



SLOVENSKI STANDARD
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Mini-couplers for the interconnection of electrical mains supplied equipment in road vehicles

Mini-couplers for the interconnection of electrical mains supplied equipment in road vehicles

Steckvorrichtungen für das Verbinden der elektrischen Einrichtungen mit Netzanschluß in Kraftwagen, Omnibussen und dergleichen

Mini-conducteurs d'interconnexion de l'équipement électrique raccordé au réseau dans les automobiles, autocars, caravanes et véhicules analogues

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English version

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STANDARD PREVIEW
This European Standard was approved by CENELEC on 24 March 1992. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

This standard was prepared by BTTF 52-3, Miniature connecting devices in cars.

The draft standard was submitted to the CENELEC Unique Acceptance Procedure in June 1991 and was ratified by CENELEC as EN 50066 on 24 March 1992.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1993-03-01
- latest date of withdrawal of conflicting national standards (dow) 1995-03-01

For products which have complied with the relevant national standard before 1995-03-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2000-03-01.

NOTE. In this document, the following print types are used:

- requirements proper: in roman type;
- test specifications: in italic type;
- explanatory matter: in smaller roman type.

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Other publications quoted in this standard

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 60309	<i>Plugs, socket-outlets and couplers for industrial purposes</i> (IEC 309, modified)	IEC 884-1	<i>Plugs and socket-outlets for household and similar purposes</i>
EN 60529	<i>Classification of degrees of protection provided by enclosures</i> (IEC 529)	ISO 1101	<i>Standard technical drawings – Geometrical tolerancing – Tolerancing of form, orientation, location and run-out – Generalities, definitions, symbols, indication on drawings</i>
HD 21.5 S2	<i>PVC-insulated cables of rated voltages up to and including 450/750 V</i> Part 5: <i>Flexible cables (cords)</i> (IEC 227-5, modified)	ISO 1456	<i>Metallic coatings – Electroplated coatings of nickel plus chromium</i>
HD 22.4 S2	<i>Rubber insulated cables of rated voltages up to and including 450/750 V</i> Part 4: <i>Flexible cables (cords)</i> (IEC 245-4, modified)	ISO 1817	<i>Rubber, vulcanized – Determination of the effect of liquids</i>
HD 214 S2	<i>Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions</i> (IEC 112)	ISO 2081	<i>Metallic coatings – Electroplated coatings of zinc on iron or steel</i>
		ISO 2093	<i>Metallic coatings – Electroplated coatings of tin</i>
HD 444.2.1 S1	<i>Fire hazard testing – Part 2: Test methods, Glow-wire test and guidance</i> (IEC 695-2-1)	ISO 4046	<i>Paper, board, pulp and related terms – Vocabulary</i>
		HD 495 S1	<i>Spring-operated impact test apparatus and its calibration</i> (IEC 817)
		IEC 614-2-2	<i>Specification for conduits for electrical installations</i> Part 2: <i>Particular specifications for rigid plain conduits of insulating materials</i>
		IEC 614-2-5	<i>Specification for conduits for electrical installations</i> Part 2: <i>Particular specifications for flexible conduits (under preparation)</i>

1 Scope

This standard specifies general safety requirements for mini-couplers with a rated current of 16 A and a rated voltage of 250 V a.c. single phase, applied for the interconnection of mains supplied equipment in road vehicles, e.g. to supply electrical heaters, battery chargers and cab heaters.

This standard may also be used for mini-couplers for other similar applications.

The standard does not apply to devices used in flexible supply cables for the connection of household electrical appliances and the like to their supply.

The introduction of requirements for mini-couplers for 440 V three phase is under consideration.

It should be borne in mind that aspects of product liability will have to be considered in conjunction with the use of mini-couplers.

2 Definitions

The following definitions apply for the purpose of this European Standard.

2.1 mini-coupler

A device for the connection and disconnection of flexible cables in the electrical mains supplied installation in road vehicles. It can consist of the following four parts:

- a connector,
a part of a mini-coupler with contact tubes, which is integral with a flexible conduit and a three core flexible cable.
- an outlet,
a part of a mini-coupler with contact tubes, which is integral with a piece of electrical equipment.
- a plug,
a part of a mini-coupler with contact pins, which is integral with a flexible conduit and a three core flexible cable.
- an inlet,
a part of a mini-coupler with contact pins, which is integral with a piece of electrical equipment.

2.2 rated voltage

The voltage value assigned to the mini-coupler by the manufacturer.

2.3 rated current

The current value assigned to the mini-coupler by the manufacturer.

2.4 clearance

The shortest distance in air between two conductive parts.

For the purpose of determining a clearance to accessible parts, the accessible surface of an insulating enclosure shall be considered conductive as if it were covered by a metal foil wherever it can be touched by hand or the standard test finger according to EN 60529, figure 1.

2.5 creepage distance

The shortest distance along the surface of an insulating material between two conductive parts.

For the purpose of determining a creepage distance to accessible parts, the accessible surface of an insulating enclosure shall be considered conductive as if it were covered by a metal foil wherever it can be touched by a hand or the standard test finger according to EN 60529, figure 1.

2.6 ambient temperature

The temperature of the air surrounding the mini-coupler.

2.7 temperature rise

The difference between the temperature of the relevant part of the mini-coupler, measured at the load specified by the test specification, and the temperature of the air in the room in which the device is installed or used.

2.8 non-rewirable connector, non-rewirable plug

An accessory so constructed that it forms a complete unit with the flexible conduit and the flexible cable after connection and assembly by the manufacturer of the accessory (see 11.5).

3 General requirement

Mini-couplers shall be so designed and constructed that when used as intended their performance is reliable and without danger to persons or surroundings.

In general, compliance is checked by carrying out all the relevant tests specified.

4 General notes on tests

4.1 Tests according to this standard are type tests.

4.2 Unless otherwise specified, the specimens are tested as delivered and under intended conditions of use, at an ambient temperature of (23 ± 5) °C. For the testing, the specimens intended for connection by flexible cable shall be equipped with a flexible cable, at least 0,5 m long and enclosed in a flexible conduit.

4.3 The tests are carried out as specified in annex B.

4.4 Unless otherwise specified, mini-couplers with contact tubes and those with pins are tested separately.

4.5 When, for a particular test, a mating mini-coupler is necessary, this mini-coupler shall be in accordance with the relevant standard sheet.

For the purpose of testing to this standard no gauges are considered to be necessary.

4.6 The neutral circuit, if any, is treated as a pole.

4.7 For the tests carried out on one specimen, a mini-coupler is deemed to not comply with the requirements of this standard if there is a failure in one or more of the tests.

For the tests carried out on three specimens a mini-coupler is deemed not to comply with the requirements of this standard, if there are more failures than that of one specimen in one of the tests.

If one specimen fails in a test, that test and those preceding, which may have influenced the result of that test, are repeated on another set of specimens, all of which shall then comply with the repeated tests.

In general, it will only be necessary to repeat the test which caused the failure.

The applicant may submit, together with the number of specimens specified in annex B, the additional set of specimens which may be needed should one specimen fail.

The testing laboratory will then, without further request, test the additional specimens and will only reject if a further failure occurs. If the additional set of specimens is not submitted at the same time, a failure of one specimen will entail a rejection.

4.8 Mini-couplers integrated in or incorporated in an appliance or equipment are tested under the conditions of use of the equipment, the number of specimens then being the same as the number of specimens of equipment required according to the relevant standard for the equipment.

5 Marking

5.1 Mini-couplers shall be marked with:

- 16 A, 250 V~;
- either the name, trade mark or identification mark of the manufacturer or of the responsible vendor;
- type reference, which may be a catalogue number;
- symbol for degree of protection by enclosure.

The marking of the rated current and the rated voltage may be as follows:

$$16/250 \sim \text{ or } \frac{16}{250} \sim$$

Mini-couplers need not be separately marked if they are integrated or incorporated in a piece of electrical equipment, as then the marking requirements of the relevant standard for the equipment apply.

5.2 Marking shall be durable and easily legible.

Compliance is checked by inspection and by rubbing the marking by hand for 15 s with a piece of cloth soaked with test-fuel as specified in ISO 1817, liquid C.

After the test, the marking shall still be legible.

5.3 Devices incorporating mini-couplers shall be accompanied by an instruction for installation specifying how to amount the device and its cable, if any, within the vehicle with regard to protection against e.g. the risks for thermal, chemical and mechanical damages, or liquid influences.

Compliance is checked by inspection and verification of the contents of the instruction sheets.

6 Preconditioning

Before mini-couplers are tested as specified in this standard, they are subjected to the following preconditioning.

The specimens are suspended freely in a heating cabinet, ventilated by natural circulation, in an atmosphere having the composition and pressure of the ambient air. The specimens are kept in the cabinet for (168 ± 1) h at a temperature of (100 ± 2) °C and are then allowed to cool down to (23 ± 5) °C.

7 Dimensions

Mini-couplers shall comply with standard sheets 1 or 2 as relevant.

Compliance is checked by measurement.

8 Protection against electric shock

8.1 Mini-couplers shall be so designed that, when they are wired and mounted as intended, live parts are not accessible.

Compliance is checked by inspection and, if necessary, by a test with the specimen wired and mounted as intended. A standard test finger, as shown in figure 1, is applied in every possible position with a force of (10 ± 1) N.

An electrical indicator with a voltage not less than 40 V and not more than 50 V is used to show contact with the relevant parts.

For mini-couplers where the use of elastomeric or thermoplastic material is likely to influence the requirement, the test is repeated at an ambient temperature of $(35 \pm 2) ^\circ\text{C}$, the mini-couplers being at this temperature.

During this additional test, the mini-couplers are subjected for $(60 + 5/-0)$ seconds to a force of $(75 + 0/-2)$ N, applied through the tip of a straight unjointed test finger of the same dimensions as the standard test finger. The finger, with an electrical indicator as described above, is applied to all places where yielding of the insulating material could impair safety.

During this test, mini-couplers shall not deform to such an extent that the dimensions shown in the standard sheet are unduly altered, and no live parts shall become accessible.

8.2 External parts of mini-couplers, with the exception of contact pins, assembly screws and the like, shall be of insulating material.

Compliance is checked by inspection.

8.3 Insulating linings, barriers and the like, shall have adequate mechanical strength and be reliably fixed.

Compliance is checked by inspection and by the tests of clause 16.

8.4 Mini-couplers shall be so designed that, when wired as intended, there are no openings giving access to live parts, except the entrance openings for contact pins.

Compliance is checked by inspection and, in case of doubt, by a test with the accessibility probe according to the relevant IP-classification of the mini-coupler.

9 Provision for earthing

9.1 Mini-couplers shall be so constructed that, when the plug

- is inserted, the earth connection is made before the current-carrying contacts of the plug become live;
- is withdrawn, the current-carrying contacts shall separate before the earth connection is broken.

Compliance is checked by inspection of the manufacturing drawings, taking into account the effect of tolerances, and by checking the specimens against these drawings.

Conformity to the standard sheets ensures compliance with this requirement.

9.2 The earthing circuit of the plug and the connector shall be in one piece or shall be permanently and reliably connected together by riveting, welding or the like.

Compliance is checked by inspection and by manual test.

When considering the reliability of the connection between parts of the earthing circuit, the effect of possible corrosion is taken into account.

9.3 Earthing contacts shall provide adequate contact pressure, and shall not deteriorate in normal use.

Compliance is checked by the test of clause 14.

10 Terminals and terminations

10.1 Non-rewirable accessories shall be provided with soldered, welded, crimped or equally effective terminations; screwed or snap-on terminals shall not be used. Connections made by crimping a pre-soldered flexible conductor are not permitted, unless the soldered area is at the tip of the conductor, outside the crimping area.

Compliance is checked by inspection.

10.2 Terminals of rewirable accessories and terminations of non-rewirable accessories shall be so located or shielded that loose strands of a conductor in the accessory cannot reduce the creepage distances, clearances or distances through insulation below the values specified in clause 19.

Compliance is checked by inspection, by manual test and by measurement.

11 Construction

11.1 Pins of plugs and inlets shall have adequate mechanical strength.

Compliance is checked by inspection and, for pins which are not solid, by the following test, which is made after the tests of clause 15.

An example of a test device is shown in figure 3.

A force of $(100 + 0/-2)$ N is exerted on the pin for $(60 + 5/-0)$ s in a direction perpendicular to the axis of the pin, by means of a steel rod having a diameter $(4,8 \pm 0,1)$ mm, the axis of which is also at right angles to the axis of the pin.

During application of the force, the reduction of the diameter of the pin at the point where the force is applied shall not exceed 0,15 mm. After removal of the rod, the diameter of the pin shall not have changed by more than 0,06 mm in any direction.

11.2 Contact pins and tubes of mini-couplers shall not be removable without dismantling the connecting device.

Compliance is checked by inspection and by manual test.

11.3 Contact tubes shall be floating and have sufficient resiliency.

Compliance is checked by inspection and by manual test after the test of clause 14.

11.4 Mini-couplers shall be so constructed that full engagement of their parts is not prevented by any projection from their engagement faces.

Compliance is checked by determining that the gap between the engagement faces of the parts does not exceed 1 mm when the parts are joined together as far as they will go.

11.5 Connectors and plugs of mini-couplers shall be non-rewirable and so constructed that:

- the flexible cable cannot be separated from the accessory without making it permanently useless, and
- the accessory cannot be opened by hand or by using a general purpose tool, for example a screwdriver used as such.

An accessory is considered to be permanently useless, when, for re-assembling the accessory, parts or materials other than the original are to be used.

Compliance is checked by inspection and by manual test.

11.6 The flexible cable connected to a mini-coupler shall be protected by a flexible conduit or by other equally effective means.

Flexible conduits and their accessories shall have adequate thermal and mechanical strength and resistance to chemicals to assure sufficient protection against stresses which may occur during the intended use.

Compliance is checked by inspection and by the tests of clause 22 and annex A.

11.7 Mini-couplers shall have positive means for retaining the parts in engagement.

Compliance is checked by inspection and by the following test.

The mini-coupler with the pins or tubes removed is engaged in interlocked position. A withdrawal force of (100 ± 2) N is exerted for $(60 + 5/-0)$ s in the direction of the axis of the device. The force is applied without jerks. The parts of the mini-coupler shall remain in engagement.

11.8 Mini-couplers shall be so designed as to allow easy insertion.

A test is under consideration.

11.9 Outlets in mini-couplers for tapping shall be provided with a covering lid, which however, need not be constructively fixed to the outlet.

Compliance is checked by inspection.

12 Protection against ingress of solid foreign bodies and harmful ingress of water and humidity

12.1 The enclosure of a mini-coupler shall provide a degree of protection not less than IP 44.

Compliance is checked by appropriate tests according to EN 60529.

The tests are made with the parts of the mini-coupler in engagement. When a mini-coupler for tapping is tested, the outlets shall be covered by lids, except for one, in which a mini-coupler with pins is inserted.

Immediately after the test for ingress of water and humidity, the specimens shall withstand an electric strength test as specified in 13.3. Inspection shall then show that water has not entered the specimens.

12.2 Mini-couplers shall be proof against humid conditions which may occur in normal use.

Compliance is checked by the following treatment, and by the measurement of the insulation resistance and by the electric strength test, specified in clause 13.

The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %. The temperature of the air, at all places where specimens can be located, is maintained within 1 °C of any convenient value t between 20 °C and 30 °C.

Before being placed in the humidity cabinet, the specimens are brought to a temperature between t °C and $(t + 4)$ °C. The specimens are kept in the cabinet for (168 ± 1) h.

In most cases, the specimens may be brought to the specified temperature by keeping them at this temperature for at least 4 hours before the humidity treatment.

A relative humidity between 91 % and 95 % can be obtained by placing in the humidity cabinet a saturated solution of sodium sulphate (Na_2SO_4) or potassium nitrate (KNO_3) in water, having a sufficiently large contact surface with the air.

In order to achieve the specified conditions within the cabinet, it is necessary to ensure constant circulation of the air within and, in general, to use a cabinet which is thermally insulated.

After this treatment, the specimens shall show no damage within the meaning of this standard.

13 Insulation resistance and electric strength

13.1 The insulation resistance and the electric strength of mini-couplers shall be adequate.

Compliance is checked by the tests of 13.2 and 13.3, which are made immediately after the treatment of 12.2, in the humidity cabinet or in the room in which the specimens were brought to the prescribed temperature.

Mini-couplers which form an integral part of an electrical equipment are tested together with the equipment according to the relevant standard for the equipment.

13.2 The insulation resistance is measured with a d.c. voltage of approximately 500 V applied, the measurement being made individually on each inlet and connector 1 min after application of the voltage.

The insulation resistance is measured consecutively as follows:

- 1) between all poles connected together and the body;
- 2) between each pole in turn and all others, these being connected together.

The term 'pole' includes, in this case, also the circuit intended for the protective conductor.

The term 'body' includes all accessible metal parts, a metal foil in contact with the outer surface of external parts of insulating material, fixing screws or the like to the base or cover, and the external assembly screws.

For the measurements, the metal foil is applied in such a way that any sealing compound is effectively tested.

The insulation resistance shall not be less than 5 M Ω .

13.3 A voltage of $(2\ 000 \pm 60)$ V of substantially sine-wave form, having a frequency of 50 Hz or 60 Hz, is applied for $(60 + 5/-0)$ s between the parts indicated in 13.2.

Initially, not more than half the prescribed voltage is applied, then it is raised rapidly to the full value.

No flashover or breakdown shall occur during the test.

The high-voltage transformer used for the test shall be so constructed that the secondary current is at least 200 mA, when the terminals of its secondary side are short-circuited after the secondary voltage having been adjusted to the intended test voltage.

The overcurrent relay shall not operate as long as the secondary current is less than 100 mA.

Care should be taken that the r.m.s. values of the test voltage applied are measured by an accuracy of $\pm 3\%$.

Glow discharges without drop in voltage are neglected.

14 Temperature rise

Mini-couplers shall be so designed that hazardous temperature is not reached in normal use, and they shall withstand the variations in temperature which may arise during extended periods.

Compliance is checked by the following test.

Mini-couplers are tested when parts with contact pins and tubes are in engagement. In a mini-coupler for tapping, one outlet with contact tubes is tested in turn. During the test, a current of 16 A is passing each pole including the earthing circuit for 30 min. During the directly following 30 min, the specimens are allowed to cool down without any electrical load. This is repeated during 216 cycles in total. The temperature rise is measured at the terminations during the last cycle and shall not exceed 45 K.

Mini-couplers which form an integral part of an electrical equipment are tested together with the equipment according to the relevant standard for the equipment.

15 Flexible cables

15.1 Mini-couplers shall be provided with an oil resistant flexible cable, the nominal cross-sectional area being not less than 1,5 mm².

Flexible cables of type H05 RN-F or H05 VV-F are deemed to be satisfactory.

Compliance is checked by inspection.

15.2 Mini-couplers shall be so constructed that the conductors of the flexible cable are relieved from strain, including twisting, where they are connected to their terminations.

Compliance is checked by inspection and by the following test.

The mini-coupler is fixed so that the axis of the cable is parallel to the centre line of the device where it enters the enclosure of the device.

The mini-coupler with cable and conduit is subjected 25 times to a pull of $(60 + 0/-2)$ N applied to the conduit. Each pull is made parallel to the conduit, without excessive jerks and with a duration of 1 s.

Immediately afterwards, the conduit is subjected for $(60 + 5/-0)$ s to a torque of $(0,25 \pm 0,02)$ N·m. The test of the cable is made after the test of the conduit, the number of pulls, however, being reduced to 10 times, the force to $(30 + 0/-2)$ N and the torque to $(0,1 \pm 0,02)$ N·m.

After the tests

- the ends of the conductors shall not have moved noticeably from their original positions in their terminations;
- the conduit or the sheath of the cable shall not have moved noticeably from their original position;
- the conduit or the sheath of the cable shall not show any noticeable damage;
- there shall be no break in the electrical connection.

16 Mechanical strength

16.1 Mini-couplers shall have adequate mechanical strength.

Compliance is checked by the tests of **16.2** and **16.3**.

16.2 Blows are applied with a spring-operated impact-test apparatus according to HD 495 S1 under the following conditions:

- temperature: $(-25 \pm 2) ^\circ\text{C}$
- impact energy: $(0,5 \pm 0,05) \text{ J}$

The test is made while the parts of the mini-coupler are in engagement. In a mini-coupler with tap connection(s) only one part with pins is inserted.

The specimen is placed on a rigid support one blow being applied to each of four points on the cover, which are seen as been possible areas of weakness.

After the test, the specimens shall show no damage within the meaning of this standard. Small pieces may be broken off without causing rejection, provided that the protection against electric shock is not affected.

Damage to the finish and small dents which do not reduce the creepage distances or clearances below the values specified in clause **19** are neglected.

16.3 A vibration test is carried out with the specimen installed on a vertical plane according to the manufacturer's instructions and repeated with the plane rotated 90° either side of the vertical, each time for $(24 \pm 0,5) \text{ h}$ with a deflection of $\pm 2 \text{ mm}$ and a frequency of 25 Hz . The movement shall have substantially sine-wave form.

After the test, the specimen shall show no damage within the meaning of this standard.

17 Resistance to heat

17.1 Mini-couplers shall be sufficiently resistant to heat.

Compliance is checked by the following test.

Parts of insulating material are subjected to a ball-pressure test by means of the apparatus shown in figure 2.

The surface of the part to be tested is placed in the horizontal position and is supported by a steel plate with a thickness of at least 3 mm . A steel ball of $(5 \pm 0,02) \text{ mm}$ diameter is pressed against this surface by a force of $(20 + 0/-1) \text{ N}$. The thickness of the specimen shall not be less than $2,5 \text{ mm}$; if necessary, two or more layers of the parts to be tested shall be used.

The test is made in a self-ventilated heating cabinet at a temperature of:

- $(125 \pm 2) ^\circ\text{C}$ for parts necessary for retaining current-carrying parts and parts of the earthing circuit in position;
- $(70 \pm 2) ^\circ\text{C}$ for other parts.

The support and the ball shall be placed in the heating cabinet for approximately 16 h to ensure that they have attained the stabilized testing temperature before the test commences.

The parts to be tested shall be placed in the heating cabinet for a period of approximately 10 min before the test load is applied.

After $(60 + 1/-0) \text{ min}$, the ball is removed from the specimen which is then cooled down, within 10 s , to approximately room temperature by immersion in cold water.

The diameter of the impression caused by the ball is measured and shall not exceed 2 mm . In the event of curved surfaces, the shorter axis is measured if the indent is elliptical.

The test is not made on ceramic material.

18 Screws, rivets, current-carrying parts

18.1 Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic, unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage of the insulating material.

Compliance is checked by inspection.

The suitability of the material is considered in respect to the stability of the dimensions.

18.2 Fastening means, which serve as electrical as well as mechanical connections, shall be locked against loosening.

Compliance is checked by inspection and by manual test.

18.3 Current-carrying parts, including those of terminals (also earthing terminals), shall be of a metal having, under the conditions occurring in the equipment, mechanical strength, electrical conductivity and resistance to corrosion adequate for their intended use.