

Australian/New Zealand Standard™

Test methods for electric cables, cords and conductors

Method 2.4: Insulation, extruded semi-conductive screens and non- metallic sheaths—Methods specific to polyethylene and polypropylene materials



AS/NZS 1660.2.4:1998

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee Committee EL-003, Electric Wires and Cables. It was approved on behalf of the Council of Standards Australia on 19 December 1997 and on behalf of the Council of Standards New Zealand on 5 December 1997. It was published on 5 March 1998.

The following interests are represented on Committee EL-003:

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Australian Electrical and Electronic Manufacturers Association
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This Standard was issued in draft form for comment as DR 97072.

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Originated in Australia as part of AS 1660.2—1974.
Previous Australian edition AS 1660.2.4—1993.
Jointly revised and designated AS/NZS 1660.2.4:1998.
Reissued incorporating Amendment No. 1 (July 2001).

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Jointly published by Standards Australia International Ltd, GPO Box 5420, Sydney, NSW 2001
and Standards New Zealand, Private Bag 2439, Wellington 6020

ISBN 0 7337 1844 2

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-003, Electric Wires and Cables, to supersede AS 1660.2.4—1993, *Test methods for electric cables, cords and conductors, Method 2.4: Insulation, extruded semi-conductive screens and non-metallic sheaths—Methods specific to polyethylene and polypropylene compounds*. It is one of a set of tests for electric cables included in the AS/NZS 1660 series. Details of the series are given in Appendix A.

This Standard incorporates Amendment No. 1 (July 2001). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

The objective of this Standard is to provide manufacturers and testers with appropriate test methods for polyethylene and polypropylene insulation, screens and sheaths of electric cables and cords.

This edition of the Standard differs from the 1993 edition as follows:

- (a) The title has been modified.
- (b) Reference to trichloroethylene has been deleted.
- (c) This edition is published as a Joint Australian/New Zealand Standard.
- (d) The determination of carbon black dispersion has been added.

In the preparation of the Standard, consideration was given to IEC 811:1985, *Common test methods for insulating and sheathing materials of electric cables, Part 4: Method specific to polyethylene and polypropylene compounds*. Acknowledgment is made for the assistance received from this source.

The term ‘informative’ has been used in this Standard to define the application of the appendix to which it applies. An ‘informative’ appendix is only for information and guidance.

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Australian/New Zealand Standard**Test methods for electric cables, cords and conductors****Method 2.4: Insulation, extruded semi-conductive screens
and non-metallic sheaths—Methods specific to
polyethylene and polypropylene materials**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out the methods of testing insulation, extruded semi-conductive screens and non-metallic sheaths for polyethylene and polypropylene insulated electric cables.

NOTE: Refer to individual cable Standards for test results criteria. Details of the AS/NZS 1660 series of Standards are given in Appendix A.

1.2 REFERENCED DOCUMENT

The following document is referred to in this Standard:

BS

2782 Methods of testing plastics, Part 7: Rheological properties, Method 720A: Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics

1.3 DEFINITIONS

For the purpose of this Standard, the definitions given in the relevant cable Standard and that below apply.

1.3.1 Median value

Value obtained from a succession of test results as follows:

- (a) Even number of results average value of the two middle results.
- (b) Odd number of results value of middle result.

1.4 TESTING TEMPERATURE

Unless otherwise specified, all tests shall be carried out in an ambient temperature of $23 \pm 5^{\circ}\text{C}$.

1.5 SELECTION OF SPECIMENS

All specimens used for testing shall be taken at least 300 mm from the end of a factory length of finished cable, flexible cable or flexible cord.

SECTION 2 METHODS OF TEST FOR INSULATION, EXTRUDED SEMI-CONDUCTIVE SCREENS AND NON-METALLIC SHEATHS

2.1 MEASUREMENT OF THE MELT-FLOW INDEX

2.1.1 General

The melt-flow index (MFI) is the quantity of material extruded in a given period of time at 190°C through a specified die under the action of a load. The method is based on Method 720A of BS 2782, Part 7.

NOTE: MFI is not applicable to material containing flame retardants.

2.1.2 Apparatus

The apparatus is basically an extrusion plastimeter. The general design shall be as shown in Figure 2.1. (An alternative method of retaining the die is shown in Figure 2.2.) The material contained in a vertical metal cylinder is extruded through a die by a loaded piston under controlled conditions of temperature. The essential parts of the apparatus shall be as follows:

- (a) A cylinder of low carbon (mild) steel, fixed in a vertical position and suitably lagged for operation at 190°C. The cylinder shall be at least 115 mm long and the internal diameter shall be 9.550 ± 0.025 mm and uniform along its length to meet the requirements of Item (b). The base of the cylinder shall be thermally insulated if the area of exposed metal exceeds 4 cm².
- (b) A piston of hardened steel, whose length shall be at least as great as that of the cylinder. The piston shall have a head of length 6.35 ± 0.2 mm. The diameter of the head shall be less than the internal diameter of the cylinder at all points along the working length of the cylinder by 0.075 ± 0.015 mm. The lower edge of the head shall have a radius of 0.4 mm and the upper edge shall have its sharpness removed. Above the head the piston shall be relieved to about 9.0 mm diameter. A stud may be added at the top of the piston to support the removable load, but the piston shall be thermally insulated from this load. Two marks shall be scribed on the piston 30 mm apart and in such a position that they are level with the top of the cylinder when the piston is inserted in the cylinder and its head is 20 mm and 50 mm respectively from the upper end of the die.
- (c) A removable load, A, that can be placed on top of the piston. The combined mass of load A and the piston shall be 2160 ± 10 g.
- (d) A heater to maintain the material in the cylinder at a temperature of $190 \pm 0.5^\circ\text{C}$ (automatic temperature control is strongly recommended).
- (e) A temperature measuring device located as close as possible to the die, but situated within the body of the cylinder and calibrated to permit temperature measurement to $\pm 0.1^\circ\text{C}$.

NOTE: It is recommended that the temperature measuring device be a mercury-in-glass thermometer located permanently within the mass of the cylinder. If any other temperature measuring device is used, then it should be calibrated at $190 \pm 0.5^\circ\text{C}$ before the commencement of each series of tests with reference to a mercury-in-glass thermometer itself conforming to Item (e), placed in the cylinder and immersed in polyethylene to its appropriate depth.

- (f) A die of length 8.000 ± 0.025 mm and internal diameter 2.095 ± 0.005 mm made of hardened steel. The die shall not project beyond the base of the cylinder.

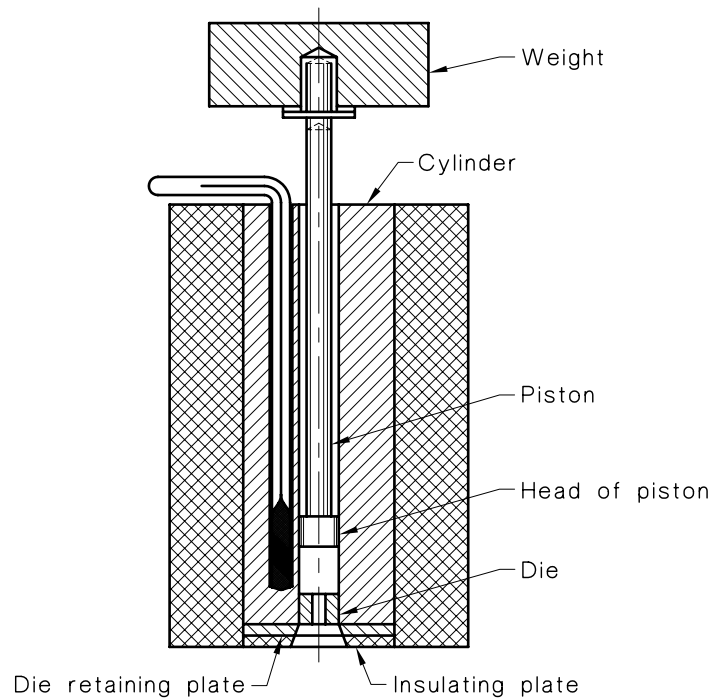


FIGURE 2.1 APPARATUS FOR DETERMINING MELT-FLOW INDEX SHOWING LARGE EXTERNAL DIAMETER CYLINDER, DIE RETAINING PLATE AND INSULATING PLATE

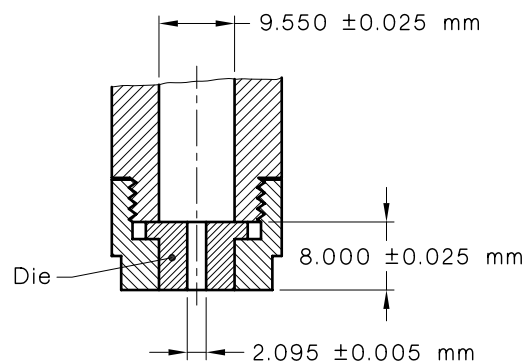


FIGURE 2.2 PART OF APPARATUS SHOWING SMALL EXTERNAL DIAMETER CYLINDER WITH AN ALTERNATIVE METHOD OF RETAINING THE DIE

2.1.3 Procedure

The procedure shall be as follows:

- (a) Ensure that the apparatus is clean and that before a series of tests is begun, the temperature of the cylinder and piston has been kept at $190 \pm 0.5^\circ\text{C}$ for 15 min, which temperature shall be maintained during the extrusion of the material.

NOTE: Abrasives or materials likely to damage the surface of the piston, cylinder or die should not be used in removing superfluous material, or in manipulating any part of the apparatus.