International Standard 6722/1

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Road vehicles — Unscreened low-tension cables — Part 1 : General requirements and test methods

Véhicules routiers — Câbles basse tension non blindés — Partie 1 : Spécifications générales et méthodes d'essai

Second edition — 1984-12-15

UDC 621.315.21 : 629.11 **Ref. No. ISO 6722/1-1984 (E)**

Descriptors : road vehicles, low-voltage, electric cables, specifications, tests, electrical tests, pressure tests, thermal tests, flame propagation test equipment, dimensions.

Price based on 10 pages

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 6722/1 was prepared by Technical Committee ISO/TC 22, *Road vehicles*.

ISO 6722/1 was first published in 1981. This second edition cancels and replaces the first edition, of which it constitutes a technical revision.

Printed in Switzerland

Road vehicles — Unscreened low-tension cables — Part 1 : General requirements and test methods

0 Introduction

ISO 6722 consists of three parts :

Part 1 : General requirements and test methods.

Part 2 : Cable classes, applicable tests and special requirements.

Part 3 : Conductor sizes and dimensions.

1 Scope

This part of ISO 6722 specifies the general requirements and test methods for unscreened low-tension cables.

2 Field of application

This part of ISO 6722 applies to all classes of unscreened low-tension cables used in road vehicle applications.

3 References

ISO 1817, *Vulcanized rubbers — Resistance to liquids — Methods of test.*

ISO 6722/2, *Road vehicles — Unscreened low-tension cables — Part 2 : Cable classes, applicable tests and special requirements.*

ISO 6722/3, *Road vehicles — Unscreened low-tension cables — Part 3 : Conductor sizes and dimensions.*

4 Test methods

4.1 Test for insulation faults of the total delivery

(For single core cables only.)

4.1.1 Principle

When the earthed dry cable is drawn through a wire coil to which a voltage is being applied, no breakdown shall occur.

4.1.2 Apparatus

Wire coil : Internal diameter equal to the cable outside diameter plus 2 mm, pitch approximately 3 mm, wire diameter 1,5 mm.

4.1.3 Test voltage

Values are specified in ISO 6722/2, at a frequency of 50 or 60 Hz.

4.1.4 Duration of test

At least 1 s for each part of the cable.

NOTE — For this test, other types of installation and a shorter duration of test may be used provided that insulation faults are detected with the same degree of certainty.

4.2 30 min test voltage and breakdown voltage

4.2.1 Specimen length

Approximately 1 200 mm.

4.2.2 Test for single core cables

(For test apparatus see the annex, clause A.1.1.)

4.2.2.1 Procedure

Immerse the specimen for 4 h in salt solution [3 % (m/m) of NaCl in water] at a room temperature of (23 ± 5) °C, ends emerging, and then immediately apply the specified test voltage for 30 min between the conductor and the solution. The cable shall not break down.

Then increase the voltage at a rate of 500 V/s until the specified value is reached. Breakdown shall not occur.

4.2.2.2 Test voltage and breakdown voltage

Values are specified in ISO 6722/2 at a frequency of 50 or 60 Hz.

4.2.3 Test for multicore cables

(For test apparatus see the annex, clause A.1.2.)

4.2.3.1 Procedure

Immerse the specimen for 4 h in salt solution [3 % (m/m) of NaCl in water] at a room temperature of (23 ± 5) °C, ends emerging, and then immediately apply the specified test voltage for 30 min :

— consecutively between each conductor and the solution and the remaining conductors connected together;

— between all conductors, connected together, and the solution.

Breakdown shall not occur.

4.2.3.2 Test voltage

Values are specified in ISO 6722/2, at a frequency of 50 or 60 Hz.

4.3 Insulation resistance

(For single core cables only.)

4.3.1 Specimen length

Approximately 5 m.

4.3.2 Procedure

Immerse the specimen for 2 h in tap water at a temperature as specified in ISO 6722/2, each end emerging by approximately 250 mm.

Apply a d.c. voltage of approximately 500 V[1] between the conductor and the water. The insulation resistance shall be measured 1 min after application of the voltage; it shall not be less than the equivalent of a volume resistivity as specified in ISO 6722/2, calculated from the formula

$$\varrho_0 = 2{,}725 \frac{l \cdot R}{\log \frac{D}{d}}$$

where

ϱ_0 is the volume resistivity, expressed in ohms millimetres;

l is the immersed length of the sample, expressed in millimetres;

R is the insulation resistance, expressed in ohms;

D is the outside diameter of the cable, expressed in millimetres;

d is the conductor diameter, expressed in millimetres.

4.4 Pressure test at high temperature

(For test apparatus see the annex, clause A.2.)

4.4.1 Test for single core cables

4.4.1.1 Specimen length

Approximately 100 mm.

4.4.1.2 Procedure

Mount the specimen in the test apparatus, load with the mass specified in 4.4.3 and maintain for 4 h at the temperature specified in ISO 6722/2 in a hot air oven with natural draught. Remove the specimen from the test apparatus and cool within 10 s by immersing in cold water. Then measure the depth of the indentation at a cross-section — in the width or length — in the area of application of the load, using a measuring microscope. The depth of the indentation shall not exceed 50 % referred to the average wall thickness, determined by six measurements distributed around the circumference of the specimen at a suitable distance from the area of indentation.

4.4.2 Test for the sheath of multicore cables

4.4.2.1 Specimen length

Take two specimens of about 100 mm length each, one from each of two places, separated by at least 1 m.

4.4.2.2 Procedure

After having removed any covering, cut a strip from each of the specimens; if the sheath shows ridges caused by the individual cores, cut the strip in the direction of the ridges so that it contains at least one groove throughout its length.

Support the strips by a metal pin. If the sheath shows ridges, the pin diameter shall be approximately equal to the core diameter; if the sheath shows no ridges, the pin diameter shall be approximately equal to the inner diameter of the sheath.

Keep the apparatus, the strips and the supporting pin for 16 h in a heating cabinet at the temperature specified in ISO 6722/2. They shall then be arranged so that the pin supports the sheath, the pin lying in the groove, if any, of the sample, and the blade pressing against the outer surface of the sheath with the weight as specified in 4.4.3. The force shall be applied in a direction perpendicular to the axis of the pin, and the blade shall also be perpendicular to the axis of the pin.

Maintain the apparatus, with the specimens in position, in this condition in the heating cabinet for 4 h.

1) Differing voltages between 100 V and 500 V are allowed, if the measuring results conform with the results obtained with 500 V.

Remove the specimens from the apparatus and cool, within 10 s, by immersion in cold water.

Measure the thicknesses of the sheaths immediately, at the point of impression and at points about 10 mm to both sides of the impression, by means of a measuring microscope.

The thicknesses within the area of the impression shall not be less than 50 % of the mean of the thicknesses at the other two measuring points.

4.4.3 Mass for the pressure tests

$$G = 0{,}08\sqrt{2D \cdot i - i^2}$$

where

G is the weight, expressed in kilograms.

Furthermore, for single core cables (see 4.4.1) :

i is the mean value of the thickness of the insulation of the sample, expressed in millimetres;

D is the mean value of the outside diameter of the sample for round cables, expressed in millimetres.

For the sheath of multicore cables (see 4.4.2) :

i is the mean value of the thickness of the sheath, expressed in millimetres;

D is the upper limit of the mean outside diameter specified for the multicore cable, expressed in millimetres.

4.5 Thermal overload test

(For single core and multicore cables.)

(For test apparatus see the annex, clauses A.3 and A.4.)

4.5.1 Specimen length

Approximately 500 mm.

4.5.2 Procedure

Suspend a 500 mm specimen vertically for 48 h in air at the temperature specified in ISO 6722/2 in a hot-air oven with natural draught.

After cooling to a room temperature of (23 ± 5) °C, wind this specimen according to clause A.3 of the annex.

After this test, the specimen shall show neither cracks, fractures nor other defects.

4.6 Shrinkage by heat

(For single core and multicore cables.)

4.6.1 Specimen length

Approximately 200 mm.

4.6.2 Procedure

Measure the exact length of the specimen at a room temperature of (23 ± 5) °C prior to the test. Put the specimen in a hot-air oven with natural draught, in a horizontal position, so that air may circulate freely from all sides. Test duration shall be 15 min at test temperature. Test temperatures shall be as specified in ISO 6722/2.

After cooling to room temperature, measure the length again; the insulation may have shrunk to the percentages in length specified in ISO 6722/2. However, no cracking shall have occurred.

4.7 Resistance to flame propagation

(For single core and multicore cables.)

(For test apparatus see the annex, clause A.5.)

4.7.1 Specimen length

Approximately 500 mm.

4.7.2 Apparatus

For this test, a Bunsen-burner fed with appropriate gas and having a combustion tube of approximately 9 mm internal diameter and a flame of approximately 100 mm height is employed; the length of the inner blue cone of the flame shall be approximately 50 mm.

The flame temperature is correct if a bare copper wire, of (0,7 ± 0,03) mm diameter, and having a free length of approximately 100 mm, inserted horizontally into the tip of the inner blue cone of the flame melts in not less than 4 s and not more than 6 s.

4.7.3 Procedure

Suspend the specimen in a room free of draughts and expose to the tip of the inner cone of the test flame, as shown in clause A.5 of the annex.

The time of exposure to the test flame shall be as specified in ISO 6722/2, but the exposure time shall not be greater than the time at which the conductor becomes visible.

Any combustion flame of insulating material must extinguish within the time specified in ISO 6722/2 after removal of the burner flame.

4.8 Flexibility at low temperature

4.8.1 Winding test

(Applicable for single core cables with a nominal cross-section ⩽ 16 mm² and for multicore cables with an outside diameter ⩽ 13,5 mm.)

(For test apparatus see the annex, clauses A.3 and A.4.)

4.8.1.1 Specimen length

Approximately 400 mm.

4.8.1.2 Procedure

Fix the specimen on a rotatable mandrel of a diameter as specified in clause A.4 of the annex. Load the free end with a mass as specified in clause A.4 of the annex and maintain for 4 h[1] hanging vertically at the temperature specified in ISO 6722/2 in a freezing chamber. Then wind at least three turns around the mandrel within the freezing chamber at a winding speed as specified in clause A.4 of the annex. The insulation shall not show cracks or fractures.

The cable core shall not protrude from the insulation sheath.

4.8.2 Impact test

(Applicable for single core cables with a nominal cross-section > 16 mm².)

(For test apparatus see the annex, clause A.6.)

4.8.2.1 Procedure

Take ten complete specimens of at least 150 mm length each, two from each of five places, separated by at least 1 m. They shall be subjected to an impact test by means of the apparatus shown in clause A.6 of the annex.

The mass of the hammer shall be as specified in ISO 6722/2.

Place the apparatus, positioned on a pad of sponge rubber of 40 mm thickness, together with the specimens in a refrigerator at a temperature according to ISO 6722/2 for at least 16 h[2]. At the end of this period, place each sample in turn in a position as shown in the figure (see A.6), with its minor axis perpendicular to the steel base; the hammer is then allowed to fall from a height of 100 mm.

After the test, allow the specimens to attain a room temperature of (23 ± 5) °C and examine them.

The insulation of at least eight of these specimens shall show no crack visible to the naked eye, after they have been twisted, while held straight, through an angle of 360° for each 100 mm of length.

4.9 Retention of core

(Only for single core cables with nominal cross-sections ⩾ 0,5 mm² and ⩽ 2,5 mm².)

4.9.1 Specimen length

Approximately 150 mm.

4.9.2 Procedure

Remove insulation at one end of the specimen over a length of 100 mm. Insert the bare conductor downwards through a hole of appropriate diameter in a horizontally clamped steel plate and attach the mass to the core as specified in ISO 6722/2 (dead weight method). No relative movement between the core and the insulation shall occur within 30 s.

4.9.3 Test temperature

Room temperature — (23 ± 5) °C.

4.10 Stripping of insulation

(Only for single core cables.)

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

4.11 Resistance to oil

(For single core and multicore cables.)

(For test apparatus see the annex, clauses A.3 and A.4.)

4.11.1 Specimen length

Approximately 500 mm.

4.11.2 Procedure

Immerse the specimen for 48 h in oil No. 1 as specified in ISO 1817 at a temperature as specified in ISO 6722/2, with the cable ends emerging approximately 50 mm above the surface of the oil.

The oil shall be stirred during the test.

Clean the specimen when removed from the oil and cool to a room temperature of (23 ± 5) °C. Then wind as indicated in clause A.3 of the annex.

During the test, the insulating envelope shall not break or tear. Percentage alterations of the average thickness of the sheath (determined before the test) are allowed as specified in ISO 6722/2.

The colour coding shall still be recognizable after this test.

4.12 Resistance to fuel

(For single core and multicore cables.)

(For test apparatus see the annex, clauses A.3 and A.4.)

1) If the test device is pre-cooled, a freezing time of 2 h is sufficient.

2) If the apparatus is pre-cooled, a freezing time of 4 h is sufficient.

4.12.1 Specimen length

Approximately 500 mm.

4.12.2 Procedure

Immerse the specimen in liquid C as specified in ISO 1817 at a room temperature of (23 ± 5) °C for 30 min with the cable ends emerging approximately 100 mm above the surface of the liquid.

Allow the specimen to dry at room temperature for approximately 30 min after removal from the liquid. Then wind as indicated in clause A.3 of the annex.

During the test, the insulation shall not break or tear. Percentage alterations of the average thickness of the sheath (determined before the test) are allowed as specified in ISO 6722/2.

The colour coding shall still be recognizable after this test.

4.13 Abrasion resistance

(For test apparatus see the annex, clause A.7.)

4.13.1 Scrape abrasion test

The scrape abrasion test rig shall conform to the requirements detailed in clause A.7 and shall consist of a device designed to abrade the surface of the insulation in both directions along the longitudinal axis of the cable for a distance of not less than 10 mm, at a frequency of 50 to 60 cycles per minute.

The test rig shall be provided with a counter for recording the numbers of cycles to failure and shall be controlled so that when the blade abrades through the insulation and makes contact with the conductor the machine will stop operating. The specimen which shall be approximately 750 mm in length shall be firmly clamped to the anvil.

The test shall be carried out at a room temperature of (23 ± 5) °C.

The blade shall be loaded with a mass as specified in ISO 6722/2. Four tests shall be made on each specimen which shall be moved forward 100 mm and rotated through 90° in one direction between tests.

The scrape abrasion resistance is defined as the number of complete cycles required for the scraping blade to abrade through the cable insulation and stop the machine. The minimum number of cycles to be withstood shall be as stated in ISO 6722/2.

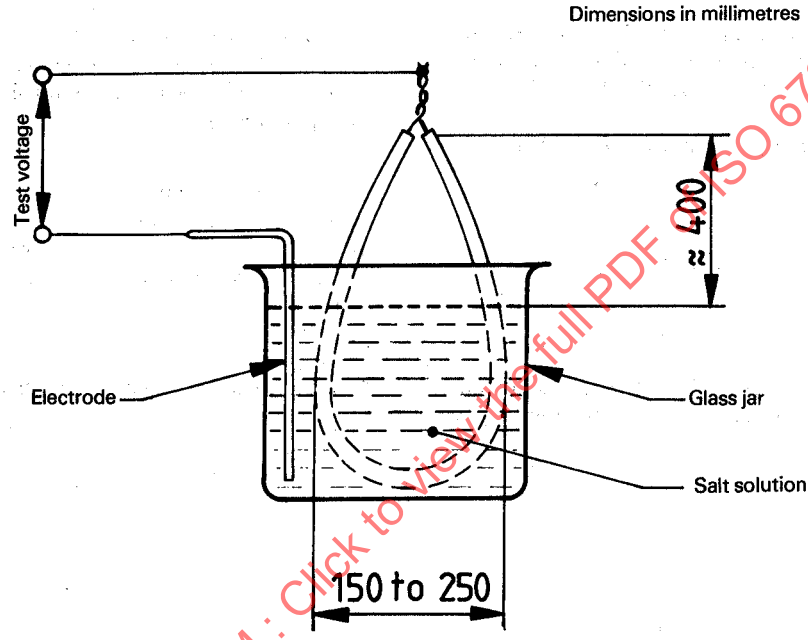
4.14 Conductor and strand coating (under consideration)

Annex

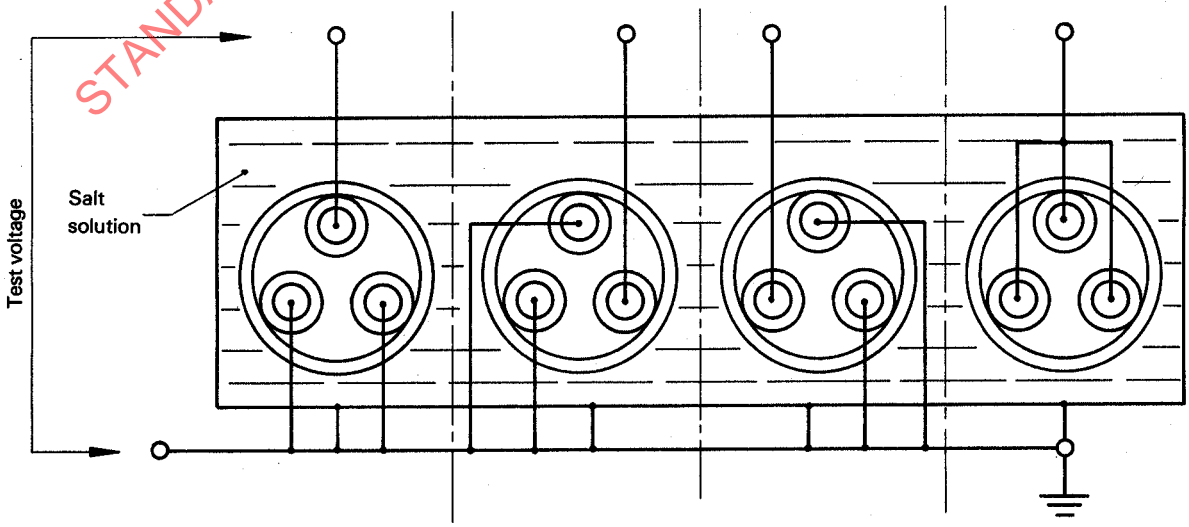
Low-tension cables — Test apparatus

A.1 Test apparatus for 30 min test voltage and breakdown voltage

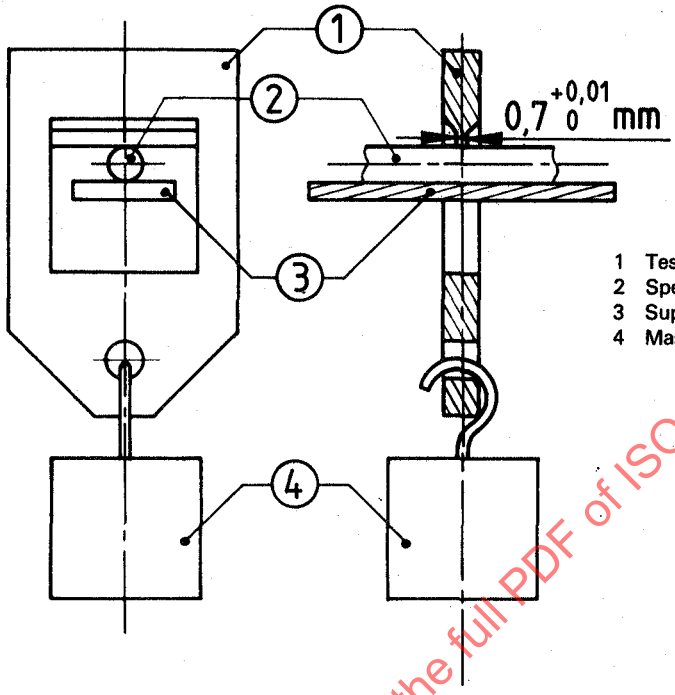
A.1.1 For single core cables (see 4.2.2)



A.1.2 For multicore cables (see 4.2.3)



A.2 Test apparatus for pressure test at high temperature (see 4.4)



1 Test frame
2 Specimen
3 Support
4 Mass

A.3 Winding on mandrel (see 4.5, 4.11 and 4.12)

Fix one end of the cable specimen to a rotatable mandrel and attach a mass to the insulation at the other end.

Wind the sample clockwise and then counter-clockwise on the rotating mandrel in closely pitched turns for a minimum of four turns in each direction (samples with an outside diameter > 15 mm, only two turns).

The mandrel diameter, mass and winding speed shall be as defined in clause A.4.

A.4 Mandrel diameters and masses for the winding tests according to 4.5, 4.8.1, 4.11 and 4.12 (depending on the cable diameters)

Nominal outside cable diameter mm	Test 4.5, 4.11, 4.12; mandrel diameter mm	Test 4.8.1; mandrel diameter mm	Mass kg	Winding speed s^{-1}
⩽ 2,5	2	6	0,5	1
> 2,5 and ⩽ 3	3	10	2,5	1
> 3 and ⩽ 4	4	15	5	1
> 4 and ⩽ 5	5	20	5	1
> 5 and ⩽ 6	6	30	10	0,5
> 6 and ⩽ 7	8	40	10	0,5
> 7 and ⩽ 8,2	10	50	15	0,5
> 8,2 and ⩽ 9,5	12	*)	15	0,5
> 9,5 and ⩽ 11	15	—	20	0,5
> 11 and ⩽ 12,5	20	—	20	0,2
> 12,5 and ⩽ 15	30	—	30	0,2
> 15 and ⩽ 17	50	—	30	0,2
> 17 and ⩽ 20	75	—	30	0,2

*) Single core cables with a nominal cross-section > 16 mm^2 shall be tested according to 4.8.2.