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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

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Paints and varnishes -- Bend test (cylindrical mandrel)
(English Translation)

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1 Scope

This standard specifies an empirical test method, for evaluating the resistance of coatings of paints, varnishes or related products to cracking and/or peeling from metal or plastic substrates, when bent about a cylindrical mandrel under standard conditions.

For multi-coat systems, each coating can be tested separately or the entire system can be tested.

The test can be carried out in the following two ways:

- As a "pass/fail" test, i.e., using a mandrel of specified diameter to assess whether the coating complies with specified requirements;
- Test the mandrels in sequence, to determine the maximum mandrel diameter at which the coating will crack and/or peel off the substrate.

This standard specifies two types of instruments, Type I and Type II. Type I is suitable for test panels which have a thickness not greater than 0.3 mm; type II is suitable for test panels which have a thickness not greater than 1.0 mm. Both instruments give similar results for the same coating; however, when testing a given product, it is common to use only one instrument.

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For the dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Standard; however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 3186-2006 Paints, varnishes and raw materials for paints and varnishes -

Sampling (ISO 15528:2000, IDT)

GB/T 9271 Paints and varnishes - Standard panels for testing (GB/T 9271-1988, eqv ISO 1514:1984)

GB 9278 Temperatures and humidities for conditioning and testing of paint specimens (GB 9278-1988, eqv ISO 3270:1984, Paints and varnishes and their raw materials - Temperatures and humidities for conditioning and testing)

GB/T 13452.2 Paints and varnishes - Determination of film thickness (GB/T 13452.2-1992, eqv ISO 2808:1974)

GB/T 20777-2006 Paints and varnishes - Examination and preparation of samples for testing (ISO 1513:1992, IDT)

3 Required supplementary information

For any particular application, the test methods specified in this standard need to be completed with supplementary information. The contents of the supplementary information are listed in Appendix A.

4.1.1 Materials

For the following two types of instruments, the mandrel shall be made of a suitable hard corrosion-resistant material, such as stainless steel.

4.1.2 Type I bending tester

Type I tester is as shown in Figures 1 and 2. This tester can be used for test panels which have a thickness of no more than 0.3 mm. It has a fixed hinge that connects the cylindrical mandrel. The diameters of the mandrels are 2 mm, 3 mm, 4 mm, 5 mm, 6 mm, 8 mm, 10 mm, 12 mm, 16 mm, 20 mm, 25 mm, 32 mm, respectively. The allowable error is ± 0.1 mm. The gap between the mandrel surface and the hinge seat plate shall be (0.55 ± 0.05) mm. There are no strict requirements on other dimensions of the instrument. The mandrel shall

be able to rotate freely around the axis. The instrument shall have a stop bar, to ensure that the two parts of the test panel are parallel after bending.

Note: It is very important to ensure that the mandrel rod does not twist in any way during the bending process, especially for 2 mm mandrels. Any twisted mandrel cannot be used.

If the product under test is applied by brushing, the brush mark shall be parallel to the long side of the test panel.

6.5 Drying and conditioning

Each painted test panel is dried (or baked) under specified conditions and left (if applicable) for a specified period of time. Unless otherwise specified, the test panel shall be conditioned for at least 16 h at a temperature of $(23 \pm 2) ^\circ\text{C}$ and a relative humidity of $(50 \pm 5)\%$ (see GB 9278), before testing.

6.6 Coating thickness

Determine the dry film thickness of the coating, in μm , using one of the methods specified in GB/T 13452.2.

7.1 Test conditions

Unless otherwise specified, the test is carried out under the conditions of temperature $(23 \pm 2) ^\circ\text{C}$ and relative humidity $(50 \pm 5)\%$ (see GB 9278).

7.2.1 General rules

Carry out the test on two test panels according to the steps specified in 7.2.2, 7.2.3 or

7.2.4. Then inspect the test panels according to the method specified in 7.2.5. If the results of the two test panels are inconsistent, take another test panel for testing.

7.2.2 Testing with Type I tester

Open the instrument completely. Install the appropriate mandrel rod. Insert the template, with the painted side facing the seat plate.

Within 1 to 2 seconds, close the instrument at a steady speed rather than suddenly bend the test panel 180° around its axis.

7.2.3 Testing with type II tester

Place the instrument (see Figure 3) stably, for example close to the edge of the test bench, so that it does not move during the test and the operator can freely operate the screw handle. Insert the test panel from above between the curved part and the mandrel rod and between the thrust bearing and the clamping jaw, so that the coating to be tested faces

away from the mandrel rod. Pull the adjusting bolt to move the thrust bearing, so that the test panel is in a vertical position and in contact with the mandrel. The test panel is fixed with the clamping jaws by turning the adjusting bolt. Turn the screw handle to bring the curved part into contact with the coating. The actual bending process is to lift the screw handle at a constant speed and rotate it through 180° within 1 to 2 seconds, so that the test panel is also bent by 180°.

Turn the screw handle to the initial position and take out the test panel. Then loosen the bending part and clamping jaw, using suitable operating parts (screw handle, adjusting screw).

Note: A piece of tissue paper can be inserted between the test panel and the curved part, to prevent the coating from being scratched during the bending process.

7.2.4 Testing at temperatures other than $(23 \pm 2) ^\circ\text{C}$

Correctly insert the test panel into the Type I or Type II tester, so that the painted side faces outward after being bent. Place the tester equipped with the test panel into a test box, that has been pre-adjusted to the specified temperature. After being placed in a test box at a specified temperature for 16 hours, conduct a bending test within 1 to 2 seconds (see 7.2.2 or 7.2.3). Put the tester into the test box and before the test panel bends, the door of the test box must be closed.

7.2.5 Inspection of test panels

Check the coating immediately under sufficient lighting conditions. If it is a Type I tester, the test panel cannot be taken out of the instrument during inspection. Use normal vision or use a 10x magnifying glass upon agreement, to check whether the coating is cracked or peeling off the substrate. Coatings within 10 mm from the edge of the test panel are not considered.

If a magnifying glass is used, this must be noted in the report, to avoid confusion with results obtained with normal vision.

7.3 Procedure for determining the maximum mandrel diameter causing coating damage

Carry out the test on a series of test panels, according to the procedures specified in 7.2.2, 7.2.3 or 7.2.4. Inspect each test panel using the method specified in 7.2.5.

Conduct the test with the mandrel in turn, until the coating cracks or peels off the substrate. Find the mandrel with the largest diameter that causes the coating to crack or peel. Repeat this step with the same mandrel on another panel to be tested. Record the diameter after confirming the result. If the coating does not fail, even with the smallest diameter mandrel, record that the coating does not fail when bent on the smallest diameter mandrel.