



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS K 7211-1 : 2006

(JPIF/JSA)

**Plastics—Determination of puncture
impact behaviour of rigid plastics—
Part 1 : Non-instrumented impact
testing**

ICS 83.080.01

Reference number : JIS K 7211-1 : 2006 (E)

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal of establishing a Japanese Industrial Standard from The Japan Plastics Industry Federation (JPIF)/Japanese Standards Association (JSA), with a draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

This Standard has been made based on **ISO 6603-1 : 2000** *Plastics—Determination of puncture impact behaviour of rigid plastics—Part 1 : Non-instrumented impact testing* for the purposes of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

JIS K 7211 consists of the following 2 parts, under the general title “*Plastics—Determination of puncture impact behaviour of rigid plastics*”:

Part 1 : Non-instrumented impact testing

Part 2 : Instrumented impact testing

Date of Establishment: 2006-08-20

Date of Public Notice in Official Gazette: 2006-08-21

Investigated by: Japanese Industrial Standards Committee

Standards Board

Technical Committee on Chemical Products

JIS K 7211-1 : 2006, First English edition published in 2007-06

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

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

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Printed in Japan

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Plastics—Determination of puncture impact behaviour of rigid plastics— Part 1 : Non-instrumented impact testing

Introduction This Japanese Industrial Standard has been prepared based on the second edition of **ISO 6603-1** *Plastics—Determination of puncture impact behaviour of rigid plastics—Part 1 : Non-instrumented impact testing* published in 2000 without modifying the technical contents for the corresponding parts (dimensions and shape) and adding some requirements not given in the original International Standard that are unique to **JIS**.

The portions given continuous sidelines or dotted underlines are the matters not included in the original International Standard. A list of modifications with explanations is shown in Annex 1 (informative).

1 Scope This part of **JIS K 7211** specifies methods for the determination of puncture-impact properties of rigid plastics in the form of flat test specimens, such as discs or square pieces, under defined conditions. Specimens may be moulded directly, cut from sheets or taken from finished products. Different types of test specimens and test conditions are defined.

These falling-dart methods are used to investigate the behaviour of plastic sheeting or moulding under the impact of a striker applied perpendicular to the plane of the specimen.

This part of **JIS K 7211** can be used if it is sufficient to characterize the impact behaviour of plastics by a threshold value of impact-failure energy based on many test specimens. **JIS K 7211-2** is used if a force-deflection or force-time diagram, recorded at nominally constant striker velocity, is necessary for detailed characterization of the impact behaviour.

These test methods are applicable to specimens with a thickness between 1 mm and 4 mm.

NOTE : For thicknesses less than 1 mm, **JIS K 7124-1** and **JIS K 7124-2** should preferably be used. Thicknesses greater than 4 mm may be tested if the equipment is suitable, but the test falls outside the scope of this part of **JIS K 7211** and **JIS K 7211-2**.

These methods are suitable for use with the following types of material:

- rigid thermoplastic moulding and extrusion materials, including filled, unfilled and reinforced compounds and sheets;
- rigid thermosetting moulding and extrusion materials, including filled and reinforced compounds, sheets and laminates;
- fibre-reinforced thermoset and thermoplastic composites incorporating unidirectional or non-unidirectional reinforcements such as mats, woven fabrics, woven rovings, chopped strands, combination and hybrid reinforcements, rovings, milled fibres and sheets made from pre-impregnated materials (prepregs).

These methods are also applicable to specimens which are either moulded or machined from finished products, laminates and extruded or cast sheet.

The test results are comparable only if the conditions of preparation of the specimens, their dimensions and surfaces as well as the test conditions are the same in particular, results determined on specimens of different thickness cannot be compared with one another (see Annex E of **JIS K 7211-2**). Comprehensive evaluation of the reaction to impact stress requires that determinations be made as a function of impact velocity and temperature for different material variables, such as crystallinity and moisture content.

The impact behaviour of finished products cannot be predicted directly from this test, but specimens may be taken from finished products (see above) for test by these methods.

Test data developed by these methods should not be used for design calculations. However, information on the typical behaviour of the material can be obtained by testing at different temperatures and impact velocities (see Annex D of **JIS K 7211-2**), by varying the thickness (see Annex E of **JIS K 7211-2**) and by testing specimens prepared under different conditions.

Two statistical methods of test are described in this part of **JIS K 7211**:

— Method A: staircase method (individual) (preferred)

In this method, a uniform energy increment is employed during testing. The energy is decreased or increased by the uniform increment after testing each specimen, depending upon the observed result (pass or fail) for the preceding test.

— Method B: group method (optional)

In this method, successive groups of at least ten test specimens are tested. The impact failure energy is calculated by statistics.

NOTE : The International Standard corresponding to this part of **JIS K 7211** is as follows.

In addition, the symbols which denote the degree of correspondence in the contents between **JIS** and the relevant International Standard are IDT (identical), MOD (modified) and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

ISO 6603-1 : 2000 *Plastics—Determination of puncture impact behaviour of rigid plastics—Part 1 : Non-instrumented impact testing* (MOD)

2 Normative references The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. If the indication of the year of publication is given to these referred standards, only the edition of the indicated year constitutes the provision of this part of **JIS K 7211** but the revision and amendment made thereafter do not apply. The normative references without the indication of the year of coming into effect apply only to the most recent edition (including amendments).

JIS K 7100 *Plastics—Standard atmospheres for conditioning and testing*

NOTE : **ISO 291** : 1997 *Plastics—Standard atmospheres for conditioning and testing* is equivalent to the said standard.

JIS K 7124-1 *Plastics film and sheeting—Determination of impact resistance by the free-falling dart method—Part 1: Staircase methods*

NOTE : **ISO 7765-1**:1988 *Plastics film and sheeting—Determination of impact resistance by the free-falling dart method—Part 1: Staircase methods* is identical with the said standard.

JIS K 7124-2 *Plastics film and sheeting—Determination of impact resistance by the free-falling dart method—Part 2: Instrumented puncture test*

NOTE : **ISO 7765-2**:1994 *Plastics film and sheeting—Determination of impact resistance by the free-falling dart method—Part 2: Instrumented puncture test* is identical with the said standard.

JIS K 7144 *Plastics—Preparation of test specimens by machining*

NOTE : **ISO 2818**:1994 *Plastics—Preparation of test specimens by machining* is identical with the said standard.

JIS K 7151 *Plastics—Compression moulding test specimens of thermoplastic materials*

NOTE : **ISO 293**:1986 *Plastics—Compression moulding test specimens of thermoplastic materials* is identical with the said standard.

JIS K 7152-3 *Plastics—Injection moulding of test specimens of thermoplastic materials—Part 3: Small plates*

NOTE : **ISO 294-3**:1996 *Plastics—Injection moulding of test specimens of thermoplastic materials—Part 3: Small plates* is identical with the said standard.

JIS K 7211-2 *Plastics—Determination of puncture impact behaviour of rigid plastics—Part 2: Instrumented impact testing*

NOTE : **ISO 6603-2**:2000 *Plastics—Determination of puncture impact behaviour of rigid plastics—Part 2: Instrumented impact testing* is identical with the said standard.

ISO 295:1991 *Plastics—Compression moulding of test specimens of thermosetting materials*

ISO 1268:1974 *Plastics—Preparation of glass fibre reinforced, resin bonded, low-pressure laminated plates or panels for test purposes*

3 Terms and definitions For the purposes of this part of **JIS K 7211**, the following terms and definitions apply:

3.1 General

3.1.1 failure any break in the surface of the specimen which is visible to the naked eye

3.2 Failure-criteria terms

3.2.1 crack any fissure that can be observed by the naked eye and that does not penetrate the full thickness of the material (see figure 1)

3.2.2 break any fissure through the full thickness of the material (see figure 2)

3.2.3 penetration failure in which the striker penetrates through the whole thickness of the test specimen [see figure 3 b)]

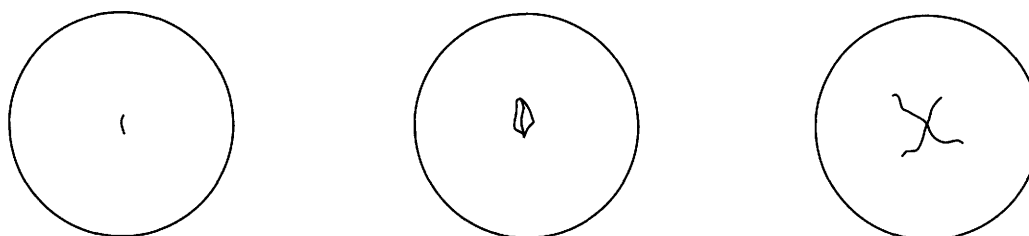
3.2.4 shattering breaking of the test specimen into two or more pieces [see figure 3 a)]

3.3 Impact-failure terms

3.3.1 50 % impact-failure energy E_{50} the energy that will cause 50 % of the test specimens to fail as defined in 3.1.1

3.3.2 50 % impact failure mass M_{50} the mass that will cause 50 % of the test specimens to fail, as defined in 3.1.1, for a given height of fall

3.3.3 50 % impact-failure height H_{50} the height that will cause 50 % of the test specimens to fail, as defined in 3.1.1, using a given falling mass



Views of specimen surfaces damaged by a “crack” (examples)

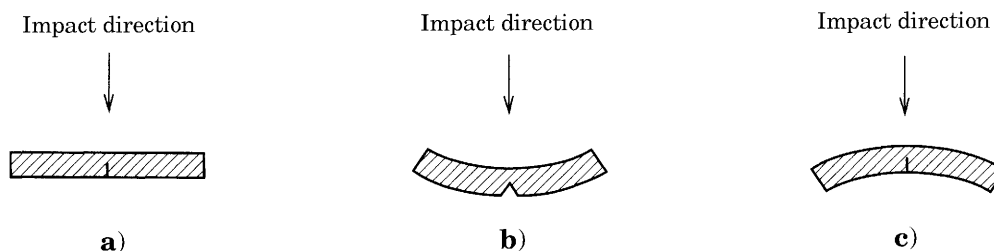


Figure 1 Sections through specimens damaged by a “crack”
[b) and c) after bending by hand]

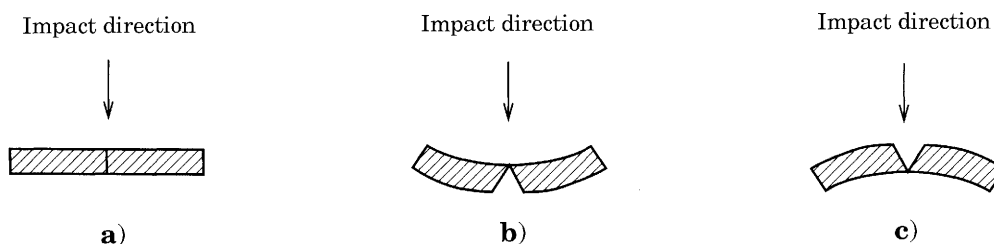


Figure 2 Sections through specimens damaged by a “break”
[b) and c) after bending by hand]

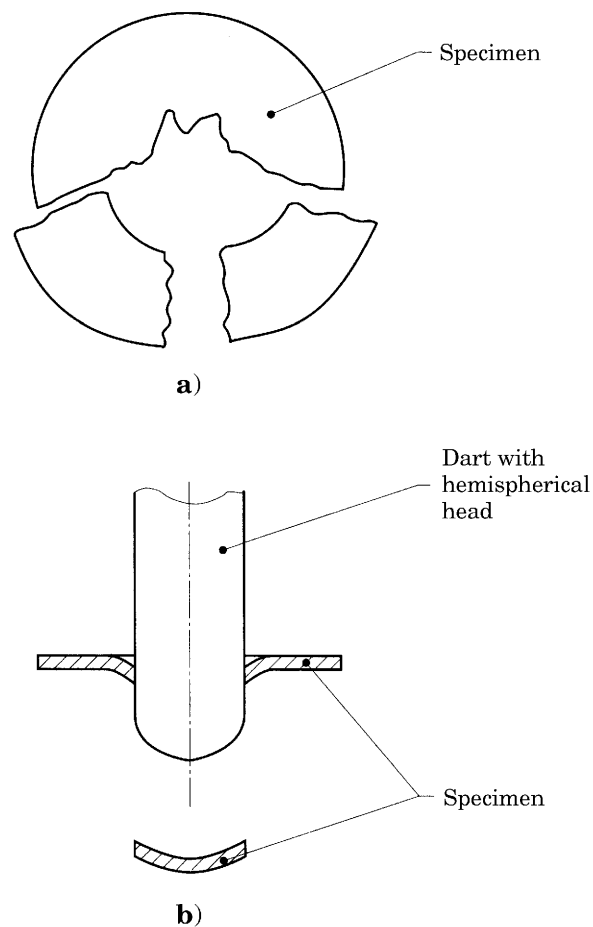


Figure 3 Example of “shattering” failure [a)] and “penetration” [b)]

4 Principle The impact strength of suitably sized test specimens is determined by striking them with a lubricated weighted striker dropped vertically from a known height. The test specimen is impacted as its centre by a striker, perpendicular to the surface of the specimen.

Two methods of adjusting the energy at impact are permitted: altering the mass at constant height and altering the height at constant mass.

NOTE : The variable-height procedure is velocity-dependent, and differing results may be observed depending upon the material’s strain rate.

Two statistical methods of test are given:

- Method A: staircase method (individual) (preferred).
- Method B: group method (optional).

5 Apparatus

5.1 Test device

5.1.1 Essential components The essential components of the test device (see figure 4) are:

- an energy carrier (dart system), of the inertial-mass type, which includes:
weights,
a striker (lubrication is required);

However, when the striker specified in **5.1.4 b)** is used, the weight shall not be applied.

- a specimen support (see figure 4), optionally with a clamping device (figure 5).

The test device shall permit the test specimen to be punctured at its centre, perpendicular to the specimen surface.

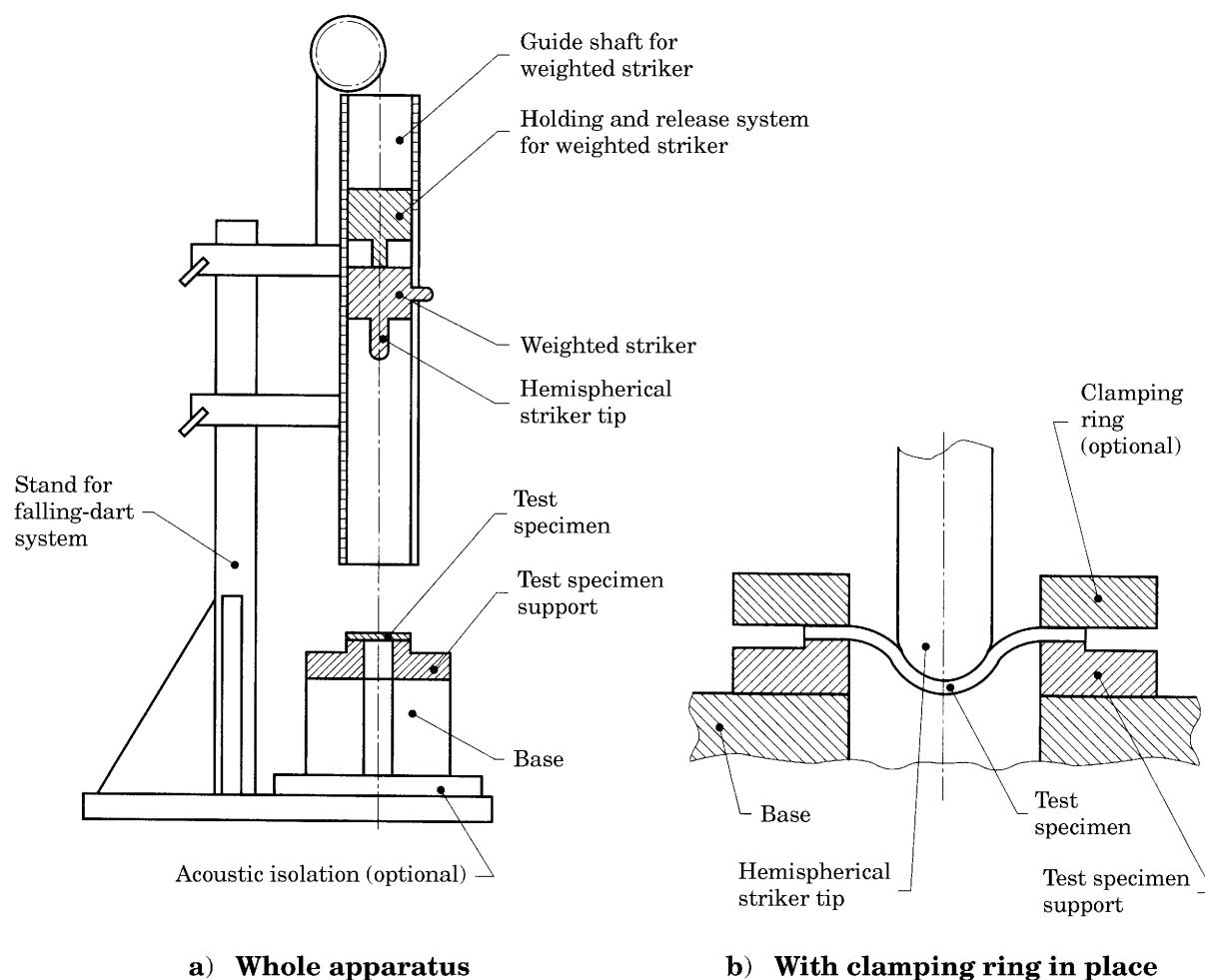


Figure 4 Falling-dart system (example)