



IMMERSION TESTING TO SIMULATE INTERNAL CONDENSATE EXPOSURE AND THE EFFECT ON ALUMINUM CORROSION

Application

This method is used to test aluminum alloys that will be exposed to exhaust gas recovery condensate by cyclic immersion of aluminum samples in a solution that simulates condensate found in exhaust gas recovery applications.

Equipment Required

1. Oven: capable of 60 °C +/- 5 °C, holding aluminum samples in solution and vented to the outside or refluxing equipment. Includes thermometers
2. De-ionized or distilled water
3. Chemicals per condensate recipe (see appendix)
4. Glass graduated cylinder
5. Clear glass or plastic wide-mouth sample bottles 500mL to 1L, with lids
6. Glass stirring rods
7. Laboratory tongs
8. Hot glue or other material to mask off areas not to be tested
9. pH meter
10. Full face shield, gloves, and other safety equipment
11. Test samples of aluminum Charge Air Cooler (CAC) materials – brazed samples of tube and internal turbulator are preferred.
 - Samples to include the current CAC material combination and proposed material combinations (to achieve A to B evaluation)
 - For each material combination, there should be 5 samples
 - Each sample should be small enough to fit into the sample bottles 500mL to 1L and have a ratio of solution to exposed metal surface as close to 6 mL/cm² as possible (note: only internal surfaces are exposed to the solution)

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Documents

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Sample Preparation

1. Mask off external surfaces of the test samples with hot glue and leave internal surfaces exposed
2. Prepare samples of condensate per the condensate recipe (see appendix). Make as much condensate as needed such that the ratio of condensate volume to exposed internal surface area is as close to 6 mL/cm² as possible
3. Measure pH of each sample as-blended and make sure it meets requirements (see appendix)
4. Mark sample bottles and fill them with the required amount of condensate solution (refer back to step 2)
5. Identify test samples (aluminum pieces)

Test Procedure

Note: 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.

1. Measure and record starting pH of condensate in each sample bottle
2. Heat oven to 60 °C +/- 5 °C
3. Place test samples into bottles. Note: Samples from a material combination may be split into several different bottles for testing
4. Loosely install lids / covers on sample bottles to keep evaporation to less than 5% of the initial volume
5. Place sample bottles in oven or on burners (with thermometer in each bottle) for 8 hours
6. At end of 8 hours, remove sample bottles from the oven / burners
7. Remove test samples and place in a vertical position for 16 hours at room temperature so that the condensate is removed and the surfaces dry
8. After the condensate solution in the bottles has cooled, measure and record pH of condensate in each sample bottle. If the pH changes more than 0.5, the condensate solution must be replaced with fresh solution
9. Repeat steps 5-8 (samples may continue to dry over weekends)
10. Testing is to continue for 6 weeks, 8 weeks, 10 weeks, and 12 weeks
11. At the conclusion of the 6th week and every 2 week period of testing thereafter, a sample of each material combination is to be removed
12. Each sample is to be further sectioned, mounted and polished for metallurgical analysis
13. Each sample is to be evaluated for type and depth of corrosion attack. Measurement of the corrosion depth (% attack of the total wall thickness) is required. A photo of the most extensive attack from each sample is also required