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Sample Prep for Corrosion Testing

Dear Advice & Counsel,

In the recent course on salt spray testing, the text indicates that for salt spray testing, parts should be cleaned using a solvent wipe (alcohol or acetone), and hard chromium plated parts should be washed with a magnesium oxide slurry. ASTM B368 calls out for MgO slurry washing only. We have been using MgO. Is there a problem with what we are doing?

Signed,
Inquiring Student

Dear Student:

The quick answer is "no," but that would make for a very short article, so let's discuss sample preparation and exposure.

ASTM B117 has the following language for sample preparation:

"***6. Preparation of Test Specimens***
6.1. Specimens shall be suitably cleaned. The cleaning method shall be optional depending on the nature of the surface and the contaminants. Care shall be taken that specimens are not re-contaminated after cleaning by excessive or careless handling.

6.2. Specimens for evaluation of paints and other organic coatings shall be prepared in accordance with applicable specification(s) for the material(s) being exposed, or as agreed upon between the purchaser and the supplier. Otherwise, the test specimens shall consist of steel meeting the requirements of Practice D 609 and shall be cleaned and prepared for coating in accordance with the applicable procedure of Practice D 609.

6.3. Specimens coated with paints or nonmetallic coatings shall not be cleaned or handled excessively prior to test.

6.4. Whenever it is desired to determine the development of corrosion from an abraded area in the paint or organic coating, a scratch or scribed line shall be made through the coating with a sharp instrument so as to expose the underlying metal before testing. The conditions of making the scratch shall be as defined in Test Method D1654, unless otherwise agreed upon between the purchaser and the seller.

6.5. Unless otherwise specified, the cut edges of plated, coated or duplex materials and areas containing identification marks or in contact with the racks or supports shall be protected with a suitable coating stable under the conditions of the practice.

NOTE 1—Should it be desirable to cut test specimens from parts or from preplated, painted, or otherwise coated steel sheet, the cut edges shall be protected by coating them with paint, wax, tape or other effective media so that the development of a galvanic effect between such edges and the adjacent plated or otherwise coated metal surfaces, is prevented."

Based on the above, your cleaning of decorative chromium plated parts with magnesium oxide meets the "suitably cleaned" language. However, if you are testing decorative chromium plated parts using a salt spray chamber, then I would assume that the nature of the plating is such that it has a low chromium plating thickness. While magnesium oxide is very low in abrasion, I would recommend using a less abrasive method of cleaning such as the solvent wipe recommended in the class text.

For hard chromium plating, the magnesium oxide scrub is recommended as the scrub will have no impact on the surface condition of the plated part. The scrub does tend to remove any impregnated oil, wax and possibly some impregnated resin. If the plater has used this type of surface impregnation, it is critical that such information be supplied to the testing laboratory. Assuming such impregnation is allowed by the customer's specification for hard chromium, I would recommend avoiding the magnesium oxide scrub. Communication between the person conducting the salt spray test and the customer is essential to make sure that the cleaning is done properly.

Now let's take a look at the CASS test specimen preparation language. ASTM B368 states:

"*8.1. Preparation of Test Specimens - Clean metallic and metallic coated specimens. Unless otherwise agreed upon, clean decorative copper/nickel/chromium or nickel/chromium coatings immediately before testing by wiping significant surfaces with a cotton pad saturated with a slurry containing 10 g of pure magnesium oxide powder (ACS reagent grade) in 100 mL of distilled water. Upon rinsing in warm running water, be sure that the clean surface is free of water break.*"

You are definitely in compliance with ASTM B368, assuming you are scrubbing the parts to a water break free state. For other types of coatings, the CASS specification reads:

"*Anodized aluminum parts may be cleaned with inhibited 1,1,1-trichloroethane or other suitable organic solvent (see Warning).*

*Do not clean organic and other nonmetallic coated specimens. Other methods of cleaning, such as the use of a nitric-acid solution for the chemical cleaning or passivation of stainless steel specimens, are permissible when agreed upon between the purchaser and the supplier. Take care that the specimens after cleaning are not recontaminated by excessive or careless handling. Protect the cut edges of plated, coated or multilayered materials and areas containing identification marks or in contact with the racks or supports with a coating that is stable under the conditions of the test, such as wax, stop-off lacquer or pressure-sensitive tape. (**Warning** - 1,1,1-trichloroethane should be used in a well-ventilated area away from open flames.)*"

While the text of the CASS specification indicates that wax is a suitable maskant for cut edges, past experience with this test in our laboratory and at GM's laboratory has found wax unsuitable, as it tends to decompose and leave residuals beyond the original border. A thick layer of high quality stop-off lacquer is far more suitable.

Exposure of test specimen

Practices that contribute to reproducible salt spray results include the following:

Salt Spray Test

ASTM B117 has the following exposure guidelnies for the salt spray test:

"*7.1.1. Unless otherwise specified, the specimens shall be supported or suspended between 15 and 30° from the vertical and preferably parallel to the principal direction of flow of fog through the chamber, based upon the dominant surface being tested.*

7.1.2. The specimens shall not contact each other or any metallic material or any material capable of acting as a wick.

7.1.3. Each specimen shall be placed to permit unencumbered exposure to the fog.

7.1.4. Salt solution from one specimen shall not drip on any other specimen."

To the above, I would add the following additional guidance:

- Expose test panels that have drilled holes so that the holes are at the bottom (prevents runs of corrosion residuals over the test surface).
- Expose test panels parallel to the fog flow pattern. This allows free fog flow between panels in accordance with paragraph 7.1.3.
- Support the test specimen from the bottom whenever possible. Use plastic hooks or plastic coated string only when necessary.
- Do not allow test specimens to touch each other.
- Do not permit spray to impinge directly on the test specimen.

CASS Test

ASTM B368 indicates:

" *8.2.1 Support or suspend the specimens 15 ± 2° from the vertical and preferably parallel to the principal direction of horizontal flow of fog through the chamber, based upon the dominant surface being tested. Support or suspend automobile parts, however, so as to expose all significant surfaces at the general level of the condensate collectors. If the position on the automobile is vertical, place the part in an incline position 15° from vertical to allow surface wetting by the condensate. If the position on the automobile is facing down, rotate the part approximately 180° to test the significant surface. If there are several significant surfaces at different angles, expose each surface of one or more specimens.*

8.2.2. Make sure the specimens do not come in contact with each other or any other metallic material or any material capable of acting as a wick.

8.2.3. Place each specimen so as to permit free settling of fog on all specimens.

8.2.4. Make sure the salt solution from one specimen does not drip on any other specimen.

8.2.5. Place the specimens in the chamber just prior to bringing the test chamber to the required temperature.

Note that the CASS specification is much stricter on exposure angle. Unless you are unusually talented and have the eyes of an eagle, the 15 ± 2° requirement can only be met through the use of a protractor. ***P&SF***

Finisher's Think Tank

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Electrocleaning operating parameters

Basis Metal	NaOH (oz/gal)	A/ft^2 (anodic)	Temp. (°F)	Time (min)
Steel	4-8	50-120	140-195	1-5
Stainless steel	5-9	40-80	140-195	1-5
Brass	1-1.5	10-30	130-160	1-3
Copper	4-8	40-60	140-195	1-5
Zinc	1-1.5	15-35	130-160	1-3
White metal	0.75-1.0	10-20	120-140	1-3

The anodic current densities are given for rack processes. In barrel treatments the anodic current densities would be much less, of a range of 10 to 20% of the values given in the table. NaOH denotes sodium hydroxide. The other source of caustic, potassium hydroxide, can also be used.

Typical electrocleaning problems

• *Etching of steel with brown filming*. The electrocleaner concentration may be low, or a formulation modification to a higher caustic level is required. The etch appearance would resemble burning, due to lack of conductivity and the brown film is iron hydroxide not dissolved due to low reserve alkalinity.

• *Corrosive pitting*. This usually occurs if an acid pickle containing hydrochloric acid is dragged in, such as the second electrocleaner in a double cleaning cycle. Chloride is oxidized to chlorine gas on the parts forming the corrosive pits. Change to a non-chloride containing acid or use an electrocleaner with a specialized inhibitor to address the problem.

• *Plated deposits blister*. There could be several factors. But if the electrocleaner is considered, hexavalent chromium could be the culprit. The basis metal surface is passivated by the chromium contaminant. Add a hexavalent chromium reducing agent or switch to a formulated electrocleaner that contains this additive. If the electrocleaner solution turns yellow accompanied by lack of foaming, it is usually a positive sign of hexavalent chromium contamination.

• *Dezincification of brass*. Electrocleaner buffering is out of balance or one is using the wrong electrocleaner formulation for the in tank requirement.

• *White pits and corrosion of zinc*. The electrocleaner concentration is out of balance or one is using wrong formulation. Use a formulation with correct caustic to inhibitor balance. ***P&SF***