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JIS K 7161 : 1994
(ISO 527-1 : 1993)

**Plastics—Determination of
tensile properties—
Part 1 : General principles**

ICS 83.080.01

Descriptors : plastics, tensile strength, tensile strain, tensile stress

Reference number : JIS K 7161 : 1994 (E)

Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of International Trade and Industry through deliberations at Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law:

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In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

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Plastics — Determination of tensile properties — Part 1 : General principles

Foreword for Japanese Industrial Standard

This Japanese Industrial Standard has been prepared based on the first edition issued in 1993 of **ISO 527-1**, *Plastics — Determination of tensile properties, — Part 1 : General principles* without modifying the technical contents.

The portions underlined with dots in this Standard are items not included in the original International Standard.

Foreword for original International Standard (extracted)

Together with the other parts of **ISO 527**, it cancels and replaces **ISO Recommendation R 527: 1966**, which has been technically revised.

ISO 527 (JIS K 7161 to 7165) consists of the following parts, under the general title *Plastics — Determination of tensile properties*:

- *Part 1: General principles*

Informative reference: JIS K 7161 *Plastics — Determination of tensile properties — Part 1: General principles* is equivalent to the said International Standard.

- *Part 2: Test conditions for moulding⁽¹⁾ and extrusion plastics*

Informative reference: JIS K 7162 *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics* is equivalent to the said International Standard.

- *Part 3: Test conditions for sheet and film*

Informative reference: JIS K 7163 will be equivalent to the said International Standard.

- *Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*

Informative reference: JIS K 7164 will be equivalent to the said International Standard.

- *Part 5: Test conditions for unidirectional fibre-reinforced plastic composites*

Informative reference: JIS K 7165 will be equivalent to the said International Standard.

Note ⁽¹⁾ "moulding": Forming methods with a use of moulds such as injection moulding and blow moulding.

Annex A to JIS K 7161 (part 1 of **ISO 527**) is for information only.

1 Scope

1.1 This Standard (part 1 of **ISO 527**) specifies the general principles for determining the tensile properties of plastics and plastic composites under defined conditions.

Several different types of test specimen are defined to suit different types of material which are detailed in **JIS K 7162 to 7165** (subsequent parts of **ISO 527**).

1.2 The methods are used to investigate the tensile behaviour of the test specimens and for determining the tensile strength, tensile modulus and other aspects of the tensile stress/strain relationship under the conditions defined.

1.3 The methods are selectively suitable for use with the following range of materials.

- rigid and semirigid thermoplastics moulding, extrusion and cast⁽²⁾ materials, including filled and reinforced compounds in addition to unfilled types ; rigid and semirigid thermoplastics sheets and films;
- rigid and semirigid thermosetting moulding materials, including filled and reinforced compounds ; rigid and semirigid thermosetting sheets, including laminates;
- fibre-reinforced thermoset and thermoplastics composites incorporating unidirectional or non-unidirectional reinforcements such as mat, woven fabrics, woven rovings, chopped strands, combination and hybrid reinforcements, rovings and milled fibres ; sheets made from pre-impregnated materials (prepregs);
- thermotropic liquid crystal polymers.

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

Note ⁽²⁾ 1.2 of JIS K 7162 (ISO 527-2) includes "cast", specifying "moulding, extrusion and cast materials" as suitable materials. The original International Standard omitted "cast", which seems an editorial error. Therefore "cast" is added to avoid misunderstanding.

1.4 The methods are applied using specimens which may be either moulded to the chosen dimensions or machined, cut or punched from finished and semifinished products such as mouldings, laminates, films and extruded or cast sheet. In some cases a multipurpose test specimen (see **ISO 3167** : 1993), may be used.

1.5 The methods specify preferred dimensions for the test specimens. Tests which are carried out on specimens of different dimensions, or on specimens which are prepared under different conditions, may produce results which are not comparable. Other factors, such as the speed of testing and the conditioning of the specimens, can also influence the results. Consequently, when comparative data are required, these factors must be carefully controlled and recorded.

2 Normative references The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

- ISO 291 : 1997 *Plastics – Standard atmospheres for conditioning and testing*
- ISO 2602 : 1980 *Statistical interpretation of test results – Estimation of the mean – Confidence interval*
- ISO 5893 : 1985 *Rubber and plastics test equipment – Tensile, flexural and compression types (constant rate of traverse) – Description*

3 Principle The test specimen is extended along its major longitudinal axis at constant speed until the specimen fractures or until the stress (load) or the strain (elongation) reaches some predetermined value. During this procedure the load sustained by the specimen and the elongation are measured.

4 Definitions For the purposes of this Standard, the following definitions apply.

4.1 gauge length L_0 : Initial distance between the gauge marks on the central part of the test specimen ; see Figures of the test specimens in JIS K 7162 to 7165 (the relevant parts of **ISO 527**). It is expressed in millimetres (mm).

4.2 speed of testing v : Rate of separation of the grips of the testing machine during the test. It is expressed in millimeters per minute (mm/min).

4.3 tensile stress σ (engineering) : Tensile force per unit area of the original cross-section within the gauge length, carried by the test specimen at any given moment. It is expressed in megapascals (MPa) [see 10.1, equation (3)].

4.3.1 tensile stress at yield; yield stress σ_y : First stress at which an increase in strain occurs without an increase in stress. It is expressed in megapascals (MPa).

It may be less than the maximum attainable stress (see Fig. 1, curves b and c).

4.3.2 tensile stress at break σ_B : The tensile stress at which the test specimen ruptures (see Fig. 1). It is expressed in megapascals (MPa).

4.3.3 tensile strength σ_M : Maximum tensile stress sustained by the test specimen during a tensile test (see Fig. 1). It is expressed in megapascals (MPa)

4.3.4 tensile stress at x % strain (see 4.4) σ_x : Stress at which the strain reaches the specified value x expressed in percentage. It is expressed in megapascals (MPa). It may be measured for example if the stress/strain curve does not exhibit a yield point (see Fig. 1, curve d). In this case, x shall be taken from the relevant product standard or agreed upon by the interested parties. However, x must be lower than the strain corresponding to the tensile strength, in any case.

4.4 tensile strain ε : Increase in length per unit original length of the gauge. It is expressed as a dimensionless ratio, or in percentage (%) [see 10.2, equation (4) and (5)]. It is used for strains up to yield point (see 4.3.1) ; for strains beyond yield point see 4.5.

4.4.1 tensile strain at yield ε_y : Tensile strain at the yield stress (see 4.3.1 and Fig. 1, curves b and c). It is expressed as a dimensionless ratio, or in percentage (%).