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**14. ABSTRACT**

**15. SUBJECT TERMS**

Lessons Learned; 5700A/AN; Failure Analysis

**16. SECURITY CLASSIFICATION OF:**

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**17. LIMITATION OF ABSTRACT**

**18. NUMBER OF PAGES**

24

**19. NAME OF RESPONSIBLE PERSON**

Kevin Abercrombie

**19b. TELEPHONE NUMBER** (include area code)

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5700A/AN Failure Analysis

Kevin Abercrombie
Naval Air Warfare Center, Aircraft Division
Patuxent River, MD

NCSLI Workshop & Symposium July 29 - August 2, 2001
5700A/AN Failure Analysis

• Introduction
  – In 1989 NAVAIR adopted the Fluke 5700A/AN Multifunction Calibrator (MFC) to replace older obsolete meter calibrators such as the Fluke 5100B.
  – Since then NAVAIR has incurred high repair costs.
  – In 1997 a project was undertaken to determine the reasons for the high repair costs.
  – This paper discusses the findings
5700A/AN Failure Analysis

- Investigation was accomplished in three phases
  - Data Collection
  - Data Evaluation
  - Corrective Action determination and Implementation
5700A/AN Failure Analysis

• Data Collection:
  – Survey form was published in the Metrology Bulletin (MetBul)
  • Requested information pertaining to the use of the 5700A/AN at the time of failure.
    – ICP in use
    – Model number of the Test Instrument (TI)
    – Environmental conditions

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- Data Collection:
  - Survey forms submitted with the 5700A/AN at time of repair.
  - Surveys were submitted for 28 5700A/AN’s
5700A/AN Failure Analysis

- Data Evaluation:
  - 28 Surveys were received.
    - 12 indicated the 5700A/AN failed at power up
    - 8 failed during artifact calibration
    - 8 failed while performing an ICP
5700A/AN Failure Analysis

- **Data Evaluation:**
  - 8 Failures while performing calibrations
    - 1 Failure was in the wideband oscillator, all other 5700A/AN functions worked properly.
    - 7 involved calibrating Ground Support Equipment
      - All 7 suffered catastrophic failure
  - It was decided to investigate these 7 units and the ICP’s that were in use at the time of failure.

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- Data Evaluation:
  - These seven 5700A/AN’s and associated ICP’s warranted further investigation.
    - Review the failure circumstances reported on the survey form.
    - Review the procedure for possible problems
    - Review the repair data to try and correlate the information.

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5700A/AN Failure Analysis

- Data Evaluation:
  - Failure Scenarios
    - Failures due to aging
    - Soft failures - 5700A/AN’s that were possibly exposed to a “reverse voltage” that did not result in catastrophic failure
    - Catastrophic failures - the 5700A/AN stopped working while being used - substantial “Reverse Voltage”.

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5700A/AN Failure Analysis

• Data Evaluation:
  – 2 scenarios involved "Reverse Voltage"
5700A/AN Failure Analysis

• Data Evaluation:
  – Reverse Voltage.
    • “An unexpected voltage present at the TI test points that is fed back into the 5700A/AN when it is connected to the TI.”
    • Reverse voltages of less than 3 volt may be enough to damage the 5700A/AN.
    • All seven 5700A/AN’s had damaged mother boards - an indicator of failure due to reverse voltage.

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5700A/AN Failure Analysis

Damaged motherboard trace caused by “Reverse Voltage” being applied to the 5700A/AN.

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5700A/AN Failure Analysis

• Data Evaluation; Sources of Reverse Voltage:
  – Defective TI
    • TI had one or more undetected electrical problems such as:
      – Floating ground
      – Wired improperly
      – Mislabeled connections
5700A/AN Failure Analysis

- Data Evaluation; Sources of Reverse Voltage:
  - Operator Error:
    - Connecting to the wrong test points
    - Improperly substituting the 5700A/AN for another standard.
    - Failing to follow the procedure.
5700A/AN Failure Analysis

- Data Evaluation; Sources of Reverse Voltage:
  - Procedural Error:
    • Not ensuring the test points are de-energized
    • Not placing the TI and/or 5700A/AN in a safe configuration before making/breaking connections.
    • Lack of appropriate WARNINGS and CAUTIONS
    • Illogical step sequences
5700A/AN Failure Analysis

- Data Evaluation
  - In 4 of the 7 cases, more than one factor contributed to the failure.
5700A/AN Failure Analysis

- Data Evaluation

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5700A/AN Failure Analysis

- Data Evaluation; Procedure Review:
  - The 7 ICPs were reviewed to determine if they contributed to the problem.
5700A/AN Failure Analysis

- Data Evaluation; Procedure Review:
  - In 5 of the 7 ICPs it was determined that they could have contributed to the failure.
    - Lacked safeguards, e.g. configuration of MFC and/or TI
    - Improper step sequence
    - Lacked Warnings and Cautions
5700A/AN Failure Analysis

- Data Evaluation; Procedure Review:
  - Additionally, in some ICPs the performance specifications of the TI did not warrant using a 5700A/AN.

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5700A/AN Failure Analysis

• Corrective Action:
  – Developed guidelines using 5700A/AN’s in ICPs
    • Ensuring test points are de-energized.
    • Safeguarding the 5700A/AN when making/breaking connections.
    • Ensuring the step sequence is logical.
    • Ensuring appropriate WARNINGS and CAUTIONS are used and properly placed in the ICP.
    • Ensure the 5700A/AN is the appropriate standard to use.

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5700A/AN Failure Analysis

• Corrective Action:
  – Training
    • Use MetBul articles to inform and remind technicians of proper use of the 5700A/AN.
  – Substitution:
    • Select an alternate standard or methodology when the TI performance specifications allow it.
5700A/AN Failure Analysis

- Conclusions:
  - The most likely cause of damage to NAVAIR 5700A/AN meter calibrators is the application of a “Reverse Voltage” to the 5700A/AN.
  - Several of the ICPs examined during this project lacked fundamental measurement practices and safeguards, and therefore could have contributed to damaging the 5700A/AN.

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5700A/AN Failure Analysis

• Conclusions:
  – Operators need to be aware of limitations associated with the use of the 5700A/AN