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JIS K 7244-2 : 1998
(ISO 6721-2 : 1994)

**Plastics—Determination of
dynamic mechanical properties—
Part 2 : Torsion-pendulum method**

ICS 83.080.01

Descriptors : plastics, mechanical behaviour of materials, strength of materials,
mechanical testing, torsion pendulums, torsion testing

Reference number : JIS K 7244-2 : 1998 (E)

K 7244-2 : 1998 (ISO 6721-2 : 1994)

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:

By this Standard, **JIS K 7213 : 1995** was withdrawn and replaced.

JIS K 7244 consists of the following parts, under the general title *Plastics—Determination of dynamic mechanical properties*:

Part 1 : General principles

Part 2 : Torsion-pendulum method

Part 3 : Flexural vibration—Resonance-curve method

Part 4 : Tensile vibration—Non-resonance method

Part 5 : Flexural vibration—Non-resonance method

Part 6 : Shear vibration—Non-resonance method

Part 7 : Torsional vibration—Non-resonance method

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Plastics—Determination of dynamic mechanical properties— Part 2 : Torsion-pendulum method

Introduction This Japanese Industrial Standard has been prepared based on ISO 6721-2 : 1994, *Plastics—Determination of dynamic mechanical properties—Part 2 : Torsion-pendulum method* without modifying its technical content and structure.

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

1 Scope This part of JIS K 7244 specifies two methods (A and B) for determining the linear dynamic mechanical properties of plastics, i.e. the storage and loss components of the torsional modulus, as a function of temperature, for small deformations within the frequency range from 0.1 Hz to 10 Hz.

The temperature dependence of these properties, measured over a sufficiently broad range of temperatures (for example from $-50\text{ }^{\circ}\text{C}$ to $+150\text{ }^{\circ}\text{C}$ for the majority of commercially available plastics), gives information on the transition regions (for example the glass transition and the melting transition) of the polymer.

It also provides information concerning the onset of plastic flow.

The two methods described are not applicable to non-symmetrical laminates (see ISO 6721-3 : 1994, *Plastics—Determination of dynamic mechanical properties—Part 3 : Flexural vibration—Resonance-curve method*). The methods are not suitable for testing rubbers, for which the user is referred to ISO 4663 : 1986, *Rubber—Determination of dynamic behaviour of vulcanizates at low frequencies—Torsion pendulum method*.

2 Normative reference The following standard contains provisions which, through reference in this text, constitute provisions of this part of JIS K 7244. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of JIS K 7244 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below.

ISO 6721-1 : 1994 *Plastics—Determination of dynamic mechanical properties—Part 1 : General principles*

Informative reference : JIS K 7244-1, *Plastics—Determination of dynamic mechanical properties—Part 1 : General principles* is identical with ISO 6721-1.

3 Definitions See JIS K 7244-1 (ISO 6721-1), clause 3.

4 Principle A test specimen of uniform cross-section is gripped by two clamps, one of them fixed and the other connected to a disc, which acts as an inertial member, by a rod. The end of the specimen connected to the disc is excited, together with the disc, to execute freely decaying torsional oscillations. The oscillation mode is that designated IV in JIS K 7244-1 (ISO 6721-1), Table 2, and the type of modulus is G_{t0} as defined in JIS K 7244-1 (ISO 6721-1), Table 3.

The inertial member is suspended either from the specimen, method A (see Fig. 1), or from a wire, method B (see Fig. 2). In the latter case, the wire is also part of the elastically oscillating system.

During a temperature run, the same inertial member can be used throughout the whole run, which results in a frequency decreasing naturally with increasing temperature, or the inertial member can be replaced at intervals by a member of different moment of inertia in order to keep the frequency approximately constant.

During the test, the frequency and the decaying amplitude are measured. From these quantities, the storage component G'_{t_0} and loss component G''_{t_0} of the torsional complex modulus $G^*_{t_0}$ can be calculated.

5 Test apparatus

5.1 Pendulum Two types of torsion pendulum, method A (Fig. 1) and method B (Fig. 2), are specified for use with this part of JIS K 7244.

(Method A) The inertial member is suspended from the test specimen and the lower end of the specimen is excited.

(Method B) The inertial member is suspended from a wire attached to a counterweight and the upper end of the specimen is excited.

Both types of pendulum consists of an inertial member, two clamps for gripping the specimen (one of which is connected to the inertial member by a rod) and a temperature-controlled chamber enclosing the specimen and the clamps.

For method B, a counterweight and connecting wire are also required.

5.2 Inertial member The moment of inertia I of the inertial member, which may be made of aluminium, for instance, shall be selected as a function of the torsional stiffness of the specimen, so that the temperature-dependent natural frequency of the system lies between approximately 0.1 Hz and 10 Hz.

When testing standard specimens (see 6.1), a moment of inertia I of $3 \times 10^{-5} \text{ kg} \cdot \text{m}^2$ is recommended if the same inertial member is to be used throughout a run.

Remarks 1 For certain materials, e.g. filled polymers, a value of I of about $5 \times 10^{-5} \text{ kg} \cdot \text{m}^2$ may be necessary.

If a constant frequency is desired over a broad temperature range, interchangeable inertial members with different values of I may be used, thereby permitting the moment of inertia to be varied in steps of less than 20 %, i.e. the frequency to be corrected in steps of less than 10 %.

When testing standard specimens (see 6.1) at a frequency of 1 Hz, a maximum moment of inertia of $3 \times 10^{-3} \text{ kg} \cdot \text{m}^2$ is recommended.

5.2.1 Method A (see Fig. 1) The total mass of the inertial member (the lower clamp and the connecting rod) shall be such that the weight W carried by the specimen is not too high [see Annex A (normative) equation (A.2)].

5.2.2 Method B (see Fig. 2) The total mass of the inertial member (the upper clamp and the rod) must be balanced by a suitable counterweight, so that the longitudinal force W acting on the specimen is minimized [see Annex A (normative), equation (A.2)].

The wire supporting these parts is part of the elastically oscillating system.

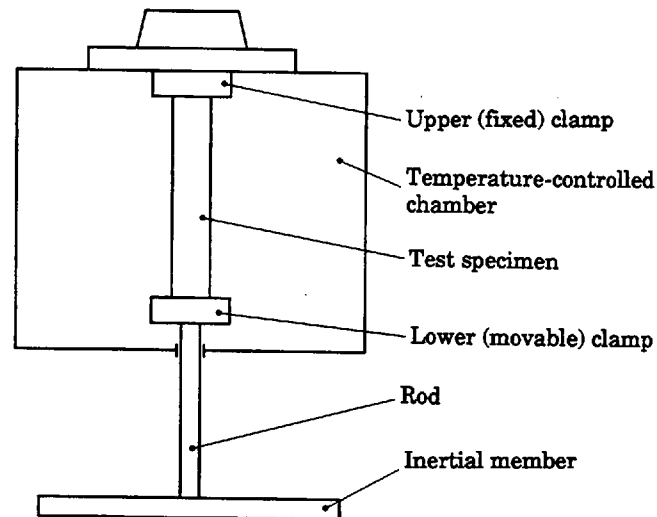


Fig. 1 Apparatus for method A

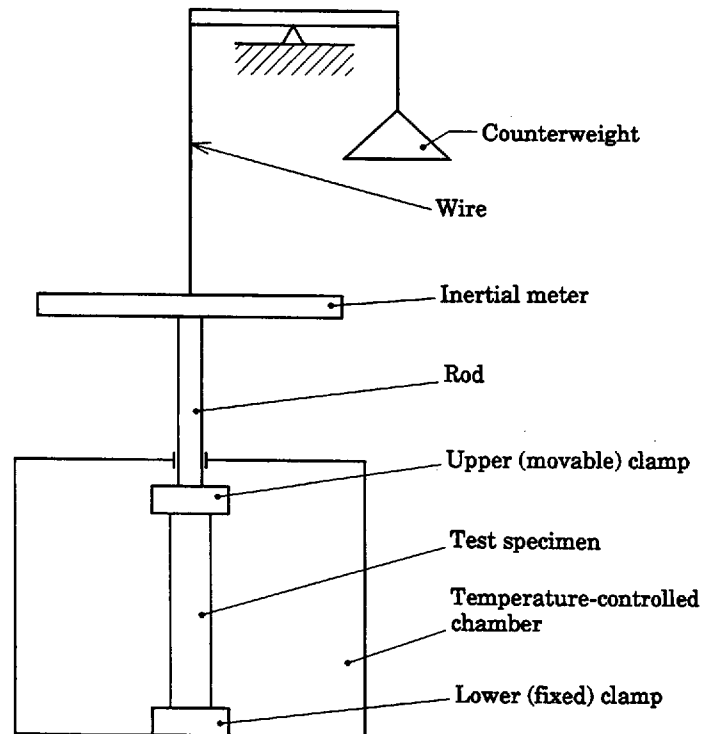


Fig. 2 Apparatus for method B

5.3 Clamps The clamps shall be designed to prevent movement of the portion of the specimens gripped within them. They shall be self-aligning in order to ensure that the specimen axis remains aligned with the axis of rotation and the test specimen remains adequately secured over the whole temperature range without distortion occurring, thus allowing the free length of the specimen to be accurately determined.

The movable clamp shall be of low mass. The moment of inertia of the whole system (consisting of the movable clamp, the inertial member and the connecting rod) shall be determined experimentally. To prevent heat passing from the specimen out of the temperature-controlled chamber and in the opposite direction, the rod connecting the movable clamp and the inertial member shall be thermally non-conducting.