Sessione ordinaria 2017

Seconda prova scritta

*Ministero dell'Istruzione, dell'Università e della Ricerca*

# I250 – ESAME DI STATO DI ISTRUZIONE SECONDARIA SUPERIORE

**Indirizzo:** ITMP – MECCANICA, MECCATRONICA ED ENERGIA
ARTICOLAZIONE MECCANICA E MECCATRONICA
OPZIONE TECNOLOGIE DELLE MATERIE PLASTICHE

**Tema di:** TECNOLOGIE MECCANICHE E PLASTURGICHE DISEGNO ED ORGANIZZAZIONE INDUSTRIALE

***Il candidato svolga la prima parte della prova e due tra i quesiti proposti nella seconda parte.***

***PRIMA PARTE***

Un laboratorio deve realizzare una serie di prove di trazione su materiali polimerici secondo la norma BS EN ISO 527-2. A tale scopo necessita dello stampo per la realizzazione di provini per stampaggio a iniezione.

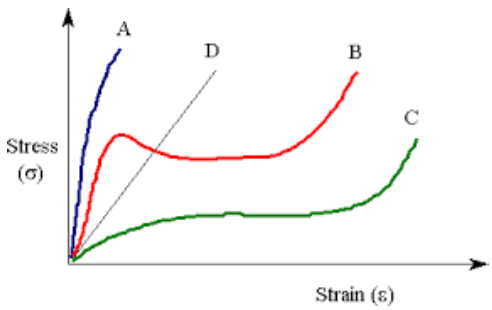
Il candidato, avvalendosi della norma allegata e assumendo con giustificato criterio ogni altro dato, esegua:

- il disegno costruttivo del provino completo di quote e tolleranze;
- il progetto di massima dello stampo illustrando mediante schizzi o schemi a blocchi i componenti costitutivi e i principali riferimenti progettuali e costruttivi.

***SECONDA PARTE***

1. Il candidato descriva la lavorazione per realizzare la figura del provino nel tassello.
2. Il candidato elenchi le attività necessarie per la realizzazione dello stampo; per ciascuna attività ne proponga la durata e costruisca il diagramma di Gantt esplicitando il percorso critico.
3. Il candidato presenti le diverse tecniche di riciclo dei materiali polimerici. Tra esse indichi, a suo parere, la più appropriata per il recupero degli sfridi di lavorazione illustrandone i vantaggi e gli accorgimenti tecnici al fine di mantenere pressoché costanti le performance dei prodotti; ovvero altre possibili soluzioni.
4. Il comportamento a trazione dei diversi materiali polimerici, in letteratura tecnica, viene descritto mediante diagrammi sforzi deformazione. La figura 1 riporta una comune rappresentazione del comportamento dei materiali polimerici. Il candidato confronti i comportamenti e riconosca le tipologie e le famiglie di materiali. Inoltre illustri e commenti, per una di esse, il comportamento a trazione in funzione della temperatura.

Figura 1






Durata massima della prova: 6 ore.
È consentito soltanto l'uso di manuali tecnici, schede tecniche fornite dalla scuola e di calcolatrici non programmabili.
È consentito l'uso del dizionario bilingue (italiano-lingua del paese di provenienza) per i candidati di madrelingua non italiana.
Non è consentito lasciare l'Istituto prima che siano trascorse 3 ore dalla dettatura del tema.

**INTERNATIONAL STANDARD** **ISO 527-2:2012(E)**

# Plastics — Determination of tensile properties —

## Part 2:
## Test conditions for moulding and extrusion plastics

### 1 Scope

**1.1** This part of ISO 527 specifies the test conditions for determining the tensile properties of moulding and extrusion plastics, based upon the general principles given in ISO 527-1.

**1.2** The methods are selectively suitable for use with the following range of materials:

— rigid and semi-rigid thermoplastics moulding, extrusion and cast materials, including compounds filled and reinforced by, for example, short fibres, small rods, plates or granules but excluding textile fibres (see ISO 527-4 and ISO 527-5). See ISO 527-1:2012, Clause 3 for the definition of “rigid” and “semi-rigid”.

— rigid and semi-rigid thermosetting moulding and cast materials, including filled and reinforced compounds but excluding textile fibres as reinforcement (see ISO 527-4 and ISO 527-5);

— thermotropic liquid crystal polymers.

The methods are not normally suitable for use with rigid cellular materials or sandwich structures containing cellular material. For rigid cellular materials see ISO 1926.

The methods are not suitable for flexible films and sheets, of thickness smaller than 1 mm, see ISO 527-3.

**1.3** The methods are applied using specimens which may be either moulded to the chosen dimensions or machined, cut or punched from injection- or compression-moulded plates. The multipurpose test specimen is preferred (see ISO 20753).

### 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 293, *Plastics — Compression moulding of test specimens of thermoplastic materials*

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 295, *Plastics — Compression moulding of test specimens of thermosetting materials*

ISO 527-1:2012, *Plastics — Determination of tensile properties — Part 1: General principles*

ISO 2818, *Plastics — Preparation of test specimens by machining*

ISO 10724-1, *Plastics — Injection moulding of test specimens of thermosetting powder moulding compounds (PMCs) — Part 1: General principles and moulding of multipurpose test specimens*

ISO 11403-3, *Plastics — Acquisition and presentation of comparable multipoint data — Part 3: Environmental influences on properties*

ISO 20753, *Plastics — Test specimens*

## 3 Terms and definitions

See ISO 527-1: 2012, Clause 3.

## 4 Principle and methods

See ISO 527-1:2012, Clause 4.

## 5 Apparatus

### 5.1 General

See ISO 527-1:2012, Clause 5, specifically 5.1.1 to 5.1.4.

### 5.2 Extensometer

For this part of ISO 527, a gauge length of 75 mm is preferred when a multipurpose test specimen is used.

A gauge length of 50 mm is also acceptable for quality-control purposes or where specified.

If strains are recorded only on one side of the test specimen, ensure that low strains are not falsified by bending, which may result from even faint misalignment and initial warpage of the test specimen and which generates strain differences between opposite surfaces of the test specimen.

NOTE Increasing the gauge length leads to higher accuracy, especially for the modulus determination. The absolute accuracy of the measurement of elongation required for a ±1 % accuracy of modulus determination is ±1,5 µm. This is less severe than the ±1 µm needed if a gauge length of 50 mm is used. Furthermore, necking outside of the gauge length will be less frequent.

### 5.3 Recording of data

See ISO 527-1:2012, 5.1.6.

NOTE For the determination of the tensile modulus under the conditions $v$ = 1mm/min, $L_0$ = 75mm, $L$ = 115 mm and $r$ = 0,000 5 mm, the recording frequency for the strain signal greater than or equal to 22 s-1 would be appropriate according to ISO 527-1:2012, Equation 1. This frequency increases as the gauge length increases. With larger gauge length the absolute elongation measured by the extensometer is larger for the same crosshead displacement, i.e the recording instrument will see more data points in the same time span.

## 6 Test specimens

### 6.1 Shape and dimensions

Wherever possible, the test specimens shall be dumb-bell-shaped types 1A and 1B, as shown in Figure 1 and Table 1. Type 1A shall be used for directly injection-moulded multipurpose test specimens, type 1B for machined specimens. Type 1A may also be used for compression-moulded specimens. For the use of proportionally scaled miniaturized specimens, see Annex A and/or ISO 20753.

NOTE 1 At 4 mm thickness, specimen types 1A and 1B are identical to the multipurpose test specimens according to ISO 3167, types A and B, respectively, and to types A1 and A2 of ISO 20753.

For purposes where large numbers of test specimens are to be exposed in limited space, for example, during analysis of environmental influences due to radiation, heat and/or chemicals (see ISO 11403-3), small test specimens of type C of ISO 20753 can be used. In such cases, frequently only the relative change of strength is of interest, and specimens of type CW are particularly useful. To accommodate wall thicknesses of the final application, thicknesses different from those preferred in ISO 20753 may be used.

NOTE 2 Other miniaturized specimens with different scale factors are defined in ISO 20753

### 6.2 Preparation of test specimens

Test specimens shall be either directly injection- or compression-moulded from the material in accordance with ISO 293, ISO 294-1, ISO 295 or ISO 10724-1, as appropriate, or machined in accordance with ISO 2818 from plates that have been compression- or injection-moulded from the compound, or obtained from cast or extruded plates (sheet). The moulding conditions shall be in accordance with the relevant International Standard for the material or, if none exists, agreed between the interested parties.

Strict control of all conditions of the specimen preparation is essential to ensure that all test specimens in a set are actually in the same state.

All surfaces of the test specimen shall be free from visible flaws, scratches or other imperfections. From moulded specimens, all flash, if present, shall be removed, taking care not to damage the moulded surface.

Test specimens from finished goods shall be taken from flat areas or zones having minimum curvature. For reinforced plastics, test specimens should not be machined to reduce their thickness unless absolutely necessary. Test specimens with machined surfaces will not give results comparable to specimens having non-machined surfaces.

### 6.3 Gauge marks

See ISO 527-1:2012, 6.3.

### 6.4 Checking the test specimens

See ISO 527-1:2012, 6.4.

### 6.5 Anisotropy

Injection moulded and extruded plates, as well as finished goods, exhibit some degree of anisotropy as a result of flow-induced orientation. The direction dependence of the tensile properties can be assessed by machining specimens parallel and normal to the flow direction characterizing the moulding process. In the absence of information on such directions, specimens shall be machined in directions as agreed between the interested parties.

### 6.6 Number of test specimens

See ISO 527-1:2012, Clause 7.

## 7 Conditioning

See ISO 527-1:2012, Clause 8.

## 8 Procedure

See ISO 527-1:2012, Clause 9.

For measurement of the tensile modulus (see ISO 527-1:2012, 3.9), the speed of testing shall be 1 mm/min for specimen types 1A and 1B (see Figure 1). This corresponds to a strain rate of approximately 1 % $min^{-1}$. For small specimens see Annex A.

## 9 Calculation and expression of results

See ISO 527-1:2012, Clause 10.

## 10 Precision

See Annex B (informative).

## 11 Test report

The test report shall include the following information:

a) a reference to this part of ISO 527, including the type of specimen and the testing speed according to:

Tensile test — ISO 527-2/1A/50

Type of specimen (see Figure 1 and Table 1)

Testing speed, in millimetres per minute

For items b) to q) in the test report, see ISO 527-1:2012, 12 b) to q).

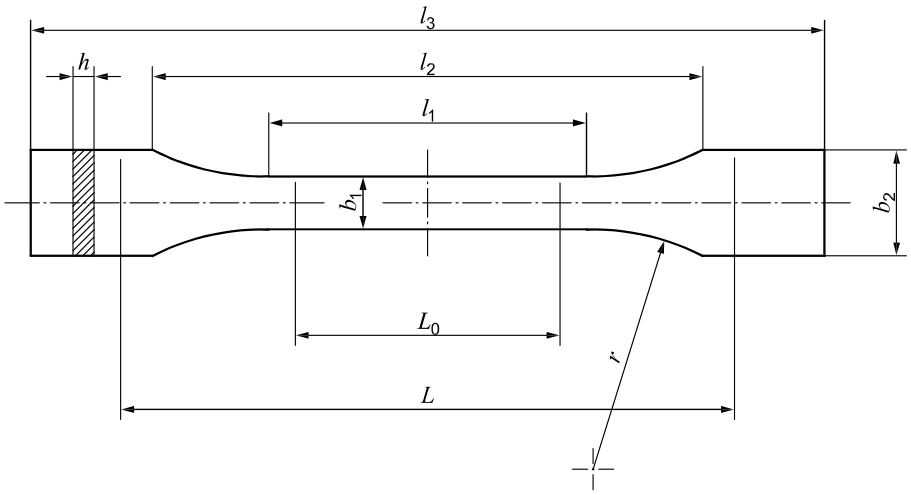



**Figure 1 — Type 1A and 1B test specimens**

**Table 1 — Dimensions of type 1A and 1B test specimens**

Dimensions in millimetres

| | Specimen type | 1A | 1B |
|---|---|---|---|
| $l_3$ | Overall length[a] | 170 | ≥150 |
| $l_1$ | Length of narrow parallel-sided portion | 80 ± 2 | 60,0 ± 0,5 |
| $r$ | Radius | 24 ± 1 | 60 ± 0,5 |
| $l_2$ | Distance between broad parallel-sided portions [b] | 109,3 ± 3,2 | 108 ± 1,6 |
| $b_2$ | Width at ends | 20,0 ± 0,2 | |
| $b_1$ | Width at narrow portion | 10,0 ± 0,2 | |
| $h$ | Preferred thickness | 4,0 ± 0,2 | |
| $L_0$ | Gauge length (preferred)<br>Gauge length (acceptable if required for quality control or when specified) | 75,0 ± 0,5<br>50,0 ± 0,5 | 50,0 ± 0,5 |
| $L$ | Initial distance between grips | 115 ± 1 | 115 ± 1 |

[a] The recommended overall length of 170 mm of the type 1A is consistent with ISO 294-1 and ISO 10724-1. For some materials, the length of the tabs may need to be extended (e.g. $l_3$ = 200 mm) to prevent breakage or slippage in the jaws of the testing machine.

[b] $l_2 = l_1 + [4r(b_2 - b_1) - (b_2 - b_1)^2]^{1/2}$, resulting from $l_1$, $r$, $b_1$ and $b_2$, but within the indicated tolerances.