

CE 33
6324
N96-17080

LIFE PREDICTION OF AGING AIRCRAFT WIRING SYSTEMS

George Slenski
U.S. Air Force
Wright Patterson Air Force Base, Ohio

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**

LIFE PREDICTION OF AGING AIRCRAFT WIRING SYSTEMS

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**

LIFE PREDICTION OF AGING AIRCRAFT WIRING SYSTEMS

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

AIRCRAFT	CONNECTOR		CONTACTS	BROKE/LOOS	WIRE		TAPE	GROMMET	RELAY/BWI	FUSEHOLD
	PLUG	BACKSHELL			CHAPPED/SHORTED	SPLIT/TIE				
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 (48%)	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	?
	450	Open	2

LIFE PREDICTION OF AGING AIRCRAFT WIRING SYSTEMS

AIRCRAFT INSPECTED AT DAVIS MONTHAN AFB

A'CRAFT TYPE & TAIL NO.	DELIVERY DATE	RETIRED DATE	TOTAL FLIGHT HOURS	CHRONOLOGY	TOTAL MONTHS WET	MONTHS DRY
<u>F-15A</u>						
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: 72 Mo.	117	72
74-135	JULY'76	APR'92	3429	Unknown: 41 Mo Luke, AZ: 73 Mo. Elmendorf, AK: 23 Mo. Hickham, HI: 40 Mo. 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	MONTHS DRY
<u>F-16A</u>						
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

LIFE PREDICTION OF AGING AIRCRAFT WIRING

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