AWTS Thermocouple Top 10 Failures

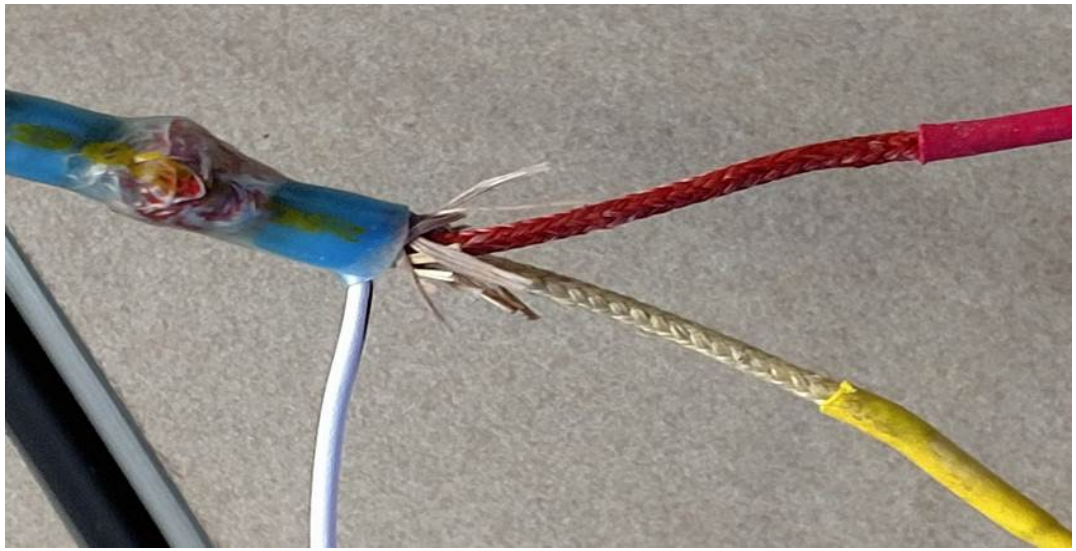
SFC Warden
AAMD ME NCOIC

Problem Statement

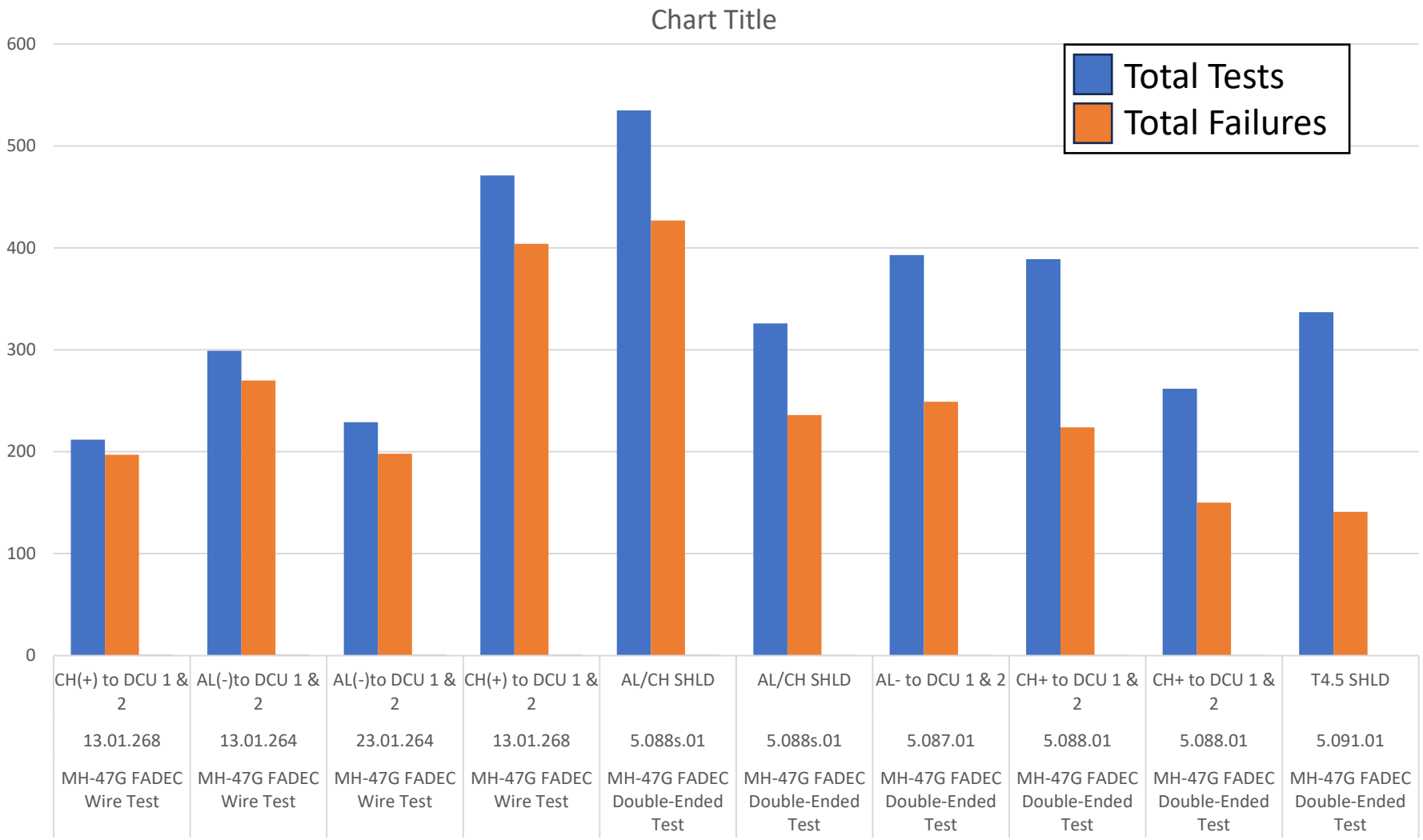
- Since implementing the Automatic Wire Test Set (AWTS), we have experienced a myriad of isolation resistance failures on the aircraft side thermocouple wiring.
- These failures are associated to the material characteristic of the Alumel/Chromel wires.
- This is a material deficiency that can cause erroneous displayed temperature indication, false PAT/PAC values and potential FADEC T4.5 values.
- The maintainers are replacing the thermocouple wires every phase.
- Half of the expended man-hours for AWTS repairs are expended replacing thermocouple wires.

Current Wire Example

- This wire (K2-3-C-307-004) utilizes a cloth insulation on each conductor that is prone to wicking fluid/moisture which causes isolation resistance failures between the conductors or conductors to shield.



Top 10 Failures



Top 10 Failures Raw

Test Name	Test Type	Circuit	Total Tests	Total Failed	% Failed
MH-47G FADEC Wire Test	13.01.268	CH(+) to DCU 1 & 2	212	197	92.92 %
MH-47G FADEC Wire Test	13.01.264	AL(-)to DCU 1 & 2	299	270	90.30 %
MH-47G FADEC Wire Test	23.01.264	AL(-)to DCU 1 & 2	229	198	86.46 %
MH-47G FADEC Wire Test	13.01.268	CH(+) to DCU 1 & 2	471	404	85.77 %
MH-47G FADEC Double-Ended Test	5.088s.01	AL/CH SHLD	535	427	79.81 %
MH-47G FADEC Double-Ended Test	5.088s.01	AL/CH SHLD	326	236	72.39 %
MH-47G FADEC Double-Ended Test	5.087.01	AL- to DCU 1 & 2	393	249	63.36 %
MH-47G FADEC Double-Ended Test	5.088.01	CH+ to DCU 1 & 2	389	224	57.58 %
MH-47G FADEC Double-Ended Test	5.088.01	CH+ to DCU 1 & 2	262	150	57.25 %
MH-47G FADEC Double-Ended Test	5.091.01	T4.5 SHLD	337	141	41.84 %

Existing Cable Specifications

- PN: K20-3-C-307-004
- The Series 307 is constructed by first wrapping each conductor with TFE tape. Each taped conductor is then braided with TFE impregnated fiberglass. The two insulated conductors are then laid parallel and braided again with TFE impregnated fiberglass. The final operation involves heating the entire construction to fuse the insulations.
- ***Performance Capabilities***
  - Continuous fiberglass temperature rating: 900°F (480°C)
  - Continuous TFE temperature rating: 500°F (260°C)
  - Single reading: 1000°F (540°C)
  - TFE retained to 600°F (315°C).

Recommended Cable Specifications

- PN: K20-3-509 (Recommended by Triumph Engine Controls)
- The conductors are insulated with color coded FEP. They're then twisted with a copper drain wire. An aluminized polyester tape is wrapped around the conductors and drain wire. Finally, FEP is applied. The finished construction can withstand temperatures in excess of 400°F (204°C). Twisted conductors minimize EMI and the taped shield eliminates most problems associated with AC "noise."
- ***Performance Capabilities***
  - Continuous temperature rating: 400°F (204°C)
  - Single reading: 500°F (260°C
  - Excellent abrasion, moisture and chemical resistance.

Cable Install Lengths

- 1 side
- -ECU to P19:4 ft 10 in
- -ECU to FWD Junction Box: 29 ft 6 in
- -FWD Junction box to #1 pod interconnect:13 ft
- -FWD Junction box to #2 pod interconnect:17 ft 6 in
- - #1 pod interconnect to #1 pod:9 ft
- - #2 pod interconnect to #2 pod:9 ft 4 in
- Total :83 ft 2 in +/- 5 ft

- #2 side
- -ECU to P19:8 ft 2 in
- -ECU to FWD Junction Box: 31 ft 7 in
- -FWD Junction box to #1 pod interconnect:13 ft 1 in
- -FWD Junction box to #2 pod interconnect:17 ft 2 in
- - #1 pod interconnect to #1 pod:9 ft
- - #2 pod interconnect to #2 pod:9 ft 4 in
- Total :95 ft 4 in +/- 5 ft

- Aircraft total: 178ft 6 in +/- 10 ft

Cable Weights

- Existing Cable
  - K20-3-C-307-004
- 1ft Cable Weight
  - 0.035lbs
- #1 Side
  - 83.16ft - 88ft
  - 2.91lbs - 3.08lbs
- #2 Side
  - 95.33ft – 100ft
  - 3.33lbs – 3.50lbs
- Totals
  - 178.5ft – 188ft
  - 6.24lbs – 6.58lbs

- New Cable
  - K20-3-509
- 1ft Cable Weight
  - 0.015lbs
- #1 Side
  - 83.16ft - 88ft
  - 1.24lbs – 1.32lbs
- #2 Side
  - 95.33ft – 100ft
  - 1.43lbs – 1.50lbs
- Totals
  - 178.5ft – 188ft
  - 2.67lbs – 2.82lbs

Cost Assessment

- K20-3-C-307-004 (01-384-4306) Cost: $8.71/ft
- K20-3-509 (Commercial) Cost: $2.34/ft
- Total :83 ft 2 in +/- 5 ft
  - Existing Cable Cost: approx. $723
  - New Cable Cost: approx. $194
- Total :95 ft 4 in +/- 5 ft
  - Existing Cable Cost: approx. $827
  - New Cable Cost: approx. $222
- Aircraft total: 178ft 6 in +/- 10 ft
  - Existing cable Cost: approx. $1,550
  - New Cable Cost: approx. $416

AAMD/TAG Comments

- Request SOFSA/SRD involvement to identify other potential paths forward.
- AAMD is requesting this replacement to be done during phase as failed cables are identified.
- Triumph:
- ***The thermocouple (TC) wire being used, K20-3-C-307-004, is a TFE Fiberglass insulation which is great for moisture, and chemical resistant. It's not as good for abrasion resistance and so the moisture leaks will cause the measurement errors because of the wire oxidation.***

- ***The suggested replacement, K20-3-509, is the best option to meet all the requirements for resistance to moisture, chemical, and abrasion.***

- ***The configuration of the shielding will need to be the same as the EMC-100 Qual. configuration. The drain wire should be connected to the T4.5 SHILD pin and the other end connected to the connector back shell.***