LIFE PREDICTION OF AGING AIRCRAFT WIRING SYSTEMS

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LIFE PREDICTION OF AGING AIRCRAFT WIRING

PROGRAM GOAL

Develop a Computerized Life Prediction Model Capable of Identifying Present Aging Progress and Predicting End of Life for the Wire

SPECIFIC PHASE I OBJECTIVES

A. Identify Critical Aircraft Wiring Properties

B. Relate Most Common Failures Identified to Wire Mechanism Causing Failure

C. Assess Wiring Requirements, Materials & Stress Environment for Fighter Aircraft

D. Demonstrate Feasibility of a Time - Temperature - Environment Model

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SUMMARY OF PHASE I PROGRAM TASKS

I. Identify critical aircraft wiring failure mechanisms

II. Relate most common failures (identified in Task I) to the wire mechanism causing failure

III. Select fighter aircraft for assessing wiring requirements, materials and overall stress environments

IV. Demonstrate that a time-temperature-environment (stress, fluids etc.) model can be developed

SUMMARY OF ACCOMPLISHMENTS TO-DATE

- Visits made to Tyndall, Eglin and Warner Robbins AF Bases to
  - Interview AF maintenance personnel
  - Gather wiring degradation and failure data based on field activity

- Comprehensive effort to identify failure mechanisms of Kapton insulation based on current knowledge base
  - Analyze tab run data
  - Interview Air Force maintenance personnel.

  Chaffing appears to be the predominant failure mode, followed by insulation cracking and topcoat flaking/cable jacket delamination.

- Site visit made to Davis Monthan AFB in Tucson, AZ to
  - Inspect F-15 and F-16 aircraft predominantly deployed in relatively dry conditions, coastal areas and mixed climate
  - Examine field records
  - Draw representative wire and harness samples from landing gear, avionics bay and other appropriate areas for in-house experimental observations and analysis.

Table I: Wiring Problem Areas Per Narrative Provided By Maintenance Personnel

RCRAFT	PLUG	CONNECTOR BACKSHELL	CONTACTS	BROKE/LOOS	WIRE CHAFFED/SHORTED	SPRT/TIE	TAPE	GROMMET	RELAY/BWI	FUSEHOLD
F-15	21 (14%)	31 (21%)	3 (2%)	6 (4%)	22 (15%)	10 (7%)	46 (31%)	4 (3%)	3 (2%)	1
F-16	9 (4%)	3 (1%)	9 (4%)	103 (46%)	67 (30%)	31 (14%)	0	1	1	0

Table II: Wiring Problem Areas Per H-MAL Codes

Aircraft	How-Mal Code	Description of How-Mal Code	Percent Problems
F-15	105	Loose/Damaged	33
	799	No Defects	22
	070	Broken	12
	020	Chaffed	11
	450	Open	3
	615	Short	3
	730	Loose	3
	750	Missing	2.5
	800	No Defect	2.5
	242	Failed to Open	2
F-16	105	Loose/Damaged	28
	070	Broken	21
	020	Chaffed	10
	242	Failed to Operate	8
	615	Short	4
	127	Improper Adjustment	3
	884	Broken Lead	3
	127	Improper Adjustment	3
	255	Incorrect Output	2
	450	Open	2

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AIRCRAFT INSPECTED AT DAVIS MONTHAN AFB

A'CRAFT TYPE & TAIL NO.	DELIVERY DATE	RETIRED DATE	TOTAL FLIGHT HOURS	CHRONOLOGY	TOTAL MONTHS WET	DRY
				F-15A		
74-127	JULY'76	MAY'92	3045	Langley, VA: 110 Mo Eglin, FL: 22 Mo. Hickham, HI: 36 Mo. Korea: 22 Mo.	0	190
74-128	JULY'76	MAR'92	3215	Luke, AZ: 117 Mo. Dobbins, GA & Warner-Robbins,GA: 72Mo.	117	72
74-135	JULY'76	APR'92	3429	Unknown: 41 Mo Luke, AZ: 73 Mo. Elmendorf, AK: 23 Mo. Hickham, HI: 40Mo. Korea: 15 Mo.	96	55
75-034	OCT'76	JAN'94	3398	Langley, VA: 57 Mo Eglin, FL: 36 Mo. Tyndall,FL: 114 Mo.	0	207

AIRCRAFT INSPECTED AT DAVIS MONTHAN AFB

A'CRAFT TYPE & TAIL NO.	DELIVERY DATE	RETIRED DATE	TOTAL FLIGHT HOURS	CHRONOLOGY	TOTAL MONTHS WET	DRY
				F-16A		
78-007	MAY'79	SEPT'94	3517	Hill, UT: 45 Mo Luke, AZ: 30 Mo. Hill,UT: 23 Mo. Luke, AZ: 23 Mo. Hill,UT: 49 Mo.	177	0
79-353	DEC.'80	AUG.'93	2652	McDill, FL: 152 Mo.		152
79-355	DEC.'80	AUG.'93	3145	McDill, FL: 54 Mo. Hill, UT: 96 Mo.	96	54
79-359	DEC.'80	AUG.'94	3271	Hill, FL: 42 Mo. McDill, UT: 60 Mo. Hill, UT / Tinker, OK: 96 Mo.	102	60

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ANTICIPATED PHASE I RESULTS

- Most Common Wiring Failure Causes in F-15, F-16, & B-1B will be Identified
- New (Baseline) and Representative Aged Wire Samples from High Failure Areas will be Procured for Environmental Analysis
- Test Matrix will be Defined to Simulate Aging/Degradation Process
- Initial Environmental Exposure and Resulting Degradation Evaluation will be Completed to Define Rudiments of a Physical Model for Remaining Life Prediction

PHASE II PROGRAM:
- DEFINITION OF A COMPREHENSIVE PHYSICAL MODEL
- FINE-TUNING, AND
- β-SITE TESTING AT AF BASES FOR MODEL VALIDATION

A TURN-KEY ALGORITHM TO BE DELIVERED TO USAF AT THE CONCLUSION OF THE PHASE II PROGRAM