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**JIS C 3660-1-1** : 2003

(IEC 60811-1-1 : 1993 / Amd.1 : 2001)  
(JCMA)

**Common test methods for insulating  
and sheathing materials of electric  
and optical cables—Part 1-1 :  
Methods for general application—  
Measurement of thickness and  
overall dimensions—Tests for  
determining the mechanical  
properties**

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ICS 29.035.01; 29.060.20

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## Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee, as the result of proposal for revision of Japanese Industrial Standard submitted by The Japanese Electric Wire & Cable Makers' Association (JCMA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS C 3660-1-1** : 1998 is replaced with this Standard.

This revision has been made based on **IEC 60811-1-1** : 1993 *Common test methods for insulating and sheathing materials of electric and optical cables—Part 1-1 : Methods for general application—Measurement of thickness and overall dimensions—Tests for determining the mechanical properties* for the purposes of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

**JIS C 3660** consists of the following parts and sections under the general title *Common test methods for insulating and sheathing materials of electric and optical cables*:

*Part 1-1 : Methods for general application—Measurement of thickness and overall dimensions—Tests for determining the mechanical properties*

*Part 1-2 : Methods for general application—Thermal ageing methods*

*Part 1-3 : Methods for general application—Methods for determining the density—Water absorption tests—Shrinkage test*

*Part 1-4 : Methods for general application—Test at low temperature*

*Part 2-1 : Methods specific to elastomeric compounds—Ozone resistance, hot set and mineral oil immersion tests*

*Part 3-1 : Methods specific to PVC compounds—Pressure test at high temperature—Test for resistance to cracking*

*Part 3 : Methods specific to PVC compounds—Section 2 : Loss of mass test—Thermal stability test*

*Part 4 : Methods specific to polyethylene and polypropylene compounds—Section 1 : Resistance to environmental stress cracking—Wrapping test after thermal ageing in air—Measurement of melt flow index—Carbon black and/or mineral filler content measurement in PE*

*Part 4 : Methods specific to polyethylene and polypropylene compounds—Section 2 : Elongation at break after pre-conditioning—Wrapping test after pre-conditioning—Wrapping test after thermal ageing in air—Measurement of mass increase—Long-term stability test (Appendix A)—Test method for copper-catalysed oxidative degradation (Appendix B)*

*Part 5 : Methods specific to filling compounds—Section 1 : Drop point—Separation of oil—Lower temperature brittleness—Total acid number—Absence to corrosive components—Permittivity at 23 °C—D.C. resistivity at 23 °C and 100 °C.*

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the original JIS is to be the final authority.

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# Common test methods for insulating and sheathing materials of electric and optical cables—Part 1-1 : Methods for general application—Measurement of thickness and overall dimensions—Tests for determining the mechanical properties

**Introduction** This Standard is the Japanese Industrial Standard prepared based on **IEC 60811-1-1** *Common test methods for insulating and sheathing materials of electric and optical cables—Part 1-1 : Methods for general application—Measurement of thickness and overall dimensions—Tests for determining the mechanical properties* published in 1993 as the second edition and Amendment 1 (2001) without modifying their technical contents.

Portions underlined with dots are the matters not stated in the original International Standard.

## 1 General

**1.1 Scope** The Standard specifies the test methods to be used for testing polymeric insulating and sheathing materials of electric cables for power distribution and telecommunications including cables used on ships, and in offshore applications.

This Standard gives the methods for measuring thicknesses and overall dimensions, and for determining the mechanical properties, which apply to the most common types of insulating and sheathing components (elastomeric, PVC, PE, PP, etc.).

Remarks : The International Standards corresponding to this Standard are given below.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

IEC 60811-1-1 : 1993 *Common test methods for insulating and sheathing materials of electric and optical cables—Part 1-1 : Methods for general application—Measurement of thickness and overall dimensions—Tests for determining the mechanical properties* and Amendment 1 (2001) (IDT)

**1.2 Normative references** The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. If the indication of the year of publication is given to these referred standards, only the edition of indicated year constitutes the provision of this Standard but the revision and amendment made thereafter do not apply. The normative references without the indication of the year of coming into effect apply limiting only to the most recent edition (including amendments).

JIS C 3660-1-2 *Common test methods for insulating and sheathing materials of electric and optical cables—Part 1-2 : Methods for general application—Thermal ageing methods*

NOTE : **IEC 60811-1-2** : 1985 *Common test methods for insulating and sheathing materials of electric cables—Part 1 : Methods for general application—Section Two : Thermal ageing methods*, Amendment 1 (1989) and Amendment 2 (2000) are identical with the said standard.

JIS C 3660-1-3 *Common test methods for insulating and sheathing materials of electric and optical cables—Part 1-3 : Methods for general application—Methods for determining the density—Water absorption tests—Shrinkage test*

NOTE : **IEC 60811-1-3** : 1985 *Common test methods for insulating and sheathing materials of electric cables—Part 1 : Methods for general application—Section Three : Methods for determining the density—Water absorption tests—Shrinkage test* and Amendment 1 (2001) are identical with the said standard.

JIS C 3660-2-1 *Common test methods for insulating and sheathing materials of electric and optical cables—Part 2-1 : Methods specific to elastomeric compounds—Ozone resistance, hot set and mineral oil immersion tests*

NOTE : **IEC 60811-2-1** : 1986 *Common test methods for insulating and sheathing materials of electric cables—Part 2 : Methods specific to elastomeric compounds—Section 1 : Ozone resistance test—Hot set test—Mineral oil immersion test* and Amendment 1 (2001) are identical with the said standard.

**2 Test values** Full test conditions (such as temperatures, durations, etc.) and full test requirements are not specified in this Standard; it is intended that they should be specified by the standard dealing with the relevant type of cable.

Any test requirements which are given in this Standard may be modified by the relevant cable standard to suit the needs of a particular type of cable.

**3 Applicability** Conditioning values and testing parameters are specified for the most common types of insulating and sheathing compounds and of cables, wires and cords.

**4 Type tests and other tests** The test methods described in this Standard are intended, in the first instance, to be used for type tests. In certain tests, where there are essential differences between the conditions for type tests and those for more frequent tests, such as routine tests, these differences are indicated.

**5 Pre-conditioning** All the tests shall be carried out not less than 16 h after the extrusion or vulcanization (or cross-linking), if any, of the insulating or sheathing compounds.

Unless otherwise specified, before any test, all test pieces, aged and unaged, shall be kept for at least 3 h at a temperature  $(23 \pm 5) ^\circ\text{C}$ .

**6 Test temperature** Unless otherwise specified, tests shall be made at ambient temperature.

**7 Definitions** For the purposes of this Standard, the following definitions apply:

**7.1 maximum tensile force** highest value reached by the load during the test

**7.2 tensile stress** tensile force per unit of the cross-sectional area of the unstretched test piece

**7.3 tensile strength** maximum tensile stress recorded in extending the test piece to breaking point

**7.4 elongation at break** increase of the reference length of the test piece, expressed as the percentage of the reference length of the unstretched test piece, at breaking point

**7.5 median value** when several test results have been obtained and ordered in an increasing or decreasing succession, the median value is the middle value if the number of available values is odd, and is the mean of the two middle values if the number is even

## **8 Measurement of thicknesses and overall dimensions**

### **8.1 Measurement of insulation thickness**

**8.1.1 General** Measurement of insulation thickness may be required as an individual test, or as a step in the procedure for carrying out other tests, such as the determination of mechanical properties.

In each case, the methods of selection of samples shall be in accordance with the relevant cable standard.

**8.1.2 Measuring equipment** A measuring microscope or a profile projector of at least  $10\times$  magnification. Both types of equipment shall allow a reading of 0.01 mm and an estimated reading to three decimal places when measuring insulation with a specified thickness less than 0.5 mm.

In case of doubt, the measuring microscope shall be taken as the reference method.

**8.1.3 Preparation of test pieces** Any covering shall be removed from the insulation, and the conductor(s), together with separator (if any) shall be withdrawn, care being taken to avoid damage to the insulation. Semi-conducting inner and/or outer layers, if bonded to the insulation, shall not be removed.

Each test piece shall consist of a thin slice of insulation. The slice shall be cut with a suitable device (sharp knife, razor blade, etc.) along a plane perpendicular to the longitudinal axis of the conductor.

The cores of non-sheathed flat cords shall not be separated.

If the insulation carries an indented marking, thus giving rise to a local reduction in thickness, the test piece shall be taken so as to include such marking.

**8.1.4 Measuring procedure** The test piece shall be placed under the measuring equipment with the plane of the cut perpendicular to the optical axis.

- a) When the inner profile of the test piece is of circular form, six measurements shall be made radially as shown in figure 1. For sector-shaped cores, six measurements shall be made as shown in figure 2.
- b) When the insulation is taken from a stranded conductor, six measurements shall be made radially as shown in figures 3 and 4.
- c) When the outer profile shows unevenness, the measurement shall be carried out as shown in figure 5.
- d) When there are unremovable screening layers under and/or over the insulation, they shall be excluded from the measurements.

If unremovable screening layers are present under and/or over an opaque insulation, a measuring microscope shall be used.

- e) Flat non-sheathed cords shall be measured according to figure 6, the thickness of insulation in the direction of the other core being taken as half the distance between the conductors.

In all cases, the first measurement shall be taken where the insulation is thinnest.

If the insulation carries an indented marking, this shall not be included in the measurements made for the calculation of mean thickness. In any case, the thickness at the position of the indented marking shall comply with the minimum requirement specified in the relevant cable standard.

The readings shall be made in millimetres to two decimal places if the specified thickness is 0.5 mm or above and to three estimated decimal places if the specified thickness of the insulation is less than 0.5 mm.

**8.1.5 Evaluation of the measurement results** The results shall be evaluated as specified in the test requirements of the relevant cable standard.

In the case of mechanical tests, the mean value of the thickness,  $\delta$ , of each test piece [see item b) 1) of 9.1.4] shall be calculated from the six measurement results obtained on that test piece.

## **8.2 Measurement of thickness of non-metallic sheath**

**8.2.1 General** The measurement of sheath thickness may be required as an individual test, or as a step in the procedure for carrying out other tests, such as the measurement of mechanical properties. The test method applies to the measurement of all sheaths for which thickness limits are specified, for example separation sheaths, as well as external sheaths.

In each case, the method of selecting samples shall be in accordance with the relevant cable standard.

**8.2.2 Measuring equipment** (See 8.1.2.)

**8.2.3 Preparation of test pieces** After all materials, if any, inside and outside the sheath have been removed, each test piece shall be prepared by cutting a thin