

JIS

JAPANESE INDUSTRIAL STANDARD

Methods of Wear Resistance Test for Metallic Coatings

JIS H 8503—1989

Translated and Published

by

Japanese Standards Association

In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

JAPANESE INDUSTRIAL STANDARD

J I S

Methods of Wear Resistance Test for Metallic Coatings H 8503-1989

1. Scope

This Japanese Industrial Standard specifies the methods of wear resistance test for electroplated coatings, hereinafter referred to as the "metallic coatings"⁽¹⁾.

Note ⁽¹⁾ This Standard may be applied to chemical plating (electroless plating).

Remark: The units and numerical values given in { } in this Standard are based on the International System of Units (SI) and are appended for informative reference.

Further, the traditional units and numerical values accompanied by the SI units and converted values in { } shall be replaced by the units and the numerical values given in the Appendix on January 1, 1991.

2. Definitions

For the main terms used in this Standard the definitions in JIS H 0400 apply, and the rest of the terms shall be as follows:

2.1 wear Wear means a phenomenon in which materials are gradually exfoliated starting from the uppermost layers by mechanical action such as friction, polishing, etc.

2.2 friction ring The friction ring means an object of circular ring shape used in combination with the sample to wear out metallic coatings. The friction ring has a variety of one with abrasive paper glued to its circumference and one made of various other materials. It is also called wear ring.

2.3 DS DS herein is the abbreviation for double stroke, hence one reciprocation of friction is termed 1 DS.

2.4 wear mass The wear mass herein means the mass (mg) of sample peeled off in a wear test.

3. Classification of Testing Methods

- (1) Sand-falling wear resistance test
- (2) Jet wear resistance test
- (3) Reciprocating motion wear resistance test

Applicable Standards:

JIS H 0400-Glossary of Terms Used in Electroplating

JIS K 6301-Physical Testing Methods for Vulcanized Rubber

JIS R 6111-Artificial Abrasives

JIS R 6252-Abrasive Papers

- (4) Flat disk revolution wear resistance test (Taber's wear resistance test)
- (5) Double ring driving wear resistance test (Amsler's wear resistance test)

4. Sample

4.1 Sampling The sample shall be taken from the significant surface of product or shall be the product itself. However, when testing the product is difficult to carry out, a substitute test piece may be used. In that case, the test piece shall be one representative of the product, and shall have the same substrate and treating conditions⁽²⁾ of metallic coatings as the product.

4.2 Shape of Sample The shape of sample shall be respectively specified in each clause of testing method.

4.3 Treatment before Test The sample shall be wiped clean with soft cloth impregnated with a solvent⁽³⁾ suited to the kind of stain.

Notes (2) The test piece herein shall be treated with the same bath and under the same condition as the product so that the equal effects of pretreatment and operating condition of metallic coatings may reflect on the test piece.

(3) The solvent herein means acetone, ethyl alcohol, ethyl ether, benzine, etc. and excludes the ones that will corrode the sample or form a protective film.

5. Conditioning of Sample

The conditioning of sample shall be carried out by generally leaving the sample as it is in a room kept at a temperature of $23 \pm 2^{\circ}\text{C}$ and a maximum relative humidity of 65% or in a thermohygrostat after cleaning its surface before the test, unless specially specified.

6. General Conditions of Test

The test shall, as a rule, be carried out in a room kept at a temperature of $23 \pm 2^{\circ}\text{C}$ and a maximum relative humidity of 65 % in the same way as in 5.

The wear resistance testing apparatus shall be correctly horizontally set on a solid laboratory table and stabilized so as not to generate abnormal movement due to vibration and the like accompanying the test.

7. Method for Sand-falling Wear Resistance Test

7.1 Summary This is a test in which abrasives are allowed fall from a specified height on to the surface of metallic coatings using an apparatus shown in Fig. 1 and the wear resistance of metallic coatings is examined.

7.2 Abrasives The abrasives to serve shall be #80 of silicon carbide abrasives C specified in JIS R 6111⁽⁴⁾.

Note (4) Prior to use, the abrasives shall be sufficiently dried by heating (at about 110°C) and kept in a dessicator.

7.3 Test Apparatus The apparatus necessary for this test shall be composed of feed tank, funnel, duct, abrasive receiving case, etc. and shall meet the following conditions:

- (1) **Feed Tank** The feed tank, though its size may be optional, shall be capable of regulating the falling amount of abrasives.
- (2) **Funnel** The funnel shall be made of glass opening angle of 60°, an inner diameter of 70 mm in the head part, length of 50 mm in the leg part and inner diameter of 50 + 0.1 mm, and its lower inside and the inside of its leg shall be finished smooth. The regulation of falling amount of abrasives may be carried out by hanging a regulation bar in the centre of funnel, and by raising and lowering it.
- (3) **Duct** The duct shall be 970 mm in length and 20 mm in inner diameter, and the distance from the dropping hole to the surface of sample shall be adjusted to 1000 mm.

7.4 Sample The sample prepared in accordance with 4. shall be used and its standard dimensions shall be 50 mm x 40 mm.

7.5 Operation

7.5.1 Select the kind of abrasives according to the class of metallic coatings, put it into a feed tank and regulate the falling amount of abrasives by shifting the opening and closing board.

Allow the standard of the falling amount of abrasives per minute to be 320 ± 10 g in the case of #80.

7.5.2 After measuring⁽⁵⁾ the mass of sample with a chemical balance, fix the sample to the sample table so that the surface of the sample is 45° to the vertical direction.

7.5.3 Actuate a stopwatch at the start of the testing and measure the time.

7.5.4 Continue the test until the mass of wear can be clearly measured or its substrate is exposed.

7.5.5 From the sample through with test, obtain the mass of sample in accordance with 7.5.2. Further, in the case of judging the exposure of substrate to be the end point, confirm the exact exposure.

Note (5) The measurement of mass of sample by a chemical balance may be omitted in the case of taking the exposure of substrate as the end point.

7.6 Judging Method

7.6.1 Method of Judging by Variation of Mass The wear resistance shall be calculated from the following formula:

$$WR = \frac{T}{w_1 - w_2}$$

where, WR : wear resistance (s/mg)
 w_1 : mass of sample before test (mg)
 w_2 : mass of sample after test (mg)
 T : test duration (s)

7.6.2 Method of Judging by Taking Exposure of Substrate as End Point
To obtain the wear resistance, whether or not the substrate is exposed within a specified time shall be examined visually⁽⁶⁾.

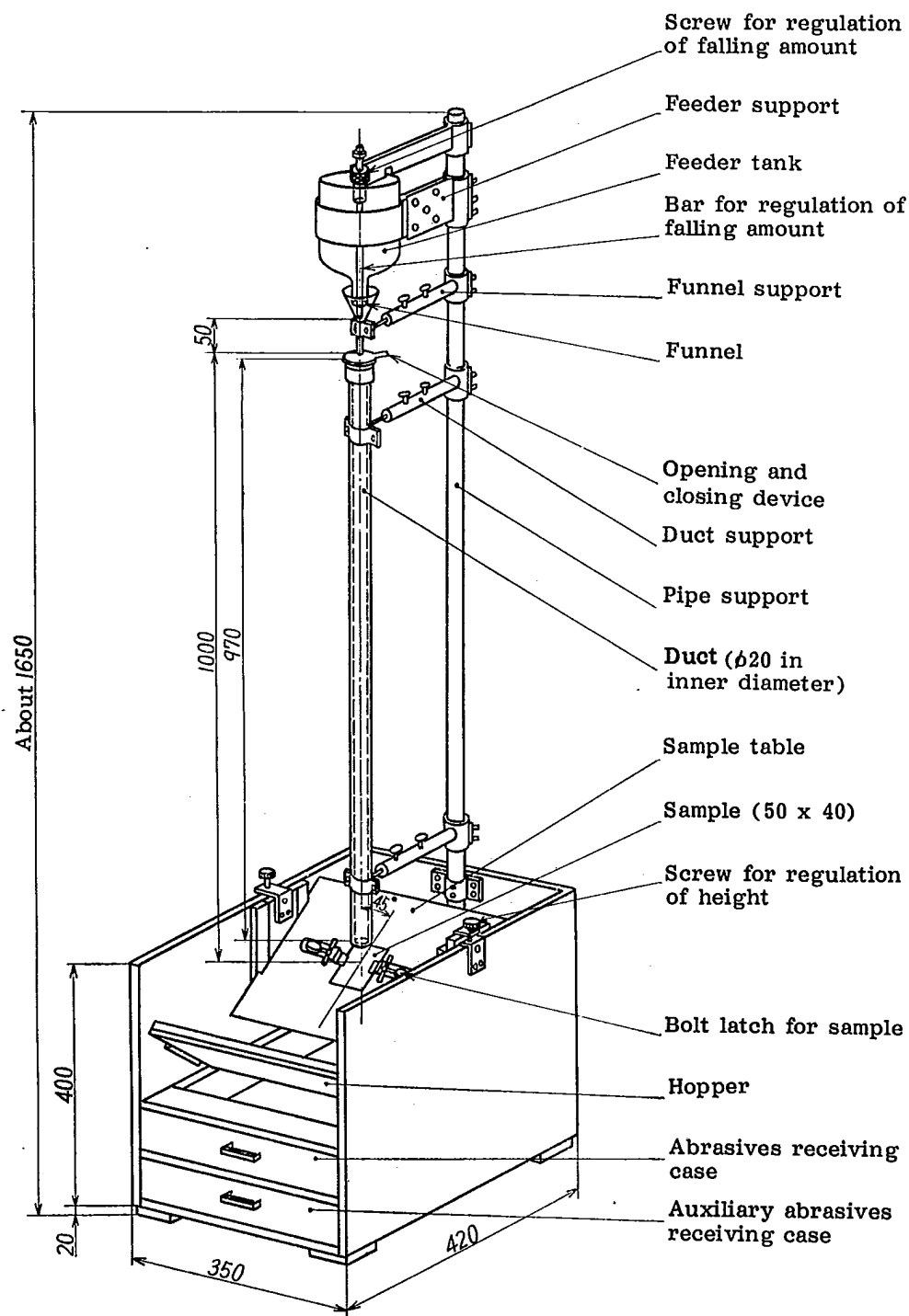
Note (6) When the exposure of substrate is not clear in the substrate of iron and steel, it is recommended that a solution of copper sulfate be dripped onto the portion.

7.7 Record The following items shall be recorded:

- (1) Testing method
- (2) Class of sample
- (3) Conditions for preparation of sample
- (4) Class of abrasives
- (5) Test duration

Fig. 1. Example of Apparatus for Sand-falling
Wear Resistance Test

Unit: mm



8. Method for Jet Wear Resistance Test

8.1 Summary This test is to examine the wear resistance of metallic coatings by a method in which abrasives are injected onto the surface of sample as accelerated by compressed air with an apparatus shown in Fig. 2.

8.2 Abrasives The abrasives to serve shall be #100 of silicon carbide abrasives C specified in JIS R 6111⁽⁷⁾. Further, those once used shall not be reused.

Note (7) Prior to use, the abrasives shall be sufficiently dried by heating (at about 110°C) and kept in a desiccator.

8.3 Test Apparatus The apparatus necessary for this test shall be composed of a hopper for abrasives, a funnel, a sample table, a water column differential pressure gauge, a pressure control valve, an air compressor, etc. and shall meet the conditions given in Table 1.

Further, the natural falling amount (g) of abrasives shall be 23 ± 1 g per minute. Though the regulation of falling amount is carried out with an opening and closing board, it may be carried out by raising and lowering an adjusting bar hung in the center of funnel.

Further, to measure the falling amount, the amount having fallen during 5 to 10 min shall be converted to the amount (g) per minute. An example of the apparatus is given in Fig. 2.

Table 1. Conditions for Test Apparatus
(Applicable till the end of 1990)

Item	Conditions
Air feed	Not less than 1.5 kW air compressor
Pressure control valve	2 kgf/cm ² {0.20 MPa} min.
Pressure gauge	2 kgf/cm ² {0.20 MPa} min.
Pressure rubber tube	8.5 mm min. in inner diameter and 10.5 mm min. in outer diameter
Water column differential pressure gauge	1000 mm H ₂ O {9.8 kPa}

8.4 Sample The sample prepared in accordance with 4. shall be used, and its standard size shall be 50 mm x 40 mm.

8.5 Operation

8.5.1 Put the abrasives into a hopper, open the opening and closing board and regulate the natural falling amount of abrasives to 23 ± 1 g per minute.

8.5.2 Fix the sample to a sample table to form 55 degrees to the vertical line (35 degrees to the surface of water).

8.5.3 Install the sample table so that the test surface of sample is about 10 mm directly below the nozzle.

8.5.4 Switch on the air compressor and regulate the air pressure between 408 and 1000 mm H₂O of water column differential pressure gauge with a pressure control valve according to the classification of metallic coatings.

8.5.5 Open the opening and closing board, inject the abrasives onto the sample and measure the time by actuating a stopwatch at the same time. Suitably regulate the variation of air pressure of injection within the range of ± 5 mm water column with a water column differential pressure gauge.

Further, successively feed the abrasives into the hopper to minimize the variation of amount.

8.5.6 After the test, wipe the surface of sample clean with soft cloth and then judge the wear resistance.

8.6 Judging Method

8.6.1 Method of Judging by Taking Exposure of Substrate as End Point
To obtain the wear resistance, whether or not the substrate is exposed within a specified test time shall be examined visually⁽⁶⁾.

8.6.2 Method of Judgment by Measuring Wear Depth of Test Part
The wear resistance shall be calculated from the following formula by obtaining the maximum value of wear depth made by an injection of a definite time by means of a stylus type surface roughness tester or a split beam microscope⁽⁸⁾, etc.

$$WR = \frac{T}{t}$$

where, WR : wear resistance (s/ μm)

T : test duration (s)

t : maximum value of wear depth (μm)

Note ⁽⁸⁾ When wear marks are small and deep, their measurement tends to be difficult.

8.7 Record The following items shall be recorded:

- (1) Test method
- (2) Class of sample
- (3) Conditions for preparation of sample
- (4) Test duration