

# TESTING OF A BIODEGRABLE CLEANER

13 FEB 1989

**OBJECTIVE:** To evaluate Simple Green, in dilute and concentrate form for its corrosive effects upon clad 7075-T6 aluminum.

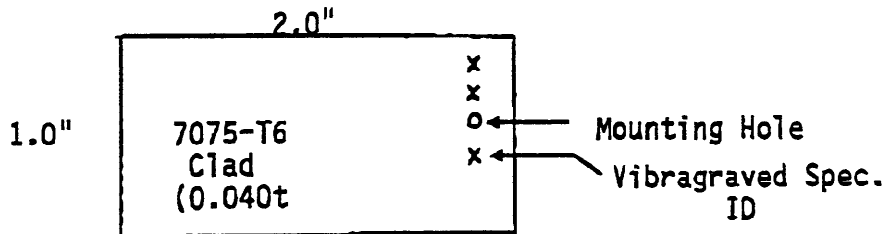
**SPECIFIED TEST PROCEDURES:** The procedures specified for evaluating the cleaner were: (1) ASTM F483-77, Total Immersion Corrosion Testing for Aircraft Maintenance Chemicals and (2) Aerospace Recommended Practice (ARP 1512), Corrosion of Aluminum Alloys by Aircraft Maintenance Chemicals-Sandwich Test.

**BIODEGRADEABLE CLEANER EVALUATED:** Simple Green

Simple Green was tested in the concentrate form and in a 7:1 dilution. Dilutions were made with tap water.

## I. IMMERSION TESTS

A. Specimen Configuration- Specimens were prepared to the configuration shown:



## B. Specimen Preparation

1. Specimens were individually immersed in a beaker of 1,1,1 trichloroethane maintained at 150±5 F. The surfaces were wiped with a clean cotton swab. Specimens were then immersed in methyl ethyl ketone. After any excess solvent was removed, specimens were placed in an oven at 100±5 F for 15 minutes.

2. Specimens were weighed on an analytical balance to 0.1 mg. Weights were recorded as 'Original Weight' in the following tables.

3. Each set (three specimens) was prepared for immersion test by placing a thin cord through the mounting holes. Very thin teflon tubing was also placed on the cord between the specimens to physically separate the specimens. An extra control set was also prepared.

## C. Test Procedure

1. Specimen Conditioning- Specimen sets were immersed in the appropriate solution with the ratio of specimen area to volume of solution being 50 ml of solution to 6.45 cm of specimen surface. Capped glass jars were the test containers. The test was conducted at 95±5 F environment for 168 hours.

## 2. Speciman Evaluation

(a.) Specimens were removed from solution and the cord and spacers removed. The specimens were rinsed with hot tap water (120-140 F) and scrubbed with a nylon bristle brush. Specimens were dipped in distilled water and rinsed with a stream of acetone.

(b.) Specimens were weighed, and the weight recorded as 'After Cond. Weight'. See table I and II for individual specimen weight changes. Table III summarizes the average weight change for each set.

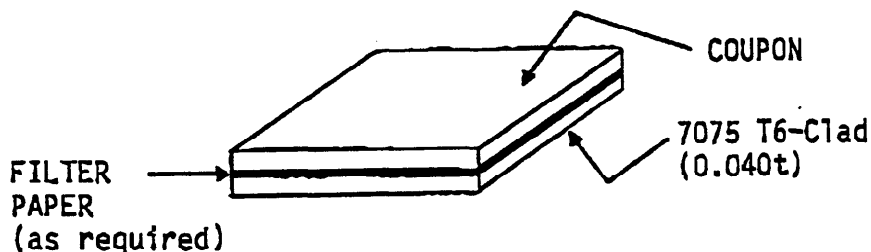
(c.) Specimens were then visually examined for appearance changes such as discolorations, etching, pitting. The visual observations are presented in Table IV.

(d.) Because it was not clear whether some specimens were dull from etching or from deposits all specimens plus controls were immersed for 5 minutes in a solution containing 2 weight % chromic acid and 5 volume % orthophosphoric acid. Specimens were rinsed to remove the acid, scrubbed with a nylon bristle brush and rinsed again with distilled water. Specimens were reweighed and the best sets visually selected. Photographs were made. The visual results are presented in I.D.2, Summary of Immersion Results, while tables V-Table VII gives the weight change results.

## II. SANDWICH TESTS

### A. Specimen Configuration

Specimens were prepared to the configuration shown. Half of the sandwich specimens had Watman GFA filter paper interspliced between the coupons. The other half did not.



### B. Specimen Preparation

1. The Sandwich specimens were divided into sets. Each set consisted of eight sandwich specimens, four having filter paper and four that did not. For each set of specimens, two specimens with filter paper and two without were tested in concentrated solution. The remaining four specimens (two with filter paper and two without) were tested using the same solution in the dilute form. Additionally, one-half set (four specimen)

was tested using synthetic tap water (ASTM D1193, Type III) and one-half using Lockheed tap water. Only one-half set was required because there was no dilution. Each specimen coupon was vibragraved with a specimen code. The same code was used as for the immersion specimens, except that codes were added for Lockheed tap water (T) and for synthetic tap water (S).

2. Specimen coupons were wiped with lint free cotton wipers moistened with acetones.

3. The mating surfaces of the sandwich specimens (and filter paper, when used) were coated with the appropriate cleaning solution. The specimens were then assembled for testing.

#### C. Test Procedures

1. Test Conditions-The specimens were exposed individually, in a horizontal position to the environmental exposure cycles. The exposure cycles consisted of 8  $\pm$ .25 hrs. at 100 $\pm$ 5 F followed by 16 hours at 100  $\pm$ F and 95-100 %RH. The specimens were exposed for 7 days. Over the weekend the specimens were exposed to 100  $\pm$ 2 F and 95-100% RH.

2. After the exposure cycles were completed, specimens were disassembled rinsed thoroughly in warm tap water while scrubbing with a nylon bristle brush. Specimens were air dried.

#### D. Test Results

1. The specimens were examined for corrosion and rated according to the following:

- 0-No visible corrosion
- 1-Very slight corrosion or discoloration
- 2-Slight corrosion
- 3-Moderate corrosion
- 4-Extensive corrosion and pitting

Results: The product, Simple Green, was corrosive to the aluminum specimens on both immersion and sandwich tests. We do not recommend the use of this product on Air Force equipment containing aluminum.

Recommendations: We recommend the product be tested on non-aluminum metals or any corrosive effects.

I. Immersion Test

A. Weight Loss After 7 days Environmental Conditioning

<u>Dilute Solutions</u>	<u>Original wt (gm)</u>	<u>After Cond. wt (gm)</u>	<u>Wt. loss (mg)</u>	<u>Visual Observation</u>
1	3.563	3.5321	30.9	Etched;
2	3.5346	3.5035	31.1	light grey
3	3.5578	3.5263	<u>31.5</u>	matte finish
		Avg wt. loss	31.17	
<u>Conc. solutions</u>				
1	3.5680	3.2636	304.4	Bottom has dark
2	3.5645	3.2298	334.7	grey etched
3	3.5699	3.3239	<u>246.0</u>	streaks tops are
		Avg wt. loss	295.03	etched light grey.

B. Weight Loss After 7 Days Environmental Conditioning After Chemical Cleaning

<u>Dilute Solutions</u>	<u>Original wt (gm)</u>	<u>After Cond. wt (gm)</u>	<u>Wt. loss (mg)</u>
1	3.5630	3.5274	35.9
2	3.5346	3.4984	36.5
3	3.5578	3.5214	<u>36.7</u>
		Avg. wt loss	36.37
<u>Conc. solutions</u>			
1	3.568	3.2475	320.08
2	3.5645	3.315	249.8
3	3.5699	3.3044	<u>265.8</u>
		Avg. wt loss	278.80

II. Sandwich Tests  
Dilute Solutions

	<u>Rating</u>
without filter paper	with filter paper
3	4
4	3
<u>Conc. Solutions</u>	
4	4
4	4

The test for Simple Green was extracted from the Lockheed-Georgia test for testing biodegradable cleaners, dated 28 Jun 88.

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