

**TESTING THE RESISTANCE OF 6000 SERIES ALUMINUM BOLTS TO INTERGRANULAR CORROSION****Application**

This procedure is designed to evaluate the susceptibility for corrosion initiation in areas near grain boundaries. Test bolt must be representative of the forming operation, heat treatment, installation torque, and degree of elastic or plastic deformation. The process is applicable to 6000 series aluminum as rolled, forged, and extruded bolts. If the bolt is coated it must be threaded into a substrate to the proper torque and then uninstalled for testing. The production representative bolt (unassembled) is immersed in an acid salt bath for two hours. Parts are then cross-sectioned and intergranular corrosion (IGC) is evaluated microscopically.

Apparatus and Materials Required

Reverse Osmosis or Deionized Water

Salt (NaCl) Food Grade, Non-Iodized

Concentrated Hydrochloric Acid (HCl, 37%)

Volumetric Flasks

400 ml Beaker

Band Saw or Cut-Off Wheel (Water Cooled)

Metallographic Epoxy Resin

Metallographic Polishing Supplies

Keller's Reagent

Optical Microscope

Balance/Scale

Chemicals, materials, parts, and equipment referenced in this document must be used and handled properly. Each party is responsible for determining proper use and handling in its facilities.

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Procedure

Number of samples

- Non-coated bolts:
 - a. Two bolts sectioned longitudinally after acid immersion (for determination of IGC).
 - b. If grain size determination is required, sectioned one longitudinally and one transversely through the threads in the as-received condition.
 - Coated bolts, including anodized:
 - a. Two bolts sectioned longitudinally after acid immersion (for determination of IGC).
 - b. Two bolts after installation/removal and acid immersion sectioned longitudinally (for determination of IGC).
 - c. as-received longitudinal (to evaluate coating for cracks)
 - d. If grain size determination is required, sectioned one transversely through the threads in the as-received condition.
1. Prepare the 1000 ml test solution by adding 933 ml of water to a volumetric flask. Add 67 ml of HCl to the water. Gently swirl the flask or use a stir bar to mix the solution. Use an ice bath if necessary to handle the exothermic reaction. Mix solution thoroughly.
 2. Add 25 g of NaCl to the solution and mix thoroughly.
 3. If the bolt has a barrier type surface coating, tighten the bolt to the high end of the torque range in a production representative joint to simulate installation. Remove and continue to step 4.
 4. Place the bolts at the bottom of a beaker, so they do not touch each other. Multiple bolts can be immersed at the same time.
 5. Pour test solution into the beaker fully covering the bolts. Use a glass stir bar to realign the bolts if necessary. The test solution is used only once.
 6. Expose the bolts for a minimum of 2 hours (+ 0.5 h) at room temperature.
 7. Remove the bolts from the test solution and immediately rinse under cool running tap water. Mechanical aids such as brushes must not be used during rinsing.
 8. For the longitudinal samples, cut the bolt in half length-wise using a band saw or water cooled abrasive saw. Other methods can be used as long as they don't introduce heat into the samples.
 9. For transverse samples, cut the bolt in half in the threaded region.
 10. Prepare metallographic mounts for each sample. For the longitudinal samples, use one mount to evaluate the full length of the bolt when possible. If the bolt is too long for a single mount, use multiple mounts to include the full length, noting the orientation of the threads with respect to the head of the bolt.
 11. Polish per ASTM E3. Use Keller's Reagent per ASTM E407 to reveal the grain structure.
 12. Evaluate the metallographic mounts microscopically
 13. Evaluate the four areas shown in Figure 1, including all of the threads. Include photomicrographs at 10x and 75x magnification in the report for the four areas. The orientation of the sample relative to the head of the bolt and magnification scale bar must be clear in the images (pressure flank of the threads is toward the head of the bolt).