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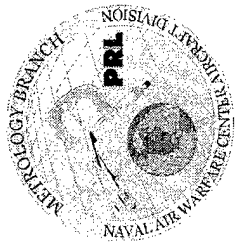
5700A/AN Failure Analysis

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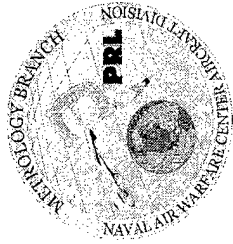
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NCSLI Workshop & Symposium July 29 - August 2, 2001



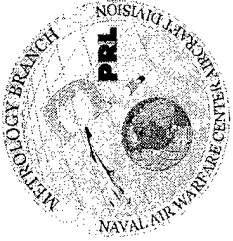
5700A/AN Failure Analysis

- 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



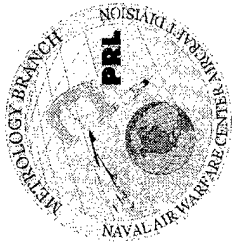
5700A/AN Failure Analysis

- Investigation was accomplished in three phases
 - Data Collection
 - Data Evaluation
 - Corrective Action determination and Implementation



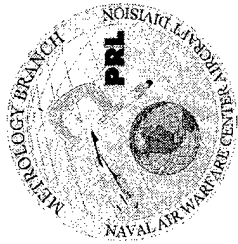
5700A/AN Failure Analysis

- 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



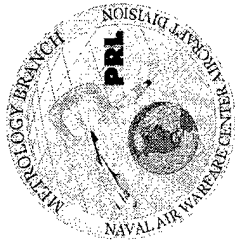
5700A/AN Failure Analysis

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



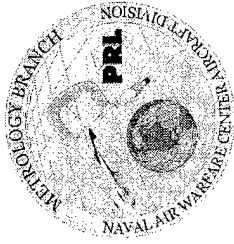
5700A/AN Failure Analysis

- 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.



5700A/AN Failure Analysis

- 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.



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".



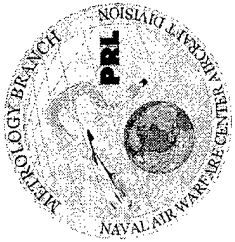
5700A/AN Failure Analysis

- 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.

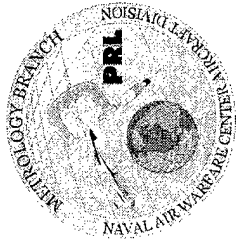


5700A/AN Failure Analysis



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

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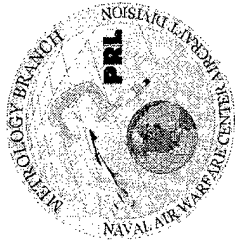
5700A/AN Failure Analysis

- Data Evaluation; Sources of Reverse Voltage:
 - Defective TI
 - TI had one or more undetected electrical problems such as:
 - Floating ground
 - Wired improperly
 - Mislabeled connections



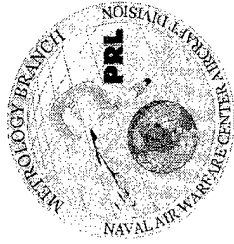
5700A/AN Failure Analysis

- 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.



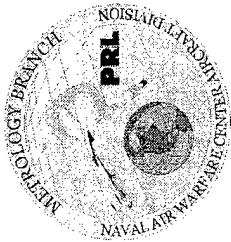
5700A/AN Failure Analysis

- 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



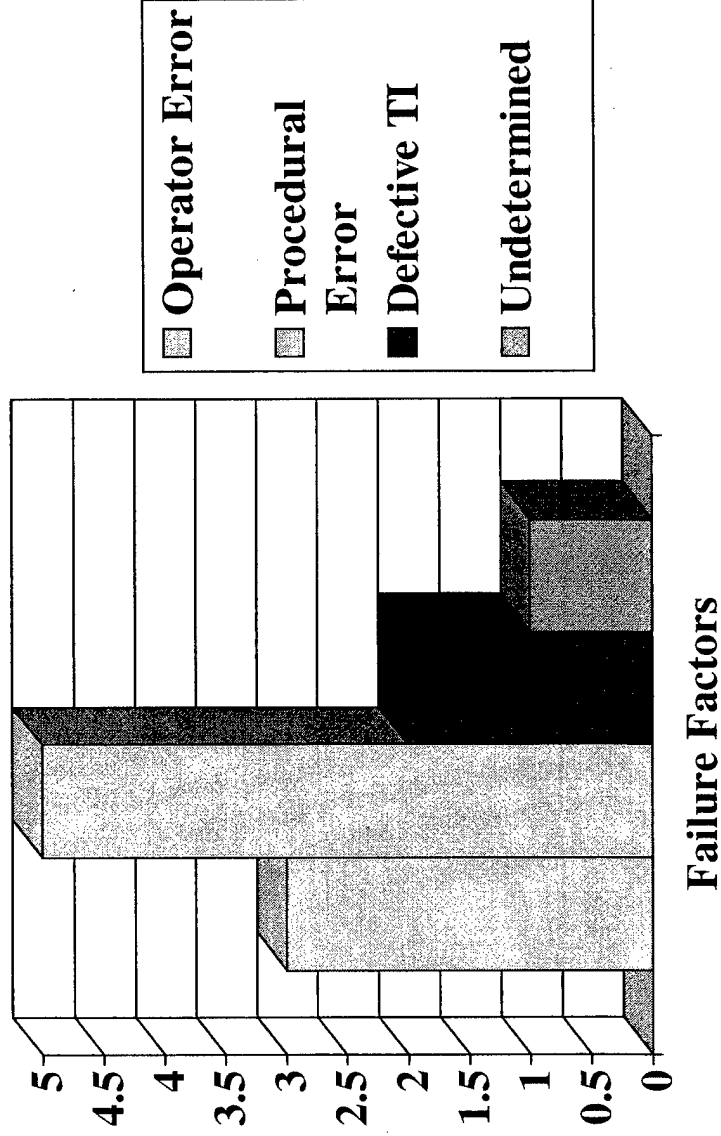
5700A/AN Failure Analysis

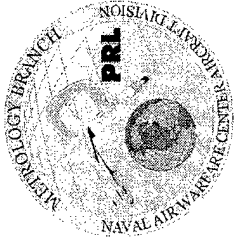
- Data Evaluation
 - In 4 of the 7 cases, more than one factor contributed to the failure.



5700A/AN Failure Analysis

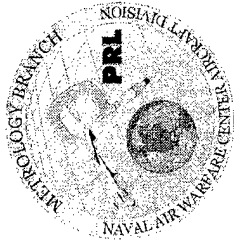
- Data Evaluation





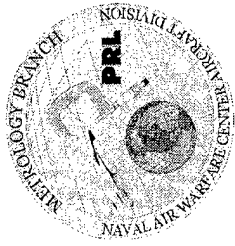
5700A/AN Failure Analysis

- Data Evaluation; Procedure Review:
 - The 7 ICPs were reviewed to determine if they contributed to the problem.



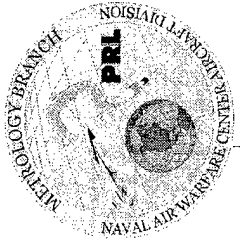
5700A/AN Failure Analysis

- 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



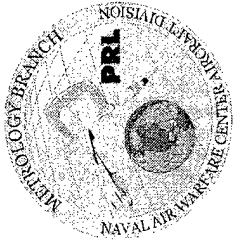
5700A/AN Failure Analysis

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



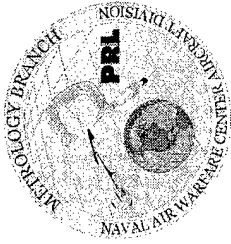
5700A/AN Failure Analysis

- 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.



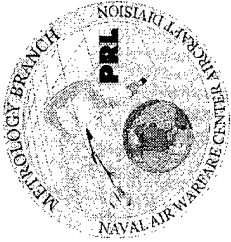
5700A/AN Failure Analysis

- 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.



5700A/AN Failure Analysis

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