

---

---

**Plastics — Thermoplastic  
polyurethanes for moulding and  
extrusion —**

**Part 2:  
Preparation of test specimens and  
determination of properties**

iTeh STANDARD PREVIEW  
(standards.iteh.ai)

*Plastiques — Polyuréthanes thermoplastiques pour moulage et  
extrusion —*

*Partie 2: Préparation des éprouvettes et détermination des propriétés*

[https://standards.iteh.ai/catalog/standards/sist/6b5b236d-d896-4c70-  
bdb6-e1e04e3ff729/iso-16365-2-2014](https://standards.iteh.ai/catalog/standards/sist/6b5b236d-d896-4c70-bdb6-e1e04e3ff729/iso-16365-2-2014)



**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

ISO 16365-2:2014

<https://standards.iteh.ai/catalog/standards/sist/6b5b236d-d896-4c70-bdb6-e1e04e3ff729/iso-16365-2-2014>



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2014

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

	Page
<b>Foreword</b> .....	<b>iv</b>
<b>Introduction</b> .....	<b>v</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Preparation of test specimens</b> .....	<b>2</b>
3.1 Treatment of the material before moulding.....	2
3.2 Injection moulding.....	3
<b>4 Conditioning of test specimens</b> .....	<b>4</b>
<b>5 Determination of properties</b> .....	<b>4</b>
5.1 General.....	4
5.2 Biological resistance.....	4
5.3 TPU properties and test conditions.....	5
<b>Annex A (informative) Material identification</b> .....	<b>10</b>

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 16365-2:2014](https://standards.iteh.ai/catalog/standards/sist/6b5b236d-d896-4c70-bdb6-e1e04e3ff729/iso-16365-2-2014)

<https://standards.iteh.ai/catalog/standards/sist/6b5b236d-d896-4c70-bdb6-e1e04e3ff729/iso-16365-2-2014>

## 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

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

- *Part 1: Designation system and basis for specifications*
- *Part 2: Preparation of test specimens and determination of properties*
- *Part 3: Distinction between ether and ester polyurethanes by determination of the ester group content*

## Introduction

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 [Figure 1](#). 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 characterization of a specific material.

For each type of thermoplastic elastomer, refer to the relevant material standard.

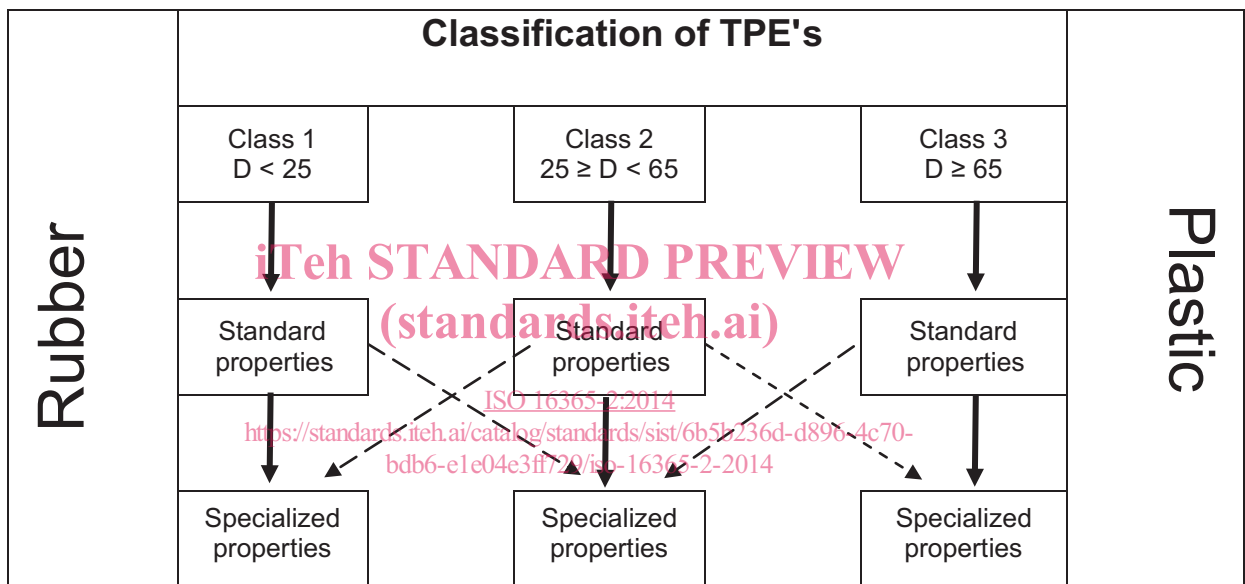


Figure 1 — Structure of thermoplastic elastomer (TPE) material standards

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

ISO 16365-2:2014

<https://standards.iteh.ai/catalog/standards/sist/6b5b236d-d896-4c70-bdb6-e1e04e3ff729/iso-16365-2-2014>

# Plastics — Thermoplastic polyurethanes for moulding and extrusion —

## Part 2: Preparation of test specimens 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 also given.

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 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 ISO 16365-1.

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 in this part of ISO 16365. Values determined are not necessarily identical to those obtained using specimens of different dimensions or prepared using different procedures.

**NOTE** This part of ISO 16365 has been developed on the basis of ISO 10350-1 as at the time of publication a standard on 'acquisition and presentation of comparable single point data' for thermoplastic elastomers' does not exist yet. After acceptance and publication of this part of ISO 16365, it is the intention to develop ISO 10350-3, based on the two International Standards mentioned before, as starting point for the development of thermoplastic elastomer material standards.

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 16365-2:2014(E)

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, *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 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 15512, *Plastics — Determination of water content*

ISO 16365-1, *Plastics — Thermoplastic polyurethanes for moulding and extrusion — Part 1: Designation system and basis for specifications*

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 granules/moulding compound 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 can 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 can be used for drying without checking the water content for each sample, if proven to give a moisture content < 0,02 % (m/m). If colour 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 can be measured after evaporation (see ISO 62 and ISO 10101) or extraction (see ASTM E1064 and ISO 12937), 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 can 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.

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 can 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 °C	Nozzle temperature °C	Melt temperature °C
Soft: D < 25	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.

The flow behaviour of the melt is important for optimizing the processing parameters. The melt flow rate/melt volume rate, using the specified temperature and load in [Table 3](#) can be used for determination of differences in melt flow behaviour (see ISO 1133-2). Only MFR/MVR data measured under exactly the same conditions are comparable. Load and temperatures are chosen in a way to obtain a MVR in the range between 5 cm<sup>3</sup>/10 min and 100 cm<sup>3</sup>/10 min, but preferably between 10 cm<sup>3</sup>/10 min and 40 cm<sup>3</sup>/10 min.