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Superseding J1293 JAN80

Submitted for recognition as an American National Standard

**(R) UNDERVEHICLE COUPON CORROSION TESTS**

**Foreword**—SAE J1293 was prepared as a recommended practice for evaluating the corrosion resistance of steel in an undervehicle deicing salt environment. This procedure recommended locating samples on the rear control arms of passenger vehicles. Due to the increasing use of unitized body designs, alternative sample mounting locations are needed. This revised procedure recommends the use of undervehicle corrosion coupon racks attached to the chassis frame of a straight truck or box truck (without a detachable trailer), which also enables a larger number of samples to be evaluated. This revision is based on techniques reported by Neville and de Souza (see ASM 8512-004).

1. **Scope**—This document is a road test procedure for comparing the corrosion resistance of both coated and uncoated sheet steels in an undervehicle deicing salt environment.

2. **References**

2.1 **Applicable Publications**—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 **ASM PUBLICATION**—Available from ATTN: MSC/Book Order, ASM International, PO Box 473, Novelt, OH 44072-9901.

R. J. Neville and K. M. de Souza, Undervehicle Corrosion Testing of Zinc and Zinc Alloy Coated Steels. American Society for Metals, Technical Paper Series No. 8512-004 (1985).

2.1.2 **SAE PUBLICATION**—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

R. J. Neville, Results of a Test for Undervehicle Corrosion Resistance (SAE Task Force, Iron and Steel Technical Committee, Division 32), SAE Paper 800144 (February 1980).

2.1.3 **ASTM PUBLICATIONS**—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ANSI/ASTM E 643-78—Method of Conducting a Ball Punch Deformation Test for Metallic Sheet Material

ASTM D 1654-74—Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ANSI/ASTM G 1-81—Standard Practice for Preparing, Cleaning and Evaluating Corrosion Test Specimens

ANSI/ASTM A 90-69—Tests for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles

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3. **Background**—A single result from one test material exposed on a given rack should not be compared to a single result from a test material exposed on another rack. A suggestion for an evaluation would be to use a minimum of two vehicles with random placement of the panels on each test rack and then averaging the results. However, the ranking of test materials from rack-to-rack should be similar.

The key features of this test are:

- a. Measurement of steel substrate corrosion rather than coating failure.
- b. Both exposed and crevice test conditions.
- c. Realistic comparison of precoated and postapplied coated material.

The reliability and reproducibility of the test are demonstrated in ASM 8512-004 and SAE Paper 800144.

4. **Method**—The test method described herein should be followed carefully and any deviations reported, as they may influence the results.

4.1 Test Materials

- 4.1.1 New coatings should be evaluated using a standard coated steel for which sufficient data have been previously generated (i.e., hot dip galvanized steel). Low carbon mild steel (uncoated) may be included to indicate the severity of the test environment.

4.2 Test Coupon Preparation

- 4.2.1 Sample thickness is optional but should be similar in a given test where galvanic edge protection is a consideration. Steel coupons, 50 x 125 mm (2 x 5 in), can be sheared directly from prefinished sheet. Postapplied coatings are applied after test coupon assembly (See 4.3).

- 4.2.2 Prepare each test coupon as shown in Figure 1.

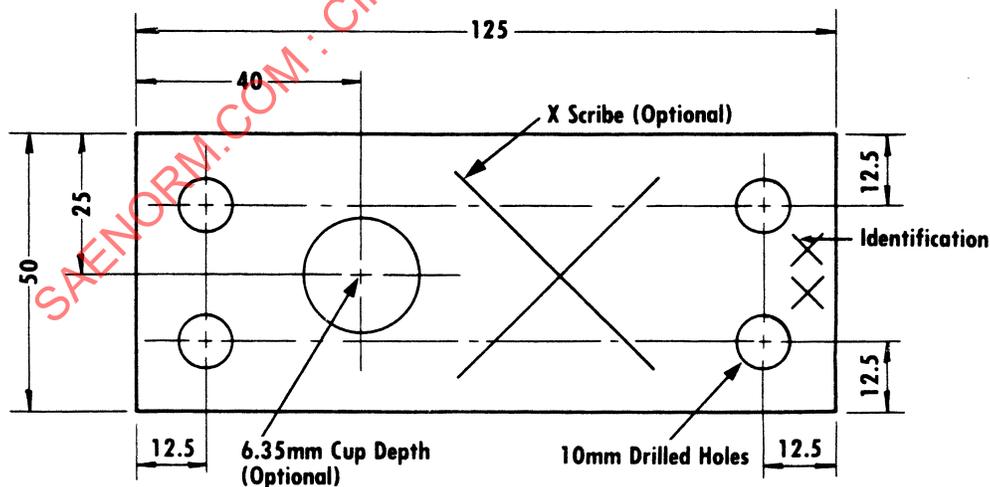


FIGURE 1—TEST COUPON DESIGN

## SAE J1293 Revised JAN90

- 4.2.3 Identify coupons as shown in Figure 1 by XX.
- 4.2.4 (Optional) If sample thickness and mechanical properties are appropriate, a ball punch deformation test (see Reference 3) may be drawn so that the coupons nest properly as follows: ball diameter, 22.2 mm (7/8 in); upper die diameter, 25.4 mm (1.0 in); and depth, 6.35 mm (0.250 in). The cup provides an indication of leading surface abrasion and formability.
- 4.2.5 (Optional) In the case of postapplied coatings, an X may be scribed between the cup and mounting holes on exposed surfaces only and should penetrate to the substrate metal (see ASTM D 1654-74). The X-scribe can provide a measure of the undercutting resistance of the coatings after test exposure.
- 4.2.6 (Optional) Bare steel coupon weights of precoated materials can be estimated by nondestructively measuring coating thickness and subtracting the weight calculated from this thickness (knowing coating density) from the total coupon weight.

Alternatively, a more accurate procedure is to evaluate the coating weight using a weigh-strip-weigh technique of an adjacent (scrap) piece of the precoated steel. This requires weighing of the sample, chemically removing the coating (See 5.4.4 and 5.5.3) and reweighing. The weight of the coating is then subtracted from the total (sample) coupon weight.

The base steel coupon weights of precoated materials should be recorded in milligrams.

- 4.2.7 (Optional) Weigh metallic coated coupons and record total coupon weight in milligrams. These data are required for coating weight loss determination when the steel substrate is not attacked during the exposure interval.

### 4.3 Test Coupon Assembly

- 4.3.1 Assemble the test coupons as shown in Figure 2 (one-sided coated steels) and Figure 3 (two-sided coated steels). To ensure that the perforation of the one-sided coated steels does not progress from the uncoated surface, the uncoated surface should be protected with an air-dry spray lacquer and electroplater's tape.
- 4.3.2 Use 10 mm I.D. x 15 mm O.D. x 0.25 mm thick polyethylene shims. For postapplied coatings, select a temperature resistance material, such as mica, to withstand the high temperature bake.
- 4.3.3 The 6.35 mm (1/4 in) I.D. Neoprene rubber grommets, selected to withstand paint bake temperatures, can be obtained from an electrical supply house. A typical assembly for the rubber grommet is given in Figure 4. The rubber grommets are necessary to isolate the test samples from the metal bolts.
- 4.3.4 Apply postapplied coatings to the coupon assembly after assembling the coupons as shown in Figures 2 or 3. It will be necessary to have longer bolts (secured by a nut) at one end of the assembly to hold the assembly together during postcoating. Another nut and washer would be necessary to secure the assembly to the support rack (Figures 2 and 3).

### 4.4 Test Rack Assembly

- 4.4.1 A typical test rack assembly is shown in Figure 5. This figure displays recommended sample spacing. Coupon assemblies can be cantilevered off of both sides of the support bar to increase the number of available test sites.

### 4.5 Test Rack Mounting

- 4.5.1 Select a vehicle with expected high driving frequency.

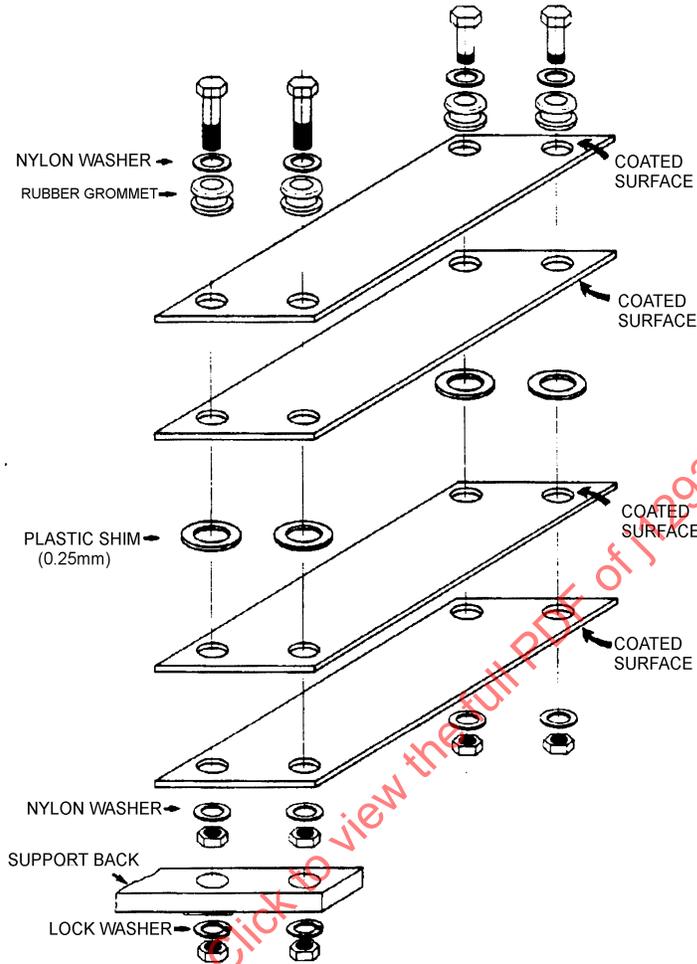


FIGURE 2—ONE-SIDED COATED STEELS COUPON ASSEMBLY

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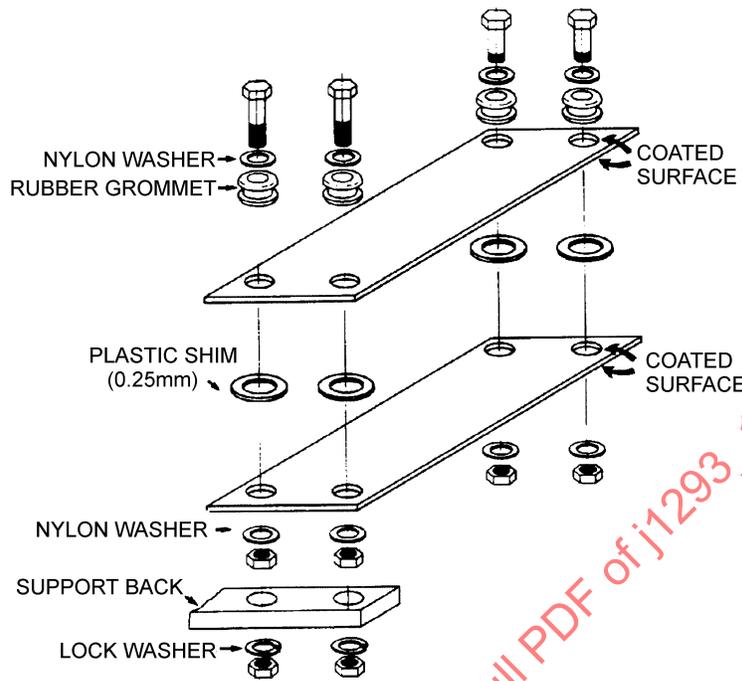


FIGURE 3—TWO-SIDED COATED STEELS COUPON ASSEMBLY

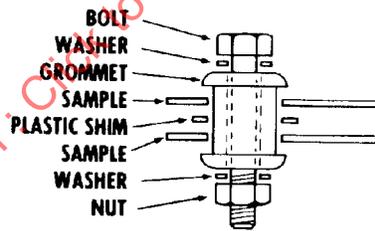


FIGURE 4—TYPICAL RUBBER GROMMET ASSEMBLY

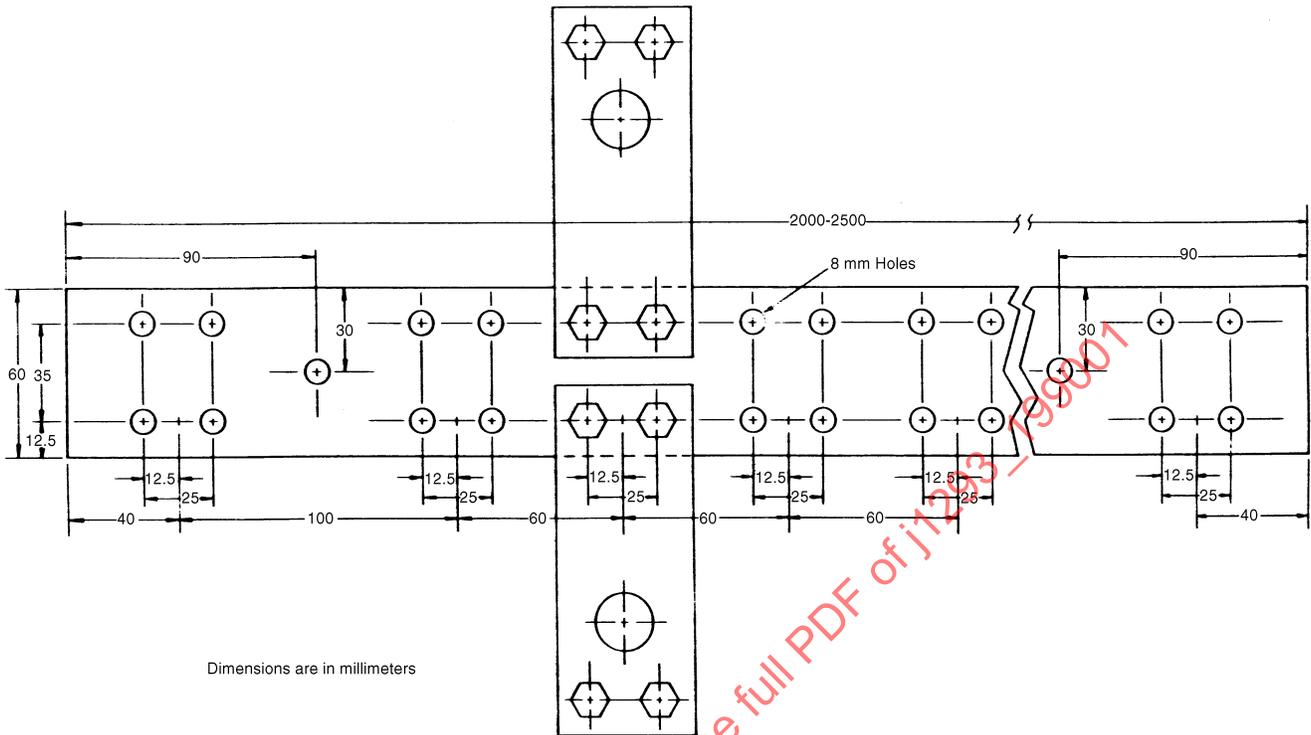


FIGURE 5—TYPICAL TEST RACK ASSEMBLY WITH TWO SAMPLES - TOP VIEW

4.5.2 Mount the test rack on the straight truck chassis frame as shown in Figures 6a and 6b. The test racks should be located such that the coupons are horizontal, and are unlikely to receive mechanical damage. Avoid direct impingement of exhaust gases on the test coupons.

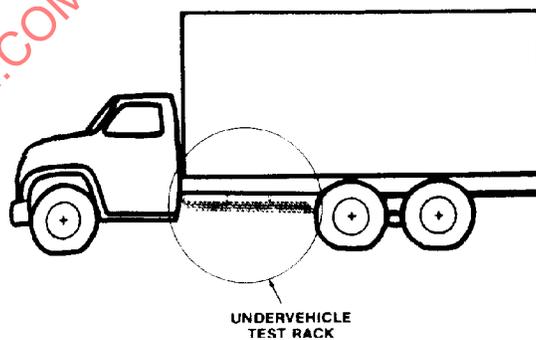


FIGURE 6A—STRAIGHT TRUCK SHOWING UNDER VEHICLE TEST RACK LOCATION

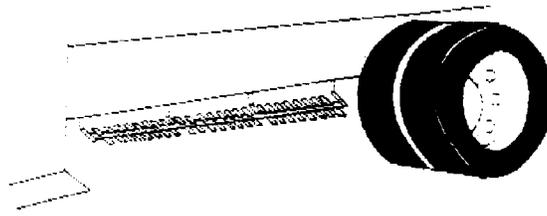


FIGURE 6B—TEST RACK WITH EXPOSED COUPON ASSEMBLIES

4.5.3 Record mounting date and odometer reading.

**4.6 Exposure**

4.6.1 The test program should be initiated at the start of the winter season in the snow belt region. Ideally, the test is initiated in September or October.

4.6.2 Test duration is optional but should be sufficient to allow ranking of material performance. For the newer cathodic electrodeposited primers, the minimum exposure recommended is three winters.

4.6.3 Test results should include a notation of the geographical area where the mileage was accumulated, e.g., city and state or province.

**5. Evaluation**

**5.1 General Inspection Before Disassembly**

5.1.1 Record removal date, calculate total exposure time on vehicle in days, and total distance traveled.

5.1.2 Inspect for mechanical damage or other unusual occurrences, such as foreign matter, and report.

5.1.3 Report rack and sample position relative to the geometry of the truck.

5.1.4 The evaluations that follow apply to each of the four surfaces of each coupon assembly (Figures 7 and 8).

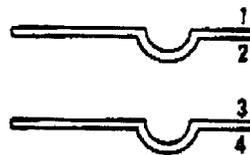


FIGURE 7—SURFACE IDENTIFICATION FOR TWO-SIDED COATING

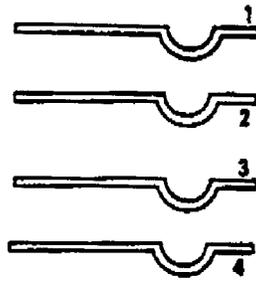


FIGURE 8—ALTERNATE TEST SETUP AND SURFACE IDENTIFICATION FOR ONE-SIDED (DISSIMILAR) COATING

**5.2 Initial Cleaning**—Wash each panel with warm water using a nonmetallic brush, sponge, or cheesecloth, and wipe or blow dry.

### 5.3 Carbon Steel Evaluation

5.3.1 Examine for edge abrasion and note if present. Estimate percent red rust, ignoring the bolted area, and describe tightness and color of scale.

5.3.2 Immerse in Clarke's solution (see ANSI/ASTM G 1-81) until all corrosion products are removed. Wipe or blow dry. Record time required for use in 5.3.6.

5.3.3 (Optional) Reweigh and record weight loss in milligrams and calculate thickness loss in micrometers using a nominal area of 50 x 125 mm (see ANSI/ASTM G 1-81).

5.3.4 Estimate visually or by the use of a low power microscope the percent area of base metal attack as indicated by surface roughening or pitting. Treat the cup the same as the flat surface for a single evaluation on all samples.

5.3.5 Note the occurrence of perforation. If perforated, no further measurements are required. If not perforated, examine for pitting using a microscope at 10X and measure the 10 deepest pits at 200X by focusing at the top and bottom of the pits. Ignore the cup. Report the average depth and range of the 10 deepest pits in micrometers.

If an insufficient number of pits is present (i.e., less than 10), report the average depth and range of the pits present and note with an asterisk the number of pits involved.

5.3.6 (Optional) Reclean sample in Clarke's solution for same length of time as recorded in 5.3.2 for blank weight loss correction.

### 5.4 Metallic Coated Steel Evaluation

5.4.1 Evaluate qualitatively as for carbon steel in 5.3.1.

5.4.2 Immerse in appropriate cleaning solution (see ANSI/ASTM G 1-81) until clean, then wipe or blow-dry. For example, clean galvanized coupons in 15% ammonium hydroxide at room temperature followed by a dip in boiling 5% chromic acid containing silver nitrate until clean.