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**Maintenance**

**HYDROGEN EMBRITTLEMENT TESTING  
AND CONTROL**

**COMPLIANCE WITH THIS PUBLICATION IS MANDATORY**

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This instruction implements *AFPD 21-1, Managing Aerospace Equipment Maintenance*. It outlines the responsibilities for hydrogen embrittlement testing and control of cleaning and electroplating solutions in the Industrial Operations Division (OO-ALC/LIO). It assigns responsibility to Commodities Directorate (OO-ALC/LI) and Technology and Industrial Support Directorate (OO-ALC/TI). It does not apply to the United States Air Force Reserve or Air National Guard units on Hill AFB.

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**SUMMARY OF REVISIONS**

This revision changes the publication designation from OO-ALC-HAFB Instruction 21-103 to Hill AFB Instruction 21-103; updated organizational office symbols in the purpose paragraph and paragraph 2.1; AFMC Form 958 and AFMC Form 959 deleted from paragraph 2.1; paragraph 2.2.1 rewritten with the following changes: CA 17 changed to CA 59, existing sentence 2 deleted, sentence 4 changed to read "Test will be run at 50 amps per square foot (ASF);" sentence 2 of paragraph 2.2.2. added; "As noted in paragraph 2.2.2.3" in paragraph 2.2.2 changed to read "per ASTM F 519;" paragraph 2.2.2.1 changed to read CA 38 and 41 (plate at 40 ASF);" sentence 2 in paragraph 2.2.2.1 added; paragraphs 2.2.2.3 and 2.2.2.4 deleted; paragraph 2.2.2.5 changed to 2.2.2.3; paragraph 2.2.3 deleted CR 35; sentence 4 in paragraph 2.2.3. added; sentence 2 of paragraph 2.2.8 added; paragraph 2.4.1. changed from Management Review Board (MRB) action to "engineering review action;" sentence 5 in paragraph 2.4.3. added; and paragraph 2.2.4 deleted. A ( | ) indicates revision from previous edition.

**1. BACKGROUND:** Electroplating solutions can cause hydrogen embrittlement in high strength steels. This regulation identifies the actions required to control embrittlement.

## 2. RESPONSIBILITIES:

2.1. The Planning (OO-ALC/LIOSP) function will identify the hardness or tensile strength to which steel landing gear components are heat treated, when information is available on the work control document.

2.2. The Chemical Science Laboratory Section (OO-ALC/TIELC) will:

2.2.1. Test cadmium plating tanks CA 59 and CA 18 for hydrogen embrittlement twice per week using the Lawrence Hydrogen Gage. The instrument will be operated per manufacturer's instructions. Test will be run at 50 amps per square foot (ASF). If the Lawrence Gage is inoperative, the Metal Processing Section (OO-ALC/LOIPB) and Engineering Branch (OO-ALC/LIOT) will be notified and notched tensile samples will be used. If a test fails, the solution will be requalified using notched tensile samples.

2.2.2. Plate two notched tensile samples (NTS) in each of the following solutions using the same process as production items with a maximum interval of 30 calendar days between test. Samples must be baked for 23 hours at 350 to 400 degrees Fahrenheit within four hours after plating. The NTS will be made from 4340 steel heat treated to 260-280 thousand pounds per square inch (KSI) per ASTM F 519.

2.2.2.1. Nickel: CA 38 and 41 (plate at 40 ASF). Plate two sets in each solution, one using the immersion acid activator and one using the anodic sulfuric hydrofluoric acid.

2.2.2.2. Phosphate: AN 53.

2.2.2.3. Nital etch: CR 67, 69, 71.

2.2.3. Plate two NTS in each chrome plating tank (CR 5, 6, 7, 12, 13, 14, 15, 16, 22, 23, 24, 25, 26, 34, 35, 36, 52) with a maximum interval of 90-calendar days between tests. Samples will be run using the same process as production items. Samples will be plated at 2.0 amps per square inch (ASI) for a minimum of three hours. Samples must be baked for 23 hours at 350 to 400 degree's Fahrenheit within fours hours after plating. When failure occurs, requalify the solution per the applicable specification.

2.2.4. Process additional samples whenever failure occurs and corrective action is required. Requalify solution per applicable specifications.

2.2.5. Notify OO-ALC/LIOPB and OO-ALC/LIOT immediately of sample failure.

2.2.6. Monitor tests results and investigate causes of any hydrogen embrittlement failures.

2.2.7. Provide corrective action as when tests fail.

2.2.8. Maintain a record of testing and failure problems.

2.2.9. Provide NTS to OO-ALC/LIOPB for testing electroless nickel solutions.

2.3. Material Science and Engineering Laboratory Section (OO-ALC/TIELM) will:

2.3.1. Test all samples for hydrogen embrittlement, maintain log on samples tested, and provide test data to OO-ALC/TIELC.

2.3.2. Notify OO-ALC/TIELC immediately of test sample failure.

2.4. OO-ALC/LIOPB will:

2.4.1. Identify all suspect parts when a failure occurs. Available parts will be held for engineering review action.

2.4.2. Plate two NTS in the electroless nickel solution with a maximum interval of 30-calendar days between tests. The samples will be plated using the same procedure as for production items. Samples will be baked 23-hours at 350 to 400 degrees Fahrenheit within 4 hours of plating and submitted to Science and Engineering Laboratory (OO-ALC/TIEL) for testing.

2.4.3. Maintain a record of all serialized and nonserialized high strength steel parts (parts heat treated above 180,000 PSI) processed through solutions which are listed in paragraphs 2.2.1, 2.2.2, and 2.2.3. A record of the number and type of all other high strength steel components processed through these tanks must also be maintained. If the routing document does not identify the strength of the steel, assume it to be high strength. In the event of an embrittlement failure, this information will be used for engineering review. The records will be maintained in accordance with AFMAN 37-139.

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