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IS 13360-4-3 (2004): Plastics - Methods of testing, Part 4: Rheological properties, Section 3: Determination of spiral flow of low-pressure thermosetting moulding compounds [PCD 12: Plastics]
Indian Standard

PLASTICS — METHODS OF TESTING

PART 4 RHELOGICAL PROPERTIES

Section 3 Determination of Spiral Flow of Low-Pressure Thermosetting Moulding Compounds

ICS 83.080.010

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

November 2004

Price Group 2
FOREWORD

This Indian Standard (Part 4/Sec 3) was adopted by the Bureau of Indian Standards, after the draft finalized by the Plastics Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

The spiral flow of a thermosetting moulding compound is a measure of the combined characteristics of fusion under pressure; melt velocity, and gelation rate under specific conditions.

This standard is useful as a quality control test and as an acceptance criterion.

This test method, by itself, is not a valid means for comparing the mouldability of similar or different moulding compounds because it cannot duplicate actual conditions prevalent in different types of production moulds.

This test method is presently intended for use at a transfer pressure of 6.9 MPa and a mould temperature of 423 ± 3 K (150 ± 3°C).

While preparing this standard considerable assistance has been derived from ASTM 3123:1998 'Standard test method for spiral flow of low-pressure thermosetting molding compounds' issued by the American Society for Testing and Materials (ASTM), USA.

For tropical countries like India, the standard temperature and the relative humidity shall be taken as 27 ± 2°C and 65 ± 5 percent respectively.

The composition of the Committee responsible for formulation of this standard is given in Annex A.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2:1960 'Rules for rounding off numerical values (revised)'.

Indian Standard

PLASTICS — METHODS OF TESTING

PART 4 RHELOGICAL PROPERTIES

Section 3 Determination of Spiral Flow of Low-Pressure Thermosetting Moulding Compounds

1 SCOPE

1.1 This test method covers a procedure for measuring the spiral flow of thermosetting moulding compounds (soft or very soft) designed for moulding pressures under 6.9 MPa. It is especially suited for those compounds that may be used for encapsulation or other low pressure moulding techniques. Textile-reinforced compounds should not be tested using this test method. It involves the use of a standard spiral flow mould in a transfer moulding press under specified conditions of applied temperature and pressure with a controlled charge mass.

1.2 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the application of regulatory limitations prior to use.

2 APPARATUS

2.1 Transfer Moulding Press — Transfer moulding press with a minimum 150 by 150 mm platen area, transfer piston pressure potentially greater than 6.9 MPa, sufficient clamp pressure to prevent flashing, and a minimum plunger speed of 25.4 mm without load. The plunger should be equipped with at least one peripheral sealing groove. It is recommended that a pot diameter between 31.75 and 44.45 mm be used whenever a choice is possible.

NOTE — Preliminary evidence indicates that, in many cases, reasonable correlation may be achieved between laboratories using presses with different pot diameters. Typical examples are presses with pot diameters of 31.75, 38.10 and 44.45 mm. However, a few well documented cases are recorded where differences in pot diameters, even within this listed range, have caused large differences in flow-length readings. Therefore, for best inter-laboratory correlation it is recommended that identical pot diameters be used.

2.2 Standard Spiral-Flow Mould — Standard spiral-flow mould shown in Fig. 1 shall be utilized.

3 MATERIALS

3.1 Moulding Compound

3.1.1 Any thermosetting moulding compound with a spiral flow between 762 mm and 1,270 mm as determined at the standard temperature and pressure of this test can be evaluated.

NOTES

1 Since the only commercially available moulds are calibrated in inches, spiral-flow length will be reported in these units. Conversion to SI units can readily be made by multiplying the flow length, in inches, by the appropriate conversion factor, 25.4 mm/ inch.

2 There is considerable evidence that the test is usable over a wider range of flow lengths, but this has not yet been confirmed by inter-laboratory testing.

3.1.2 Form

The form of the moulding compounds shall be either loose powder or granules at 23 ± 2°C.

NOTE — Pellets may be used if found necessary, however, flow length may be affected by their use.

4 CONDITIONING

All the moulding compounds shall be tested in as-received condition. For referee testing, all material shall be shipped and stored for a minimum of 24 h at the standard laboratory temperature, before breaking the seal on the container. Care should be taken to preserve the as-received moisture content and tests shall be made as soon as possible once the container has been opened. Alternative methods of conditioning samples may be used, provided they are mutually agreed to between the manufacturer and the purchaser.

5 TEST CONDITIONS

5.1 Spiral-Flow Mould

The mould shall be clean and free from any mould-release agents or lubricants. Several preliminary mouldings shall be made with the material to purge the helical runner before beginning the test. This procedure is essential when changing from one compound to another and is recommended as routine practice.

5.2 Moulding Conditions

5.2.1 Temperature

A temperature of 150 ± 3°C shall be maintained on the mould and transfer plunger. The temperature may be measured by thermocouples attached to the mould and plunger. The temperature shall be allowed to reach equilibrium by waiting at least 3 min between mouldings.
PLAN VIEW CC

SECTION VIEW AA

PLAN VIEW BB

Bill of Material

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Size</th>
<th>Material</th>
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<td>1 1</td>
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<td>16 x 138 x 140 mm</td>
<td>A. H. T. S.</td>
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<tr>
<td>2 1</td>
<td>SPRUE PLATE</td>
<td>16 x 138 x 140 mm</td>
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<tr>
<td>3 4</td>
<td>HULL STD. HANDLES</td>
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<tr>
<td>4 8</td>
<td>SOC. HD. CAP SCREWS</td>
<td>6.3 - 1.27 x 44.4 mm</td>
<td>STEEL</td>
</tr>
<tr>
<td>5 1</td>
<td>DOWEL PIN</td>
<td>6.3 Φ x 19 mm</td>
<td>–</td>
</tr>
<tr>
<td>6 1</td>
<td>DOWEL PIN</td>
<td>9.5 Φ x 19 mm</td>
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</tbody>
</table>

Note

1. SPIRAL IS A GENERATED SPIRAL, NO OFFSET
2. MOULD SURFACES ARE HIGH POLISH & FLASH CHROME PLATE
3. INDENTATION AT SPIRAL ENTRY IS ZERO mm INDENTATION EVERY 25.4 ALONG C.L. OF SPIRAL ARE NUMBERED ATLEAST EVERY 254 mm

FIG. 1 STANDARD SPIRAL — FLOW MOULD
5.2.2 Transfer Pressure

The actual pressure applied to the compound at the base of the pot shall be 6.90 ± 0.17 MPa (1000 ± 25 psi). In most presses the gauge pressure is not sufficiently accurate for determining transfer pressure. Therefore, the force exerted by the plunger shall be measured by some means such as an accurately calibrated direct-reading force gauge or proving ring. The actual transfer pressure is then calculated as pascal by dividing the force in newton by the plunger area in square meters.

5.2.3 Charge Mass

The mass of the compound shall be determined empirically so that the thickness of the moulded cull (cured compound on top of the sprue plate of the mould), after test, is between the amount of compound and the dimensions of the transfer pot critical in obtaining meaningful, reproducible spiral-flow values. The use of excessive amounts of compound will result in shorter, inconsistent spiral flows. For transfer pots 31.75 mm to 44.45 mm in diameter, 20 g of compound is suggested as the starting charge mass.

5.2.4 Transfer Plunger Speed

The transfer plunger speed without load (as described in 2.1) shall be controlled between 25 and 100 mm/s. The elapsed time between insertion of the charge into the pot and the development of pressure on the charge by the plunger shall be no more than 5 s. Too long a dwell before transferring will cause erratic results.

5.2.5 Press Cure Time

Sufficient cure time shall be used to facilitate easy removal of the spiral from the mould. This time will vary with the compound under test. Manufacturers recommendations for cure shall be followed.

5.2.6 Transfer Plunger Grooves

If the transfer plunger is equipped with grooves, they must be cleaned before each new moulding.

5.3 Flow Length

Flow length shall be the farthest point at which the material completely fills the cross-section of the helix runner.

6 PROCEDURE

6.1 Heat the mould and transfer the plunger to 150 ± 3°C.

6.2 The plunger preferably is equipped with sealing grooves. These must be cleaned free of compound before checking pressure and before each moulding.

6.3 Using a force gauge or proving ring, adjust the transfer pressure to 6.90 ± 0.17 MPa.

6.4 Weigh out the compound to the nearest 0.1g as previously determined to yield a 3 to 3.5 mm moulded cull.

6.5 Place the compound in the transfer pot and activate the transfer cycle immediately. Cure the compound as recommended for easy removal.

6.6 Open mould and remove the cured material. Read the spiral flow length directly from the moulded specimen at the point of farthest continuous flow to the nearest 25.4 mm.

6.7 Repeat 6.4 to 6.6 until three consecutive flow readings agree to within ±5 percent of their average.
ANNEX A

( Foreword )

COMMITTEE COMPOSITION

Plastics Sectional Committee, PCD 12

Organization

Borage Pvt Ltd, Mumbai
All India Plastic Industries Association, Delhi
Central Institute of Plastics Engineering & Technology (CIPET), Chennai
Central Food Technological Research Institute (CFTRI), Mysore
Directorate General of Health Services, New Delhi
Gas Authority of India Ltd, Noida
GE Plastics India Limited, Gurgaon
Gharda Chemicals Ltd, Distt Thane
Gujarat State Fertilizers & Chemicals Limited, Vadodara
Haldia Petrochemicals Limited, Kolkata
Indian Centre for Plastics in the Environment, New Delhi
Indian Institute of Packaging, Mumbai
Indian Petrochemicals Corporation Limited, Vadodara
Industrial Toxicology Research Centre (ITRC), Lucknow
Jain Irrigation Systems Ltd, Jalgaon
Machino-Basell India Limited, Gurgaon
Ministry of Defence (DMSRDE), Kanpur
Ministry of Environment & Forests, New Delhi
National Chemical Laboratory, Pune
Reliance Industries Ltd, Mumbai
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Amendments Issued Since Publication

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BUREAU OF INDIAN STANDARDS

Headquarters:
Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002
Telephones : 2323 0131, 2323 33 75, 2323 9402

Regional Offices:

Central: Manak Bhavan, 9 Bahadur Shah Zafar Marg
NEW DELHI 110 002
Telephones : 2323 6717, 2323 7617, 2323 3841

Eastern: 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi
KOLKATA 700 054
Telephones : 2337 8499, 2337 8561, 2337 8626, 2337 9120

Northern: SCO 335-336, Sector 34-A, CHANDIGARH 160 022
Telephones : 60 3843, 60 9285

Southern: C.I.T. Campus, IV Cross Road, CHENNAI 600 113
Telephones : 2254 1216, 2254 1442, 2254 2519, 2254 2315

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