



# Joint Services Wiring Action Group



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For Open Publication**

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## **Wiring Restraint Devices Fuel Immersion Eval & High Temp Heat Shrink Tape Suitability Eval**

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# Outline



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# Background



- According to the AS50881D specification, the lacing tapes are not to be used inside fuel tanks as they can come loose and clog filters. Also, the plastic straps have been pulled from this specification.
- There are no current procedures or guidelines to provide secondary support of cable/harnesses inside fuel areas.





# Project Overview



- An action chit was initiated to test and evaluate the plastic straps (zip ties) and lacing tape (aramid) after long time exposure on fuel fluid.

The following were some of the wiring restraint devices evaluated during the testing:

- White Nylon Cable Ties
- UV Black Nylon Cable Ties
- Tefzel Cable Ties
- PEEK Cable Ties
- Aramid Lacing Tape



# Project Overview



- Test plan was developed using some of the test requirements of the SAE AS23190 in combination with the test schedule described on the SAE ARP8615 Specification.
- The SAE AS23190 Specification refers to the Wiring, Positioning, and Support Accessories General Spec.
- The SAE ARP8615 Specification refers to the General Specification for Fuel Systems Components.
- The testing was performed at the Pax River AIR 4.4 Propulsion System Evaluation Facility (PSEF).



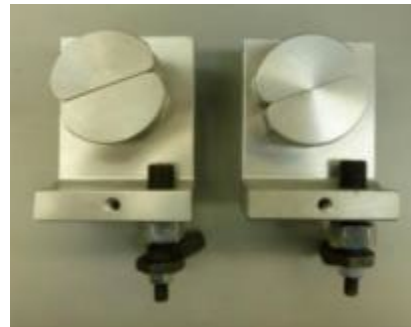
# Objectives



- For this evaluation, a group of plastic straps and lacing tapes will be submerged in fuel, to determine if there is any degradation related to the tensile strength performance of the wiring restraint devices as well as fluid retention of the material.
- The focus of this test will be quantifying performance loss of materials over aircraft life in fuel exposure applications.
- Provide potential resolution to the current selection of wiring restraint devices intended for fuel area applications.
- Document the test results in NAVAIR test format.

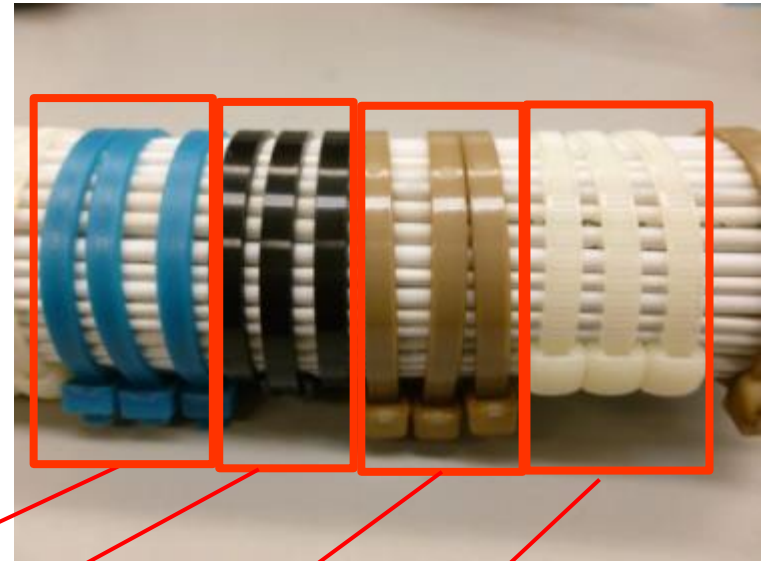
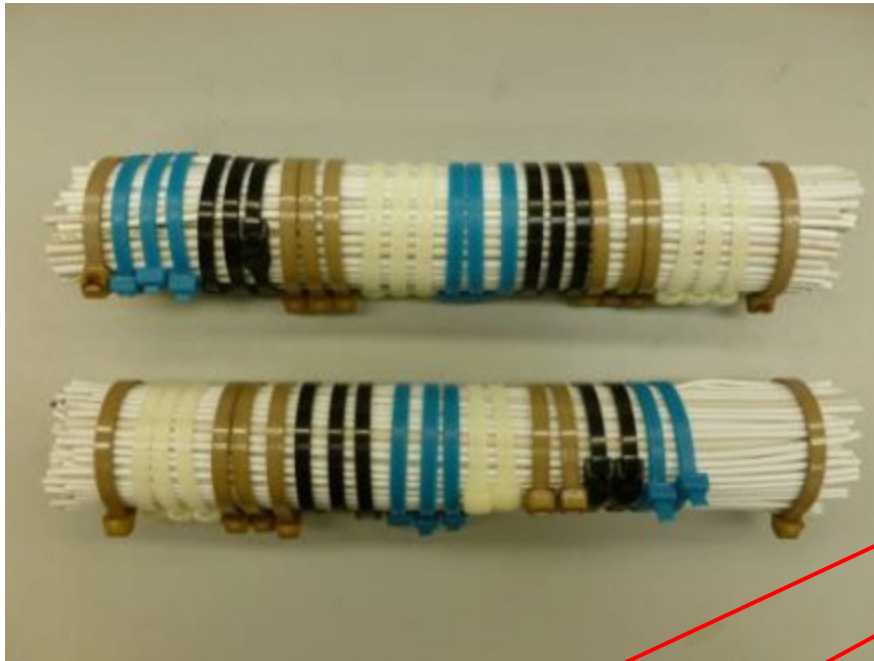


# Tools





# Samples



Tefzel

UV Nylon

PEEK

Nylon





# Samples



Aramid Tape A-A-52084B-C-2  
(Yellow-Natural)



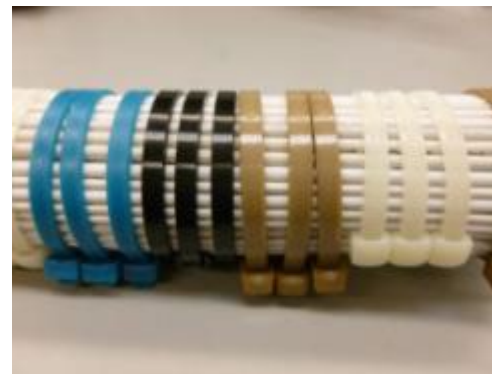
Aramid Tape A-A-52084B-C-2  
(White with Black Traces)



# Observations



- The MS39087-1 tool was used to install the cable ties in the 1.5” wire bundle to reduce issues related to the force required to install the cable ties.
- The Tefzel (Aqua Blue) cable tie was damaged when the MS39087-1 tool was used, therefore, these cable ties were installed manually.
- The UV Black cable ties had a low profile head, different to the rest of the plastic straps. These samples were slightly loose compared with the rest of the samples.
- The PEEK sample was the most difficult to move after installation, the second one was the white nylon.





# Fuel Immersion Test Details



The max temperature rating of the nylon and Tefzel cable ties is 85C while the max temperature rating of the Aramid Lacing Tape and PEEK cable ties is 260C.





# Test Details

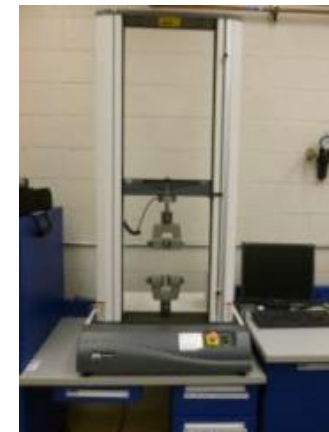


## Test Schedule

	Phase I		Test A	Phase II		Test B	Phase III		Test C
Test Period	Soak	Dry	<b>3 Samples Cable Tie/5 Samples Lacing Tape</b>	Soak	Dry	<b>3 Samples Cable Tie/5 Samples Lacing Tape</b>	Dry	Dry	<b>3 Samples Cable Tie/5 Samples Lacing Tape</b>
Ambient & Fluid Test Temp (Celsius)	85	75		100	75		-57 +/-4	75	
Period Duration (hrs)	96	24		36	30		18	24	
Test Condition	JP-5	Air		JP-5	Air		Air	Air	

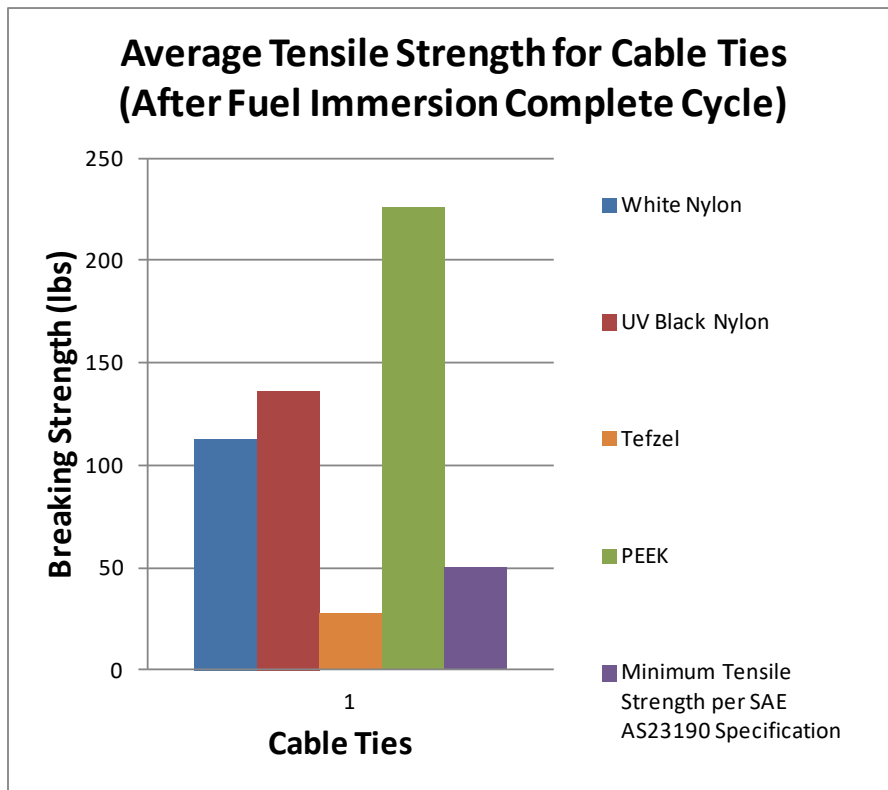
At each of the test periods (Test A ,Test B & Test C), 3 samples of each type shall be subjected to a tensile strength based on the AS23190A and A-A-52084B

Sample	Tensile Strength (lb) Requirement Minimum
White Nylon	50
UV Black Nylon	50
Tefzel	50
PEEK	150
Lacing Tape	50





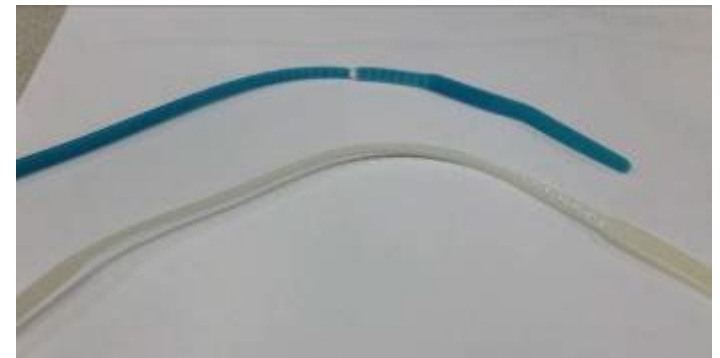
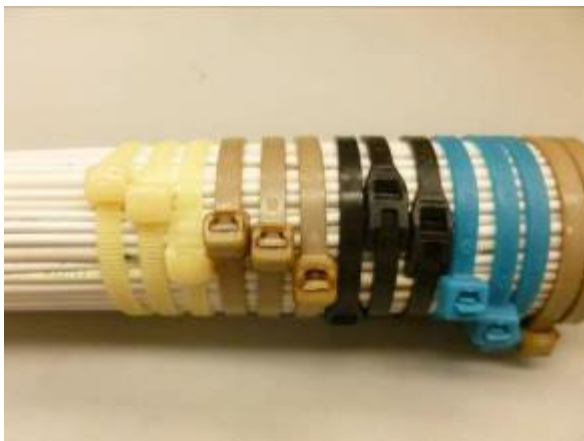
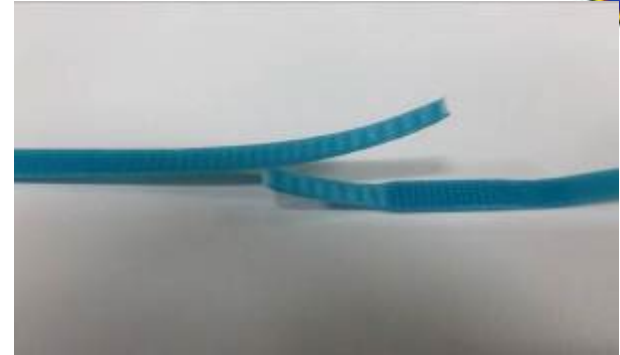
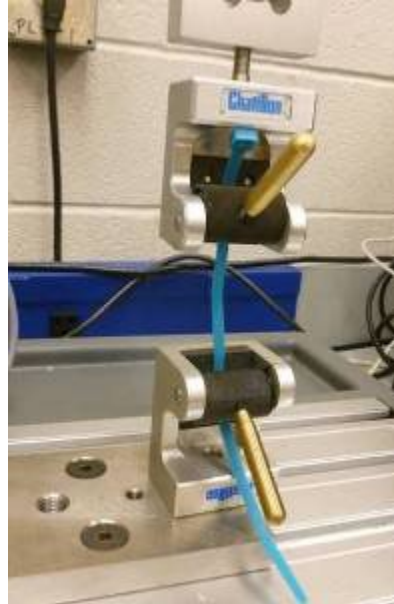
# Results







# Additional Testing





# Conclusion



- Most of the samples passed the breaking strength testing, however, the Tefzel Cable Ties failed the breaking strength testing. The PEEK cable ties were found to have the higher tensile strength properties, however, these cable ties are not qualified under the SAE AS 23190B specification.
- Test Report has PAO approval for public release and is available at JSWAG website, Action Chits #731 and #810.



# Background



- Fuel Splash areas, especially in Severe Wind Moisture Prone (SWAMP) environments require protection to ensure long performance and safety. The NA 01-1A-505-01 manual offers no specific solution for this application.





# Project Overview



According to the OEM, the high temperature heat shrink tape is a bi-layer, side entry, heat recoverable sealing product whose length will shrink a predetermined percentage upon the application of heat in excess of 220C.

The recommended equipment to recover the heat shrink is the Raychem CV-1983 Thermogun or a heat gun/reflector combination that meet at least 2000 W and capable of reaching temps of 300-310C (572-590F).



# Objectives



- Test the performance and suitability of the High Temperature Heat Shrink hi-temp tape along with impact to harness being repaired.
- Evaluate the use of the IR-1759 and HT-900 Heat Guns for use on aircraft in line repairs.
- Document the test results in NAVAIR test format.





# Tools





# Evaluation Details



The evaluation was performed on a small harness (3 feet length, .5 inch diameter), where thermocouples were attached to the harness in different sections of the harness. A layer of teflon tape was used to provide additional temperature protection to the wire harness and to secure a thermocouple to measure the temperature on the wires.



# Results



It was found that the highest temp measured in the wires was 85C. The highest temperature measured over the teflon tape was 142C. The repair area was approx 10 inches.

The evaluation was repeated with the following changes: no teflon tape and a repair area of 6 inches. The highest temperature measured in the wires was found to be 150C with an average 135C.



# Observations



The following are some observations found during the testing:

- High Temperature Peaks were obtained when the heat gun was applied in one area close to the thermocouple and the wire harness kept steady for a few seconds. Therefore, if the heat is evenly applied, the high temp peak will decrease during the installation.
- The removal of the high temp heat shrink tape was found to be easy to remove. No issues were found during the removal of the tape.
- The high temperature heat shrink tape felt very rigid and solid after assembly is cooled.







# IR-1759 Testing



A quick evaluation was performed using the IR-1759 Heat Gun. This evaluation validated that the IR-1759 heat gun can't be used in combination with the high temperature heat shrink tape. The tape started to melt/deteriorate after heating application.





# HT-900B Testing



An evaluation using the HT-900B heat gun was planned, but the HT-900 on station was not capable of reaching the appropriate temperature. This tool was sent to field service for repair, after repair is completed, the HT-900B tool will be used for another suitability testing to determine if the high temp heat shrink tape and HT-900 can be approved for aircraft in-line repairs.



# Conclusion



Suitability Evaluation was completed without any issues using the Steinel HG 2310 Heat Gun at Pax River, Bldg 1461, QPL Lab.

There will be installation limitations, as this tape requires a minimum of 300C of heat application for proper sealing. Wires in affected bundle should be rated >150C to avoid any degradation to the harness.

The use of IR-1759 heat gun is not recommended for the high temp heat shrink tape application.

Another evaluation will be performed using the HT-900B heat gun.



# Questions



## Questions?

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