



Stone Impact Resistance of Coatings

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This standard describes the test procedures to evaluate the stone impact resistance of organic coatings. It is applicable to coated metallic, plastic or composite materials. Method A is a contained method where the gravelometer is contained in a constant temperature freezer and Method B is the transfer method where test panels are transferred from a freezer to the gravelometer at room temperature. Method C is a contained method where the gravelometer is contained in a constant temperature room. If this standard is used on uncoated panels (e.g., molded-in-color (MIC) plastic), alternate evaluation and rating procedures will be required.

Method A: A cold room or freezer of sufficient size in which the gravelometer and the test samples can be maintained at $-18\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.

Method B: A freezer in which the test samples can be cooled to the test temperature of $-18\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. Pre-conditioning that causes frost on the surface of the test specimens must be avoided.

Method C: A room in which the gravelometer and the test samples can be maintained at $+22\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

1.2 Applicability. This standard is typically used, but not limited to, exterior applications on the car body for different organic coated substrates. The standard can also be used for other purposes, e.g., as preload of organic coated metallics in front of corrosion testing such as chassis parts, underhood parts, etc.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

SAE J400

2.2 GM Standards/Specifications.

None

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Gravelometer. A gravel projecting machine constructed according to design specification shown in SAE J400. Similar types of commercial apparatus meeting these specifications can be obtained from different sources, for example: T. J. Bell, 1340 E. Home Avenue, Akron, OH 44310. Q-Panel Col. 800 Canterbury Rd., Cleveland, OH 44145 (North America distributors); Erichsen GmbH & Co. KG, Am Iserbach 14, 58675 Hemer Germany (Europe distributor); Express Trading Estate, Farnsworth, Bolton, BL49TP (England distributor); Q-Panel China, RM1001, Yongding Building, 3388 Gonghexin Road, Zhabei District, Shanghai, 201201 China (China distributor). Contact the Responsible Engineer for guidance.

3.2.2 Gravel-Water-Eroded Alluvial Road Gravel 8 mm to 16 mm in Size. It is important to remove the small pieces before reusing the gravel. Gravel meeting these specifications can be obtained from different sources. Suppliers providing test equipment can typically deliver gravels. Contact the Responsible Engineer for guidance. Additional source in Europe: Q-Lab Deutschland GmbH, In den Hallen 30, 66115 Saarbrücken, Germany.

3.2.3 Tape. The use of a filament strapping tape such as 3M 898 or 3M 8981 is recommended. Other tapes can be used as agreed upon by both the lab and the test requestor.

3.2.4 Freezer.

3.3 Test Vehicle/Test Piece. Not applicable.

3.4 Test Time.

Test time: 1 h (without temperature conditioning)

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Not applicable.

4 Procedure

4.1 Preparation.

4.1.1 Test samples shall be cut from parts that are being evaluated when size and geometry of the part permit. When this is not possible, special test plaques (test panels of 100 mm x 300 mm are most suitable) shall be prepared using the same substrate material, substrate thickness, surface preparation (such as phosphatizing or anodizing), coating material processing that duplicates that used on the part.

For initial sample approval and in arbitration purposes, at least three test pieces shall be tested for each test temperature.

Note: Test samples that are small (not meeting size requirements) or have a complex geometry must have performance requirements defined on the engineering drawing.

4.1.2 When test panels are used to evaluate a new substrate material or coating system, the panel preparation shall be defined by the engineer requesting the evaluation.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 Test Procedure. All test specimens must be positioned at approximately 90 degrees to the trajectory of the stones unless otherwise specified by the responsible engineer.

- Method A: Condition at $-18\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.
- Method B: Condition such that the samples are tested at $-18\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.
- Method C: Condition at $+22\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

Note: Temperatures defined above are at start of gravel exposure. Actual sample temperature will increase during test because of warm air flow. Maximum sample temperature is $-18\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for Method A and Method B, and $+22\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for Method C, unless otherwise specified in the material specification. Adjustment of sample temperatures prior to test initiation for Method B to meet required temperatures during testing must be determined by each test laboratory due to differences in cooling apparatus, test facility environment or layout, and test sample composition or quantity. It is likely that the storage temperature for conditioning test samples prior to test initiation will be lower than the test temperature.

4.3.2 Adjust the air pressure on the gravel apparatus to approximately 480 kPa (70 psi) with the air valve open. Keep the lid to the gravel chamber on the apparatus closed during this operation as a safety precaution.

4.3.3 After adjusting the air pressure, shut off the air valve, open the lid to the gravel chamber, and collect approximately 473 mL (1 pt) of graded gravel in suitable container, unless otherwise specified by the responsible engineer.

4.3.4 Place one test sample at the desired test temperature in the panel holder with the coated side facing the front of the apparatus and close the lid to the gravel chamber.

Note: The actual exposure zone of a 101 mm x 304 mm (4 in x 12 in) is 101 mm x 152 mm (4 in x 6 in).

4.3.5 Gravel Feed. Feed gravel manually or automatically to the air stream within approximately 8 s. Do not turn on air stream prior to gravel feed.

4.3.6 Shut off the air valve, open the lid to the gravel chamber and remove the tested panel. Allow the panel to return to room temperature and remove any condensed moisture, dust and other contaminants by wiping dry with a cloth.

4.3.7 Cover the exposure zone of the test panel with approximately a 100 mm (4 in) wide strip(s) by using a tape as identified in section 3.2.3. Press the tape down firmly by rubbing and then pull off to remove any loose chips or paints.

4.3.8 Identification of Chips to Substrate. In some cases a clear detection of chips that penetrate the paint layers to the substrate can be complicated. The following procedure can be used as an aid to highlight chips to the substrate. This procedure can be used for ferrous materials and their commonly used inorganic coil coatings like electrogalvanized zinc, hot-dip zinc and zinc-magnesium. The procedure cannot be used for aluminum material.

4.3.8.1 Procedure. Highlight chips to substrate on test panels using a Copper Sulfate or Copper Chloride solution. Use a 20% weight/volume solution of CuSO_4 or CuCl_2 in water. Wet the surface of the test panel with the solution. The surface will rapidly turn orange-brown if there is no paint film. If there is paint film, there will be no change in color.

5 Data

5.1 Calculations.

5.1.1 Evaluation and Rating.

5.1.1.1 Unrepresentative Chips. Unrepresentative chip(s) can be eliminated from the evaluation according to the following guidelines. In making this determination, all like test samples (minimum three per test condition per 4.1.1) shall be taken into account.

- No more than one chip per panel can be eliminated from the evaluation.
- No more than two chips per three panel set can be eliminated from the evaluation.

Unrepresentative chips are defined as chips which are different than those typically found on the panels in the panel set, for example, double hits.

5.1.1.2 Test Sample Rating. Samples can be rated using the following procedure. Note that this process does not apply to uncoated panels (e.g., MIC plastic).

5.1.1.2.1 For each layer, as applicable in the coating system, starting with chips to substrate, record point of failure (based on Table 1).

Table 1: Point of Failure Notation

Notation	Layer
S	Substrate
E	ELPO
P/S	Primer Surfacer
B	Basecoat
C	Clearcoat
M	Monocoat