INTERNATIONAL STANDARD

ISO 20567-3

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Paints and varnishes — Determination of stone-chip resistance of coatings —

Part 3: Single-impact test with a free-flying impact body

Peintures et vernis — Détermination de la résistance des revêtements aux impacts de cailloux —

Partie 3: Essai de choc simple par corps percutant en vol libre

Reference number
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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 20567-3 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

ISO 20567 consists of the following parts, under the general title *Paints and varnishes — Determination of stone-chip resistance of coatings*:

— *Part 1: Multi-impact testing*

— *Part 2: Single-impact test with a guided impact body*

— *Part 3: Single-impact test with a free-flying impact body*

Introduction

In the automotive industry, multi-layer paint coatings are applied to car bodies for protection. Grit, road-metal and other materials can damage these coatings in such a way that individual layers come off or the whole coating delaminates from the substrate.

Stone chipping can be simulated by means of single- and/or multi-impact tests. Part 1 of this International Standard describes a multi-impact test, Parts 2 and 3 describe a single-impact test.

Paints and varnishes — Determination of stone-chip resistance of coatings —

Part 3:
Single-impact test with a free-flying impact body

1 Scope

This part of ISO 20567 specifies a method for the evaluation of the resistance of automobile finishes and other coatings to the impact of a single, free-flying body projected onto the surface under test to simulate the impact of stones.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1513, *Paints and varnishes — Examination and preparation of test samples*

ISO 1514, *Paints and varnishes — Standard panels for testing*

ISO 2808, *Paints and varnishes — Determination of film thickness*

ISO 3290-1, *Rolling bearings — Balls — Part 1: Steel balls*

ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

EN 485-2, *Aluminium and aluminium alloys — Sheet, strip and plate — Part 2: Mechanical properties*

EN 485-4, *Aluminium and aluminium alloys — Sheet, strip and plate — Part 4: Tolerances on shape and dimensions for cold-rolled products*

EN 573-3, *Aluminium and aluminium alloys — Chemical composition and form of wrought products — Part 3: Chemical composition and form of products*

3 Principle

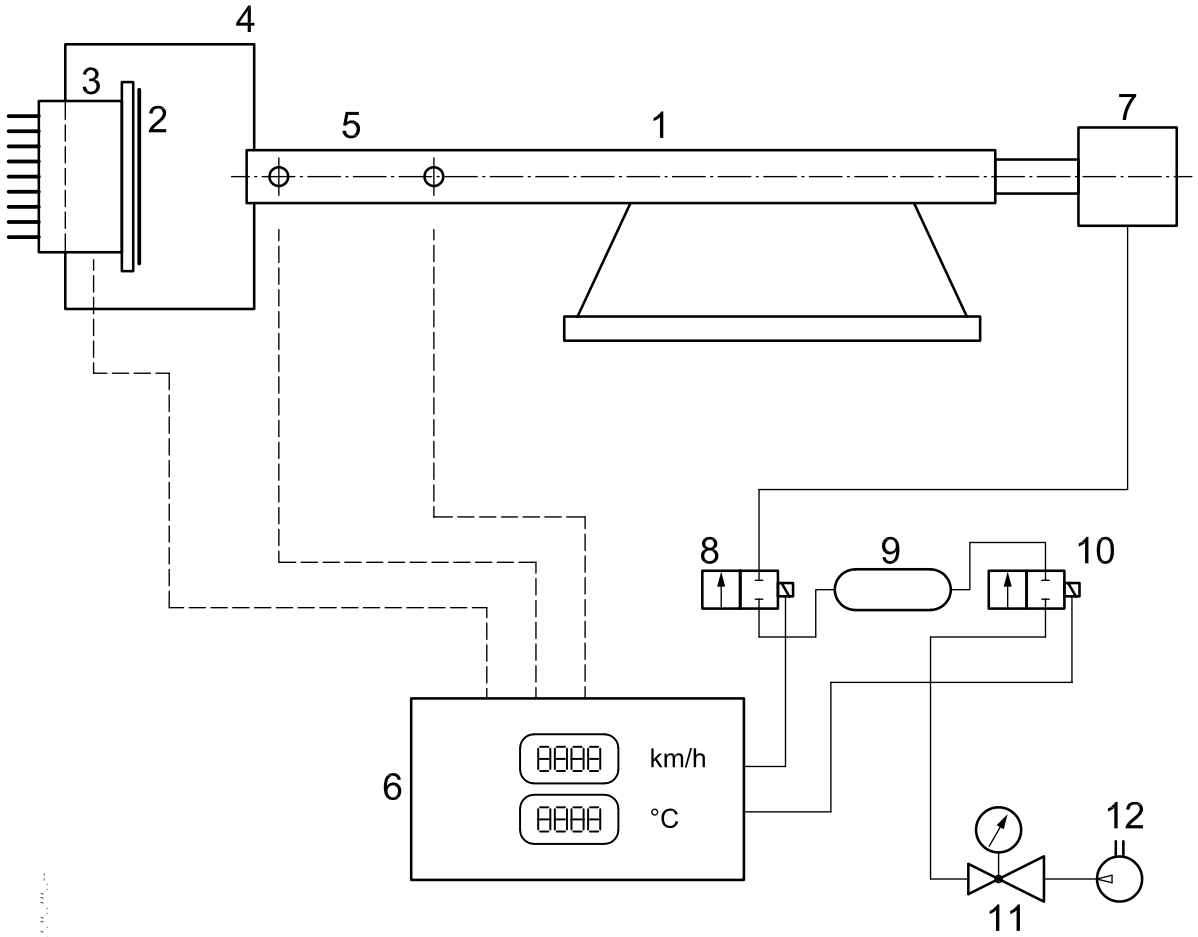
The stone-chip resistance of the coating under test is determined by projecting a single, free-flying body onto it in a test in which those parameters with a significant effect on the damage, i.e. the impact angle, speed, mass and geometry of the impact body, are defined. The temperature can be altered as required.

The test result is expressed in terms of the size of the area that has been damaged, after removal of pieces of the coating which have delaminated from the substrate as a result of the impact, plus, in the case of multi-layer paint systems, details of the damage to each coating layer.

4 Apparatus and materials

4.1 Single-impact tester, as shown in Figure 1.

An impact body is accelerated by compressed air in a defined manner. The speed is determined by measuring the travel time between two light beams and then displayed. The test panel is mounted on a movable holder whose angle can be adjusted and whose temperature can be set in the range from −20 °C to +30 °C.



Key

1 impact-body-accelerating tube
2 test panel
3 test-panel holder
4 protective housing
5 light-beam device for measuring speed of impact body
6 control unit with display for impact-body speed and test-panel temperature
7 access door (for introducing the impact body)
8 start valve
9 pressure chamber
10 charge valve
11 pressure regulator
12 compressed-air supply

Figure 1 — Single-impact tester

4.2 Impact body: hardened-steel ball of 2 mm nominal diameter with a mass of 0,033 g (a ball bearing in accordance with ISO 3290-1). Each steel ball shall be used only once.

4.3 Magnifying glass, with ×5 to ×10 magnification.

5 Calibration

A suitable calibration method for the apparatus is specified in Annex A.

6 Sampling

Take a representative sample of the coating material to be tested, as described in ISO 15528.

Examine and prepare each sample for testing, as described in ISO 1513.

7 Test panels

7.1 Substrate

Use 200 mm × 100 mm steel test panels that are between 0,7 mm and 1,0 mm thick.

7.2 Preparation and coating

Prepare each test panel in accordance with ISO 1514 before coating and drying or stoving. Use the application method and drying or stoving conditions specified by the paint manufacturer.

7.3 Thickness of the coating

Determine the thickness, in micrometres, of the dry coating by one of the procedures specified in ISO 2808.

8 Procedure

8.1 Conditioning of the test panels

Condition the test panels, for at least 16 h at (23 ± 2) °C and (50 ± 5) % relative humidity (see ISO 3270) before carrying out the test.

8.2 Test conditions

The impact body shall be shot at the test panel at a speed of (250 ± 10) km/h [(69,4 ± 2,8) m/s] and at an angle of (2,0 ± 0,5)° to the normal.

The preferred test temperatures are:

a) (23 ± 2) °C;

b) (0 ± 2) °C;

c) (–20 ± 2) °C.

8.3 Number of test runs

Carry out at least five test runs on each of two test panels.

8.4 Preparation for the test

Set the test-panel holder to the required temperature. Set the pressure by means of the pressure regulator so that the speed of the impact body is within the range specified in 8.2, i.e. set it to the value determined during calibration of the apparatus (see Clause A.3).

8.5 Determination

Mount the test panel on the holder, wait until the temperature has stabilized, load the impact body and start the test. In the case of multiple determinations, move the test panel by approximately 10 mm each time. On completion of the test, remove any pieces of the coating which have delaminated from the substrate, e.g. by means of a jet of nitrogen at 40 bar (4 MPa) or adhesive tape[1)], or mechanically under a microscope with a knife or steel needle.

9 Evaluation

Evaluation of the damage may be carried out visually by means of a microscope or magnifying glass (×5 to ×10 magnification) and templates (see Figure 2) or by optical imaging.

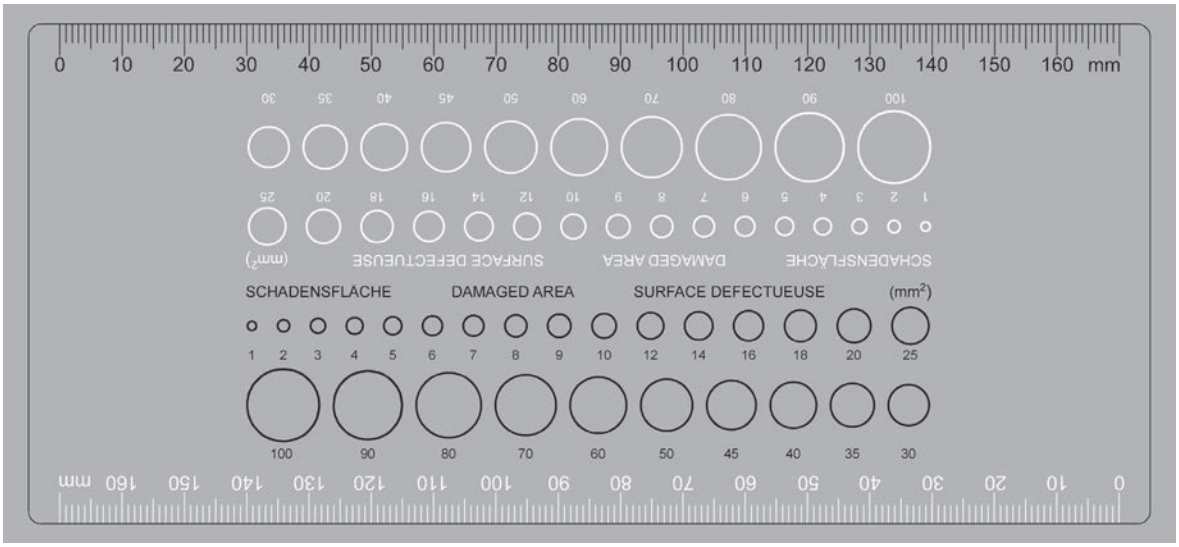


Figure 2 — Template for evaluating the damaged area

The degree of damage is determined by measuring the total surface area (in square millimetres) of the damaged coating including the imprint of the impact body and shall be rounded to the nearest whole number.

In addition to the degree of chipping, the main separation level or the layers of the coating system between which loss of adhesion occurred may be stated.

10 Precision

10.1 General

The precision of this method depends on the specific mechanical properties of the coatings and substrates. Thus low intermediate-coat adhesion with multi-layer systems or a film thickness which varies locally will result in an above-average degree of scatter in the measured damaged areas. The values specified below for the repeatability and reproducibility should therefore be regarded as typical average values.

10.2 Repeatability limit, *r*

The repeatability limit, *r*, is the value below which the absolute difference between two test results (each being the average of two valid determinations) can be expected to lie, with a 95 % probability, when the

1) Adhesive tape with an adhesive strength between 6 N/25 mm width and 10 N/25 mm width (determined in accordance with IEC 60454-2) has proved to be suitable.

method is used under repeatability conditions, i.e. when the test results are obtained on identical test material by the same operator in the same laboratory within a short period of time using the same apparatus.

For this method, *r* is typically 5 % (relative to the average of the two test results).

10.3 Reproducibility limit, *R*

The reproducibility limit, *R*, is the value below which the absolute difference between two test results (each being the average of two valid determinations) can be expected to lie, with a 95 % probability, when the method is used under reproducibility conditions, i.e. when the test results are obtained on identical test material by operators in different laboratories using different apparatus.

For this method, *R* is typically 10 % (relative to the average of the two test results).

11 Test report

The test report shall contain at least the following information:

a) all details necessary for complete identification of the product tested (manufacturer, trade name, batch number, etc.);

b) a reference to this part of ISO 20567 (ISO 20567-3:2012);

c) details of the test panels, including:

   1) details of the substrate (including material and thickness) and its surface preparation,

   2) the method used to apply the product to the substrate, including the drying or curing time and conditions for each layer,

   3) if applicable, the conditions under which the panels were aged,

   4) details of how the test panels were conditioned before the test and, if applicable, details of any tests carried out previously with the same test panels,

   5) the dry-film thickness of the coating, in micrometres, and the method in ISO 2808 used to measure it, plus a note as to whether the tested coating consisted of a single layer or several layers;

d) the test temperature;

e) the method used for removing loose coating;

f) the result of the test, as specified in Clause 9;

g) any deviation from the specified test method;

h) the date of testing.

Annex A
(informative)

Calibration of the apparatus

A.1 Apparatus and materials

A.1.1 Calibration plate: cold-rolled aluminium plate in accordance with EN 485-4, material designation EN AW-5083 in accordance with EN 573-3, temper O/H111 in accordance with EN 485-2, and a thickness of 3 mm.

A.1.2 Measuring microscope, with the following specifications:

— magnification ×50 to ×100;

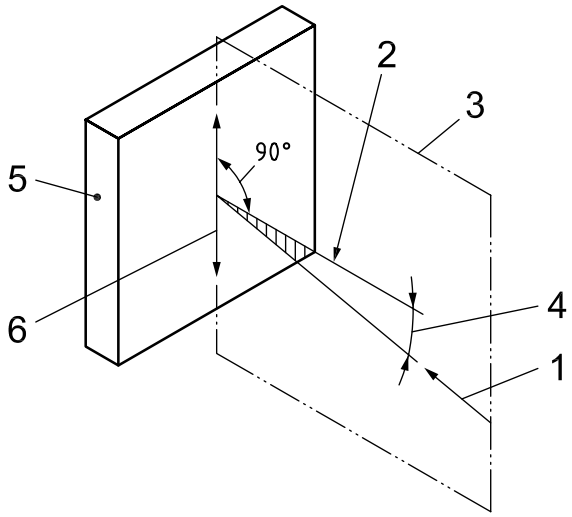
— measuring range at least 1 200 µm;

— resolution 2 µm.

A.2 Calibration procedure

Set the speed to that specified in 8.2. Clamp the calibration plate to the test-panel holder in such a way that the rolling direction lies in the plane including the normal to the surface of the calibration plate and the impact direction (see Figure A.1). Set the temperature of the test-panel holder to 23 °C. Carry out at least five impact tests at points on the calibration plate 10 mm apart. Measure the diameter of the impacts using the microscope (A.1.2) and calculate the arithmetic mean.

The mean value of the impact diameter should not differ by more than 20 µm from the value given on the calibration plate. If the difference is more than 20 µm, determine the calibration value as specified in Clause A.3.



Key

1 impact direction
2 normal to surface
3 plane including normal to surface and impact direction
4 impact angle
5 calibration plate
6 rolling direction

Figure A.1 — Correct orientation of the calibration plate

A.3 Determination of the calibration value

Repeat the calibration specified in Clause A.2, varying the setting of the pressure regulator until the mean value of the impact diameter does not differ by more than 20 µm from the value given on the calibration plate.

NOTE The sensitivity of the calibration is about 0,5 (km/h)/µm. This value can be used for optimizing the setting of the pressure regulator.

The reading on the speed display is the calibration value for the speed. When preparing the apparatus for the test (see 8.4), the apparatus should be set to this speed until the next calibration is carried out.

Bibliography

[1] ISO 3270, *Paints and varnishes and their raw materials — Temperatures and humidities for conditioning and testing*

[2] IEC 60454-2, *Pressure-sensitive adhesive tapes for electrical purposes — Part 2: Methods of test*

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