

4.10.2 Sample length

This shall be approximately 200 mm.

4.10.3 Procedure

Prior to testing, measure the exact length of the sample at room temperature. Put the sample in an oven in a horizontal position, so that air may circulate freely from all sides. Test duration shall be 15 min. The test temperature shall be $(150 \pm 2) ^\circ\text{C}$. Cool the sample to room temperature. Then measure the length again.

4.10.4 Requirement

For all cable classes, after this test, the insulation is permitted to have shrunk by up to 2 % in length. However, the sample shall show neither cracks, fractures nor other defects.

Additionally, for cable types 3A and 3B, the resistance — measured before and after the test with the same sample — shall not have changed by more than + 50 % or – 30 %.

4.11 Resistance to flame propagation

4.11.1 Sample length

This shall be approximately 500 mm.

4.11.2 Apparatus

For this test, a Bunsen-burner fed with appropriate gas and having a combustion tube with an internal diameter of approx. 9 mm and a flame of approx. 100 mm height shall be employed. The length of the inner blue cone of the flame shall be approximately 50 mm and the temperature at its tip shall be a minimum of $900 ^\circ\text{C}$.

See annex A.

4.11.3 Procedure

Suspend the sample in a draught-free room and expose it to the tip of the inner cone of the test flame, as shown in Figure A.4.

The times of exposure to the test flame shall be as given in Table 5.

4.11.4 Requirement

Any combustion flame from insulating material shall have become extinguished within the time specified in Table 5 after removal of the burner flame.

Table 5 — Exposure and extinction times

Time in seconds	
Exposure	Extinction
± 1	max.
15	70

4.12 Flexibility at low temperatures

4.12.1 Sample length

This shall be approximately 400 mm.

4.12.2 Procedure

Fix the sample on a rotatable mandrel with a diameter in accordance with A.2. Load the free end with a force of 45 N and maintain the sample for 4 h in a freezing chamber at a temperature in accordance with Table 6. Then, within the freezing chamber, wind at least three turns around the mandrel at a winding speed of 1 turn/s.

NOTE If the apparatus is pre-cooled to the test temperature, a freezing time of 2 h is sufficient.

Table 6 — Test temperatures

Cable class	A	B	C	D	E	F
Test temperature, °C	± 3	– 20	– 30	– 40	– 50	

4.12.3 Requirement

For all cable types, after this test, the sample shall show neither cracks, fractures nor other defects.

Additionally, for types 3A and 3B, the resistance — measured before and after the test with the same sample — shall not have changed by more than + 50 % or – 30 %.

For reactive cable, verify with approximately 12 V d.c. that no interruption has occurred.

4.13 Mechanical strength

4.13.1 General

This test is applicable to cable types 3A, 3B and 4.

4.13.2 Sample length

This shall be approximately 1 200 mm.

4.13.3 Apparatus

See annex A.

4.13.4 Procedure

Suspend the sample in the test apparatus specified in clause A.6 and subject it to a force, F , in accordance with Table 7 for 5 min.

Table 7 — Test forces for mechanical strength test

Cable outside diameter mm	Force, F N
5	180
7 and 8	250

4.13.5 Requirement

For types 3A and 3B, after this test, the resistance — measured before and after the test with the same sample — shall not have changed by more than + 50 % or – 30 %.

For reactive cable, verify with approximately 12 V d.c. that no interruption has occurred.

4.14 Insulation stripping

4.14.1 Test

Where cables are required to be stripped, it shall be possible to remove at least 20 mm cleanly and without difficulty.

4.14.2 Requirement

Specific stripping force values, where required, shall be agreed between the cable manufacturer and the user.

4.15 Fluid compatibility

4.15.1 General

These tests are intended for qualifying cables for limited exposures to fluids.

Each fluid compatibility test is to be performed on an unused sample of cable approximately 400 mm in length. Approx. 50 mm of the cable at each end shall extend above the surface of the fluid during immersion.

4.15.2 Resistance to oil

4.15.2.1 Procedure

Immerse the sample in oil No. 1 as specified in ISO 1817, maintaining this oil at a temperature of $(90 \pm 2) ^\circ\text{C}$ for a minimum of 48 h. Stir the oil during the test. Wipe any excess oil from the sample when removing it from the oil and cool it to room temperature. Then wind the sample in accordance with A.4.

4.15.2.2 Requirement

During the test, neither the insulation nor the outer sleeve shall break or tear. Variations of between – 5 % and + 15 % of the original diameter are permitted.

4.15.3 Resistance to fuel

4.15.3.1 Procedure

Immerse the sample in liquid C as specified in ISO 1817 at room temperature for a minimum of 30 min. Allow the sample to dry at room temperature for approximately 30 min after removal from the liquid. Then wind in accordance with A.4.

4.15.3.2 Requirement

During the test, neither the insulation nor the outer sleeve shall break or tear. Variations of between -5% and $+15\%$ of the original diameter are permitted.

4.15.4 Resistance to brake fluid

4.15.4.1 Procedure

Heat the sample in an oven at a temperature of $(90 \pm 2)^\circ\text{C}$ for 4 h, then immediately immerse it in brake fluid as specified in ISO 4926 at room temperature and maintain for 5 min to 10 min. Remove the sample from the liquid, drain for 2 min and then reheat in an oven at a temperature of $(90 \pm 2)^\circ\text{C}$ for 48 h. Wipe any excess fluid from the sample after removal from the oven and cool it to room temperature. Then wind the sample in accordance with A.4.

4.15.4.2 Requirement

During the test, neither the insulation nor the outer sleeve shall break or tear. Variations of between -5% and $+15\%$ of the original diameter are permitted.

4.15.5 Resistance to antifreeze

4.15.5.1 Procedure

Heat the sample in an oven at a temperature of $(90 \pm 2)^\circ\text{C}$ for 4 h, then immediately immerse it in a 1:1 ethylene glycol/water mixture at $(95 \pm 5)^\circ\text{C}$ and maintain for 96 h. Remove the sample from the liquid and cool it to room temperature. Wipe any excess fluid from the sample. Then wind the sample in accordance with A.4.

4.15.5.2 Requirement

During the test, neither the insulation nor the outer sleeve shall break or tear. Variations of between -5% and $+15\%$ of the original diameter are permitted.

4.16 Accelerated life tests

4.16.1 Sample length

This shall be approximately 1 200 mm.

4.16.2 Apparatus

See annex A.

4.16.3 Procedure

4.16.3.1 General

Prior to testing, wind the sample in accordance with, first A.4, then A.2.

The tests specified in 4.16.3.2 to 4.16.3.6 shall be carried out in sequence, on the same sample, either with or without the sleeve. When immersed in liquids, the cable ends shall emerge approx. 100 mm from the liquid surface.

After each of the tests, apply a voltage, in accordance with A.2, starting from 0 V and increasing at a rate of 500 V/s, until the following value is reached:

- for 5 mm cable, 15 kV (r.m.s.);
- for 7 mm cable, 23 kV (r.m.s.);
- for 8 mm cable, 23 kV (r.m.s.).

For an existing application, a 7 mm cable of 20 kV (r.m.s.) may be used when agreed between supplier and user⁴⁾.

4.16.3.2 Resistance to salt water

Heat the sample in an oven to the appropriate heat ageing test temperature (see Table 8) for 4 h and immediately immerse it in a salt solution [3 % (mass fraction) of NaCl in water] and maintain at $(50 \pm 2) ^\circ\text{C}$ for 16 h. Remove it from the solution, drain for 30 min at room temperature and then test in the metal sleeve for 30 min at a test voltage in accordance with 4.16.3.1.

4.16.3.3 Resistance to oil

Heat the sample in an oven to the appropriate heat ageing test temperature (see Table 8) for 4 h and immediately immerse it in oil No. 1 as specified in ISO 1817 and maintain at $(90 \pm 2) ^\circ\text{C}$ for 16 h. Remove the sample from the oil, allow it to drain and cool to room temperature, then test in the metal sleeve for 30 min at a test voltage in accordance with 4.16.3.1.

4.16.3.4 Resistance to fuel

Immerse the sample in liquid C as specified in ISO 1817 at room temperature for 30 min. Remove it from the liquid, drain for 4 h without the sleeve (in order to avoid the risk of explosion) and then test in the metal sleeve for 30 min at a test voltage in accordance with 4.16.3.1.

4.16.3.5 High temperature test

Heat the sample at the appropriate temperature specified in Table 8, maintained for 48 h. Then allow it to cool to room temperature.

Table 8 — High temperature test temperatures

Cable class	A	B	C	D	E	F
Test temperature, °C ± 2	90	105	120	155	180	220

Next, test the sample in the metal sleeve for 30 min at a test voltage in accordance with 4.16.3.1.

4) This situation is to be reviewed at the next periodical revision of this International Standard.

4.16.3.6 Low temperature test

After the high temperature test, unwind the sample from the mandrel, leaving one end secured to it, and apply a force of 45 N to the other end. With the force fully supported by the sample, cool the mandrel and the sample to the temperature specified in Table 9, and maintain for 4 h.

Table 9 — Test temperatures for low temperature test after high temperature test

Cable class	A	B	C	D	E	F
Test temperature, °C	± 3	– 10	– 15	– 20	– 30	– 40

After this period, wind the sample on the mandrel in accordance with A.2 for five complete turns at the rate of one turn every 5 s. This operation shall be carried out in the cold chamber at a temperature in accordance with Table 9. Then allow the sample to return to room temperature.

Finally, test the sample in the metal sleeve for 30 min at a test voltage in accordance with 4.16.3.1.

4.16.4 Requirement

During the accelerated life tests, no high voltage breakdown shall occur.

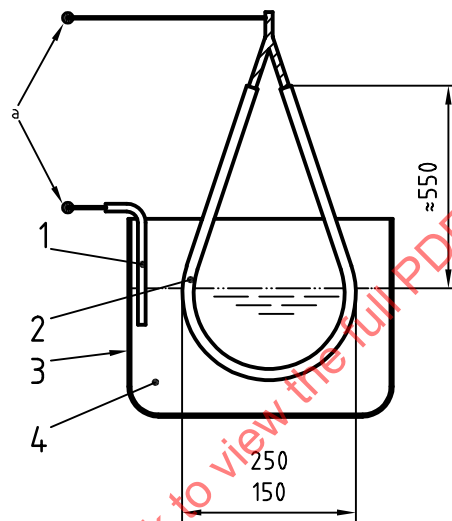
Annex A (normative)

Test apparatus

A.1 Thirty minute test voltage and breakdown voltage

See Figure A.1. For the test methods, see 4.5.

Dimensions in millimetres



Key

- 1 Electrode
- 2 Sample
- 3 Non-conductive vessel
- 4 Salt solution

^a Test voltage.

Figure A.1 — Thirty minute test voltage and breakdown voltage test apparatus

A.2 Resistance to corona effect and accelerated life

See Figure A.2 and Table A.1. This test apparatus is used for the tests given in 4.7 and 4.16.

Winding of the cable is as follows.

- a) Fix a free end of the sample to the mandrel. Apply a force of 25 N to the other end of the cable and rotate the mandrel against the force so that the sample is wound up in five complete turns of a pitch of approximately 19 mm. During winding, the sample shall not be forced against the natural torsion.
- b) Fix the other end of the sample, remove the force and push a close-fitting sleeve over the sample. The sleeve and the mandrel shall be of non-magnetic metal. The sleeve shall have flared ends.