



Standard Test Method for Chloride Resistance Test for Chromium Electroplated Parts (Russian Mud Test)¹

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1. Scope

1.1 This standard details a laboratory method to accelerate the effects of exposure to hygroscopic corrosive chloride compounds on electroplated chromium components. It is applicable to any substrate and coating system that utilizes electroplated chromium as the final metallic coating.

1.2 Field experience has shown that hygroscopic chlorides are significantly more aggressive than sodium chloride toward chromium electroplated deposits. The most common of which is calcium chloride.

1.3 The standard does not specify exposure periods to be used for a specific product nor the interpretation to be given to the results. The suitability of this test and correlation of results with service experience should be determined before it is specified for coating systems.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

- B117 Practice for Operating Salt Spray (Fog) Apparatus
- B368 Test Method for Copper-Accelerated Acetic Acid-Salt Spray (Fog) Testing (CASS Test)
- D1193 Specification for Reagent Water

¹ This test method is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.10 on Test Methods.

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3. Significance and Use

3.1 This test replicates in the laboratory the corrosive actions of a film containing hygroscopic chlorides and solid material (mud) on electroplated chromium. The test's reactive media, the test slurry, was developed to simulate the film found on electroplated chromium deposits during a winter in Russia, thus the common name for the test, Russian Mud Test.

3.2 This test is used for specification acceptance, simulated service evaluation, manufacturing control, and research and development. It was developed specifically for use on components with electrodeposited chromium coatings exposed to hygroscopic chlorides. Test and production specimens may be used. Use of a standardized test could help in developing improved quality of chromium electrodeposited components and lead to the development of improved electroplated chromium systems.

3.3 This test simulates the amount of electrodeposited decorative and functional chromium deposit lost when exposed to the combination of "mud/solid material" and hygroscopic chlorides, most commonly calcium chloride. The metric is the loss of only the chromium and adjacent nickel layer. Other tests used with nickel/chromium electroplated components, such as CASS (Test Method B368), simulate the resistance of the part to basis metal corrosion involving all of the component's deposits and substrate.

4. Apparatus

4.1 The apparatus required for this test consists of an environment chamber capable of controlling both temperature and humidity within the specified range (see 7.4). The chamber must be large enough to hold the test specimens without touching one another or the walls of the chamber. Also, the reaction products formed on one specimen shall not fall on another specimen. Materials of construction shall not affect the corrosiveness of the test environment, nor be themselves corroded by the test environment. Practice B117 offers a guide for chamber design.

5. Reagents and Materials

5.1 **Table 1** specifies the laboratory grade consumable materials used in this test.

TABLE 1 ACS Reagent-Grade or Equivalent Consumable Materials

Item Name	CAS #	Description/Use
Water (Practice D1193 Type IV)	7732-18-5	Test slurry Electrolyte
Kaolin	1332-58-7	Soil/mud base media
Calcium Chloride Dihydrate	10035-04-8	Corrosive media
Sodium Hydroxide ^A	1310-73-2	Solution pH adjustment
Sulfuric Acid ^A	7664-93-9	Solution pH adjustment
Isopropyl Alcohol	67-63-0	Test sample cleaning

^AFor ease of control, solutions that are approximately 0.25 N are recommended.

6. Test Slurry Formulation

6.1 *Stock Solution*—Using the consumable materials listed in **Table 1**, prepare a stock solution containing dissolved calcium chloride produced by maintaining a ratio of 57.5 g calcium chloride dihydrate for every 94 mL of water and 8 mL of 0.25 N NaOH. The pH of the solution shall be 9.5 ± 0.5 . If not, investigate the possibility of contaminated or low purity consumables.

6.1.1 A different normality of NaOH may be used, however, the total volume of liquid (originally 8 mL of 0.25 N NaOH solution and 94 mL of water) shall be maintained at 102 mL. Adjust the volume of added water to compensate for the difference in the volume of NaOH solution needed. The trial stock solution produced in 6.1 is used to start formulating the composition of the final stock solution. A stock solution pH of 9.5 ± 0.5 is only required when the equivalent of 0.25 N NaOH is used in 6.1. The procedure in 6.2 might establish the requirement of a different concentration of NaOH for the final stock solution and thus a different pH.

6.2 *Test Slurry*—Mix the stock solution with kaolin at a ratio of 3 g kaolin per 5 mL stock solution (6.1).

6.2.1 Measure the pH of the test slurry by diluting a portion of the test slurry (for example, 10 mL) with an equal volume of **Table 1** water. The pH of the diluted test slurry shall be 7.0 ± 0.5 .

NOTE 1—The pH of the diluted test slurry is measured by using a calibrated digital pH meter. A self-flushing probe is recommended due to the high concentration of solids in the sample.

NOTE 2—Diluted test slurry cannot be used on test samples.

6.2.2 If the pH of the diluted test slurry is not 7.0 ± 0.5 , it shall be titrated with standardized solutions of either NaOH or sulfuric acid until the required pH is obtained. Use the titration value to calculate the final amount of NaOH required and prepare another batch of stock solution (6.1) and test slurry (6.2) using the same batches of consumable materials. Repeat 6.1 and 6.2 until the diluted test slurry pH is 7.0 ± 0.5 without further adjustment.

6.2.3 The formulation developed to obtain the required pH of 7.0 ± 0.5 shall be used as long as the same batches of consumable materials are used.

NOTE 3—Field experience has established that Kaolin can differ by batch and supplier. This is the main reason that it is necessary to first establish the required volume of NaOH needed to make the stock solution (6.1) used, in turn, to prepare the test slurry (6.2) with the set of consumable materials being used. Before establishing the required volume of NaOH, it is recommended that all consumable materials listed in **Table**

1 be available for the production of many batches of test slurry.

NOTE 4—The pH of the test slurry is a critical requirement for the Russian Mud Test, not the pH of the stock solution.

6.3 The shelf life of the stock solution (6.1) is 1 month. The shelf life of the test slurry (6.2) is 12 h.

NOTE 5—For convenience, make up enough stock solution to last 1 month and then use it to prepare the test slurry just prior to conducting the Russian Mud test.

7. Procedure

7.1 Clean the test specimen using a clean, non-abrasive cloth soaked with a 50/50 volume mixture of isopropyl alcohol and Type IV water. Ensure that the test piece is fully dried before proceeding.

7.2 Identify the surfaces on the specimens being tested that are to be evaluated during the test. At each designated location, apply approximately 0.6 mL of the slurry in a circular spot using a pipette, eye dropper or similar application method. The solution shall be applied at the center of the circle and allowed to spread out naturally. Do not manually spread the slurry after applying it to the surface. Each application spot should be separated from other spots by at least 1 cm in all directions. If enough room is available at any location, apply up to three duplicate spots to observe possible variability in test results.

7.3 Test pieces shall be placed into the test chamber so that the test slurry is as horizontal as possible, so that the slurry does not run off of the test specimen onto another test specimen and each test piece is completely exposed to the test environment, and the samples do not interfere with each other.

7.4 The test chamber shall be controlled at a temperature of $60 \pm 3^\circ\text{C}$ and $23 \pm 5\%$ relative humidity.

8. Evaluation of Results

8.1 The test duration, minimum number of test spots, inspection frequency, and test results (**Appendix X1**) must be specified and agreed upon by the requestor and laboratory prior to the beginning of the test.

8.2 At each inspection interval, remove test specimens from, or turn off, the test chamber. Remove the agreed upon test spots from each sample by wiping the areas with warm tap water and a clean, non-abrasive cloth. Evaluate each area from which the slurry was removed under 10× magnification. Assign a rating to each spot according to the scale in **Appendix X1**. The acceptance criteria for evaluation shall be specified by the requestor. Continue the test in the controlled chamber until the next inspection interval or until the end of the test.

8.3 The total amount of time per day the environmental chamber is open for the inspections shall not exceed 60 minutes. There shall be only one inspection per day. If operational conditions dictate that these requirements cannot be met, it shall be noted in the laboratory report.

NOTE 6—Maintain a record of the test spots after each inspection by marking the test specimens, photographs, or other suitable method.

9. Records and Report

9.1 The following information shall be included in the test report unless previously agreed upon between the requestor and the laboratory: