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**Rubber vibration isolators — Testing
methods**

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Rubber Manufacturers Association (JRMA) /Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently, **JIS K 6385:2001** is replaced with this Standard.

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Rubber vibration isolators — Testing methods

Introduction

This Japanese Industrial Standard was established in 1962 and has gone through five revisions up to the present. The previous revision was carried out in 2001; however it is revised this time to respond to the users' demands for practical test conditions so that their testing can be facilitated, being in conformity with the tendency of diversity of testing methods according to further diversification and advancement of rubber vibration isolators.

No corresponding International Standard has been established at this point.

1 Scope

This Standard specifies the testing methods for rubber products and rubber products fitted with brackets (hereafter referred to as "rubber vibration isolators") generally used for the purpose of preventing propagation of vibration/impact, absorbing vibration and softening impact.

WARNING : Persons carrying out tests based on this Standard should be familiar with normal laboratory practice. This Standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this Standard to establish appropriate safety and health practices.

NOTE : This Standard is also applicable to rubber vibration isolators made of cellular rubber, rubber vibration isolators reinforced with fibre, rubber vibration isolators containing fluid by sealing, controllable type rubber vibration isolators, etc.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS K 6200 *Rubber — Vocabulary*

JIS K 6250 *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

JIS K 6253-1 *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 1 : General guidance*

JIS K 6253-2 *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 2 : IRHD method (hardness between 10 IRHD and 100 IRHD)*

JIS K 6253-3 *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 3 : Durometer method*

- JIS K 6253-4 *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 4 : IRHD pocket meter method*
- JIS K 6253-5 *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 5 : Calibration and verification of hardness testers*
- JIS K 6257 *Rubber, vulcanized or thermoplastic — Determination of heat ageing properties*
- JIS K 6258 *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*
- JIS K 6259 *Rubber, vulcanized or thermoplastics — Determination of ozone resistance*
- JIS K 6272 *Rubber — Tensile, flexural and compression test equipment (constant rate of traverse) — Specification*
- JIS K 6394 *Rubber, vulcanized or thermoplastic — Determination of dynamic properties — General guidance*
- JIS K 8150 *Sodium chloride (Reagent)*
- JIS Z 2371 *Methods of salt spray testing*

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in **JIS K 6200** and **JIS K 6394**, and the following terms and definitions apply.

3.1 deflection

displacement generated when a force (load) is applied to a rubber vibration isolator

3.2 static spring constant

spring constant measured under static equilibrium state

3.3 torsion

action to give relative angular displacement on inner tube and outer tube by applying moment around the central axis in rubber vibration isolators such as cylindrical type [see figure 1 b)]

3.4 pinch

action to give relative angular displacement on inner tube and outer tube by applying moment around an arbitrary axis perpendicularly intersecting to central axis in rubber vibration isolators such as cylindrical type [see figure 1 b)]

3.5 dynamic vibration absorber

auxiliary vibration device to reduce the vibration in vibration system

3.6 shock absorber rubber

rubber vibration isolator for softening impact, suppressing excess displacement when a large force is applied and preventing contact of members, damage, generation of ab-

normal sound, etc.

3.7 shock absorption capacity

energy which a rubber vibration isolator absorbs until the motion due to impact stops, and the area enclosed by force (load) — deflection curve and the maximum deflection (see figure 12)

3.8 durability test

test for measuring the number of repetitions or time until a rubber vibration isolator is destroyed or the specified characteristic value is reached by adding repeated stimulus [displacement or force (load)] for the purpose of presuming the life of rubber vibration isolators

3.9 resonance magnification factor

ratio of the forced amplitude ξ and the maximum amplitude $x_{0\max}$ of additional mass m in spring — mass system (see figure 7)

3.10 compliance, H

ratio ($H = X/F$) of the amplitude of displacement X to the amplitude of force F , which is the frequency response function between the displacement and the force when a rubber vibration isolator is vibrated (see figure 9)

3.11 mobility, $H\nu$

ratio ($H\nu = V/F$) of the amplitude of speed V to the amplitude of force F , which is the frequency response function between the speed and the force when a rubber vibration isolator is vibrated

3.12 inertance, Ha

ratio ($Ha = A/F$) of the amplitude of acceleration A of the point to the amplitude of force F , which is the frequency response function between the acceleration and the force when a rubber vibration isolator is vibrated

3.13 set

phenomenon in which a rubber vibration isolator is deformed by applying a force but it does not return to the original shape even by removing the force

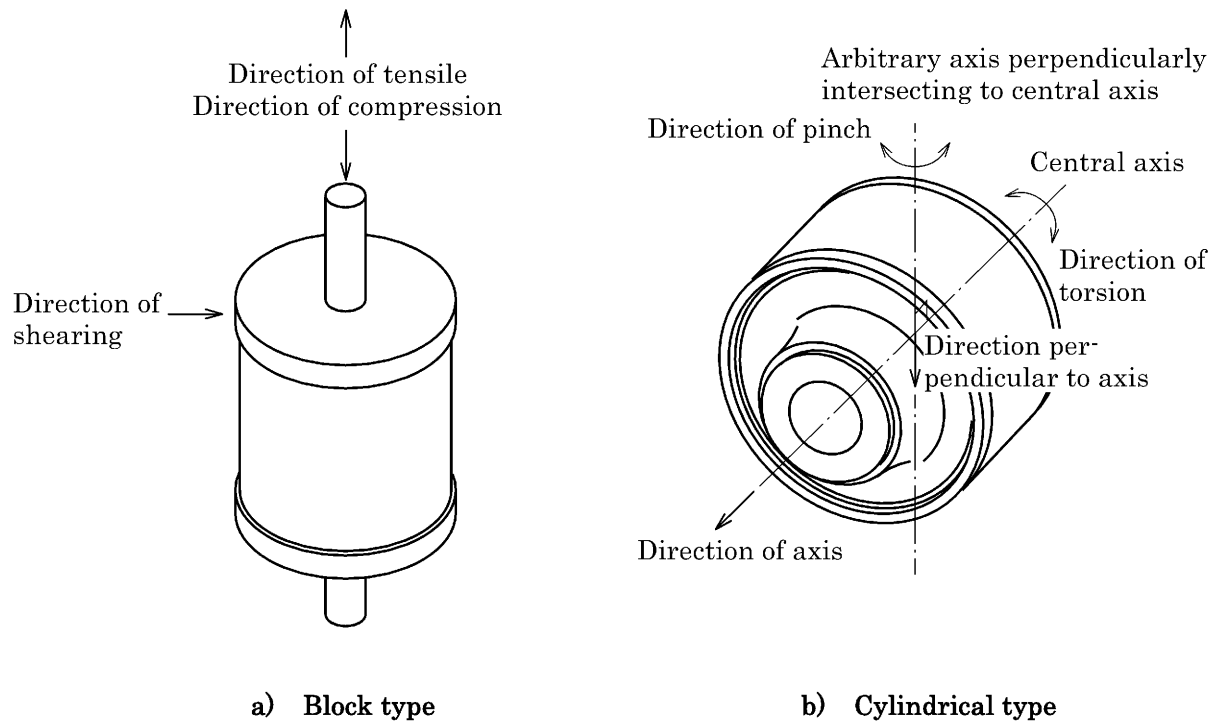


Figure 1 Typical rubber vibration isolators and loading directions thereof

4 Test items

Test items shall be as given in table 1.

Table 1 Test items

Characteristics	Type of test	Applicable clause
Static spring characteristics	Static spring characteristic test	6
Dynamic characteristics	Measuring test of dynamic properties	7.2
	Measuring test of resonance frequency (dynamic vibration absorber)	7.3
	Shock absorbing characteristic test (shock absorber rubber)	7.4
Hardness	Hardness test	8
Strength	Destructive test	9.2
	Non-destructive test	9.3
Thermal ageing resistance property	Thermal ageing test	10
Ozone deterioration resistance property	Static ozone deterioration test	11.2
	Dynamic ozone deterioration test	11.3
Durability	Constant displacement durability test	12.2
	Constant force (constant load) durability test	12.3
	Impact durability test	12.4
	Resonance durability test	12.5
Salt damage resistance property	Salt water immersion test	13.2
	Salt water spray test	13.3
Fluid resistance property	Immersion test	14

5 General conditions for tests

5.1 Standard temperature in laboratory

The standard temperature in laboratory shall be $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ specified in 6.1 of JIS K 6250. However, it shall be $27\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ in the tropical zone or subtropical zone. When for the test condition, the room temperature is designated, the temperature in laboratory shall be $5\text{ }^{\circ}\text{C}$ to $35\text{ }^{\circ}\text{C}$. In this Standard, the humidity is not specified; however, it should be recorded.

5.2 Treatment of sample or test piece after being vulcanized

The definition of sample or test piece shall be according to JIS K 6200; however, the rubber vibration isolator or rubber piece cut from rubber vibration isolator shall be used. For these, when the conditioning time is specified in test item, including the time, the time elapsed shall be 16 h or longer after being vulcanized.

5.3 Number of sample or test piece

The number of sample or test piece shall be one; however, it may be two or more according to the purpose of test.

6 Static spring characteristic test

6.1 General

This test shall be carried out to measure the relation between the force (load) and the deflection of rubber vibration isolators under static condition and calculate static spring constant.

The expression of “force (load)”, “displacement” or “deflection” shall be replaced by “torque”, “torsion angle” or “pinch angle”, respectively as regarding torsion or pinch.

6.2 Testing apparatus

The testing apparatus shall be the tensile test equipment specified in JIS K 6272 and the like whose upper limit of testing force (testing load) falls within the range from 20 % to 100 % of the capacity thereof. The tolerance on the measurement of force (load) of testing apparatus shall be $\pm 1\text{ }%$ of the indicated value in the range from 20 % to 100 % of the capacity thereof.

The tolerance on the measurement of deflection should be $\pm 1\text{ }%$ of the maximum deflection of sample or test piece. When a sample or test piece is attached to a testing apparatus, the rigidity of platform for sample or test piece shall be large enough to measure the static characteristics accurately.

6.3 Conditioning of sample or test piece

The sample or test piece shall be placed under standard condition in a laboratory for at least 3 h before the start of test.

6.4 Test conditions

The test conditions shall be as follows.

The test temperature shall be the standard temperature unless designated between the parties concerned with delivery.

- a) **Range of test force (test load) and deflection** The rough range between upper and lower limits of the force (load) or deflection should be set in the range of 1.2 times to 2 times of the calculation range of static spring constant.

The lower limit value for pulsating shall be zero. When the static spring characteristic test is carried out, it is recommended that force (load) F be plotted on ordinate, deflection x be plotted on abscissa and the relation of $F - x$ be continuously recorded in orthogonal axial system.

- b) **Displacement speed of test** For the displacement speed of loading/unloading of test, the displacement speed of testing apparatus shall be set so that one cycle of loading/unloading takes about 1 min to 2 min, and shall be recorded in test report. An example of test speed shall be as follows.

1, 2, 3, 5, 10, 20, 30, 50, or 100 mm/min

6.5 Testing methods

The testing methods shall be the following three methods.

- a) **One-way method** Before carrying out the measurement, repeat loading/unloading twice to sample or test piece from the force (load) zero to the test force (test load) or the upper limit of test deflection under the same conditions as those at the time of measurement. Immediately after that, carry out the measurement of force (load) — deflection (see figure 2). In this case, the point of the third force (load) zero is to be the point of zero deflection.
- b) **Two-way method** Before carrying out the measurement, repeat loading/unloading twice to sample or test piece from the force (load) zero to the test force (test load) or the upper limit of test deflection under the same conditions as those at the time of measurement. Immediately after that, carry out the measurement of force (load) — deflection [see figure 3 a) and figure 3 b)]. In this case, the point of the third force (load) zero is to be the point of zero deflection.
- c) **Both-way loading method** Before carrying out the measurement, repeat loading/unloading twice to sample or test piece from the force (load) zero to the upper and the lower limits of the test force (load) or the test deflection in the rightward and backward directions respectively under the same conditions as those at the time of measurement. Then, immediately after that, carry out the measurement of force (load) — deflection [see figure 4 a) and figure 4 b)]. In this case, the point of force (load) zero of the first time is to be the point of zero deflection.

6.6 Calculation of static spring constant

The calculation method of static spring constant K shall be as follows.

The calculation range shall be the range of x_1 to x_2 or F_1 to F_2 in figure 2 to figure 4; and x_1 , x_2 , F_1 and F_2 shall be set so that an inflection area is not included in the range (see figure 5).

- a) **One-way method** The static spring constant K by one-way method shall be calculated from two points (F_1, x_1) and (F_2, x_2) recorded on the $F - x$ graph according to the following formula (1) (see figure 2).

$$K = \frac{F_2 - F_1}{x_2 - x_1} \dots\dots\dots (1)$$

where, K : static spring constant (N/mm) or (N·m/rad)
 F : force (load) (N) or torque (N·m)
 x : deflection (mm) or torsion angle/pinch angle (rad)

- b) **Two-way method** The static spring constant K by two-way method shall be calculated according to the following.

- 1) **In the case of designating calculation range by force (load)** Supposing that an average deflection is x_1 at force (load) F_1 and an average deflection is x_2 at the force (load) F_2 , it shall be calculated according to formula (1) [see figure 3 a)].

The average deflection x_1 is the average value of deflections x_{11} and x_{12} of force (load) F_1 at loading/unloading in figure 3 a).

- 2) **In the case of designating calculation range by deflection** Supposing that an average force (average load) is F_1 at deflection x_1 and an average force (average load) is F_2 at deflection x_2 , it shall be calculated according to formula (1) [see figure 3 b)].

The average force (average load) F_1 is the average value of forces (loads) F_{11} and F_{12} of deflection x_1 at loading/unloading in figure 3 b).

- c) **Both-way loading method** The static spring constant K by both-way loading method shall be calculated according to the same method as that in two-way method [see figure 4 a) and b)].

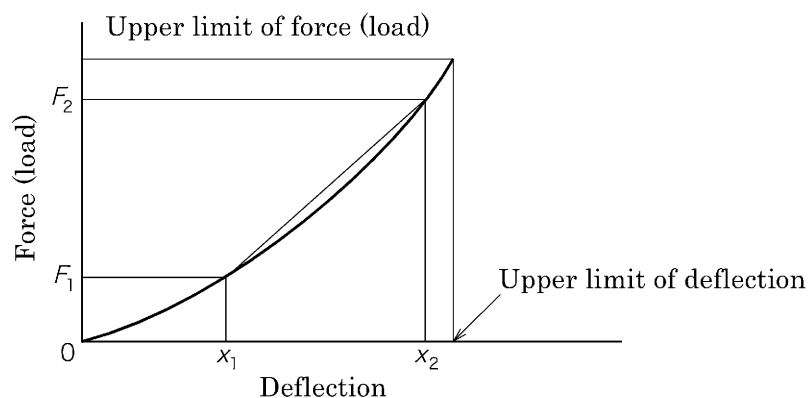
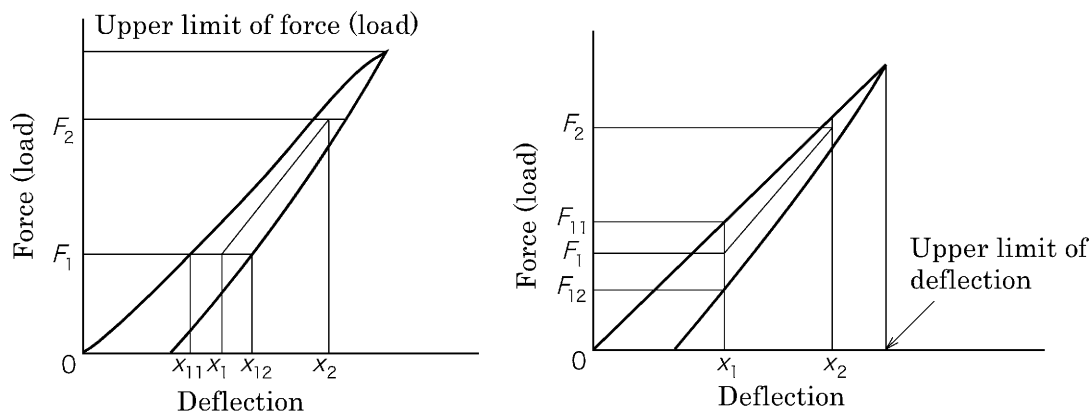
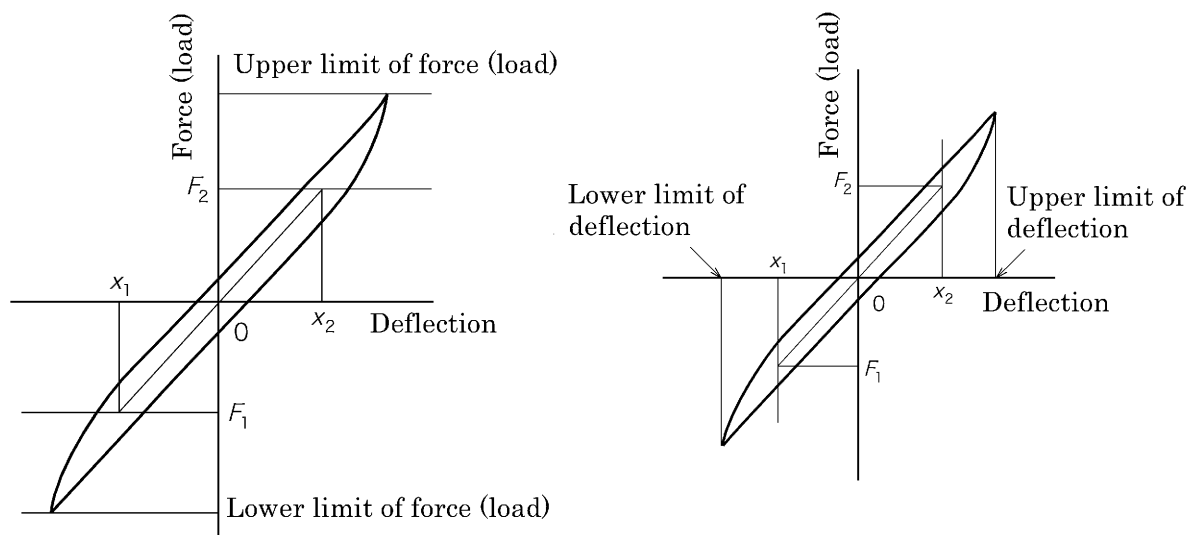


Figure 2 Force (load) — deflection curve by one-way method



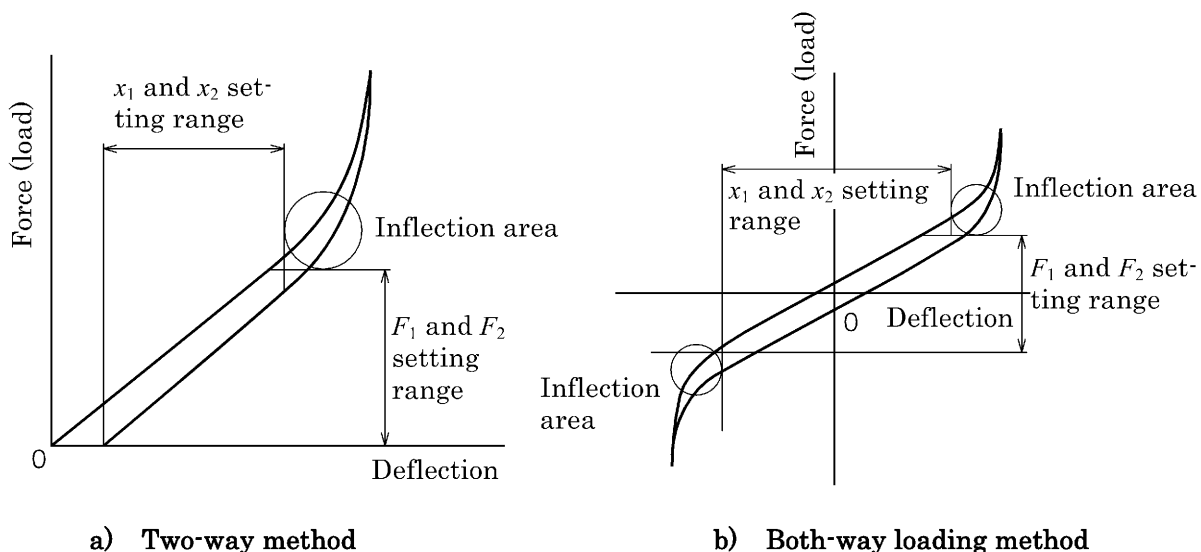
a) In the case of designating by force (load) b) In the case of designating by deflection

Figure 3 Force (load) — deflection curve by two-way method



a) In the case of designating by force (load) b) In the case of designating by deflection

Figure 4 Force (load) — deflection curve by both-way loading method



a) Two-way method

b) Both-way loading method

Figure 5 Setting range of calculation when inflection area exists