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AWTS Certification Test Protocol - Solving Intermittent Issues

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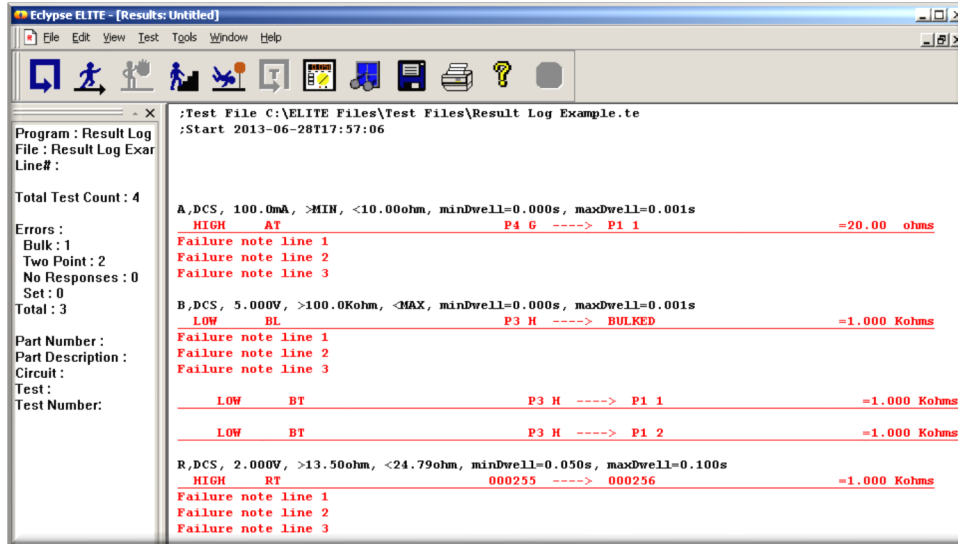
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Distribution Statement A. Approved for public release; distribution is unlimited.

AWTS ESATS II

- ▶ Selected for ADDEWIS
- ▶ Army Platforms
 - ▶ HH-60
 - ▶ CH-47
 - ▶ AH-64
- ▶ 160th SOAR
 - ▶ HH-60
 - ▶ CH-47
 - ▶ MH-6

AWTS is a complete Test system



National Institute of Standards
and Technology (NIST) Compliant

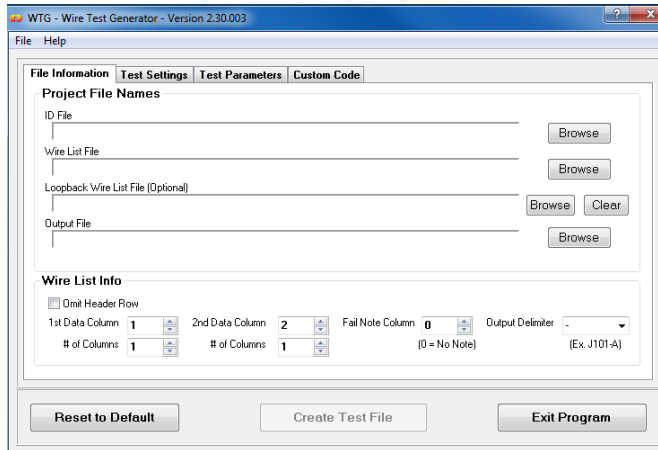
- ▶ All Configurations Provide Test Execution and Development
- ▶ ELITE™ v2.11 software
- ▶ Used at each level of maintenance (I, O, D)
- ▶ Precision Measurements - extremely accurate
- ▶ Records all test measurements, allowing data analysis and trending
- ▶ Meets Mil-PRF-28800 Class 1 and 2.

- ▶ Received Authorization to Operate
 - ▶ Commander Naval Air System Command
 - ▶ “This authority means the AWTS software meets the Navy’s stringent cyber security risk requirements for use in the fleet to help our maintainers conduct electrical testing of aircraft and systems.”
- ▶ Authorized by Army 160th SOAR
 - ▶ For use with Logbooks on Digital Integrated Maintenance Environment (DIME)
- ▶ MAPPING - Ability to implement Self-Learn to map circuits and create a Test Program rapidly.

Applications

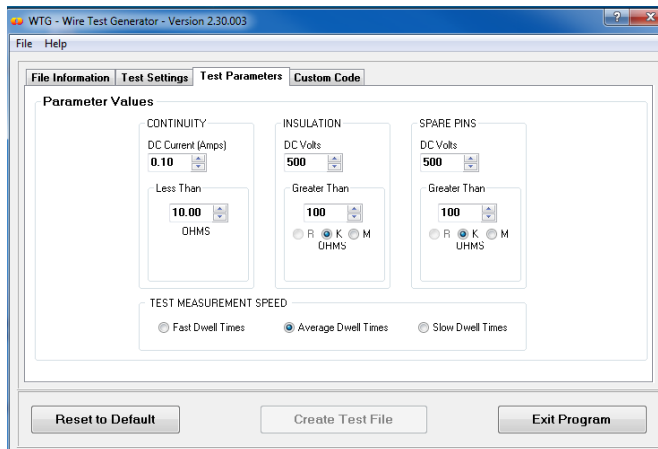
- ▶ Resistors
- ▶ Capacitors
- ▶ Diodes
- ▶ Zeners
- ▶ Transformers
- ▶ Relays
- ▶ Switches
- ▶ Circuit Breakers
- ▶ 1553 couplers
- ▶ Rate Gyro
- Variacs (variable transformer)
- Potentiometers
- LEDS
- Light Bulbs
- Time Delay Relays
- Oscillators
- Operational Amplifiers
- Stepper Motors
- DC Motors
- AC Motors (-03)
- LVDT
- Synchro
- Resolver
- Contactors

Wire Mapping/Wire Test Generator



▶ Wire Mapping/Self-Learn

- ▶ Will create a TPS by connecting to a known good cable.
- ▶ TPS can then be ran multiple times.



▶ Wire Test Generator (WTG)

- ▶ Will create a TPS from a wire list.
- ▶ Wire list can be created from a schematic diagram.

What is an Intermittent System Failure?

- ▶ “Intermittent System Failure” is a functional failure that does not always occur.
 - ▶ The most common Intermittent System Failures occur in the harsh inflight environment, and do not occur on the ground, making detection and repair difficult and often result in a No Fault Found (NFF)/Can Not Duplicate (CND). Thus, the fault often recurs inflight.
- ▶ Many Intermittent System Failures are caused by a fault in the EWIS.
 - ▶ The Fault or root cause of the Intermittent System Failure is not intermittent.
 - ▶ Typical faults corrosion, loose pins, sticky relay etc., are present until repaired.
- ▶ AWTS CTP detects the root cause or fault.
 - ▶ Detecting the always present root cause is more reliable than trying to detect the Intermittent Functional Failure which rarely occurs on the ground.

Detecting the Root cause of In-Flight pilot reported discrepancies

- ▶ To detect the root causes of pilot reported discrepancies the AWTs employs multiple testing methods.
 - ▶ First traditional electrical testing methods are used to identify and eliminate existing hard faults in the EWIS system.
 - ▶ Next the AWTs uses precision testing protocols referred to as Certification Test Protocols (CTP).
- ▶ CTP analyzes the physical uniformity of the wiring to identify subtle hard to find anomalies.
- ▶ Using a series of electrical tests, the AWTs constructs a physical uniformity model of a given electrical circuit.
 - ▶ Although thresholds are used to identify the physical uniformity of a given circuit or group of wires, these thresholds do not determine a pass/fail criteria.
 - ▶ Once the physical uniformity of a group of wires is established the “outliers” (those wires that differ in physical uniformity) can be further analyzed to determine the root cause of the physical difference.
 - ▶ That root cause can then be traced back to in-flight reported discrepancies.
 - ▶ Often the root cause is found to be degradation and not hard faults (open/Shorts).

Faults Detected by AWTs - Commonly Root cause of Intermittent Failures

- ▶ Broken wires making intermittent contact
- ▶ Degradation
 - ▶ Corrosion in connectors
 - ▶ Salt residue on pins and connectors
 - ▶ Loose connections
 - ▶ Terminal loose nut
 - ▶ Loose connectors
 - ▶ Recessed pin
 - ▶ Loose crimp
 - ▶ Dirty Relay Contacts
 - ▶ Insulation Leakage
 - ▶ Cracked Insulation
- ▶ Poor maintenance
 - ▶ Bad Crimps on pins
 - ▶ Bad solder joints
 - ▶ Bad wire splices
 - ▶ Loose connector
 - ▶ Damaged or recessed pin
 - ▶ Mis-wire
 - ▶ Incorrect wire routing
- ▶ **Other Physical Non-Uniformities**

How Does CTP Work

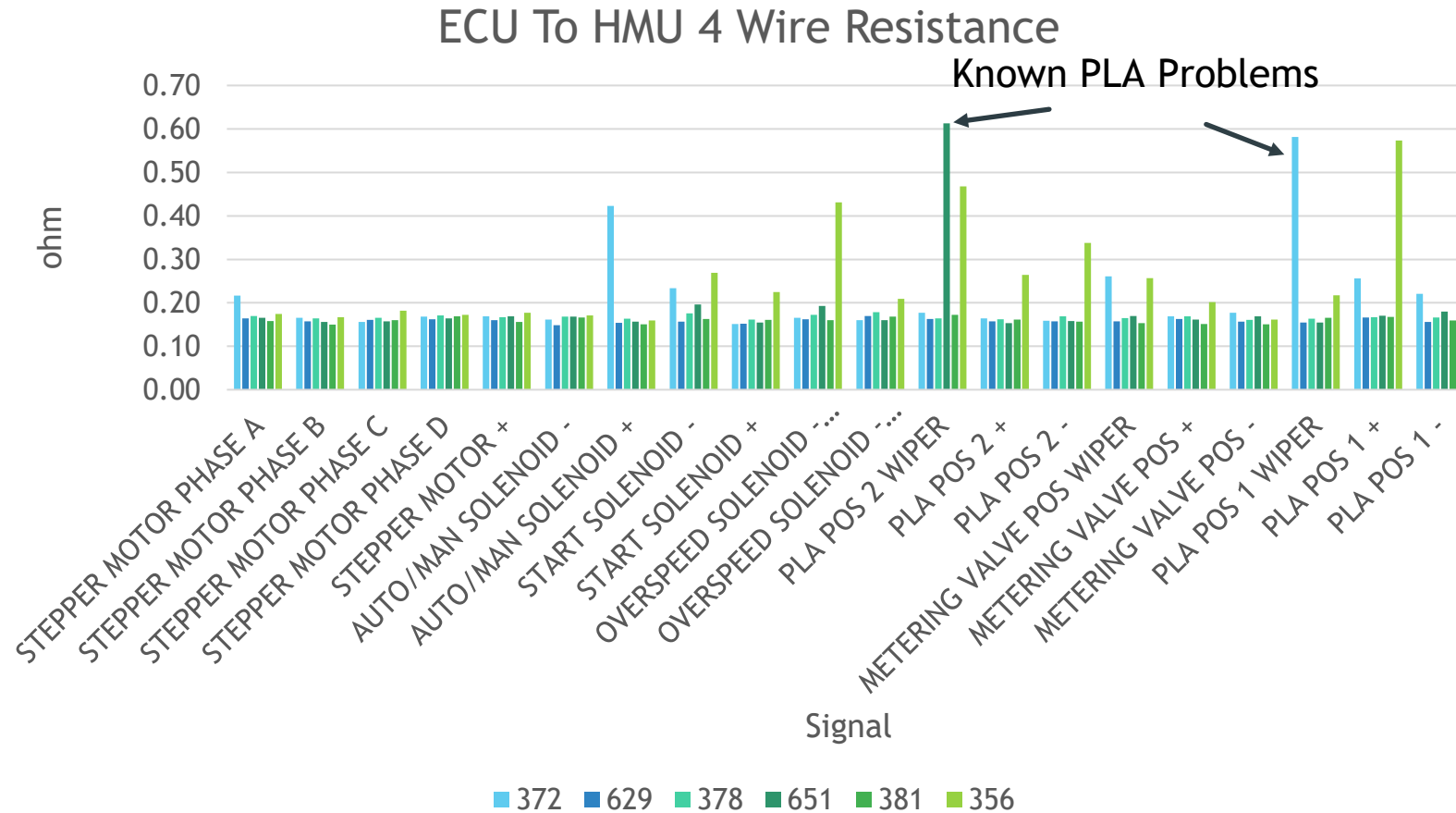


- ▶ CTP was developed in concert with the Men and Women of the 160th Special Operations Aviation Regiment Ft Campbell KY.
- ▶ CTP is designed to detect non-linear and or unstable conductive paths.
- ▶ CTP starts by making multiple precision resistance measurements made with different current or voltage.
 - ▶ AWTs is designed to do this with a couple milliohm accuracy and repeatability.
- ▶ Set pass/fail limits based on expected resistance for the continuity path.
- ▶ Process the multiple measurements just made on the conductive path to detect non-linear and or unstable resistance.
 - ▶ A good conductive path will be linear and stable (all measurements will be equal).
 - ▶ Non-Linear - caused by dirt, corrosion, etc.
 - ▶ Unstable - caused by loose terminal, recessed pin, bad crimps etc.

For more information on Army usage contact 160th SOAR/TAG

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- ▶ Measurement clearly detects 2 aircraft with known Intermittent Symptoms.
- ▶ Functional Failure Limits of 1 to 5 ohm would not detect problem.

Aircraft 10-08806 - Data Concentrator

Chart #3 CTP Measurements (Serial Number: 10-08806)

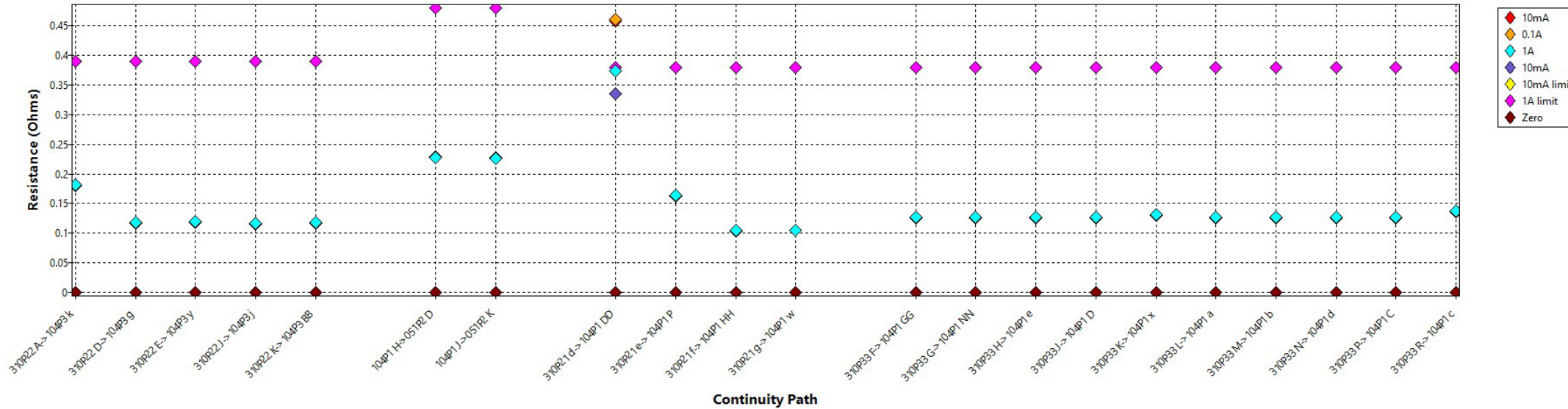
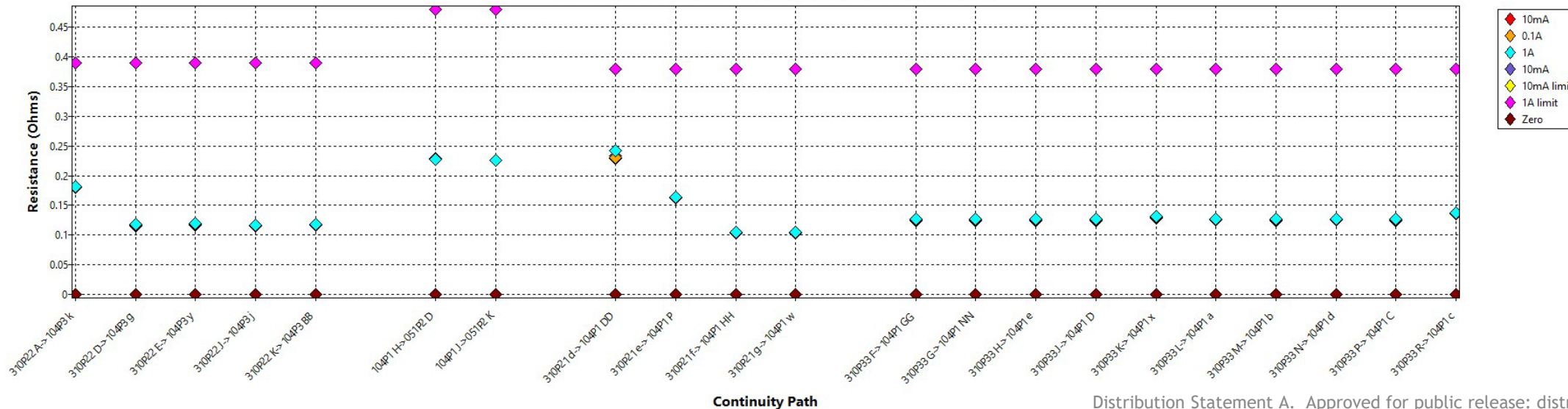
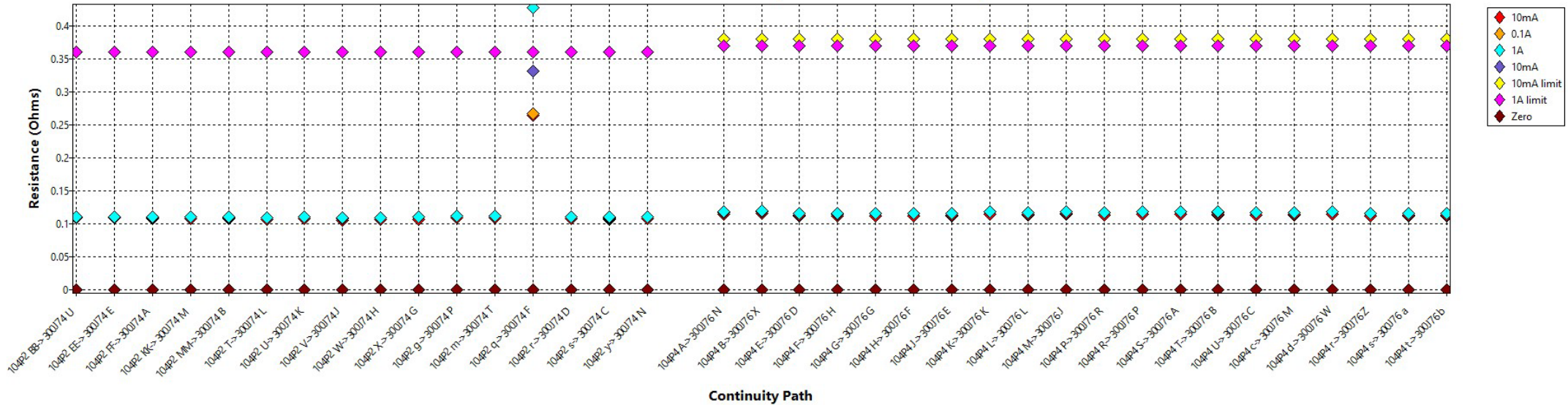


Chart #3 CTP Measurements (Serial Number: 10-08806)



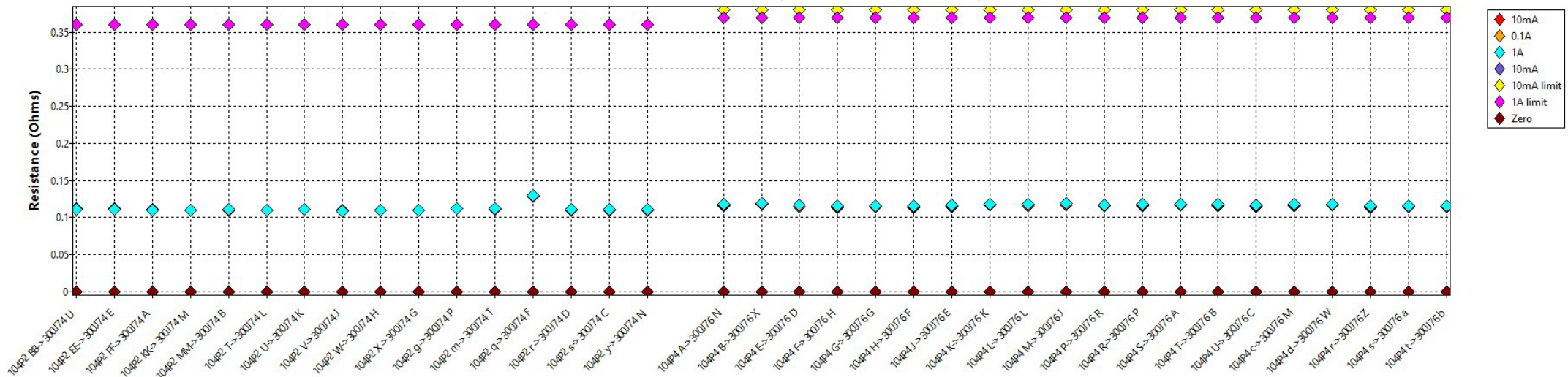
Aircraft 10-08806 - FADEC

Chart #2 CTP Measurements (Serial Number: 10-08806)



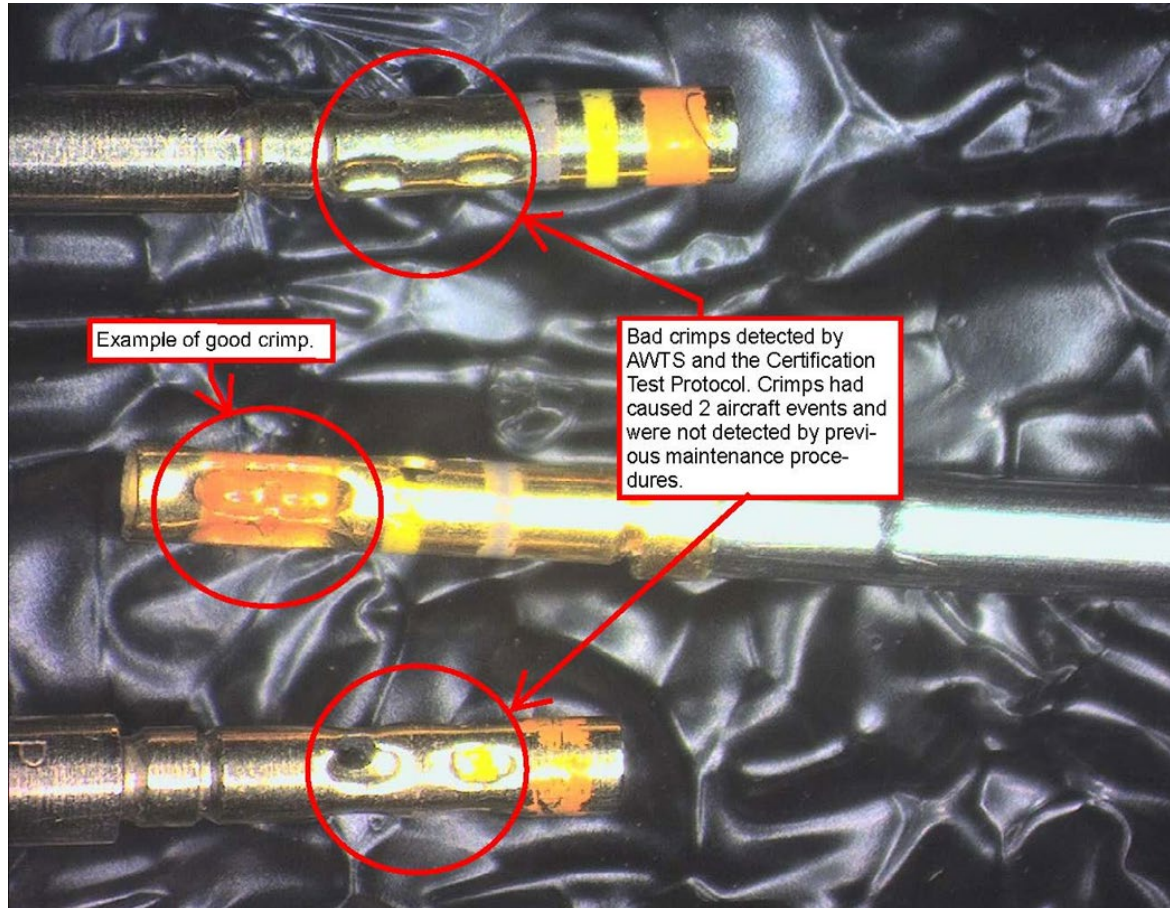
Continuity Path

Chart #2 CTP Measurements (Serial Number: 10-08806)



Continuity Path

This caused 2 in-flight events, and 2 NFF/CND
AWTS CTP found fault missed by BIT and ring out



CTP Success



AWTS and CTP

- ▶ Using the AWTS with CTP:
 - ▶ Is proving to be the most effective method for identifying and eliminating the root cause of intermittent in-flight reported discrepancies.
 - ▶ Allows for preventive EWIS maintenance by identifying EWIS degradation before it becomes an in-flight reported discrepancy/intermittent failure.



ESP+

Single wire tester

Primary use - Distance to fault

Instructions found in -

TM 1-1500-323-24-1





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Questions?