



Plastics — Thermoplastic polyurethanes for moulding and extrusion

Part 2:

Preparation of test specimens and determination of properties

Plastiques — Polyuréthanes thermoplastiques pour moulage et extrusion —

Partie 2: Préparation des éprouvettes et détermination des propriétés

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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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16365-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

ISO 16365 consists of the following parts, under the general title *Plastics — Thermoplastic polyurethanes for moulding and extrusion*:

- *Part 1: Designation*
- *Part 2: Preparation of test specimens and determination of properties*
- *Part 3: Distinction of Ether TPU and Ester TPU and mixtures by analysis*

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Introduction

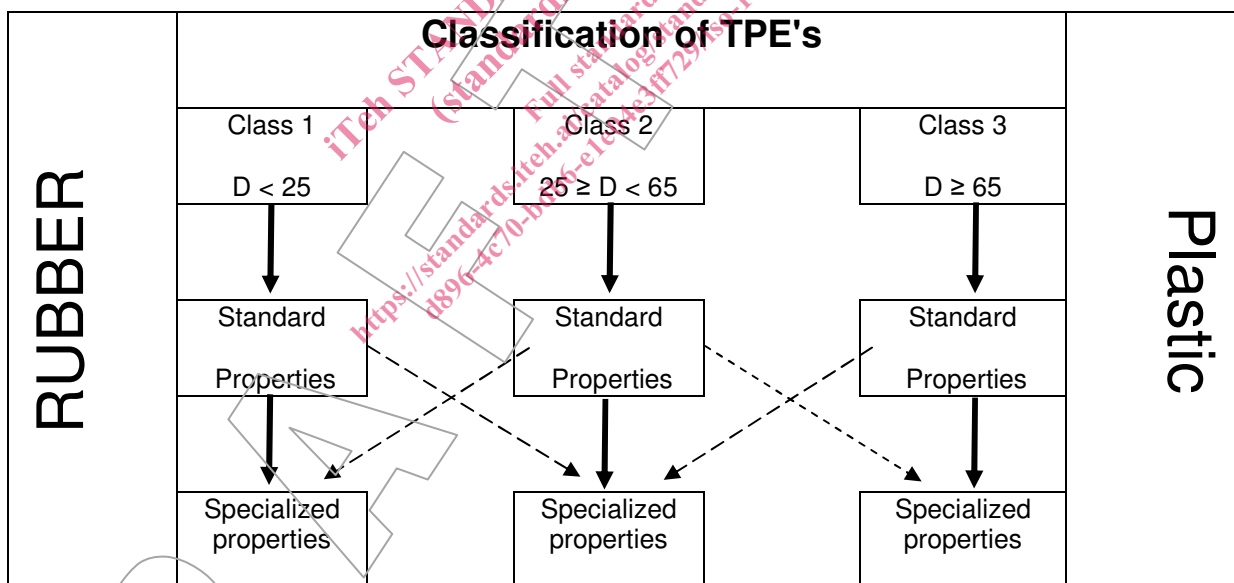
Structure of Thermoplastic Elastomer Material standards

For each type of thermoplastic elastomer is referred to the relevant material standard.

Thermoplastic Elastomer materials are classified into groups by the primary elastomeric property Hardness and with this as result of some relation with modulus, as shown in the figure below. The classification on basis of Hardness considers the special position of TPE's between the Rubber materials on the one side and the Plastic materials on the other.

Each class is subdivided in standard properties and special properties. The standard properties for a class are not only connected with the adjacent group(s) by many of the specified properties but also by special properties specified in the adjacent class(es). A standard property in a class can be a special property in an adjacent class and vice versa.

Special properties are those properties which are in wide use or of particular significance in the practical characterisation of a specific material.



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Plastics — Thermoplastic polyurethanes for moulding and extrusion — Part 2: Preparation of test specimen and determination of properties

1 Scope

This part of ISO 16365 specifies the methods of preparation of test specimens and the standard test methods to be used in determining the properties of thermoplastic polyurethane moulding and extrusion materials. Requirements for handling test material and for conditioning both the test material before moulding and the specimens before testing are given here.

Procedures and conditions for the preparation of test specimens in a specified state and procedures for measuring properties of the materials from which these specimens are made are given. Properties and test methods which are suitable and necessary to characterize thermoplastic polyester/polyurethane and polyether/polyurethane (TPU) moulding and extrusion materials, are listed.

The properties have been selected from the general test methods in ISO 10350, Other test methods in wide use or of particular significance to these moulding and extrusion materials are also included in this part of ISO 16365, as are the designatory properties specified in part 1.

In order to obtain reproducible and comparable test results, it is necessary to use the methods of preparation and conditioning, the specimen dimensions and the test procedures specified herein. Values determined will not necessarily be identical to those obtained using specimens of different dimensions or prepared using different procedures.

NOTE This standard has been developed on basis of ISO 10350-1 as at the moment a standard on 'Acquisition and presentation of comparable single point data' for thermoplastic elastomers' does not exist yet. After acceptance and publication of this standard and the analogical standard 'Thermoplastic Polyester/ester and polyether/ester (TPC) for moulding and extrusion materials — Preparation of test specimen and determination of properties', it is the intension to develop ISO 10350-3 Acquisition and presentation of comparable single point data' for thermoplastic Elastomers, based on the two standards mentioned before, as starting point for the development of Thermoplastic Elastomer material standards.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies

ISO 34-1; *Rubber, vulcanized or thermoplastic – determination of tear strength – Part 1: trouser, angle and crescent test pieces*

ISO 37; *Rubber, vulcanized or thermoplastic -- Determination of tensile stress-strain properties*

ISO 179-1; *Plastics – Determination of Charpy impact properties – Part 1: Non-instrumented impact test*

ISO 179-2; *Plastics-- Determination of Charpy impact properties – Part 2: Instrumented impact test*

ISO 291; *Plastics - --Standard atmospheres for conditioning and testing.*

ISO 294-1; *Plastics – Injection moulding of test specimens of thermoplastic materials –Part 1: General principles and moulding of multipurpose and bar test specimens*

ISO 294-3; *Plastics – Injection moulding of test specimens of thermoplastic materials –Part 3: Small plates.*

ISO 294-4; *Plastics - Injection moulding of test specimens of thermoplastic materials-Part 4: Determination of moulding shrinkage.*

ISO 472; *Plastics - Vocabulary*

ISO 527-1; *Plastics –Determination of tensile properties –Part 1: General principles*

ISO 527-2; *Plastics –Determination of tensile properties –Part 2: Test conditions for moulding and extrusion plastics*

ISO 815; *(all parts) Rubber, vulcanized or thermoplastic -- Determination of compression set*

ISO 846 *Method D Plastics – Evaluation of the action of microorganisms*

ISO 868; *Plastics and ebonite – Determination of indentation hardness by means of a durometer (Shore hardness)*

ISO 1133-2; *Plastics – Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics – Part 2: Method for materials sensitive to time-temperature history and/or moisture*

ISO 1183; *(all parts) Plastics –Methods for determining the density and relative density of non-cellular plastics*

ISO 4649; *Rubber, vulcanized or thermoplastic - Determination of abrasion resistance using a rotating cylindrical drum device*

ISO 16365-1; *Plastics — Thermoplastic polyester/polyurethane and polyether/polyurethane (TPE-U) for moulding and extrusion materials — Part 1: Designation*

ISO 10350-1; *Plastics – Acquisition and presentation of comparable single-point data – Part 1: Moulding materials*

IEC 60093; *Methods of test for volume resistivity and surface resistivity of solid electrical insulation materials.*

IEC 60112; *Method for determining of the proof and the comparative and the proof tracking indices of solid insulation materials under moist conditions.*

IEC 60243-1; *Electric strength of insulating materials – Test methods –Part 1: Tests at power frequencies.*

IEC 60250; *Recommended methods for the determination of the permittivity and dielectric dissipation factor of electrical insulating materials at power, audio and radio frequencies including metre wavelengths.*

IEC 60695-11 -10: *Fire hazard testing – Part 11-10 Flammability-11-10: Test flames – 50 W horizontal and vertical flame*

3 Preparation of test specimens

3.1 Treatment of the material before moulding

The water content of the granules shall have reached room temperature and the moisture content shall not exceed 0,02% (m/m).

For drying a dehumidified air dryer is recommended, but an oven with circulating air may also be used provided that the drying temperature is increased by 20 °C. For a dehumidified air dryer 3 h at 100 °C might be sufficient, but for several products longer times up to 1 day and a temperature of 110 °C may be used for drying without checking the water content for each sample, if proven to be to give a moisture content < 0,02 % (m/m). If color master batches, pigments or other additives are added it is recommended to prepare a premix with the granules before drying. If the material tends to become sticky it might be necessary to choose a lower temperature in order to be able to handle the material.

The water content may be measured after evaporation (ISO 62, ISO 10101) or extraction (ASTM E1064, ISO12937), of the water from the sample using solvents like water free alcohols and subsequent water determination e.g. by Karl Fisher titration, ISO 15512 or any other suitable method to determine moisture content in the range of 0,02 % (m/m) accurately. The moisture content of filled or reinforced materials shall be expressed as a percentage of the total mass of the compound.

To ensure that the moisture content remains low, it is recommended that the sample material in the feed hopper of the injection-moulding machine be blanketed with a suitable gas (dried air, nitrogen or argon, for example). Better results may be obtained using a dehumidifier hopper drier. Drying for the preparation of test specimen is recommended if the container has been opened several times after delivery of dry product or drying.

Excessive moisture content in the granule can lead to degradation during preparation of test specimen and thus to wrong results. Foaming and formation of gas bubbles are indications that the moisture content is excessively high.

NOTE Thermoplastic polyurethanes absorb moisture from air. Storage of granules in dry conditions is therefore recommended before processing. In order to prevent condensation on the granule if storing at low temperatures, material should be brought to room temperature before opening the container. Containers should be tightly closed after use. The granules should be exposed to the surrounding air only as long as absolutely essential.

3.2 Injection moulding

Injection-moulded specimens shall be prepared in accordance with ISO 294-1, using the conditions specified in table 1. The specimens shall be prepared by injection moulding from dry granules. Test specimen may be cut out from the sample plates using cutting blades.

It is essential that specimens are always prepared by the same procedure using the same processing conditions. The material shall be kept in moisture-proof containers until it is required for use.

Table 1 — Conditions for injection moulding of test specimens

Material Shore D hardness	Heating zone temperature	Nozzle temperature	Melt temperature
Soft; < 25 D	200 – 220	210 – 230	205 – 225
Medium; 25 ≥ D < 65	205 – 225	215 – 235	210 – 230
Rigid; D ≥ 65	210 – 230	220 – 240	215 – 235
Injection pressure: 10 – 100 MPa Holding pressure: 10 – 100 MPa Back pressure 0,5 – 2 MPa			

The processing parameters and temperatures are chosen in a way to minimize differences of mechanical properties in flow direction and crosswise. If the differences are higher than 5% (mean value) the direction needs be indicated together with the test results.