

# United States Army Special Operations Aviation Command

---



## **160<sup>th</sup> SOAR(A) Troubleshooting Analysis Group**

On-wing Wire Diagnostic Practices  
for Intermittent Symptoms  
23 October 2015



# Intermittent Symptoms

---

- Usually detected by Built-In-Test (BIT) equipment, but also include Crew Observed abnormalities.
- BIT typically monitors functions, not individual wire paths.
- BIT fault thresholds are not published in technical manuals.



# Intermittent Symptoms

---

- Could Not Duplicate at least once
- Replacement without repeat equals success
- Higher level No Fault Found not re-investigated
- False removals typically blamed on:
  - Next level testing
  - Technical manual procedures
  - Other end LRU
  - Inaccurate Pilot report
  - Bad wiring



# Intermittent Symptoms

---

- Most experienced troubleshooters would agree that a degraded Electrical Wiring Interface System (EWIS) could be causal
- How do we determine the serviceability of the EWIS on-wing?



# Intermittent Symptom Diagnostics

---

- Not a primary focus during training.
- Fault Isolation Procedures rarely address intermittent symptoms.
- Meters are often ineffective in detecting degraded conditions.



# EWIS Degradation

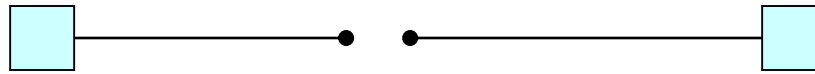
---

- Loose Connector
- Pin retention
- Cold-cracked solder joints
- Contamination (moisture-fluid-particulates)
- Chaffing
- Corrosion
- Contact degradation
- Grossly over-crimped or under-crimped



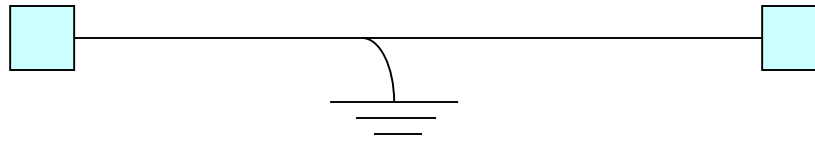
# Wire Failure Modes

**Open Wire**



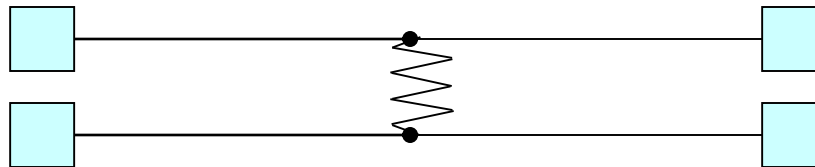
**Fails  
Continuity Check**

**Short to Ground**



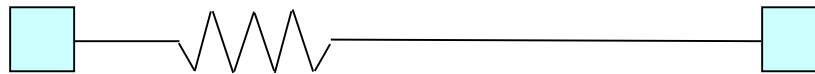
**Continuity  
Checks OK**

**Short  
Between  
Wires**



**Continuity  
Checks OK**

**Series  
Resistance**



**Continuity  
Checks OK**

*(Ohms or milli-ohms of Resistance)*



# Typical Troubleshooting Steps

---

- Continuity (<1.0 ohms) using DMM
- Short to ground (OL) using DMM
- Replace sending LRU
- Replace receiving LRU
- Replace Troubleshooter
- Repeat sequence





# Other Troubleshooting Steps

---

- Visual inspection
- Disconnecting, reconnecting
- Cleaning
- Flexing
- Piggyback harness or wire
- Remove and replace



# Automatic Wire Test Set (AWTS)

---

- Pros
  - Comprehensive
  - Flexible
  - Repeatable
- Cons
  - Test Adapter Cables (TACs)
  - Test protocol development
  - Development process-organization
  - Configuration management



# Pass/Fail Criteria

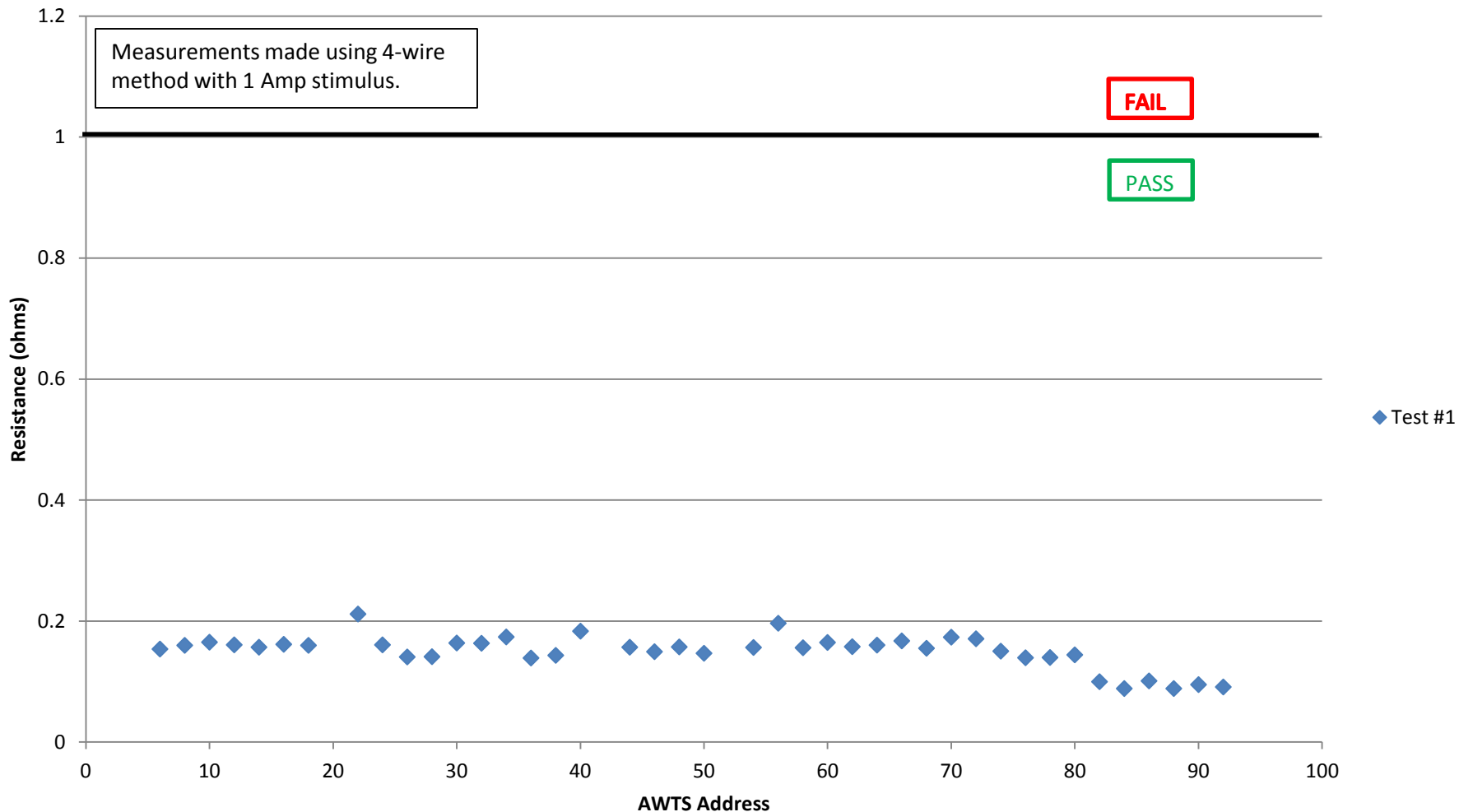
---

- Functional
  - Established by OEM
  - Measured by BIT
  - Often proprietary
  
- Material
  - Initially established by hardware specification
  - Adjusted by recorded measured values
  - Diagnostically decisive results



# Recent Findings

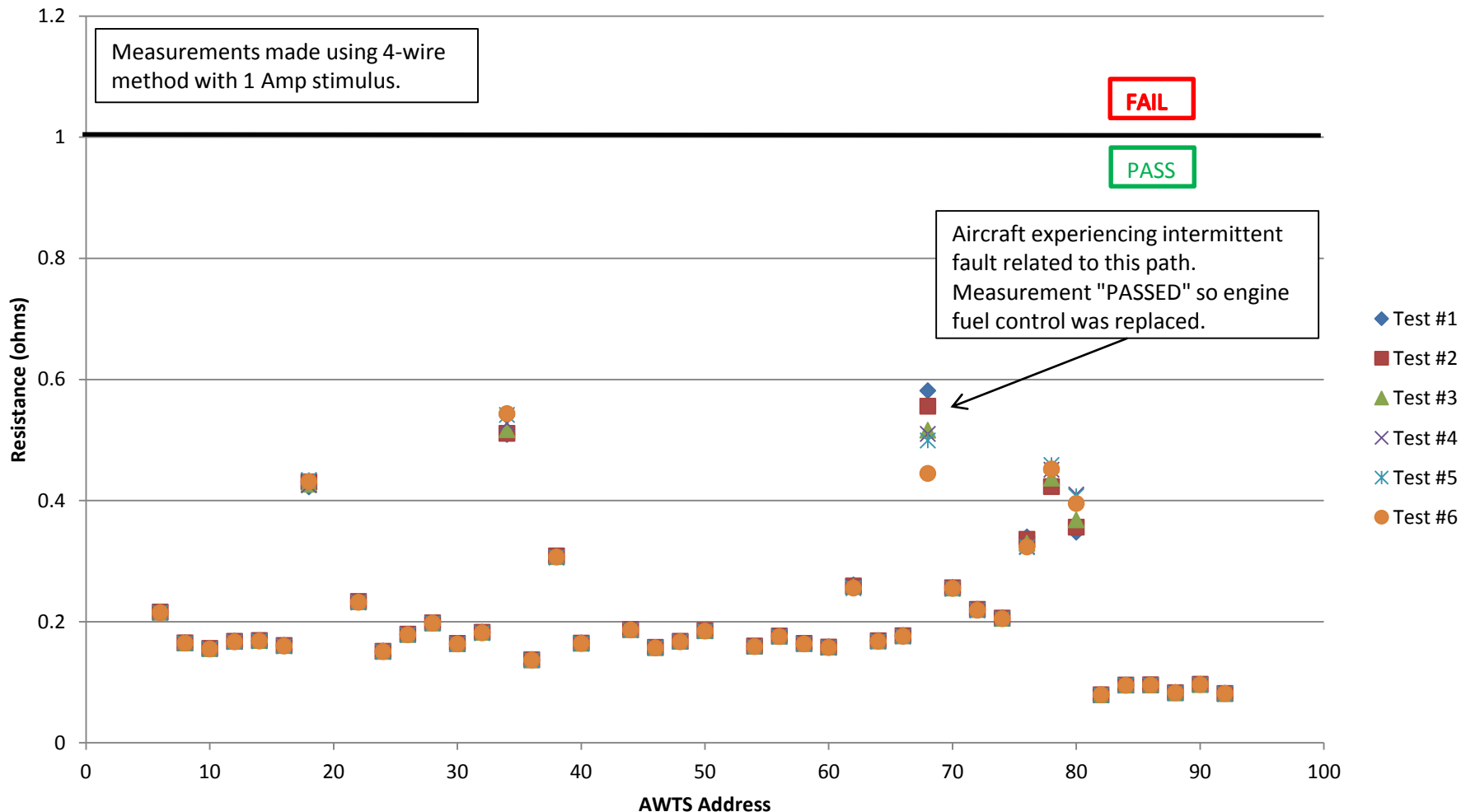
## Integration Test





# Recent Findings

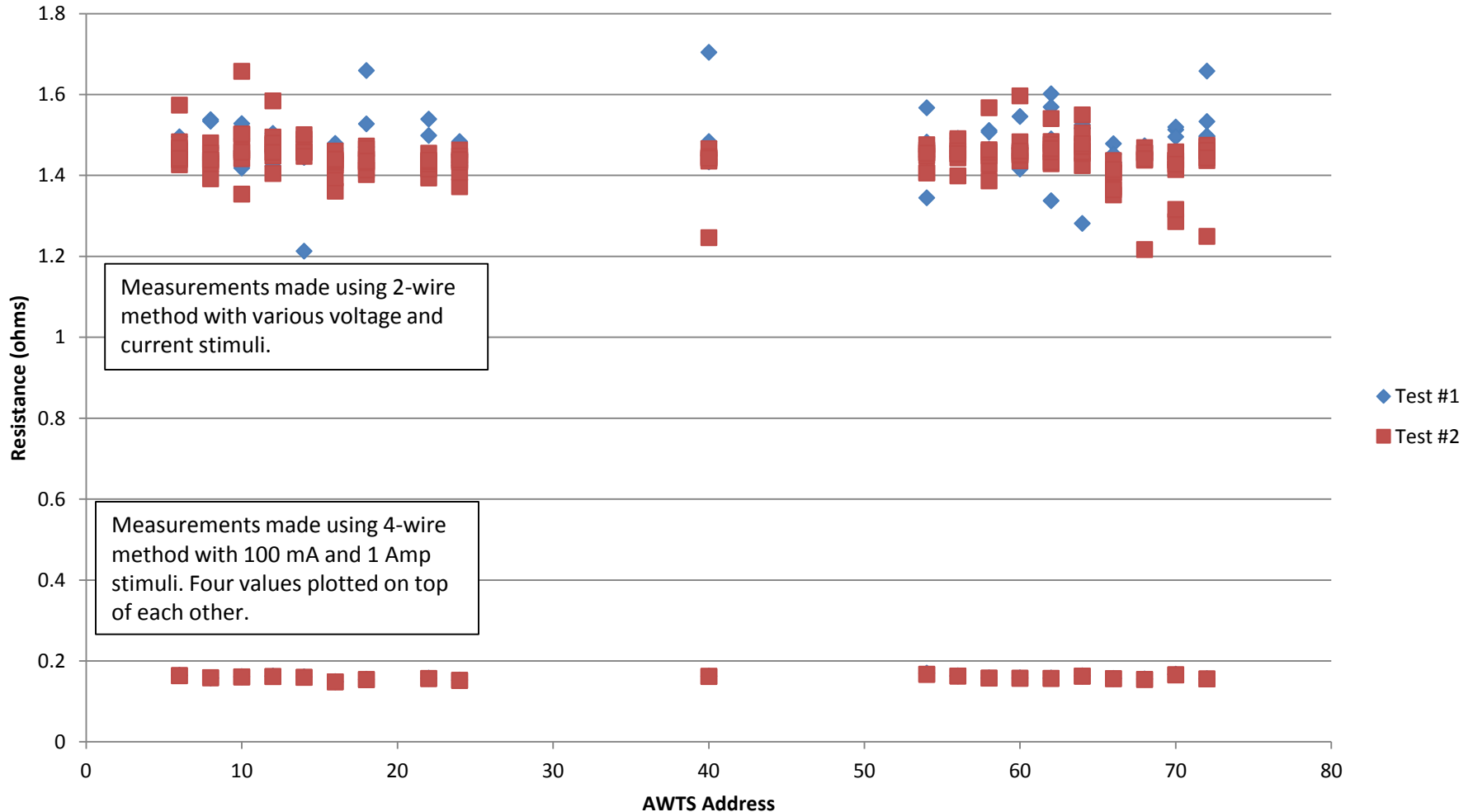
## MH-6M 372 Troubleshoot





# Recent Findings

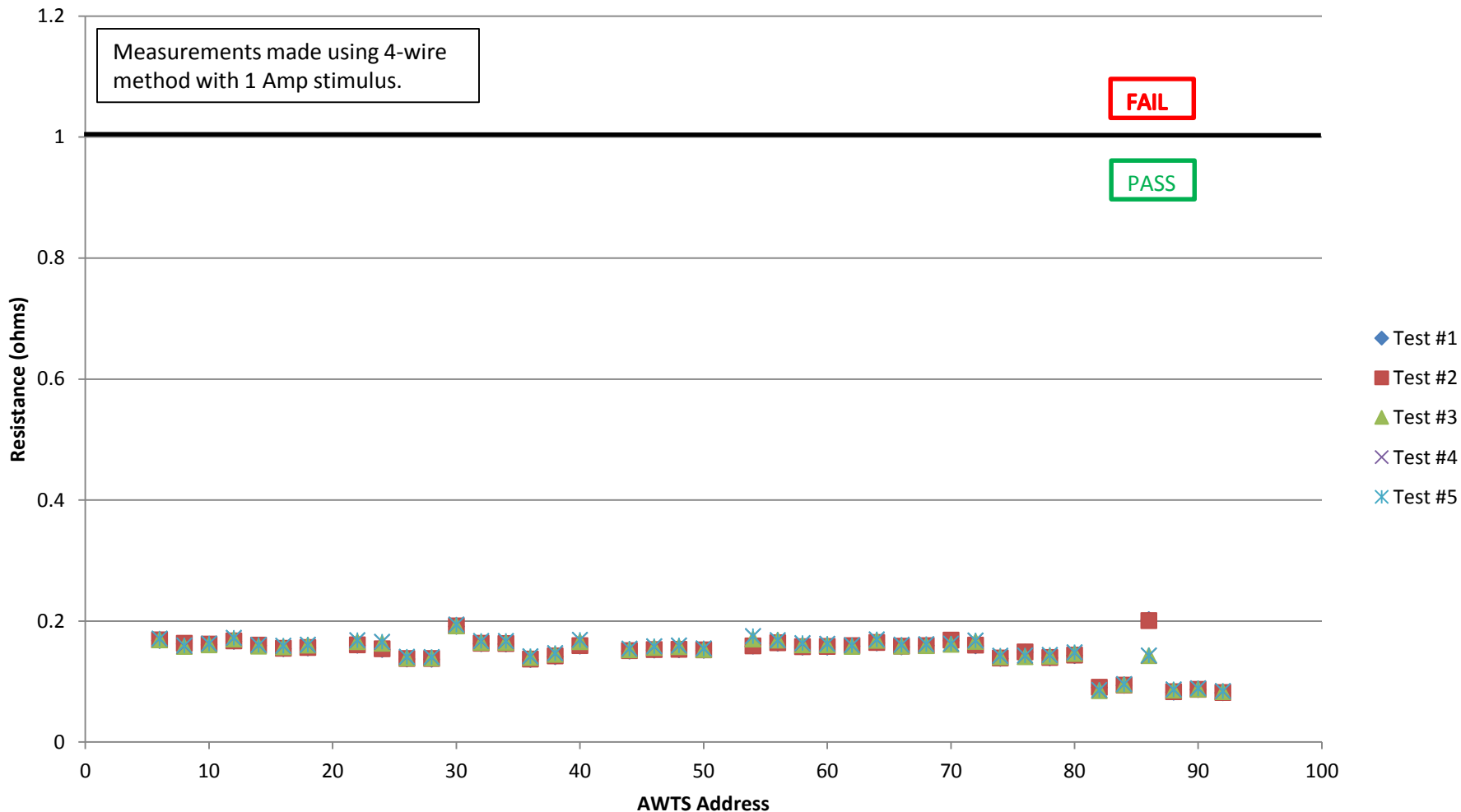
## MH-6M 629 Scheduled Maint.





# Recent Findings

## MH-6M 629 Scheduled Maint.



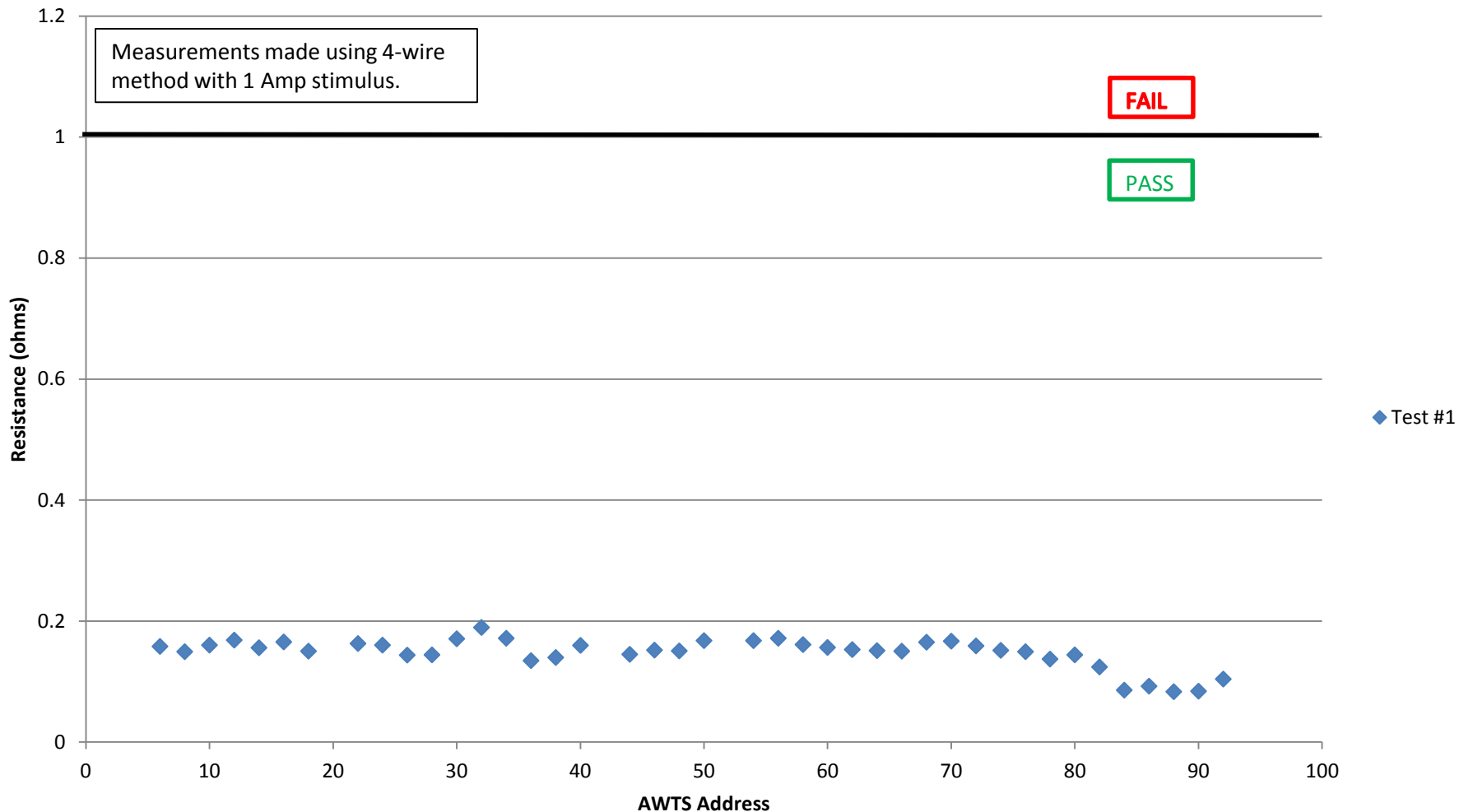






# Recent Findings

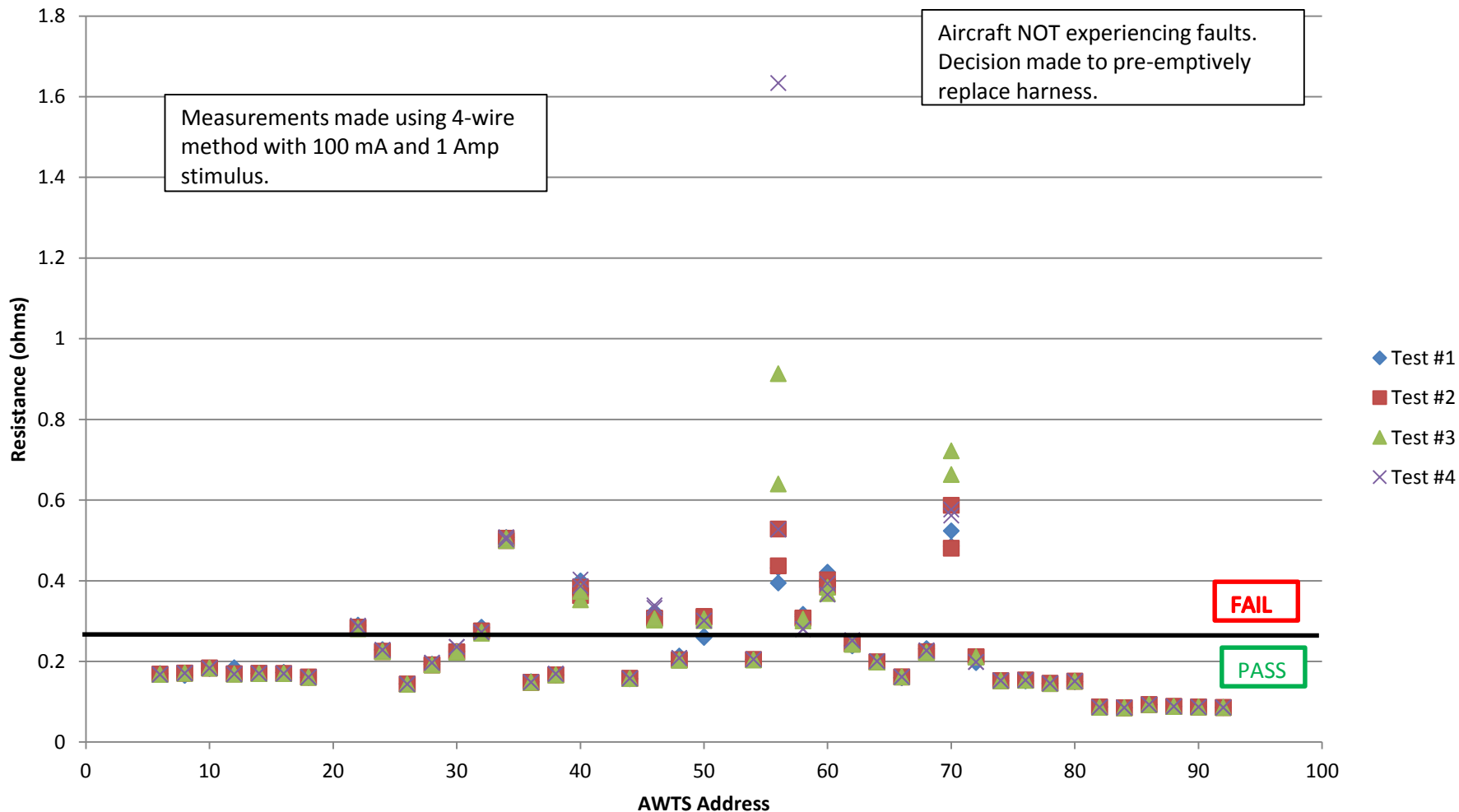
## MH-6M 381 Scheduled Maint.





# Recent Findings

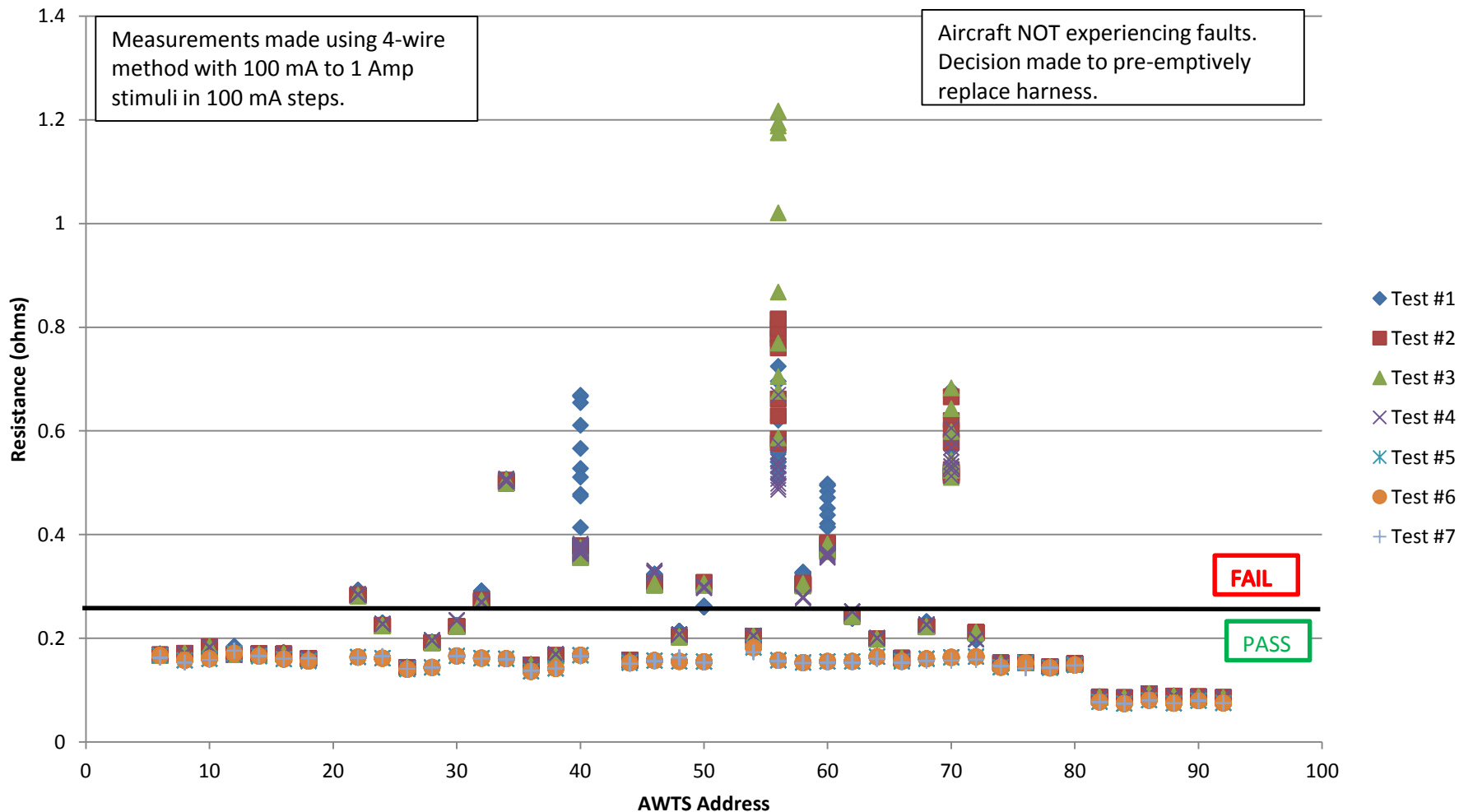
## MH-6M 356 Scheduled Maint.





# Recent Findings

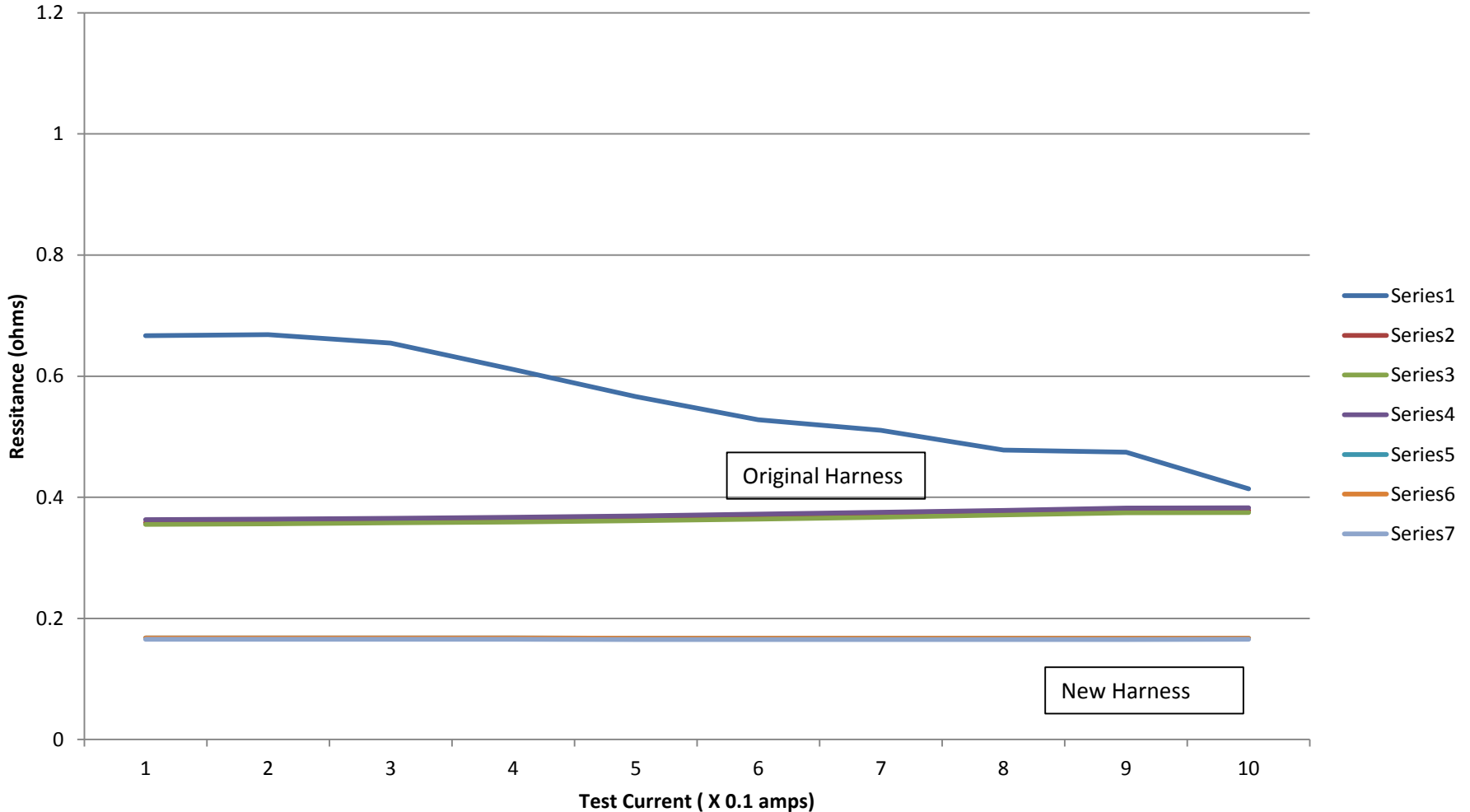
## MH-6M 356 Scheduled Maint.





# Recent Findings

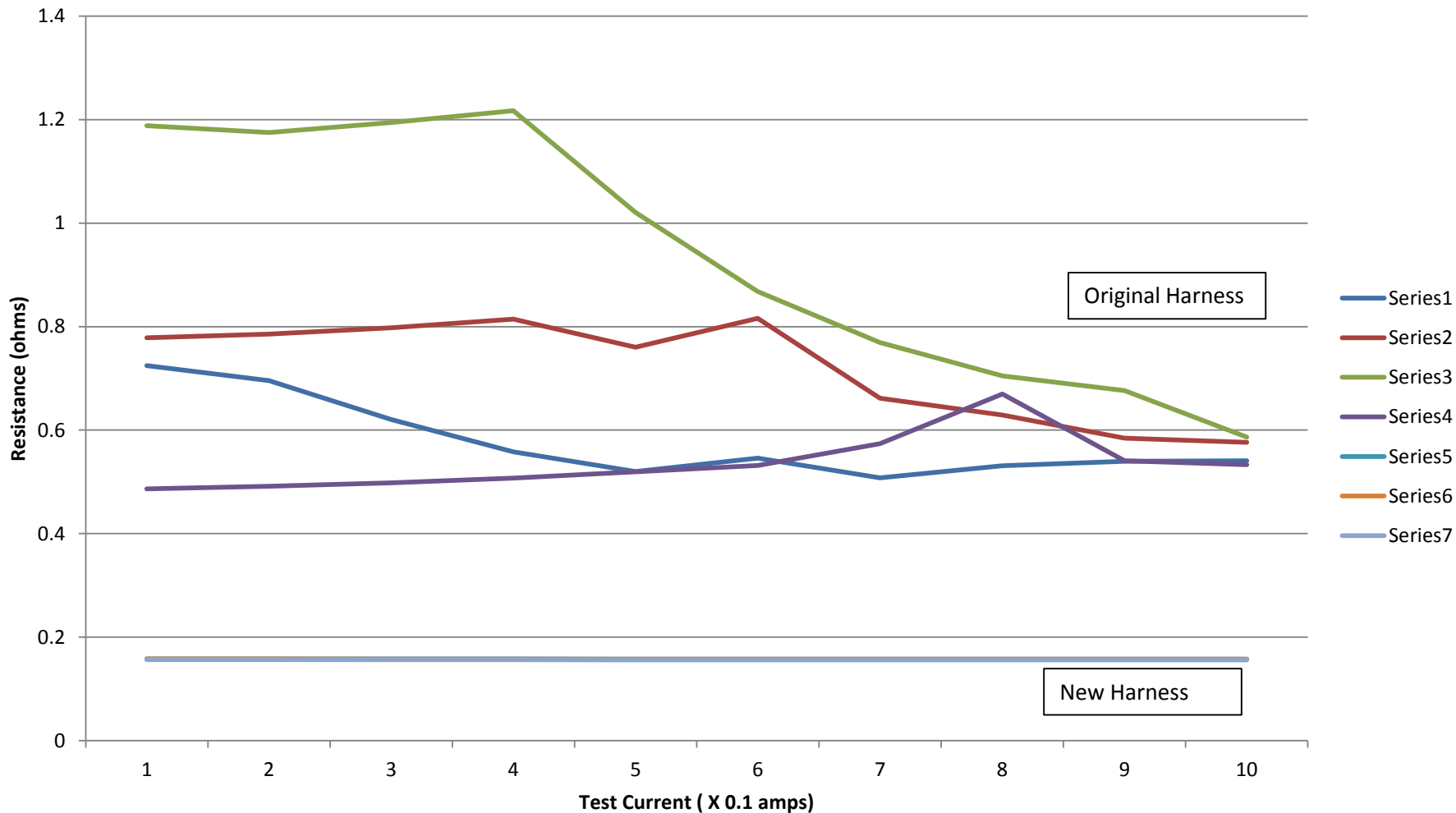
## MH-6M 356 Address 40





# Multi-Stimulus Affects

## MH-6M 356 Address 56





# Fleet Results-Path Forward

---

- FADEC System EWIS evaluated on 22 aircraft
- 6 Engine Interface Harnesses Replaced since January 2015
- 2 Engine Harnesses Replaced
- 2 Auto/Manual Switches Replaced
  
- MH-47G FADEC System Test Protocol Set scheduled to be complete by mid November.
- Expect Similar Findings



# Proposed Certification Protocol

---

- Low power continuity test: 1 VDC and 5 milli-amps
- High power continuity test: 100 milli-amps and 1 amp
- Low Voltage Insulation Resistance (IR): 10 VDC, 5 milli-amps, flex test
- High Voltage Insulation Resistance (IR): 100VDC, 5 milli-amps; 500 VDC, 5 milli-amps
- All measured values recorded
- Initial condition compared to end state
- If materially uniform, what else needs to be done?



# Intermittent Symptoms

---

QUESTIONS



# United States Army Special Operations Aviation Command

---



***VOLAMUS OPTIMUS***



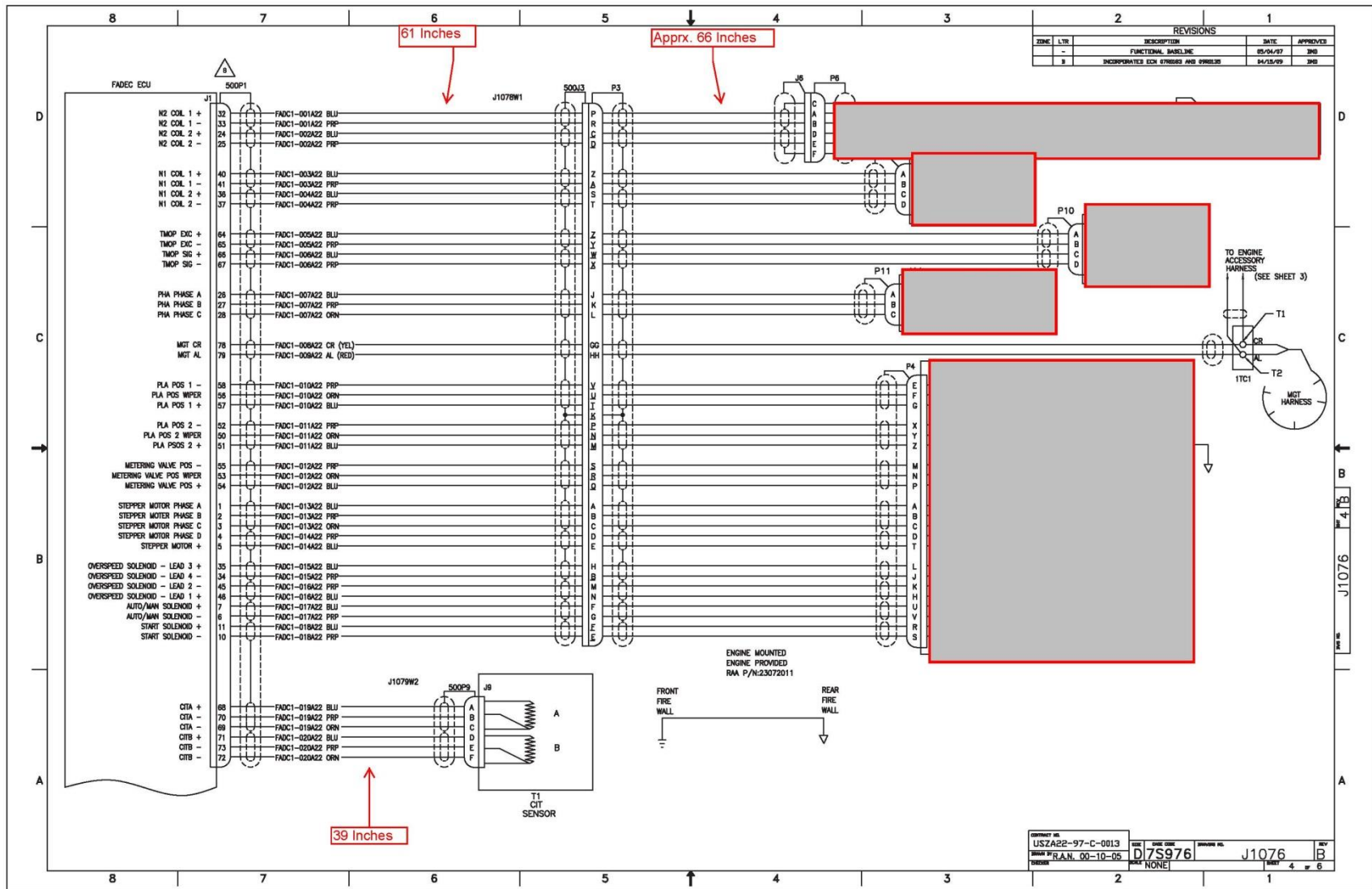
# Intermittent Symptoms

---

**Back Up Slides**



# Intermittent Symptoms



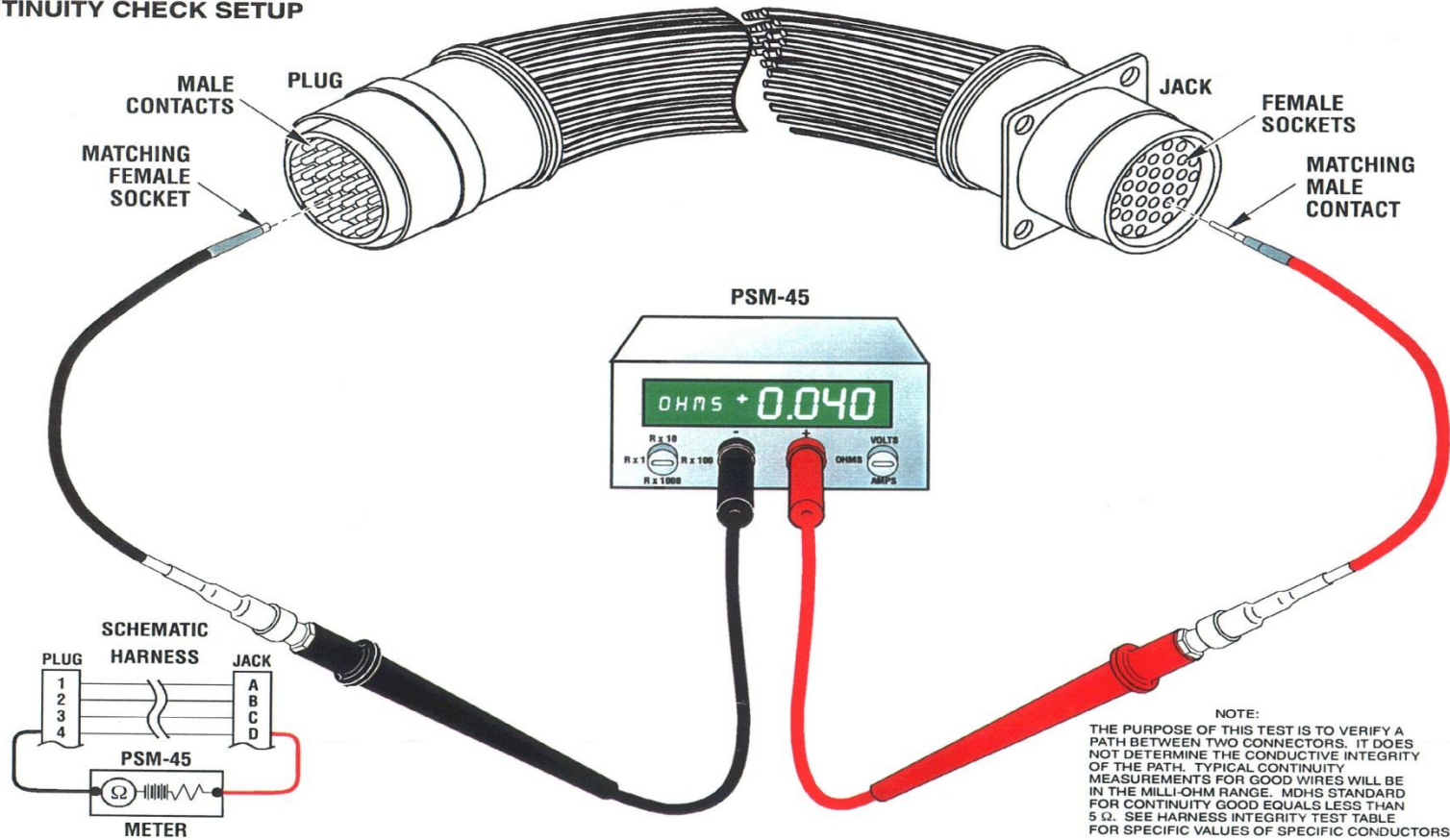


# Continuity Test

TABLES

## CONTINUITY CHECK SETUP

TAG 9-1090-208-23-2



AGJ004  
8-41

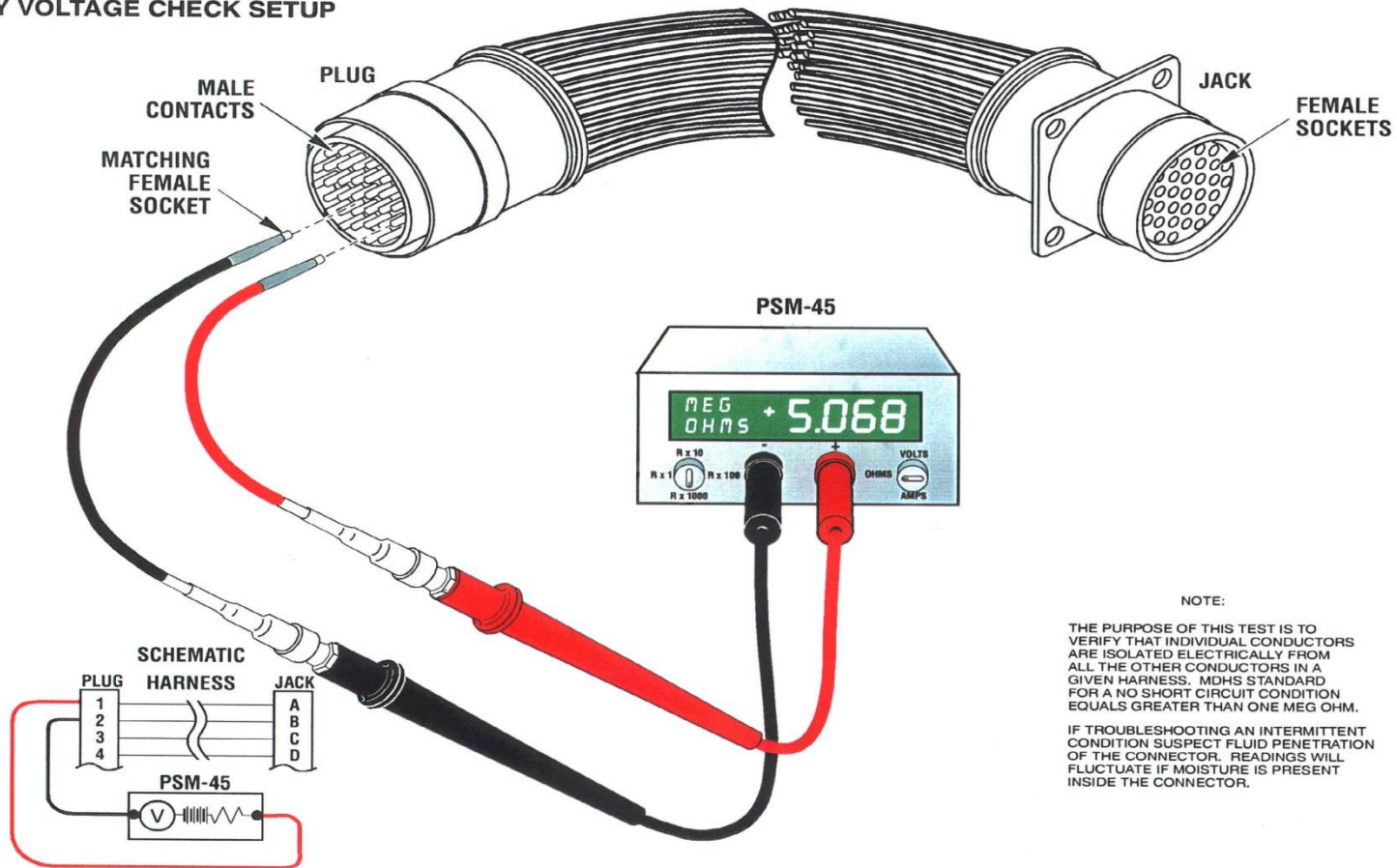


# Short Circuit Test

TABLES

STRAY VOLTAGE CHECK SETUP

TAG 9-1090-208-23-2



NOTE:

THE PURPOSE OF THIS TEST IS TO VERIFY THAT INDIVIDUAL CONDUCTORS ARE ISOLATED ELECTRICALLY FROM ALL THE OTHER CONDUCTORS IN A GIVEN HARNESS. MOHS STANDARD FOR A NO SHORT CIRCUIT CONDITION EQUALS GREATER THAN ONE MEG OHM.

IF TROUBLESHOOTING AN INTERMITTENT CONDITION SUSPECT FLUID PENETRATION OF THE CONNECTOR. READINGS WILL FLUCTUATE IF MOISTURE IS PRESENT INSIDE THE CONNECTOR.

AGJ006  
8-42



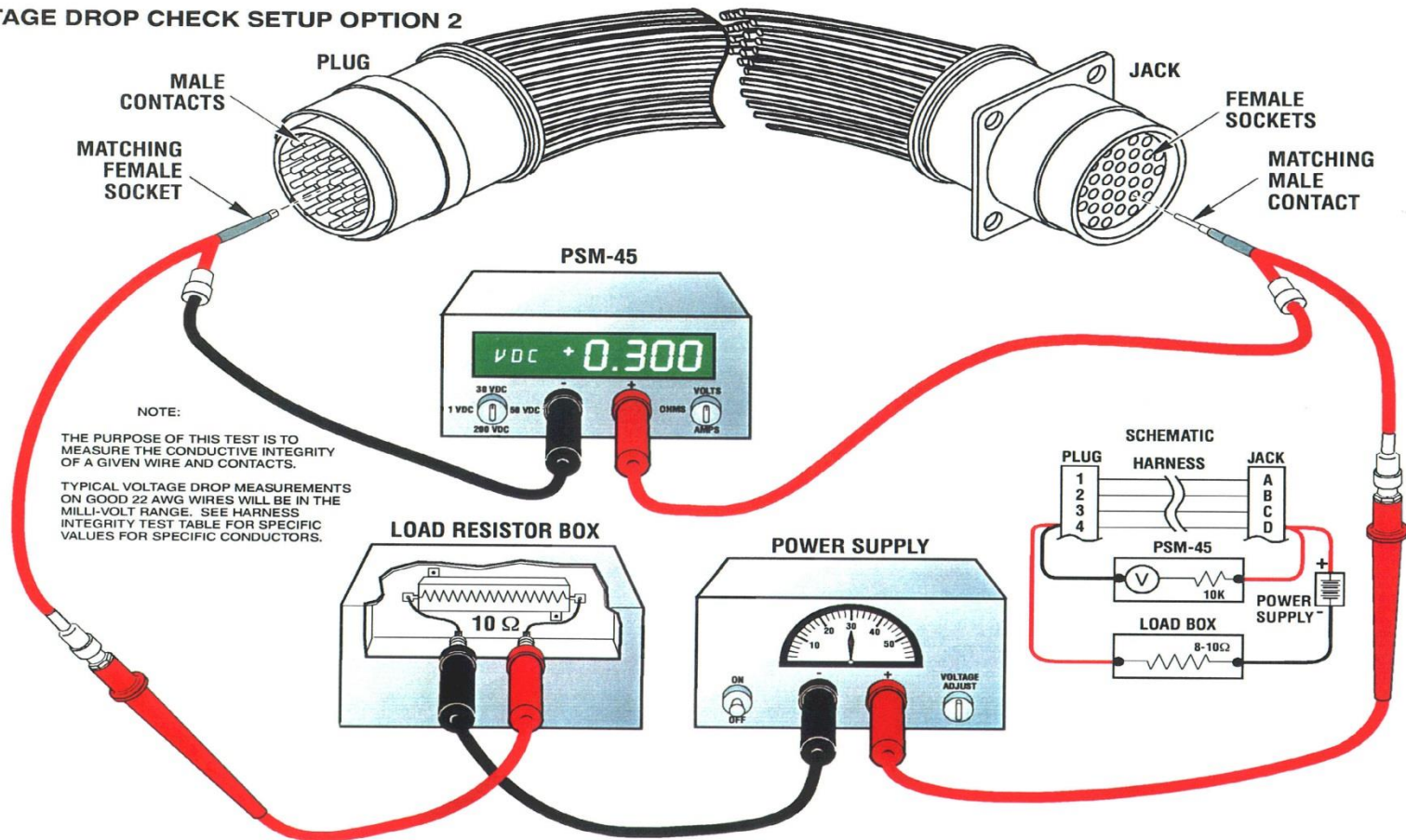


# Voltage Drop Test-Direct

TABLES

TAG 9-1090-208-23-2

## VOLTAGE DROP CHECK SETUP OPTION 2



AGIU007  
8-45