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Plastics — Thermoplastic polyester/ester and polyether/ester elastomers for moulding and extrusion —

Part 2: Preparation of test specimens and determination of properties

Plastiques — Élastomères thermoplastiques à base de polyester/ester et polyéther/ester, pour moulage et extrusion —

Partie 2: Préparation des éprouvettes et détermination des propriétés

Reference number
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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 14910-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 9, *Thermoplastic materials*.

This second edition cancels and replaces the first edition (ISO 14910-2:1997), which has been technically revised.

ISO 14910 consists of the following parts, under the general title *Plastics — Thermoplastic polyester/ester and polyether/ester elastomers for moulding and extrusion*:

— *Part 1: Designation system and basis for specification*

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

This corrected version of ISO 14910-2:2013 includes the following corrections:

— in Figure 1, the line between “TPEs” and “Standards properties” has been deleted;

— in Table 4, the dimensions of the specimen type for water absorption determination “60 × 6 × 1” have been replaced by “60 × 60 × 1”.

Introduction

The structure of thermoplastic-elastomer material standards is based on the following considerations.

For each type of thermoplastic elastomer, reference is made to the relevant material standard.

Thermoplastic-elastomer materials are classified into three classes according to the primary elastomeric property, hardness, as shown in Figure 1 below. This classification on the basis of hardness reflects the special position of thermoplastic elastomers between rubber materials on the one hand and plastics on the other.

Each class is subdivided into standard properties and special properties. The classes have many standard properties and many special properties in common. Furthermore, a standard property in one class can be a special property in another 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.

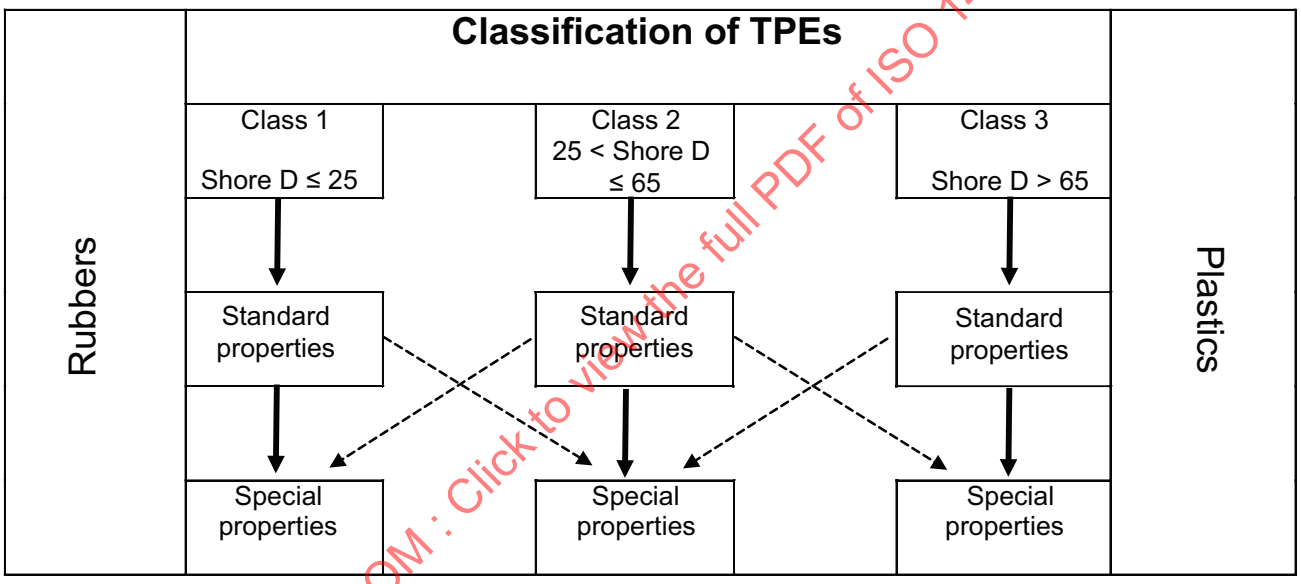

Figure 1 — Classification of thermoplastic elastomers on the basis of their hardness

Plastics — Thermoplastic polyester/ester and polyether/ester elastomers for moulding and extrusion —

Part 2: Preparation of test specimens and determination of properties

1 Scope

This part of ISO 14910 specifies the methods of preparation of test specimens and the standard test methods to be used in determining the properties of thermoplastic polyester/ester and polyether/ester moulding and extrusion materials. Requirements for handling test material and/or for conditioning both the test material before moulding and the specimens before testing are 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 made are given. Properties and test methods which are suitable and necessary to characterize thermoplastic polyester/ester and polyether/ester moulding and extrusion materials are listed.

The properties have been selected from the general test methods in ISO 10350-1. Other test methods in wide use for or of particular significance to these moulding and extrusion materials are also included in this part of ISO 14910, as are the designatory properties specified in ISO 14910-1 (hardness, melting temperature and tensile modulus).

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 14910. Values determined will not necessarily be identical to those obtained using specimens of different dimensions or prepared using different procedures.

NOTE This part of ISO 14910 has been developed on the basis of ISO 10350-1 as, at the moment, no standard exists for the acquisition and presentation of comparable single-point data for thermoplastic elastomers. After publication of this part of ISO 14910 and the analogous document for polyurethanes (ISO 16365-2), it is the intention to develop ISO 10350-3 for the acquisition and presentation of comparable single-point data for thermoplastic elastomers, based on this part of ISO 14910 and ISO 16365-2, as the basis 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 34-1:2010, *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 62, *Plastics — Determination of water absorption*

ISO 75-2, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite*

ISO 178, *Plastics — Determination of flexural 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 294-1, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 1: General principles, and moulding of multipurpose and bar test specimens*

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

ISO 306, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST)*

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

ISO 815-1, *Rubber, vulcanized or thermoplastic — Determination of compression set — Part 1: At ambient or elevated temperatures*

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

ISO 899-1, *Plastics — Determination of creep behaviour — Part 1: Tensile creep*

ISO 974, *Plastics — Determination of the brittleness temperature by impact*

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 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pyknometer method and titration method*

ISO 1183-2, *Plastics — Methods for determining the density of non-cellular plastics — Part 2: Density gradient column method*

ISO 1183-3, *Plastics — Methods for determining the density of non-cellular plastics — Part 3: Gas pyknometer method*

ISO 3167, *Plastics — Multipurpose test specimens*

ISO 4589-2, *Plastics — Determination of burning behaviour by oxygen index — Part 2: Ambient-temperature test*

ISO 8256, *Plastics — Determination of tensile-impact strength*

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

ISO 11357-3, *Plastics — Differential scanning calorimetry (DSC) — Part 3: Determination of temperature and enthalpy of melting and crystallization*

ISO 11357-4, *Plastics — Differential scanning calorimetry (DSC) — Part 4: Determination of specific heat capacity*

ISO 11359-2:1999, *Plastics — Thermomechanical analysis (TMA) — Part 2: Determination of coefficient of linear thermal expansion and glass transition temperature*

ISO 14910-1, *Plastics — Thermoplastic polyester/ester and polyether/ester elastomers for moulding and extrusion — Part 1: Designation system and basis for specification*

ISO 15512, *Plastics — Determination of water content*

ISO 22007-2, *Plastics — Determination of thermal conductivity and thermal diffusivity — Part 2: Transient plane heat source (hot disc) method*

ISO 22007-3, *Plastics — Determination of thermal conductivity and thermal diffusivity — Part 3: Temperature wave analysis method*

ISO 22007-4, *Plastics — Determination of thermal conductivity and thermal diffusivity — Part 4: Laser flash method*

IEC 60093, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials*

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

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: Test flames — 50 W horizontal and vertical flame test methods*

ASTM E96, *Standard Test Methods for Water Vapor Transmission of Materials*

3 Preparation of test specimens

3.1 Treatment of the material before moulding

Before processing, the material sample shall have reached room temperature and the moisture content of the material sample shall not exceed 0,05 % (by mass).

The material shall be dried as specified in Table 1, preferably using a vacuum oven with a dry N_2 purge and a maximum pressure of 100 mbar.

Table 1 — Drying conditions

Dryer type	Temperature
Vacuum oven with N_2 purge; $p \leq 0{,}01$ MPa	80 °C to 135 °C
Vacuum oven	80 °C to 120 °C
Desiccant dryer, pre-dried-air dryer	80 °C to 120 C°
Hot-air oven	80 °C to 135 °C

Drying at higher temperatures might change the molecular mass and hence the properties of the material. The drying temperature recommended by the supplier should preferably be used.

The moisture content of filled or reinforced materials shall be expressed as a percentage of the total mass of the compound. The moisture content shall be determined in accordance with ISO 15512.

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 might be obtained using a dehumidifier hopper drier.

3.2 Injection moulding

Injection-moulded specimens shall be prepared in accordance with ISO 294-1, using the conditions specified in Table 2. The moulding conditions recommended by the supplier should preferably be used. The specimens shall be prepared by injection moulding from dry granules. 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 2 — Conditions for injection moulding of test specimens

Mould temperature °C	Melt temperature °C	Nozzle temperature °C	Heating-zone temperature		
			Front °C	Centre °C	Rear °C
20 to 50	Melting temperature + 30 °C	230 to 250	200 to 240	200 to 240	200 to 240
Injection pressure: 10 MPa to 100 MPa, holding pressure: 10 MPa to 100 MPa, back pressure: 0,5 MPa to 2 MPa, injection velocity: 100 mm/s to 300 mm/s.					

4 Conditioning of test specimens

Test specimens for the determination of mechanical properties, electrical properties and density shall be conditioned for at least 16 h at (23 ± 2) °C and (50 ± 10) % relative humidity.

5 Determination of properties

5.1 General

In order to obtain reproducible and comparable test results, it is necessary to use the methods of specimen preparation and conditioning, the specimen dimensions and the test procedures specified in this part of ISO 14910. Values determined will not necessarily be identical to those obtained using specimens of different dimensions or prepared using different procedures.

All tests shall be carried out in the standard atmosphere of (23 ± 2) °C and (50 ± 10) % relative humidity unless specifically stated otherwise in Tables 4 to 8.

Table 3 is compiled from ISO 10350-1 (see Clause 1) and gives an overview of the standard properties and special properties which are appropriate to thermoplastic polyester/ester and polyether/ester moulding and extrusion materials. These properties are those considered useful for comparisons of data generated for different thermoplastic elastomers.

Tables 4, 6 and 8 contain those properties that are considered to be standard properties for the relevant hardness class. Tables 5, 7 and 9 contain those properties that are considered to be special properties for the relevant hardness class, i.e. in wide use and/or of particular significance in the practical characterization of thermoplastic polyester/ester and polyether/ester moulding and extrusion materials.

Table 3 — Overview of standard properties and special properties for the characterization of thermoplastic polyester/ester and polyether/ester materials

Properties	Test method	Shore D ≤ 25		25 < Shore D ≤ 65		Shore D > 65	
Rheological properties		Standard	Special	Standard	Special	Standard	Special
Melt mass-flow rate/melt volume-flow rate	ISO 1133-2	X		X		X	
Mechanical properties		Standard	Special	Standard	Special	Standard	Special
Hardness, Shore D	ISO 868	X		X		X	

Table 3 *(continued)*

Properties	Test method	Shore D ≤ 25		25 < Shore D ≤ 65		Shore D > 65	
Tensile modulus	ISO 527–2	X		X		X	
Tensile stress							
— at 5 % and 10 % strain					X	X	
— at > 50 % strain			X		X		X
Stress at break		X		X		X	
Yield stress			X		X	X	
Strain at break			X	X		X	
Nominal strain at break		X		X			X
Strain at yield			X		X		X
Tensile creep modulus	ISO 899-1		X		X		X
Flexural modulus	ISO 178		X		X	X	
Tensile-impact strength	ISO 8256		X		X		
Charpy unnotched impact strength	ISO 179-1 or ISO 179-2		X	X	X	X	
Charpy notched impact strength			X		X	X	
Brittleness temperature	ISO 974	X			X		X
Tear strength	ISO 34-1:2010, method B, procedure (a)	X		X			X
Compression set	ISO 815-1	X			X		X
Thermal properties		Standard	Special	Standard	Special	Standard	Special
Specific heat capacity	ISO 11357-4		X	X		X	
Thermal conductivity	ISO 22007-2, ISO 22007-3 or ISO 22007-4		X		X		X
Melting temperature	ISO 11357-3	X		X		X	
Deflection of temperature under load	ISO 75-2				X	X	
Coefficient of linear thermal expansion	ISO 11359-2:1999, method A		X		X		X
Vicat softening temperature	ISO 306				X	X	
Oxygen index	ISO 4589-2		X		X		X
Burning behaviour	IEC 60695-11-10		X		X		X
Electrical properties		Standard	Special	Standard	Special	Standard	Special
Relative permittivity	IEC 60250		X		X		X
Dissipation factor, tan δ	IEC 60250		X		X		X
Volume resistivity	IEC 60093		X		X		X
Surface resistivity, σ_e	IEC 60093		X		X		X
Dielectric strength	IEC 60243-1		X		X		X
Comparative tracking index (CTI)	IEC 60112		X		X		X
Other properties		Standard	Special	Standard	Special	Standard	Special
Density	ISO 1183-1, ISO 1183-2 or ISO 1183-3	X		X		X	

Table 3 *(continued)*

Properties	Test method	Shore D ≤ 25		25 < Shore D ≤ 65		Shore D > 65	
Water absorption.	ISO 62	X		X		X	
Moulding shrinkage	ISO 294-4	X		X		X	
Water vapour transmission	ASTM E96		X		X		X
Moisture content	ISO 15512		X		X		X

5.2 Shore D hardness ≤ 25

5.2.1 Standard properties and test conditions

Table 4 — Standard properties and test conditions — Shore D hardness ≤ 25

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[a]	Test conditions and supplementary instructions	
Rheological properties						
MVR or MFR	cm^3/10 min or g/10 min	ISO 1133-2	Moulding compound	Dried	Load 2,16 kg, 5 kg or 10 kg	
					Melting temperature	Test temperature
					≤ 175 °C	190 °C
					> 175 °C but ≤ 210 °C	230 °C
					> 210 °C	250 °C
Mechanical properties						
Hardness	Shore D units	ISO 868	≥ 80 × ≥ 10 × ≥ 12	M	Five measurements ≥ 9 mm from any edge, ≥ 6mm apart Specimens may be stacked to obtain minimum thickness.	
Tensile modulus	MPa	ISO 527-2	ISO 527-2/1BA	M	1 mm/min	
Stress at break	MPa		ISO 527-2/1BA or 5A		500 mm/min	
Nominal strain at break	%				500 mm/min	
Tensile impact strength	kJ/m^2	ISO 8256	80 × 10 × 4 machined double V-notch, r = 1	M	Only to be quoted if fracture cannot be obtained with notched Charpy test	
Brittleness temperature	°C	ISO 974	20 × 0,25, 2,5 × 0,05, or 2,0 × 0,1	M		
Tear strength	kN/m	ISO 34-1:2010, method B, procedure (a)	Angle test piece, 2 mm thick	M	Test speed 500 mm/min	
Compression set	%	ISO 815-1	Ø 13 × 6	M	23 °C for 72 h and 70 °C for 24 h	
Thermal properties						
Melting temperature	°C	ISO 11357-3	Moulding compound	M	Record peak melting temperature Use 10 °C/min	

Table 4 *(continued)*

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[a]	Test conditions and supplementary instructions
Coefficient of linear thermal expansion	$°C^{-1}$	ISO 11359-2:1999, method A	Prepared from ISO 3167	M	Transverse and longitudinal Determine the value over the temperature range 23 °C to 55 °C
Other properties					
Density	kg/m^3	ISO 1183-1, ISO 1183-2 or ISO 1183-3	Prepared from ISO 527-2/1BA	M	
Water absorption	%	ISO 62	60 × 60 × 1	M	Saturation value in water at 23 °C
Mould shrinkage	%	ISO 294-4	60 × 60 × 2	M	
[a] M = injection moulding					

5.2.2 Special properties and test conditions

Table 5 — Special properties and test conditions — Shore D hardness ≤ 25

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[a]	Test conditions and supplementary instructions
Mechanical properties					
Tensile stress at > 50 % elongation	MPa	ISO 527-2	ISO 527-2/1BA or 5A	M	300 % elongation at 500 mm/min
Yield stress	MPa				500 mm/min
Strain at break	%				500 mm/min
Strain at yield	%				500 mm/min
Tensile creep modulus	%	ISO 899-1	ISO 527-2/1BA	M	1 h, 1 000 h
Flexural modulus	MPa	ISO 178	ISO 178	M	23 °C and −40 °C or 23 °C and 100 °C at 2 mm/min
Charpy unnotched impact strength	kJ/m^2	ISO 179-1 or ISO 179-2	80 × 10 × 4	M	Method 1eU, edgewise impact −30 °C or −40 °C Also record type of failure
Charpy notched impact strength	kJ/m^2		80 × 10 × 4 machined V-notch, r = 1	M	Method 1eA, edgewise impact −30 °C or −40 °C Also record type of failure
Thermal properties					
Specific heat capacity	$J \cdot K^{-1}$	ISO 11357-4	Moulding compound		
Thermal conductivity	W/m·K	ISO 22007-2, ISO 22007-3 or ISO 22007-4	As per relevant part of ISO 22007	M	
Temperature of deflection under load	°C	ISO 75-2	80 × 10 × 4	M	0,45 MPa
Coefficient of linear thermal expansion from −40 °C to 23 °C	$°C^{-1}$	ISO 11359-2:1999, method A	Prepared from ISO 3167	M	Transverse and longitudinal

Table 5 *(continued)*

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[a]	Test conditions and supplementary instructions
Coefficient of linear thermal expansion from 55 °C to *T* °C	°C^{-1}	ISO 11359-2:1999, method A	Prepared from ISO 3167	M	Transverse and longitudinal End temperature *T* in accordance with manufacturer's instructions
Oxygen index	%	ISO 4589-2	80 × 10 × 4	M	Use procedure A (top surface ignition)
Burning behaviour		IEC 60695-11-10	125 × 13 × *d*	M	*d* = 0,75 mm or 1,5 mm
Electrical properties					
Relative permittivity		IEC 60250	≥ 60 × ≥ 60 × 2	M	Frequency 100 Hz and 1 MHz (compensate for electrode edge effects)
Dissipation factor					
Volume resistivity	Ω·m	IEC 60093		M	
Surface restivity	Ω				
Dielectric strength	kV/mm	IEC 60243-1	≥ 60 × ≥ 60 × 1	M	
Comparative tracking index (CTI)	V	IEC 60112	≥ 20 × ≥ 20 × 4	M	
Other properties					
Water vapour transmission	g/m^2·h	ASTM E96	As specified in ASTM E96		
Moisture content	%	ISO 15512	Moulding compound		Coulometric method

[a] M = injection moulding

5.3 25 < Shore D hardness ≤ 65

5.3.1 Standard properties and test conditions

Table 6 — Standard properties and test conditions — 25 < Shore D hardness ≤ 65

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[a]	Test conditions and supplementary conditions	
Rheological properties						
MVR or MFR	cm^3/10 min or g/10 min	ISO 1133-2	Moulding compound	Dried	Load 2,16 kg, 5 kg or 10 kg	
					Melting temperature	Test temperature
					≤ 175 °C	190 °C
					> 175 °C but ≤ 210 °C	230 °C
					> 210 °C	250 °C
Mechanical properties						
Hardness	Shore D units	ISO 868	≥ 80 × ≥ 10 × ≥ 6	M	Five measurements ≥ 9 mm from any edge, ≥ 6mm apart Specimens may be stacked to obtain minimum thickness	

Table 6 *(continued)*

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[a]	Test conditions and supplementary conditions
Tensile modulus	MPa	ISO 527-2	ISO 527-2/1BA	M	1 mm/min
Stress at break	MPa		ISO 527-2/1BA or 5A		500 mm/min
Strain at break	%				500 mm/min
Nominal strain at break	%				500 mm/min
Charpy unnotched impact strength	kJ/m^2	ISO 179-1 or ISO 179-2	80 × 10 × 4	M	Method 1eU, edgewise impact −40 °C Also record type of failure
Charpy notched impact strength	kJ/m^2		80 × 10 × 4 machined V-notch, r = 1	M	Method 1eA, edgewise impact −40 °C Also record type of failure If fracture cannot be obtained, use ISO 8256 tensile impact
Tear strength	kN/m	ISO 34-1:2010, method B, procedure (a)	Angle test piece, 2 mm thick	M	Test speed 500 mm/min
Thermal properties					
Specific heat capacity	$J \cdot K^{-1}$	ISO 11357-4	Moulding compound		
Melt temperature	°C	ISO 11357-3	Moulding compound		Record peak melting temperature Use 10 °C/min
Coefficient of linear thermal expansion	$°C^{-1}$	ISO 11359-2:1999, method A	Prepared from ISO 3167	M	Transverse andlongitudinal Determine the value over the temperature range 23 °C to 55 °C
Other properties					
Density	g/cm^3	ISO 1183-1, ISO 1183-2 or ISO 1183-3	Prepared from ISO 527-2/1BA	M	
Water absorption	%	ISO 62	60 × 60 × 1	M	Saturation value in water at 23 °C
Mould shrinkage	%	ISO 294-4	60 × 60 × 2	M	
Water vapour transmission	$g/m^2 \cdot h$	ASTM E96	As specified in ASTM E96		

[a] M = injection moulding

5.3.2 Special properties and test conditions

Table 7 — Special properties and test conditions — 25 < Shore D hardness ≤ 65

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[a]	Test conditions and supplementary instructions
Mechanical properties					
Tensile stress at 5 % and 10 % elongation	MPa	ISO 527-2	ISO 527-2/1BA or 5A	M	500 mm/min
Tensile stress at > 50 % elongation	MPa				200 % or 300 % elongation at 500 mm/min
Yield stress	MPa				500 mm/min
Strain at yield	%				500 mm/min
Tensile creep modulus	MPa	ISO 899-1	ISO 527-2/1BA	M	1 h, 1 000 h
Flexural modulus	MPa	ISO 178	80 × 10 × 4	M	23 °C and −40 °C or 23 °C and 100 °C
Tensile-impact strength	kJ/m^2	ISO 8256	80 × 10 × 4 machined double V-notch, r = 1	M	Only to be quoted if fracture cannot be obtained with notched Charpy test
Charpy unnotched impact strength	kJ/m^2	ISO 179-1 or ISO 179-2	80 × 10 × 4	M	Method 1eU, edgewise impact −30 °C Also record type of failure
Charpy notched impact Strength	kJ/m^2		80 × 10 × 4 machined V-notch, r = 1	M	Method 1eA, edgewise impact −30 °C Also record type of failure
Brittleness temperature	°C	ISO 974	20 × 0,25, 2,50 × 0,05, or 2,0 × 0,1	M	
Compression set	%	ISO 815-1	Ø 13 × 6	M	23 °C for 72 h and 70 °C for 24 h
Thermal properties					
Thermal conductivity	W/m·K	ISO 22007-2, ISO 22007-3 or ISO 22007-4	As per relevant part of ISO 22007	M	
Temperature of heat deflection under load	°C	ISO 75-2	80 × 10 × 4	M	0,45 MPa
Coefficient of linear thermal expansion from −40 °C to 23 °C	°C^{-1}	ISO 11359-2:1999, method A	Prepared from ISO 3167	M	Transverse and longitudinal
Coefficient of linear thermal expansion from 55 °C to T °C	°C^{-1}	ISO 11359-2:1999, method A	Prepared from ISO 3167	M	Transverse and longitudinal End temperature T in accordance with manufacturer's instructions
Vicat softening temperature	°C	ISO 306	10 × 10 × > 3	M	
Oxygen index	%	ISO 4589-2	80 × 10 × 4	M	Use procedure A (top surface ignition)
Burning behaviour		IEC 60695-11-10	125 × 13 × d	M	d = 0,91 mm or 3,0 mm
Electrical properties					

Table 7 *(continued)*

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[a]	Test conditions and supplementary instructions
Relative permittivity		IEC 60250	≥ 60 × ≥ 60 × 2	M	Frequency 100 Hz and 1 MHz (compensate for electrode edge effects)
Dissipation factor					
Volume resistivity	Ω·m	IEC 60093		M	
Surface restivity	Ω				
Dielectric strength	kV/mm	IEC 60243-1	≥ 60 × ≥ 60 × 1	M	
Comparative tracking index (CTI)	V	IEC 60112	≥ 20 × ≥ 20 × 4	M	
Other properties					
Moisture content	%	ISO 15512	Moulding compound	M	Coulometric method
[a] M = injection moulding					

5.4 Shore D hardness > 65

5.4.1 Standard properties and test conditions

Table 8 — Standard properties and test conditions — Shore D hardness > 65

Property	Unit	Standard	Specimen type (dimensions in mm)	Specimen preparation[a]	Test conditions and supplementary instructions	
Rheological properties						
MVR or MFR	cm^3/10 min or g/10 min	ISO 1133-2	Moulding compound	Dried	Load 2,16 kg, 5 kg or 10 kg	
					Melting temperature	Test temperature
					≤ 175 °C	190 °C
					> 175 °C but ≤ 210 °C	230 °C
					> 210 °C	250 °C
Mechanical properties						
Hardness	Shore D units	ISO 868	≥ 80 × ≥ 10 × ≥ 6	M	Five measurements ≥ 9 mm from any edge, ≥ 6mm apart Specimens may be stacked to obtain minimum thickness	
Tensile modulus	MPa	ISO 527-2	ISO 527-2/1BA	M	1 mm/min	
Tensile stress at 5 % and 10 % elongation	MPa		ISO 527-2/1BA or 5A		500 mm/min	
Stress at break	MPa				500 mm/min	
Yield stress	MPa				500 mm/min	
Strain at break	%				500 mm/min	
Flexural modulus	MPa	ISO 178	ISO 178	M	23 °C and −40 °C or 23 °C and 100 °C at 2 mm/min	