

SALT DEPOSITION ON F-5 AIRCRAFT IN VARIOUS SERVICE ENVIRONMENTS

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ABSTRACT

Conductivity testing, via Bresle patch analysis, was performed on F-5 aircraft in Key West, FL, Fallon, NV, and Yuma, AZ to compare the level of salt contamination present at each location. The inspection locations were selected based on the observations of the pilots and maintenance staff of VFC-111, the squadron stationed in Key West, FL. The selected locations represented the areas of highest concern and recurring problem areas noticed by maintenance staff. Testing was performed at several points during the flight schedule: before the first flight of the day, following a flight, and prior to and following a scheduled clear water rinse event. The results obtained from Key West, FL and Fallon, NV indicate a large discrepancy in the amount of salt contamination present in the two locations, with Key West yielding much higher readings. These results lead the researchers to believe that the aircraft in residency in Key West should be treated in similar fashion to those maintained aboard aircraft carriers, including more frequent wash and inspection cycles, and potentially proper marinization of the aircraft with marine specific coatings.

Key words: atmospheric corrosion, environment, marine environments

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INTRODUCTION

Fighter Squadron Composite One One One (VFC-111) is a US Navy adversary squadron based out of Naval Air Station (NAS) Key West, Florida. VFC-111 operates F-5 Tiger-II tactical fighter jets (Figure 1) as part of their dissimilar air combat training program provided to fighter squadrons within the Navy, Marine Corps, Air Force, Air Force Reserve, and Air National Guard.



Figure 1: F-5 Tiger-II Tactical Fighter Jet

Recently, VFC-111 has noticed a significant uptick in the corrosion observed on the jets, particularly related to the air intakes. VFC-111 has been in contact with the squadrons based in Fallon, NV and Yuma, AZ who also operate the F-5 Tiger-II aircraft. These squadrons do not report similar issues with their jets, which are approximately the same age as the fleet in Key West, FL, and operate similar missions and schedules.

At the invitation of VFC-111 Commanding Officer CDR Matthew Meritt, Executive Officer CDR Derek Ashlock, and Maintenance Officer LCDR Timothy Norris, several team members from the Naval Research Laboratory (NRL) along with a contingent from the Naval Air Warfare Center Aircraft Division (NAWC-AD)⁽¹⁾ were permitted to visit the hangar at NAS Key West, Boca Chica Airfield to observe some of the F-5 aircraft. During the visit, the officers of VFC-111 made particular mention of the corrosion occurring inside the air intakes as well as the riveted areas on the skin of the intakes. Figure 2 provides photos of both the exterior and interior views of the air intake on the F-5.

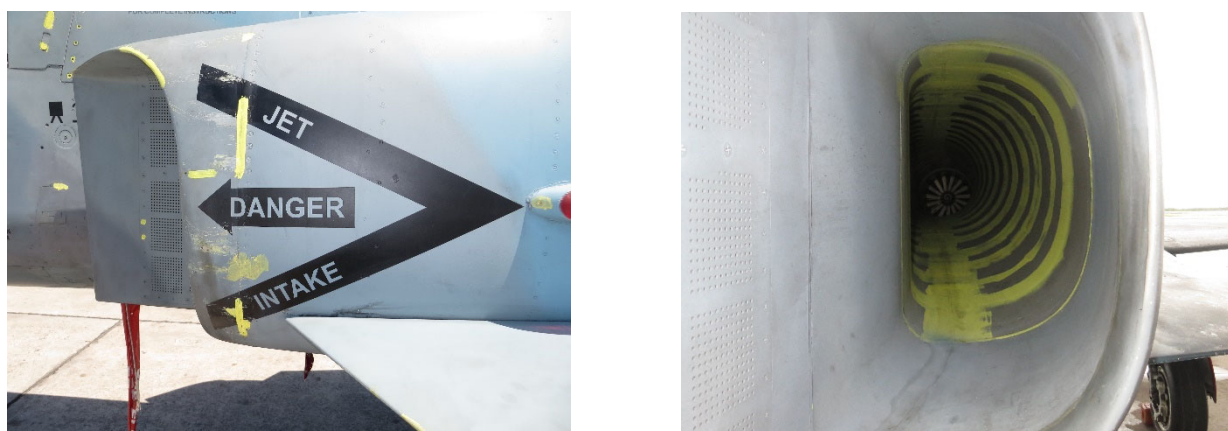


Figure 2: Exterior portion of air intake (left); Interior of air intake (right)

During the course of the field visit and ensuing discussion, it was determined that the largest variation between the jets in Key West and those in Fallon or Yuma is climate. These jets, which were originally designed and maintained as Air Force assets, were not intended for deployment in marine environments,

and were never marinized when they were obtained as Navy assets. Key West is a marine environment, with plenty of influence from the Atlantic Ocean and Gulf of Mexico, whereas Fallon and Yuma experience a desert climate. Due to the large differences in climate, it seemed a logical first step in aiding VFC-111 would be to determine that the jets based in Key West are subject to more harsh conditions than those of Fallon or Yuma. These severe conditions would lead to an accelerated rate of corrosion of parts as experienced by the Key West fleet.

This program was performed to quantify the salt content on the interior and exterior surfaces of the air intakes of the F-5 aircraft stationed in Key West, Fallon, and Yuma via conductivity readings. Readings were taken on jets of varying conditions including:

- jets under normal storage conditions, prior to and following a scheduled wash
- one jet of the Key West fleet which had been stored in the hangar for an extended period
- one jet of the Yuma fleet which had been stored in the hangar for a period of ten days
- one jet of the Fallon fleet which had been stored in the hangar for a period of four days
- one jet from the Fallon fleet which was flown to Key West and immediately stored in the hangar

EXPERIMENTAL PROCEDURE

The level of salt contamination of the air intakes of the F-5 aircraft was determined by measuring the conductivity of liquid samples obtained via the Bresle patch method. The Bresle patch method involves adhering a latex patch of known dimension to the area of interest. Deionized water (3.0 mL) was added via syringe inserted in the foam outer rim of the patch. During a period of 10 minutes the water was drawn back into the syringe and redistributed into the latex test cell a total of three times. This “flushing” action using the syringe helps to agitate the test surface to release surface contaminants and places them in solution with the deionized water. A photo of the test set-up is provided in Figure 3.

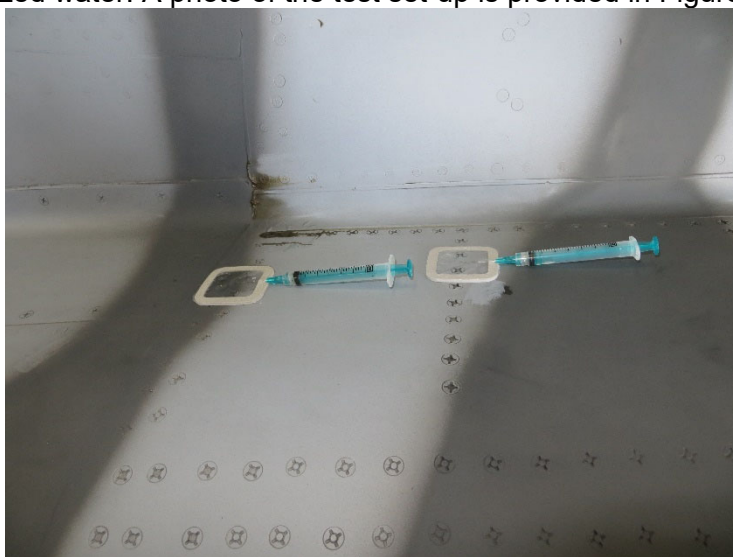


Figure 3: Bresle Patch Test Set-up

Following the 10-minute waiting period, the solution was removed by syringe one final time and a few drops were placed onto the sensor of a Horiba LAQUAtwin conductivity meter. Conductivity is the measurement of how well water conducts electricity, which increases with the number of ions present in the solution. Thus, the higher the reading, the larger the concentration of ions in the solution removed from the test area. The deionized water used for testing was verified daily to assure it had not been contaminated and would not interfere with the results of the testing. The deionized water read between 0 – 3 $\mu\text{S}/\text{cm}$.

According to the maintenance staff for VFC-111, the jets undergo a wash-down approximately every 14 days. NRL reached out to Mr. William Renfro of Pacific Architects and Engineers (PAE)⁽²⁾ to coordinate