ATMOSPHERIC LABORATORY AND OUTDOOR TESTING OF ALUMINUM ALLOY ENVIRONMENT ASSISTED CRACKING

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Environmentally assisted cracking (EAC) of high strength aluminum alloys in corrosive atmospheres presents significant maintenance and safety issues for aircraft and other lightweight structures. Testing for the combined effects of atmospheric corrosion and mechanical loading to characterize EAC resistance presents unique challenges in producing results that are relevant to naval aviation. This testing relevant to aerospace structures is further complicated by the presence of crevices, galvanic couples, and use of protective coatings that influence the corrosion damage and the risk of SCC in-service. Recent research has been focused on establishing an EAC test system that can be used to characterize material system performance in service relevant laboratory and outdoor test environments (AMPP TM21449). The test method and measurement system have been developed to provided continuous estimates for crack length *in situ* using mechanics modeling to relate sample compliance to crack length.

A test system and method have been developed to assess corrosion inhibiting coatings and their capacity to protect structures from EAC initiation in corrosive atmospheres. EAC initiation and propagation is influenced by the complex interactions of load, environment, and alloy microstructure. These factors were explored to produce a method that quantifies the resistance to crack initiation provided by protective coatings using a high strength aluminum alloy (AA7075-T651) substrate. This EAC system and test method enables coating performance comparisons. Accurate assessment of coating performance will reduce the risk associated with introducing new environmentally compliant coatings for aerospace applications. A corrosive environment, smooth-notch double cantilever beam fracture sample, static loading condition, and continuous monitoring system are employed to measure onset and propagation of cracks in atmospheric corrosion tests (Figure 1). The EAC test system has been developed for use in laboratory corrosion test cycles or at outdoor corrosion test sites for evaluation in service environments. Results demonstrate a strong dependence of the cracking resistance on galvanic coupling and inhibited primer type.

AMPP TM21449-2021, Continuous Measurements for Determination of Aerospace Coating Protective Properties.

Figure 1. Annotated image of the EAC test system, including an instrumented load fixture and double cantilever beam (DCB) specimen