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July - Nov. 1968
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1 Jan. 1969

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REPORT

OF THE

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CAPABILITY REVIEW (U)

JULY - NOVEMBER 1968

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APPENDICES

NAVAL AIR SYSTEMS COMMAND

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APPENDICES

1 JANUARY 1969

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REPORT

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JULY – NOVEMBER 1968

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1 JANUARY 1969

NAVAL AIR SYSTEMS COMMAND

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[redacted]

D. PROPOSED ACTION	CNO	FLEET CDR's	TYCOM's	CVA's	CVW's	RCVW's	CNM	NAVAIR	NAVORD	BUPERS	CNA TECHTRA	OPTEVFOR	NWC CHINA LAKE	NMC PT. MUGU	NADC	NATC	NATSF	NWEF	NARF's	NWS's	FMSAEG	SPCC	NAVMAG SUBIC	NAV AV SAF CEN	INDUSTRY
III V A.1.d.	X																								
V A.2.a.								X																	
V A.2.b.								X																	
V A.2.c.								X																	
VI A.1.			X	X				X																	
VI A.2.			X					X	X											X					
VI A.3.								X	X											X					
VI A.4.								X	X											X					
VI B.1.	X							X																	
VI B.2.	X		X			X		X		X	X														
VII A.1.								X																	
VII A.2.								X																	
VII B.			X					X																	
VII C.			X																X						
VII D.1.								X											X						
VII D.2.								X											X						
VII D.3.								X																	
VII D.4.								X																	X
VII D.5.			X					X											X						
VII E.1.								X																	
VII E.2.								X																	
VII E.3.								X																	
VII E.4.								X																	X
VII E.5.			X		X			X																	
VII F.								X																	X
VII G.1.a.			X																						
VII G.1.b.														X											
VII G.1.c.														X											
VII G.1.d.								X																	
VII G.2.a.								X																	
VII G.2.b.								X						X											
VII G.2.c.														X											
VII G.2.d.														X											
VII G.2.e.																						X			
VII G.2.f.			X																						
VII G.2.g.								X									X								
VIII A.	X																								
VIII B.1.								X																	
VIII B.2.							X	X																	
VIII B.3.							X	X																	
VIII B.4.	X						X	X																	
VIII C.	X	X	X																						
IV I A.	X	X																							
I B.1.	X	X	X																		X				
I B.2.		X	X																						
I B.3.		X	X																						
I B.4.		X	X																						
I B.5.		X	X																						
I B.6.		X	X																						
I B.7.																					X				
I C.1.	X	X	X		X																				
I C.2.	X	X	X		X																				
I C.3.	X		X				X	X																	
I D.	X		X				X	X																	
I E.	X	X	X			X																			

D. PROPOSED ACTION	CNO	FLEET CDR's	TYCOM's	CVA's	CVW's	RCVW's	CNM	NAVAIR	NAVORD	BUPERS	CNA TECHTRA	OPTEVFOR	NWC CHINA LAKE	NMC PT. MUGU	NADC	NATC	NATSF	NWEF	NARF's	NWS's	FMSAEG	SPCC	NAVMAG SUBIC	NAV AV SAF CEN	INDUSTRY
IV I F.	X	X	X				X	X																	
I G.			X																						
II A.								X																	X
II B.								X					X												
III A.								X																	
III B.	X						X	X																	
III C.	X						X	X																	
III D.	X							X																	X
III E.	X							X																	X
III F.								X						X	X										X
IV A.								X				X													X
IV B.								X				X													X
IV C.			X					X																	X
V A.	X							X													X				X
VI A.1.a.(1)								X																	X
VI A.1.a.(2)								X																	X
VI A.1.b.								X																	X
VI A.2.a.(1)			X		X			X																	
VI A.2.a.(2)								X																	
VI A.2.a.(3)			X					X																	
VI A.2.a.(4)								X																	X
VI A.2.a.(5)								X																	X
VI A.2.a.(6)								X									X								X
VI A.2.b.								X																	
VI A.3.a.								X																	
VI A.3.b.								X																	X
VI A.3.c.(1)								X																	X
VI A.3.c.(2)																									X
VI A.3.d.(1)								X																	X
VI A.3.d.(2)								X																	X
VI A.3.d.(3)	X							X																	X
VI A.3.e.								X						X											
VI A.4.a.(1)								X																	
VI A.4.a.(2)	X						X	X																	
VI A.4.a.(3)	X						X	X																	
VI A.4.a.(4)								X																	
VI A.4.a.(5)								X											X						
VI A.4.b.(1)								X																	
VI A.4.b.(2)	X						X	X																	
VI A.4.b.(3)	X						X	X																	
VI A.5.	X							X				X													
VI B.1.a.(1)								X						X											X
VI B.1.a.(2)								X																	
VI B.1.a.(3)								X																	
VI B.1.b.								X																	X
VI B.1.c.(1)								X																	
VI B.1.c.(2)								X																	X
VI B.1.d.								X														X			
VI B.1.e.(1)								X																	
VI B.1.e.(2)								X																	X
VI B.1.f.								X																	
VI B.1.g.								X						X					X						X
VI B.1.h.							X	X						X											
VI B.1.i.(1)																									X
VI B.1.i.(2)								X																	X
VI B.1.i.(3)								X																	X

x

	D. PROPOSED ACTION	CNO	FLEET CDR's	TYCOM's	CVA's	CVW's	RCVW's	CRM	NAVAIR	NAVORD	BUPERS	CRA TECHTRA	OPTEVFOR	NWC CHINA LAKE	NMC PT. MUGU	NADC	NATC	NATSF	NWEF	NARF's	NWS's	FMSAEG	SPCC	NAVMAG SUBIC	NAV AV SAF CEN	INDUSTRY
IV	VI B.1.j.(1)								X																	X
	VI B.1.j.(2)								X						X					X						
	VI B.1.j.(3)								X																	
	VI B.2.a.	X							X																	
	VI B.2.b.	X							X						X											
	VI B.2.c.	X							X																	
	VI B.3.a.			X					X					X												
	VI B.3.b.	X		X				X	X																	
	VI B.3.c.	X						X	X																	
	VI B.3.d.	X																								
	VI B.3.e.								X																	
	VI B.4.a.(1)								X																	
	VI B.4.a.(2)								X											X						
	VI B.4.a.(3)								X											X	X	X				
	VI B.4.b.(1)								X						X											
	VI B.4.b.(2)								X																	
	VI B.5.a.(1)								X																	
	VI B.5.a.(2)								X											X						
	VI B.5.a.(3)								X						X					X						X
	VI B.5.a.(4)	X																								
	VI B.5.a.(5)	X																								
	VI B.5.b.(1)								X																	
	VI B.5.b.(2)	X						X	X																	
	VI B.5.c.(1)								X																	
	VI B.5.c.(2)	X						X	X																	
	VI B.5.c.(3)	X						X	X																	
	VI C.1.a.								X																	
	VI C.1.b.								X																	
	VI C.1.c.								X																	
	VI C.2.								X																	
	VI C.3.								X					X												
	VI C.4.								X																	X
V	I A.								X																	
	I B.							X	X																	
	I C.								X																	
	I D.								X	X					X					X	X	X				X
	I E.																			X						
	I F.								X																	
	II A.								X											X						X
	II B.								X											X						X
	II C.	X						X	X											X						
	II D.								X																	X
	II E.(a)								X											X						
	II E.(b)								X																	
	II E.(c)								X											X			X			
	II E.(d)								X											X			X			
	II E.(e)			X																						
	II F.																			X						
	II G.								X											X						
	II H.								X											X						X
	II I.								X						X					X	X	X				
	II J.								X											X						X
	II K.								X											X						X
	II L.								X																	
	III A.								X											X		X				

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D. PROPOSED ACTION		CNO	FLEET CDR's	TYCOM's	CVA's	CVW's	RCVW's	CNM	NAVAIR	NAVORD	BUPERS	CNA TECHTRA	OPTEVFOR	NWC CHINA LAKE	NMC PT. MUGU	NADC	NATC	NATSF	NWEF	NARF's	NWS's	FMSAEG	SPCC	NAVMAG SUBIC	NAV AV SAF CEN	INDUSTRY
V	IV A.								X											X	X					
	V A.								X																	
	V B.								X																	
	VI A.								X									X								X
VI	3 A.								X					X	X						X	X				
	3 B.								X					X	X							X				
	3 C.	X						X	X																	
	3 D.	X	X	X				X	X													X				
	3 E.			X		X																				
	3 F.	X						X	X																	
	3 G.	X						X	X																	

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[redacted]

PROPOSED ACTION MATRIX

This section contains a proposed action matrix wherein proposed action assignments for commands and activities concerned are keyed to each of the specific recommendations appearing in Appendices I through VI.

APPENDIX	D. PROPOSED ACTION / RECOMMENDATION NUMBER	CNO	FLEET CDR's	TYCOM's	CVA's	CVW's	RCVW's	CNM	NAVAIR	NAVORD	BUPERS	CNA TECHTRA	OPTEVFOR	NWC CHINA LAKE	NAVMISCEN PT. MUGU	NADC	NATC	NATSF	NWEF	NARF's	NWS's	FMSAEG	SPCC	NAVMAG SUBIC	NAV AV SAF CEN	INDUSTRY
I	I								X																	
	II								X																	X
	III								X																	
	IV								X																	X
	V								X																	X
	VI								X					X	X											X
	VII								X					X	X											X
	VIII	X						X	X																	
	IX								X					X	X	X	X	X	X	X						X
II	II B.1.								X	X											X					
	II B.2.								X																	
	II B.3.								X																	
	II C.1.								X	X											X					
	II C.2.								X	X																
	II C.3.								X																	X
	II C.4.								X												X					
	II D.1.								X																	
	II D.2.								X														X			
	II D.3.								X	X																
	II D.4.								X												X		X			
	II D.5.								X												X					
	II D.6.				X				X													X			X	
	II D.7.								X																	
	II E.1.								X																	
	II E.2.								X	X																
	II E.3.								X	X												X				
	II E.4.								X																	
	II F.1.								X							X					X					
	II F.2.								X																	
	II F.3.			X	X	X	X		X	X											X	X				
	II F.4.								X																	
	II F.5.								X	X												X				
	II F.6.			X					X	X															X	
	II G.1.								X																	
	II G.2.			X					X																	
	II G.3.								X																	
	II G.4.								X																	
	II G.5.								X																	
	II G.6.								X																	
III	I A.	X	X	X	X						X															
	I B.	X	X	X	X	X					X															
	I C.1.	X							X			X														
	I C.2.								X			X														
	I C.3.								X			X														
	I D.1.	X							X																	X

D. PROPOSED ACTION		CNO	FLEET CDR's	TYCOM's	CVA's	CVW's	RCVW's	CNM	NAVAIR	NAVORD	BUPERS	CNA TECHTRA	OPTEVFOR	NWC CHINA LAKE	NMC PT. MUGU	NADC	NATC	NATSF	NWEF	NARF's	NWS's	FMSAEG	SPCC	NAVMAG SUBIC	NAV AV SAF CEN	INDUSTRY
III	I D.2.	X							X					X	X											X
	I E.	X											X													
	I F.	X							X																X	X
	I G.	X							X			X														X
	I H.			X								X														
	I I.1.			X	X	X	X																			
	I I.2.			X																						
	I I.3.						X						X		X											
	I I.4.			X			X																			
	I I.5.			X		X																				
	I J.1.			X								X			X											
	I J.2.			X																						
	I K.1.	X									X	X														
	I K.2.											X														
	I K.3.			X							X															
	I K.4.	X										X														
	I K.5.	X										X														
	I K.6.	X										X														
	I K.7.	X										X														
	I K.8.			X			X																			
	II A.1.			X		X			X																	X
	II A.2.								X									X								
	II A.3.								X																	
	II B.1.								X																	
	II B.2.						X		X				X													
	II B.3.								X									X								X
	II C.7.a.(a)								X						X		X		X							
	II C.7.a.(b)								X					X	X		X		X							X
	II C.7.a.(c)													X	X				X							X
	II C.7.b.(2)	X	X	X															X							
	II C.7.c.(2)							X																		
	II C.7.d.(2)								X																	
	II C.8.								X					X	X		X									
	II D.1.								X																	
	II D.2.								X						X							X				
	II D.3.							X	X	X				X	X										X	
	II E.1.								X									X								X
	II E.2.								X																	X
	II E.3.								X									X								X
	II E.4.								X									X								X
	III A.1.	X		X	X	X																				
	III A.2.			X	X	X																				
	III B.								X																	
	III C.1.	X		X					X						X											
	III C.2.	X	X	X				X	X	X																
	IV A.	X		X	X						X															
	IV B.								X																	
	IV C.								X																	
	IV D.1.			X					X																	
	IV D.2.			X	X				X	X											X					
	IV D.3.								X																	X
	IV D.4.								X																	X
	IV E.								X																	X
	V A.1.a.								X										X							
	V A.1.b.								X																	
	V A.1.c.								X																	

[redacted] UNCLASSIFIED

APPENDIX I

REPORT

OF THE

AIR-TO-AIR MISSILE SYSTEM

CAPABILITY REVIEW (U)

JULY–NOVEMBER 1968

APPENDIX I

NAVAL AIR SYSTEMS COMMAND

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APPENDIX I

REPORT OF TASK TEAM ONE

Chairman: Mr. B. W. Hays, Naval Weapons Center, China Lake

"Is Industry delivering to the Navy a high quality product, designed and built to specifications?"

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INTRODUCTION

A. The mission of Task Team One was to determine, "Is industry delivering to the Navy a high quality product, designed and built to specifications?" and, if the answer to this question were negative, to ascertain the causes and determine possible corrective actions. In preparing to answer this question Task Team One, comprised of 30 representatives from the Navy and industry, met over a three-day period during the week of 19 August 1968 to discuss the problem. In addition, members of Team One visited Aerojet; Ling-Temco-Vought; McDonnell Douglas; Rocketdyne; Raytheon; Westinghouse; the Air Force Plant Representative at Aerojet; Defense Contracts Administration Service Office; Navy Plant Representative at Westinghouse; Chief of Naval Operations; Naval Air Systems Command, Naval Missile Center, Point Mugu and Naval Weapons Center, China Lake.

B. In the course of inquiry, it was pointed out repeatedly that the Navy does not actually define what is meant in air-to-air systems by a "high quality product" and relies on industry to determine how much quality is required in each part of the system. The individual contractor's integrity is jeopardized if he either underestimates the requirements or fails to meet his established criteria. Moreover, government contracts are written in a manner which discourages expenditures by industry on quality control beyond what industry feels are the bare minimum requirements. This results in pitting the contractors' profit incentives against maintaining a high integrity image.

C. Task Team One feels that industry has not been delivering an air-to-air system product of sufficiently high quality to satisfy the Navy requirements. It is felt, however, that industry can deliver as high a "high quality" product as is requested of them. It is incumbent upon the Navy to define more adequately its systems quality requirements, and to state in contracts its quality requirements instead of quality goals. Further, when quality becomes a stated requirement, it should be funded by the Navy in the same manner as any other contractual end item.

INDEX

I. NAVAIR AIR-TO-AIR SYSTEM PROGRAM MANAGEMENT

Conclusion

Questions concerning the effectiveness of the current NAVAIR Management of Air-to-Air Missile Systems were raised by several of the groups consulted in both industry and the Navy. There was general concurrence that better quality products could be procured if better program direction were accorded to all elements of the missile systems.

A detailed study of the NAVAIR Management System reveals it to be conceptually sound and functionally similar to management schemes successfully employed elsewhere in the military and in industry. NAVAIR Instructions 5400 series establish sufficient authority to make the program organization effective. However, the study revealed that both the SIDEWINDER and SPARROW III program management organizations are extremely understaffed. It is estimated that the SPARROW III Program Manager should have six to seven people (vice the current one) and the SIDEWINDER Project Coordinator should have five people (vice the current one). Discussions with both the Project Management Office, PMO, and the NAVAIR functional groups revealed that heavy workloads for understaffed functional groups are also prevalent. The PMO's devote the majority of their efforts to fulfilling their responsibilities to their immediate line supervisors, Air 01 and PMA, for program coordination, budgetary submissions, and program procurement actions. Since the PMO's do not have the staff to direct the functional groups in accordance with NAVAIRINST's 5400 series, they have delegated such authority to the functional groups. Unfortunately, since basic missile system sub-groups such as the rocket motor, warhead, guidance, launcher, etc., are handled by different functional divisions, delegation of program coordination functions, by exception or otherwise, results in coordination between Division level personnel rather than at the Branch level. Further with the functional tasks elevated to the Division level, it becomes difficult for the PMO, a Commander in each instance, to assert authority over a senior officer, even though his authority is provided by NAVAIRINST's. This results in uncoordinated efforts between the functional groups as well as ineffective utilization of the currently available personnel. Based on detailed study, it is concluded that while the basic management scheme is sound, it can definitely be improved to provide greater program direction and coordination of the functional personnel. This, in turn, will improve program direction of industry efforts and greatly assist in meeting the Government quality needs.

Recommendation

It is recommended that the NAVAIR Program Management and functional organizations be consolidated by realignment of personnel currently assigned so as to maximize their effectiveness without significantly increasing the number of personnel required. Realignment to provide better lines of authority and physical colocation of many of the functional personnel and PMO's would significantly improve communications and program coordination and direction. Detailed comments on the internal organizational actions recommended have been submitted directly to the Commander, Naval Air Systems Command, by the Review Director.

II. QUALITY CONTROL AT THE CONTRACTOR'S FACILITY

Conclusion

Team One's findings indicate that the Navy specifies quality goals to industry to a greater extent than it specifies specific quality requirements. The most explicit contractual coverage of Quality Control (QC) is the application of MIL-Q-9858A, Quality Program Requirements. However, this document states the QC requirements in broad and general terms so the document is applicable over wide spectrum of government representatives' interpretation and application of MIL-Q-9858A. The net result is a considerable variation in QC standards between contractors and even between contractors producing the identical product. Team One concludes that an interpretation of MIL-Q-9858A should be made by the Purchasing Activity in all SPARROW and SIDEWINDER system component contracts.

Recommendations

Tab A has been prepared to state the Navy's interpretation of many of the generalized requirements of MIL-Q-9858A without adding requirements to, or removing requirements from, this basic document. Tab A has been written so that it can be included directly in NAVAIR contracts as part of the supplies or services section.

It is strongly recommended that Tab A be included in all future SPARROW or SIDEWINDER System component contracts. This will greatly increase the standard of Quality Control in some contractor facilities and will bring a degree of standardization in QC between contractors.

III. LOCAL CONTRACTOR GOVERNMENT REPRESENTATIVE ACTIONS

Conclusion

From the contacts made by Team One, it is obvious that the amount of Government representation in the monitoring of the quality control exercised by the contractor is considerably different at various facilities. For instance, at one facility there was one government representative at an average GS-11/12 level for every 50 contractor employees on this contract while at another contractor's plant producing the same item there was one government representative at an average GS-7/9 level for every 160 contractor employees. This wide range of control not only allows uncoordinated quality control requirements, but places contractors in different competitive positions. It was apparent that the quality of the two products was directly proportional to the degree of government monitoring.

DCASO representatives stated during the Air-to-Air Symposium that if the monitoring requirements are completely and specifically stated, the DCAS organization can provide the personnel to do the monitoring. Based on the desirability of adequate and consistent government control it is concluded that the exact and specific Government inspection monitoring requirements should be defined and directed by NAVAIR to the local Government representatives.

Recommendations

Tab B is the specific inspection monitoring requirement for the SIDEWINDER AIM-9D missile. It is strongly recommended that these requirements be directed to the local Government representatives of SIDEWINDER contractors and that NAVAIR request increased DCAS personnel be provided to accomplish the required monitoring. It is estimated that three additional people at Raytheon, Lowell, Mass., on the guidance and control group contracts and one additional person at each of the other sub-groups contractors are required to meet the requirements of Tab B.

It is further recommended that NAVAIR task the Quality Assurance Office to provide the detailed inspection monitoring requirements on the SPARROW missile and that these be directed to the local Government representatives for the SPARROW contracts.

IV. QUALITY CONTROL SURVEY OF CONTRACTORS FACILITIES

Conclusion

Visits at the various contractors facilities for SPARROW III and SIDEWINDER AIM-9D production indicate that the Quality Control at Raytheon, Lowell, could be improved for the SPARROW III Guidance Control Group production. NAVAIR recently conducted a quality survey of this facility for the SIDEWINDER contracts which revealed several quality control concerns as reported in Naval Weapons Center letter Serial 3883 of 5 September 1968 to NAVAIR. During the recent Task Team One visit to Raytheon, Lowell, many of the same or similar quality discrepancies noted in the SIDEWINDER report were observed in the SPARROW III assembly areas.

Recommendations

It is recommended that a Quality Control Survey Team be established by NAVAIR. This Team should be directed to do a QC survey of Raytheon SPARROW III production facilities as was accomplished by the SIDEWINDER survey. This Team could be from Quality Assurance Office Washington, the Quality Assurance Office at Pomona, or one of the Navy field activities. The team would be directed to ascertain in detail the extent to which applicable documentation, the quality assurance plan, and quality control procedures are being followed. It would determine the acceptability and adequacy of the plant area, assembly and test equipment, inspection and acceptance equipment, personnel training, and general execution of the quality control plan. The recommendations of this Quality Control Survey Team should be carefully considered by the NAVAIR SPARROW III Program Manager and implemented as required.

V. RELIABILITY STUDIES

Conclusion

High failure rates of electronics equipments can be caused by one, or a combination of, many aspects, including marginal designs, use of unreliable components, quality control, and environment. Discussions with Raytheon and Westinghouse personnel indicate that the reliability and design margin studies which were originally planned for the SPARROW III and the AWG-10 were seriously curtailed by limited funding. The mean-time-between-failure (MTBF) of five to ten hours experienced by MACAIR for the AWG-10 is indicative of a design that requires additional attention on component selection, parts burn-in, and design margin studies.

The Hughes Surveyor Program has almost exactly the same complexity of design as the AWG-10, i.e., 29,000 active components and 110,000 total components and the Survey achieved an MTBF of 365 hours. This high MTBF was accomplished by a complete reliability program. Also, Hughes has proven that considerable dollar savings are realized when programs utilize effective component screening, parts burn-in, and design margin studies. These savings result from the greatly reduced time and expense wasted by equipment failures, down time, failure analysis, repair, rework, component replacement, spares inventory, retest time, and mission failures. Tab C is an Aerospace Technology Report which substantiates the above conclusions and provides dramatic proof of the increase in system MTBF and cost savings. Tab C shows how an expenditure of $305,000 for reliability on the Early Bird Program resulted in a savings of $1,016,000 in final systems tests costs. Similar improvements in reliability and costs will be achieved on the SPARROW III and AWG-10 if similar programs are initiated by NAVAIR.

Recommendations

It is strongly recommended that funding be provided for total reliability programs at both Raytheon and Westinghouse. These programs would select components, establish burn-in procedures, and recommend design changes based on design margin studies for the SPARROW and the AWG-10. Such a program should cost less than $3,000,000 for the AWG-10 and could result in a MTBF of approximately 100 hours. A detailed plan for such a program could be obtained from the Quality Assurance Office, one of several Naval activities, or contracted for from a reliability study corporation such as ARINC or Computer Applications. Raytheon and Westinghouse could respond also.

VI. PRODUCTION MONITORING TESTS, PMT

Conclusion

Many groups consulted expressed concern that Production Monitoring Tests (PMT) were not being applied to the entire missile system and that there were different requirements between programs. It was repeatedly suggested that considerable time, confusion, and costs could be saved if a standard PMT plan were authorized for all air launched guided weapons. This plan would include information, sample techniques, types of testing required, accept/reject criteria, system requirements, system reliability requirements, and government and contractor responsibilities. Further discussions indicate that NAVAIR should establish whether free flight test results are the basis for lot rejection.

Recommendation

Tab D is written as a standard PMT plan. In response to the concerns expressed by many parties, it is recommended that such a plan be incorporated in all air-launched guided missile contract procurements.

This plan advocates the use of free flight tests for lot acceptance/rejection criteria rather than utilizing the free flight tests for information purposes, only. The reason for advocating this procedure is based on a review of the current PMT results for SHRIKE, an information purpose only plan, and SIDEWINDER, an accept/reject plan. This review indicates the following:

1. Difference in cost between the two concepts.

(a) Accept/Reject Plan expends approximately three missiles per lot if the quality of the hardware is high - i.e., 90% or better. These quantities are computed based on the plan of Tab D.

3 missiles @ $10,000 - $30,000

(b) Three air-firings test, i.e., Range Cost, Airplanes, Telemetry, Data Reduction, Reports, etc.

3 missiles @ $30,000 - $90,000

(c) Contractor statistical risk is that less than three lots per 100 lots will be rejected based on sampling probability if his product is at 90% or better reliability. Contractor initial effort on these returned units will be to retest. Approximately 50 missiles are retested to prove lot acceptance before the lot would be resubmitted for rerum of P.M.T.

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$$50 \text{ missiles retest @ } \$5{,}000 \times \frac{3 \text{ lots}}{100 \text{ lots}} = \$7{,}500$$

$$3 \text{ missiles expended at } \$10{,}000 \times \frac{3}{100} = 900$$

$$3 \text{ tests @ } \$30{,}000 \times \frac{3}{100} = \underline{2{,}700}$$

$$\$11{,}100$$

(d) The cost that cannot be quoted is the charge to avoid this type of lot acceptance. However, it is reasonable to assume a contractor assignment of three full-time people to the P.M.T. facility at $30,000/yr a piece. On a one lot per month basis:

$$3 \times \$30{,}000 \times \frac{1}{12} = \$\ 7{,}500$$

The Total cost per lot = $138,600

or an increase in RFI missile cost of

$$\frac{138{,}600}{200} \quad \$\ 693 \quad \text{or } 7\%$$

The cost of air-firing for information only and will be the same for (a) and (b) above and zero for (c) and (d) above. The difference in cost for firing for score and for information then is:

Total cost difference 138,600 - 120,000 = $18,600

plus the intangible of (d) above.

Cost increases in RFI missile cost is:

$$\frac{\$18{,}600}{200} = \$93 \quad \text{or} \quad 1\%$$

The cost for either concept is high but the difference between the two methods is not.

2. Advantages of firing for lot acceptance/rejection criteria.

(a) The contractor is aware that he has to produce a high quality product, 90% or better, or he may expend considerable amounts of company monies for failure analysis, repair rework, and retest. He will consider quality control as a requirement rather than a goal.

(b) The testing agency will have to be expert and responsible because of the contractual pressures. Currently, programs which fire for

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information have low priority at the test facility and as a result, the tests tend to lag the production by three or more months and the reports are even later. This leaves some doubt as to their informational value. Firing for score, although painful until the test agency gets up to speed, does provide meaningful information in a timely fashion.

(c) The test plan is a strong incentive for the contractor to produce a high quality product so as to remain in the Stage III test conditions, because fewer total missiles will be required since unexpended rounds can be used for lot formation. Reliability and confidence information is acquired from the accumulative lot sample plans that is not received by firing an uncontrolled low number of missiles per lot for information purposes.

(d) By bringing the test agency into the program more significantly it will be better prepared to accept the technical field activity cognizance of the program at an earlier date.

(e) NAVAIR is in a stronger managerial position over the program. Without this, the accept/reject authority has been totally redelegated to local government factory representatives and to limited ground tests at a test agency.

3. Disadvantages of firing for score would be:

(a) Possible delay of lot shipment because of statistical lot rejection, about 3 lots per 100, or because of problems at the test activity. Of course, the government can waive these tests on an individual basis as the conditions dictate. These concerns should be carefully weighed against the possible alternatives.

(b) Test pilots will do the majority of the firings, rather than squadron pilots. This means a loss in possible training experience by squadron pilots. It must be remembered that these tests are for missile quality control and not pilot training. However, if this aspect is important, squadron pilots can be used with an anticipated higher number of "no test" missile expenditures.

Since the cost difference is low (approximately 1% of missile costs) and the advantages are significant, it is recommended that NAVAIR utilize the PMT free flight test results for product acceptance criteria in addition to other requirements.

VII. MISSILE SYSTEMS ENVIRONMENTAL TEST PLAN

Conclusion

One significant reason that the Navy does not more adequately describe the total systems quality requirements and relies on operational specifications is the lack of information concerning systems environmental conditions.

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This is particularly appropriate on the SIDEWINDER AIM-9D and to a lesser extent on SPARROW III. Environmental tests are required to determine that adequate procedures are used for evaluation of the quality of hardware produced at the contractor's facility and the quality of reworked hardware at the NARF's.

Recommendations

Tab E is an outline of a missile systems environmental test plan which would provide the data required on SIDEWINDER AIM-9D by stating requirements for evaluating the acceptability of missile systems components by non-destructive testing. Detailed environmental test plans are required for both the AIM-9D and the AIM-7, covering initial production at Raytheon as well as repair and rework at the NARF's.

VIII. SECOND SOURCE CONSIDERATIONS

Conclusion

Normally, the primary advantage of second source contracting is considered to be competitive pricing with a resultant lower product price. This consideration is valid and important as proven by the second source contracts on the AIM-9B with Philco and General Electric, MK-46 Torpedo with Aerojet and Honeywell, SHRIKE with Texas Instruments and Univac, and the WALLEYE with Hughes and Martin. However, a review of the above multiple source contracts indicates reduced price is not the only significant improvement second source contracts provide. This contracting method provides incentive for the contractors to be competitive in regard to quality control, reliability, maintainability, and in particular, in responsiveness to design changes required by the Navy. Historically, the second source concept encourages the contractor to be more aggressive in improving his performance since the Navy has a very powerful method of measuring his performance, i.e., the other contractor.

Second source contracts could overcome another present deficiency in that one or both of the contractors could provide a data package to be used by the NARF's for repair and rework efforts. Also, the Navy would be in a position of being able to determine the correctness and completeness of these documents through comparison. It should be observed that from the standpoint of national security considerations alone, the investment of the majority of the Navy's air-to-air missile capability in one prime contractor may well be sufficient justification for multiple sources.

All government contacts made by Team One were in favor of a second procurement source for SPARROW III as a means of increasing the quality of the product and obtaining a complete data package.

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Recommendations

It is recommended that the AIM-7E and AIM-7F programs be multiple contractor programs. This recommendation is made not only because of improvement-of-the-product objectives, but to disperse the Navy's air-to-air missile production capability. SPARROW will be a major DOD procurement item for the next several years. Sufficient yearly quantities are planned so that the cost of initiating a second source can be amortized.

IX. CHANGE CONTROL ACTION, ECP

Conclusions

Several factions expressed concern over the time that it takes for the Navy to act on ECP's in the SPARROW and SIDEWINDER programs, and the failure to keep all interested parties informed with regard to pertinent changes for system interface control. In air-to-air missilery aircraft-fire control-missile interfaces are critical. Seldom can one be changed without affecting one or both of the others.

Recommendations

It is recommended that the NAVAIR Project Coordinator hold change control meetings at NAVAIR to discuss and take appropriate action prior to change action by the NAVAIR Change Control Board. This concept was previously established under the SIDEWINDER Guidance and Control Section Change Procedure, Bureau of Naval Weapons, FWAA-23:MJD; 2 June 1960, and was very successfully utilized for several years. The basic purpose of having all interested parties meet is to speed up the dissemination of information and to accommodate the vital interface considerations. The parties which should attend would be the PMO, AIR-05, AIR-04, AIR-02, all system contractors, local contractor Government Representatives, NARF's, and cognizant field activities. Meeting schedules would be dictated by the program needs.

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Quality Program Provisions
for Inclusion in Supply Contracts
for Guided Missile Systems and Subsystems

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Quality Program Provisions
for Inclusion in Supply Contracts
for Guided Missile Systems and Subsystems

Section 1.0 Supplies or Services

1.x Quality Program

Section 2.0 Description and Specifications

2.x Quality Program. The contractor shall provide and maintain a quality program acceptable to the procuring activity for all supplies and services covered by this contract.

2.x.x The contractor shall require each of his subcontractors and suppliers to provide and maintain a quality program conforming to all of the requirements herein except as otherwise approved by the procuring activity. The contractor's quality program shall not be acceptable unless all suppliers of all products for eventual delivery under this contract have established a quality program acceptable to the procuring activity.

2.x.x The quality program shall be in accordance with MIL-Q-9858A and the provisions herein.

Section 4.0 Deliveries or Term of the Contract

4.x Item 1.x. Quality Program.

4.x.1 The contractor shall develop his quality program and procedures in sufficient time to permit evaluation and acceptance by the procuring activity within 90 days of award. The program shall not be acceptable until all requirements herein have been effectively implemented.

4.x.2 The contractor shall have developed and implemented his plan for the quality program requirements of suppliers and subcontractors, and shall have received approval of the procuring activity for the plan, prior to acceptance of any products from suppliers and subcontractors, or fabrication of any hardware intended for eventual delivery required by this contract.

4.x.3 The contractor shall have received approval of the procuring activity of his quality program before purchase of material and supplies or manufacture or assembly of any hardware for delivery under the terms of the contract. (If required, the contracting officer may direct here that preproduction or prototype hardware fabrication may commence upon award, when such hardware is required under the terms of the contract.)

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4.x.4 Failure of the contractor to gain approval of his quality program in sufficient time to permit hardware deliveries in accordance with the delivery schedule set forth herein shall not be considered cause for failure to meet such delivery schedules.

Section 7.0 Additional Provisions

The following interpretations of MIL-Q-9858A requirements shall apply:

7.x Quality Program Requirements

7.x.1 Section 1.2 of MIL-Q-9858A, Contractual Intent; Delete the last two sentences thereunder, and add:

"The quality program shall be judged acceptable by the procuring activity before fabrication or procurement of any product for eventual delivery to the procuring activity may begin. The quality program shall be subject to disapproval by the procuring activity whenever the contractor's procedures or processes do not accomplish their objectives. Approval of the contractor's quality program shall not in any way relieve the contractor of his responsibility for compliance with all contract requirements."

7.x.2 Section 1.3 of MIL-Q-9858A, Summary; add:

"The provisions of section 1.3 shall not be construed to alter or reduce the requirements set forth elsewhere in this specification, and are intended only to summarize those requirements."

7.x.4 Section 3.1 of MIL-Q-9858A, Organization; add:

"The authority and responsibility of personnel performing quality functions shall be stipulated in the company organization plan or other appropriate document duly approved by the head of the company. Personnel responsible for directing the quality program shall have direct unimpeded access to a management level above the production manager and shall report on the status and adequacy of the program at intervals of not more than 90 days. The report and the documented review thereof shall be made available to the procuring activity representative."

7.x.5 Section 3.2 of MIL-Q-9858A, Initial Quality Planning; add:

"3.2.1 Quality Program Plan. The contractor's quality program shall be documented in the form of a Quality Program Plan (QPP) which shall contain a description of the quality organization, including the responsibility and authority of each functional element, flow charts, work instructions, and other documentation prepared to implement the quality program. The plan shall identify all policies, existing instructions, and procedures which are necessary to comply with the provisions of this specification. The plan shall be made available for review by the procuring activity and must be judged acceptable before approval of the contractor's quality program.

"3.2.2 Flow Charts. Flow charts shall be prepared outlining each step in the fabrication, processing, inspection, and testing operations for each item of assembly. Flow charts shall include the identification number of all manufacturing or process sheets, process specifications, inspection and work instructions, and test procedures. Flow charts shall include a separate entry for each operation and include a unique symbol for each different type of operation."

"3.2.3 QPP Changes. Subsequent to approval of the QPP, the procuring activity shall be notified in writing within 24 hours of instituting any change to processes, assembly methods, inspection or test procedures, or to the quality organization together with justification for such changes. These changes shall be subject to disapproval by the procuring activity."

7.x.6 Section 3.3 of MIL-Q-9858A, Work Instructions, add:

"3.3.1 Documentation Control. All fabrication, assembly, inspection and test instructions shall be placed under the contractor's document control system."

"3.3.2 Instruction Content. Fabrication, assembly, inspection and test instructions shall define the work to be done, the step-by-step method for accomplishment, tooling and test or inspection equipment required, the criteria for acceptance, record keeping instructions, and disposition. Maximum use of multicolor or multishade graphics, diagrams, overlays and visual standards should be made."

"3.3.3 Instruction Format. All instructions shall be typewritten or printed, shall contain the date of issue, and revision level, and shall be authenticated by a member of the quality organization. No handwritten instructions or changes shall be permitted. The instructions shall be clearly legible, and shall be protected from damage by the use of clear plastic envelopes or other appropriate means. Faded, defaced, or otherwise damaged instructions shall be promptly replaced."

"3.3.4 Instruction Placement. All instructions shall be placed so as to permit unimpeded view by the operator at all times. Multi-sheet instructions shall be arranged in a manner to facilitate proceeding from sheet to sheet. No fabrication, assembly, inspection or test operation shall be performed without direct access to the appropriate instructions."

"3.3.5 Audit. The quality program shall contain, as a separate section of the QPP, provisions for auditing the preparation, maintenance, control, and use of the required instructions. The functions required by this specification shall be audited on a scheduled basis. The audit shall include evaluation of all quality operations and documentation, comparison with established requirements, notification of required corrective action, and follow-up to assess results of corrective action. The audit shall ascertain that the work is being performed as specified, and that compliance with the instructions does in fact produce the required quality output. Monthly audit reports shall be submitted to the head of the quality organization, and shall be made available to the procuring activity upon request."

7.x.7 Section 3.4 of MIL-Q-9858A, Records; add:

"The contractor shall maintain records of all inspections and tests performed throughout the entire procurement, fabrication and assembly cycle. The records shall provide evidence that required inspections and tests have been performed, and shall include part, component or system identification, inspection or test involved, number of conforming articles, number rejected, and causes for rejection. The records shall cover both conforming and non-conforming items. Where variables data are involved, the actual numerical results obtained shall be indicated, and where data or information are recorded, the film, tape, or other recording media shall be identified with the characteristic measured, the date and identification of the article under test. For nonconforming articles, the records shall include the results of analysis, cause and corrective action taken."

7.x.8 Section 5.1 of MIL-Q-9858A, Responsibility; add:

"The contractor's responsibility shall include technical assistance and training to suppliers as required to achieve required reliability and quality levels."

"5.1.1 Source Inspection. The contractor shall provide objective evidence that the subcontractor complies in detail with applicable requirements. Objective evidence does not include unverified tests performed by the subcontractor on his own products, or his own evaluation of his facilities or capabilities."

"5.1.2 Inspections and Tests. The contractor shall assure that all specified inspections and tests required for acceptance (including qualification, preproduction and quality conformance) have been performed. Tests and inspections performed at the supplier's facilities shall be verified by the contractor, and evidence of such inspections and tests shall be made available to the procuring activity upon request."

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7.x.9 Section 5.2 of MIL-Q-9858A, Purchasing data; add:

"Each procurement document shall be reviewed by the contractor's quality organization prior to release, and shall be available for review by the procuring activity. This review shall encompass determination that the applicable provisions of this paragraph are included, that the supplier has been approved in accordance with the source selection requirements of 5.1, and that the articles have been qualified for their specific application in accordance with the requirements of the contract."

7.x.10 Section 6.1 of MIL-Q-9858A, Materials Control; add:

"6.1.1 <u>Receiving Inspection</u>. The contractor's receiving inspection shall provide that articles shall not be accepted unless they have been inspected by the supplier in accordance with the purchase orders and satisfactory evidence of such inspection is submitted. The quality program shall provide for planning and performance of inspections and tests on all procured articles to verify quality requirements of specifications and drawings and changes thereto, either at the source, or at the contractor's plant, or both. The quantity and degree of inspection performed shall be consistent with the critical nature of the article, the information available from previous inspections or tests, and the documentation requirements on the article.

"Procured articles which are subject to age deterioration shall include an indication of the date that the critical life of the article was initiated and the date at which the useful life will be expended. All such articles shall be adequately protected in subsequent stores and handling operations, and the expiration date shall be prominently marked on each of the smallest containers that may be issued for use."

"6.1.2 <u>Identification</u>. All receipts at the contractor's plant shall be clearly identified and this identity maintained in store rooms and during processing in order that items procured under this contract may be readily recognized. Raw materials shall be identified at receiving and this identification shall be maintained either on the fabricated article or on records traceable to the fabricated article. All purchased articles released from the contractor's receiving inspection shall be clearly identified to indicate conformance or rejection."

"6.1.3 <u>Coordination of Contractor and Supplier Measuring and Test Equipment</u>. The contractor shall coordinate his inspection, measuring, and test equipment and correlate his inspection and test procedures with the subcontractor."

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7.x.11 Section 6.2 of MIL-Q-9858A, Production Processing; add:

"6.2.1 Special Working Environment. The contractor shall provide adequate facilities for the fabrication, assembly, and testing of supplies to be delivered in accordance with this contract. Unless otherwise specified in the detail specifications, the minimum standards for working environment of Table I shall apply."

"6.2.2 Inspection and Test Planning. The contractor's program shall provide the necessary planning function for tests and inspections conducted during the entire phase of fabrication, processing, and assembly. The planning shall be based on a comprehensive study of the articles, the fabrication and processing operations, the methods of material integration, assembly, and checkout, and the final test and inspection procedures. Inspections shall be established at points which will minimize delays resulting from deficiencies, and in all cases shall be at or before the last point at which the acceptability of the operation or quality of the characteristic may be verified."

"6.2.3 Process Control Procedures. Process control procedures shall be prepared when necessary to supplement applicable process specifications to provide detailed performance and control methods. These procedures shall document the preparation, fabrication details, conditions to be maintained during each phase of the process, the methods of verifying the adequacy of processing materials, solutions, equipment, their associated control parameters, including statistical quality control plans where applicable, and the required records to indicate the results of such inspection and process verification. The contractor's quality organization shall review the written procedures for those process controls and conduct audits to determine that the actual operations conform with approved methods and procedures."

"6.2.4 Material Control. Controls shall ensure that only conforming materials and articles are used. Materials and articles not conforming or not required for the operation involved shall be removed from work operations. Positive action shall be taken to protect controlled processes or operations from contamination by residue from nonconforming materials and from previous operations. The contractor shall ensure that each operation of inspection (and to the extent practicable, fabrication) is traceable to the individual responsible for its accomplishment."

7.x.11 Section 6.3 of MIL-Q-9858A, Completed Item Inspection; add:

"6.3 Completed Item Inspection and Testing. The system shall provide for the performance of all tests and inspections specified in the contract or item specification and for the recording of all data derived. In addition to determining contractual conformance, the contractor shall report

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immediately any unusual phenomenon, occurrence, difficulty or questionable condition, whose detection and correction is not specifically contained in the applicable requirements, to the procuring activity, in order that the necessary action and/or provision of contractual coverage may be initiated. After completion of final tests and inspection, any modifications, repairs or replacements, either authorized or unauthorized, shall necessitate a reinspection and retest to the extent determined necessary by the procuring activity to completely verify acceptability and compatibility with associated components, subassemblies, assemblies, and systems. The contractor shall employ detailed written procedures for acceptance inspection and testing of all parts and subassemblies, whether manufactured in house or purchased. All detailed final acceptance test procedures must be approved by the procuring activity."

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Table I

MINIMUM STANDARDS FOR WORKING ENVIRONMENTS

Type of Work	Cleanliness Note 1	Lighting, Foot Candles Note 2	Air Temperature Note 3	Relative Humidity Note 4	Dust Control Note 5	Ventilation or Exhaust Note 6	Noise Note 7	Habitat Note 8
Machine Shop								A
Tolerance to .01	Class D	70	60-100°F	U	Class D	Note 6	90db	
Tolerance to .001	Class C	100	65-95°F	U	Class C	Note 6	70db	
Tolerance to .0001	Class C	200	65-85°F	30-70%	Cla[illegible]	Note 6	60db	
Tolerances Finer than .0001	Class A	500	65-75°F	30-50%	Class A	Note 6	50db	
Propellant, Chemical and Potting Areas	Class B	100	65-95°F	30-50%	Class B	Note 6	70db	A
Plating and Heat Treating	Class C	70	55-105°F	U	Class C	Note 6	90db	A
Electronic Assembly	Class B	100	65-95°F	30-70%	Class B	Note 6	70db	A
Nonprecision Mechanical Assembly	Class B	100	65-95°F	U	Class B	Not Reqd	70db	A
Precision Mechanical Assembly								A
Tolerances to .0001	Class B	200	65-85°F	30-70%	Class B	Not Reqd	60db	
Tolerances Finer	Class A	500	65-75°F	30-50%	Class A	Not Reqd	50db	
Inspection Stations	Equal to Product Inspected					Not Reqd	70db	A

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Notes to Table I

1. Cleanliness Definitions

   a. Class D
   Daily Cleanup: Removal of scrap, clean up spilled oil, etc.

   b. Class C
   Prompt Cleanup: Scrap, oil, and residue shall not be allowed to accumulate. Food and beverages are not permitted.

   c. Class B
   Prompt Cleanup: Oil, residue, spilled chemicals removed immediately. Floor, walls and work area shall have hard, grease resistant, easily cleaned surfaces. Food and beverages are not permitted.

   d. Class A
   Cleanliness controlled in accordance with FED-STD 209. Class 100,000. Food and beverages are not permitted.

2. Lighting

   Indicated values are minimum light intensity values in the work area. Supplemental lighting shall be used when necessary to improve precision and minimize operator fatigue, but brightness ratios within the operators field of view shall not exceed 10 to 1.

3. Air Temperature

   Designated temperature limits are average temperature measurements taken in proximity of the work stations.

4. Relative Humidity

   Designated relative humidity shall be as measured at room ambient temperature. "U" indicated uncontrolled relative humidity.

5. Dust Control Definitions

   a. Class D - No dust control required
   b. Class C - Outside air shall be filtered to remove dust particles. Type of filter is unspecified.
   c. Class B - Outside and recirculated air shall be filtered to remove dust particles. Filter rating shall be 10 micron maximum.
   d. Class A - Dust control shall be in accordance with FED-STD-209, Class 100,000.

6. Ventilation or Exhaust

Forced ventilation or exhaust shall be provided whenever required to minimize operator fatigue.

7. Noise

Noise is defined as the average sound level existing at the work station when measured with a standard sound-level meter.

8. Habitat

a. No eating, drinking, or personal grooming is allowed in these work areas.

Quality Assurance Representative
Product Verification Inspection Requirements
for the AIM 9D Sidewinder Missile

Note: Suggested levels of Government monitoring are considered as minimum requirements.

TAB I-B

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INDEX

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A. Subject: Contractor inspection for the MK 18 Mod 1 Guidance Control Group is to be monitored by the local Quality Assurance Representative at the percentage level given. The monitoring requirements are broken into five groups.

I. General requirements.
II. Seeker requirements.
III. Miscellaneous requirements.
IV. Electronic requirements.
V. Servo requirements.

I. General Requirements.

From MIL-G-23986.

All tests of paragraph 4.7 monitor 100%
All tests of paragraph 4.8 monitor 100%

Insure interface compatibility by 100% monitoring of the use of the following gages.

2478335	Special Ring Gage-Concentricity Between Diameters and Location of Slot
2823993	Dial Fixture-Location of .2474 Datum
2409660	Fixture-Bracket Acceptance for Interchangeability

II. Seeker Requirements.

a. Refrigerated Detector Unit. It is recommended that the following requirements of WS-1592A, Purchase Description, Refrigerated Detector Unit, be monitored on a 5 percent basis.

(1) Failure Report and Analysis System as specified in paragraph 4.1.3.
(2) Certification of test equipment, ref. paragraph 4.5.1.
(3) Test Conditions, ref. paragraph 4.5.2.
(4) Acceptance Tests per section 4.6.
(5) Environmental Tests per section 4.7.

b. Magnet-Mirror BUWEPS drawing 2192519 & 2581052

(1) Specular Reflectance, Note 5 (B); Monitor 5%
(2) Sphericity, Note 5 (E); Monitor 5%
(3) Scratch & Digs. Note 5 (F); Monitor 5%

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c. Mirror-Damper Assembly, BUWEPS drawing 1985163

(1) Mirror Surface flatness, Note 7, Monitor 5%
(2) Mirror Surface quality, Note 8, Monitor 5%
(3) Inspection, Note 10, Monitor 10%
(4) Visual Inspection, Note 12, Monitor 5%
(5) Specular Reflectance, Opacity & Pinholes, Monitor 5%
Ref: Drawing BUWEPS 2250957 (Coating Sheet Technical)

d. Insert, Coated, BUWEPS drawing 2166692

(1) Pinholes, Note 3, Monitor 5%
(2) Cleaning, adherence & Boiling Water, Notes 4, 5, 6, Monitor 5%
(3) Transmittance values, Note 2, ref: Drawing 223644 (S); Monitor 10%

e. Lens, Reticle Field BUORD drawing 2250°28

(1) Surface Quality, Note 2, Monitor 5%
(2) Inclusions, Note 3, Monitor 5%
(3) Surface Flatness, Note 4, Monitor 5%

f. Reticle, Field Lens Assembly BUORD drawing 2103857

(1) Pattern centering, Note 3, Monitor 5%
(2) Foreign matter & Opaqueness, Note 5, Monitor 5%
(3) Scratch & Digs, Note 7, Monitor 5%
(4) Adherence, Note 9, Monitor 5%
(5) Edges sharp & clear, Note 10, Monitor 10%

g. Pattern, Reticle, BUWEPS drawing 15717548

(1) Inspect for pattern conformance with Notes 1, 2, and 3, Monitor 10%

h. Dome, Optical, BUWEPS drawing 2192624

(1) Surface Finish, Note 3, Monitor 5%
(2) Sphericity, Note 4, Monitor 5%
(3) Edge Chips, Note 5, Monitor 5%
(4) Concentricity, Note 7, Monitor 10%

i. Spin Bearing Pair, drawing 2192628, Monitor 10%

(1) Verify that the spin bearings are cleaned and lubricated in accordance with paragraph 3.9 of WS-1627A and paragraph 4.2.5 of OD-15371C and/or OD-13080[illegible].

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[redacted]

(2) Verify that the preload of the Spin Bearing Pairs is in accordance with paragraph 3.7.2. of WS-1627A and paragraph 4.2.5.1 of OD-15371C and/or OD-30806.

j. Gimbal bearing, drawing 2103866; Monitor 10%

(1) Verify that cleaning, lubrication, and removal of excess oil is in accordance with paragraph 4.2.5 of OD-15371C and/or OD-30806.

(2) Verify that the Gimbal bearings meet the torque requirements of Note 5 of drawing 2103866.

k. Optical Gyro Assembly. It is recommended that the following in-process inspections be monitored on a 10% basis. All paragraphs refer to OD-15371C.

(1) Para 5.1.27 Gimbal axis intersection & preload.
(2) Para 5.1.3.25 40 degree Gimbal check.
(3) Para 5.2.1.15 Clamping Screw back-off torque.
(4) Para 5.2.2.7 Optical Barrel-Shielding Sleeve concentricity.
(5) Para 5.2.3.19 Optical Barrel-Stud concentricity
(6) Para 5.2.3.23 Optical Barrel-Support back-off torque
(7) Para 5.3.1.12 Reticle to Holder concentricity and perpendicularity.
(8) Para 5.3.1.11 Reticle push-off
(9) Para 5.4.1.5 Reticle runout
(10) Para 5.4.1.15 Gyro phasing and collimation
(11) Para 5.4.1.17 Mirror Magnet push-off
(12) Para 5.4.1.21 Mirror Magnet stabilization
(13) Para 5.4.1.22.1 Support Post to Lens measurements
(14) Para 5.4.1.22.3 Reticle Holder back-off torque
(15) Para 5.4.22.11 Baffle back-off torque
(16) Para 5.4.2.9 Focus
(17) Para 5.4.2.10.2 Secondary Mirror collimation
(18) Para 5.4.2.17 Dynamic Balance
(19) Para 5.2.21 Support Post, Sunshade Nut and Gravity balance
(20) Para 5.1.3.8.1 Spin Bearing outside diameter clearance
(21) Para 5.4.1.2 Spin Bearing inside diameter clearance
(22) Para 5.4.2.22 Paint Damage
(23) Para 5.1.1.6 and 5.1.2.2 Gimbal bearing fits (OD & ID Clearances)

l. Dome Housing Assembly: It is recommended that the following test be monitored on a 5 percent basis.

(1) Dome housing pressure and leak test. Ref: paragraphs 3.2.4.1 and 3.2.4.2 of OD 20573.

m. Clean Room. It is recommended that the following parameter of OD 20574, Clean Room conditions; be monitored on a weekly basis.

(1) Para 4.1. Temperature and Humidity limits
(2) Para 4.2 (B), Contamination Level

n. Head Coil. It is recommended that the following Head Coil parameters be monitored on a 10 percent basis.

(1) Head Coil Potted Assembly, ref: Drawing 1569869

(a) Sheet 1 Zone B 6, .580± .005 Dimension
(b) Sheet 1 Zone C 6, .1625 Diameter Basic dimension
(c) Sheet 1 Zone B 5, .906± .001 Dimension
(d) Sheet 2 Note 10 Painting
(e) Sheet 2 Note 11 Insulation resistance
(f) Sheet 2 Note 17 Electrical Requirements
(g) Sheet 2 Note 7 Boresight

(2) Head Coil Potted Assembly, Ref: Drawing 2319174

(a) Sheet 1, Zone U 12, .3395± .0005 Dimension
(b) Sheet 1, Zone R 9, .609R Min. Dimension
(c) Sheet 2, Zone U 13, .905-.907 Dimension.
(d) Sheet 2 Note 12 (c) Electrical requirements
(e) Sheet 2 Note 8 Boresight
(f) Sheet 2 Note 11, Painting
(g) Sheet 2 Note 12 (A & B) Insulation resistance

o. Seeker Section. It is recommended that the following requirements of drawing 2192523 be monitored on a 20 percent basis.

(1) Performance Specifications Number 1. and 4.
(2) Note 5, Cell clearance
(3) Note 3, Torque requirements

III. Miscellaneous requirements.

a. Cable Assembly-Umbilical
Dwg 1517791G

Note 3. Check to insure that three uniform twists are incorporated in the wire bundle. Monitor 25%

Note 10. Check to insure that the nitrogen line enters the housing on the hard potting at an angle greater than 80° (in respect to the axis of symmetry of the cable as shown on the drawing) Monitor 10%

Note 15. Insure that proper techniques are used in adhering the boot to the cable near the housing. Only the above area is of concern in the note. Monitor 25%

Note 18. Monitor 5%
Note 19. Monitor 5%
Note 22, Only the electrical and pneumatic examination of the sample cable after the 50,000 flexures. Monitor 100%

Sheet 1. The orientation of the cable referred to in section BB. Monitor 10%

The axial & position alignment of probe and contacts. Zone C3 Monitor 5%

b. Housing, Umbilical Release
Dwg. 1517793D

1.897± .002	Zone F4	Monitor 15%
1.820± .002	Zone F4	"
1.468± .005 .000	Zone F4	"
.391± .002	Zone E5	"
.081± .001R	Zone B5	"
.111± .001R	Zone B5	"

c. Housing, G&C Unit
Dwg. 2192625U

Sheet 1

4.698/4.703 dimension	Zone FG-4	Monitor 15%
.126/.128 dimension	Zone DC-1	Monitor 10%

Detail U AB-11 thru 14

.058/.063	Zone B13	
$18^\circ +0^\circ$, $20'-0^\circ, 0'$	Zone B12	Monitor 5%
.2475/.2473	Zone C12	

3.312/3.316	Zone F-16	Monitor 15%

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Check flags

◎T.001 TIR	Zone A14	
∥ V .002	Zone C15	Monitor 5%
⊥ U .001	Zone C15	

or ECO equivalent
Note 3
Sheet 3

Detail M-check the following:

.296± .002	Zone J11	
.130± .001	Zone J12	Monitor 5%
.203± .002	Zone I11	
.036± .001	Zone I10	

d. Wiring Harness

Dwg 2439943K
Sheet 2

Cable orientation of connectors to base.
Zone B thru D, 4 thru 6. Monitor 25%

e. Base, Umbilical

Dwg. 2439842E
Sheet 1

Dimensions:

.389/.393		
.029/.032		
.131/.127		
1.899/1.895	Zone F-8	Monitor 15%
1.822/1.818		
1.470/1.475		
1.440/1.445		

Sheet 2

Dimensions:

.188/.192	Zone C-15	Monitor 10%
.433/.438		
.390/.395	Zone E-15 & 16	Monitor 10%
.195/.197		
.216/.219		

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[redacted]

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TAB I-B

IV. Electronic Requirements

1. Assemblies and modules deriving requirements from WS 1602 and OD20576C and drawing notes.

TITLE	DRAWING #	REQUIREMENT DRAWING NOTE NO	APPLICABLE REFERENCE	MONITOR %
Sync Filter Module	2412413	6,7,		
Driver Module	2412414	5,6,		
Resistor Module Assembly	2439994	3		
Pentode Module	2439926	3		
Preamp Module	2412385	10,11	WS 1602	5%
Self Destruct Module	2412492	1,2,3		
Detector & AGC Module	2412411	5,10		
Sync Filter Module	2412412	6, 7		

WS 1602 refers to OD 20576C, "Design and Fabrication of Resistance-Welded Electronic Circuit Modules and Assemblies". Materials to be used in the welded module and for encapsulating the modules should be monitored to assure compliance with paragraph 5.5 and 5.6.

Monitor 5%

Certification and Qualification of welding machines and operators shall be monitored to determine compliance with paragraph 4.2, 5.3.1 and 5.3.2 of OD20576C.

Monitor 100% on schedule basis

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[redacted]

2. Assemblies deriving requirements from WS 1612 and MIL-T-27, and MIL-R-10509 and drawing notes.

TITLE	DRAWING #	REQUIREMENT DRAWING NOTE NO	APPLICABLE REFERENCE	MONITOR %
Saturable Reactor	2412388	1	WS 1612	10%
Filter Reactor	2412400	4.3.2	MIL-T-27	5%
Resistor-Low Noise	2439956	1,2B	MIL-R-10509	10%

3. Assemblies deriving requirements from WS 3820 and drawing notes.

TITLE	DRAWING #	REQUIREMENT DRAWING NOTE NO	APPLICABLE REFERENCE	MONITOR %
Transformer Assembly	2439830	1,2		
Q Multiplier	2439851	1,2		
Reactor, B+	2412391	1,3		
Reactor Regulator	2413392	1,2,4		
Reactor	2412394	1, 2,		
Transformer Detector	2412396	1,3		
Transformer Reference	2412397	1,3	WS 3820	5%
Transformer Driver	2412398	1.2,4		
Power Transformer	2412389	1,2,3		
Reactor	2412485	1,2,4		
Pulse Transformer	2412468	1,2,3		
Head Coil	2319174	16, 12		

4. Assemblies deriving requirements from WS 6536

TITLE	DRAWING #	REQUIREMENT DRAWING NOTE NO	APPLICABLE REFERENCE	MONITOR %
Gyro P.W.A.	2603356	1		
Carrier Amp P.W.A.	2603352	1	WS 6536 Wire termination, Hand solder, Machine solder	5%
Mag Amp & P.S.P.W.A.	2603348	1		
Gage Amp P.W.A.	2603344	1		
Electronics Section	2581347	1	WS 6536 Wire Termination, Hand solder, Machine solder	5%
Head Coil	2319174	2		

WS 6536, specifies that soldering materials, tools and equipment meet specific requirements.

Monitor 5%

Qualification and certification of soldering personnel shall be done per WS 6536.

Monitor 100% on a schedule basis

5. Assemblies for which all requirements are included on the drawing.

Electronics Section	2581347	3,5,6,7,8, 13,14,15, 17	NA	Monitor 5%
Preamp Assembly	2412479	1,5,6,8,9, 10	NA	Monitor 5%
Wiring Harness	2439943	2,6,7,10, 12,15	NA	Monitor 5%

V. Servo Requirements

a. Dwg. 2439855-3 - Notes of Servo Test Procedure Monitor 100%

b. Dwg. 2319148-1 - Cylinder Block Assembly plus Alternator and Turbine Orifice

Note 1. Install, leak test and calibrate orifices (4 cyl.)
Monitor 10%

Note 4. Install blowout disc and plug assembly
Monitor 10%

Note 12. Leak check around gas generator igniter seal; remove nozzle and blowout disc
Monitor 10%

Note 13. Check overall impedance of five orifices
Monitor 10%

Notes 16 & 17 Matching & performance of alternator & orifice with magnetic amplifier
Monitor 10%

c. Dwg. 2319147 - Cylinder Block and Post Assembly

2319147-1

- Note 2 - Quality of Brazing — Monitor 10%
- Note 3 - Magnaflux inspection — Monitor 10%
- Note 5 - Quality of electroless nickel plating — Monitor 10%
- Note 6 - Size, finish, location & alignment of .1718 + .0002 - .0000 holes — Monitor 10%

2319147-2

Inspect cylinder block & cylinder sleeve insert for:

1. Size, quality & alignment of 3.125 -20UNS -2B threads — Monitor 10%
2. Flatness, squareness & finish on seating surfaces for O-ring — Monitor 10%
3. Size, position, alignment & finish of cylinder bores — Monitor 10%
4. Location of four 10-32NF-2Bx3/8 deep holes (Zone C-3) — Monitor 10%

2319147-3 Inspect cylinder block for size, alignment, location & surface finish of pressure passage Zone B-5 Monitor 10%

d. Dwg. 2439837, Forward Rocker Arm Potted Assembly - and Dwg. 2439838, Aft, Rocker Arm Potted Assembly

Note 2. Inspect preloading of fin fuze crystal Monitor 5%

e. Dwg. 2439833, Forward Rocker Arm, Machined Dwg. 2439834, Aft Rocker Arm, Machined

On both drawings, inspect rocker arm machined, for:

1. Position, size, alignment and finish of .1715 + .0005 -.0000 holes "N" Zone E-3 & "R" Zone B-5 Monitor 5%

2. Position, size, alignment & finish of .1715 + .0005 -.0000 holes in Zones F-2 and E-4 Monitor 5%

3. Position, size, geometry & finish of crystal recess Zones D-2 & 3, View F Zone B-3 and B-4 & 5 Monitor 5%

f. Dwg. 2439807-1

1. Inspect for application of enamel, electrical insulating, to screws item 8, note 5 Monitor 20%

2. Also, to screws 1537445 as required by call cut in Zone H-13 Monitor 20%

g. Dwg. 2439806

1. Inspect for quality of potting Note 1-D Monitor 10%

2. Inspect for resistance to ground Note 1-E Monitor 10%

h. Dwg. 2166674, Rod Connecting Assembly

Zone E-9 Alignment of bushing hole to face of shoulder surface "A" Monitor 10%

i. Dwg. 2439805, Case Piston

Zone F-7 - Squareness of top of case to I.D. Monitor 10%

j. Dwg. 1985179, Relief Valve

Valve shall conform to requirements of WS-1582

Para. 3.5.1	- Operation pressure ambient	Monitor	10%
3.5.1.1	- Stability	Monitor	10%
3.5.2	- Leakage	Monitor	10%
3.5.3	- Flow rate	Monitor	10%
3.5.4	- High temperature air test	Monitor	100%
3.5.6	- High temperature gas operation	Monitor	100%
4.12	- Environmental tests following treatment	Monitor	100%

k. Dwg. 2166576, Pin, Solid Clevis and
Dwg. 2166577, Pin, Solid Rocker Arm

Inspect for conformance to drawings for physical dimensions and surface finish — Monitor 5%

l. Dwg. 1555449, Band, Heater Assembly

Notes 5 & 6 - Environmental tests of lot samples	Monitor	5%
Note 8 - Quality and Quantity of Encapsulation	Monitor	5%

m. Dwg. 1517782, Band, Heater

Note 2 - Heating element rating	Monitor	10%

n. Dwg. 1555450, Thermostat (Band, Heater)

Note 2-A(2) - Calibration	Monitor	25%
Note 2-C - Contact Resistance	Monitor	25%
Note 4 - Contact life test and environmental test of lot samples	Monitor	25%
Note 5 - Contact creepage	Monitor	25%

o. Dwg. 2580677, Generator, Power

Check the following requirements of WS 1624 (referred to in Note 1)

Para. 3.5.1	Starting torque	Monitor	5%
3.5.2	Output voltage	Monitor	5%
3.5.3	Acceleration	Monitor	5%
3.5.4	Internal inductance	Monitor	5%
3.5.5	Internal direct current resistance	Monitor	5%
3.5.6	Harmonic distortion	Monitor	5%

Para. 3.5.7	Insulation resistance	Monitor 5%
3.10	Workmanship	Monitor 5%
3.5.8	Hot gas operation	Monitor 100%
3.6	Tests following environmental procedure	Monitor 100%

B. Subject. Inspection for the MK 15 Mod 3 Target Detection Device is to be monitored by the local Quality Assurance Representative at the percentage level given.

From WS-1656A Amendment 2

Para. 3.2.2, 3.2.3, 3.2.4, 3.2.5.2, 3.2.5.3, 3.2.5.4, 3.2.5.5, 3.2.6.1, 3.2.6.4, 3.2.6.6, 3.2.6.7, 3.2.6.8, 3.2.7, 3.2.8 — 100% Monitoring

Dwg 1995254	All Requirements	100% Monitoring
Dwg 2049075	Requirements: Para 2.1, 2.2, 2.4, 2.5, 2.9, 2.14	100% Monitoring
Dwg 2186230 Dwg 2186232	Verify dimensional requirements of WS-1656A Amendment 2. Para 3.2.1 Item 130, 131, 132, 133, 134	100% Monitoring

From WS-1656A Amendment 2

Para 3.2.1
Item 1 thru 6
106 thru 110
112
113
119
122
123
137
138
139
144
145
154
155
— Monitor to the AQL specified in WS-1656A

C. SUBJECT: Inspection for the MK 13 Mod 0 Safety and Arming Device is to be monitored by the local Quality Assurance Representative at the percentage level given.

From OS 11257 (Latest edition)

Para 3.2.2.4	Laboratory Arming	
	Requirement 1 thru 6	Monitor 100%
Para 3.2.2.6	Safety Determination	
	Requirements 1, 2, and 3	Monitor 100%
Para 4.6.1	Verification of drawing requirements	
	Inspections 107, 109, 113, and 126	Monitor 100%
	Inspections 1 thru 10	Monitor 10%
Para 3.2.2.5.1	Safe Resistance	
	Requirements 1 thru 5	Monitor 10%
Para 3.2.2.5.2	Arm Resistance	
	Requirements 1 thru 4	Monitor 10%

D. SUBJECT: Inspection requirements of the Mk 48 Mod 2 Warhead shall be at least as tight as shown in Section 1-107b of DSAM 8260.1 based on its classification of characteristics. Contractor inspection is to be monitored by the local Quality Assurance Representative at a 10% level unless otherwise specified.

DL 2603878 Mk 48 Mod 2 LOADED ASSEMBLY
DWG 2603878 Mk 48 Mod 2 LOADED ASSEMBLY

SHEET 1

CRITICAL

C1:	Note 2	MONITOR 100%
C2:	Note 10	MONITOR 100%

MAJOR

M101:	Note 3
M102:	Note 4
M103:	Note 5
M104:	Note 6
M105:	Note 9

SHEET 2

CRITICAL

C3: $6.260 \pm {}^{.034}_{.000}$ (see Note 13) ZONE D6 MONITOR 100%

MAJOR

M106: .474 Max. ZONE B8

DWG 2603791 CASE ASSEMBLY

SHEET 1

MAJOR

M101:	Note 2A, Item 1
M102:	Note 2B, Item 2(1) Material
M103:	Note 2B, Item 2(4) Annealing
M104:	Note 2C, Item 3

(CC not established): Note 3, Verify Encapsulation AQL 1.0

SHEET 2

CRITICAL

C6:	4.838 ± .003 Dia.	ZONE C8
C7:	4.838 ± .003 Dia.	ZONE C3

MAJOR

M105:	⊙ | A | .004	ZONE B8
M106:	⊙ | A | .005	ZONE B7
M107:	$13.188 \pm {}^{.010}_{.000}$	ZONE D5
M108:	⊙ | B | .005	ZONE D3
M109:	4.380 ± .005 Dia.	ZONE C4
M110:	$4.375 \pm {}^{.008}_{.000}$ Dia.	ZONE C8

SHEET 3

CRITICAL

C1:	$.028 \pm {}^{.006}_{.002}$	ZONE C8
C2:	$.028 \pm {}^{.006}_{.002}$	ZONE C4
C3:	$72°0' \pm {}^{0°0'}_{0°20'}$	ZONE D4
C4:	$72°0' \pm {}^{0°0'}_{0°20'}$	ZONE D7
C5:	$4.636 \pm {}^{.000}_{.020}$	ZONE C5

MAJOR

M111:	-C- / ⊥ A .004	ZONE D7
M112:	∥ C .004 / ⊥ B .004	ZONE D4
M113:	$.288 \pm {}^{.010}_{.000}$	ZONE C7
M114:	≋ 0.010	ZONE C1
M115:	.131 ± .001	ZONE C3

M116: .131 ± .001 ZONE C1

M117: $.210 \pm ^{.010}_{.005}$ ZONE B3

M118: $.210 \pm ^{.010}_{.005}$ ZONE B1

(CC Not established:) .070 Min. Wall ZONE C6 AQL 1.0

SHEET 4

MAJOR

M119: $.187 \pm ^{.000}_{.003}$ ZONE D3

M120: $.187 \pm ^{.000}_{.003}$ ZONE C2

Insure interface compatibility by monitoring the use of the following gages 100%.

2117315 Fixture - Alignment of Slots

559426 Special Ring - Concentricity Between Diameters

559427 Special Ring - Concentricity Between Diameters

2117316 Special Plug - Mating Between Booster Enclosure and Mating Joint

E. Subject. Inspection requirements of the following Rocket Motor units shall be at least as tight as shown in Section 1-107b of DSAM 8260.1 for its classification of characteristics. Inspection is to be monitored by the local Quality Assurance Representative at a 10% level.

DL 2580617 5.0 Inch Rocket Motor
DL 2580618 5.0 Inch Rocket Motor, Mk 36 Mod 5 Load Assembly
DL-1517776 Filter, Radio Interference Assembly
DL 1568376 Igniter Rocket Motor Mk 264, Mod 1 Assembly
DL 269495 Squib Electric Mk 5 Mod 0

DL 2580617, 5.0 INCH ROCKET MOTOR, MARK 36 MOD 5 EMPTY ARRANGEMENT

DWG. 2580617, 5.0 INCH ROCKET MOTOR MARK 36 MOD 5 EMPTY ARRANGEMENT, ASSEMBLY DRAWING, NO CC NEEDED.

TAB I-B

DWG. 1517206 HANGER, FORWARD

CRITICAL

C1:	Material: Steel, 150,000 psi minimum yield at 0.22% offset and 6% minimum elongation in 2 inches.	NOTE 1

MAJOR

M 101:	Surface D in the direction of the 1.750 dimension shall be parallel to surface C within 0.004.	NOTE 7
M 102:	$.200^{+.000}_{-.005}$ TPY	ZONE F-10
M 103:	[.002] [-C-]	ZONE F-9
M 104:	1.720 ± .010	ZONE H-12
M 105:	[-B-]	ZONE H-13
M 106:	.343 DIA through 100° CSK, .650 DIA 2 holes [⊕ .005 DIA]	ZONE D-9
M 107:	Heat treat in accordance with MIL-H-6785.	NOTE 2
M 108:	Finish: Cad plate type II .0003 thick 00-P-416 or ELEC. ZINC type II .0002 thick 00-Z-325.	NOTE 3

DWG. 1517393, RING, COUPLING MOTOR TUBE FWD

CRITICAL

C1:	.042 ± .002	ZONE I-13
C2:	.068 ± .002	ZONE I-15
C3:	.070 ± .005	ZONE I-12
C4:	$18^{\circ}\,^{+0^{\circ}0''}_{-0^{\circ}20''}$	
C5:	Material: Steel, 150,000 psi minimum yield strength at 0.2% offset and 6% minimum elongation in 2 inches.	NOTE 1

C6: Inspection: Prior to plating and painting parts shall be 100% penetrant inspected in accordance with MIL-I-6866, Type I. Part shall be free of pits, cracks, scratches or other discontinuities. — NOTE 8

(NO CC) Surfaces shall be plated in accordance with MIL-STD-171, 1.1.2.3. — NOTE 3

(NO CC) Welding shall be in accordance with MIL-W-8611. — NOTE 4

MAJOR

M 101:	[-A-] 11°30" ± 30"	ZONE C-9
M 102:	5.171 DIA ± .005	ZONE E-9
M 103:	.125 $^{+.003}_{-.002}$	ZONE H-12
M 104:	.129 ± .005	ZONE H-15
M 105:	.140 $^{+.003}_{-.001}$ DIA	ZONE G-12
M 106:	.625 ± .005	ZONE J-14
M 107:	ALTERNATE: One piece construction optional.	NOTE 2
M 108:	.496 ± .001	ZONE G-11

DWG. 1569740, TUBE, MOTOR INTEGRAL RIB (REPLACES DWG. 1517392)
NO CC's ON PRINT

DWG. 1517404, CLOSURE, HEAD NON-PROPULSIVE

CRITICAL

C1:	.005 $^{+.005}_{-.000}$ R	ZONE B-13
C2:	.174 $^{+.000}_{-.006}$ DIA x .374 deep flat bottom CSK 100° x .197 DIA 6 holes equally spaced	ZONE A-10
C3:	.182 ± .005	ZONE C-13

TAB I-B

C4:	$.664^{+.005}_{-.000}$	ZONE C-14
C5:	⊙ B .010 TIR	ZONE H-5
C6:	$3.653^{+.000}_{-.005}$	ZONE G-5
C7:	⊙ A .005 TIR	ZONE E-5
C8:	$\sqrt{32}$	ZONE B-13
C9:	$3.872^{+.000}_{-.003}$	ZONE H-4
C10:	$5^{\circ}\,^{+0^{\circ}}_{-5''}$	ZONE A-14
C11:	9/32 MAX	ZONE C-5

MAJOR

M 101:	$.445 \pm .005$	ZONE I-7
M 102:	Finish in accordance with OO-P-416, type II, Class 2.	NOTE 2
M 103:	The entire head closure shall be magnetic particle inspected in accordance with MIL-I-6868. Part shall be free of cracks, laminations and inclusions.	NOTE 4

DWG 1517422, NOZZLE

CRITICAL

C1:	$.032^{+.015}_{-.000}$ R	SHEET 2 ZONE C-4
-C2:	$.190^{+.000}_{-.010}$	SHEET 2 ZONE D-4
+C3:	$.005^{+.005}_{-.000}$ R	SHEET 2 ZONE C-6
-C4:	$7^{\circ}\,^{+0^{\circ}}_{-7^{\circ}}$	SHEET 2 ZONE C-4

C5:	.975 ± .005	SHEET 1 ZONE D-11
C6:	1.032 ± .010	SHEET 1 ZONE E-9
C7:	17°20" ± 0°10"	SHEET 1 ZONE H-14
-C8:	$1.668^{+.004}_{-.000}$ DIA	SHEET 1 ZONE F-14
C9:	DELETED	
C10:	⊙ A .005 TIR	SHEET 1 ZONE H-16
C11:	.255 ± .005	SHEET 1 ZONE D-10
C12:	⊙ A .005 TIR	SHEET 1 ZONE J-9
C13:	11 B .002	SHEET 1 ZONE J-9
C14:	$4.457^{+.000}_{-.005}$ DIA -1 (DIM BLOCK)	SHEET 1 ZONE F-7
C15:	$4.463^{+.008}_{-.000}$ DIA -1 (DIM BLOCK)	SHEET 1 ZONE F-5
C16:	2.230 ± .005	SHEET 1 ZONE C-12
C17:	$4.647^{+.000}_{-.005}$ DIA -2 (DIM BLOCK)	SHEET 1 ZONE F-6
C18:	$4.673^{+.007}_{-.000}$ DIA -2 (DIM BLOCK)	SHEET 1 ZONE F-6
C19:	⊙ A .005 TIR	SHEET 2 ZONE B-5
C20:	$4.695^{+.000}_{-.003}$ DIA -1 (DIM BLOCK)	SHEET 1 ZONE F-7

C21:	| 11 B .005 |	SHEET 1 ZONE J-12
C22:	$4.884^{+.000}_{-.003}$ DIA -2 (DIM BLOCK)	SHEET 1 ZONE F-7
C23:	| — B .002 | | -A- |	SHEET 1 ZONE J-8
C24:	LEAK TEST Each assembly shall withstand 25 psig minimum pneumatic pressure applied to the seal in the direction of arrow G for a minimum of 30 seconds. The seal shall neither fracture, crack nor leak.	SHEET 1 NOTE 9
C25:	Material: piece 2, graphite molded (fine grain) type ATJ Material: pieces 3 and 4 asbestos-phenolic, molding RPD-150 or RPD-151.	SHEET 1 NOTE 1
C26:	The surfaces of piece -1 that will be in contact with piece -3 shall be sand blasted prior to molding.	SHEET 1 NOTE 4
C27:	Assembly of piece -2, piece -3 and piece -4: (A) Bond piece -4 to piece -3 using adhesive, MIL-A-8623, type III to form a solid joint. (B) Bond piece -2 to piece -4 and piece -3 with adhesive, MIL-A-8623 type III to form a solid joint.	SHEET 1 NOTE 6
C28:	If the molded surface of piece -3 is removed, a .0005-005 thick coat of sealer epoxy-polyamide in accordance with MIL-C-22750 shall be applied. Dimensions apply after coating.	SHEET 1 NOTE 7
C29:	The grain of the graphite insert, piece -2 shall be in a plane perpendicular to the axis of the nozzle.	SHEET 1 NOTE 8

C30:	Each assembly shall be radiographically inspected at three places 120° apart around the circumference in accordance with MIL-STD-453. Part shall have no single crack, delaminated area or void exceeding 0.13 inch in maximum dimension and the total cross-sectional area of such defects in any inch square shall not exceed 0.015 square inch.	SHEET 1 NOTE 13
(NO CC)	Surfaces bonded to piece -2 shall not be coated with sealer.	SHEET 1 NOTE 10
(NO CC)	Sealer coat shall overlap adjoining parts 1/8 ± 1/16 as indicated by ——— . . ——— (Dash Dot Dot Dash) lines.	SHEET 1 NOTE 11

MAJOR

M 101:	18°0" ± 0°10"	SHEET 1 ZONE E-9
M 102:	$2.222^{+.000}_{-.005}$	SHEET 1 ZONE C-11
+M 103:	$1.668^{+.004}_{-.000}$ DIA	SHEET 1 ZONE F-14
M 104:	⊙ A .005 TIR	SHEET 1 ZONE E-14
M 105:	The steel ring (piece 1) shall be finished in accordance with MIL-STD-171, finish no. 1.1.2.2 or 1.9.2.2.	SHEET 1 NOTE 2
M 106:	Projection of conical surfaces, mismatch not to exceed .005.	SHEET 1 ZONE I-14
M 107:	$4.884^{+.000}_{-.045}$ DIA (DIM BLOCK)	SHEET 1 ZONE F-7
M 108:	$4.695^{+.000}_{-.045}$ DIA (DIM BLOCK)	SHEET 1 ZONE F-7

DWG. 1517423, HANGER, FORWARD SUBASSEMBLY

MAJOR

M 101:	After potting, check continuity from item 2 to 6, and 1 to 5. Reading shall be 0.10 ohms maximum resistance. Check continuity from item 2, to item 1, reading shall be one megohm minimum resistance. Test probe should reach through hole in cap of item 2 and touch the contact button for a correct reading.	NOTE 1
M 102:	Self-locking nuts, item 8, shall be tightened to 7 ± 1 inch pounds torque prior to potting.	NOTE 5
M 103:	1/32 MAX (See Note 1)	ZONE D-3
M 104:	Check resistance from 1 to 3, reading shall be one megohm minimum resistance.	NOTE 3-A
M 105:	After assembly the cavity within item 1 shall be potted with item 10, and shall fill the cavity to the "limit of potting" surface, but shall not extend past surface X. Care shall be taken to minimize voids in the potting.	NOTE 1
M 106:	Self-locking screw, item 9 shall be tightened to 8 ± 1 inch pounds torque prior to potting.	NOTE 6

DWG 1555430, SHIELDING GASKET, ELECTRONIC
(Print has not been classified)

DWG 1555586
No comment (all minor characteristic)

DWG 1555594, RING, RETAINING

CRITICAL

C1:	.050 ± .005	ZONE D-12
C2:	4.660 ± .010 DIA	ZONE E-8

MAJOR

M 101: MATERIAL: Plastic material, laminated, thermosetting cotton fabric base, phenolic resin, mechanical grade. NOTE 1
ALTERNATE: MIL-P-15035 Type FBM.

M 102: After machining, the retaining ring shall be treated by a method that will render the resulting exposed surfaces fungus-resistant when testing in accordance with MIL-STD-810, Method 508.1, procedure 11. NOTE 4

DWG. 1557440, SHIM, CENTER HANGER
ALL CHARACTERISTICS MINOR

DWG. 1557441, DECAL, SAFETY
ALL CHARACTERISTICS MINOR

DWG. 1557447, DECAL, IDENTIFICATION
ALL CHARACTERISTICS MINOR

DWG. 1557449, DECAL, WARNING
ALL CHARACTERISTICS MINOR

DWG. 1560588, INSULATOR
ALL CHARACTERISTICS MINOR

DWG. 1560589, BUTTON, ELECTRICAL CONTACT

MAJOR

M 101: Finish no. 1.1.2.2 or 1.9.2.2 per MIL-STD-171. NOTE 2

DWG. 1560592, LEAD IGNITER-GROUND

MAJOR

M 101: Terminal shall be crimped to the ends of the wire in accordance with MIL-T-7928, type I, using a positive action crimping tool. NOTE 1

M 102: The maximum resistance from terminal to terminal shall be 0.1 ohm NOTE 3

DWG. 1560600, INSULATOR, TERMINAL
ALL CHARACTERISTICS MINOR

DWG. 1560603, SPRING, NON-PROPULSIVE HEAD CLOSURE

CRITICAL

-C1:	.509 ± .020 Free length	ZONE C-8

MAJOR

M 101:	Solid length shall be .297 maximum	NOTE 2-D
+M 102:	.509 ± .020 Free length	ZONE C-8
M 103:	Load at compressed length of .445 shall be 8 ± 1 pounds.	NOTE 2-A
M 104:	Material: Steel, spring wire in accordance with QQ-W-470.	NOTE 1
M 105:	Finish 1.1.2.2 of MIL-STD-171.	NOTE 3

DWG. 1560604, "O" RING

CRITICAL

C1:	Material: Rubber, silicone, in accordance with AMS 3303.	NOTE 1
C2:	Surface of "O" ring, except for indicated flash, shall be smooth and free from nicks, cuts or any other visual surface defects or irregularities.	NOTE 3
C3:	"W" DIA .139 ± .004	ZONE D-5
C4:	Inside diameter (3 Dash #5)	ZONE E-5

DWG. 1560855, COVER, DUST MOTOR TUBE
ALL CHARACTERISTICS MINOR

DWG. 1560838, PIN, RING RETAINING

MAJOR

M 101:	$.1250 \begin{smallmatrix}+.0003 \\ -.0000\end{smallmatrix}$ DIA	ZONE F-8

DWG. 1560839, SCREW

CRITICAL

C1: Inspection: Before plating, parts shall be 100% magnetic particle inspected in accordance with MIL-I-6868. Parts shall be free of pits, cracks, scratches or other discontinuities. NOTE 2

C2: Inspect in accordance with MIL-STD-414 NOTE 3
- A. Ultimate tensile strength: Inspect Level II, AQL .10, single specification limit.
- B. Hardness: Inspection Level II, AQL .10 total percent defective double specification limit.

MAJOR

M 101: Part shall be in accordance with MIL-B-7838, except as shown. NOTE 1

M 102: Cadmium plate in accordance with QQ-P-416, type II, Class 2. Embrittlement relief treatment must be performed. NOTE 4

DWG. 1560844, COLLAR, PINNED
ALL CHARACTERISTICS MINOR

DWG. 1560854, PIN, GUIDE

MAJOR

M 101: $.1240 \begin{smallmatrix}+.0005 \\ -.0000\end{smallmatrix}$ DIA ZONE D-8

DWG. 1560860, TERMINAL, WIRE
ALL CHARACTERISTICS MINOR

DWG. 1560866, TAPE
ALL CHARACTERISTICS MINOR

DWG. 1560872, COVER, PROTECTOR

MAJOR

M 101: Material: Rubber, silicone, high-temperature resistant, durometer shore hardness 70, color red. Alternate: ZZ-R-765, Class II, grade 70, color red. — NOTE 1

DWG. 1561127, BUTTON ASSEMBLY CONTACT

MAJOR

M 101: Adhesive not permitted inside of 0.170 DIA hole on exposed face of contact button, DWG. 1560589-1. — NOTE 2

DWG. 1561128, SLEEVE
ALL CHARACTERISTICS MINOR

DWG. 1561129, CAP
ALL CHARACTERISTICS MINOR

DWG. 1569517, SKID, HANGAR, CENTER

MAJOR

M 101: .200 $^{+.000}_{-.005}$ 2 places — ZONE E-4 1/2

M 102: [— | .003] [11 A .002] — ZONE E-5

M 103: 63/ 3 places — ZONE E-5

M 104: 1.745 $^{+.000}_{-.003}$ — ZONE D-5

M 105: 1/4-28UNF-3B 90° CSK .260 DIA 6 holes
[⊕ .002 DIA] — ZONE A-4

M 106: Heat treat to 180,000 to 200,000 psi ultimate tensile strength in accordance with MIL-H-6875. — NOTE 1

M 107: Passivate in accordance with finish 5.4.1 of MIL-STD-171. — NOTE 3

M 108: .370 minimum full threads 6 places ZONE B-3

DWG. 1569518, BAND, HANGER, CENTER

CRITICAL

Note: Parallel callout of |-A-| on DIA is wrong ZONE C-6

|-A-|

C1:	5.030 $^{+.005}_{-.000}$ DIA	ZONE C-6
C2:	.060 - .010 I.D.	ZONE B-6
C3:	| 11 | A | .002 |	ZONE D-4
C4:	.260 $^{+.001}_{-.000}$ DIA through .437C Bore far side to depth shown 6 holes | ⊕ .002 DIA |	ZONE E-6

MAJOR

M 101:	.060 + .010 O.D.	ZONE B-6
M 102:	.080 $^{+.010}_{-.000}$	ZONE B-5
M 103:	- .003	ZONE D-4
M 104:	1/4-28UNF-3B 90° CSK x .250 DIA. Both sides 4 holes equally spaced | ⊕ .005 DIA |	ZONE E-3
M 105:	.272 $^{+.003}_{-.001}$ DIA .406 DIA C Bore to .063 deep 4 holes equally spaced | ⊕ .005 DIA |	ZONE F-3
M 106:	Heat treat to 180,000 to 200,000 psi ultimate tensile strength in accordance with MIL-H-6875.	NOTE 1
M 107:	Passivate in accordance with number 5.4.1 of MIL-STD-171.	NOTE 3

M 108: Part shall meet the requirements of MIL-C-6021, Class 1A, grade B, except the areas indicated by DOT DOT DASH (..——) lines which shall have no defects. Impression stamp serial number with 1/16 inch high numerals in location shown. NOTE 2

DWG. 1569519, HANGER, CENTER, ASSEMBLY
Assembly print. No CC necessary.

DWG. 1569520

MAJOR

M 101:	$.1875^{+.0005}_{-.0000}$ DIA	ZONE B-5
M 102:	⊕ .005 DIA	ZONE B-5
M 103:	$.200^{+.000}_{-.005}$ 2 places	ZONE C-5
M 104:	$.490^{+.005}_{-.000}$ 2 places	ZONE D-5
M 105:	$.505^{+.000}_{-.005}$ 2 places	ZONE F-5
M 106:	$.995^{+.005}_{-.000}$ 2 places	ZONE E-5
M 107:	$1.010^{+.000}_{-.005}$ 2 places	ZONE E-5
M 108:	$1.515^{+.000}_{-.005}$ 2 places	ZONE E-6

M 109: Material: Steel, corrosion resistant 17-4 PH, investment casting in accordance with AMS 5355. Heat treat to 180,000 to 200,000 psi ultimate tensile strength in accordance with MIL-H-6875. NOTE 1

M 110: Part shall meet the requirements of MIL-C-6021, Class 1A, grade B, except the areas indicated by DOT DOT DASH (··——) lines which shall have no defects. Impression stamp serial number with 1/16 inch high numerals in location shown. NOTE 2

[redacted]

M 111: $1.745^{+.000}_{-.003}$ ZONE D-4

M 112: | ⊥ | B | .002 | ZONE D-4

DWG. 1569521, BAND, HANGER, AFT

MAJOR

M 101: 1/4-28UNF-3B 90° CSK .250 DIA. Both sides ZONE B-3

4 holes equally spaced [⊕ .005 DIA.] See Note 4.

M 102: $.1875^{+.0005}_{-.0000}$ DIA 3 holes in line .005 DIA ZONE F-3

M 103: $.490^{+.005}_{-.000}$ ZONE E-4

M 104: $.505^{+.000}_{-.005}$ ZONE E-4

M 105: $.995^{+.005}_{-.000}$ ZONE E-4

M 106: $1.010^{+.000}_{-.005}$ ZONE E-4

M 107: $1.500^{+.005}_{-.000}$ ZONE E-4

M 108: 2.585 ± .005 R ZONE C-5

M 109: $.272^{+.004}_{-.001}$ DIA. See Note 4 holes equally ZONE C-3

spaced .406 DIA C Bore .063 deep [⊕ .005 DIA]

M 110: Material: Steel, corrosion resistant, 17-4 PH, investment casting in accordance with AMS 5355. Heat treat to 180,000 to 200,000 psi ultimate tensile strength in accordance with MIL-H-6875. NOTE 1

M 111: Part shall meet the requirements of MIL-C-6021, Class 1A, grade B, except the areas indicated by DOT DOT DASH (..——) lines which shall have no defects. Impression stamp serial number with 1/16 inch high numerals in location shown. NOTE 2

[redacted]

DWG. 1569522, HANGER, AFT, ASSEMBLY

CRITICAL

-C1:	.065 - .010	ZONE C-6

MAJOR

+M 101:	.065 + .010	ZONE C-6
M 102:	.875 ± .010	ZONE E-4
M 103:	The 5.040 DIA shall average within the specified tolerance when in a free state.	NOTE 1
M 104:	[11 A B .002]	ZONE D-4
M 105:	[⊥ A .002] [-B-]	ZONE F-4

DWG. 1569740, TUBE, MOTOR INTEGRAL RIB

CRITICAL

C1:	[⊙ A .005 TIR]	SHEET 1 ZONE I,J-12,13
+C2:	3.880 ± .005 DIA	SHEET 1 ZONE H-12
+C3:	4.400 ± .005 DIA	SHEET 1 ZONE G,H-12
C4:	$4.838^{+.003}_{-.002}$ DIA	SHEET 1 ZONE G-12
C5:	[⊙ D .005 TIR]	SHEET 1 ZONE F-12,13
C6:	5/16 - 24 UNF -2B (.343 MIN FULL FORM THD 2 PLACES) [⊙ .005 DIA] See Note 13	SHEET 1 ZONE D-12,13
-C7:	$.060^{+.004}_{-.003}$ See Note 4	SHEET 1 ZONE I-9

+C8:	1.400 ± .005	SHEET 1 ZONE D,E-10
-C9:	.460 ± .020	SHEET 1 ZONE D-9
C10:	.050 ± .015	SHEET 1 ZONE D-9
C11:	63	SHEET 1 ZONE C,D-8
C12:	See note 16 (CAD PLATE ON .460 SURFACE)	SHEET 1 ZONE B,C-8,9
+C13:	4.894 ± .005 DIA SEE NOTES 2, 19 and 26	SHEET 1 ZONE H-5,6
C14:	5.049 ± .006 DIA SEE NOTES 3 and 19	SHEET 1 ZONE H,I-5
-C15:	5.168 ± .010 DIA STA 70.905	SHEET 1 ZONE G,H-4,5
C16:	⊙ B .010 TIR	SHEET 1 ZONE F-5
-C17:	$.060^{+.010}_{-.003}$	SHEET 2 ZONE I,J-6
C18:	$.140^{+.003}_{-.002}$ SEE NOTE 19	SHEET 2 ZONE C-7
C19:	$.028^{+.006}_{-.002}$	SHEET 2 ZONE C-4,5
C20:	.269 ± .005	SHEET 2 ZONE B-4,5
C21:	$.020^{+.010}_{-.000}$ R	SHEET 2 ZONE C-2
C22:	Material: (Steel, 160,000 psi minimum yield strength at 0.2% offset and 6% minimum elongation in 2 inches.) (120,000 psi minimum yield strength is permissible within the first 2 1/4 inches from the forward end of the motor tube.)	SHEET 3 NOTE 1

C23:	(Removal of wing rib sections in the hanger cutout area, sta 54.327 to sta 57.824 shall produce a step of $.010^{+.015}_{-.000}$ above the tube OD.)	SHEET 3 NOTE 1 B-5
C24:	The surface generated by the 3.880 diameter shall not be deformed after the drilling and topping operation.	SHEET 3 NOTE 13
C25:	Within one hour max, after application of plating NOTE 16, but prior to Conversion Coating the part shall be baked at 375°F $\pm 25^\circ$ for a period of three hours.	SHEET 3 NOTE 17
C26:	Each completed motor tube shall be tested and shall withstand without deformation an internal hydrostatic pressure of 3300 psi.	SHEET 3 NOTE 19
C27:	The entire OD of the motor tube, the ID 1.400 aft of the forward end shall be magnetic partial inspected in accordance with MIL-I-6868, crack or indications related to the original mill rolled surface such as laps, seams, sheets or folds shall be cause for rejection.	SHEET 3 NOTE *18 (A)
C28:	$18^\circ\ 0'\ ^{+1^\circ\ 0'}_{-0^\circ\ 0'}$	SHEET 2 ZONE B,C-4,5

MAJOR

M 101:	⊥ B .004	SHEET 1 ZONE J-11,12
-M 102:	4.400 ± .005 DIA	SHEET 1 ZONE G,H-12
M 103:	$30^\circ \pm 3^\circ$	SHEET 1 ZONE C-8,9
-M 104:	1.400 ± .005	SHEET 1 ZONE D,E-10
M 105:	4.894 ± .005 DIA SEE NOTES 2, 19 and 26	SHEET 1 ZONE H-5,6
M 106:	$.1245^{+.0005}_{-.0000}$ DIA ⊕ .005 DIA SEE NOTE 22	ZONE H,I-4

[redacted]

M 107: $30^\circ \pm 3^\circ$	SHEET 1 ZONE D-3,4
M 108: $1/16 \begin{smallmatrix}+5/64 \\ -1/64\end{smallmatrix}$	SHEET 1 ZONE E-2
M 109: $30^\circ \pm 3^\circ$	SHEET 1 ZONE C,D-1,2
M 110: .033 TIR MAX	SHEET 2 ZONE H-16
M 111: .049 TIR MAX	SHEET 2 ZONE H,I-15
M 112: .055 TIR MAX	ZONE I-14,15
M 113: .053 TIR MAX	SHEET 2 ZONE I-13,14
M 114: $.200 \pm .020$	SHEET 2 ZONE C-15
M 115: $.147 \begin{smallmatrix}+.006 \\ -.009\end{smallmatrix}$ SEE NOTE 20	SHEET 2 ZONE C,D-13
M 116: $.175 \begin{smallmatrix}+.000 \\ -.015\end{smallmatrix}$ R TYP	SHEET 2 ZONE B,C-12,13
M 117: .188 TYP	SHEET 2 ZONE J-8
M 118: 5.970	SHEET 2 ZONE J-4
M 119: $45^\circ \pm 2^\circ$ TYP SEE NOTE 11	SHEET 2 ZONE J-4
-M 120: $.455 \pm .015$ TYP	SHEET 2 ZONE I,J-4
M 121: $20.00 \pm .005$	SHEET 2 ZONE E-6
M 122: $16.000 \pm .005$	SHEET 2 ZONE E-5

[redacted]

M 123:	8.000 ± .005	SHEET 2 ZONE F-4,5
M 124:	4.000 ± .005	SHEET 2 ZONE F-4
M 125:	Material: (Steel, 160,000 PSI minimum yield strength at 0.2% offset and 6% minimum elongation in 2 inches.) 120,000 PSI minimum yield strength is permissible within the first 2 1/4 inches from the forward end of the motor tube.)	SHEET 3 NOTE 1
M 126:	The 5.014 ± .011 diameter at the forward end of the motor shall blend smoothly with the OD of the .060 wall thickness area, so that when a functional test fixture is attached to the motor tube, plane "Y" of the test fixture shall be 11 B .003.	SHEET 3 NOTE 9
M 127:	Datum [-B-] , for purposes of inspection, shall be those outside surface contacting inspection rollers "M" and "O" at the positions indicated in the "indicator and roller locations" detail. Concentricity and perpendicularity of features shall be inspected by rotating the tube on rollers "M" and "O." The total indicator valves apply at locations shown. (After meeting the above conditions, the motor tube shall meet the 0.980 minimum condition described in the hanger location checkout.)	SHEET 3 NOTE 10
M 128:	The tolerance of the 45° angle may be $\pm 2^\circ$; however, the maximum variation between the angles of the slots on any one rib shall not exceed $0^\circ 30'$ non-cumulative relative to each other.	SHEET 3 NOTE 11
M 129:	After testing, each 21 1/32 length of wing rib as described in "rib layout" sheet 2 shall accept a test fixture 22 inches long, having a cross section configuration as defined in "functional fixture" sheet 2. The 22-inch length of the 0.154 groove may have a maximum bow of 0.001. The base of the fixture shall bottom on each surface of the rib described by the 0.175 radius in section G-G.	

DWG. 1571828, PIN, HANGER, AFT

MAJOR

M 101:	— .003 M	ZONE C-3
M 102:	Material: Steel wires, AMS 5673. Heat treat to 250,000 to 280,000 psi tensile strength in accordance with MIL-H-8675.	NOTE 1

DWG. 1571861, DECAL, CLAMP RING SCREW
ALL CHARACTERISTICS MINOR

DWG. 1571862, DECAL WING SCREWS
ALL CHARACTERISTICS MINOR

DWG. 458498, LOCKWIRE, BOOSTER NOZZLE

CRITICAL

C1:	.187 ± .003	ZONE E-8
C2:	Material: Steel, cold drawn 70,000 psi minimum yield strength at 0.2% offset, 10% minimum elongation in 2 inches.	NOTE 1
C3:	Finish 1.1.2.2 or 1.9.2.2 of MIL-STD-171.	NOTE 3
C4:	.187 ± .003	ZONE E-8

DL 2580618, 5.0 INCH ROCKET MOTOR, MARK 36 MOD 5 LOADED ASSEMBLY

DWG. 2580618, 5.0 INCH ROCKET MOTOR, MARK 36 MOD 5 LOADED ASSEMBLY

CRITICAL

C1:	.308 MAX	SHEET 2 ZONE B-6
C2:	.020 MAX	SHEET 2 ZONE F-3
C3:	.015 ± .015 (See note 11)	SHEET 2 ZONE E-2
C4:	The motor shall conform to the requirements of WS 4225.	SHEET 3 NOTE 1

C5:	Items 4 and 22 shall be coated with item 5 prior to assembly.	SHEET 3 NOTE 3
C6:	Check tne continuity of the Rocket Motor ignition circuit using an approved tester (or test set).	SHEET 3 NOTE 5
C7:	Items 21 shall be bonded to the grain, tube and tube liner with item 20. In Zone G there shall be no unbonded areas or voids larger than 1/4 inch in a radial direction within .100 inch of the propellant. No voids or unbonded areas are permitted between item 21, the tube, and the tube liner. In Zone F, a total of 1/2 square inch of unbonded area or voids is permitted. In Zone H, no voids or unbonded areas are permitted.	SHEET 3 NOTE 6
C8:	Radiographic examination shall be performed at ambient temperature in accordance with WS 4225.	SHEET 3 NOTE 8

MAJOR

M 101:	$90^\circ \pm 30^\circ$	SHEET 2 ZONE C-2
M 102:	After assembly of item 2, assemble item 7 and item 8, to item 2 as shown (Red lead to ceramic insulated terminal). Tighten nuts, item 9 to 6 ± 1 inch pounds torque and coat area shown in dashed lines, with sealing compound, item 10.	SHEET 3 NOTE 4
M 103:	All bearing surfaces of items 23 and 24 shall be coated with item 5 prior to assembly. Assembly of item 24 shall be accomplished with approximately 1 1/2 turns of item 23, so that the ends of the lock-wire are not visible through the entrance hole in the tube.	SHEET 3 NOTE 7
M 104:	Each wire rib shall accept a gage 22 inches minimum in length, having a cross-section configuration as shown in figure 1. The length of the .154 groove may have a maximum bow of .001 inch. The base of the gage shall bottom on each surface at the base of the rib. The base of the gage shall be slotted to clear aft hanger band.	SHEET 3 NOTE 9

DWG. 1557475, INHIBITOR, AFT

CRITICAL

C1:	Material: Rubber base inhibiting compound, WS 6529, type II.	SHEET 1 NOTE 1
C2:	Exterior surfaces shall be free of contamination. Advisory: Clean plastic gloves should be worn by personnel handling part.	SHEET 1 NOTE 3

MAJOR

M 101:	In Zone G there shall be no voids larger than 1/4 inch in a radial direction within .100 inch of surface E. In Zone F, a total of 1/2 square inch of voids is permitted. In Zone H, no voids are permitted.	SHEET 1 NOTE 2
M 102:	Flash shall not exceed .031 inches and is only permissible on corners indicated.	SHEET 1 NOTE 4
M 103:	.440 ± .030	SHEET 1 ZONE C-2
M 104:	.080 ± .030	SHEET 1 ZONE B-2

DWG. 2580609, PAINTING AND MARKING ASSEMBLY

MAJOR

M 101:	Painting and Marking Requirements	SHEET 1 NOTE 1
M 102:	Locate items 2, 3, 4, 9 and 10 on the finished surface of the tube, 90° from the plane of the vertical centerline. The second item of items 3, 4 and 10 shall be located diametrically opposite those shown.	

DWG. 2580611, HANGER ASSEMBLY MOD 5

CRITICAL

C1:	Item 2 shall be assembled with item 1 using item 9, the screws shall be coated with items 10 and 14 and tightened to 140 ± 5 inch pounds torque.	NOTE 1

C2: Item 7 shall be assembled to meet requirements of note 3. Pins tightened to a torque of 40 ± 5 inch pounds after coating with items 10 and 14. NOTE 2-A

C3: The eight (8) screws, item 8, used in the center and Aft Hanger assemblies shall be coated with sealing compound and primer, items 10 and 14, and tightened to 40 ± 5 inch pounds torque. Excess compound shall be wiped away. NOTE 2-D

C4: Item 4 shall be secured permanently before propellant is cast in tube. NOTE 2-E

C5: After compliance to notes 1 and 2, items 2, 3 and 4, shall pass without interference into and through a functional fixture which has dimensions shown in figure 1 and is sixty (60) inches long minimum. NOTE 3

C6: All threaded fasteners shall be treated in accordance with MIL-S-22473 in the following sequence. NOTE C-6

A. All fastener threads shall be vapor degreased, stored in an atmosphere of low humidity and kept clean until ready for use.
B. Prior to assembly, all fastener threads shall be dipped in grade O primer and allowed to dry.
C. The primed fastener threads shall then be dipped in grade AA sealing compound, installed and tightened, any fastener disturbed within 6 hours, shall be removed and redipped in the sealing compound.

C7: Each hanger assembly shall be inspected with ultraviolet light to verify the presence of sealing compound on all threaded fasteners. NOTE 6

MAJOR

M 101: The adhesive support tape, items 5 and 6, shall be saturated with adhesive, item 11. NOTE 2-B

M 102:	The height of item 3 shall be adjusted using item 7 to comply with note 3.	NOTE 2-C

DWG. 2580613, TUBE, MOTOR, LOADED

CRITICAL

C1:	Item 2 shall be in accordance with WS 4225 and shall be vacuum cast into item 1.	SHEET 1 NOTE 1
C2:	Item 4 must be permanently installed prior to casting propellant. Hangers omitted for clarity.	SHEET 1 NOTE 2
C3:	The liner shall be bonded to both the motor tube wall and to the propellant, no separation is permitted as determined by X-ray examination.	SHEET 1 NOTE 7
C4:	Surfaces indicated by dot dot dash (..——) lines shall be free of propellant, inhibitor, or other foreign material.	SHEET 1 NOTE 8

MAJOR

M 101:	The total weight of the cast propellant within the motor tube shall be 59.4 pounds minimum to 61.6 pounds maximum.	SHEET 1 NOTE 4
M 102:	Aft end grain configuration shall be verified by inspection of the tooling prior to each casting.	SHEET 1 NOTE 11
M 103:	$.060 \begin{smallmatrix} +.060 \\ -.000 \end{smallmatrix}$ (See note 6)	SHEET 1 ZONE D-1
M 104:	2.588 DIA ± .010 [⊙ A .020 TIR] [-B-]	SHEET 1 ZONE B-2
M 105:	3.766 DIA ± .010 [⊙ .020 TIR]	SHEET 1 ZONE E-1

DWG. 2580615, TUBE, MOTOR, LINED

CRITICAL

C1:	The motor tube, item 1, shall be prelined as shown using item 2. The pre-liner shall be flush with surface "W" within 0.015. The pre-lining may be performed as prescribed in OD 30728.	NOTE 2
C2:	.060 ± .040 liner thickness throughout 3.000 MAX LENGTH.	SHEET 1 ZONE B-5
C3:	$.030^{+.020}_{-.010}$ (See note 3)	ZONE C-3

MAJOR

M 101:	The internal surfaces shall be clean and free of foreign material. The motor tube item 1, shall be cleaned as per note 1 A, B, C and D.	NOTE 1

DWG. 2580650, CLOSURE ASSEMBLY

CRITICAL

C1: All threaded fasteners shall be treated in accordance with MIL-S-22473 in following sequence: — NOTE 6

A. All fastener threads shall be vapor degreased, stored in an atmosphere of low humidity and kept clean until ready for use.
B. Prior to assembly, all fastener threads shall be dipped in primer, item 13, and allow to air dry.
C. The primed fastener threads shall then be dipped in item 6 or item 11, installed and tightened. Any fastener disturbed within 6 hours, shall be removed and redipped in the sealing compound.

MAJOR

M 101: Assemble item 10 on item 12. Apply item 11 to threads of item 2. Assemble item 2 in item 1 as shown, and tighten to 450 to 550 inch pounds torque. (See note 6.) NOTE 1

M 102: Remove items 8 and 9, and locate items 4, 12, 9 and center terminal of item 3. Apply item 7 to threads of item 2 and tighten item 8 to 4 ± 1 inch pounds torque. NOTE 2

M 103: The igniter circuit shall be checked with an approved tester on test set. Resistance test may be accomplished as specified in OD 30728. NOTE 3

M 104: Coat area shown with dash dot dot (—— ..) lines with item 7. NOTE 4

M 105: Apply item 6 to item 5, assemble, and tighten to 5 ± 1 inch pounds torque. (See note 6.) NOTE 5

DL 1517776, FILTER, RADIO INTERFERENCE ASSEMBLY

DWG. 1517776, FILTER, RADIO INTERFERENCE ASSEMBLY

MAJOR

M 101: Solder Item 2 to Item 1, Item 11 to Item 1 and all lead connections in accordance with MIL-S-6872, using Item 13. NOTE 1

M 102: Pot assembly as follows: All cavities within the housing, Item 1, excluding the cavity indicated as area A, shall be filled $1/32 \; {}^{+1/64}_{-0}$ from surface Z using Item 14. Care shall be taken to minimize voids in the potting. All electrical elements and connections in the cavities shall be completely covered with sealing compound and $1/32 \; {}^{+1/64}_{-0}$ below surface Z. NOTE 3

M 103: Each assembly shall meet the following requirements when tested as specified. NOTE 4

A. Test number 1 as shown.
B. Capacitance to ground shall be 9.90 microfarads minimum when tested in accordance with MIL-STD-202, Method 305, at 60 ± 6 cps test frequency. Limit of accuracy of test equipment shall be ± 2 percent.
C. High potential: When tested in accordance with MIL-STD-202, Method 301, by applying a direct current voltage of 35 volts maximum between the housing, Item 1, and the insulated feedthru terminal, Item 2, and the wire terminal, Item 9 connected together, leakage current shall be limited to one ampere maximum.

DWG. 1517777, HOUSING

MAJOR

M 101: Finish 1.4.3.1 of MIL-STD-171, .001 thick. NOTE 2

M 102: Part shall be inspected for internal discontinuities in accordance with MIL-C-6021, Class II A, Level C. After coating presence of any defect listed in Table III of MIL-C-6021 shall be cause for rejection, except surface irregularities. Misruns and core shifts are permitted within drawing tolerances. NOTE 3

M 103: .906 BSC PAGE 1 ZONE C-6

M 104; 1.124 BSC PAGE 1 ZONE B-5

M 105: .500 PAGE 1 ZONE D-3

DWG. 1555427, CAPACITOR, FIXED, FEEDTHRU

MAJOR

M 101: Capacitor shall meet the construction performance and environmental requirements of MIL-C-110 15/13 Type CK 70 AW 152M, except design and dimensions shall be as specified on this drawing. NOTE 1

DWG. 1555428, CAPACITOR, FIXED, FEEDTHRU

MAJOR

M 101: Capacitor shall meet the performance requirements of the Sprague Electric Company Engineering Bulletin Number 3525, Type 180D Tantalex Feedthru capacitors dated May 1962 when tested in accordance with the applicable sections of the bulletin. NOTE 4

DWG. 1555431, TERMINAL, FEEDTHRU, INSULATED

MAJOR

M 101: Terminal stud shall be brass, electro-tin plated. Plating shall be 0.00025 inch minimum thick. NOTE 3

M 102: When terminal is soldered securely to a metal chassis, using 1/16 inch nominal wide metallized band, thread portion of terminal stud shall withstand 10 inch-pounds minimum torque without breaking metallized band or fracturing ceramic to stud bond. NOTE 4

M 103: Terminal shall withstand subjection to any temperature from minus 55°C to plus 150°C without fracturing of ceramic or loosening of metallizing. NOTE 5

DWG. 1557518, IDENTIFICATION PLATE

MAJOR

M 101: The mask shall be a 1.0 inch diameter paper disc insulating the area under it from the pressure sensitivity. NOTE 5

DL 1568376, IGNITER ROCKET MOTOR MARK 264 MOD 1 ASSEMBLY

DWG. 1555641, GRAIN

NOTE 1 Material: The grain shall meet the requirements of WS 1620.

NOTE 3 Grain shall be free of microscopic imperfections (such as scratches, cracks, laminations, inclusions, voids and foreign material).

DWG. 1560892, BOOSTER ASSEMBLY

MAJOR

M 101:	(A) Coat surface "A" of body with sealing compound. Synthetic rubber accelerator required MIL-S-8516, Class 1.	NOTE 1
M 102:	Before assembly, coat rim of cup, surface B .562 diameter reference, DWG. 1560895 with sealing compound, synthetic rubber, accelerator required MIL-S-8516, Class 1.	NOTE 2

DWG. 1560894, BODY

MAJOR

M 101:	$.011 \pm .002$	SHEET 1 ZONE G-8
M 102:	$.115 \begin{smallmatrix}+.000\\-.010\end{smallmatrix}$	SHEET 1 ZONE C-10
M 103:	$.018 \pm .003$	SHEET 1 ZONE C-8

DWG. 1560895, CUP

MAJOR

M 101:	$.090 \begin{smallmatrix}+.000\\-.005\end{smallmatrix}$	SHEET 1 ZONE F-8
M 102:	$.010 \pm .001$	SHEET 1 ZONE F-8

M 103: .562 $^{+.000}_{-.010}$ DIA

SHEET 1
ZONE C-6

DWG. 1568376, IGNITER ROCKET MOTOR MARK 264 MOD 1

MAJOR

M 101: Prime grain assembly Item 1 and tube assembly threads Item 2 with grade Q primer. Item 10 allow primed parts to dry for 2 hours. Apply grade A sealing compound Item 6 to grain assembly. Insert grain assembly Item 1 into aft end of tube assembly Item 2. Seating against depth gage DWG. 1556359 align screwdriver slots to correspond with either set of .101 diameter holes. NOTE 2

M 102: Coat threads of electric squib MARK 5 MOD 0 Item 5 with grade Q primer Item 10. Allow squib threads to dry for 2 hours. NOTE 4

M 103: Apply grade A sealing compound Item 6, to electric squib Item 5, and insert electric squib Item 5 into tube assembly, Item 2 until flange seats against tube assembly. Torque to 300 ± 50 inch pounds. NOTE 5

M 104: Prior to and after assembly the igniter rocket motor assembly shall be free of oil, grease, and all foreign material. NOTE 7

M 105: Radiographically examine each igniter in accordance with MIL-STD-453 to determine the presence, proper location and acceptable condition of internal component parts. NOTE 10

M 106: After assembly, inspect all surfaces coated with Item 6 with fluorescent light to verify sealing of the threaded surfaces of Items 1 and 5. NOTE 11

DWG. 1568377, GRAIN ASSEMBLY

MAJOR

M 101: Prior to and after assembly, the grain, Item 1, the igniter setscrew Item 2, and insulation sleeve Item 3, shall be free of oil, grease, and all foreign material. NOTE 1

M 102: Insert grain Item 1, into igniter setscrew Item 2, before grain has been inserted into insulation sleeve Item 3. NOTE 2

M 103: Place grain assembly in 170 ± 10°F oven for 15 minutes to allow shrinkage of the insulation sleeve Item 3 onto the grain Item 1, and igniter setscrew Item 2. The aft end shall be trimmed as shown. The installed insulation sleeve shall be free of fissures, wrinkles, and blisters. NOTE 3

DWG. 1568380, TUBE ASSEMBLY

MAJOR

M 101: Prior to and after assembly, the tube Item 1 shall be free of oil, grease, and all foreign material. NOTE 1

M 102: Prior to assembly of insulation sleeve Item 2 the tube, Item 1 shall be coated with epoxy resin adhesive Item 3. While the adhesive is still tacky, the insulation sleeve shall be heat shrunk on the tube and the adhesive allowed to cure. After cooling the insulation sleeve shall be trimmed flush to 1/8 inch maximum from each end of tube. The installed insulation sleeve shall be free of fissures, wrinkles, and blisters. NOTE 2

M 103: Tube assembly when supported at each end with a leak tight fixture shall meet the leak requirements of WS 3853. NOTE 3

M 104: Four .101 diameter holes shall be kept free of adhesive Item 3. NOTE 4

DWG. 1556359, GAUGE, DEPTH

MAJOR

M 101: $1.060^{+.000}_{-.005}$ — PAGE 1, ZONE B-3

DL 269495, SQUIB ELECTRIC MARK 5 MOD 0

DWG. 1296819, SQUIB ELECTRIC MARK 5 MOD 0

CRITICAL

C1: The final assembly shall be shorted with nut, AN 340-6, and shorting washer, DWG. 1560571 during handling and storage. Install nut with 4 ± 1 inch pound torque. — NOTE 7

MAJOR

M 101: Body and bridge wire assembly DWG. 1296833 shall be free of oil, grease and other foreign material. — NOTE 1

M 102: Bridge wire shall be covered with a bead of 15 ± 5 milligrams of initiation charge, drawing 1560576. The bead shall be dried for a minimum of 4 hours at 110°F to 150°F before further loading of assembly. — NOTE 2

M 103: The bottom cavity of the body and bridge wire subassembly DWG. 1296833 shall be filled with 30 ± 5 milligrams of boron-potassium-nitrate granules 458505-3, in such a manner as to completely cover the beaded bridge wire. It shall extend up to, but not beyond the 0.180 dimension of the squib body DWG. 1517178. Installed granules shall be encrusted by adding 2 drops (0.7 ± 0.2 milligrams) of ethyl cellulose lacquer DWG. 652243 and shall be dried for a minimum of 4 hours at 140° to 160°F before further loading. — NOTE 3

M 104: Loose charge 70 ± 5 milligrams of boron-potassium-nitrate granules, DWG. 458505-1 shall be placed into cup, DWG. 458694. — NOTE 4

M 105: The loaded cup DWG. 458694 shall then be installed into squib body, DWG. 1517178, to minimum of 0.030 from lip. Exposed surface of cup shall be coated with epoxy Type I, MIL-A-8623. Epoxy shall dry at 70 ± 10°F temperature for a minimum of 1 hour. A fillet of silicone rubber compound MIL-S-23586 Type II, Class 3, Grade A, shall be applied as shown. Within 5 minutes the lip of squib body shall be crimped 360° to secure cup. Finished crimp must be 90° + 5° - 0° to the axis of the assembly. Exposed surface of cup must be free of compound. — NOTE 5

M 106: The resistance of the bridge wire circuit must be 0.7 ± 0.2 ohms when measured with a maximum of 50 milliamps. — NOTE 6

DWG. 1296833, BODY AND BRIDGE WIRE SUBASSEMBLY

<u>MAJOR</u>

M 101: The bridge wire shall be resistance wire QQ-R-175 composition D, except as noted: — NOTE 1

A. The resistance shall be between 165-180 ohms per foot at 50°C.

B. The proportions of nickel, chromium and iron may vary from the specification provided that the resistance requirements of Note 5 are met.

M 102: The welded bridge wire shall form a sound electrical and mechanical joint that will support a load of 25 ± 1 grams applied normal to the axis of the wire. Each leg of the bridge shall be tested. — NOTE 4

DWG. 1517178, BODY SQUIB

<u>MAJOR</u>

M 101:	⊥ A .005	SHEET 1 ZONE J-10
M 102:	⊥ A .005	SHEET 1 ZONE J-9
M 103:	3/4-16UNF-2A PD ⊙ A. 003 TIR	SHEET 1 ZONE 1-6

M 104: .260 + .003 - .000 DIA — SHEET 1, ZONE H-7

M 105: .030 + .010 - .000 — SHEET 1, ZONE G-8

DWG. 1560572, PIN

MAJOR

M 101: Material: Nickel 51%, iron 49% tensile strength 70,000-150,000 psi, yield strength 0.2% offset 50,000 psi average elongation in 2 inches 35%. — NOTE 1

DWG. 458694, CUP

MAJOR

M 101: .0030 + .0000 - .0015 — SHEET 1, ZONE G-12

M 102: .0040 + .0000 - .0025 — SHEET 1, ZONE F-12

DWG. 1560576, CHARGE, INITIATION

MAJOR

M 101: Material: Uniform by weight consisting of: — NOTE 1

A. Normal lead styphnate in accordance with MIL-L-17186. The lead styphnate shall be milled in accordance with NAVORD OD 6699 to provide the approximate particle size range specified in section 4.4.

B. Zirconium in accordance with JAN-Z-399. Prior to use, the zirconium shall be washed with distilled water to remove all traces of impurities and then wet-screened through a 325 U.S. sieve. All material passing through the sieve shall be dried at 75 to 80° C. Discard all the zirconium not passing through the 325 U.S. sieve.

C. Lead dioxide in accordance with MIL-L-376, Class I.

D. The resin shall be a vinyl acetate copolymer. It shall contain 85 to 88 percent vinyl chloride and 12 to 15 percent vinyl acetate. The resin shall have a specific gravity of 1.35 to 1.37. Material shall be furnished as a powdered white solid, not less than 98 percent of which shall pass through a No. 20 sieve, conforming to specification RR-S-366. Prior to use, vinyl resin shall be dissolved in normal butyl acetate conforming to TT-B-838.

M 102: For standard testing sieves refer to RR-S-366. NOTE 2

F. Subject. Inspection requirements of the following wing units shall be at least as tight as shown in Section 1-107b of DSAM 8260.1 for its classification of characteristics. Inspection is to be monitored by the local Quality Assurance Representative at a 10% level.

DL 1517560 Damper Assembly
DL 1517540 Rolleron Assembly
DL 1517535 Wing Assembly Guided Missile Mk 1 Mod 0

DL 1517560, DAMPER ASSEMBLY

DWG. 1517560, DAMPER ASSEMBLY

MAJOR

M 101: Lubricate O-Rings, Item 6, Rod, Item 8, and ends of shaft, damper assembly, Item 2, outside of O-Rings grooves with grease, Item 12. NOTE 2

M 102: After filling, crimping and cutting the bellows tube, (solder end of tube with solder, Item 14, in accordance with MIL-S-6872. End of tube after crimping shall be free of Item 13 prior to soldering). NOTE 4

M 103: With the damper housing, Item 1, held stationary and the damper shaft assembly, Item 2, attached to a torque test fixture, the breakaway torque shall not exceed 0.10 foot pounds. The damping torque shall be as follows: NOTE 5

[redacted]

A. 0.020 to 0.30 ft-lbs at 1 Radian per second.
B. 0.35 to 0.50 ft-lbs at 2 Radians per second.
C. 0.80 to 2.00 ft-lbs at 5 Radians per second.
D. 1.75 to 5.00 ft-lbs at 10 Radians per second.

Hysteresis shall not exceed 1.00 ft-lbs at 5 Radians per second.
Measurements shall be made while turning the damper shaft assembly, Item 2, through an arc of 20°. (10° on both sides of a neutral position).
Advisory. See SA 492583 for tooling which has been used satisfactory.

M 104: Compress bellows to .945 ± .010 before filling. — ZONE B-3

M 105: After tightening of screws, Item 4, apply epoxy, Item 19, over screws to fill cavity between screws, Item 4, and housing, damper, Item 1. — NOTE 8

M 106: After tightening of bellows assembly, Item 11, to housing, damper, Item 1, apply epoxy, Item 19, as shown to bond bellows to housing.

M 107: Parts list, Item 10, torque to 30 in-lbs ± 1 in-lb. — ZONE B-1

M 108: Parts list, Item 4, torque to 8 in-lbs ± 1 in-lb. — ZONE B-1

M 109: Parts list, Item 11, torque to 15 in-lbs ± 1 in-lb. — ZONE B-1

DWG. 1298080, O-Ring

MAJOR

M 101: ID per tabulation block-1, -2 and -3 — ZONE C-3

M 102: DIA W per tabulation block -1, -2 and -3 — ZONE C-3

[redacted]

M 103:	.005 MAX 2 places	ZONE B-3
M 104:	.003 MAX 2 places	ZONE C-3
M 105:	Surface of O-Ring, except for indicated flash, shall be smooth and free from nicks, cuts, or any other surface defects or irregularity in excess of .001 in height or depth.	NOTE 2
M 106:	Original source of supply	ZONE B-4

DWG. 1517561, SEGMENT, DAMPER

M 101:	√32	ZONE B-3
M 102:	√32	ZONE E-5
M 103:	√32	ZONE E-4
M 104:	⊥ A .0002	ZONE E-4
M 105:	⊥ A .0002	ZONE E-5

DWG. 1517562, HOUSING, DAMPER

M 101:	.5016 DIA $^{+.0003}_{-.0000}$	ZONE D-5
M 102:	√8	ZONE D-5
M 103:	.030R TYP	ZONE C-3
M 104:	√[illegible]	ZONE D-3
M 105:	√32	ZONE C-3
M 106:	⌖ .005 DIA	ZONE C-5
M 107:	10-32 UNF-28 (90° CSK x .314 DIA)	ZONE B-3

DWG. 1517563

MAJOR

M 101:	Coat the .5009 $^{+.0000}_{-.0005}$ DIA surfaces and vertical surfaces, indicated by DASH DASH DOT (—— ——.) lines at the 1.750 dimension with lubricant, solid film, dry per MIL-L-22273. All dimensions and tolerances apply after application of film.	NOTE 2
M 102:	Damper Segment, DWG. 1517561, shall be selectively fitted into this area and shall maintain a (Maximum of 0.0002 total clearance between ends of damper segment and 1.750 ± .005 dimension damper segment shall fit freely with damper shaft.)	NOTE 3
M 103:	Material: Steel, cre, AISI 416, 98,000 PSI minimum tensile strength. Alternate: QQ-S-763, Class 416, 98,000 PSI minimum tensile strength.	NOTE 1
M 104:	√16	ZONE F-4
M 105:	√16	ZONE F-4
M 106:	.387 ± .003 DIA TYP	ZONE B-6
M 107:	Edge of holes to be free of nicks, burns and chatter marks, 2 places.	ZONE C-5
M 108:	⊥ A .0002	ZONE C-5
M 109:	⊥ A .0002	ZONE C-4
M 110:	⊙ A .003 TIR	ZONE C-6

DWG. 1555358, SHAFT, DAMPER ASSEMBLY
Assembly print no cc necessary

DWG. 156980, DRIVE SCREW, DAMPER
No cc on print

DWG. 1560981, ROD, DAMPER
No cc on print

DWG. 1560983

MAJOR

M 101: .040 DIA (Edge of hole to be free of nicks and burns.)

DWG. 1560984

MAJOR

M 101:	.005 ± .001	ZONE C,D-3,4
M 102:	.386 ± .004 DIA	ZONE B-4
M 103:	.001 ± .001 Radial split	ZONE B-3

DWG. 1560985

MAJOR

M 101: Material: QQ-S-766, Class 302 to 304 incl. (Condition half-hand)

DWG. 1561092, SCREW SEGMENT
No CC's on print

DL 1517540, ROLLERON ASSEMBLY

DWG. 1517540, ROLLERON ASSEMBLY

MAJOR

M 101: The bearings, Item 2, shall be selectively fitted to each wheel hub such that an interference fit of 0.000025 to 0.000025 clearance shall be maintained between the bearing inner race bore and the outside diameter of the hub of the wheel assembly; Item 3. NOTE 3

M 102: Press the bearings, Item 2 into the rolleron case machined assembly, Item 1, until securely seated, without deforming the case or the bearing. Assemble the wheel, Item 3 and the shim, Item 4, into the case. Select shims that shall maintain a 4 lb ± 1 lb preload on the bearing, install the right hand preload screw, Item 5, and the left hand preload screw, Item 6, with a torque of 45-47 inch pounds. Any contamination of the bearing grease will necessitate cleaning of the bearings and the installation of new grease, Item 4, in accordance with WS 1615. — NOTE 4

M 103: Seal the bearing dust caps, part of 1517544, in place using base, Item 15, and hardener, Item 16.

M 104: The wheel, Item 3, shall be balanced dynamically within 200 micro-ounce inches in each plane (i.e. each side of the wheel). Balancing holes to be 0.014 DIA by 0.080 maximum deep and drilled in areas shown on a 3.000 ± 0.015 DIA circle.

M 105: The wheel, Item 3, shall be operated at 30,000 RPM for five (5) minutes prior to checking the rundown time. The wheel after the driving source is removed, shall slow down from 6,000 RPM ± 50 RPM to 3,000 RPM ± 50 RPM within 8.75 seconds ± 1.75 seconds.

DWG. 1517541, CASE ROLLERON (Right hand)
No CC's on print

DWG. 1517542 ROLLERON CASE (Machined assembly)

MAJOR

M 101: Right and left hand rolleron cases, Items 1 and 2, shall be assembled, machined and kept in matched sets in accordance with paragraph 2-101.3.5 MIL-STD-100A.

M 102: .7495 ± .0001 DIA — ZONE F-4

M 103: ⊥ B .0001 — ZONE F-4

TAB I-B

UNCLASSIFIED [redacted]

M 104:	⊕ .005 DIA	ZONE F-4
M 105:	○ .0001	ZONE F-4
M 106:	≡ .010 Ⓢ | A Ⓢ	ZONE E,F-3
M 107:	11 B .0002	ZONE E,F-3
M 108:	⊙ C .0001 TIR	ZONE E-3
M 109:	○ .0001	ZONE F-3
M 110:	⊕ .005 DIA	ZONE A,B-5

DWG. 1517544, BEARING, ROLLERON

MAJOR

M 101:	The 0.265 ± .001 dimension between surface "X" and surface "W" shall be verified when the bearing is supported on the surface "W" and a 4.00 ± .010 pound load is applied to the inner race in the direction shown.	NOTE 3
M 102:	$.2500 {}^{+.0000}_{-.0002}$ DIA	ZONE D-3
M 103:	$.7500 {}^{+.0000}_{-.0002}$ DIA	ZONE C,D-2

DWG. 1517754, CASE, ROLLERON (Left hand)
No CC's on print

DWG. 1555363, WHEEL ASSEMBLY

MAJOR

M 101:	Establish an interference fit between Items 1 and 2 at the 0.980 DIA REF of 0.003 minimum.	NOTE 1
M 102:	.063	ZONE B-4
M 103:	⊥ A .002	

UNCLASSIFIED [redacted]

DWG. 1555365 WHEEL

MAJOR

M 101: The 63° angle and the 0.100 depth of the side bracket shall be maintained for a minimum of 0.610 with a 0.750 R minimum runout. — NOTE 2

M 102: The $.100^{+.005}_{-.010}$ depth tolerance applies to bucket depth except that the depth of all buckets shall not vary more than 0.002 total on each side. — NOTE 4

M 103: 3.294 DIA over .1250 DIA gaging pins — ZONE C-2

M 104: $3.250^{+.005}_{-.015}$ DIA — ZONE C-4

DWG. 1555673, GUIDE VANE RIGHT HAND

MAJOR

M 101: When cast, 100% radiographic inspection per MIL-C-6021 is required. Zone A shall be class B minimum and Zone B shall be class D minimum as specified in MIL-C-6021. — NOTE 1

M 102: Cadmium plate in accordance with QQ-P-416, Class 3, Type II, baking at 375° ± 25° F for a minimum of 3 hours after plating is mandatory. — NOTE 2

DWG. 1560949 SCREW, PRELOAD (Right hand)

MAJOR

M 101: Screw head to withstand 40 in-lb of torque without evidence of failure. Test shall be in accordance with FF-S-86. — NOTE 3

M 102: Finish 1.1.2.3 + 5.1.1.2 of MIL-STD-171 hydrogen embrittlement relieve. — NOTE 4

M 103: .310 MIN perfect thread — ZONE B-2,3

DWG. 1560950 SCREW, PRELOAD (Left hand)

MAJOR

M 101:	Screw head to withstand 50 in-lb of torque without evidence of failure. Test shall be in accordance with FF-S-86.	NOTE 3
M 102:	Finish 1.1.2.3 + 5.1.1.2 of MIL-STD-171 hydrogen embrittlement relieve.	NOTE 4
M 103:	.310 MIN perfect thread.	ZONE B-2,3

DWG. 1560952 SCREW, CASE

MAJOR

M 101:	Self-locking element shall be in accordance with MIL-F-18240. Type A.	NOTE 2
M 102:	$.598 \begin{smallmatrix} +.000 \\ -.020 \end{smallmatrix}$	ZONE B-3
M 103:	.375 ± .015	ZONE B-3

DWG. 1560953 SCREW, GUIDE VANE

MAJOR

M 101:	Self-locking element shall be in accordance with MIL-F-18240 Type A.	NOTE 2
M 102:	.175 ± .015	ZONE C-3

DWG. 1561102, SHIM
No CC's on print

DWG. 1562367, PIN, STRAIGHT

MAJOR

M 101:	.1252 ± .0001, -3 part, D DIA	ZONE B-3

DWG. 1567572 HUB

MAJOR

M 101:	The taper of the wheel shaft shall not exceed 0.000050 regardless of size (S) over the entire length.	NOTE 3
M 102:	.25000 $^{+.00000}_{-.00020}$ DIA TYP	ZONE D-3
M 103:	◯ A .0001 TIR	ZONE C-3
M 104:	◯ Ⓢ .00005	ZONE C-3
M 105:	Case harden external surfaces to Rockwell C 55 minimum to a depth of 0.015 maximum in accordance with MIL-S-6090. Core properties shall be 90,000 psi minimum yield with 15% minimum elongation.	
M 106:	PD ⊙ B .003 TIR	ZONE D-3
M 107:	PD ⊙ B .003 TIR	ZONE D-4

DL 1517535 WING ASSEMBLY GUIDED MISSILE MARK 1 MOD 0

DWG. 1571691 RIVET, BLIND

MAJOR

M 101:	Material: Rivet and drive pin, aluminum alloy 2117, QQ-A-430.	NOTE 1
M 102:	.0875 DIA	ZONE B-4
M 103:	.080 DIA	ZONE C-4
M 104:	.125 $^{+.003}_{-.001}$	ZONE C-3

DWG. 1517535 WING ASSEMBLY, GUIDED MISSILE, MARK 1 MOD 0

MAJOR

M 101:	Torque to 32 ± 1 in-lb	PAGE 1 ZONE F-3

M 102: Torque to 18 ± 1 in-lb — PAGE 1, ZONE E-3

M 103: Action of cager assembly Item 5, shall be tested at final assembly with the wing and rolleron assembly. — NOTE 4

A. The cage assembly shall not uncage at less than 150 pounds test pull and shall uncage at less than 1.80 pounds test pull. Pressure of spring, Item 11, may be adjusted to meet cage test requirements.

M 104: The wing and rolleron assembly shall fit freely over the functional test fixture as shown and seat to surface Y. — NOTE 5

DWG. 1517536 WING ASSEMBLY

MAJOR

M 101:	Apply coating, Item 8, .025 $^{+.000}_{-.005}$	NOTE 5-B
M 102:	Thermofoam 607, Type I & IA	PARTS LIST ITEM 12
M 103:	BAC #607	PARTS LIST ITEM 11
M 104:	E-400	PARTS LIST ITEM 8
M 105:	TYPE III, Class 2 MIL-A-25463	PARTS LIST ITEM 6
M 106:	Mask all holes	NOTE C-5
M 107:	45° Ref 5 places to be set to functional Fixture DWG. 1517535	ZONE C-3

DWG. 1517537, FRAME, WING

MAJOR

M 101: Material: Aluminum alloy in accordance with federal specification QQ-A-367, composition 2618. — SHEET 3, NOTE 1

Alternate: Aluminum alloy with the following properties at the temperatures indicated.

Temperatures °F Minimum	Yield Strength PSI Minimum	Elongation % Minimum
72	41,000	4
300	33,000	4
500	22,000	4

Two specimens per fed. test method STD 151 from each heat shall be tested at each temperature listed above after uniformly heating the specimens from room temperature to test temperature in a period of not less than 10 minutes nor more than one hour. The specimens shall be loaded at a strain rate of 0.016 ± .005 inches per second.

Yield strength shall be determined by 0.2% offset method.

M 102:	Apply chemical film to all surfaces of frame in accordance with MIL-A-8625.	SHEET 3 NOTE 7
M 103:	.1870 $^{+.000}_{-.005}$	SHEET 1 ZONE C-2
M 104:	.1870 $^{+.000}_{-.005}$	SHEET 1 ZONE D-3
M 105:	⊕ .005 DIA	SHEET 1 ZONE C-2
M 106:	2.050	SHEET 1 ZONE E-2
M 107:	7/16 DIA X .5 deep .501 ± .001 DIA X 3 1/8 deep .005 DIA	SHEET 1 ZONE D-1
M 108:	Sym within ± .015 as described by a plane located by points A, B, and C.	SHEET 1 ZONE F-1
M 109:	.130 ± .002	SHEET 1 ZONE F-2
M 110:	≡ .005 Ⓢ	SHEET 1 ZONE F-2

M 111:	.218 ± .003 DIA, .275 ± .001 C bore to depth shown in section F-F.	SHEET 1 ZONE F-3

DWG. 1568846 FRAME, WING

MAJOR

M 101:	Material: Aluminum alloy in accordance with federal specification, QQ-A-367, composition 2618T61.	SHEET 4 NOTE 1
M 102:	[≡ .005 Ⓢ]	SHEET 1 ZONE F-2
M 103:	.1870 $^{+.0003}_{-.0000}$	SHEET 1 ZONE D-2
M 104:	.1870 $^{+.0003}_{-.0000}$	SHEET 1 ZONE D-3
M 105:	[⌖ .005 DIA]	SHEET 1 ZONE D-3
M 106:	2.050	SHEET 2 ZONE F-2
M 107:	7/16 DIA X 6 7/16 deep .501 DIA ± .001 32√ X 3 1/8 deep [⌖ .005 DIA]	SHEET 2 ZONE D-1
M 108:	℄ Sym within ± .015 as described by a plane located by points A, B, and C.	SHEET 1 ZONE F-1
M 109:	.130 ± .002	SHEET 1 ZONE F-2
M 110:	.218 ± .003 DIA X DEPTH shown .275 ± .001 DIA C bore X depth shown .150 DIA MAX Drill point permissible [⌖ .005 DIA]	SHEET 2 ZONE E-1

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DWG. 1517538, CORE, HONEYCOMB

MAJOR

M 101: Material: Core, material, honeycomb, 4.5 ± .045 PCF average density, 1/8 cell size, 0.001 inch foil thickness, performed .5052 aluminum alloy in accordance with MIL-C-7538, 4.5-1/8-10P (5052). — NOTE 1

DWG. 1517539, SKIN, WING

MAJOR

M 101: Material: Aluminum alloy 2024-T-3. Alternate: AMS 4037, 3024-T-3. — NOTE 1

M 102: .016 — ZONE C-3

DWG. 1517543, COVER, ROLLERON

MAJOR

M 101: (Mark "REMOVE BEFORE FLIGHT") in 1/4 characters in area shown using red, color no. 11105 FED-STD-595 using roll-leaf, hot stamping, enamel pigment. — NOTE 3

DWG. 1555671, HINGE, ROLLERON

MAJOR

M 101: 375 ± .001 DIA — ZONE B-2

M 102: [⌖ .002 DIA] — ZONE B-2

M 103: 45° — ZONE B-2

M 104: $.196^{+.005}_{-.001}$ 100° CSK, .392 DIA — ZONE D-3

2 holes [⌖ .005 DIA]

[redacted]

DWG. 1555672 CORE, HONEYCOMB, AFT

MAJOR

M 101: Material: Core, material, honeycomb 4.5 ± 0.045 PCF average density, 1/8 cell size, 0.001 inch foil thickness, perforated 5052 aluminum alloy. Alternate: MIL-C-7438 4.5 1/8-10P (5052).

DWG. 1556363 SLUG, CAGER

MAJOR

M 101:	Coat part with polytetrafluoroethylene resin in accordance with OD 10362 on all external surfaces.	NOTE 3
M 102:	$.126^{+.001}_{-.000}$	ZONE D-2
M 103:	.063 ± .002	ZONE D-2
M 104:	$.497^{+.000}_{-.001}$	ZONE D-2
M 105:	$.197^{+.005}_{-.000}$	ZONE D-2
M 106:	1.340	ZONE D-3
M 107:	.500	ZONE C-3
M 108:	.625	ZONE C-3
M 109:	.125	ZONE C-4
M 110:	.093R	ZONE D-4
M 111:	$.187^{+.001}_{-.000}$	ZONE B-3
M 112:	.375	ZONE B-3
M 113:	.130 ± .002	ZONE A-3
M 114:	.125	ZONE A-3
M 115:	.120 ± .001	ZONE A-3

M 116: .074 ± .001 ZONE A-3

M 117: $.1250 ^{+.0001}_{-.0002}$ ZONE C-2

M 118: 2.050 ZONE D-3

DWG. 1555392 SCREW, WING

MAJOR

M 101:	Material: Steel AISI 4037. Part shall meet the requirements of MS 16998-48. Heat treat to Rockwell C36-40 in accordance with MIL-H-006875.	NOTE 1
M 102:	Induction harden area indicated by DOT DOT DASH ( ) 0.015 to 0.30 inch depth to Rockwell C45-55.	NOTE 2
M 103:	5/8	ZONE C-3
M 104:	1 3/4	ZONE C-3
M 105:	3/16 Sphere R	ZONE C-3
M 106:	Self locking element shall be in accordance with MIL-F-18240. Type A.	NOTE 3

DWG. 1560937 SCREW

MAJOR

M 101:	Material: Steel AISI 4130, condition A. Alternate: QQ-S-624 condition A. Heat treat to Rockwell C38-41, per MIL-H-6875.	NOTE 1
M 102:	Self-locking element shall be in accordance with MIL-F-18240. Type A.	NOTE 3
M 103:	Finish 1.1.2.3 of MIL-STD-171 hydrogen embrittlement relieve.	NOTE 2

DWG. 1560938 SCREW, ROLLERON

MAJOR

M 101:	Self-locking element shall be in accordance with MIL-F-18240, Type A, except to 350° F.	NOTE 2
M 102:	.500	ZONE B-3

DWG. 1560939 SCREW, HINGE

MAJOR

M 101:	Material: (Screw head shall withstand 40 inch pounds of torque without evidence of failure.) Test shall be in accordance with Federal Spec FF-S-86 unless otherwise specified, the requirements of NAS 51 P11032-10 apply.	NOTE 1
M 102:	Self-locking element shall be in accordance with MIL-F-18240. Type A.	

DWG. 1560941 SPRING, HELICAL COMPRESSION

MAJOR

M 101:	Material: Steel, cre, wire AISI 302 Alternate: QQ-W-423, Comp FS 302, Cond B	NOTE 1
M 102:	$.209 \begin{matrix} +.000 \\ -.010 \end{matrix}$	ZONE B-2
M 103:	Load at comp. length of 0.180 8 lbs ± 3 lb	ZONE B-4

DWG. 1560946 CAGER ASSEMBLY

CRITICAL NONE
MAJOR NONE

DWG. 1560947 CAGER

MAJOR

M 101:	Material nylatron GS (to be changed to MIL Spec)	NOTE 1

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M 102: $.125\ ^{+.000}_{-.001}$ — ZONE D-4

M 103: .128 ± .001 — ZONE B-3

M 104: $.124\ ^{+.000}_{-.001}$ — ZONE B-3

M 105: .345 — ZONE B-3

M 106: .065 — ZONE A-3

DWG. 1555416 SPRING, CAGER

MAJOR

M 101: Material: Steel, cre, wire, AISI 304, spring temper.
Alternate: QQ-W-423 form II, condition B composition 304. — NOTE 1

M 102: Finish 5.4.1 of MIL-STD-171 — NOTE 2

M 103: $.125\ ^{+.000}_{-.003}$ DIA — ZONE C-3

M 104: .260 ± .005 — ZONE C-3

M 105: 1 lb 6 oz to deflect .125 ± .010 — ZONE A-3

[redacted]

JANUARY 1967

AEROSPACE TECHNOLOGY

RESEARCH REPORT

Report Number 20

DESIGNING FOR RELIABILITY

Presented at the 1967 Annual Symposium on Reliability— 10 through 12 January 1967, Washington, D.C.

AUTHOR: Frank A. Barta

HUGHES

HUGHES AIRCRAFT COMPANY
SPACE SYSTEMS DIVISION

SSD 60482R

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CONTENTS

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SUMMARY

This paper presents reliability's role in influencing the design of hardware for two major Hughes Aircraft Company programs: the lunar soft-landing spacecraft, Surveyor (developed for NASA/JPL) and the communications satellites: Syncoms 1, 2, and 3, the Applications Technology Satellites (developed for NASA), Early Bird, and four Intelsat IIs) developed for Comsat).

Since an overview of approximately 6 years of the programs' operation (or a combined total of more than 12 years) is covered, only a selected number of reliability items are presented.

Some of the results obtained early in the programs, such as the evolution of the parts program during the various phases of design, are reviewed. The savings resulting from elimination of parts failures during system tests, Hughes' derating policy with previously unpublished derating curves for high reliability operation, and levels of parts acceptance are also reviewed.

Included are management controls involving Trouble and Failure Reports, necessary steps to ensure corrective action, and methods of transmitting pertinent information to key management personnel. Operation of the consent-to-ship and consent-to-launch procedures and the review of actions taken at lower organizational levels by top-management committees are described. (Acceptance or rejection of the committees' findings determines whether or not a spacecraft is shipped or launched.)

In addition, a brief status report of all operational hardware, data on hardware approaching operational readiness, and data affecting failure rates are presented.

INTRODUCTION

LUNAR SOFT-LANDING SPACECRAFT

The National Aeronautics and Space Administration supported several types of systems for the purpose of unmanned exploration of the moon. One of these, the Surveyor spacecraft system, includes spacecraft to be launched several months apart. On the first launch, 30 May 1966, Surveyor I softlanded on the moon after 63 hours, 36 minutes. During its launch, transit, landing, and postlanding operations, it accomplished all mission objectives.

The basic objectives of the system are: 1) to develop a technology for and accomplish a series of soft landings on selected areas of the moon, and 2) to perform operations on the lunar surface that will contribute to scientific knowledge of the moon and provide basic information for the Apollo program.

Other objectives are to demonstrate the capability of midcourse and terminal maneuvers; maintain communications with the spacecraft; prove the Atlas/Centaur launch vehicle; obtain in-flight engineering data on spacecraft subsystems in cruise and midcourse maneuver and on the closed-loop terminal descent guidance and control system; obtain data on the subsystems used on the lunar surface; televise a footpad, material surrounding it, and the moon's topography; determine radar reflectivity of the lunar surface; and obtain temperature data of both the spacecraft and the moon.

COMMUNICATIONS SATELLITES

Three of the first four Hughes-built communications satellites are in orbit. Synchronous, spin-stabilized, and continuously operational, they are providing high quality, reliable communications throughout the world.

Syncoms 2 and 3, under operational control of the Air Force Systems Command, are the only truly reliable link with the Far East. Early Bird, owned by the Communications Satellite Corporation (Comsat), is the first satellite to provide 24-hour commercial television and telephone communications between the United States and Europe.

As of 11 January 1967, the trio of satellites had accumulated impressive records of reliable operation (see Table 1). One failure occurred on Syncom 2 in 1964. Investigation indicated that a PNP silicon alloy transistor used as a commutator switch had sustained a collector-to-emitter short. The data is still readable, but operation was switched from encoder 1 to encoder 2.

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TABLE 1. HUGHES COMMUNICATIONS SATELLITE OPERATION

Satellite	Customer	Orbit Objective in Days	Days in Orbit*	Percent of Objective
Syncom 2	NASA	30	1272	4240
Syncom 3	NASA	30	882	2940
Early Bird	Comsat	548	615	112

*Status as of 11 January 1967.

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COMMON OPERATION PHILOSOPHY

At the start of both programs, each spacecraft had a short life objective--90 days for Surveyor I and 30 days for Syncom. The basic philosophy of both programs is to:

1) Select the best parts and components available for the assemblies and use only those that can be qualified as satisfactory

2) Maintain stringent subcontractor controls

3) Emphasize failure mode and effects analyses and design reviews

4) Assemble carefully and test until all weak spots and failures have been detected

5) Correct all failures and determine the failure mechanisms and eliminate them

6) Test until the hardware is capable of operating over the period required under specified environmental conditions

COMPONENT PARTS AND MATERIALS PROGRAM

An uncertainty facing designers in both programs was the effect of space environments on parts and materials which had satisfactorily performed in earth-associated environments. Each material and part used in the fabrication of a spacecraft required extensive testing to demonstrate its ability to withstand the new environments. The magnitude of the problem was also related to the quantity of parts to be used. Syncom 1 contained 3500 electronic parts or approximately 10 percent of the 36,000 required for the initial Surveyor spacecraft design. Surveyor I, a modified version of the first design, contained 29,000 parts. Surveyor program personnel were the first to face the problem of selecting parts that would be reliable in space environments.

SURVEYOR PROGRAM

The management of parts and materials for Surveyor spacecraft was the responsibility of the Reliability function of the Surveyor Laboratory. Implementation of the parts and materials program was shared between the Reliability function and the Components and Materials Laboratory of the Research and Development Division. The Reliability Section furnished technical direction, funding, and monitoring of the effectiveness of tasks performed under funds provided. This section also analyzed, evaluated, and surveyed the tasks contributing to reliability to gain needed assurance of adequate performance.

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The primary responsibility of the Components and Materials Laboratory was the preparation of component and part specifications, participation in negotiations of contracts with vendors, and procurement and testing of samples. The laboratory performed other supporting tasks, attended design reviews, and provided expert consultation and guidance in the application and selection of parts and materials. The laboratory provided the necessary test support to Receiving Inspection on high reliability electronic components. They also initiated a preliminary Preferred Parts List which was periodically updated.

Preferred Parts List

The Surveyor Preferred Parts List was Hughes' first step in establishing a standard in terms of a preferred list of multiple-use component parts for space applications. The parts were chosen on the basis of proven history in Hughes systems. In the beginning, the parts listed were only design guides for breadboard and experimental fabrication. All components on the list were capable of withstanding the 48-hour temperature soak at 125°C without degradation, in compliance with sterilization requirements. Another consideration in their selection was that the parts be common to all Surveyor units and assemblies.

Parts Program

In order to acquire highly reliable parts and components for Surveyor, the following actions were performed:

1) Preparation of a specification defining specific environments the parts must withstand and their performance characteristics

2) Review of parts application in a system

3) Performance of a detailed failure diagnosis when a malfunction occurred to determine if the assignable cause was a result of an inherent design characteristic of the part, a quality control defect, or a misapplication

4) Performance of test and analysis of data acquired to verify that the failure rate of the part meets requirements.

5) Publishing and distributing a preferred parts handbook to various design activities. (This later resulted in a formal Approved Parts List (Spec) for Surveyor.)

6) Preparation of a Surveyor Standard Practices Handbook describing how to assemble parts in the spacecraft and how to safeguard against any reliability degradation that could occur because of in-process handling and routing

The parts specifications prepared by the Components and Materials Laboratory required that the vendor:

1) Perform acceptance testing of each lot

2) Carry out a 240-hour burn-in on all deliverable parts (subject to some exceptions)

3) Perform accelerated environmental tests on selected samples off the production line

4) Furnish data showing the results of acceptance and environmental tests

The critical parameters of all parts received were 100-percent inspected and tested by Hughes Receiving Inspection. If excessive failures occurred in fabricated assemblies, a Failure Review Board determined the cause and the corrective action required. Before release of Surveyor I parts, all bills of material were reviewed to verify that only acceptable parts were listed.

Materials Program

Implementation of the materials program followed closely that of the parts program. Specifications, processes, acceptance requirements, materials data book, and other analogous directives were prepared. A major critical element was the delineation of process specifications and acceptance requirements. In many cases such as potting compounds, various chemicals were mixed just prior to application in assembly. The correct mixture of compounds and elements under controlled temperatures and cleanliness was mandatory. To maintain quality, documentation of such procedures was vital considering batch-to-batch variability has to be low and intervals between batches were sometimes 6 months to a year.

The materials program required other special studies and tests. Of particular importance in the finishing medium was the selection of seals (inorganic and organic) and polishing techniques (vapor-deposited metal, brightening chem-milled surfaces, etc.) to maintain thermal control of the spacecraft. Investigation of many insulating materials, such as aluminized teflon tape and mylar, was also required along with the development, testing, and documentation of sealing and assembling techniques using adhesives, riveting, brazing, welding, soldering, potting, lubricants, etc.

The materials program required extensive testing in high vacuum to assure that foreign material of large quantities did not outgas or sublime and deposit on various portions of the spacecraft. For instance, outgassing of foreign materials or sublimation could have deposited on the Surveyor I television mirrors preventing taking pictures. Also, if thin film had coated a thermal control surface, its function would have been destroyed and the temperature of the device would have varied widely.

COMMUNICATIONS SATELLITE PARTS PROGRAM

Establishment of Criteria for Long Life

At the start of the communications satellite program, many of the items found successful in Surveyor were incorporated in the Syncom parts program. As new programs with much longer life objectives were undertaken, it was necessary to determine what could be done to secure even more reliable, failure-free parts. Figure 1 shows the key points considered in the revised parts procurement plan.

Based on knowledge gained in the Syncom program, a revised list of parts, materials, and processes was issued authorizing items for long-life communications satellites. The list was constantly updated and under control. Any deviations from the list required full justification and project management approval before incorporation in flight hardware. Standardization to a few common parts minimized the number of items requiring stringent qualification.

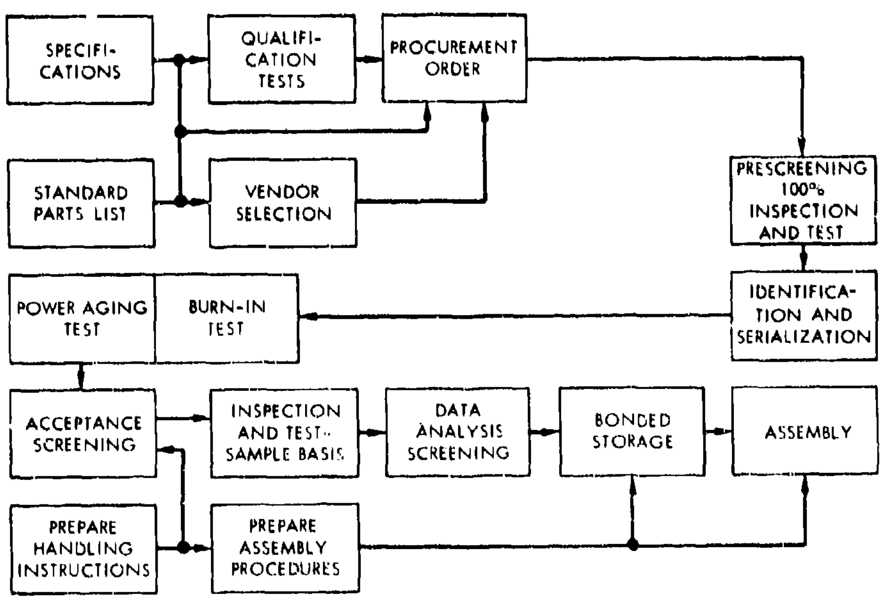

Figure 1. High Reliability Parts Program

Supplier reliability and acceptance test specifications were revised as needed to more accurately reflect the necessary requirements. An innovation introduced in the parts test programs was power aging for a specified number of hours after the burn-in.

Existing suppliers were reviewed and evaluated, and potential suppliers investigated. Suppliers were selected on the basis of:

1) Manufacturing process control capability

2) Achievement of product uniformity

3) Documentation and visibility of manufacturing process and process control

4) Understanding of product limitations

5) Knowledge of device failure modes

6) Active programs for elimination of major failure modes through failure analysis and recurrence prevention measures

7) Evidence of reliability improvement

8) Thorough quality control

<u>Computerized Parts Data Program</u>

Another innovation in the selection of parts was programming a computer to select parts for flight units. A 7094 computer selected only the best parts on the basis of stability and minimum drift of critical parameters.

The suppliers were responsible for prescreening, identification, and serialization of acceptable parts; a 240-hour burn-in; a 510- or 1260-hour power aging; acceptance tests; and transcribing the results of these tests to IBM cards. In addition to checking certain parameters on an attribute basis, the supplier was required to measure and record critical parameter measurements at 0, 240, 750, and 1500 hours. These measurements were printed out on a tab list by serial number and submitted to Hughes. Suppliers certified that all parts shipped were within specification throughout the tests.

In the Syncom program, the 100-percent inspection and test had been performed in Receiving Inspection. In the revised program, incoming parts shipments were sampled, accepted, or rejected after testing to uncover out-of-specification parts. On all parts accepted, the tab list accompanying the lot was submitted to the Components Department for flight parts selection. Table 2 lists tests performed on the satellite programs.

TABLE 2. COMMUNICATIONS SATELLITE INSPECTION AND TEST PROGRAMS

Item	Syncom	Early Bird	ATS	Intelsat IIA
Source inspection	No	Yes	Yes	Yes
100-percent receiving inspection	Yes	No (sample)	No (sample)	No (sample)
Qualification tests	Yes	Yes	Yes	Yes
Specification tests	Yes	Yes	Yes	Yes
Prescreening	No	Yes	Yes	Yes
240-hour burn-in	Yes*	Yes**	Yes**	Yes**
510-hour power aging	No	Yes**	Yes**	Yes**
1260-hour power aging (510 plus 750)			Yes**	

*Attributes only.
**Attributes and variables.

The net result of more reliable parts plus improved designs and better derating was to greatly reduce parts failures during major subsystem and system tests. Figure 2 illustrates the actual number of failures in these different satellite test programs. Because of the difference in the number of parts used per spacecraft in each program, failures are shown in terms of a 100,000-part spacecraft; actual failures are shown on the left side of the figure.

Probably the failure reduction in testing is not apparent until the comparison of parts program costs versus costs due to part failures is examined in Figure 3.

Table 3 shows that the parts screening cost for the Early Bird program is approximately three times that of the Syncom program. The combined testing cost of Early Bird, based on 14,000 parts, is only $305 thousand - a difference of over $1 million above the actual Syncom testing cost.

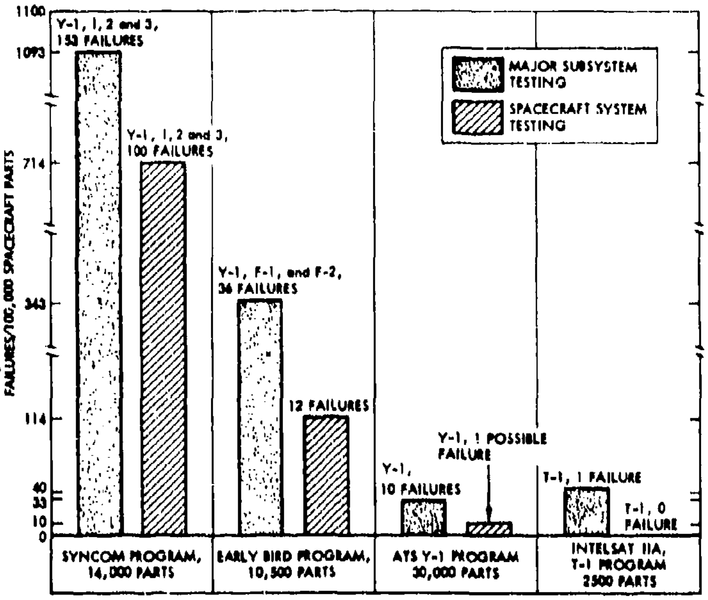

Figure 2. Comparison of Program Part Failures per 100,000-Part Spacecraft Experienced During System and Major Subsystem Tests

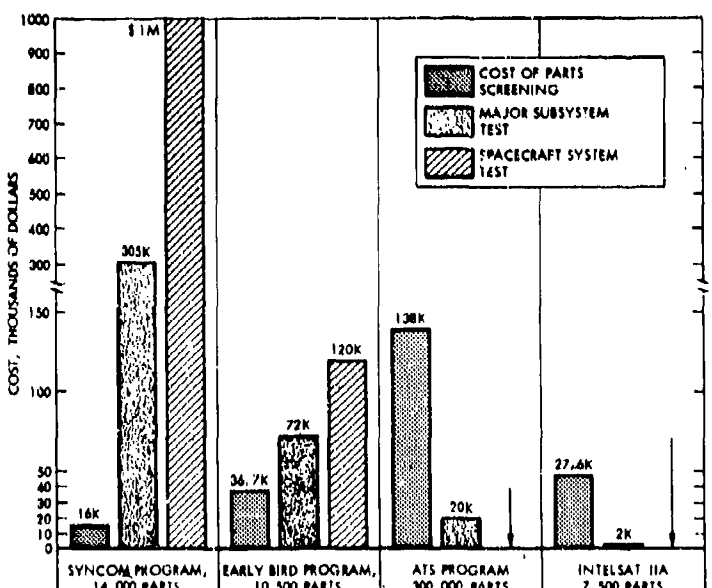

Figure 3. Parts Program Costs Versus Cost Due to Failure of Parts During System and Major Subsystem Tests

In Figure 3, the costs presented for ATS and Intelsat IIA - the only figures available at the time of preparation of this paper - are shown for information purposes only. The costs used in the bar charts are based on estimated cost of rework, personnel involved, test equipment time, and lost schedule time.

TABLE 3. COMPARISON OF TEST COSTS DUE TO PARTS FAILURES AND PRESCREENING COSTS FOR SYNCOM AND EARLY BIRD PROGRAMS

Item	Syncom Costs	Comparison of Costs	Early Bird Costs (based on 14,000 parts)
Parts screening	$ 16,000		$ 49,000
Subsystem testing	305,000		96,000
System testing	1,000,000		160,000
Syncom total	$1,321,000	$1,321,000	$305,000
Early Bird total		305,000	
Difference in costs		$1,016,000	

COMPARISON OF OBSERVED FAILURE RATES WITH MIL-HDBK-217

Data Sources for Reliability Prediction

Useful by-products have resulted from monitoring and analyzing data from Hughes Aircraft Company's three operational satellites. The purpose of the analysis is to obtain realistic part failure rates. Predictions based on these failure rates are probably more meaningful than those based on individual part testing since operational data includes certain variables such as design of circuits, part utilization, and standards of procurement otherwise difficult to take into account.

The validity of before-the-fact reliability predictions and estimates can always be questioned on the grounds of the basic assumptions made in the analysis and the failure rates used. The MIL-HDBK-217 failure rates can be modified in those cases where Hughes has operational satellite experience.

Operational Experience

Evidence of the low failure rates achieved is given by operational data from the communications satellites. With only one part failure, these satellites have accumulated over 95-million-electronic-part hours. Using the minimum failure rates in MID-HDBK-217A (Table 12-IX, page 4-32), the expected part failures predicted would be 26.4, while the probability of only one failure would be less than 10^{-6}. A sharp decrease in part failures during major control item testing has been observed, indicating future reliability of parts will be higher than that of parts used on Syncoms 2 and 3, and Early Bird.

Parts Derating and Applications

In the parts count prediction, assumptions are often made about parts derating and temperature. During design of electronics, reliability can be enhanced and established by sufficient derating of voltage, power, or other stresses, and by providing environmental control of temperature and possibly of radiation and mechanical vibration. By extrapolation of MIL-HDBK-217 data, guideline curves for derating electronic parts are shown in Figure 4. The policy established for their use is shown in Table 4. This work was started and completed before MIL-HDBK-217A had been issued. The same extrapolation described in the following paragraphs can be carried out on the 217A handbook data.

Extrapolation of MIL-HDBK-217

The derating curves of Figure 4a through 4h show the electrical stress derating versus temperature necessary to achieve a given failure rate. These curves were derived by straightforward linear extrapolation of the MIL-HDBK-217 failure rate curves beyond the point of cutoff curvature. For simplicity, a straightline approximation is made that introduces slight deviation at the bottom of the curves. The format used to present the failure rate stress derating information is arranged to show a constant failure rate curve. These curves emphasize the importance of stress derating in improving reliability. They also simplify the selection of optimum ratio of electrical to temperature stress, depending on prevailing conditions. The relationship of failure rate for solid-state devices to temperature stress only, as presented in MIL-HDBK-217A and other recent publications, substantiates these derating policies. Failure rate values for digital transistors, switching, high voltage, and mixer diodes were assigned for each stress level curve based on operational results and published data.

When the failure rate derating curves of the handbook were linearly extrapolated (avoiding the cutoff curvature) to the lower levels of derating, as actually applied in the design of previous space systems, the figures

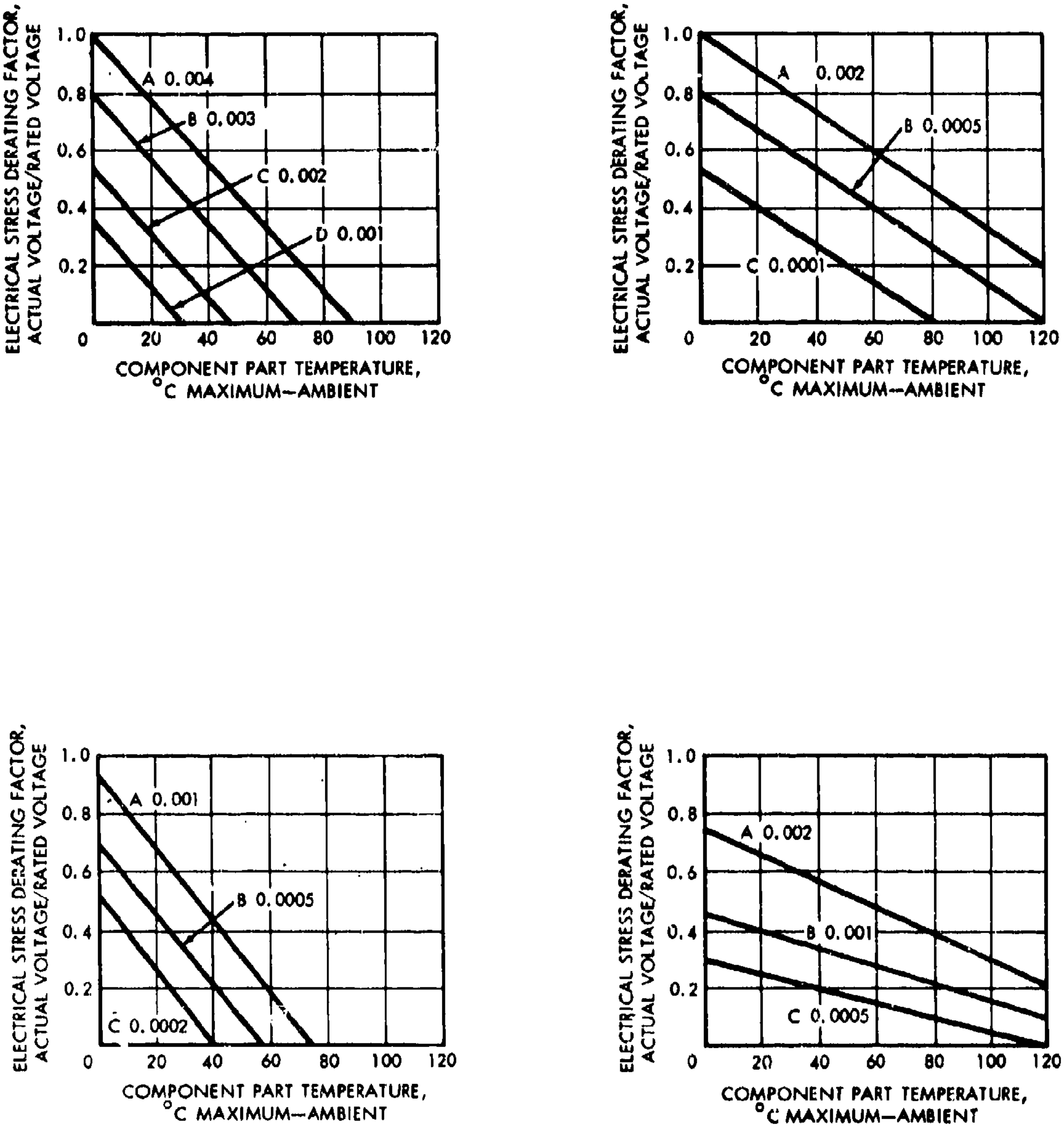

Figure 4. Derating Curves
Failure rate in failures per 10^5 hours

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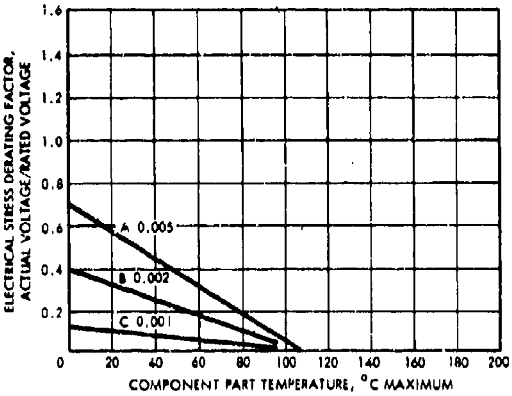

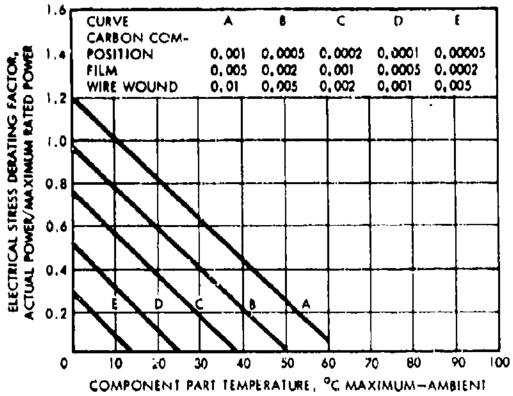

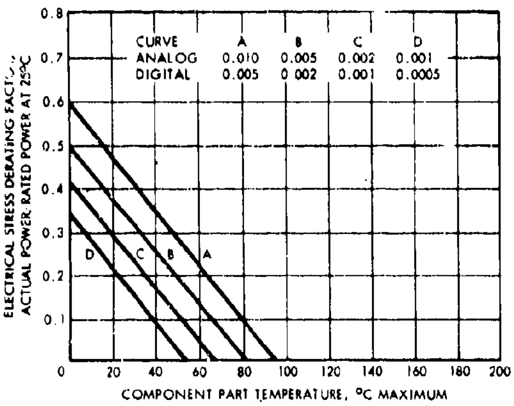

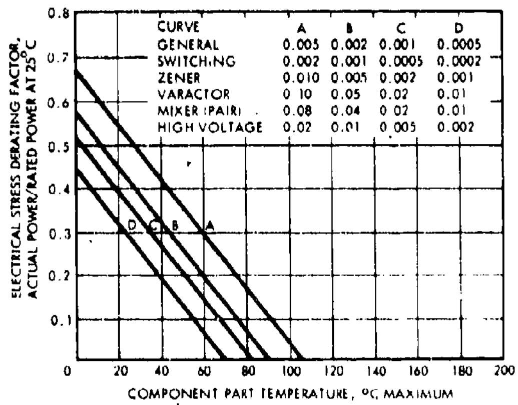

Figure 4 (continued). Derating Curves
Failure rate in failures per 10^5 hours

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TABLE 4. ELECTRONIC PARTS DERATING POLICY

Part Type	A* Recommended Stress Level for High Reliability Applications	B** Tolerable Stress Level in Isolated Cases	C*** Overstressed - Approval of Application Requirement
Capacitors			
Tantalum	Below curve B	-	Above curve B
All others	Below curve C	To curve B	Above curve B
Resistors			
All types	Below curve D	To curve C	Above curve C
Diodes	Below curve D	To curve C	Above curve C
Silicon	30-percent rated voltage	To 50-percent rated breakdown voltage	50-percent rated breakdown voltage
Transistors	Below curve D	To curve C	Above curve C
Silicon	30-percent rated voltage	To 50-percent rated breakdown voltage	50-percent rated breakdown voltage

*Most parts should be derated to this level.
**To be used only when Level A imposes unrealistic requirements.
***Justification of this deviation must be addressed to the Program Product Effectiveness Manager prior to design review.

showed agreement with the operational data accumulated to date. The resulting failure rates were used for system reliability predictions, and the corresponding stress levels were used to establish the derating policy for the spacecraft design outlined in Table 4.

Using the knowledge gained from the communications satellite operational analysis and optimum derating data from the extrapolated curves, Table 5 shows the failure rates for synchronous satellite application. This data is indicative of part failure rates in synchronous satellite application that are possible under optimized conditions.

TABLE 5. FAILURE RATES FOR SYNCHRONOUS SATELLITES USING OPTIMUM DERATING

Parts	In Failures per 10^5 Hours
Capacitors	
Ceramic	0.0001
Glass	0.0002
Paper	0.0005
Mylar	0.0010
Tantalum	0.0030
Connectors	
Coax	0.0002
Multipin	0.0020
Crystals	0.0040
Crystal filters	0.0050
Diodes	
General purpose	0.0005
Mixer (pair)	0.0100
Switching	0.0002
Varactor	0.0100
Zener	0.0010
High voltage	0.0020
Ferrite devices	0.0200
Coils, chokes, and inductors	0.0014
Transformers	0.0028
Resistors	
Carbon components	0.0001
Film	0.0005
Wirewound	0.0010
Transistors	
Analog	0.0010
Digital	0.0005
Tunable cavities	0.0020
Traveling-wave tubes	0.1280
Sensistors	0.0020
Solder or weld connection (assume 2.2 connections per part)	0.00002
Integrated circuits	0.1 times the failure rate of the equivalent discrete circuit. (Quoted manufacturer's failure rate may be used if available.)

Addendum No.
to MIL-D-18243A(AS)

STANDARD PRODUCTION MONITORING TEST PLAN

PRODUCTION MONITORING REQUIREMENTS

FOR

AIR-LAUNCHED GUIDED MISSILE SYSTEM

Approved:____________

Date:______________

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PRODUCTION MISSILE TEST PROGRAM
FOR
AIR-LAUNCHED GUIDED MISSILE SYSTEM

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to MIL-D-18243A(AS)

PRODUCTION MISSILE TEST PROGRAM
FOR
AIR-LAUNCHED GUIDED MISSILE SYSTEM

1. SCOPE, CLASSIFICATION AND PURPOSE

1.1 SCOPE. - This addendum covers the requirements of the Naval Air Systems Command for the production missile test program of the Air-Launched Guided Missile. This addendum is complete within itself. No reference to Specification MIL-D-18243(Aer) is necessary for the interpretation of the requirements contained herein.

1.2 CLASSIFICATION. - The production missile test program consists of tests specified herein utilizing approved service type support and test equipment and service configured aircraft.

1.3 PURPOSE. - The purpose of the production missile test program is to determine whether or not the producer is meeting:

(a) The missile system performance requirements of____ Specifications__________.

(b) The missile performance and reliability requirements of ____ Specification__________.

(c) The missile motor performance requirements of____ Specification__________.

(d) The missile warhead performance requirements of ____ Specification__________.

(e) The missile safety-arming device performance requirements of Specification__________.

2. APPLICABLE SPECIFICATION, OTHER PUBLICATIONS AND DRAWINGS. -

The following documents are applicable to the extent specified herein. (List)

3. REQUIREMENTS. -

3.1 GENERAL

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3.1.1 DEVIATIONS. - Deviations from this addendum shall not be permitted except by written authorization from the NAVAIRSYSCOM or as specifically stated herein. When deviations are needed, the deviations shall be requested from the NAVAIRSYSCOM for each production missile test at least 15 days prior to the scheduled test. Deviations shall not affect the missile configuration, and handling and test procedures, and shall not introduce any delay factor that may prevent the missiles being launched within the specified time. When installing telemetering, provisions for telemetering which are a part of the basic missile configuration as delivered shall be utilized.

3.1.2 RESPONSIBILITY. - The production missile test program will be conducted by the NAVMISCEN, hereafter called the testing activity, and shall be observed by the producer.

3.1.2.1 PRODUCER RESPONSIBILITY. - The production missile test program shall be conducted under the technical observation (see paragraph 6.1.10) of the producer. At the earliest practicable date the testing activity is to notify the producer when the unpacking is expected to start in order that the producer shall provide personnel to be present to observe the unpacking and operational and flight tests of all missiles to be tested. The producer shall observe all tests performed by the testing activity and shall indicate by concurrence or nonconcurrence that each equipment has or has not been checked out in accordance with the applicable handbooks (see 6.1.6). When the producer does not concur that the missile, the missile installation, the aircraft equipment and test equipment were checked out in accordance with applicable handbooks or instructions, the producer shall inform the NAVAIRSYSCOM in writing and in detail wherein any of these were not checked out properly. The producer shall be responsible for the furnishing of one set of missile equipment schematic drawings to the testing activity, which completely and accurately reflects the configuration of each production lot.

3.1.2.2 GOVERNMENT. - The testing activity will exercise technical direction (see 6.1.2) and technical control (see 6.1.1) of the production missile test program. The Government will furnish and utilize the specified complement of test equipment for this missile as well as equipment peculiar to the requirements of production missile testing.

3.1.3 LOCATION OF PRODUCTION MISSILE TESTING. - Production missile testing will be normally conducted at the Naval Missile Center, Point Mugu, California.

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3.1.4 WEIGHT AND BALANCE. - The actual weight and center of gravity locations encountered in operation of the guided missiles shall be simulated. This may be accomplished by installation of actual equipment or by substitution of ballast such that weight, center of gravity, and moment of inertia characteristics (where of importance to the test concerned) of the missiles are simulated.

3.1.5 HANDLING PROCEDURE. - The production test missiles, specified in 4.1.1, shall be handled in accordance with the handling requirement of applicable handbooks (see 6.1.6). This paragraph (3.1.5) is intended to cover packaging, transporting, storage, preparing, assembling, and loading of the missile.

3.1.6 RETEST. - Missiles which fail to pass checkout equipment tests may be given one retest to establish that the missile (not the test equipment) was at fault. If the test then indicates that the missile is satisfactory the previous test shall be indicated as satisfactory and so scored.

3.2 GROUND AND PRELAUNCH TESTS

3.2.1 RECEIVING INSPECTION. - Each missile received as an assembled round shall be unpacked and subjected to disassembly into major component sections in accordance with the applicable handbook (see 6.1.6). In the disassembly process, the missile sub-assemblies and major component sections shall be visually inspected and tested in accordance with the following paragraphs of applicable NAVORD QAP:

Item	Paragraph (QAP-)
Unpacking inspection	
Assembled round inspection	
Guidance-control section/warhead mating inspection	
Warhead/rocket motor mating inspection	
Safety-arming device and electronic firing switch installation inspection	
Guidance-control accessory inspection	

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Item	Paragraph (QAP-)
Guidance-control section inspection	
Safety-arming device inspection	
Electronic firing switch inspection	
Warhead inspection	
Rocket motor MK___Mods_______ inspection	
Rocket motor MK___ Mods_______inspection	

Missiles found to contain defects of class "Critical" or "Major" as defined in appropriate QAP- shall be rejected from further testing and set aside for examination. Missiles which pass the receiving inspection test (i.e., have no defects of "Critical" or "Major" classification) shall be scored as satisfactory on the chart of figure 9, and shall then be given the "Depot Test." Missiles which fail the receiving inspection test shall be examined by the producer and the testing activity to establish the reason(s) for failure and action shall be taken as follows:

(1) MISSILE DEFECT. - If it is determined that a defect (of "Critical" or "Major" classification) was due to deficient producer assembly, inspection, test, or packaging, the missile shall be scored as unsatisfactory on the chart of figure 9.

(2) DAMAGE IN SHIPMENT OR HANDLING. - If it is determined that a defect was due to damage in shipment or handling beyond the control of the supplier, the defect shall be scored as "No Test" and the missile not scored as unsatisfactory for that defect on the chart of figure 9. Missiles which contain "Critical" or "Major" defects due to damage in shipment or transportation handling shall not be utilized in subsequent testing; such missiles will be replaced by other missiles.

3.2.2 DEPOT TEST. - Missile guidance-control sections which pass the Depot Test step shall be scored as satisfactory on the chart of figure 1. Missile guidance-control sections which fail the Depot Test shall be scored as unsatisfactory on figure 1. One retest will be allowed to establish that the missile (and not the test equipment) was at fault. Missiles which fail this test shall be examined by the testing activity (with producer observing), to establish the reason(s) for failure.

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3.2.3 TELEMETERING INSTALLATION. - Telemetering equipment shall be installed subsequent to the Depot Test on required missiles, by the testing activity, in accordance with applicable procedures and instructions. Complete telemetering installations shall be calibrated in accordance with applicable procedures and instructions.

3.2.4 REPEATED DEPOT TEST. - Following the installation or removal of telemetering equipment, each missile guidance-control section shall be given a repeated depot test in accordance with the applicable handbook (see 6.1.6). Each missile which passes this test shall be scored as satisfactory on the chart of figure 1. Missile guidance-control sections which fail this test shall be examined by the testing activity (with producer observing) to establish the reason(s) for failure and action shall be taken as follows:

(1) MISSILE FAILURE. - If it is determined that the failure was due to a guidance-control section malfunction and not a result of installing telemetering, the missile shall be scored as unsatisfactory on the chart of figure 1. If it is determined that the failure was due to installation of telemetering, the missile shall be scored as "No Test" and omitted from the scoring chart.

(2) TELEMETERING FAILURE. - If it is determined that the failure is due to the telemetering equipment, the telemetering shall be repaired and recalibrated, or replaced, and the missile shall receive another repeated Depot Test in accordance with the applicable handbook.

3.2.5 MISSILE ASSEMBLY. - Guidance-control sections which have telemetering installed and have successfully passed the repeated Depot Test shall be mated to selected rocket motors and safety-arming devices for the free-flight configuration.

3.2.6 PRELAUNCH TEST. - Missiles which have successfully passed assembly tests and have been installed on an aircraft and carried aloft and energized, shall be considered to be in the prelaunch test step of the test sequence until an attempt is made to launch the missile, or the missile is off loaded or is jettisoned. Each missile selected for flight test shall be subjected to at least one prelaunch test, of at least 30 minutes energized time duration, followed by aircraft landing, prior to the airborne test in which launching is attempted. This test shall not be conducted so as to specifically avoid exposure to any of the captive flight environments within the requirements of________of Specification________. This paragraph shall not limit the missile to one airborne flight prior to the launching attempt.

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3.2.6.1 READY LIGHT OBTAINED. - Missiles installed on an aircraft, which are carried aloft and energized and which properly actuate the missile ready indication in the aircraft weapon system shall be considered to have successfully passed the prelaunch test step of the test sequence and shall be so scored on the chart of figure 2. Each test during which the missile properly actuates the missile ready indication in the aircraft weapon system shall be considered a successful prelaunch test even though no attempt is made to launch the missile.

3.2.6.2 READY LIGHT NOT OBTAINED. - Missiles which when installed on an aircraft do not properly actuate the missile ready indication shall be examined by the testing activity (and observed by the producer) to establish the reason(s) for failure and action shall be taken as follows:

(1) MISSILE FAILURE. - If it is determined that the failure was due to a missile guidance-control section malfunction the missile shall be scored as unsatisfactory on the chart of figure 2.

(2) OTHER EQUIPMENT FAILURE. - If it is determined that the failure was due to failure of aircraft equipments or to causes other than a missile malfunction, the missile prelaunch test shall be scored as "No Test" and omitted from the scoring chart, and the missile continued in the test program.

3.2.6.3 NO ATTEMPT TO LAUNCH. - Missiles which when carried aloft and which actuate the missile ready indication in the aircraft weapon system but on which launch is not attempted, shall be continued in the launching program provided that telemetry data indicates no failure of the missile. Both the testing activity and the producer shall examine the telemetry data on missiles in the prelaunch test. When launch is not attempted and the telemetry data indicates that a missile failure has occurred which was not indicated by either the missile ready indication then action shall be taken as follows:

(1) MISSILE FAILURE. - If it is determined and confirmed by ground examination, that the failure was due to a missile guidance-control section malfunction the missile shall be removed from the launching program and shall be scored as unsatisfactory on the charts of figures 3 and 4 as a free-flight failure.

(2) OTHER EQUIPMENT FAILURE. - If it is determined that the failure was due to failure of aircraft equipment, missile telemetering, or to causes other than a missile malfunction, the missile shall be continued in the launching program, upon correction of the problem,

provided that internal disassembly of the guidance-control section has not occurred.

3.3 FREE-FLIGHT TESTS

3.3.1 ATTEMPT TO LAUNCH. - The Free-Flight test step of the test sequence shall commence when the pilot has obtained the correct indications selecting and readying the missile and has attempted to launch the missile by depressing the missile trigger switch.

3.3.1.1 LAUNCHED

3.3.1.1.1 SUCCESSFUL GUIDANCE-CONTROL SECTION. - Those missile guidance-control sections which, when launched, meet the performance requirements in both guidance and fuzing signal specified for the specific flight test in the flight test plan, shall be scored as satisfactory on the chart of figure 3. In addition, those missiles which meet the guidance performance requirements specified in the flight test plan shall be scored as satisfactory on the chart of figure 4, and those missiles which meet the guidance and fuzing performance requirements specified in the flight test plan shall be scored as satisfactory on the chart of figure 5.

3.3.1.1.2 UNSUCCESSFUL GUIDANCE-CONTROL SECTION. -

(a) Due to guidance-control section - Those missiles which, when launched, fail to meet the performance requirement specified in flight test plan, Appendix and the failure is due to malfunction in other than GFE components of the missile guidance-control section as indicated by telemetry data, shall be scored as unsatisfactory on the chart of figure 3. When the failure is due to guidance performance it shall also be scored as unsatisfactory on figure 4. When the failure is due to fuzing performance it shall also be scored as unsatisfactory on figure 5.

(b) Due to other causes - Those missile guidance-control sections which, when launched, fail to meet the performance requirements specified in the Flight Test Plan and the failure is due to malfunction in GFE components of the missile, shall be scored as "No Test." Additional missiles may be launched.

(c) No Agreement - If no agreement is reached between the producer and the testing activity on the assignment of the cause of the failure, the matter shall be referred to the NAVAIRSYSCOM for resolution.

3.3.1.1.3 SUCCESSFUL MOTOR PERFORMANCE. - Those missiles which, when launched, indicate that the missile motor has met the performance requirements of ________ Specification ________ shall be scored satisfactory on the chart of figure 7.

3.3.1.1.4 UNSUCCESSFUL MOTOR PERFORMANCE. -

(a) Due to motor - Those missiles which, when launched, indicate by telemetry data that the missile motor has failed to meet the performance requirements of ________ Specification ________ shall be scored as unsatisfactory on the chart of figure 7.

(b) Due to other causes - Those missiles which, when launched, indicate by telemetry data the missile motor performance has failed to meet the requirements of ________ Specification ________ and the failure is due to malfunction of components other than the motor, shall be scored as "No Test" and omitted from the scoring chart.

3.3.1.1.5 SUCCESSFUL SAFETY-ARMING DEVICE PERFORMANCE. - Those missiles which, when launched, indicate by telemetry data that the missile safety-arming device has met the performance requirements of Specification shall be scored as satisfactory on the chart of figure 9.

3.3.1.1.6 UNSUCCESSFUL SAFETY-ARMING DEVICE PERFORMANCE. -

(a) Due to safety-arming device - Those missiles which, when launched, indicate by telemetry data that the missile safety-arming device has failed to meet the performance requirements of Specification shall be scored as unsatisfactory on the chart of figure 9.

(b) Due to other causes - Those missiles which, when launched, indicate by telemetry data that the missile safety-arming device performance has failed to meet requirements of ________ Specification ________ and the failure is due to malfunction of components other than the safety-arming device, shall be scored as "No Test" and omitted from the scoring chart.

3.3.1.2 NOT LAUNCHED. - Missiles which are carried aloft but which fail to launch when so ordered shall be examined by the testing activity with the producer observing to establish the reason therefor. Action shall be taken as follows:

(a) Due to missile - If it is determined by examination that the failure was due to a missile guidance-control section malfunction in other than GFE components, the missile shall be scored as unsatisfactory on the chart of figure 3 and figure 4.

(b) Due to other causes - If it is determined that the failure to launch resulted from causes other than missile guidance-control section malfunction, the test shall be considered "No Test" and omitted from the chart of figure 3 and figure 4. The missile shall be kept in the production missile test program provided that damage or internal disassembly of the guidance-section has not occurred; otherwise, another guidance-control section shall be used as a replacement.

(c) No Agreement - If no agreement is reached between the producer and the testing activity on the assignment of the cause of the failure, another missile shall be used as a replacement, and the matter shall be referred to the NAVAIRSYSCOM for resolution.

3.4 LAUNCHING CONDITIONS

3.4.1 LAUNCH AIRCRAFT. - Aircraft used for missile launch in the production missile test program shall utilize missile launching and control equipment functionally representative of that used in the Fleet. The testing activity shall check the launch aircraft and the producer shall observe the checking of this equipment in accordance with applicable handbooks and the producer shall accept the launching airplane installation. This check shall include a determination that weapons control system is operating within normal accuracy limits and shall include adjustments and/or servicing as necessary to assure such normal accuracy. No missiles shall be launched unless the aircraft and the aircraft installation have been accepted by both the testing activity and the producer within 24 hours prior to the flight. It shall be an objective to launch the missiles on the second carried flight.

3.4.2 INSTRUMENTATION. -

(1) Missile Telemetering - In accordance with Specifications and as required for the missile configuration (see 6.1.8).

(2) Launch Aircraft Instrumentation - Instrumentation necessary to measure AMCS performance is required as a minimum. Additional instrumentation to measure aircraft pilot, or fire control equipment functions may be installed in the aircraft when it is desired to gain additional system or missile data.

3.4.3 TARGET. - The target description will be as specified in the applicable test plan prepared by the testing activity for the particular missile configuration under test.

3.4.4 FLIGHT TEST CONDITIONS. - The flight test conditions will be as specified in the applicable test plan for the missile configuration under test as prepared by the testing activity and approved by the NAVAIRSYSCOM.

3.4.5 ALLOCATION. - Launching aircraft and flight conditions shall be chosen in a random fashion from the flight test plan, so as to exercise the missile across the performance envelope while avoiding extreme or marginal performance regions.

3.4.6 MEASUREMENT AND ANALYSIS. - The testing activity shall monitor and record telemetered information from each attempted launch or launch. Information so recorded shall be analyzed by the producer and the testing activity following each flight; the results of such analysis shall be contained in the test reports and summarized in the reports required under 5.1 herein.

3.5 LABORATORY EVALUATION TESTS. - At least one sample of each production lot of guidance-control sections, motors, warheads and safety-arming devices shall be subjected to laboratory evaluation tests, conducted by the testing activity and which may be observed by the producer. Samples subjected to this test shall not be subsequently subjected to the ground and prelaunch tests of 3.3 or the free-flight tests of 3.4. Sample equipment performance in the laboratory evaluation tests shall be summarized by the testing activity and significant results documented in the final report of 5.1; and the results of these tests shall be included in the scoring requirements of 4.1.4. As a minimum test requirement of the guidance-control section, the testing activity shall perform (a) a disassembly inspection of the sample to determine its conformance with accepted quality standards of manufacture, and conformance to applicable drawings and documentation, and (b) tests of selected circuits to determine the extent of tolerance variations. In addition, when the flight tests of a lot have not included tests of the certain performance objectives, then a randomly selected guidance-control section of the lot, following the flight test series, shall be subjected to laboratory tests to observe operation of components which perform these functions.

When a missile deficiency is observed in any of these tests, the remaining samples of the lot shall be subjected to the test, in order to determine whether the observed deficiency is of a random or systematic nature. Results of laboratory tests conducted shall include information and analysis of random component failures encountered during the course of testing.

3.5.1 WARHEAD FIRING TEST. - One sample warhead of each production lot shall be subjected to a static firing test, utilizing a simulated safety-arming device, in a suitable arena. The test conditions shall be in accordance with   Specification   , and shall utilize a varying stabilization temperature from sample to sample. Assessment of warhead performance shall be as follows:

3.5.1.1 SUCCESSFUL WARHEAD PERFORMANCE. - Those warheads, which when subjected to the static firing test, indicate that the warhead has met the performance requirements of   of Specification   shall be scored as satisfactory on the chart of figure 11.

3.5.1.2 UNSUCCESSFUL WARHEAD PERFORMANCE. -

(a) Due to warhead - Those warheads which, when tested, fail to meet the performance requirements of   of Specification   , and it is determined that the failure was due to the warhead, shall be scored as unsatisfactory on the chart of figure 11.

(b) Due to other causes - Those warheads which, when tested, fail to demonstrate satisfactory performance of the warhead, and it is determined that the failure was due to other than the warhead, shall be scored as "No Test" and omitted from the scoring chart.

3.5.1.3 INSPECTION TO DOCUMENTATION. - One missile from each test sample which has passed the individual test shall be shipped to the NAVAIRSYSCOM Tech. Rep., Pomona for inspection to documentation. This missile shall conform to the applicable documentation to be accepted. Lot rejection may occur only for lack of conformity.

4. SAMPLING, INSPECTION, AND TEST PROCEDURES.

4.1 SELECTION. - All missile guidance-control sections, motors, warheads, and safety-arming devices selected for the production missile test program will be chosen by the cognizant Government representative from the production quantities accepted by the cognizant Government representative at the producer's plant. Samples will be selected at random in such a manner as to assure a fair representation of the production lot (see 4.1.2). Samples shall not be selected which have been subjected to environmental testing or any other special tests which would render the

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samples non-representative of the production units. The serial numbers of the selected samples shall be forwarded to the NAVAIRSYSCOM and the testing activity.

4.1.1 PRODUCTION TEST MISSILES. - A sample from each lot of missiles, consisting of guidance-control section, motor, warhead, and safety-arming device manufactured or repaired will be allocated for Production Testing. The selected items shall be tested as specified herein.

4.1.2 PRODUCTION LOT. - Unless otherwise specified in the procurement documents, a production lot shall consist of the following quantities of missiles as accepted initially in sequence by the cognizant Government inspector.

(a) At a monthly production equal to or less than 100; lot equals 100 missiles.

(b) At a monthly production greater than 100 per month, but equal to or less than 200 per month; lot equals monthly production quantity.

(c) At a monthly production greater than 200 per month; lot equals 200.

4.1.3 SAMPLE SIZES FOR PRODUCTION LOTS. - Thirteen missiles will be randomly selected by the cognizant Government representative from each lot. The sample will be shipped to a testing facility specified by the procuring activity for quality conformance testing.

4.1.3.1 BONDING PROCEDURE. - After selection of a lot sample, the remaining missiles of that lot shall be placed in bond, as specified in the contract or purchase order, until Government acceptance of the lot.

4.1.3.2 RECEIVING INSPECTION, DEPOT, SHIPBOARD, AND PRELAUNCH TESTS. - The entire sample of 13 missiles shall be subjected to the Receiving Inspection; all missiles which pass the Receiving Inspection shall be given the Depot Test; all missiles which pass the Depot Test shall be given the Shipboard Test; those missiles which pass the Shipboard Test and which will be used in the Free-Flight Test, and having telemetering installed prior to the Shipboard Test, will then be given the Prelaunch Test.

4.1.3.3 PRELAUNCH AND FREE-FLIGHT TESTS. - Missiles which have been selected for flight test, have telemetering installed, and have passed all previous tests, shall be installed on a compatible aircraft and taken aloft and given the prelaunch test. The aircraft launching equipment may be modified so as to provide the option of energizing the missile during the airborne period. Sufficient missile guidance-control sections shall be selected at random from the missiles which have successfully passed the Depot Test, for configuration with telemetering for the Free-Flight Test. Missiles subjected to the Free-Flight Test shall have successfully passed all previous tests.

4.1.3.4 CONFIGURATION OF FREE-FLIGHT TEST MISSILES. - The configuration of Free-Flight Test missiles shall consist of the missile guidance-control section, rocket motor, complete telemetry (6.1.8(a)) and safety-arming device.

4.1.3.5 LABORATORY EVALUATION TESTS. - Sample missile guidance-control sections, motors, warheads, and safety-arming devices remaining after the Free-Flight Tests shall be selected as required for the Laboratory Tests of 3.5.

4.1.4 SCORING

4.1.4.1 SCORING - ASSEMBLED ROUND QUALITY. - For appraisal of compliance with the assembly requirements of 3.1.4 (Specification for Assembled Round AIM-7E-2 Guided Missile), all missiles given receiving inspection tests shall be scored on figure 9.

4.1.4.2 SCORING - GUIDANCE-CONTROL SECTIONS. -

(a) Reliability - For appraisal of compliance with the reliability requirements of ______ of Specification ______, all Depot Tests, repeated Depot Tests, and Prelaunch Tests shall be scored on figures 1 & 2.

(b) Performance - For appraisal of compliance with the performance requirements of ______ of Specification ______, all missiles tested in the Free-Flight Tests (except those designated "No Test") shall be scored on figures 3, 4, and 5.

4.1.4.3 SCORING - MOTOR. -

(a) Inspection - For appraisal of compliance with the quality requirements of Specification ______, all motor inspection tests and assembly mating checks shall be scored on figure 6.

(b) Performance - For appraisal of compliance with the performance requirements of ______ of Specification ________, all motors tested in the Free-Flight Test (except those designated "No Test") shall be scored on figure 7.

4.1.4.4 SCORING - SAFETY-ARMING DEVICE. -

(a) Inspection - For appraisal of compliance with the quality requirements of Specification ________, all safety-arming device inspection tests and assembly mating checks shall be scored on figure 8.

(b) Performance - For appraisal of compliance with the performance requirements of Specification ________, all safety-arming devices tested in the Free-Flight Test (except those designated "No Test") shall be scored on figure 9.

4.1.4.5 SCORING - WARHEAD. -

(a) Inspection - For appraisal of compliance with the physical design requirements of ______ of Specification ________, all warhead inspection tests and assembly mating checks shall be scored on figure 10.

(b) Performance - For appraisal of compliance with the performance requirements of ______ of Specification ________, all warheads tested in warhead static firing tests of 3.5.1 (except those designated "No Test") shall be scored on figure 11.

4.1.5 MISSILE LAUNCHING. - Each missile selected for flight test shall be launched by the testing activity within 60 days from the date of acceptance of the last sample missile of the lot. Specific extensions of the 60-day firing requirement may be granted by the NAVAIRSYSCOM.

4.1.6 DELIVERY OF PRODUCTION TEST MISSILES. - Production test missiles shall be delivered as directed by the NAVAIRSYSCOM.

4.1.7 DISPOSITION. - The disposition of missile components not expended in flight tests, upon the completion of the test program, shall be as directed by the NAVAIRSYSCOM.

4.1.8 INSPECTION. - All samples selected shall have received individual tests as specified in the applicable design data addendum prior to delivery for production testing.

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4.2 SATISFACTORY PRODUCTION. - Production shall be considered satisfactory when the following criteria are satisfied.

4.2.1 PRODUCTION LOT CRITERIA - GUIDANCE-CONTROL SECTION. - Production lot acceptance criteria are as follows:

4.2.1.1 RECEIVING INSPECTION TEST. - No failures as defined in 3.2.1 as attributable to the missile are observed in the sample of 13 missiles subjected to receiving inspection test.

4.2.1.2 DEPOT AND PRELAUNCH TESTS. - No more than 2 failures as defined in 3.2 as attributable to the missile are observed in the 13 missiles subjected to test.

4.2.1.3 FREE-FLIGHT TEST. -

4.2.1.3.1 TEST CRITERIA. - Table I presents by stages, the number of missiles of each test sample which shall be subjected to the Free-Flight Test, and indicates the number of missile failures which are cause for rejection of the lot represented by the sample.

(a) In Stage I, if three missiles fail, testing shall cease, the lot shall be rejected.

(b) In Stage II, if the test sample exceeds the number of failures permitted in Table I, the lot represented by such test samples shall be suspended pending the outcome of the succeeding lot; should the succeeding lot be rejected the suspended lot shall also be rejected; should the succeeding lot be accepted, suspended lot shall also be accepted provided no general discernible cause of failure of the suspended lot has been disclosed.

(c) In Stage III, if the test sample exceeds the number of failures permitted in Table I, the lot represented by such test samples shall be suspended pending the outcome of the succeeding lot. Testing of the succeeding lot shall immediately revert to Stage II. Should the succeeding lot be rejected the suspended lot shall also be rejected. Should the succeeding lot be accepted, the suspended lot shall also be accepted provided no general discernible cause of failure of the suspended lot has been disclosed.

(d) In every case of lot suspension either in Stage II or Stage III an accept/reject decision must be made on the basis of testing the succeeding lot sample.

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Table 1. Stages for Free-Flight Tests

Stage	Test Sample	Successes/Accept	Failures/Reject
I	8	6	3
II	5	4	2
III	2	2	2
	4	3	2

Stage I shall be used at the start of a contract, after a major design or model change, and when two successive lot samples fail to meet either the criteria for Stage II or Stage III acceptance.

Stage II shall be used after two successive test sample quantities have passed while in Stage I, and when the preceding test sample quantity fails to meet the criteria of Stage III acceptance. Once Free-Flight testing has advanced from Stage I to Stage II, or has reverted to Stage II from Stage III, testing shall remain in Stage II until two successive lot samples have either failed or passed.

Stage III shall be used after two successive test sample quantities have passed while in Stage II. Once free-flight testing has advanced from Stage II to Stage III, testing shall remain in Stage III until a lot sample fails to meet the acceptance criteria of Stage III; in which case the succeeding lot shall be tested in Stage II.

4.2.1.4 CUMULATIVE GUIDANCE-CONTROL SECTION PRODUCTION CRITERIA. - The cumulative results of tests, including both initial tests conducted on first submittal of lots and subsequent tests conducted after resubmittal, lie above the low limits shown in figures 1, 2, 3, 4, and 5, as calculated by 6.2.

4.2.2 PRODUCTION LOT CRITERIA - ROCKET MOTOR MK___MOD____.- Production lot acceptance criteria are as follows:

4.2.2.1 MOTOR INSPECTION AND ASSEMBLY MATING CHECKS. - No failures as defined in 3.2 as attributable to the rocket motor are observed in the rocket motors subjected to inspection and assembly mating checks.

4.2.2.2 MOTOR FREE-FLIGHT TEST. - No failures as defined in 3.3.1.1.4 as attributable to the rocket motor are observed in the rocket motors subjected to free-flight test.

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4.2.2.3 CUMULATIVE ROCKET MOTOR PRODUCTION CRITERIA. - The cumulative results of tests, including both initial tests conducted on first submittal of lots and subsequent tests conducted after resubmittal, lie above the low limits shown in figures 6 and 7.

4.2.3 PRODUCTION LOT CRITERIA - SAFETY-ARMING DEVICE. - Production lot acceptance criteria are as follows:

4.2.3.1 SAFETY-ARMING DEVICE INSPECTION AND ASSEMBLY MATING CHECKS. - No failures as defined in 3.2 as attributable to the safety-arming device are observed in safety-arming devices subjected to inspection and assembly mating checks.

4.2.3.2 SAFETY-ARMING DEVICE FREE-FLIGHT TEST. - No failures as defined in 3.3.1.1.6 as attributable to the safety-arming device are observed in the safety-arming devices subjected to Free-Flight Test.

4.2.3.3 CUMULATIVE SAFETY-ARMING DEVICE PRODUCTION CRITERIA. - The cumulative results of tests, including both initial tests conducted on first submittal of lots and subsequent tests conducted after resubmittal, lie above the low limits shown in figures 8 and 9.

4.2.4 PRODUCTION LOT CRITERIA - WARHEAD. - Production lot acceptance criteria are as follows:

4.2.4.1 WARHEAD INSPECTION AND ASSEMBLY MATING CHECKS. - No failures as defined in 3.2 as attributable to the warhead are observed in the warheads subjected to inspection and assembly mating checks.

4.2.4.2 WARHEAD FIRING TEST. - No failures as defined in 3.5.1 as attributable to the warhead are observed in the warheads subjected to the static firing test.

4.2.4.3 CUMULATIVE WARHEAD PRODUCTION CRITERIA. - The cumulative results of tests, including both initial tests conducted on first submittal of lots and subsequent tests conducted after resubmittal, lie above the low limits shown in figures 10 and 11.

4.3 CESSATION OF FLIGHT TESTS

4.3.1 CESSATION OF GUIDANCE-CONTROL SECTION TESTS. - Flight tests of a guidance-control section lot shall be terminated when one of the following conditions have occurred: (list)

4.3.2 CESSATION OF ROCKET MOTOR TESTS. - Flight tests of a rocket motor production lot shall be terminated when one failure (3.3.1.1.4) is observed in a sample motor of the production lot in the Free-Flight Test; flight tests of a rocket motor production lot may be terminated when one failure is observed in inspection and assembly mating checks and, in the judgment of the testing activity, such cessation action is warranted. Cessation of tests in a rocket motor production lot shall not cause cessation of flight tests of the missile when other rocket motor production lots are available and may be used.

4.3.3 CESSATION OF SAFETY-ARMING DEVICE TESTS. - Flight tests of a safety-arming device production lot shall be terminated when one failure (3.3.1.1.6) is observed in a sample device of the production lot in the free-flight test; flight tests of a safety-arming device production lot may be terminated when one failure is observed in inspection and assembly mating checks and, in the judgment of the testing activity, such cessation action is warranted. Cessation of tests in a safety-arming device production lot shall not cause cessation of flight tests of the missile when other safety-arming device production lots are available and may be used, or when the device is not required for specific flight tests of other missile components.

4.4 UNSATISFACTORY PRODUCTION

4.4.1 UNSATISFACTORY PRODUCTION - GUIDANCE-CONTROL SECTION. - Production shall be considered unsatisfactory when one or more of the conditions of 4.2.1 are not satisfied.

4.4.2 UNSATISFACTORY PRODUCTION - ROCKET MOTOR. - Production shall be considered unsatisfactory when one or more of the conditions of 4.2.2 are not satisfied.

4.4.3 UNSATISFACTORY PRODUCTION - SAFETY-ARMING DEVICE. - Production shall be considered unsatisfactory when one or more of the conditions of 4.2.3 are not satisfied.

4.4.4 UNSATISFACTORY PRODUCTION - WARHEAD. - Production shall be considered unsatisfactory when one or more of the conditions of 4.2.4 are not satisfied.

4.5 ACTION IN THE EVENT OF UNSATISFACTORY PRODUCTION. - The action to be taken in the event of unsatisfactory production shall be as follows:

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4.5.1 FAILURE OF A MISSILE LOT SAMPLE TO SATISFY CRITERIA

4.5.1.1 RECEIVING INSPECTION. - If a lot fails to satisfy the criteria of 4.2.1.4, each failed missile shall be examined by the testing activity and the producer to establish the reason for failure. Lots, and samples which fail due to established defects in material, workmanship, or other non-conformance to the requirements of the assembled-round contract shall be returned to the contractor for correction in accordance with the guaranty provisions of the contract. Upon reacceptance by the cognizant Government inspector, another sample of 13 missiles shall be selected at random from the lot and tested as provided in 4.1.3.

4.5.1.2 DEPOT AND PRELAUNCH. - If a lot fails to satisfy the criteria of 4.2.1.1, each failed guidance-control section shall be examined by the testing activity and the producer to establish the reason(s) for failure. Lots, and samples which fail due to established defects in material, workmanship, or other non-conformance to the requirements of the contract shall be returned to the producer for correction in accordance with the guarantee provisions of the contract. Upon reacceptance by the cognizant Government inspector, another sample of 13 missiles shall be selected at random from the lot and tested as provided in 4.1.3; new sample being selected at random so as not to exclude the missiles in the previous sample.

4.5.1.3 FREE-FLIGHT. - If a lot, or several lots collectively, fail to satisfy the criteria of 4.2.1.3, the producer and the testing activity shall investigate the possible causes of failure. Acceptance of guidance-control sections at the producer's plant may be suspended pending investigation of the problems and an agreed on course of corrective action between the producer and the NAVAIRSYSCOM. When it is concluded that the indicated failure of the lot or lots was due to the guidance-control section, the lot or lots shall be returned to the producer for correction in accordance with the guarantee provisions of the contract. Upon reacceptance by the cognizant Government inspector, another sample shall be selected from the lot and tested as provided in 4.1.3.

4.5.1.4 CUMULATIVE PRODUCTION CRITERIA. - If the cumulative results of tests plotted or calculated in accordance with 4.2.1.3 fall below the lower limits and thus in the rejection area, acceptance of guidance-control sections at the producer's plant may be suspended pending investigation of the problems and an agreed on course of corrective action between the producer and the NAVAIRSYSCOM. The NAVAIRSYSCOM reserves the right of determination of the final course of action including the resumption of acceptance.

4.5.2 FAILURE OF ROCKET MOTOR LOT SAMPLE TO SATISFY CRITERIA

4.5.2.1 ROCKET MOTOR INSPECTION AND ASSEMBLY MATING TESTS. - If a lot fails to satisfy the criteria of 4.2.2.1, and additional sample of 20 motors of the production lot shall be selected and examined by the testing activity and the producer to establish whether additional reason(s) for failure exist. Lots, and samples which fail due to established defects in material, workmanship, or other non-conformance to the requirements of the contract shall be returned to the producer for correction in accordance with the guarantee provisions of the contract. Upon reacceptance by the cognizant Government inspector, another sample of six rocket motors shall be selected at random from the lot and tested as provided in 4.1.3; new sample being selected at random so as not to exclude the motors in the previous sample.

4.5.2.2 ROCKET MOTOR FREE-FLIGHT TESTS. - If a lot fails to satisfy the criteria of 4.2.2.2, an additional sample of four rocket motors shall be selected and subjected to instrumented restrained firing tests. The producer and the testing activity shall analyze the test data and shall investigate the possible causes of failure. Acceptance of rocket motors at the producer's plant may be suspended pending investigation of the problems and an agreed on course of corrective action between the producer and the NAVAIRSYSCOM. When it is concluded that the indicated failure of the lot was due to the motor, the lot shall be returned to the producer for correction in accordance with the guarantee provisions of the contract. Upon reacceptance by the cognizant Government inspector, another sample shall be selected from the lot and tested as provided in 4.1.3.

4.5.2.3 ROCKET MOTOR CUMULATIVE PRODUCTION CRITERIA. - If the cumulative results of motor tests plotted or calculated in accordance with 4.2.2.3 fall below the lower limits and thus in the rejection area, acceptance of rocket motors at the producer's plant may be suspended pending investigation of the problems and an agreed on course of corrective action between the producer and the NAVAIRSYSCOM. The NAVAIRSYSCOM reserves the right of determination of the final course of action including the resumption of acceptance.

4.5.3 FAILURE OF SAFETY-ARMING DEVICE LOT SAMPLE TO SATISFY CRITERIA

4.5.3.1 SAFETY-ARMING DEVICE INSPECTION AND ASSEMBLY MATING TESTS. - If a lot fails to satisfy the criteria of 4.2.3.1, an additional sample of 20 safety-arming devices shall be selected and examined by the testing activity and the producer to establish whether additional reason(s) for failure exist. Lots and samples which fail due to established defects

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in material, workmanship or other non-conformance to the requirements of the contract shall be returned to the producer for correction in accordance with the guarantee provisions of the contract. Upon reacceptance by the cognizant Government inspector, another sample of six safety-arming devices shall be selected at random from the lot and tested as provided in 4.1.3; new sample being selected at random so as not to exclude the devices in the previous sample.

4.5.3.2 SAFETY-ARMING DEVICE FREE-FLIGHT TESTS. - If a lot fails to satisfy the criteria of 4.2.3.2, an additional sample of four safety-arming devices shall be subjected to instrumented simulated flight operation at the testing activity environmental test facility. The producer and the testing activity shall analyze the test data and shall investigate the possible causes of failure. Acceptance of safety-arming devices at the producer's plant may be suspended pending investigation of the problems and an agreed on course of corrective action between the producer and the NAVAIRSYSCOM. When it is concluded that the indicated failure of the lot was due to the safety-arming device, the lot shall be returned to the contractor for correction in accordance with the guarantee provisions of the contract. Upon reacceptance by the cognizant Government inspector, another sample shall be selected from the lot and tested as provided in 4.1.3.

4.5.3.3 SAFETY-ARMING DEVICE CUMULATIVE PRODUCTION CRITERIA. - If the cumulative results of safety-arming device tests plotted or calculated in accordance with 4.2.3.3 fall below the lower limits and thus in the rejection area, acceptance of safety-arming devices at the producer's plant may be suspended pending investigation of the problem and an agreed on course of corrective action between the producer and the NAVAIRSYSCOM. The NAVAIRSYSCOM reserves the right of determination of the final course of action including the resumption of acceptance.

4.5.4 FAILURE OF WARHEAD LOT SAMPLE TO SATISFY CRITERIA

4.5.4.1 WARHEAD INSPECTION AND ASSEMBLY MATING TESTS. - If a lot fails to satisfy the criteria of 4.2.4.1, an additional sample of 20 warheads shall be selected and examined by the testing activity and the producer to establish whether additional reason(s) for failure exist. Lots, and samples which fail due to established defects in material, workmanship or other non-conformance to the requirements of the contract shall be returned to the producer for correction in accordance with the guarantee provisions of the contract. Upon reacceptance by the cognizant Government inspector, another sample of six warheads shall be selected at random from

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the lot and tested as provided in 4.1.3; new sample being selected at random so as not to exclude the warheads in the previous sample.

4.5.4.2 WARHEAD FIRING TESTS. - If a lot fails to satisfy the criteria of 4.2.4.2, an additional sample of four warheads shall be subjected to the static firing test of 3.5.1. The producer and the testing activity shall analyze the test data and shall investigate the possible causes of failure. Acceptance of warheads at the producer's plant may be suspended pending investigation of the problems and an agreed on course of corrective action between the producer and the NAVAIRSYSCOM. When it is concluded that the indicated failure of the lot was due to the warhead, the lot shall be returned to the producer for correction in accordance with the guarantee provisions of the contract. Upon reacceptance by the cognizant Government inspector, another sample shall be selected from the lot and tested as provided in 4.1.3.

4.5.4.3 WARHEAD CUMULATIVE PRODUCTION CRITERIA. - If the cumulative results of warhead tests plotted or calculated in accordance with 4.2.4.3 fall below the lower limits and thus in the rejection area, acceptance of warheads at the producer's plant may be suspended pending investigation of the problems and an agreed on course of corrective action between the producer and the NAVAIRSYSCOM. The NAVAIRSYSCOM reserves the right of determination of the final course of action including the resumption of acceptance.

5. REPORTS

5.1 TEST REPORTS. - Within 24 hours after completing all Depot and Prelaunch Tests of a lot sample, and after each launching the testing activity shall submit a preliminary report of the results to the NAVAIRSYSCOM. The testing activity shall furnish the producer(s) with the conclusions contained in the preliminary report. Within eight working days following the completion of the lot test the testing activity shall submit five copies of the final report to the NAVAIRSYSCOM (Attn: AIR-5108C) and one copy of this final report to the producer(s). If the producer does not concur with the testing activity final report, he shall, within one working day of receipt of such reports, inform the NAVAIRSYSCOM, (AIR-5108C) directly with reasons therefor. The producer shall simultaneously send a copy of this non-concurrence to the testing activity.

6. NOTES

6.1 DEFINITIONS. - Definitions and interpretations of terminology used herein are as follows:

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6.1.1 TECHNICAL CONTROL. - Technical control is defined as the specialized or professional guidance and direction exercised by an authority of the Naval Establishment in technical matters. Included in technical control is the authority to conduct, alter, or stop tests authorized by the NAVAIRSYSCOM according to the dictates of safety, interference to other projects, compliance with contractual specifications, or undue expenditures of Government funds or property.

6.1.2 TECHNICAL DIRECTION. - Technical direction is defined as including the formulation of general test programs and detail test plans, the preparation of articles to be tested, the prosecution of article tests, the evaluation of test data, the reporting of test results, and the orientation of the test program and plans based on these data.

6.1.3 NAVAIRSYSCOM. - Any reference to the "NAVAIRSYSCOM" herein shall mean the Naval Air Systems Command, Department of the Navy, Washington, D. C.

6.1.4 OBSERVERS. - Qualified personnel, that will closely follow the progress of the missile through test and flight evaluation.

6.1.5 PRODUCER. - The producer is the contractor or rework activity responsible for manufacture, repair, refurbishment, assembly, and test of air-launched missiles.

6.1.5.1 CONTRACTOR. - Reference to contractor herein shall mean the contractor(s) of the guidance-control section, rocket motor, safety-arming device or warhead, as applicable.

6.1.5.2 REWORK ACTIVITY. -

6.1.6 APPLICABLE HANDBOOKS. - Any reference to applicable handbooks herein shall mean those publications promulgated by the NAVAIRSYSCOM for the adjustment, test, assembly, and handling of the equipments involved. When available publications do not completely reflect current equipment, modified test procedures may be used subject to concurrence between the testing activity and the contractor.

6.1.7 DEPOT TEST. - As used herein the term Depot Test shall mean those tests normally performed on missiles received at the Naval Weapons Stations, in accordance with the Handbook of Operational Checkout Instructions Using Test Set AN/DPM, NAVWEPS __________.

6.1.8 TELEMETERING. - For information, telemetry as used herein, consists of:

(a) (Complete Telemetry) Transmitter Group, Telemetric Data ________, in accordance with Specification ________, and Transmitter Group, Telemetric Data ________, in accordance with Specification

(b) (Video Telemetry) Transmitter Group, Telemetric Data ________, in accordance with Specification ________.

6.1.9 INSTRUMENTATION. - A photon scoring system, utilizing a gamma ray emissive element installed in the missile and a sensing system installed in the target, may be used for measurement of missile to target miss distance.

6.1.10 TECHNICAL OBSERVATION. - Technical observation is defined as including observation of the following: (1) formulation of general test programs and detail test plans; (2) the preparation of articles to be tested; (3) the prosecution of article tests; (4) the evaluation of test data; (5) the report of test results; and (6) the reorientation of the test program.

6.1.11 PRELAUNCH TEST. - Missiles shall be considered to be in a prelaunch status when: (1) they have successfully passed Depot Tests, (2) have successfully passed complete missile assembly checks, and (3) have been mounted on the launchers, taken aloft and powered.

6.1.12 FREE-FLIGHT TEST. - Missiles shall be considered to be in Free-Flight Test status when they have successfully passed Depot and Prelaunch Tests, and the pilot attempts to launch, or launches the missile.

6.1.13 AMCS. -

6.2 ASSUMPTIONS. -

(a) The curves shown in figures 1 through 11 illustrate the 2.0 sigma limit (lower 95 percent confidence limit) of the basic reliability line. Figures 1 through 11 may be constructed to include the scoring of all missile tests in a test program, in the following manner:

Sigma is computed by assuming that the Binominal distribution is applicable and thus using the formula

$$= n\ p\ q$$

in which n = the cumulative number of tests

p = the specified probability of success

q = 1 - p

Sample computation:

In figure 1, the specified reliability of 95 percent at n = 20 tests, produces a cumulative success number of 19.

Now $= n\ p\ q$, in which n = 20, p = .95 and q = .05

So $= 0.95 = 0.9746$ . . . (approximately).

then $2.0 = 1.949$ . . . (approximately).

So the limit line is at

$19 - 1.949 = 17.051$ (approximately),
successful missiles in 20 tests.

(b) The upper curves shown in figures 4 and 5 illustrate the 1 sigma limit (upper 68 percent confidence limit) of reliability lines designated as performance targets. The upper curves of figures 4 and 5 may be utilized for award of incentive fees, as provided for in the production contract.

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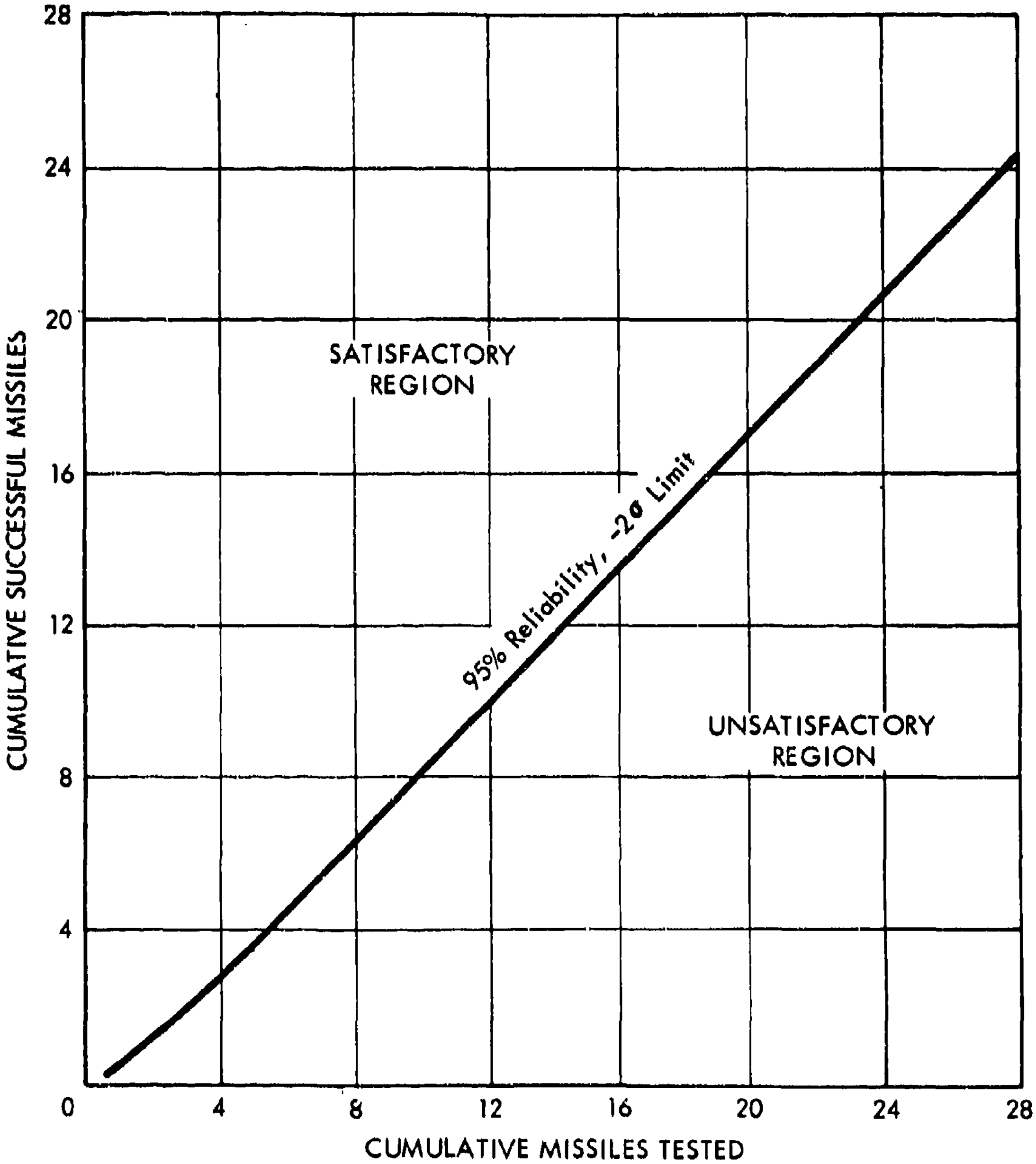

Figure 1. Score Chart for Depot Tests

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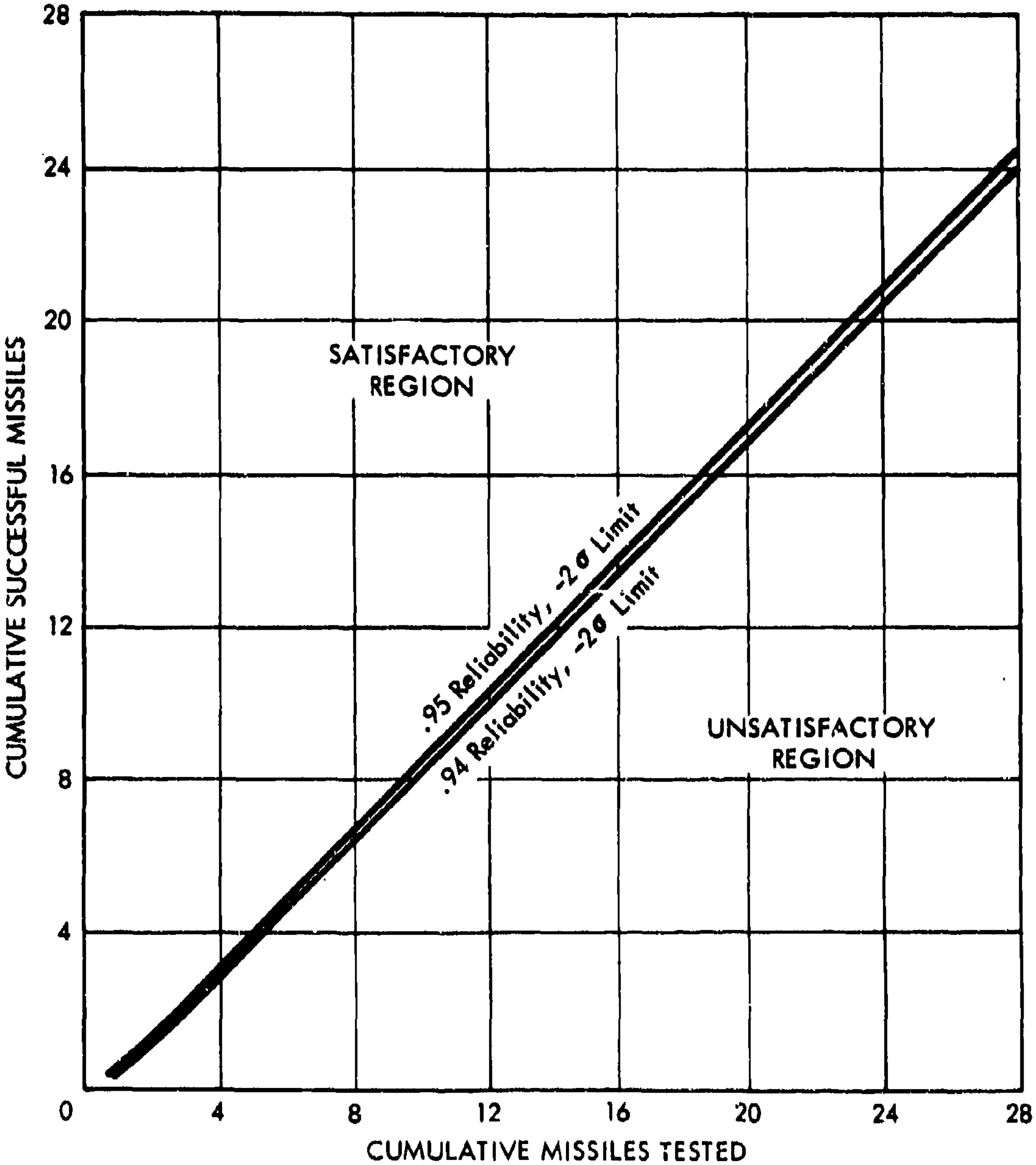

Figure 2. Score Chart for Prelaunch Tests

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to MIL-D-18243 A(AS)

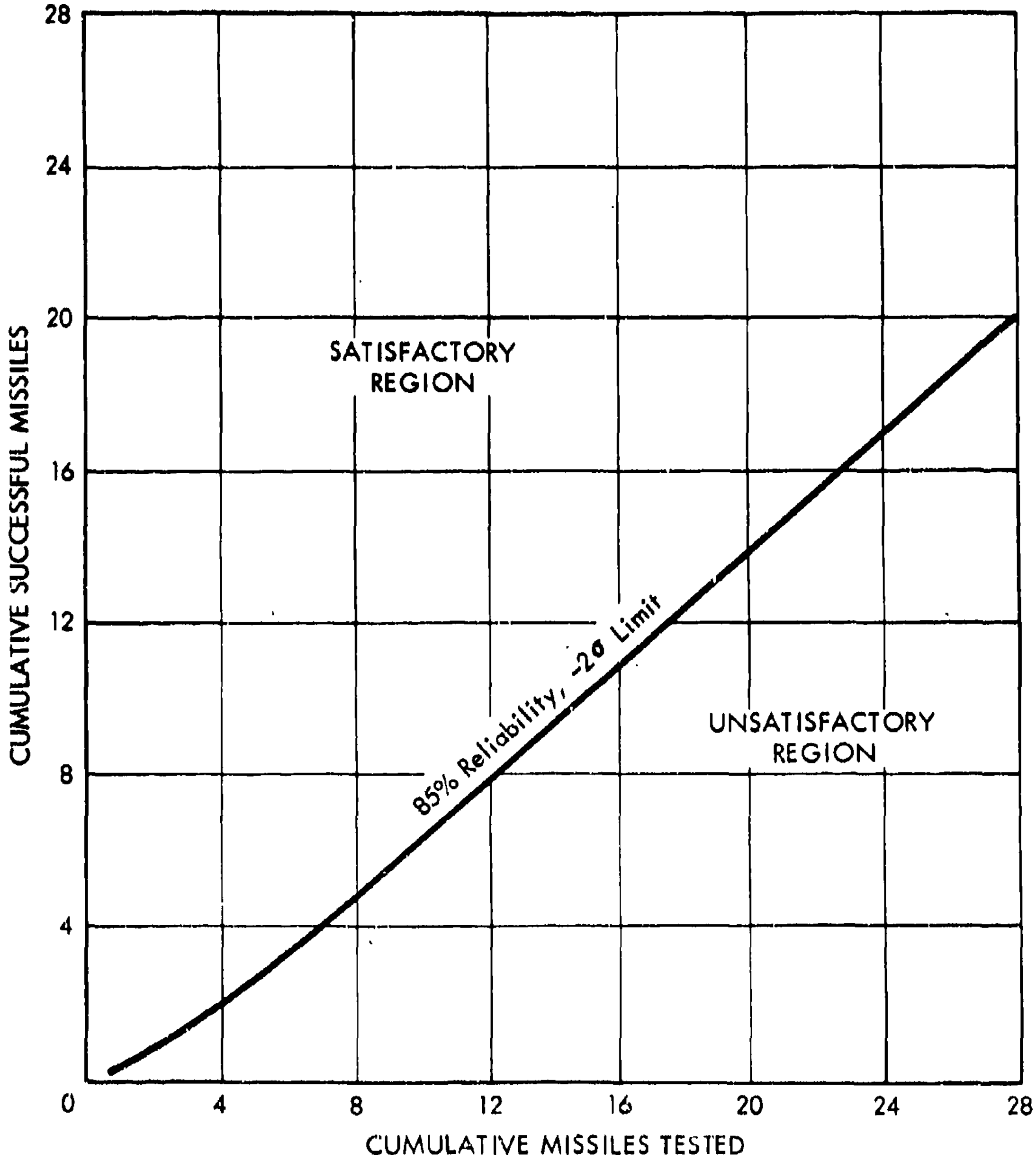

Figure 3. Score Chart for Flight Tests

Addendum No.
to MIL-D-18243 A(AS)

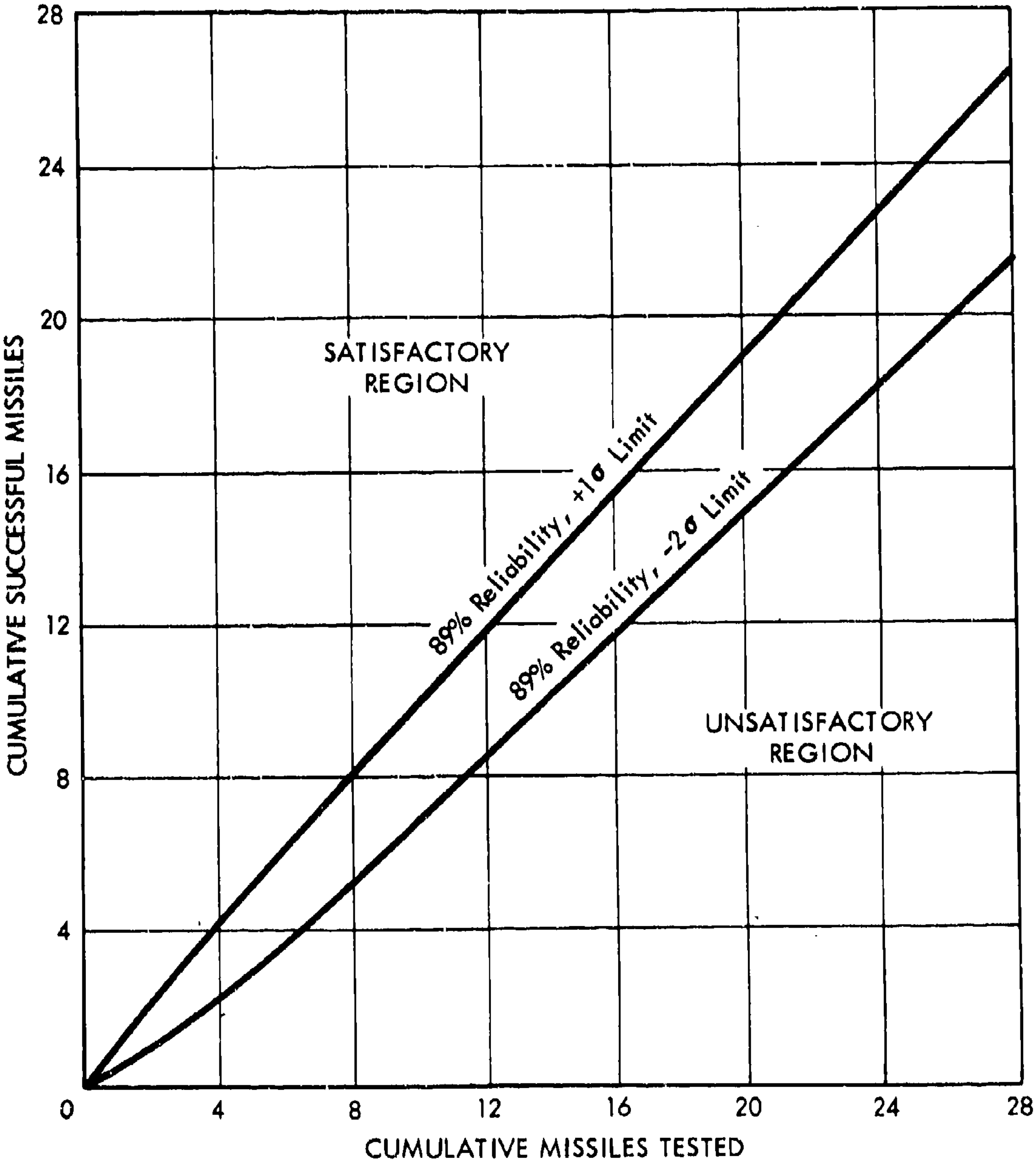

Figure 4. Score Chart for Launch and Guidance Tests

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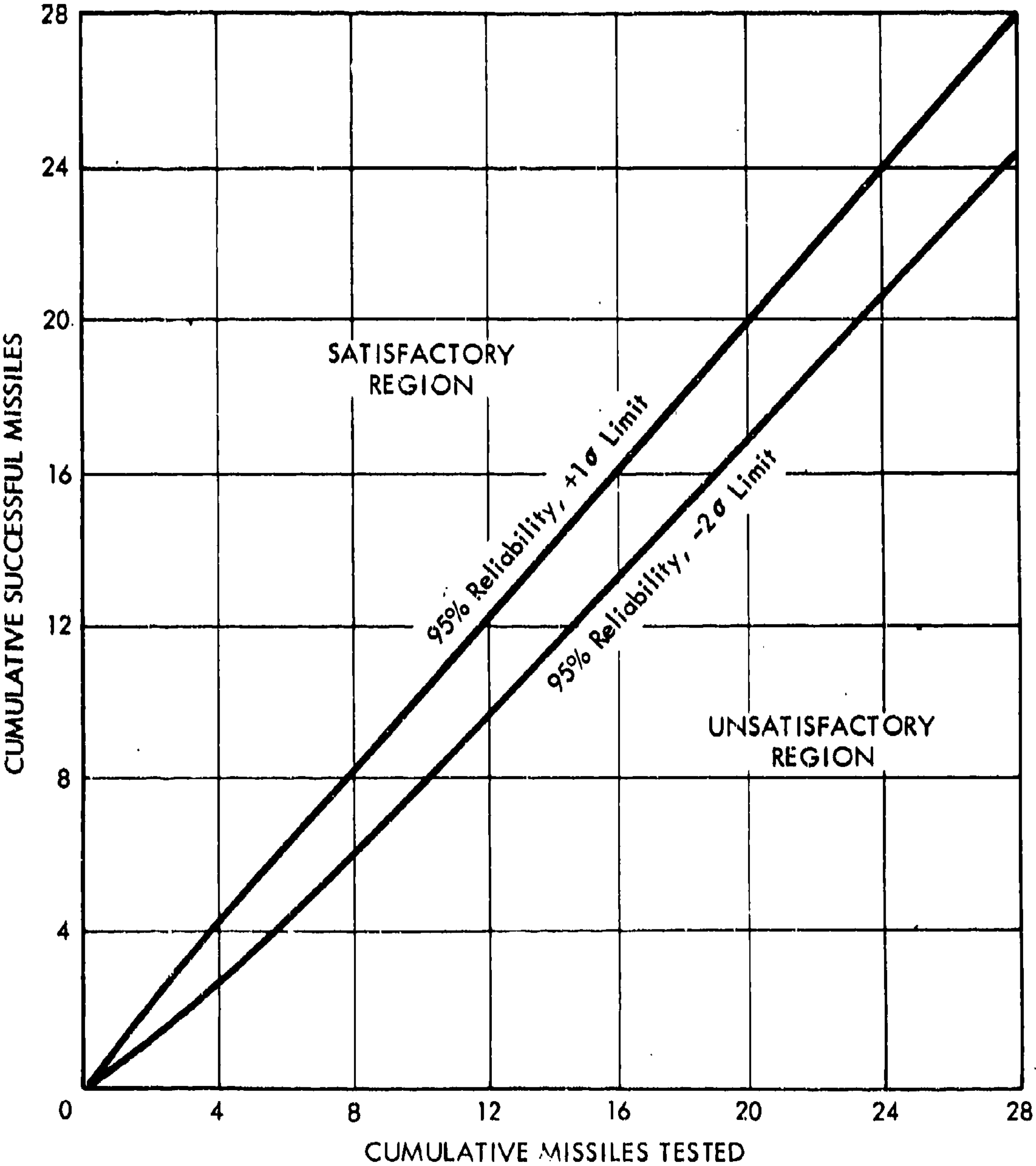

Figure 5. Score Chart for Fuzing Tests

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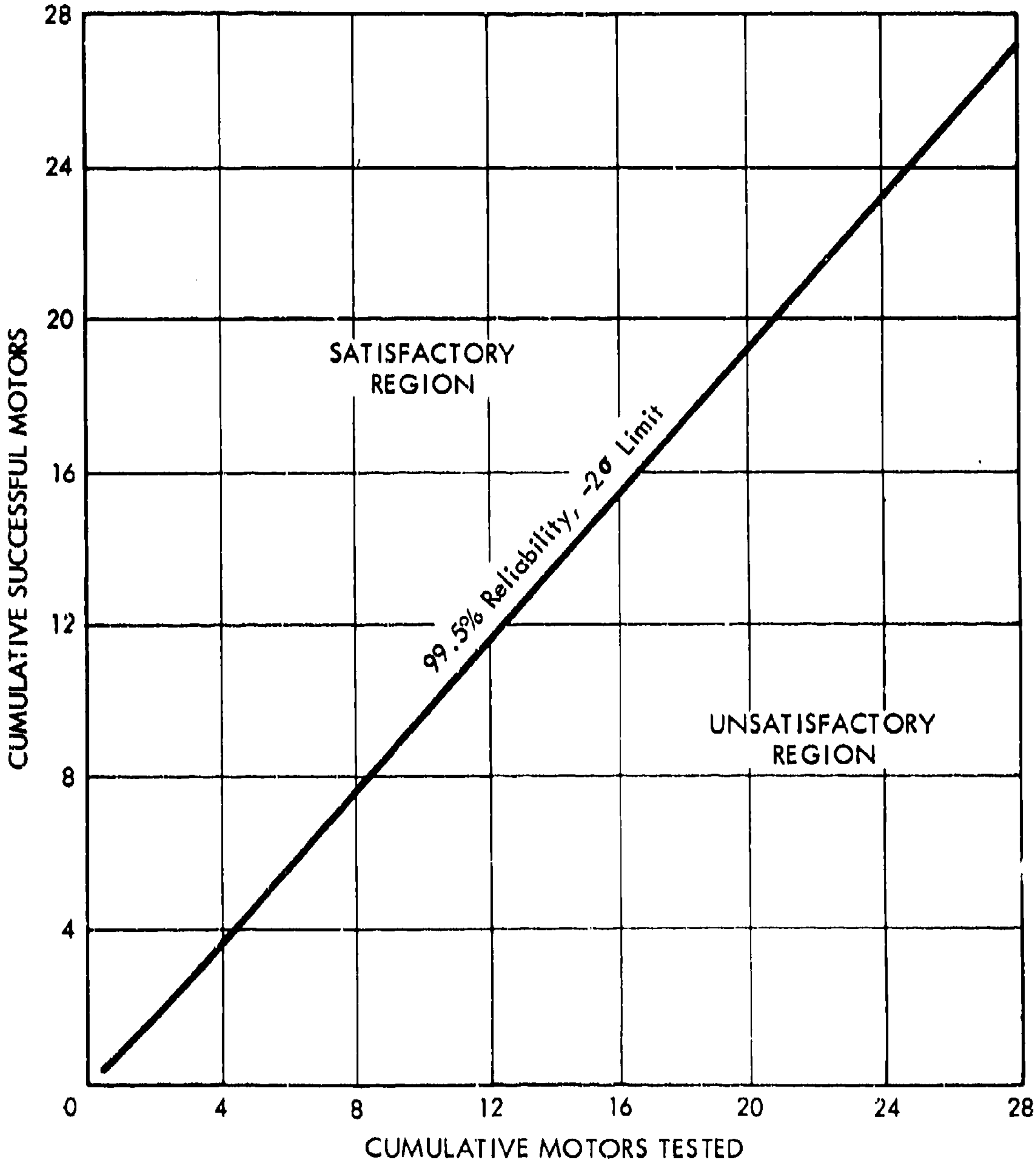

Figure 6. Score Chart for Rocket Motor Inspection and Assembly Mating Checks

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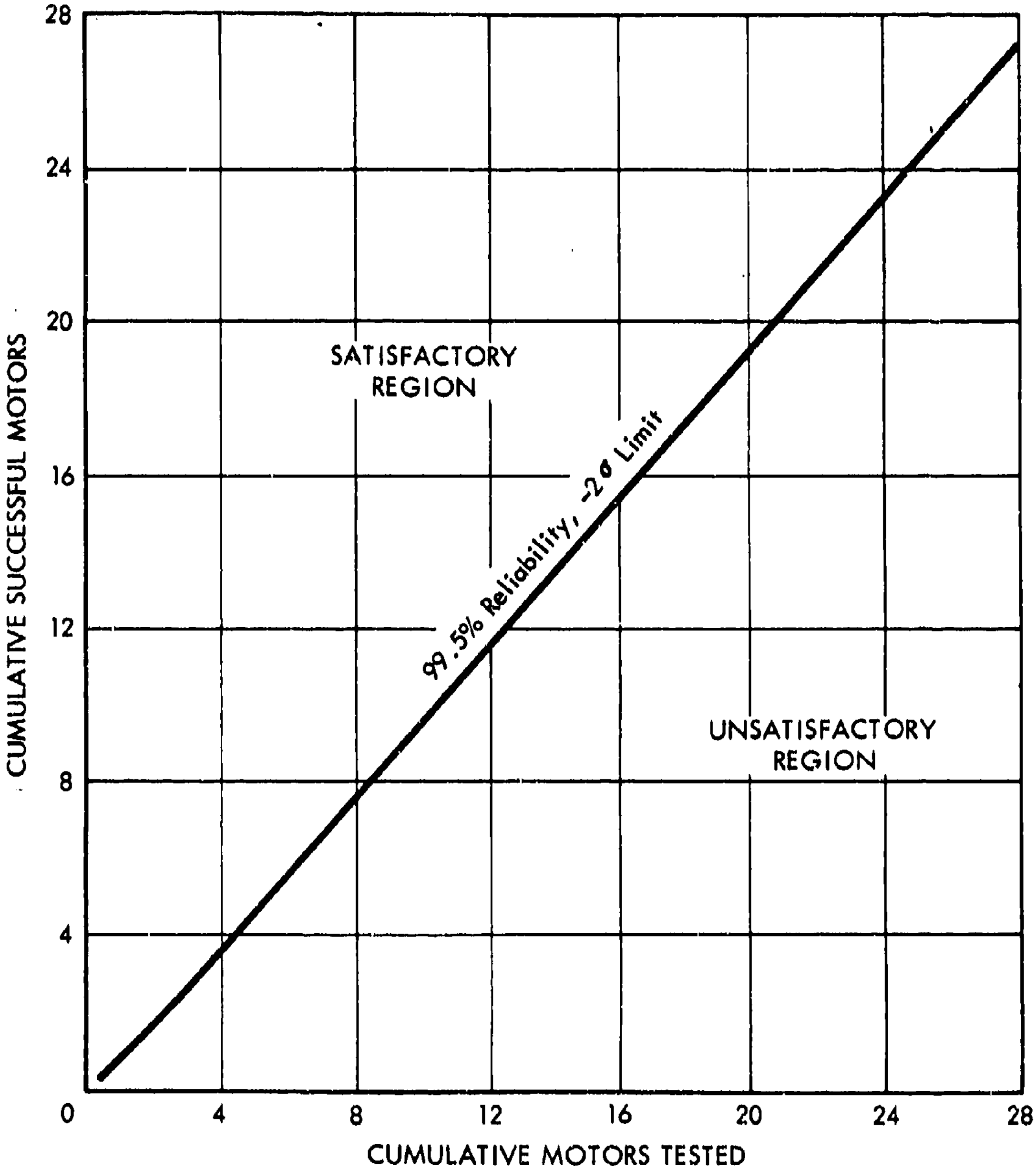

Figure 7. Score Chart for Rocket Motor Flight Tests

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to MIL-D-18243 A(AS)

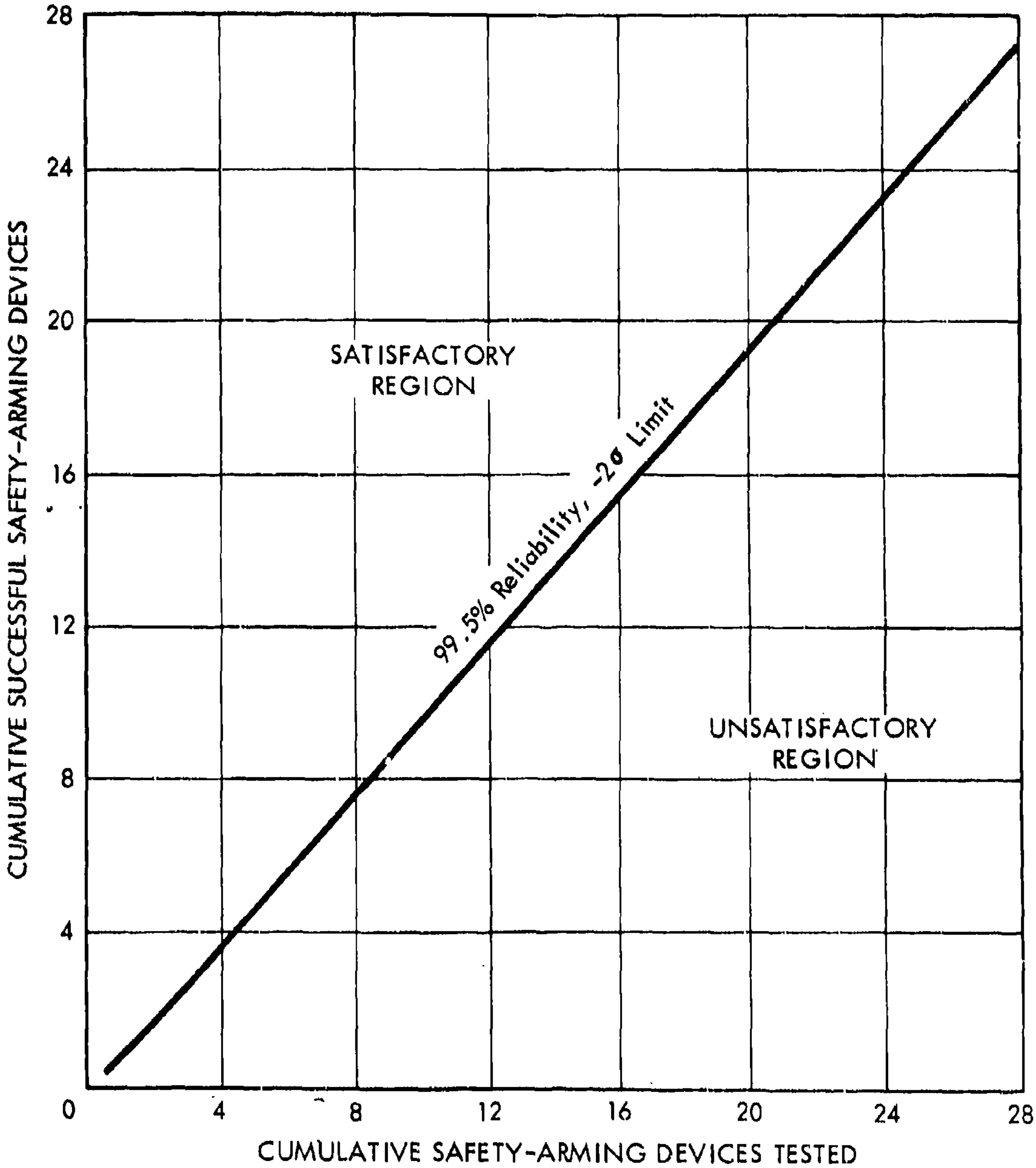

Figure 8. Score Chart for Safety-Arming Device Inspection and Assembly Mating Checks

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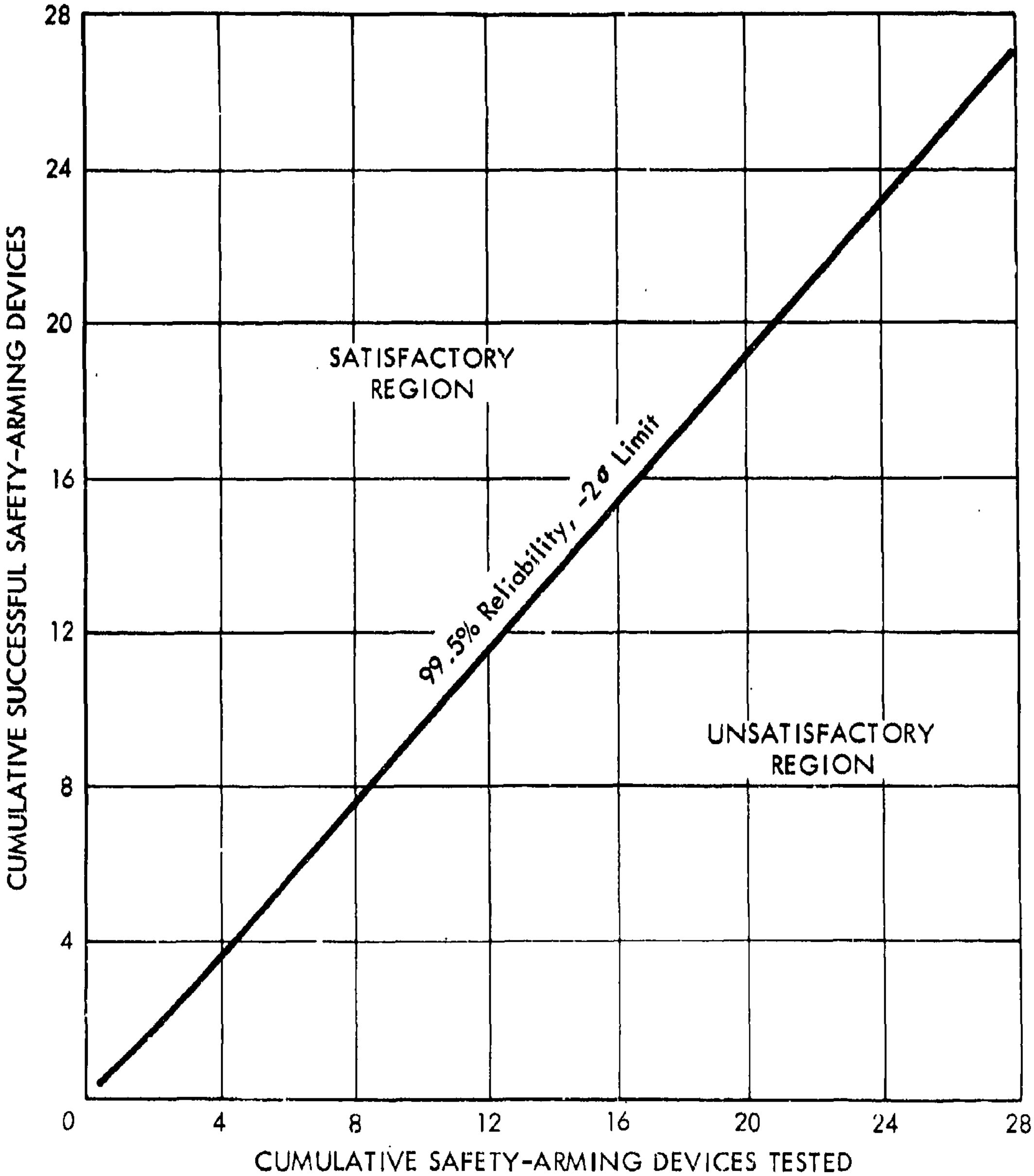

Figure 9. Score Chart for Safety-Arming Device Flight Tests

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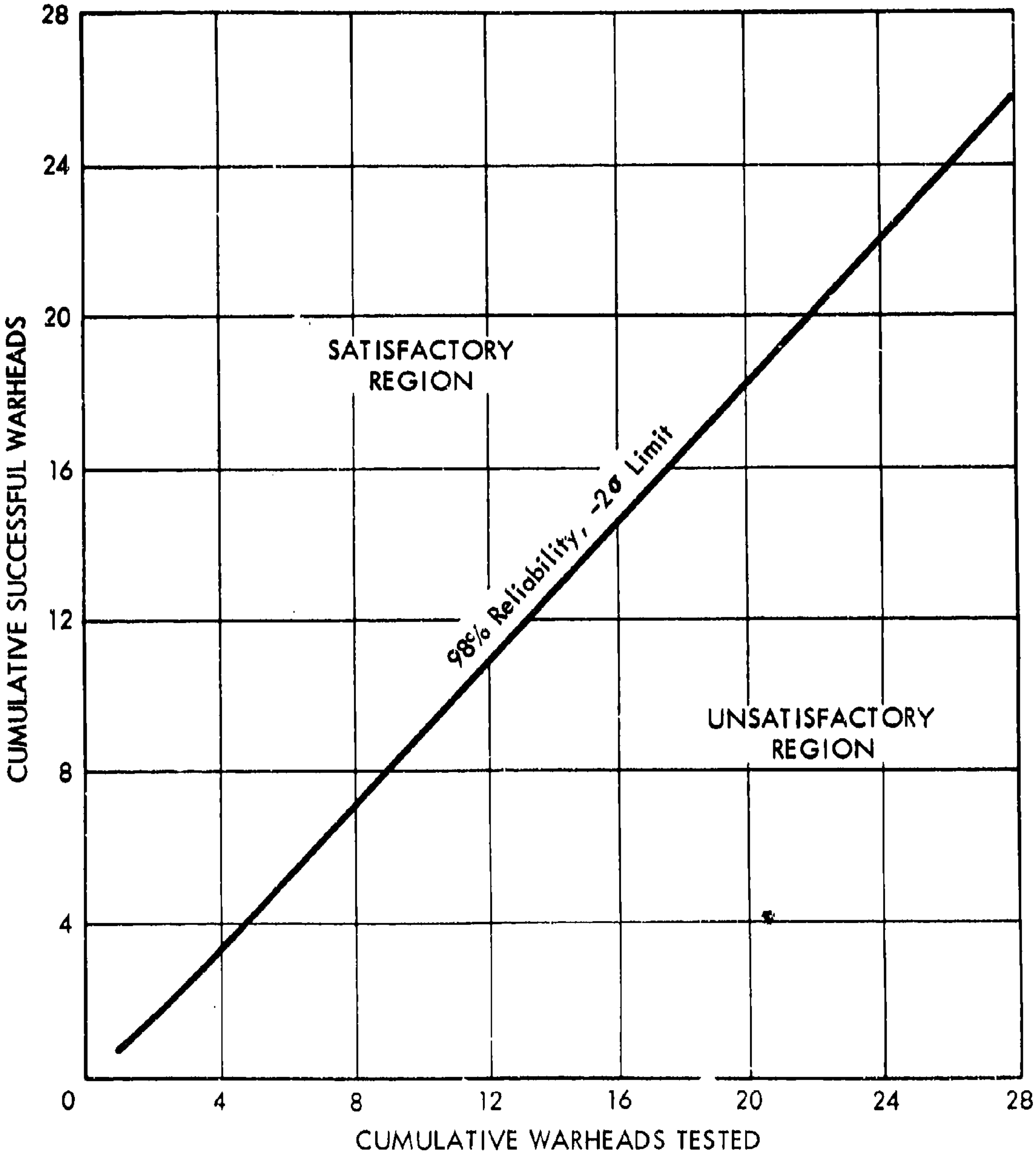

Figure 10. Score Chart for Warhead Inspection and Assembly Mating Checks

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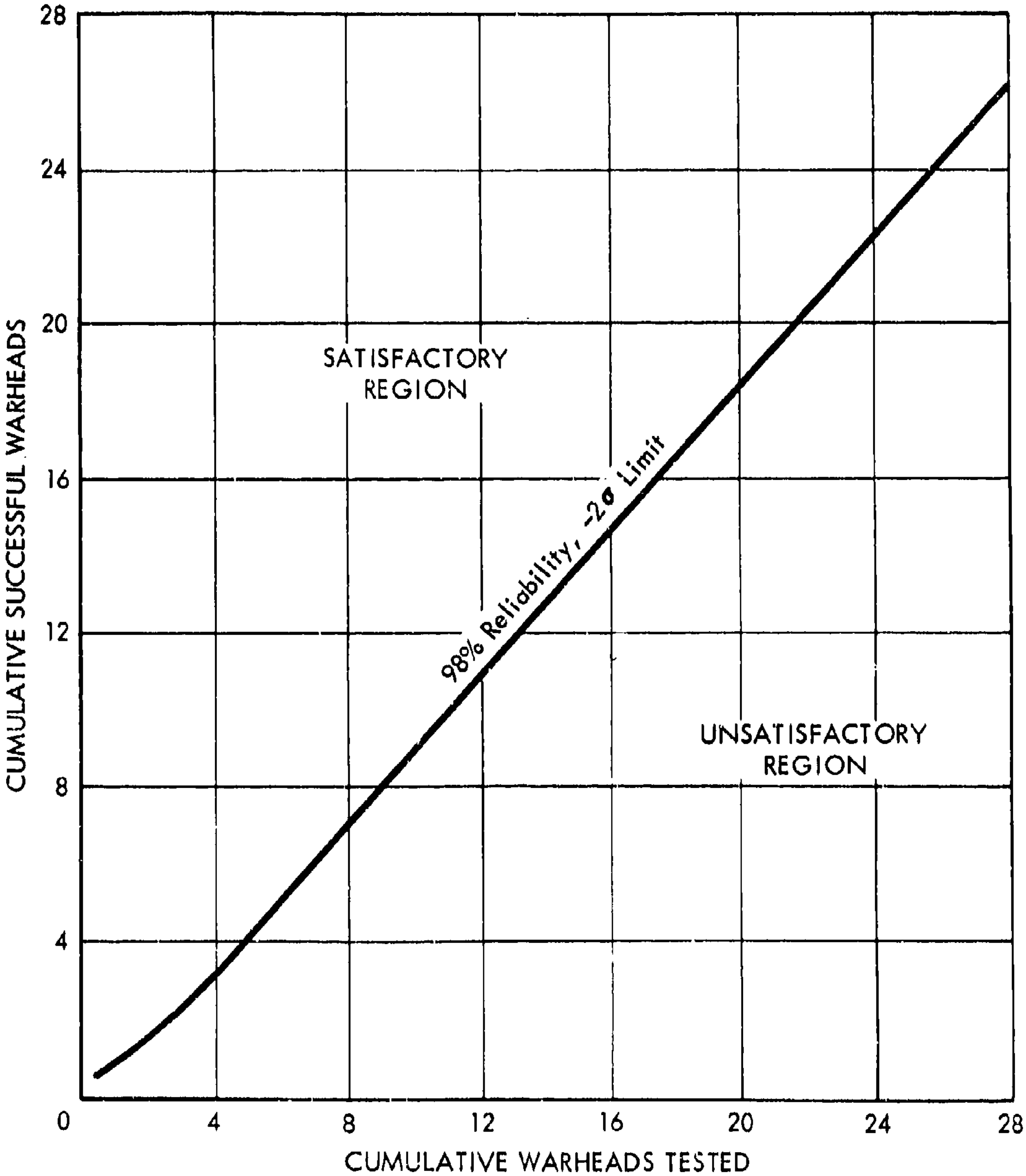

Figure 11. Score Chart for Warhead Performance Tests

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ENVIRONMENTAL TEST PLAN (AIM-9D)

A. INTRODUCTION

1. Background

The AIM-9D SIDEWINDER Missile in service use, particularly in Southeast Asia, has suffered an alarming number of structural failures, many resulting in break up of the missile during captive flight or upon aircraft recovery aboard the carrier. One of the elements determined (by investigation of these failures) to be lacking for thorough engineering evaluation of the problem was a satisfactory definition of the environment seen by the missile under service use conditions.

2. Objective

The general objective of this test plan is to provide the definition of the aircraft missile captive flight environment on the F4 and F8 service aircraft for evaluation of structural, functional and system interface effects on missile system performance.

B. TEST DESCRIPTION

1. Test Objective

Define worst case conditions for normal aircraft missile configuration for the complete captive flight cycle including carrier or shore based take-off and landing, and various flight conditions and maneuvers to which the system is normally subjected in service use.

2. Specific Environmental Objectives

Under various configurations of aircraft launcher and airborne stores, define the following:

(a) The structural loading to which the missile airframe, fins, and rollerons are subjected.

(b) The vibrations to which the missile is subjected.

(c) The temperature environment, including extremes, gradients and heat transfer characteristics to which the missile is subjected.

3. Test Plan

Environmental data is to be obtained on both the F4 and F8 aircraft during captive flight of the AIM-9D SIDEWINDER missile from takeoff to landing. A matrix of aircraft, stores and missile configurations will be examined under various worst case conditions of weight, MACH No., altitude, maneuver and aerodynamic performance to identify the characteristics of the environment to which the missile is subjected. Flight conditions may be modified or added depending upon analysis of data gathered from previous flights. A specific test plan appendix will be provided prior to commencement of the program.

4. Test Method

The following general test methods will be utilized:

Ground Test

(a) Conduct mechanical interface tests with test missile loaded on launch stations.

(b) Checkout and calibrate instrumentation under static load conditions with missile on launcher.

Flight Tests

A flight test appendix will be provided which specifically defines the aircraft, missiles, and stores configuration, the takeoff, flight profile and landing requirements, instrumentation and tracking requirements, as well as all support, data collection and analysis requirements for the test. Requirements for chase plane, photo coverage, voice annotation and time reference information will be specified.

C. TEST REQUIREMENT

1. Test Articles

At a minimum of four current production, AIM-9D Guidance, Control Airframe Groups (GS&A) and inert motors and warhead sections will be required. At least one each service equipped F4 and F8 aircraft will be required.

2. Test Instrumentation

Data will be obtained by means of airborne on-board tape recorder, telemetry units and photographic coverage. The following general instrumentation of the missile will be required:

(a) Structural instrumentation includes strain gages and low frequency accelerometers for obtaining normal forces, bending moments, body bending and torsional stresses.

(b) Vibration instrumentation includes high frequency accelerometers and acoustic transducers with a minimum of 20 to 2000 HZ frequency response.

(c) Temperature will be obtained with thermocouples or thermisters installed in the missile airframe, motor and warhead sections.

D. DATA REQUIREMENTS AND DOCUMENTATION

1. Data Collection

All instrumentation data will be recorded on magnetic tape with voice annotation and time reference information. The following additional sources of data will be utilized:

(a) Aerography data

(b) Flight crew debriefing

(c) Photography - motion picture and still

2. Analysis of Data

Analysis of data collected during the test program will be categorized as follows:

(a) Structural Analysis

Static, dynamics, and combined loading conditions

(b) Vibration analysis

Frequency, amplitude and time domain

(c) Temperature analysis

Extremes, gradients, and heat transfer characteristics

3. Documentation

Interim technical memorandum reports will be provided as the test program progresses. A final technical report will summarize all test results and include recommendations for areas requiring further engineering investigation or corrective action.

Cost Estimates

1. Cost estimates associated with implementation of the recommendations of Task Team One are as follows (Numerals are keyed to sections of the basic report):

I. NAVAIR Air-to-Air Systems Program Management

Cost associated with this portion of the report is internal to NAVAIR and cannot be estimated at this time.

II. Quality Control at the Contractors Facility

Direct costs to NAVAIR to implement this recommendation should be zero, and the cost to NAVAIR Programs for Quality Control should be reduced.

III. Local Contractor Government Representative Actions

Direct cost to NAVAIR to implement this recommendation should be zero.

IV. Quality Control Survey of the Contractors Facility

Action has already been taken on this recommendation. Since costing is internal to NAVAIR it cannot be adequately estimated at this time.

V. Reliability Studies

The AWG-10 reliability program at Westinghouse has an initial cost of $1.5 million and a recurring cost of $0.5 million. The Sparrow III, 7E and 7F reliability programs at Raytheon, have an initial cost of $1.33 million and a recurring cost of $0.32 million. The Raytheon cost would be lower if this recommendation were applied only to the 7E or the 7F, but because of duplication of effort which would be involved between these two missiles, the reduced cost would be considerably less than 50%. The total cost for the Reliability Studies and design margin evaluations is estimated at $3.65 million.

VI. Production Monitoring Tests (PMT)

Assuming the tests will be conducted at Pacific Missile Range, Pt. Mugu, where equipments are currently available, the cost of PMT will become part of the normal programs budget and the additional cost to NAVAIR at this time should be zero.

VII. Missile Systems Environmental Test Plan

Assuming an adequate staff and equipments for the planning, instrumenting, conducting and evaluating of thirty environmental flights, the total cost for the flight portion would be $450,000. The necessary laboratory environmental effort confirmation and to design production evaluation tests will be $600,000. The total cost of the missiles systems environmental tests is estimated at $1,050,000.

VIII. Second Source Considerations

Assuming a reasonable procurement from the second source, that would attract qualified vendors, a minimum of 100 rounds, and assuming the cost for the missile components and assembly would be part of the normal production procurement budget, the only initial cost to NAVAIR would be the tooling and start-up costs. This is estimated to be $400,000.

IX. Change Control Action (ECP)

The cost to NAVAIR to implement this recommendation should be zero.

2. Total estimated cost for implementation of Team One recommendations is $4.28 million initially, and $.82 million recurring. Consultation with Westinghouse, Raytheon, and with Pt. Mugu, was made to assist in the formulation of these estimates.

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APPENDIX II

REPORT

OF THE

AIR-TO-AIR MISSILE SYSTEM

CAPABILITY REVIEW (U)

JULY–NOVEMBER 1968

APPENDIX II

NAVAL AIR SYSTEMS COMMAND

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APPENDIX II

REPORT OF TASK TEAM TWO

Chairman: Mr. W.W. West, Naval Weapons Center, Corona Laboratories

"Are Fleet support organizations delivering a high quality product to the CVA's and to the forward area sites ashore?"

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INTRODUCTION

A. Task Team Two was assigned the Fleet Support area of the Air-to-Air Missile Systems Capability Review. Tabs A and B pictorially illustrate the Fleet Support (Logistics) equipments currently associated with the SPARROW and SIDEWINDER AAM weapons systems. The Fleet Support (Logistics) area problems consisted of approximately 40 discrepancies within 7 major categories. These problems (discrepancies) were distributed among such major categories as Missile Containers, Maintenance, Management, Test Equipment, Missile Testing, Quality Surveillance, Personnel Training, and Publications.

B. The major portions of the investigative review were conducted through visits to cognizant commands and activities by the Task Team Two chairman and members of the team during the period 23 August through 8 November 1968.

C. The Problem Areas assigned to the Team, both specific and general, were identified and analyzed in detail; investigative comments were recorded and documented; and conclusions and recommendations based on these analyses were formulated.

D. It is concluded that there are a number of improvements in procedures and methods which can and should be made.

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INDEX

I. BACKGROUND

A. Upon acceptance of its charter Task Team Two immediately commenced active investigations into fleet support problem areas. Team members, while acting to solve the immediate Fleet support problems of current interest (in order to improve the AIM-7 and AIM-9 weapons systems capabilities in Southeast Asia) nevertheless, kept in mind the possibilities of future use of this documented information during similar circumstances.

B. As the inquiry and data collation continued, it soon became apparent that fleet support problems identified in the Symposium were not to be considered unique. A thorough and deliberate search of data associated with the current problem areas disclosed that in many cases the very same problem (perhaps varying by small degrees) had already been documented by a previously empowered study group. Five documents, covering many of the current problem areas in addition to some considered as completed, are noteworthy. They are listed as follows:

(1) Letter Report: SPARROW III Guidance/Control Section Container Weatherproofing Tests Concerning: NAVMISCEN N3122/BD June 4, 1964.

(2) Letter Report: FWAM-71:JHE 18 September 1964 Logistics and Provisioning Conference for SPARROW III Reusable Containers, Notes and Action items; Forwarding of.

(3) Letter Report: U.S. Naval Missile Center F-4/SPARROW III Weapon System Team Report (U) 19 April 1966 to 31 May 1966 (C) 50/NA 0496 18 August 1966.

(4) Raytheon Memo: Southeast Asia Trip with the Air Force AIM-7/9 Fact Finding Team Report (U) Raytheon Memo 7623-1304 25 October 1967 (C).

(5) Letter Report: Naval Air Systems Command Representative, Pacific SPARROW III Investigation Team Report (U) 11 November to 27 November 1967 Code 23A/ RES:seb Ser 0234 December 22, 1967 (C)

C. It is interesting to note that the listed reports cover a period in time beginning in June 1964 and continue into December of 1967. The situation, therefore, spurred the team's resolve to produce an objective, truthful, well coordinated, and as technically complete a report as humanly possible within the existing time constraints. The team members have investigated, documented, drawn conclusions to, and recommended (via coordinated efforts) solutions for, those fleet support problem areas originally assigned, as well as some that were uncovered during the course of the team's inquiries, in direct response to fleet needs.

D. The team's recommendations, if followed, should eliminate future fleet support problems of the same nature.

II. MAJOR CONCLUSIONS AND RECOMMENDATIONS

A. General

At the termination of the investigation period, Task Team Two reached certain major conclusions of a broad nature regarding the Fleet Support/ Logistics problem areas. This section presents an overall summary of these conclusions and recommendations based on the major discrepancy categories. More detailed conclusions and recommendations of organizational, program and technical nature are presented in Tabs to this report.

It is the opinion of the team that the supporting activities can improve the quality of missiles delivered to the fleet with the implementation of the following recommendations:

B. Management (See Tab D)

1. Better coordination is required between NAVAIRSYSCOM and NAVORDSYSCOM in providing necessary management direction to the NWS/NAD's in the area of Test, Maintenance, Logistics and Storage of Air-to-Air Missiles.

2. BUWEPS Instruction 08810.1 dated 14 June 1963 requires review, revision and reissue by NAVAIRSYSCOM. The minutes of the Logistics and Planning Conference on 18 September 1964 stated this document was then undergoing review. However, to date, no evidence of issuance is in existence.

3. Delegate, under the direction of NAVAIRSYSCOM, the in-service engineering functions for SPARROW and SIDEWINDER.

C. Publications (See Tab E)

1. Naval Air Systems Command retain the use of the Quality Assurance Provisions (QAP) as being invaluable to Quality Assurance personnel. The QAP should remain a separate working document, but may be integrated into other manuals as desired.

2. Air-Launched Weapon QAP's be promulgated as joint NAVAIRSYSCOM/ NAVORDSYSCOM publications and that NAVAIRSYSCOM establish a procedure for review and approval of preliminary drafts and revisions.

3. Naval Air Systems Command retain present SPARROW missile and support equipment publications in the current format and utilize current revision provisions to these publications. Consider only promulgation of new publications (commencing with AIM-7F and All-Up-Round) in the recently adopted format of Specification MIL-M-38784 and DOD 5220.22-M.

4. NWS Standard Operating Procedures (SOP's) for air-launched weapons be reviewed and approved by NAVAIRSYSCOM rather than WPEC NAD Crane.

D. Containers (See Tab I)

1. NAVAIRSYSCOM issue instructions directing compliance with SPCC ltr 781/PLL/807/4423/ALM of 29 August 1968.

2. NAVAIRSYSCOM issue instructions giving authority to forward areas to use strapping material to band containers for return of components to CONUS.

3. NAVAIRSYSCOM immediately coordinate with NAVORDSYSCOM to expedite the implementation of all pertinent action items contained in enclosure (1) to Chief BUWEPS ltr FWAM-71:JHE of 18 September 1964 titled, "Logistics and Provisioning Conference for SPARROW Reusable Containers, Notes and Action Items."

4. NAVAIRSYSCOM levy requirements on the NWS's to provide refurbished containers to the forward areas as required.

5. NAVAIRSYSCOM conduct a packaging and handling study to investigate the adequacy of present techniques and material and evaluate "turnaround" vs. "throw away" containers.

6. NAVAIRSYSCOM issue instructions requiring that logbooks be taped to the G & C skin vice being placed in the container logbook compartment.

7. NAVAIRSYSCOM issue instructions downgrading the security classification of missile handbooks.

E. Test Equipment (See Tab F)

1. SPARROW shipboard test equipment be standardized. From a line maintenance, installation, and simplicity-of-operation standpoint the AN/DPM-14 test set is superior; however, a Tester Correlation Study is needed to validate the comparative performance of the DPM-7, DSM-32, and DPM-14 and to evaluate the reliability and dependability of the DSM-32 and DPM-14 as shipboard test tools. To provide standardization a directive is required specifying installation and utilization of shipboard test equipment. Procurement action as necessary should be initiated.

2. Uniform calibration criteria for SPARROW test equipment be established. The frequency and responsibility for periodic calibration and maintenance should be specified by a NAVAIRSYSCOM/NAVORDSYSCOM directive. An interim bulletin should be issued to ensure periodic on-site calibration of Naval Weapon Station AN/DPM-7 test systems by Navy calibration laboratories.

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3. A SPARROW test equipment standardization committee be reconvened for periodic review of current and proposed support equipment. Initial review should encompass NWS special support and general purpose test equipment.

4. Establish a configuration control system for SPARROW test equipment. NAVAIRSYSCOMREPS be assigned configuration and change kit control responsibility to ensure standardization and testing compatibility.

F. Maintenance (See Tab G)

A review of maintenance procedures and directives indicates that improved maintenance can be expeditiously obtained by considering the following recommendations:

1. That NAVMISCEN Point Mugu expedite investigations concerning elimination of the desiccant container and SRS crystal failure rate and that NAVAIRSYSCOM issue a directive at the earliest time based on NAVMISCEN Point Mugu's recommendations.

2. That NAVAIRSYSCOM issue a directive requiring 100% QA inspections of all air launched guided missile components being worked at the Depot and Intermediate Maintenance Levels.

3. That all levels of maintenance be directed in a manner that the total system concept is perpetuated throughout the stockpile to target sequence.

4. That immediate action by NAVAIRSYSCOM be initiated to bring the entire air launched guided missile systems into the Material Maintenance Management program (3-M) not later than January 1970.

5. A program requiring periodic proficiency inspections of NWS's be established.

6. NAVAIRSYSCOM expand the NAVMAG Subic Bay facility to include capability for intermediate G & C and rocket motor repair. Currently 31% of AIM-7E G & C's are in the repair pipeline. The Mean Down Time for missiles failing outside CONUS, as reported by FMSAEG for CY '67, is 296 days for a missile in the Atlantic area and 270 days for a missile in the Pacific area. The number of SPARROW G & C's being entered in the repair pipeline can be reduced by the establishment of a Forward Area Intermediate Repair Facility at NAVMAG Subic.

G. Quality Surveillance (See Tab H)

1. NAVAIRSYSCOM revise, update and promulgate an instruction similar to NAVORDINST 4355.3 (CH-1 of 7/15/66) to establish a NAVAIRSYSCOM program for quality surveillance of air launched guided missiles.

2. NAVAIRSYSCOM ensure promulgation of instructions by Type Commanders and Marine Corps activities to effectively monitor the captive flight history and its observed effects upon all air launched missiles in the inventory. (These instructions should be similar to COMNAVAIR Note 8810 of 2 August 1968.)

3. NAVAIRSYSCOM revise, update, and promulgate an instruction superseding BUWEPSINST 08810.1 of 14 June 1963 to provide direction for the support of air launched missiles and associated supporting equipment.

4. NAVAIRSYSCOM supersede enclosure (2) to BUWEPSINST 08810.1 to permit across-the-board 10% sampling at the QEL of the SPARROW stockpile and further permit "stringent re-test" at the QEL of SPARROW sections rejected at the NWS as is currently provided for in paragraph 6.b.(3) and enclosure (1) of BUWEPSINST 08810.1.

5. Currently NAVAIRSYSCOM procures SPARROW components on a one for one basis. It is recommended that NAVAIRSYSCOM adopt the following procurement requirements for the AIM-7E/7E2 to permit adequate surveillance sampling:

Nomenclature	Units Per
GC&A (including sub-assemblies) AIM-7E/7E2	1.01
Propulsion Mk-38/52	1.20
Electronic Firing Switch Mk-73	1.10
Safety-Arming Device Mk-5/35	1.10
Warhead Mk-38	1.03

6. NAVAIRSYSCOM adopt a procurement requirement for the AIM-7F and associated missile components similar to the procurement requirement recommended herein for the AIM-7E/7E2.

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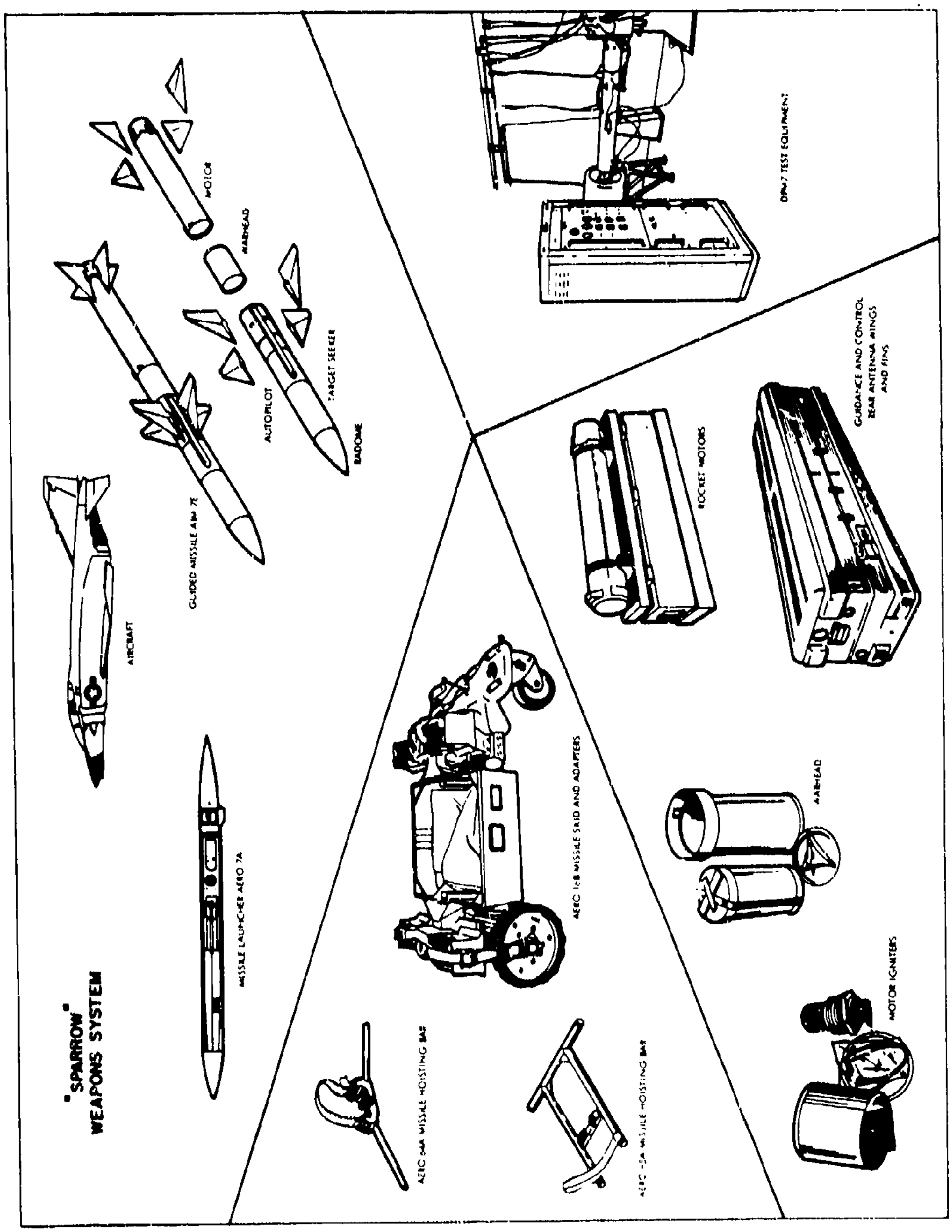

Sparrow Weapons System

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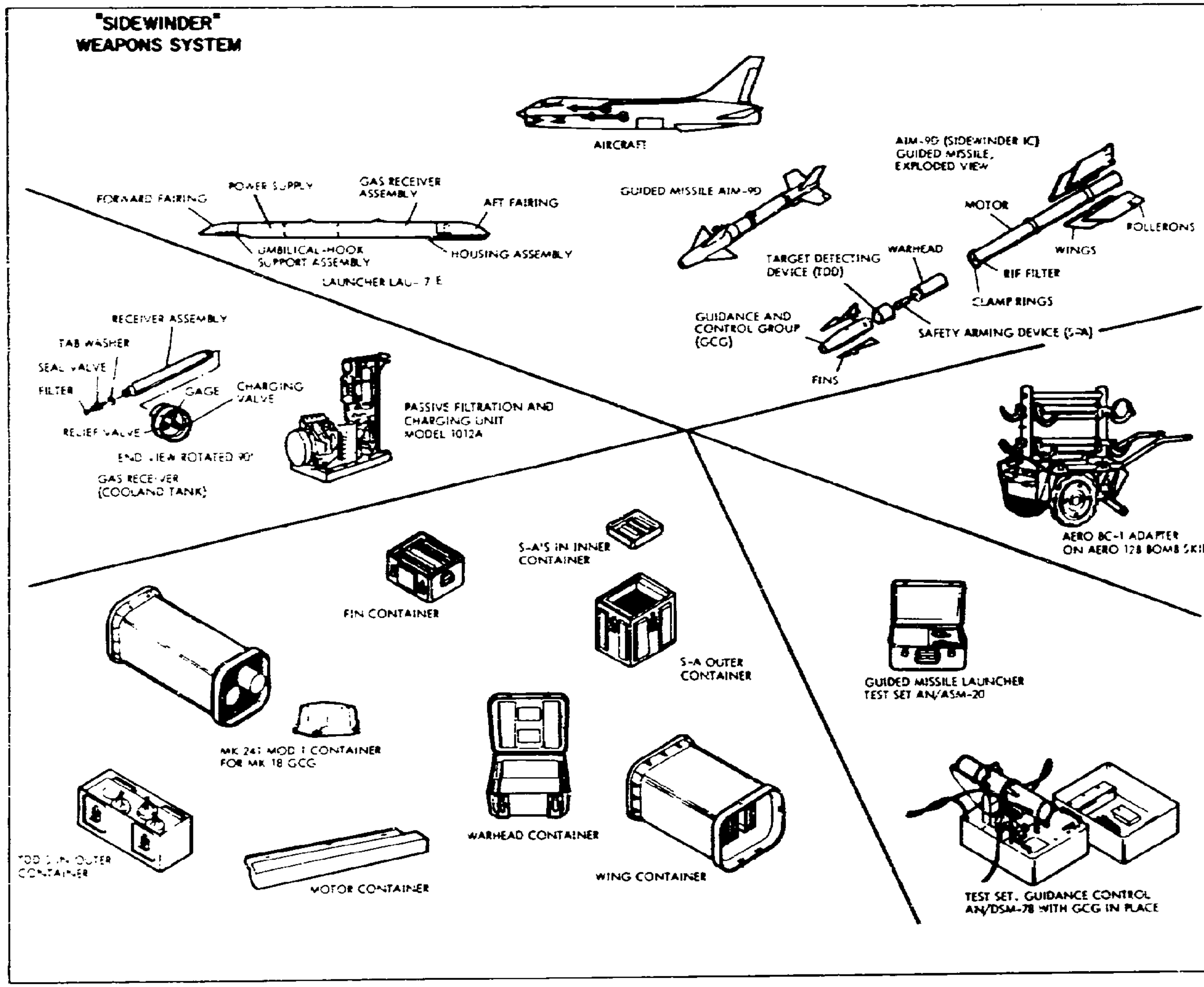

Sidewinder Weapons System

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FLEET MISSILE SUPPORT

1. Fleet Missile Support should include: (1) provisioning and replenishing missiles, support equipment, and spares to Naval Weapon Stations (NWS), NAVMAG Subic, ships, training facilities, and Navy and Marine Corps Stations; (2) handling and storage of missile components; (3) maintenance and repair of missile components and support equipment; and (4) initial and follow-on training requirements.

2. The present logistics program is limited to the initial operational phase of the missiles with respect to storage and issue of the missiles, support equipment, and spares to using activities; and the handling, testing, maintenance, and repair of missiles and support equipment in quantities anticipated under restrictive conditions. It is not fully geared to the combat situation now existing in Southeast Asia.

3. The logistics support of missiles extends from the contractors' facilities to the disposal of the missiles by firing or by off-loading for redistribution and/or return to the NWS.

4. There are four operational phases: commercial, testing and storage, tactical, and training. The flow of missile components throughout these phases is shown in Figure 1. The Task Team Two Report deals only with the missile fleet support areas.

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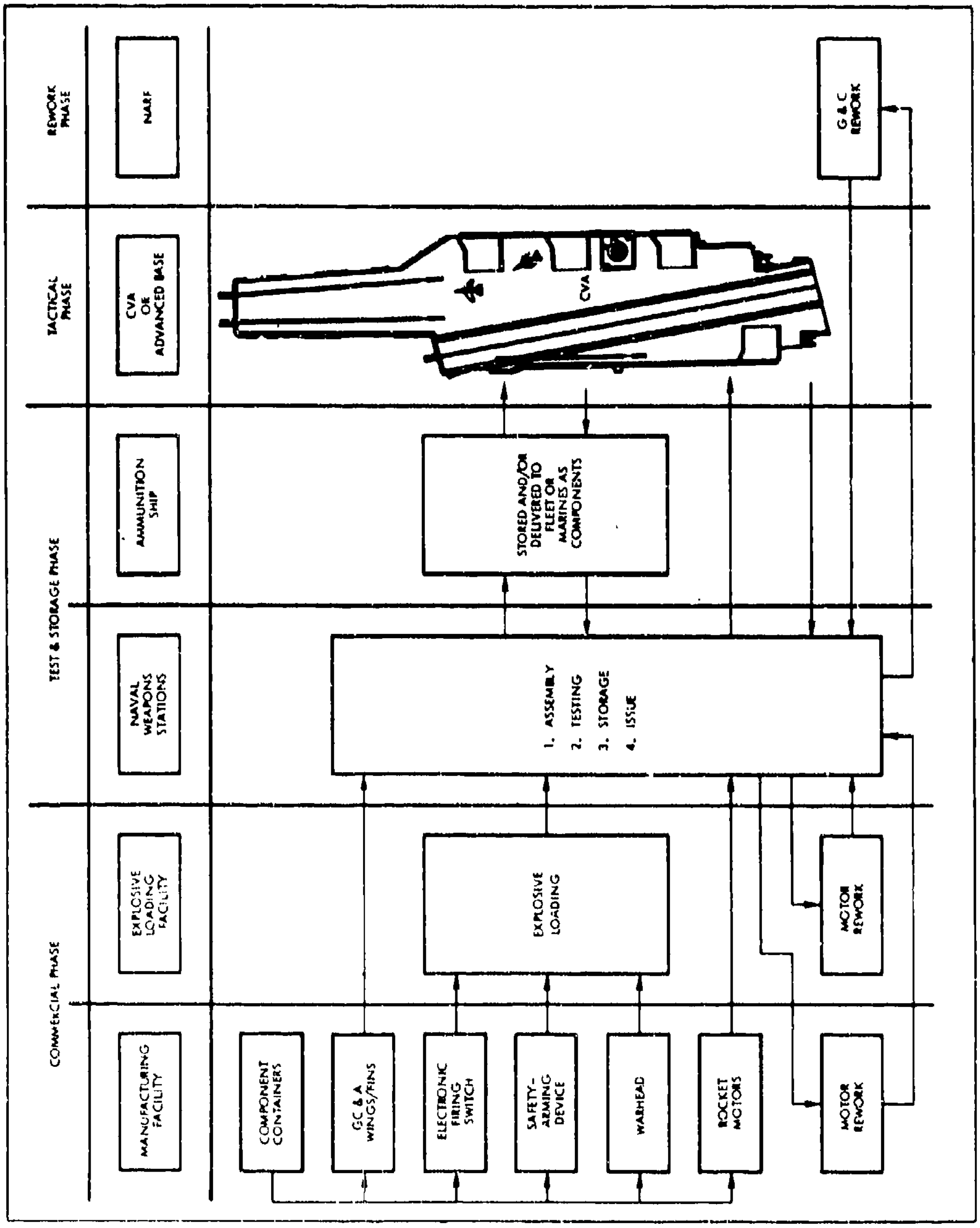

Figure 1. Typical AAM Weapons System Flow Diagram

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GENERAL MANAGEMENT PLAN

1. The investigation of Air-to-Air Missile (AAM) problems conducted by Task Team Two at the Naval Weapons Stations (NWS) indicated a strong need for a central, responsive, and authoritative in-service engineering activity of the type provided for surface launched missiles by the Naval Ship Missile System Engineering Station (NSMSES) at Port Hueneme. The NWS's, as well as other activities, have problems associated with AAM's which could and should be solved by such an activity.

2. Offices of the Naval Air Systems Command containing the AAM program managers and other cognizant personnel are receiving fragmented information that has not been completely evaluated to the proper degree for every user. This has resulted in a degradation of authority and unauthorized assumptions of responsibility, leaving the operating forces and field activities in a position of having inadequate and confused guidance. Examples of inadequate guidance include incompatibility between NARF final test and NWS incoming test, and the lack of a central publication updating and verification authority.

3. To correct this management problem and provide a system that is workable within the present scheme, it is recommended that activities such as NAVMISCEN Point Mugu or NWC China Lake have their missions and authority expanded to include the in-service engineering services for air-to-air missiles. Implementation would provide an organization that would provide:

a. For including and implementing air-launched missiles in accordance with requirements of NAVAIRINST 4700.2 and the 3-M System.

b. For setting up the requirements for reports so that they will be of value in evaluating the entire systems.

c. Inspection teams and requirements that would ensure uniformity of maintenance, operations, and training throughout the Navy.

d. A collation point for all information that is necessary for recognizing a valid problem and implementing its correct solution.

e. An engineering service that can establish realistic acceptance and rejection standards.

f. An engineering service that can ensure documentation is up-to-date and correct.

g. An engineering service that can recognize a problem area before it occurs and can recommend a solution.

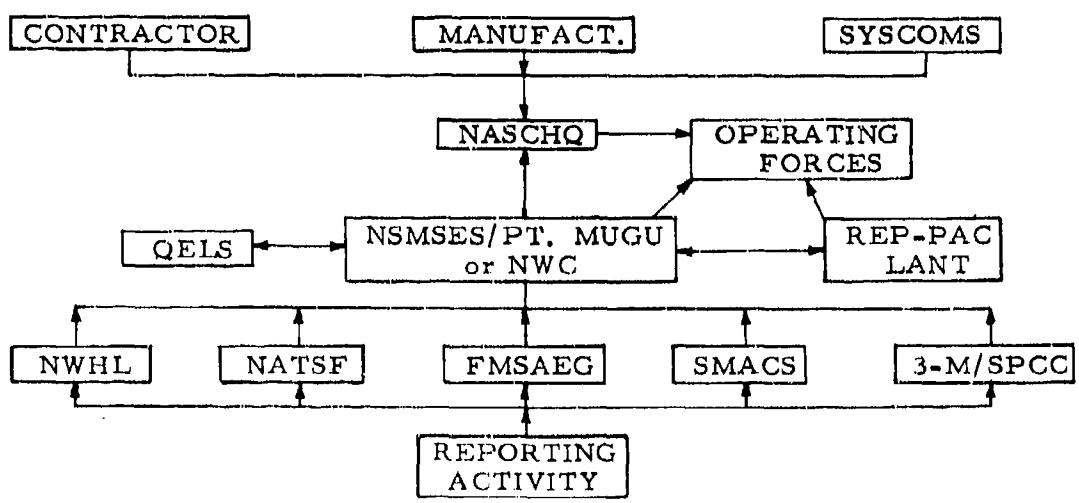
h. An overall surveillance program that is coordinated and meets its objectives.

i. NAVAIRSYSCOMHQ with information that has had all superfluous data deleted, and recommendations for action that would be factual in nature.

4. The in-service engineering activity should have responsibility and authority for maintaining the data package, providing engineering support and direction to participating field activities, reviewing and approving/rejecting class II changes, reviewing and recommending action on class I changes, and maintaining configuration control. The in-service engineering activity would also review all collected data (Material Maintenance Management Program (3-M), UR's, FMSAEG, Serialized Missile Accounting and Control System (SMACS)) and make recommendations, or take action, based on engineering analysis of the data.

This type of in-service engineering organization could be implemented at a minimum cost since the directives for the creation already exist (NAVAIR 4700.2 Inst. Naval Aircraft Maintenance Program Changes) and there are at least two field activities (NAVMISCEN, Point Mugu and NWC, China Lake) where this capability currently exists, which could assume the task with a minimal increase in manpower and funding.

An organizational illustration (below) depicts the major commands and their interface. This organization presently exists within the Command System and should be identified by directives and provisions made for funding.



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PUBLICATIONS

1. During the period 23-26 September 1968, a conference was held at the Naval Weapons Center, China Lake, to review SIDEWINDER AIM-9D Weapon Systems Technical Manuals. Enclosure (1) of reference (e), (Tab J), contains the minutes of this conference. The committee has reviewed the above where applicable to the Fleet support activities area and, on the whole, concurs with the efforts, conclusions and recommendations of the conference. However, it should be noted that the committee definitely does not endorse the cancellation of the Quality Assurance Provisions (QAP).

2. The QEL organization at NWS Seal Beach includes a technical documentation group which is responsible for the initial preparation and continual up-dating of QAP's. QAP's are standardized inspection documents for use by Quality Assurance personnel at the NWS's, NAD's and other ordnance facilities during the processing of all Navy and Marine Corps ordnance except the Fleet Ballistic Missile. QAP's are available for all air-launched missiles and are up-dated whenever the need arises.

3. QAP's directly influence the maintenance of proper quality and reliability criteria for complex weapons through provision of standardized and realistic inspection requirements. They provide a continuous source of feedback data on the condition of ordnance received from contractors and on the effects of handling, storage, and shipboard environments. The results of inspections employing these documents are used by NAVAIRSYSCOM and its representatives (such as FMSAEG, QAO, NAVAIRSYSCOMREPLANT and NAVAIRSYSCOMREPAC) as the basis for withholding material from issue, changing test requirements, improving designs and processes, etc.

4. All existing air-launched weapon QAP's are identified as NAVORD publications and are not signed off by NAVAIRSYSCOM. It is recommended that future air-launched weapon QAP's be promulgated as joint NAVAIRSYSCOM/NAVORDSYSCOM publications and that NAVAIRSYSCOM establish a procedure for review and approval of preliminary drafts and revisions. Except for the above changes it is further recommended that the system now in effect for preparing and up-dating air-launched weapon QAP's be continued in its present form. Investigation by Task Team Two disclosed that this system is most efficient and that the QAP's do serve a real requirement.

5. Members of the committee associated with quality assurance and liaison performed by the committee with Fleet support personnel performing quality assurance work indicate that the QAP's are necessary and invaluable to assure the highest acceptable level of quality of missile components be provided to the Fleet.

TAB II-E

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6. Other publications, SOP's (Standard Operating Procedures), are being prepared as required by the NWS's and other air-launched missile processing activities. SOP's include engineered performance standards and material flow plans in addition to tool, equipment, manpower, facility and method requirements. These SOP's, which vary in procedural instructions depending on the originating NWS, are submitted to WPEC NAD Crane for approval. These SOP's constitute a valuable management tool and have a significant effect on the quality, reliability, and uniformity of air-launched weapons. It is, therefore, recommended that SOP's for air-launched weapons be reviewed and approved by NAVAIRSYSCOM rather than NAD Crane, thereby standardizing operating procedures at the Fleet support facilities. The QEL technical documentation group at NWS Seal Beach has informally proposed that it be designated to act for NAVAIRSYSCOM in this capacity. This assignment would be in line with other technical documentation responsibilities assigned to that group and could therefore be accomplished with minimum additional effort.

7. A similar conference was held at the Raytheon Company, Lowell, Mass., on 4 September 1968, during which time technical manuals for the SPARROW Weapon System were discussed. Much of this conference was centered around an involved integration and consolidation of some SPARROW manuals, and with the rewriting of all SPARROW manuals in accordance with Specification MIL-M-38784 and DOD 5220.22-M. Several manuals to be revised are concerned with the AIM-7C, AIM-7D and AIM-7E versions of the missile and with the AN/DPM-7, AN/DSM-14 and AN/DSM-32 Test Equipments.

8. As a result of NAVAIR findings and subsequent CNO action, directives have been issued to: (1) dispense with reworking the AIM-7C at the NARF and (2) AIM-7C expenditures in the Fleet squadrons are not to be counted against the squadron annual training allowance. In short, the AIM-7C will soon be removed from the inventory. The AIM-7D missiles are currently expended in Fleet training exercises and will be used only in lieu of the AIM-7E until such time as the AIM-7E is available in sufficient inventory quantities. Thus, the days of the AIM-7D are, also, numbered in the inventor.

9. As indicated in another section of this report, retention of the above SPARROW Test Sets is contingent on progress made with the All-Up-Round (AUR). In addition, support equipmen for these equipments will also, of course, become obsolete.

10. The team also questions the validity of combining Technical Manuals, Volume I, Theory of Operation, and Volume III, Schematic Diagrams for the AIM-7C, 7D and 7E SPARROW. It is recommended, however, that consideration be given to combining such manuals beginning with the AIM-7F.

[redacted]

11. In view of the above, Task Team Two is of the opinion that it is neither practical, necessary nor economically sound to direct efforts towards revision of the current family of AIM-7C, 7D and 7E SPARROW publications. Should it be concluded that publications should be prepared to meet Specification MIL-M-38784 and DOD 5220.22-M, it is the committee's recommendation that only new publications beginning with future missiles (such as the AIM-7F) and Test Sets (such as the AUR Test Set) be effected.

TEST EQUIPMENT

1. A limited correlation/compatibility study was initiated to determine the reliability and repeatability of the AN/DPM-7, AN/DPM-14, and AN/DSM-32 test equipment. Data obtained are pertinent to type of test set to be utilized aboard CVA's. In accordance with NAVAIR policy concerning testing criteria at the shipboard maintenance level, this review was confined to the AN/DPM-14 and AN/DSM-32.

2. The following comparative criteria were developed to determine the merits of each unit for shipboard testing requirements:

a. The AN/DSM-32 is presently installed on nine CVA's in commission for testing AIM-7D/E Guidance and Control sections. With the onset and partial acceptance of the so-called shipboard NO TEST program, attention to maintain, use and modify the AN/DSM-32 has decreased over the past two years. To assure operational availability, refurbishment (including incorporation of applicable SEC's, including AIM-7E-2 capability) will be required. Funds and lead time involved are unknown at this time. There are six AN/DPM-14 units currently available to NAVAIR which have test capabilities similar to the AN/DSM-32. Funds have been obligated to update the DPM-14 to include AIM-7E-2 capability, and modifications are currently being installed. A Navy contract has been awarded for the procurement of ten additional AN/DPM-14 units for the Marine Corps. These ten will have AIM-7E-2 capability installed when delivered.

b. Test Capability

(1) AN/DSM-32 - A support equipment change is required to provide AIM-7E-2 test capability. The contractor has not been requested to prepare an engineering change proposal. It is estimated the approximate cost for the basic kit would be $4000. This price does not include installation cost or updating to latest configuration (SEC's and EMC's).

(2) AN/DPM-14 - Will test AIM-7D/E. SEC 1389 is being incorporated in fleet units to reflect test capability for the AIM-7E-2. New production units will have this capability.

c. Test Parameters

(1) AN/DSM-32 - Provides a broader scope in test parameters, including testing of HOJ and Oil Time which are not incorporated in the AN/DPM-14. Other functions separately tested on this unit are indirectly tested on the AN/DPM-14. Table (1) provides a comparison chart of test parameters for the three basic SPARROW test sets.

(2) AN/DPM-14 - A review of FMSAEG test reports indicates that this tester will detect the major parameters of missile failure reported by fleet activities. A more comprehensive report will be available, however, upon the conclusion of the correlation/compatibility study.

d. Maintenance and Calibration

(1) AN/DSM-32 - Requires weekly and monthly testing performed by trained technicians. Organizational level operation and maintenance training only is available for missile department personnel. Periodic on-site alignment, repair, and calibration is being provided by field teams from the Naval Air Rework Facilities, Alameda and Norfolk.

(2) AN/DPM-14 - Portable, thereby facilitating repair and calibration on an exchange basis. Intermediate level maintenance could be assigned to the shipboard AIMD and performed in the appropriate electronics area. Under this concept operator training and skill level could be minimal for missile testing.

e. Installation

(1) AN/DSM-32 - Requires space allocation for fixed installation. Only two carriers not equipped with this unit. Two test sets required per CVA to preclude extended loss of capability due to unit failure.

(2) AN/DPM-14 - Fixed installation not required. Location of checkout area can be changed without a ship alteration.

f. A combination test installation was also reviewed: the electronics package of the AN/DPM-14 and the AN/DSM-32 test stand and hydraulic unit. The major advantage is a reduction in acquisition cost and procurement lead time as the AN/DPM-14 hydraulic units are long lead time items. The use of dual maintenance publications to support this combination is the prime disadvantage.

3. Recommendations

From a field maintenance, installation (excluding initial cost) and simplicity of operation standpoint, the AN/DPM-14 is the most desirable tester for shipboard utilization; however, insufficient data are available to establish its performance as adequate to the task of identifying valid GO missiles.

Information was not available to compare the performance of test sets to prediction of SPARROW kill rate other than through a look at test functions and high missile failure parameters. The AN/DSM-32 appears superior for minimum performance testing; however, an in-depth Tester Correlation Study is needed to validate comparative performance, dependability and reliability. It is recommended that the NAVMISCEN Pt. Mugu undertake this task.

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Table 1. Comparison of Test Parameters of the Sparrow Test Sets (Sheet 1 of 5)

AN/DSM-32	AN/DPM-14	Failure Percentage
1. Auto Tune	Auto Tune	62
2. Head & Hub Oil Time	No	3
3. Low Lock	No (Fixed Set)	6
4. Re-Lock	Re-Lock	1
5. Range Arm Fuze	Range Fuze	1
6. Wing Lock Time (ETD)	Wing Lock Time (ETD)	
7. English Bias	No	1.5
8. Integrator Drift	Accelerometer	2
9. Accelerometer Gain	Accelerometer	4
10. Roll Gyro Gain (C Alt)	Roll Gyro (C Alt)	1.5
11. High Lock	No	-
12. Head Drift	Radar Track (A Alt)	7
13. Autopilot Sen	Radar Track (A Alt)	4
14. HOJ	No	0.6
15. Craft Gyro Gain	Craft Gyro Gain	1
16. Head Stabilization	Systems	1.4
17. No Voltage Check	No Voltage Check	0
18. EPU Run Down Time	EPU Run Down Time	
19. Squib MEAS	Squib MEAS	0
20. Head Press Switch	No	

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Table 1. Comparison of Test Parameters of the Sparrow Test Sets (Sheet 2 of 5)

TESTING STATUS OF 654 SPARROWS

Type of Defects	Step Failed	Percentage
Auto Tune	1	62
Front & Rear locking sensitivity		
Head & Hub oil time	2	3
Low Lock	3	6
Re-Lock	4	1
Doppler fuze operation	5	1
Short Sweep	6	3
Electronic time delay	7	1
English bias	8	1.5
Integrator balance	9	2
Accelerometer gains	10	4
Roll gyro gains	11	1.5
High Lock	12	0
Head drift	13	7
Radar Gains	14	4
HOJ	15	0.6
Craft Gyro Gains	16	1
Head stabilization	17	1.4
Squib circuit measurement	18	0
No voltage check	19	0

Table 1. Comparison of Test Parameters of the Sparrow Test Sets (Sheet 3 of 5)

DPM-14, DPM-7, and DSM-32

DPM-7 NARF/NWS/NAS	DPM-14 AF/Marines/Navy	DSM-32 Navy/Shipboard
1. Auto Tune	Auto Tune	Auto Tune
2. Head & Hub Oil Time	NO	Head & Hub Oil Time
3. Lo Lock	NO (Systems)	Lolock
4. Relock	YES	Relock
5. Range Arm Fuze	Range Fuze	Range Arm Fuze
6. Short Sweep	NO	NO
7. Wing Lock Time (ETD)	Wing Lock Time (ETD)	Wing Lock Time (ETD)
8. English Bias	NO	English Bias
9. Initial Eng. Bias	NO	NO
10. Integrator Drift	Accelerometers	Integrator Drift
11. Accelerometer Gains (A-Alt)	Accelerometers (C-Alt)	Accelerometer Gains
12. Roll Gyro Gains (C-Alt)	Roll Gyro (C-Alt)	Roll Gyro
13. High Lock	NO	High Lock
14. Head Drift (A-Alt)	Radar Track (A-Alt)	Head Drift
15. Radar Gains (A-Alt)	Radar Track (A-Alt)	Autopilot Sens & Head Control Dynamics
16. HOJ	NO	HOJ
17. Craft Gyro Gain (C-Alt)	Craft Gyro Gain	Craft Gyro Gain
18. Head Stabilization	YES (In a Sense)	Head Stabilization
19. No Voltage Check	No Voltage Check	No Voltage Check
20. Squib Measurement	Squib Measurement	Squib Measurement
21. EPU Run Down Time	EPU Run Down Time (Air Force only)	EPU Run Down Time
22. Head Pressure Switch	NO	Head Pressure Switch

Table 1. Comparison of Test Parameters of the Sparrow Test Sets (Sheet 4 of 5)

OPERATIONAL CHECKOUT OF AIM-7E USING THE VARIOUS TEST SETS

Step No. AN/DPM-7	Test Name	Missile Functions or Circuits Tested	Comparable Test On: DSM-32	Comparable Test On: DPM-14
1.	Auto-Tune Front and Rear Locking Sens	Front and Rear Receivers, Klystron Local Oscillator and Speedgate	1.	1.
2.	Head and Hub Oil Time	Front Antenna and and Wing-Servo Hydraulics	3.	None
3.	Low Lock	Speedgate and Sweep Control Circuits	4.	None
4.	Re Lock	Speedgate and Sweep Control Circuits	5.	None
5.	Doppler Fuze Operation	Speedgate and Fractional Doppler Gate	2.	9.
6.	Short Sweep	Sweep Control Circuits	None	None
7.	Electronic Time Delay	Autopilot and Wing Servo Circuits	6.	3.
8.	English Bias	Autopilot Circuits	12.	None
9.	Integrator Balance	Autopilot Circuits	8.	7.
10.	Accelerometer Gains	Autopilot Circuits	9.	5.
11.	Roll Gyro Gains	Autopilot Circuits	7.	6.
12.	High Lock	Speedgate	13.	None
13.	Head Drift	Head Control Circuits	13.	7.
14.	Radar Gains	Autopilot Circuits and Guidance	14 & 15	7.
15.	HOJ	Wideband Tracking Loop	16.	None
16.	Craft Gyro Gains	Autopilot Circuits	10.	4.
17.	Head Stabilization	Head Control Circuits and Hydraulic Servo	11.	None

[redacted]

Table 1. Comparison of Test Parameters of the Sparrow Test Sets (Sheet 5 of 5)

SEEKER SECTIONS		DSM-32	DPM-14
Autotune		31/38	68/124
Head Drift/Radar Track		1/38	3/124 19/124 13/124
System Failure	Head Hard Over Wings Hard Over Wings Dead		9/24
Fuze Fire		1/38	6/124
Range Arm		1/38	
Autopilot Error		4/38	
Range Arm			5/124
Head Oil Time		1/38	

CONTROL SECTIONS	DSM-32	DPM-14
Autotune	30/36	
Roll	5/36	2/36
Acceleration	1/36	8/96 6/96
Int. Drift		
Craft		5/96
EPU		10/36
ETD		1/96

[redacted]

MAINTENANCE

1. Approximately 31% of the SPARROW G & C inventory in SEA is reported monthly as being non-RFI. The Mean Down Time (MDT) for rejected G & C units outside West Coast CONUS, as reported by FSMAEG, is 270 days.

2. To reduce the MDT and the number of missiles in the repair pipeline, it is recommended that a forward area repair facility be established to operate as a limited maintenance facility with capability to repair certain more frequently occurring failures and to eliminate the return of "false rejects" to the NARF. By locating this facility close to operational users, administrative and shipment costs to CONUS, the number of missiles currently in the Navy repair pipeline, and the process and repair time for missiles will be substantially reduced. In addition to the primary function of the site, informal on-the-job-training can be provided for Navy personnel in proper operating and troubleshooting procedures using the AN/DPM-7. This informal training can be accomplished without affecting normal Forward Area Intermediate Repair operation or staffing requirements.

3. Preliminary investigation has disclosed that certain excess Government assets, adaptable to use at this facility, are presently in storage in Raytheon warehouses awaiting Government disposition. Although this equipment will require modification and/or refurbishment, the lead time is much shorter than that for new equipment of similar capability.

4. The Contractor could assist the Navy in a program to establish a forward area repair facility with a capability to repair only those critical components of the AIM-7 Guidance and Control Section listed below and to eliminate the return of false rejects of the AIM-7 Guidance and Control Section to NARF. This facility could build up to a capability to receive one hundred eighty (180) missiles with an ultimate yield of one hundred (100) missiles per month.

5. The major items to be replaced at the forward area repair facility are as follows:

a. Klystron and associated parts; i.e., Klystron Motor, Coupler, and associated nominal resistors and capacitors.

b. Elements of the D. C. power supply, including transistors and associated nominal resistors and/or capacitors.

c. Electronic Time Delay Module.

d. Electric Power Unit - to be cycled back to factory for repair.

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e. Head Rate Gyro and heater assembly and associated nominals.

f. Accelerometers.

6. AIM-7E G & C Inventory (World Wide)

31 July 1968
3904 of which 1003 reported to be non-RFI.

31 August 1968
3927 of which 1183 reported to be non-RFI.

30 September 1968
3864 of which 1264 reported to be non-RFI.

MEAN DOWN TIME* FOR REJECTED SPARROW III TSG/FCG COMBINATIONS CY '67

	Total Rejects by Field Activities	MDT Prior to Receipt at NWS	Rejects Confirmed by NWS	MDT From NWS Thru O&R to NWS	Sections Received at NWS From O&R
East Coast					
Outside CONUS	58	203	40	93	26
Inside CONUS	64	29	51	136	31
West Coast					
Outside CONUS	697	108	596	162	218
Inside CONUS	15	106	10	273	6

*Mean Down Time (MDT) is reported in days.

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SEA G&C INVENTORY - AIM-7E

CVAs	JAN 68	FEB 68	MAR 68	APR 68	MAY 68	JUN 68
-43	162(22)	133(2)				
61	195(31)	193(58)	190(35)	168(23)		
63	224(12)	228(3)	228(5)	222(15)	222(15)	222(55)
65	246(6)	246(31)	246(31)	155	148(6)	148(6)
66					220	221
64						223
All AEs	251(15)	279(15)	195(7)	115	165	215
NM Subic Bay	215 (190)	145 (126)	323 (300)	508 (487)	365 (340)	526 (433)
H&MS-11&13	205(12)	198(26)	198(36)	167(37)	167(63)	231(70)
In Transit	51					
Total SEA (7E)	1549 (288)	1422 (261)	1380 (414)	1335 (562)	1287 (424)	1786 (564)

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QUALITY SURVEILLANCE

1. Quality Surveillance is generally assumed to include data from the NWS QEL, QA, NARF, ship and shore stations tests, and from squadron operational reports. This section of the report is concerned with the air-launched missile surveillance program as it is currently defined. NAVORDINST 4355.3 (CH-1 of 7/15/66) (formerly BUWEPSINST 4355.29 of 15 April 1966) promulgates a quality surveillance program for Navy guided missiles and provides basic guidelines of implementing quality surveillance programs on guided missile systems, missile subassemblies and ancillary equipment. The instruction is applicable to and assigns implementing responsibility for those Naval activities cognizant of missile storage, assembly, check-out, repair and operational use. Chart One is a visual presentation indicating possible NAVORDSYSCOM field activity participation in the air-to-air missile surveillance program.

Chart 1. Naval Weapons Field Activity Participation in Air-to-Air Guided Missile Quality Surveillance Programs

DESIGNATED ACTIVITY / PROGRAM AREA	FMSAEG	NAD Crane (QEL)	WPNSTA Concord (QEL)	WPNSTA Concord (GMSD & QA)	NAVORDSTA Indian Head	WPNSTA Seal Beach (QEL)	WPNSTA Seal Beach (AWD & QA)	NAD Oahu (QEL)	NMEF Yorktown (QEL)	WPNSTA Yorktown (FMSD & QA)
Missile Round	X			A			A			A
GC & A			X	A		O	A		O	A
Fuzes and Connecting Cables		X	O	A		O	A		O	A
Warheads		O	X	A		O	A		O	A
Propulsion and Gas Generators			O	A	X	O	A		O	A
Telepacs			O			O			X	

Legend: X, Coordinary Activity
O, Participating Activity
A, Assisting Activity

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2. Enclosure (1) of NAVORD letter ORD-004:WSK of 8 March 1967 provides a general plan for implementation of the air-launched guided missile round quality surveillance program. The program is to be administered by several Coordinating Activities that are responsible for major missile subassemblies and components and by one Missile Round Group (FMSAEG), which is to have overall responsibility. Each Coordinating Activity is to have central cognizance over operations of a portion of the program. Participating Activities peripheral to each Coordinating Activity may assist in performing special tests on components when such tests are within their capability and resources. The Participating Activities are to have the responsibility of making initial analyses and interpretations of data which each generates.

3. FMSAEG references (ad) and (ae) of Tab J are examples of promulgation of the coordinated efforts (under a single cover) of the above activities, depicting the missile round serviceable quality estimate utilizing all available data. However, it should be noted that promulgation of these reports has not been timely and efforts should be intensified to correct this deficiency.

4. Of special interest, however, is the fact that the above documents have been prepared under NAVORDSYSCOM instruction. To date, no official direction from NAVAIRSYSCOM has been promulgated either in support of or differing with the existing NAVORDSYSCOM requirements. This requirement from NAVAIRSYSCOM is urgently and immediately needed to assure that the missile round materials in storage and service use will have adequate quality and serviceability. It is, therefore, recommended that the Naval Air Systems Command provide instructions implementing a Quality Surveillance program for all air-launched missiles.

5. To ensure complete missile component surveillance, positive identification of each missile component must be maintained throughout its service life. NAVAIRSYSCOMHQ message R162323Z of Feb 1968 directed that data be collected on all air-launched missile components and that, following accumulation of 125 captive flights, the component be removed from service. COMNAVAIRPAC Note 8810 of 2 August 1968 promulgated the special provisions of the Air-Launched Guided Missile Weapon Systems Performance Data Reporting Program (established by BUWEPSINST 8810.2) for collection of these data in the Pacific Fleet. A sizeable amount of these data have been reviewed and processed at FMSAEG to date and special reports have been published for use in monitoring component captive flight history. Unfortunately, no similar direction to collect these data has yet been promulgated from COMNAVAIRLANT nor from Marine Corps activities. It is recommended that these directives be promulgated immediately to provide a complete component history of all air-launched missile components from all fleet users.

6. BUWEPSINST 08810.1 of 14 June 1963 was promulgated to provide information and guidance to the Fleet and Naval Weapons Shore Establishments and provides direction in matters of policy, planning and general operating procedures for support of air-launched missiles and, to some extent, associated supporting equipment. The instruction provides direction in the following areas of air-launched missile support:

a. Air-Launched Missile Issue Control and Coordination
b. Air-Launched Missile Facilities
c. Quality Surveillance and Stockpile Evaluation
d. Maintenance
e. Shipping Containers
f. Field Service
g. Alterations and Modification Policy
h. Repair Parts
i. Fleet Return of Material
j. Reports

7. Review of the above listed areas as it applies under the purview of Task Team Two (i.e. NWS, QEL, etc.) indicates that the instruction is in need of revision and re-issue by NAVAIRSYSCOMHQ due to changes in requirements or lack of direction since 1963 in some areas.

8. For example, Interim Air-Launched Missile Bulletin No. 54 (IALMB-54) was published in view of the fact that certain NAVAIRSYSCOM and NAVWEPS documents and BUWEPS 08810.1 were conflicting in directions to the Fleet relative to shipboard testing and inspection. Although IALMB-54 supersedes and resolves conflict in this singular area, other out-dated policies or problem areas resulting from conflicting documentation still remain unresolved.

9. In another aspect of the existing surveillance program, BUWEPSINST 08810.1 directs that the QEL shall:

> "Provide a monitoring service to determine the adequacy of the checkout and test program, both by a stringent recheck of rejected missiles as well as random and periodic sampling."

It is obviously the intent of the above that this stringent monitoring be applicable to both the SPARROW and SIDEWINDER missiles. However, it should be noted that at present, this monitoring is performed only in the case of SIDEWINDER. No investigative analyses are currently conducted on a routine basis of rejected SPARROW G and C sections. Current SPARROW analyses by the QEL consist solely of misfire diagnoses and diagnoses of G and C sections rejected during prosecution of NAVAIRSYSCOMHQ special project entitled the "Performance Evaluation Program" (PEP). Established in 1965, by authority of BUWEPSINST 8810.6 and, although very limited in scope, to monitor quality of the NARF rework process through a sampling of each NARF quarterly output, the failure diagnoses of rejected PEP missiles by QEL Concord have been extremely beneficial and invaluable in detecting missile rework differences and deficiencies. (For further details concerning prosecution of and sample results arising from the PEP program, refer to such FMSAEG reports as FMSAEG Technical Memorandum E-5-790). Enclosure (2) of BUWEPSINST 08810.1 does not require the "stringent re-test" at the QEL for rejected SPARROW sections as is required in enclosure (1) of BUWEPSINST 08810.1 for the SIDEWINDER.

10. In view of the above, it is obvious that quality assurance and surveillance procedures and practices for all air-to-air missiles require standardization. Promulgation of a revised version of BUWEPSINST 08810.1 reflecting the requirements of the real world today should result in an improvement in the overall quality, reliability and effectiveness of air-to-air missiles.

11. Perhaps two reasons for the apparent differences in the surveillance programs of the SPARROW and SIDEWINDER are due to the procurement policies and subsequent available assets of the separate missile components. The SPARROW missile G and C and its associated components (i.e. warhead, electronic firing switch, rocket motor, safety-arming device) are purchased on a one-for-one basis. That is, the same total number of components are purchased for each G and C procured. Thus any destructive surveillance or test of missile components result in unacceptable reduction in inventory. The SIDEWINDER GCG and associated components are not purchased on a one-for-one basis, thus the across-the-board 10% sampling of the SIDEWINDER stockpile can be supported. The result has been that surveillance data for SPARROW components has not been available from which determinations of component shelf-life, etc., can be made.

12. For example, NOS Indian Head (responsible for SPARROW Electrical Power Unit (EPU) Gas Generator surveillance) has, since 1966, been attempting to procure AIM-7E EPU Gas Generators for surveillance sampling. The EPU samples were not made available in view of the size of the inventory stock. Procurement of these samples was deemed imperative as results from a report, reference (af), published on surveillance of a Gas Generator identical to the SPARROW unit except for grain length and environment indicated that the service life for this propellant formulation was four years. Catastrophic failure in the form of low-order detonations, and critically reduced burning times were reported. Since AIM-7E EPU units over four years old are currently in the Fleet, it is obvious of the importance and need for surveillance testing.

13. As the above is typical of the difficulty encountered in procuring samples for surveillance in the SPARROW program and in view of these deficiencies, the entire program suffers. It is, therefore, recommended that

the following procurement requirements of AIM-7E/7E2 components be considered for adoption.

Nomenclature	Units Per
GC and A (including subassemblies) AIM-7E/7E2	1.01
Propulsion MK-38/52	1.20
Electronic Firing Switch MK-73	1.10
Safety-Arming Device MK-5/35	1.10
Warhead MK-38	1.03

14. The above procurement is deemed necessary since, if a surveillance program is to support a missile program, the surveillance program must first be supported and supplied with the required assets to perform the surveillance. These policies should also be considered in procurement of the AIM-7F and associated missile components.

15. Another effect of present day procurement policies is evidenced in CINCPACFLT (C) message 030728Z of February 1968. The message states, in part, that, "... contingency planning for deployment in the Sea of Japan has demonstrated that stocks of AIM-7E SPARROW missiles and AIM-9D SIDEWINDER missiles do not support the desired air-combat readiness posture in PACFLT." A factor contributing to this problem is that rocket motors rejected in SEA for minor discrepancies such as replacement of seals, repaint, etc., are being returned to CONUS for these minor repairs. It is logistically sound and practical that at least a minor motor repair facility be established at NAVMAG Subic Bay to reduce the number of motors in the SEA-CONUS-SEA repair pipeline. It is strongly recommended that the NAVMAG Subic Bay facility be expanded to include this minor motor repair capability.

16. A result of the quality surveillance program which should be investigated in the field of air-to-air missiles is that of removing from service any disposed of missile components, determined through the surveillance program to be unsuitable or ineffective for use. Such recommendations have been made in the past in some areas; however, extreme difficulty is encountered in obtaining approval to remove such units from the inventory.

17. For example, surveillance studies performed at NAD Crane indicate that the quality of MK-5-1 Safety-Arming Devices is marginal and total suspension has been recommended. The NAVAIRSYSCOMHQ has provided only limited concurrence and has suspended several production lots.

18. It is recommended that the air-launched missile surveillance program now in effect be augmented to the fullest extent possible to first, adequately determine the quality level of the stockpile and second, to ensure that quality is upgraded and maintained at the highest possible level.

19. A properly managed surveillance program is necessary to provide data for the improvement of maintenance, rework, improved design, and final disposition action for these missile components. The present program is not managed in a manner to provide data from which to determine realistic component shelf life or service life.

20. The Navy presently has an in-house capability to perform a complete surveillance program on all air-launched weapons. Under a qualified in-service engineering activity, the Navy can effectively provide data that will ensure that the fleet receives a high quality missile system. This program should be performed at an Air Systems Activity such as NWC or NAVMISCEN for all air-launched missile components.

21. Within a properly constituted in-service engineering facility, the program would include the complete missile system, i.e. airframe, guidance and control, warhead, target detective device, etc. All components of a missile system will be treated as an entity instead of, at present, fragmenting the missile surveillance program. To facilitate this program, an operational document must be issued that gives the in-service engineering facility the authority and direction to carry out its mission effectively.

22. Since the ground rules will be the same for all units, interface problems can be minimized. The activity assigned the management responsibility will function in three main areas of missile surveillance endeavors. The first is to provide a working, traceable, engineering foundation on which Quality Surveillance test specifications can be based. The second is to handle requests for problem solutions as they arise in any specific CNO, NAVAIRSYSCOM, Weapon Station or Fleet Operational Areas. The third is to initiate rework programs to upgrade the missile system and to provide missile component failure trends. The properly managed quality surveillance program should incorporate real world storage and operational environmental conditions. The present surveillance program takes a missile system and fragments its components at various NOS's and NAD's. Surveillance criteria are determined by each command and are usually quite different for each component. Attempts have been made by these commands to conduct surveillance under environmental conditions which approach the real world. However, the fact is that the real world environmental conditions have not been defined.

23. The major areas of missile component breakdown or induced hazard conditions due to the environment, are thermal, hygroscopic, dynamic corrosion, contamination and electromagnetic. Before we can even begin to provide

accurate missile surveillance we must determine the environment to which the missiles are subjected. Reference NWC TP 4464 Part 1, Part 2 and Part 3 which contain the environmental limitations in charts, technical limitations, and environmental frame of reference for the test engineer, designer, and project manager.

24. Environmental criteria are a major controlling factor in the design and missile service life determination of air-to-air missiles. The accepted criteria, as set forth in military specifications may be such that there are missiles that meet production test requirements, yet have failed undergoing strenuous fleet environmental conditions. It is important, then, that the actual environment of missiles be studied to substantiate existing specifications or to revise the limitations in accordance with the real world situation. Reference (s) Tab J lists types of environmental conditions that have been studied and indicates areas that should be studied.

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DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
304 Contact Fuze indicates critical condition with primer firing.	304 Fuze is not needed since 303 will fire on contact too. The Air Force has discontinued use of the 304 Contact Fuze. Recommend that NWC Corona make a study of this action to determine if the 303 Fuze is reliable enough in contact firing to discontinue the use of the MK-304.	NWC Corona
Organizational Level Shore-base Sparrow handling equipment is inadequate. Assembled missiles are presently transported on locally devised trailers and are loaded onto aircraft utilizing MK6 Bomb and Torpedo Trucks.	Procure suitable trailers to transport assembled missiles over unimproved roads for distances up to three miles. Procure suitable missile loading equipment to permit safe expeditious loading of Sparrow Missiles onto F4 Aircraft fuselage missile stations. Aero 42A loader is available and an investigation into this loaders status and applicability should be made.	NAVAIR-534
Consolidation of failure data on Sparrow III applicable to USN/AF/U.K. is lacking.	Have a procedure set up whereby all Sparrow III failures applicable to all users USN/AF/U.K. be reported to a common point for transition to NavAir. A quarterly computer listing is currently promulgated by FMSAEG listing total parts replaced at the NARF by part rumber for all AIM-7s overhauled and further segregated by NAVY and AF. The lists shall be further expanded to include Federal Stock Number (FSN) to increase the usefulness of these data to SPCC, NAVAIR and NARF Planning Organizations.	FMSAEG

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TEST EQUIPMENT DISCREPANCIES

DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
Test Equipment Procedures: Investigation has revealed an apparent need to up-date, standardize, and disseminate standard test procedures for the DPM-7, DSM-32, and DPM-14 Test Sets.	Form a Sparrow Missile Test Set Standardization Team composed of technically qualified people to compile and review all existing procedural deviations from applicable handbooks, HOIs, etc. It would be requested that all NARFs, NWSs and QELs send their current test procedures/test revisions in for review by the above team.	NAVAIR 4103
Calibration Procedures: Determine adequacy of Sparrow III Test Equipment, including Associated Measurements/Calibration documentation.	Reactivate committee concept established in 1965 for the purpose of making the above determination in order to recommend appropriate action needed to update present test equipment or recommend replacement, as required, including related documentation. Recommend coordinated effort of NAVAIRSYSCOMREPAC/LANT Metrology Divisions to implement above action. Assistance to be solicited from all activities concerned. Suggest first meeting to be called in Sep. '68. Discussion: AIM-7D/E test equipment review conducted by TEAM TWO at Raytheon Oxnard during 8-10 Oct. 1968. Recommendation concerning AN/DPM-7, AN/DPM-14, and AN/DPM-32 contained in basic report. In depth review of maintenance procedures and documentation was not attempted, however. Action: Recommend NAVMISCEN Point Mugu be assigned the task to coordinate a standardization team for an in depth review of Sparrow test equipment.	NASCREPLANT/PAC

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TAB II-1

DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
Test Procedures: Adequacy of Sparrow Test Equipment calibration documentation.	A calibration requirements summary to review test equipment, calibration cycles, calibration concepts, and procedures. Area of review to encompass Fleet and NARF test equipment. NAVAIRSYSCOMREPLANT will coordinate effort and forward results and recommendations to NAVAIR. AIR-4103.	NAVAIRSYS-COMREPLANT ASCR 3210
	Discussion/Action: Initial review conducted at Raytheon Oxnard during 7 Oct. 1968 covering ADMRL listing for AIM-7D/E, AERO-1A, AWG-10, and LAU-17. NATSF (ESAC) will develop and maintain calibration requirements data and provide periodic status reports. The Metrology Requirements List, NAVAIR 17-35-MTL-1 will be revised to reflect initial review data.	
	NATSF (ESA), NAVPLANTREP Pomona (MEC) NAVMISCEN Point Mugu and NAVAIRSYSCOMREPS will coordinate to ensure development of required calibration documentation.	

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DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
Degradation of Test Sets, DPM-7.	Immediately institute a total refurbishment program. These sets are now 12 years old and in desperate need of refurbishment. Follow this refurbishment program with a comprehensive correlation. Discussion: All AN/DPM-7s were standardized and updated with the contractor installation of SEC-54 issued in 1964 to provide test capability for AIM-7E-2 missiles. SEC-1390 will be made by contractor field team. This change also requires incorporation of all SECs issued since 1964. Upon installation and acceptance each test set will be redesignated AN/DPM-7A. Recommendations: a. Prior to contractor installation of SEC-1390 a NARF field team should calibrate and verify installation of all applicable AN/DPM-7 modifications/changes. Where required, necessary updating or sectional replacement will be accomplished by this team. b. NAVAIRSYSCOMREPS will maintain an inventory and status record for all missile test sets in their respective areas. c. All future SECs provide for change identification and Kit control by NAVAIRSYSCOMREPS.	NARF and NAVAIRSYS-COMREPLANT/PAC

DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
DPM-7 Calibration/Qualification: Metrology Publication and NAVWEPS 01-265GMAF-1 Sparrow handbook differ in calibration/qualification requirements. Does DPM-7 need "calibration", by whom, how often, who is certifying agent? Will "qualification" suffice as done at present by navy technicians? Does system performance check give adequate reliability?	Metrology publication requires updating. Recommend that procedures be promulgated for a periodic calibration by a certified calibration lab. NWS Yorktown feels that the present 30 day system performance check performed by NWS technicians is sufficient. Discussion: Calibration requirements for AN/DPM-7 reviewed during TEAM TWO test equipment meeting at Raytheon Oxnard 8-10 Oct. 1968 and amplified in basic report. Action: Periodic on-site calibration on a 6-month cycle of the entire AN/DPM-7 system is required. A specific procedure for calibration is under development for utilization by Navy Calibration Laboratories. NARF Alameda and Norfolk will provide calibration support pending issuance of procedure. Periodic calibration supplements 16-30DPM7-3 maintenance procedures. The Metrology Requirements List, NAVAIR 17-35MTL-1 will be revised by NATSF to reflect current documentation.	NAVAIRSYSCOM-REPLANT/PAC
Incompatibility of the DPM-7 and AIM-7E2. The DPM-7 tester is not compatible with AIM-7E-2 missile at present, due to ECP-54 not having been incorporated in the DPM-7s, located at NAS Cubic Point Missile Test Facility.	Recommend that ECP-54 be incorporated in DPM-7s immediately. Until above ECP is incorporated, recommend no further off-load of AIM-7E-2 missiles after 30 captive flights, since only valid tester is modified DPM-14 which is located aboard each ship which carries AIM-7E-2. Kit delivery started September 1968 with the initial kit delivered to NAVMAG Subic. Test set modification to be completed for all DPM-7s by December 1968.	NAVAIRSYS-COMAIR-4103

PERSONNEL/TRAINING DISCREPANCIES

DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
Naval Weapon Stations. With all-up missile delivery requirements the work load in missile processing will increase with no increase of manpower. BUPERS has made no changes to the manpower authorization to meet this increase in workload.	When all-up deliveries are required (Oct. '68 and Feb. '69), production of Sparrow and Sidewinder will be reduced merely because it takes more time to build an all-up-round than it takes to handle the G & C alone. A vertical project for air-launched weapons systems similar to the SMS project could protect NAVAIR'S interest in all phases of the systems from nuts and bolts to properly qualified personnel. NWSs will utilize military manpower exclusively for processing the all-up-round. It is recommended that a static civilian work force made up of Wage Board Employees be used at the NWSs to assist the military. This would provide cradle-to-grave continuity in the air-launch missile processing facilities.	NAVAIRSYSCOM-Long Range BUPERS-Short Range
Lack of qualified DPM-7/DSM-32 Maintenance personnel in Fleet, even after attending Maintenance Training schools.	NAMTRAGRU Memphis re-evaluate adequacy of present training courses and update as necessary. Request coordinate with NASCREPLANT/PAC. Fleet activities must screen personnel programmed for this maintenance training to ensure that the prerequisite of a good electronic background is had.	NAVAIR-4132-F
Sidewinder AIM-9D Test Set AN/DSM-78 Maintenance at NAVMAG Subic.	It is recommended that the nearest Calibration Laboratory be designated to maintain and calibrate the AN/DSM-78.	COMNAVAIRPAC/NAVAIRSYSCOMREPAC

DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
Carrier Missile Shops and NWS personnel are performing similar testing and handling functions. Assembly, test and maintenance of all sections, not just G & C sections. NAMTRADETS are not equipped to handle ordnance type items.	Arrange to have some system established whereby carriers prior to deployment would send AOs, AQs and non-rated ordnance personnel to the nearest NAMTRADET or similar training activity for team training in every phase of ordnance handling. This training should provide team training of the entire system from stockpile to target.	NAVAIR-4103/ Type Commanders
Inexperienced personnel stationed onboard AEs and AOEs as well as personnel attached to CVAs and squadrons, are not familiar with the acceptable substitution components that can be used to assemble complete missiles.	The addition of a page or section to OD 16135 which would identify the acceptable component substitutions for the AIM-7E, AIM-7E-2, and AIM-9D. The present format of noun name, mark and Mod, and NALC should be followed.	NAVAIRSYSCOMHQ SPCC

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CONTAINER DISCREPANCIES

DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
Shortage of G & C Shipping Containers. Container Status 1 Aug. 1968 CONUS 1,242 RFI 2,403 NON-RFI 1,365 IN USE 5,010 TOTAL Last USN procurement was in FY '63 and were of the "Vendolator" design. In FY '64 USN procured for USAF an improved container from Zero Mfg. Co. In 1966 USAF went to an all-up round type container and offered USN 2,550 of Zero type containers for free.	1. USN request USAF to expedite transfer of Zero type container to USN (approx. 2,500) and USAF excess Vendolator type containers (approx. 1,000). 2. SPCC provision the Zero type container. 3. Investigate the Zero type improvements and determine if these improvements can be retrofitted by the NWS to the Vendolator type container. 4. Investigate adequacy of present packaging and handling procedures for air-to-air missiles. Relative merits of "turnaround" vs. "throw away" containers should be reevaluated.	NAVAIR PMA-232-12
Continuing shortage of G & C containers precludes use for local delivery to NARF and carriers at NAS Alameda.	For over-the-road shipments from Concord (via truck) to Alameda, authorize use of wooden skids/pallets as presently used at Subic and on station Concord.	NAVAIR-4107

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DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
An inadequate program exists for the management and control of missile containers.	More effective management control must be given to expensive missile containers. At the present, an effective accounting system is not in existence. Problems are created by CVAs loading missiles at one station and off-loading at another, causing a distribution problem. This situation has created a problem when attempting to return unserviceable missile components to rework. Suggest an accounting system similar to, but separate from, the AMMD accounting system, for high cost/critical AMMD containers only. For instance, an (ALFA) character container code beginning with "C" and excluding "O" and "I" would allow accounting for 13,824 different containers. Action has been taken.	NAVAIRSYS-COM/SPCC
RFI Containers are not available at NAVMAG Subic for shipment of non-RFI G & Cs Conus for repair.	Authori. : using activities to utilize containers without all the latches. As an interim measure "Band" the coffin containers to ensure container integrity. Further direct SPCC to provide 100 containers per month to NAVMAG Subic. AIR 4103 immediately issue instructions, by message, to authorize the banding procedure.	NAVAIR 4103

UNCLASSIFIED [redacted]

DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
G & C Logbooks are presently put into a compartment in the container that does not provide adequate physical security for the logbooks. The compartment covers are easily removed and knocked off in shipment allowing the logbooks to fall out or be removed.	Logbooks should be taped to the G & C skin with masking tape or olive drab ordnance tape prior to being placed into the container. This will totally preclude loss or mutilation of logbooks. Action has been assigned to NAVAIRSYSCOM at the Sparrow Symposium #10 and is not complete.	NAVMISCEN
Wooden and Metal Type Motor Containers for Sparrow/Sidewinder and AIM-9D Wing Container. These containers are subjected to moisture intrusion from environmental conditions and present a quality control problem for forward support areas and fleet. High humidity causes corrosion of exposed metal surfaces.	It is recommended that motors be packaged in Marvelseal barrier bags and desiccated prior to being placed in wooden or metal containers. Drawings and specifications will have to be developed for inclusion in all handbooks and QAPs. Sufficient funding and command attention will ensure that a $40,000 missile is not delivered in packaging that was designed to save money and not the missile.	NAVAIR-4107

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DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
All-Up-Round Containers: Currently two USN activities are procuring the MK-12 Mod 2 AUR Container from two different contractors. Preproduction delivery is scheduled for 15 November 1968. Production delivery December 1968 Total buy: 1,440 containers.	Determine now if these containers are the same or will each require separate support. If support is determined to be separate, investigate the possibility of changing specifications to ensure that only one type container is provided by both manufacturers.	NAVAIRSYSCOM
Sparrow Warhead Container MK 244 Mod 0: Rain and moisture entering container damaging S & A device, firing switch and rusting warhead mating threads.	It is recommended that palletizing procedures utilized by NWSs and NAVMAGS be changed to require that a sheet of 1/4 inch exterior plywood be banded over the top of the warhead containers. This would reduce moisture intrusion in the forward areas to a minimum.	NAVAIR-4103

PUBLICATION DISCREPANCIES

DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
Handbooks: Classified handbooks, such as assembly and testing are not available to shipboard personnel on a permanent basis. In some instances, personnel who normally make use, or should make use, of these books are not aware of their existence, simply because they are classified and are kept in office safes.	Declassify handbooks that are required to perform normal missile assembly/disassembly, loading, storage, testing, etc. Further declassify handbook individual test stations; i.e., rework manual. It is understood that paragraphs, such as missile theory, must be eliminated so that the information is still available. It is recommended that all Sparrow publications be listed in the first portion of each handbook with a short title. NAVAIRSYSCOM has initiated the preparation of technical manuals that will declassify all air weapons handbooks.	NAVAIRSYSCOM
MK6 Motors have been reworked and are not being used by the Fleet due to lack of confidence.	Provide an ALMB superseding previous bulletins concerned with MK6-3 problem. Explain actions taken in rework, results of tests, and assure using activities that "RGX" motors are completely reliable for unrestricted Fleet use. AIR-4103 should direct NAVMISCEN Point Mugu to issue subject ALMB.	NAVAIR-4103
Wing/Fins: Authorization to stencil wings with the letters "E" or "D" is non-existent. NWS Concord presently stencils all wings for ease of identification in processing and Fleet use.	QAP 008 and NAVAIR pubs. should be changed to require the stencilling of wings with an "E" or "D". Official action has been taken by NAVAIRSYSCOM and NWS's are complying with the requirement.	NAVAIR-4103

DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
Standard Operating Procedures (SOPs) are not being prepared and used by all activities.	Needed are SOPs for segregation, test, inspection, handling and packaging for Sparrow and Sidewinder. Ensure complete distribution to all Sparrow and Sidewinder handling activities, including NAVMAG Subic/NAS Cubic Point.	NAVAIRSYSCOM NAVORDSYSCOM

MAINTENANCE DISCREPANCIES

DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
Excessive quantity of damaged MK38 Motor Fire Cables in that the connector which mates to the igniter often has broken pins and deformed threads.	Redesign the connector and cable. Subject connector has been redesigned by MDC and is currently being procured by NAVAIRSYSCOM on FY '69 missile procurements.	NAVAIR-5108A
NAVMISCEN submitted a proposed change recommending the elimination of the missile desiccant container. This item is a nuisance to the NARF's and if Mugu's analysis is correct, it should be eliminated. The validity of the purging requirement associated with the item is also questioned.	Expedite decision on proposed change within NAVAIRSYSCOM. (NAVAIRSYSCOM awaiting additional data from NAVMISCEN.)	NAVAIR-5108 NAVAIR-53322A
NARF Alameda has experienced a high failure rate on SRS Crystals for a long period of time. Suspect the Sparrow SRS is ineffective in the fleet. There is no test on this system except at the NARF's. Suspect stray radiation is damaging crystals.	NAVMISCEN expedite investigation of SRS failure rate. Request that the SRS be evaluated for need of more or improved tests to be made at NARF or field levels.	NAVAIR-53322A

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DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
ALMC-17 (Drip Loop Tie) is not adequate for long term solution (SPARROW).	Redesign to use a metal clip to hold cable rather than string. ECP-47 corrects this problem. ECP approval is expected November 1968 and will appear in production missiles approximately in December 1968. Retrofit will start at the NARF's six months after receipt of order for retrofit kits.	Raytheon Co. NAVAIR-4103
Replacement sections of SPARROW G & C units are not available at NAS Cubi Point missile test facility. This necessitates costly and time consuming return to CONUS of faulty G & C units, a large number of which could be adequately repaired locally. This would thereby shorten turn around time considerably.	Recommend spare radomes and target seeker sections be positioned at NAVMAG Subic/NAS Cubi in the following initial quantities: Radome - 20 Level Control Section - 50 Allowance Target Seeker Section - 50 Follow-up requisitions would adjust to usage experience. Spare radomes are currently available through the Navy supply system. The spare G & C units have not been procured by Navy and Navy currently has no plans for procuring spare units.	NAVAIRSYS-COMHQ SPCC COMNAVAIRPAC COMSERVPAC

[redacted]

DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
Fleet spares. Wings/Fins and spare parts not being returned to NWS with the G & Cs upon CVA offload.	Develop and issue an off-load check list to all concerned. Use of Liaison personnel from appropriate NWS to assist and verify CVA off-load. The above was previously proposed as action item #10 5th Sparrow Symposium. Continuing problem which can be partially solved by establishment of team training concept.	NAVAIR-4103
Present policy permits lot sampling of major Sparrow components. In view of present difficulties is 100% QA inspection required?	Recommend 100% QA inspection of all major components. Paragraph 1.6.1 of QAP 008 permits lot sampling subject to workload. Recommend that Par. 1.6.1 of QAP 008 be suspended and require a 100% QA inspection of all Air-to-Air missile components.	PMA-32 QAO-432 ORD-935
Test Equipment Standardization and Aging. Doubt exists that all DPM-7s are identical in wiring and that actual wiring is identical to the schematics.	Refurbish, update, and standardize all DPM-7s in conjunction with modification for 7E-2 test capability. Call in and re-issue vice on-site work is recommended. DPM-7 Test Sets are currently being programmed to be replaced by All-Up-Round (AUR) test sets in approximately one year. Those facilities not requiring DPM-7 units shall be furnished DPM-14 test sets modified for AIM-7E-2 capability. The feasibility of extensive refurbishment of the DPM-7 should be weighed against progress with the All-Up-Round concept.	NAVAIR-4103 REPLANT REPAC

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DESCRIPTION OF DISCREPANCY	INVESTIGATIVE COMMENTS	ACTIVITY RESPONSIBLE
Retest After Failure-Procedures. FMSAEG INST. 8800/2 and other documents allude to retest of Sparrow missile after DPM-7 failure prior to rework or test set adjustment; however, no specific procedures are defined, or established. Retest after failure policy is a result of false reject. Should missile be accepted if retest is go on second test set? Should missile be accepted if retest is go on original test set?	Define exact procedures for retest after failure. Something such as the following should be included in the present documentation to provide guidance to the NWSs for standardization of testing AIM-7s. A G & C which has failed test should, as a first step, be thoroughly checked out to ensure that it is correctly hooked up to the test set. As a second step, the G & C should then be tested on a second test set, if available. If the G & C fails on the second test set, it can be assumed that it is a No-Go G & C. However, if a G & C tests satisfactorily on the second test set, it should be retested on the first test set for the purposes of isolating whether the G & C or test set is malfunctioning.	NAVAIR-5108C

[redacted]

TAB II-J

REFERENCES

(a) BUWEPSINST (C) 08810.1 of 14 June 1963

(b) NAVORDINST 4355.3 (CH-1) of 15 July 1966

(c) BUWEPSINST 4355.29 of 15 April 1966

(d) NAVORD letter ORD-044:WSK of 8 March 1967

(e) NWC China Lake letter 5555/WJH:tt Ser. 4255 of 2 October 1968

(f) NPP Indian Head (C) letter QASN-2/FCK:sdm 8811/2 (C-14) Ser. 0540 of 11 August 1966

(g) NOS Indian Head letter TFS23/WSH 8811/2 of 30 August 1968

(h) NPP Indian Head letter QASN-2/FGK:sdm 8811/2 (C-14) of 18 February 1966

(i) NPP Indian Head letter QASN-2/FGK:sdm 8811/2 of 4 June 1966

(j) NOS Indian Head letter TFS23/WSH 8811/2 of 10 September 1968

(k) NMEF Yorktown letter QEA:DLW:jbk 8800 Ser. 1607 of 29 May 1968

(l) NWS Concord (C) letter 60430:JEG:wr 8815 Ser. 0163 of 12 July 1968

(m) NWS Concord (C) report QE/CO (SP III) 67-3 of March 1967

(n) CINCPACFLT (C) Msg R030728Z of February 1968

(o) NAVAIRINST 5400.38 of 26 June 1968

(p) NAVAIRNOTE (C) 013010 of 20 March 1968

(q) Institute for Defense Analyses Science and Technology Division, Research paper (C) P-369, "Environmental Temperature Specifications, Their Effects on Rocket Motor Cost and Performance (U)" December 1967

(r) NOTS China Lake TP 4254 "Environmental Criteria Determination for Pyrotechnics" of April 1967

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(s) NWC China Lake TP 4464 Part 1 and Part 2 "Environment of Criteria Determination for Air-Launched Technical Propulsion Systems" of July 1968

(t) NWC China Lake TP 4143 Part 1 thru 4 "Storage Temperature of Explosive Hazard Magazines" of May 1968

(u) NAVAIR (C) letter AIR-4107B:IK of 21 March 1968 "Sparrow III Explosive Components, Status of (U)"

(v) NAVAIR (C) letter AIR-4107B of 5 March 1968 "Sparrow III Explosive Components, Status of (U)"

(w) Quality Evaluation Laboratory Naval Weapons Station Concord, California Report (C) of June 1968 "Evaluation of AIM-7 (Sparrow III) Mi ile Components"

(x) NAD Crane letter QEWG-LEK:grs 8811/1 of 15 October 1968

(y) NOSC letter ORD-044:WSK of 8 July 1966

(z) NWS Concord (C) letter 60430:JEG:fe 8810 Ser. 092 of 19 April 1968

(aa) NWS Concord (C) letter 60430:JEG:wr 8810-0 Ser. 0291 of 28 September 1967

(ab) NWS Concord (C) letter 60430:DJB/RDR:do 8810 Ser. 0165 of 3 July 1968

(ac) NOS Indian Head letter TFS23/WSH 8811/2 of 25 July 1968

(ad) SIDEWINDER GUIDED MISSILE SURVEILLANCE REPORT DATA (Technical Memorandum E-5-716)

(ae) SPARROW III GUIDED MISSILE SURVEILLANCE REPORT (Technical Memorandum E-5-)

(af) Picatinny Arsenal Technical Memorandum 1647 "Surveillance Characteristics of EPU Hawk Fuel" July 1965

REPORT

OF THE

AIR-TO-AIR MISSILE SYSTEM

CAPABILITY REVIEW (U)

JULY–NOVEMBER 1968

APPENDIX III

APPENDIX III

NAVAL AIR SYSTEMS COMMAND

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APPENDIX III

REPORT OF TASK TEAM THREE

Chairman: CDR. B. H. Gilpin, USN, Naval Missile Center, Pt. Mugu

"Do shipboard and squadron organization (afloat and ashore) launch on optimally ready combat Aircraft-Missile System?"

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INTRODUCTION

A. The mission of Task Team Three was to determine if shipboard and squadron organizations (afloat and shore) launch an optimally ready combat aircraft-missile system. Problems reported during the air-to-air symposium were investigated and, during subsequent investigation, additional problems were revealed. This report contains recommended solutions or recommends additional investigation where insufficient information is available.

B. The major portion of the report and the majority of the reported problem areas pertain to the SPARROW missile system. While many of the problems equally affect the SIDEWINDER missile, the lower combat reliability of the F-4/SPARROW and its importance as a primary air-to-air weapon system accentuated the SPARROW problem areas.

C. The following considerations are highlighted in those sections of the report which follow:

1. The manning and performance of CVA missile shops and squadrons suffers from the overall Navy shortage of electronics maintenance personnel. Several problem areas such as inadequate training aids and lack of training equipment require immediate action. Because of SEA (Southeast Asia) operation the experience level in the CVA missile shops and squadrons is presently at the highest level since the introduction of guided missile systems. Training, however, is still largely a 'bootstrap' operation in many areas and a reduction in SEA operations will drastically increase the importance of a comprehensive, coordinated training program in maintaining the proficiency of Fleet enlisted personnel.

2. With the increasing complexity of weapon systems and the multitude of support equipments required to maintain them, the provision of suitable operational and maintenance technical manuals is a major problem. New techniques in information collection and display must be adopted. The preparation of all weapon loading manuals and checklists at one central activity (NWEF) is significantly improving the quality of these documents.

3. An effective air-launched missile technical proficiency inspection for deploying CVA's and squadrons, patterned after the Nuclear TPI, would provide a significant increase in missile system readiness and is considered to be one of the more important recommendations of this report. Implicit in the inspection function is the necessity for follow-up and continuing technical support in the forward area to ensure that deficiencies are, in fact, corrected and that desired performance levels, once attained, are maintained.

4. The attention focused on test philosophy for air-launched missiles, particularly the SPARROW, is attributed to the lack of user's confidence in the overall weapon system reliability. In actuality, varying the test frequencies, or changing the test equipment for missile guidance section testing, has had little effect on the overall system reliability. Reliability improvements are required, however, and must be attacked through better quality control and maintenance and surveillance procedures.

5. Safety requirements for air-to-air missiles aboard CVA's are confusing and contradictory and are in conflict with operational requirements. A thorough study of air-to-air weapons systems safety parameters and requirements must be undertaken, and overall coordination of safety instructions must be improved.

6. There are numerous minor SPARROW logistic problems which should be corrected. The F-8/AIM-9C SIDEWINDER system is not receiving logistic support. The required support should be provided, or the decision should be made to cancel the AIM-9C program.

7. Increased emphasis is required on the development, procurement, and support of adequate shipboard support equipment. The existing problems are attributed to fund limitations and to the lack of overall direction and management.

8. Changes in Navy and Marine Corps policy vis a vis air-to-air weapons system maintenance and employment are required. Of major importance is an increased emphasis on maintainability and reliability problems in the Fleet, with less emphasis, or even a moratorium, on performance improvements.

INDEX

I. TRAINING/PERSONNEL

Training and personnel problems involve personnel allowances, the availability of training aids, up-to-date equipment, types of training available, and basic training methodology.

A. Manning of CVA Missile Shops

Discussion and Conclusion

At present there are not enough qualified individuals staffing G/M (Guided Missile) Shops aboard CVA's.

Recommendation

The following minimum personnel allowances be authorized for CVA Air-Launched G/M Shops:

1 - AQC or ATC with NEC-7916
1 - AQ-1 NEC-7916
1 - AQF-2 NEC-7916
3 - AO1
5 - AO2
11 - AO3
20 - AOAN
42 - Total

B. Non-Flying Ordnance Officers for VF Squadrons

Conclusion

An ordnance ground officer should be assigned to both F4 and F8 squadrons to provide the important focus of attention to all of the weapons functions and, in particular, to air-to-air missile capability.

Recommendation

BUPERS assign an ordnance ground officer to all fighter squadrons.

C. Training Aids and Equipment at NAMTRADETS

Discussion

The NAMTRADET courses in missile assembly, handling and checkout utilize borrowed missile sections when available. In some instances the components are not of current configuration. Components, such as inert motors, have been manufactured by the contractors for Air Force classroom training;

however, the NAMTRADETS are forced to use expended motor cases acquired from NAVMISCEN. Support equipments in use at the NAMTRADETS do not have the latest changes such as that required to test the AIM-7E2.

Conclusion

The training aids and equipments used by the NAMTRADETS in missile training should be of the latest configurations, designed specifically for training use where necessary, and should be procured in adequate numbers. None of these conditions presently exists.

Recommendations

1. The equipment shown in Tab A should be supplied to all NAMTRADETS providing instruction in SPARROW and SIDEWINDER missile systems. This is considered to be the minimum equipment requirements to sustain SPARROW and SIDEWINDER training.

2. NAVAIRSYSCOM (AIR-534) ensure that NAMTRAGRU receives SSE Change Kits prior to their fleet introduction.

3. NAVAIRSYSCOM (AIR-413) provide for training for a minimum of four (4) NAMTRAGRU instructors on all proposed changes to SSE.

D. AIM-7E2 Maintenance Training Film

Discussion

Initial maintenance training for AIM-7E2 will be conducted by Raytheon Company as a part of the contract defined by NAVAIRSYSCOM. This training will start in December 1968. Additional requirements for updating missile assembly crews and missile loading crews exist from a shipboard environment standpoint.

Conclusion

An updated AIM-7E2 SPARROW maintenance training film should be produced, stressing missile assembly, handling, loading and identification of the AIM-7E2 as associated with shipboard missile shops, shipboard handling and loading procedures.

Recommendations

1. The AIM-7E2 SPARROW maintenance training film be produced by Raytheon Company without cost to the Navy. This film will be reviewed by Westinghouse Company, McDonnell Aircraft Company, Naval Missile Center, and Naval Air Systems Command prior to release to fleet squadrons. This training film should be completed as soon as possible and distribution to all fleet squadrons be controlled by Chief of Naval Operations (OP-563).

2. CNO and NAVAIRSYSCOM review requirements for a similar film on SIDEWINDER and direct NAVMISCEN to produce.

E. Device 5F8 SPARROW/SIDEWINDER/F4J AWG-10 Sound/Slide Programs

Conclusion

The 5F8 sound/slide programs for the SPARROW/SIDEWINDER and F4J AWG-10 are extremely valuable in the training of aircrews and maintenance personnel in Naval Aviation Maintenance Training Detachments (NAMTD), Carrier Readiness Attack Wing Squadrons (RCVW's) and Fleet Squadrons.

Recommendation

There is a need to publish a matrix for current and projected 5F8 programs for the SPARROW, SIDEWINDER and F4J AWG-10. Additionally, these sound/slide tapes must be reviewed, revised and updated prior to introducing new missile/weapons systems or modifications thereof in fleet squadrons. These sound/slide tapes should complement and be coordinated with programmed instruction/publications.

F. Visual Training Aids (Dilbert Type Posters)

Conclusion

The posters, or visual training aids, will provide a humorist approach to the problem associated with missile handling, missile buildup, missile loading, and aircrew procedures. The importance of the problem areas will become uppermost to the maintenance crews and aircrews.

Recommendation

The "Dilbert Type" posters should depict problem areas in the Missile/ Weapons System that can be controlled by training or increased knowledge of the system. A series of posters, approximately twenty, to be developed using a common characterization of a Navy man doing all the wrong things to the Missile/Weapons System.

A proposal will be submitted by Raytheon Company in November 1968 for the series of posters. Raytheon will provide the art work associated with this training at no cost to the Navy. An alternate proposal will include printing and distribution. Navy distribution will be controlled by Naval Safety Center (Code 70), and the Chief of Naval Operations (Op-562).

G. Programmed Instruction for F4/SPARROW Weapons System

Conclusion

Technical publications are difficult to read and comprehend the information that is presented. Missile publications and weapons systems publications both fall into this category. A series of Manuals that are easily read, understood, and contain systematic examinations for maintenance personnel and aircrews are required during deployments to refresh and instruct personnel in ready rooms and missile spaces without formal classroom instruction.

Recommendation

Programmed instruction manuals should be provided in three areas:

1. Missile Assembly and Testing
2. Missile Handling and Loading
3. Aircrew Procedures

The manuals should be produced in sufficient quantity to insure adequate distribution to operating units, NAVWEPSTAs, and aircraft carriers. A proposal by Raytheon Company will be submitted in November 1968 for the three areas indicated. The distribution of the programmed instruction manuals should be controlled by the Chief of Naval Operations (Op-562).

H. Location of AIM-7 Missile Test Equipment Schools

Discussion

Relocation of the DSM-32/DPM-7 Schools and associated equipments from Jacksonville, Florida to Oceana, Virginia, is necessary to provide better and closer liaison with AIRLANT squadrons and CVA's.

Conclusion

AIM-7 missile test equipments for training are not presently located for best utilization.

Recommendation

NAMTRAGRU move East Coast AIM-7 training assets from NAS, Jacksonville to NAS Oceana as soon as possible.

I. Training of Missile Loading Personnel

Discussion

Poor training and non-standardization of missile loading teams results in excessive missile damage during aircraft rearming. In addition, the lack of training is a significant factor in causing the high misfire rate during combat firings. Presently, there is no mandatory requirement for formal schools, on-the-job training, proficiency inspections, or standards for VF squadron aircrews and missile loading crews. Additionally, there is no missile loading crew concept established in VF squadrons today which clearly defines individuals responsible for air-to-air missile handling loading.

Conclusion

Training and qualification of missile loading teams results in missile damage and misfires. An adequate training and certification program is urgently required.

Recommendations

1. Implement standardized air-to-air missile loading crew training, procedures, and inspections, based on lessons learned in nuclear weapons programs.

2. Type Commanders issue implementing instructions as required by OPNAVINST 3571.3.

3. The Fighter Weapons School in the RCVW's, assisted by VX-4 and NAVMISCEN, ensure that missile loading and unit inspection criteria are complete, valid, and up-to-date.

4. Establish an air-to-air missile loading team course in the RCVW at NAS Oceana and NAS Miramar.

5. Establish missile loading crews in each VF squadron, consisting of 6-9 enlisted, with missile loading designated as a primary responsibility.

J. Schools for Guided Missile and Squadron Ordnance Officers

Discussion

1. Existing schools for CVA Guided Missile Officers and squadron ordnance officers are not adequate. Schools presently provided for G/M personnel consist of test equipment operation and maintenance, and shipboard handling and missile assembly. A summary course designed specifically for G/M officers and squadron ordnance officers is required, encompassing the theory of operation, test equipment, Fleet problems, publications and reporting requirements.

2. There is a lack of supervisors trained in the handling and assembly of the SPARROW missile.

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Conclusion

A school in missile systems is required, tailored to the specific requirements of G/M officers and squadron ordnance officers.

Recommendations

1. Establish a one-week course for squadron ordnance officers and a two-week course for CVA G/M officers at NAVMISCEN or at NAMTRADET's at NAS Oceana and NAS Miramar.

2. COMNAVAIRLANT and COMNAVAIRPAC ensure that a minimum of two missile shop supervisors from each CVA have attended the AIM-7 missile handling and assembly course taught by NAMTRADET's.

K. Enlisted Training Plan

Discussion

Adequate numbers of supervisory personnel (CPO/1st/2nd) are not available to meet allowances in critical rates of fighter squadrons and CVA's due to low U. S. Navy reenlistment rates. "A" schools (AO/AQ/AT/AE) are presently operating at 100 percent of capacity, yet annual fleet student graduate requirements are still in excess of "A" school capability. Non-rated personnel (without "A" school) are being assigned to augment these squadron/ship shortages of supervisory personnel.

A review was conducted at the Aviation Ordnance "A" School, NATTC, Jacksonville, Florida, of the syllabus, NAMTRADET specialized training, and BUPERS/USMC procedures for ordering enlisted personnel to CVA's and squadrons. The present AO "A" school capacity is 1500 USN and 500 USMC graduates per year based on a syllabus of 17.6 weeks. The current annual fleet requirements are 2279 for the U. S. Navy and approximately 700 for the U. S. Marine Corps. Based on the present AO "A" school syllabus, this means that there will be a shortage of 779 USN and approximately 200 USMC "A" school graduates during FY 69 due to lack of MILCON and instructor personnel. Additional barracks and mess halls would be required to increase AO "A" school capacity. The review revealed that the present AO "A" school syllabus could reasonably be compressed from 17.6 weeks to 12.5 weeks. Further, weekly student inputs can be increased from 40 (30 USN and 10 USMC) students per week to 60 (46 USN and 14 USMC) students per week with no increase in facilities (MILCON) or instructors. This would result in an annual input of 2300 USN and 700 USMC students in AO "A" school. The 12.5 week syllabus involves streamlining to eliminate unnecessary information that would be specialized later in the NAMTRADET syllabus, according to the ultimate duty station of the individual. An example of the present and recommended flow is as shown in Tabs C-1 and C-2.

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Conclusions

1. An increase in AO "A" school output, coupled with revised syllabi, would permit the U. S. Navy and U. S. Marine Corps to meet current annual requirements with additional, better qualified personnel. Further it will provide standardized entry level personnel for the ordnance rating system.

2. Additional studies of AQ/AT/AE "A" schools are required to determine if the respective syllabi can be streamlined to eliminate information to be covered by specialized training later in the NAMTRADETS, thereby increasing school capacity and improving quality of graduates to CVA's and squadrons.

Recommendations

1. CNO, BUPERS, and CNATECHTRA examine the first term enlistment training program to emphasize: training vice education, earlier contact with hands-on-hardware training, earlier contact with current fleet equipment and procedures, and increased utility of the first term enlistee.

2. CNATECHTRA examine "A" school syllabi for AO's, AE's, AT's and AQ's, coupled with follow-on specialized training in the NAMTRADETS and the RCVN's with the objective of providing functionally qualified personnel in the numbers required by the Fleets.

3. Examine BUPERS/EPDOPAC detailing procedures to ensure that personnel trained in air-to-air missilery are initially detailed and retained in that job capacity throughout their first enlistment.

4. Institute a 12.5 week streamlined AO "A" syllabus as soon as possible with a concomitant increased student input of 60 per week.

5. Establish shipboard air missile assembly and handling courses at NAMTRADETS Oceana and Miramar. These courses would be phased to include all air launched missiles as they are introduced into the fleet. The initial courses should cover SPARROW and SIDEWINDER, as well as the present air-to-surface missile family.

6. Establish shipboard conventional ordnance handling and assembly courses for AO-3 and below at the present Air-Launched Weapons NAMTRADETS.

7. Establish organizational level missile and bomb handling courses at the existing Weapons System NAMTRADETS. These courses should be specialized to meet squadron needs by type aircraft (F4, F8, A4, A6, A7). These courses should be in addition to the present weapons system maintenance courses.

8. Establish On-the-Job Training in the RCVW's to provide loading team training for each type of Fleet aircraft.

II. PUBLICATIONS/REPORTING

There are several problems in publications and reporting procedures which directly affect CVA operation.

A. Aircraft/MCS Maintenance Publications

Discussion

1. Maintenance publications have not changed appreciably in the past few years and have been generally unsatisfactory. With the advent of more complex weapons systems, the problem of maintaining current publications places an unnecessary burden on maintenance activities.

The operational effectiveness of air-to-air missile systems is being adversely affected by relatively low manpower productivity, especially in the maintenance area. In fact, there is some evidence indicating that the manpower productivity of maintenance personnel has been decreasing over the years at the same time that the complexity and inherent capability of the weapon systems has been increasing. The acuteness of the problem of ineffective manpower productivity will continue to increase unless some drastic changes are made in the very near future.

2. Analysis of aircraft maintenance statistics has revealed that an abnormal amount of time is being spent in information research and troubleshooting, particularly in the unscheduled maintenance area. Handbooks, the present form of data available, have become increasingly cumbersome as the complexity of the associated aircraft and systems increase.

3. One new concept in maintenance information, designed to reduce maintenance manhours, has been developed by the McDonnell Douglas Corporation. The system, called WSMAC (Weapon System Maintenance Action Center) was originally created for the Phantom II aircraft produced in St. Louis, Missouri for the United States Navy and Air Force. Using a microfilm storage system and a retrieval unit built by Eastman Kodak Company and utilizing their commercially proven MIRACODE system, WSMAC provides access to any and all technical data by button selection. Codes, compatible with work unit codes for maintenance accounting, set into the keyboard, allow retrieval in seconds of any request. Operation of the unit is simple and requires no specially trained operator.

4. McDonnell-Douglas reports that the WSMAC system in use at their plant has saved thousands of dollars in aircraft maintenance search time alone.

5. Other approaches to improve manpower productivity are available. Project PIMO (Presentation of Information for Maintenance and Operation) developed by Serendipity Incorporated for the USAF C-141 system is a good example. A proposal to develop maintenance job guides for the AN/AWG-10 Missile Control System for the F-4J aircraft has been submitted to NAVAIRSYSCOMHQ in October 1968 by Serendipity Incorporated, Chatsworth, California.

Conclusion

System maintenance publications are voluminous, difficult to use and understand, difficult to maintain current and consume many man-hours to revise and maintain. Concepts such as WSMAC and PIMO offer potential solutions to these publications problems.

Recommendations

1. Extend contractor support to the VF92 WSMAC evaluation to include the first 90 days of the WESTPAC deployment.

2. NAVAIRSYSCOMHQ assign a high priority to explore all avenues of presenting maintenance information that will result in a dramatic improvement in manpower productivity.

3. NAVAIRSYSCOM use the AN/AWG-10 Missile Control System as a test system to evaluate methods of improving the presentation of information for maintenance and operations. Review the proposal submitted by Serendipity Incorporated to develop maintenance job guides, expanding as necessary to include a coordinated evaluation of WSMAC, PIMO, RAPID, and other proposals/concepts for the presentation of technical information.

B. Missile Publications for Operations and Maintenance

Discussion

1. During September 1968 publication review conferences were conducted to review and correct deficiencies in the technical manuals for both SPARROW and SIDEWINDER. Brief summaries of the conferences are as follows:

SPARROW - Discrepancies between manuals due to duplication of information and different revision dates will be eliminated by consolidation of manuals where possible. Information contained in various OP's and NAVORD publications will be consolidated in NAVAIR manuals. All pertinent technical manuals will be declassified where possible. The contractor will provide an AIM-7 SPARROW missile Technical Manual Guide (TMG) listing all technical manuals. The TMG will be revised every 90 days. Tactical/NATOPS manuals were not reviewed.

UNCLASSIFIED [redacted]

SIDEWINDER - ALL SIDEWINDER technical manuals were reviewed and action assigned for correction of deficiencies. Several problems reported consisted of manuals not being revised following initial distribution, specific requirements for Marine Corps operations and All-Up-Round concept not being reflected in the manuals, and data in conflict with official publications being published in unofficial bulletins released by various field activities. Review of Tactical/NATOPS manuals revealed that descriptive data and launch envelopes were not up-to-date in all manuals.

Recommendations

1. NAVAIRSYSCOM assure follow-up and correction of deficiencies reported by NWC letter Serial 4255 of 2 October 1968.

2. NAVAIRSYSCOM review status of Tactical/NATOPS manuals for SPARROW missile and expedite revision.

3. NAVAIRSYSCOM implement revision of technical manuals for SPARROW and SIDEWINDER.

C. Conventional Weapons Loading Manuals and Checklists

Discussion

1. There are numerous inadequacies and conflicts concerning airborne stores loading manuals and conventional weapons release and control checklists.

2. NAVAIRINST 5400.2 issued 27 July 1966 established a program to provide centralized verification of stores/aircraft combinations for operational compatibility at NWEF (Naval Weapons Evaluation Facility), Albuquerque, New Mexico. This instruction applies to all publications intended for general Fleet use that relate to combinations of stores (including nuclear weapons) and aircraft.

3. A review of recent aircraft accidents and incidents involved with the carriage and release of airborne stores has revealed that conflicts and inadequacies exist in current publications concerning airborne stores, their preparation, loading, carriage and release. The lack of proper instructions has resulted in various improvised Fleet procedures, some of which have been improper and unsafe. Additionally, related information was found to be scattered throughout various manuals.

4. NWEF currently prepares loading manuals, conversion manuals, release and control checklists and stores reliability cards for each aircraft/store combination as appropriate.

UNCLASSIFIED [redacted]

5. NWEF verifies procedures for loading, unloading, suspension checkout and release of airborne stores.

6. NWEF also prepares corrections to preliminary technical manuals submitted for verification and prepares advance changes to published documents when required.

7. Specific problem areas and recommendations that will enable NWEF to provide adequate, accurate and current publications are contained in the following paragraphs. If these problems are corrected the overall system effect will increase system reliability and safety.

a. Problem:

Acquiring accurate timely data for development of conventional weapons checklists by NWEF.

(1) Discussion:

It is extremely difficult for NWEF to acquire timely accurate source data for developing conventional weapons checklists. This problem is very apparent in the areas of new weapons, weapon improvement, aircraft modifications, SSE, and handling equipment.

(2) Recommendations:

(a) Include NWEF representatives as a part of BIS (Board of Inspection and Survey) Trials and OPEVALS (Operation Evaluations) at NAVMISCEN and NATC Patuxent River and provide administrative and technical support to these representatives in developing or modifying procedures to ensure that accurate checklists are available when new or updated aircraft are introduced into the Fleet. All BIS and OPEVALS should use proposed or existing Naval Weapon Evaluation Checklists to determine their adequacy.

(b) In the development of a new weapon or modification of an aircraft, Cognizant Field Activities/Participating Field Activities (CFA/PFA) and/or prime contractors provide NWEF with a data package containing recommended loading procedures, SSE (Special Support Equipment), and release and control systems checks.

(c) NWEF establish a technical records center containing source data for conventional weapons checklists. CFA/PFA or prime contractor provide updated source data to NWEF on existing systems and programmed systems.

b. Problem:

Difficulty in verifying conventional weapons checklists/manuals.

(1) Discussion:

Since verification normally involves the use of Fleet assets (aircraft, weapons, equipment, facilities and personnel) belonging to the using commands, it is difficult, time consuming, and requires numerous trips on the part of NWEF personnel in the verification of checklists - manuals.

(2) Recommendation:

CNO (Chief of Naval Operations) issue a directive to type commands to provide necessary Fleet configured, operationally ready assets, on a priority basis to NWEF, for checklist verification as required by NWEF.

c. Problem:

Lack of technical support and review of checklists by CFA, PFA, or prime contractor prior to verification.

(1) Discussion:

It is presently difficult and time consuming on the part of NWEF to acquire necessary accurate technical information and inprocess review of proposed checklist/manuals.

(2) Recommendation:

Naval Materiel Command direct NAVAIRSYSCOM and NAVORDSYSCOM (Naval Ordnance Systems Command) to provide timely technical support and inprocess review by CFA, PFA, and prime contractor on all conventional weapons checklists and manuals prior to verification by NWEF.

d. Problem:

Preparation of reproducible checklists and SRCs (Stores Reliability Cards) is time-consuming.

(1) Discussion:

At present tape-type machines using manual inputs are employed. Investigations are underway to determine the feasibility of using computers to store and reproduce data for revisions and changes to checklists and SRCs. Using computers would reduce the time required to produce changes and revisions considerably.

(2) Recommendation:

Fund NWEF for computer services to facilitate increased volume of changes and revisions.

8. NWEF has the responsibility to provide verification of stores/aircraft combination for operational compatibility. NWEF is continuing to develop and improve conventional weapons checklists/manuals. The main problems encountered by NWEF are lack of equipment, technical support, and to retain trained qualified personnel to write and verify checklists. At the present time there are four highly qualified officer personnel scheduled to depart NWEF by March 1968. This will require 6 months to a year to re-establish present expertise. The Ordnance Technical Publications Division is staffed by 8 Naval Officers, 8 enlisted personnel, and 8 civilian personnel with approval for 4 additional civilians who are responsible to write and keep updated over 600 conventional weapons loading manuals/checklists and SRCs. The Facility has a limited amount of assets which would enable checking and verification checklists on-site. This requires NWEF personnel to travel extensively to update existing procedures and develop new checklists/manuals.

Conclusion

NWEF has received limited support from CFAs, test and evaluation facilities, and Fleet units in form of UR's access to equipment, technical support and in-process review. If NWEF is to continue to provide adequate, timely and accurate procedures, steps should be taken to eliminate stated problem areas. One of the most important ways to attain reliability and safety is to provide adequate, workable, accurate and current checklists to operating Fleet units. This can be accomplished by NWEF, if adequate support, personnel, and assets are provided.

Recommendations

Immediate

(1) Direct CFAs, PFAs, and test and evaluation facilities to provide technical support and assets as required by NWEF.

Long Term

(2) Automate reproduction of checklists and SRCs by using computer devices.

(3) Allot a minimum of 600K dollars for a building program to increase existing facilities. Increase existing manning to adequately cover existing requirements as illustrated in TAB E.

D. Missile Malfunction Reporting

Discussion

1. There are presently 9 reports related to missile malfunctions. These reports are:

(a) Accident (Aircraft and Explosive Ordnance)

(b) Incident (Aircraft and Explosive Ordnance)

(c) Ordnance Malfunction (Major and Minor)

(d) Safety UR

(e) Special UR

(f) AAMREP

(g) AAMREP (Captive Flight)

(h) Guided Missile Service Record (GMSR)

(i) Individual Missile Logbook

2. The malfunction of an air-to-air missile requires that operating activity personnel select the appropriate report(s) to fit the situation. The report types, formats and instructions are listed in TAB D.

3. The 3M system has features which report malfunction and usage. Reports 6 through 9, above, tend toward adaptation to the 3M system.

4. The UR reporting system and the Ordnance Malfunction reporting requirements both contain provisions which apply to missile malfunctions not of the explosive ordnance nature.

5. The GMSR (Guided Missile Service Record) contains information which could be readily combined with other information.

6. The classification of the missile logbook complicates complete and accurate recording. No provisions are made to report malfunctions of missile test equipment.

Conclusions

1. The numerous reports, reporting formats and reporting instructions which deal with air-to-air missile malfunctions are both time-consuming and confusing to personnel in operating activities.

2. Technical information reports and malfunction reports should be consolidated to the maximum extent possible.

3. The 3M system offers a possible method to reduce the number of reports and to provide automatic reporting of usage and of some malfunctions.

4. Provisions must be made to include missile test equipment in the reliability reporting system.

Recommendations

1. NAVAIRSYSCOM revise NAVAIRINST 4700.2 to include UR reporting of air-to-air missile and missile test sets rather than Ordnance Malfunction reporting.

2. NAVAIRSYSCOM in conjunction with FMSAEG, FWSGLANT, NAVMISCEN review existing missile technical reports for use, necessity and consolidation.

3. Naval Materiel Command with NAVAIRSYSCOM, NAVORDSYSCOM, NAVSAFECEN, NAVMISCEN, NAVWEPCEN's and other cognizant agencies, review possible 3M inputs which would simplify and standardize ordnance malfunction incident/accident reporting.

E. Updating of Publications

Discussion

Fleet maintenance technicians are constantly faced with the problem of maintaining systems with out-of-date maintenance publications. Publications do not include most recent changes resulting from system modifications.

Conclusion

Fleet maintenance technicians must be provided with up-to-date technical information, either official or unofficial, that is compatible with their particular system's configuration.

Recommendations

1. In those cases where the contractor is unable to provide handbook data to NATSF in sufficient time to be included in manuals concurrent with Fleet delivery of equipment, require the contractor to provide preliminary unofficial data to the appropriate Fleet activities until official manual changes become available.

2. NAVAIRSYSCOMHQ ensure that the information contained in applicable Navy-generated changes and bulletins is forwarded to the responsible contractor for inclusion in the appropriate manuals.

3. In view of the large number of weapon system configurations and the impending configuration freeze, concentrate effort on developing a good set of handbooks for the freeze configuration in a timely manner.

4. Cover intermediate configurations by a series of difference data and deployment documents rather than complete handbook revisions.

III. INSPECTION/SUPPORT

Increased emphasis on inspection and support is required to ensure maximum readiness.

A. Pre-deployment Reviews/Inspections

Discussion

1. Weapon System Pre-deployment Reviews are currently being held for CVA's and squadrons. The effectiveness of these reviews is limited by lack of direction, military team leadership, timeliness, operational priority, standardization, documentation, technical scope, and follow-up. The arrival of an "Expert Team" at an operational activity already heavily burdened with maximum training and limited turnaround time meets with varying degrees of enthusiasm.

2. With strong authority and military team leadership, the technical talent and system knowhow of these "Expert Team" members can provide a tangible increase in system readiness. This should be accomplished in accordance with the following plan:

(a) Direction - The basic directive should be originated at the CNO (Chief of Naval Operations) level directing the type Commanders to follow a CNO approved Inspection Work Sheet Format (TABs F and G) for applicable airborne weapon systems to include associated fire control systems. Inspection formats to be submitted to CNO for approval from missile and fire control system CFA's (Cognizant Field Activities) via project desk at Air Systems Command.

(b) Military Team Leadership - The Type Commander should assign, as team leader, a staff officer, senior or equal in rank to the CVA Weapons Officer or squadron CO being inspected.

(c) Timeliness - Six months prior to deployment date, the inspection formats for each applicable system should be forwarded to the Commanding Officer of the activity to be inspected, the inspection to be conducted 60 to 90 days prior to deployment. This provides guidelines to the activity to be inspected, for assigning personnel to formal schooling, and for having test equipment calibrated and handling gear repaired. Sixty to 90 days allows some time to correct deficiencies noted during the inspection.

(d) Operational Priority - The inspection should be afforded highest priority and cooperation of the inspected activity.

(e) Standardization - A CNO approved inspection format to be used for weapon or fire control system.

(f) Documentation - A formal inspection report to be returned to the operating activity inspected by the type command as a follow-up to an on-site debrief.

(g) Technical Representation - The present team members from NAVMISCEN (including local NAVMISCEN NCTS), the CFA, and NASCREPLANT/PAC should be supplemented by NAESU CETS/NETS to cover applicable fire control systems.

(h) Follow-up - The Type Commander should enlist the aid of required support activities to correct any deficiencies noted during the inspection prior to deployment. In addition, a follow-up inspection using the same team and criteria should be conducted for the CVA and Squadrons at sea 60 to 120 days following deployment to determine the effectiveness of follow-up and to investigate additional problems encountered in operations.

Conclusions

Weapon System Pre-deployment Reviews currently being held for CVA's and deploying squadrons are not accomplishing desired results due to a lack of emphasis, direction, and follow-up. A CNO directive is required to assign the responsibility for a more formal review to the Type Command, using technical personnel from support activities.

Recommendations

1. CNO promulgate a directive requiring Type Commanders to conduct an ALMTPI (air-launched missile technical proficiency inspection) for all deploying CVA's and squadrons with recommended inspection formats, similar to TABS F and G.

2. Type Commanders follow-up on ALMTPI's by on-site reviews in each CVA 60-120 days following deployment to the Sixth or Seventh Fleets.

B. Technical Assistance

Discussion

1. There is some confusion among operating activities with regard to procedures for obtaining technical assistance on the air-launched missile system.

2. The NAVMISCEN provides the technical assistance and training on all air-launched weapons to using activities by the assignment of NCTS's (Navy Civilian Technical Specialists) to the operating commands. The NCTS's or technical representatives are under the operational control of the Fleet as advisors and instructors in the operation and maintenance of the air-launched weapon systems. This function for the AERO 1A and AN/AWG-10 is provided by NAESU (Naval Aviation Engineering Service Unit). The procedure for obtaining these services is contained in NAVAIRINST 4350.2 and the coordination of the services is the responsibility of the Engineering Technical Services Officer on the TYCOM Staff. The overall management structure and procedures are not adequately described in existing instructions.

Conclusion

Engineering Technical Services for air-launched weapons are being provided; however, governing instructions do not adequately describe the procedures for the operating activities to acquire and utilize these services.

Recommendation

NAVAIRSYSCOM revise NAVAIRINST 4350.2.

C. Augmented Maintenance Support

Discussion

Weapon system planning, insofar as maintenance personnel, support equipment, maintainability requirements, and other such factors are concerned, has not anticipated the tempo of operations that is now being experienced in SEA. For this reason, the existing organizational maintenance capabilities of on-line CVA's require augmentation. Facilities and personnel are available at NAS Cubi Point, which could be used for this purpose.

Conclusion

Due to the sustained tempo of operations in SEA, and a shortage of trained organizational level maintenance personnel, the proper maintenance of weapons systems aboard on-line CVA's is extremely difficult to achieve.

The practicability of augmenting NAS Cubi Pt. in order to provide for AMCS "peaking" services for VF squadrons while CVA's are in port at SUBIC Bay should be specifically investigated.

Recommendations

1. Immediate

It is recommended that CNO form a team composed of representatives from Commander, Naval Air Force Pacific; Commander, Naval Air Force Atlantic; the Naval Air Systems Command; Commander, Fleet Air Western Pacific; Naval Air Systems Command Representative Atlantic; Naval Air Systems Command Representative Pacific; and the Naval Missile Center to determine how best to utilize existing facilities and personnel at NAS Cubi Point to augment shipboard weapons system maintenance.

2. Long Term

Weapon system planning and logistics planning documents should incorporate plans for augmenting the logistical and maintenance support of weapon systems in the event of operational employment of the weapon system at levels significantly above initial plans.

IV. MAINTENANCE AND TEST PHILOSOPHY

INTRODUCTION

Maintenance and testing problems requiring design changes are covered in Appendix IV. The problems included in this section, therefore, describe the management and philosophy of maintenance and testing.

A. Shipboard Missile Test Equipment

Discussion

Missile test equipment aboard CVA's is presently calibrated and maintained by the missile shop. Shortage of qualified AQ's/AT's precludes adequate maintenance with resulting false rejects and poor availability of equipment. Adoption of the portable DPM-14 missile test for SPARROW would decrease the maintenance requirements in that the test set can be periodically offloaded to the calibration laboratories as presently done with the other missile test sets.

Conclusion

Provided its performance can be validated by a Tester Correlation Study, adoption of the DPM-14 as the standard shipboard test equipment will alleviate existing maintenance problems with SPARROW test equipment.

However, this will not change the requirement for qualified electronics personnel.

Recommendation

Staff the CVA Guided Missile Division with sufficient AQ's/AT's properly trained to perform assigned maintenance responsibilities.

B. Air-Launched Missile Maintenance Procedures

Discussion

1. The organizational, intermediate and depot level maintenance procedures for air-launched missiles have never adequately been defined or delineated. There is confusion in Fleet activities concerning maintenance policies and procedures for air-launched missiles.

2. NAVAIRINST 08810.1 defines the maintenance for air-launched missiles. The purpose of this document is to provide guidance and information to using activities in the processing and maintenance of the air-launched missiles. This instruction was last published in 1958. NAVMISCEN was requested to coordinate the revision of this instruction to incorporate the newer weapon systems and update the technical information. This revision was completed in 1964. Since that time, it has been reviewed, revised, modified and rewritten by various command levels and is presently under review by NAVAIRSYSCOM. The vital information contained in this instruction includes missile test frequencies, shelf life for ordnance components and defines the 3 levels of maintenance for each weapon system.

Conclusion

Maintenance procedures for missiles have not been revised since 1958. The operating activities urgently require this information.

Recommendation

NAVAIRSYSCOM assign to a field activity the responsibility of maintaining and publishing NAVAIRINST 08810.1. Direct that the instruction be updated every 12 months and that an annual review conference be held. Enclosures to 08810.1 for new weapon systems should be incorporated prior to Fleet introduction.

C. NAVAIRINST 4700.2

Discussion

Present maintenance levels and procedures for air-launched missiles are not defined for operating activities. NAVAIRINST 4700.2 presently refers to NAVAIRINST 08810.1 for this information. The proposed revision of NAVAIRINST 08810.1 defines maintenance procedures for air-launched missiles.

Recommendation

Include in NAVAIRINST 08810.1 the definition of maintenance policies for air-launched missiles, and expedite revision of this instruction to prescribe three levels of maintenance for air-to-air missiles. Malfunction reporting for air launched missiles should be deleted from 08810.1.

D. Air-Launched Missile Test Philosophy

Discussion

1. The shipboard test philosophy for air-launched missiles is governed by the following factors:

a. Captive flight environment - Air-to-Surface weapons such as WALLEYE and BULLPUP operate successfully as "No-Test" missiles because they are essentially one-shot devices. Air-to-Air missiles are subjected to repetitive captive flight cycles, and the degradation in missile reliability as a function of captive flights must be predictable. The allowable degradation that the user will permit will then establish the upper limit on the captive flights between periodic testing.

b. Depth of Test - The thoroughness of the missile periodic test is determined by the complexity and design of the test set. Generally, the greater the depth or thoroughness to which the missile is tested, the greater the complexity of the test equipment. In the case of the SPARROW the test equipment varies in thoroughness from the 40% check performed by the aircraft SELECT light to the 100% check performed on the NARF production line. All missiles should be provided periodically with an extensive check at a NARF or NAVWEPSTA. For example, if shipboard testing does not include a test of Resistor R1, and Resistor R1 normally accounts for 1% of the total failures, eventually all of the missiles being captive flown will have a failed resistor R1 unless they have been returned periodically to an NAVWEPSTA or NARF for a test which does check that resistor.

c. Inherent design reliability - A fallacy in test philosophy is that testing will increase missile free flight reliability. If the missile reliability is degraded during operations, periodic testing will screen out those failed missiles; however, components fail during missile flight and all components are not tested. Periodic testing will not screen these failures out of the system. The inherent design reliability of a missile cannot be increased by periodic testing.

d. Effect of sub-systems - The reliability of the 20 mm gun has been compared to the reliability of the SPARROW missile. In this comparison, the status of the aircraft radar, the launcher maintenance and the post-launch maneuvering of the aircraft are not excluded from the missile reliability because they are essential sub-systems necessary for missile success; however, missile testing will not affect the degradation to system reliability caused by sub-systems other than the missile.

e. Purpose of shipboard testing - The three reasons for conducting shipboard testing are.

(1) To isolate faults for maintenance and repair.

(2) To provide assurance that the system has remained in a GO status.

(3) To provide an assessment to the pilot of which systems are available prior to commitment.

Air-launched missiles are not maintained or repaired on board ship, therefore only (2) and (3) apply. The desirability of combining the assurance test and the assessment test into one Missile-on-Aircraft-Test (MOAT) is discussed below.

The MOAT would provide maximum user's confidence in the status of the system.

2. Based on the foregoing, the following comments are provided concerning the two air-to-air missiles currently in operation:

a. SIDEWINDER - The AIM-9D is tested on the aircraft prior to each flight by illuminating the seeker with a flashlight and ascertaining that an audio signal is present. A periodic test is conducted using the Mark 409 test set, which is a relatively uncomplicated portable shipboard tester, every 100 hours of activated time, or approximately every 50 captive flights. The loss of audio during the preflight test and in flight provides a limited MOAT. There has been little concern or investigation of the adequacy of SIDEWINDER testing policy because of the missile's free flight reliability demonstrated in training and in combat. This reliability is due to the small effect of the SIDEWINDER sub-systems on overall system reliability, and to the lesser complexity of the SIDEWINDER as compared to the SPARROW.

b. SPARROW - The SPARROW has had test frequencies varying from every 5 to every 30 captive flights. Tests are conducted with the DPM-7, during shorebased operations, the DSM-32 aboard CVA's, and the DPM-14 is used exclusively by the Marines and Air Force. The aircraft SELECT light provides a limited MOAT as a preflight and inflight test. There has been much command attention directed to the SPARROW testing policy and extensive investigation has been conducted by various activities. However, comparison of Navy versus Air Force firings during SPARROW SHOOT and combat firings, and engineering investigations, such as TAB H, do not indicate a significant change in missile free-flight guidance and fuzing reliability due to changes in test frequency or test equipment. The concern directed towards SPARROW test philosophy is due to the design reliability, seriously degraded by the effects of unreliable sub-systems. The combination of these two factors has resulted in an extremely low overall system reliability.

Conclusion

The attention focused on test philosophy for air-launched missiles, particularly the SPARROW, is attributed to the lack of user's confidence in the overall weapon system reliability. In actuality, varying the test frequencies, or changing the test equipment for missile guidance section testing has had little effect on the overall system reliability.

Recommendations

1. Continue shipboard testing of the SPARROW missile to maintain user confidence.

2. Return SPARROW missiles to a NAVWEPSTA for check and reissue after every 30 captive flights. Consider adoption of a policy for shipboard test every 10 captive flights until return for rework after 60 flights, unless rejected earlier.

3. NAVAIRSYSCOM specify that a high reliability be maintained throughout the repetitive captive flight cycle for future air-to-air missiles.

4. NAVAIRSYSCOM establish, as a design goal, that shipboard testing of future air-launched missiles be limited to a Missile-on-Aircraft Test (MOAT).

E. Missile on Aircraft Test (MOAT) for SPARROW

Discussion

1. To maximize the probability of successful launch of the SPARROW missile, it is necessary to check the missile as thoroughly as feasible and as near to the time of launch as is practical. At present the only missile-on-aircraft test is by means of the SELECT light. This test will detect an estimated 40-50% of SPARROW G&C failures.

2. Test of the missile G&C aboard the CVA (attack aircraft carrier) requires that the missile be downloaded periodically from the aircraft, disassembled, tested, reassembled, and reloaded on an aircraft. This process requires many man-hours and increased the incidence of physical damage

to the missile during handlings. In addition, shipboard test equipment is difficult to maintain, requires personnel trained in its maintenance, and requires spares, handbooks, and space aboard the CVA.

3. The IRR (Improved Rearming Rates) program anticipates that air-launched missiles, including the SPARROW, will be received and stowed aboard ship in a fully assembled condition (including rocket motor and warhead) and provides for modification of CVA's to conform to this concept. For reasons of safety, SPARROW missiles cannot be tested aboard the CVA when fully assembled. Test of SPARROW missiles aboard ship under the IRR program would require disassembly, test, and reassembly of the missile. This process would negate much of the purpose of the IRR concept.

4. An alternative to test aboard the CVA would be an expanded test of the missile while on board the aircraft (MOAT). MOAT would provide for a comprehensive missile check-out on the aircraft during pre-launch and flight and would be compatible with the IRR program. The feasibility of an expanded MOAT of future Air-to-Air Missiles should be investigated.

Conclusion

The use of shipboard equipment to test air-launched missiles is undesirable and incompatible with the improved rearming rates program. An alternative to shipboard test equipment is offered by missile on aircraft test.

Recommendation

NAVAIRSYSCOM particularize and specify the requirement for development of an expanded missile on aircraft test, possibly as part of the Built-in-Test, to allow the aircrew to ascertain the missile status, for future Air-to-Air Missile systems.

V. SAFETY

INTRODUCTION

Operational requirements during combat operations conflict with CVA safety requirements. USS AMERICA MSG 190547Z Jul 1968 details the inconsistencies of procedures contained in OP 4 Vol. 2, OP3347, OP3365 and NAVAIR 01-245FD-75-21.

A. CVA Safety Requirements

Discussion

1. Existing safety procedures require removal of the SPARROW missiles from all aircraft at the completion of the daily flight operations.

The operational requirements in SEA frequently require the carrying of up to 72 missiles during one day of operations. In addition, approximately 30 additional missiles must be maintained as a backup in ready issue status. The safety requirement to download all missiles results in the disassembly and strikedown of these missiles over the capacity of the CVA ready service magazine. The extra handling results in physical damage to the missile and missile components.

2. The air-launched missile systems are highly susceptible to personnel error during aircraft checkout and missile loading due to non-standardization of safety procedures and test equipment. There is little standardization of safety procedures, firing interlock circuitry and stray voltage test receptacles on Navy aircraft. In addition, the HERO (Hazards of Electromagnetic Radiation to Ordnance) testing of SIDEWINDER is incomplete.

Conclusion

Shipboard safety requirements are unrealistic and conflict with operational requirements. A thorough safety review of the F-4 and F-8 SPARROW and SIDEWINDER systems is required.

Recommendations

1. Immediate

a. NAVAIRSYSCOM/NWEF review the procedures contained in TAB I and modify as required to provide an approved procedure which will preclude daily downloading of SPARROW missiles.

b. NAVAIRSYSCOM expedite completion of SIDEWINDER HERO testing.

c. NAVAIRSYSCOM institute a review of ordnance safety with particular emphasis on shipboard procedures during periods of extensive operational commitment.

d. CNO activate an air-to-air Missile Safety Study Group to conduct a thorough safety study of the F-4 and F-8 aircraft weapons systems as described in TAB J.

2. Long-Term

a. Standardize nomenclatures and functions of aircraft installed weapon control equipment, firing circuitry and safety interlocks.

b. Standardize stray voltage tests, receptacles and equipment for all weapon systems.

c. Establish a monitoring agency to assure that directives do not overlap or conflict and are validated before promulgation.

VI. LOGISTICS

INTRODUCTION

Of the two problems contained in this section, one item is submitted to improve logistics; however, the other item is submitted due to the lack of logistical support.

A. SPARROW COMPONENTS

Discussion

1. Wings - Wings currently are identified by part number only, making rapid identification difficult and increasing the possibility of inadvertent mixing of wings (e.g., 7E and 7D wings installed on 7D missile). AIMC 15 has not been incorporated in all wings. AIMC 15 requires epoxying of the lead weights into the wings to prevent their loosening and deforming during captive flight.

2. Fins - Fins are not properly identified on their containers. A plastic or cowhide mallet is required to remove fins from the missile; however, a fin is frequently used as a hammer rather than using a mallet. This practice results in damage to numerous fins.

3. Phase "C" Antenna - The Phase "C" (rear) Antenna is subject to moisture intrusion, dirt (inside) and physical damage. Many antennas are removed by striking the polyrod antenna. No test of these antennas is conducted, either aboard ship or at NAVWEPSTA, although a gross functional test of the antenna is performed by the aircraft (SELECT Light). Dirt, damage, etc., do not present a significant problem and do not appear to significantly degrade reliability during one deployment, provided that the antennas are offloaded at the end of deployment and returned to NAVWEPSTA for inspection, cleaning, and re-issue. In many cases, these antennas are not returned to a NAVWEPSTA and their condition deteriorates considerably with time and usage. Problems caused by moisture getting into the antenna should be eliminated with incorporation of ECP 47.

4. Umbilical Inserts, Launcher Ejector Footpads and Lower Motor Fire Connectors - These components form the interface between the aircraft (launcher) and the AIM-7 missiles. Umbilical inserts and lower motor-fire connectors should be periodically cleaned, inspected and checked for electrical continuity to insure their proper operation. Launcher station checks prior to missile loading should be performed with the actual umbilical insert and lower motor-fire connector which will be installed with the missile. Aviation Armament Bulletin No. 361 requires

that lower motor-fire connectors be replaced whenever the missile is removed from the launcher, either by launching or offloading. Launcher ejector footpads are required to dampen the shock applied to the missile during ejection. These footpads are not always available, nor are they always used when available.

Conclusion

SPARROW components such as wings, fins, antennas, etc., are degraded from handling damage or shipboard environment. This degradation can be minimized by assuring that the components are offloaded to a NAVWEPSTA for cleaning and inspection following each deployment, and by assuring that the CVA has sufficient spares onboard prior to deployment.

Recommendations

1. Direct all CVA's when offloading missile G&C's to a NAVWEPSTA from deployment to offload all missile components including wings, fins, umbilical inserts and lower motor-fire connectors.

2. Direct appropriate NAVWEPSTA's to assist the CVA's in offloading missiles and components.

3. Establish realistic allowances for all missile components including umbilical inserts, lower motor-fire connectors and footpads, and charge NAVWEPSTA with the responsibility of delivering these components to the CVA's along with initial loadout of missiles, and with the responsibility of insuring that these components have been cleaned, inspected and checked as appropriate.

4. Provide identifying markings on all SPARROW wings and fins and their containers.

B. F-8/AIM-9C SIDEWINDER

Discussion

1. The F-8/AIM-9C SIDEWINDER system, for the most part, is not in a combat ready status. This problem exists throughout the Fleet.

2. NASC has initiated a program to remanufacture 395 F-8 aircraft of all models. The remanufacturing changes extend the service life and significantly improve the weapons systems and load-carrying capability of the F-8 aircraft.

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3. The remanufacturing program was initiated because of the F-8's "all decks" capabilities and continued mission effectiveness coupled with programmed utlization of the 27C class attack carriers. Initially, only F-8E squadrons were equipped with the AIM-9C missile. This was a total of 8 squadrons. Presently, plans show a total of 14 F-8H and F-8J squadrons with full AIM-9C capabilities being formed. This has resulted in a shortage of the required special test and support equipment.

4. At present, no formal maintenance or operational training is being offered at the NAMTRADET's or RCVW's. Official publications are lacking in technical detail, updating, maintenance instruction, tactics and operation envelopes. F-8H's (modified F-8D's) now being received have had the AIM-9C system (less the deviated pursuit computer CP-742) since original manufacture in 1959 and 1960. This system, to date, has never been used, checked out, or maintained.

5. The PP2315/A launcher power supply required by AIM-9C has proven a high cost item and has a high failure rate. There is no repair or maintenance capability for failed units.

6. The new SEAM (SIDEWINDER EXPANDED ACQUISITION MODE) system, developed for use in the F-8H and F-8J aircraft, increases the lock-on capability of the AIM-9D missile by scanning and slaving its seeker. This offsets a portion of the need for the AIM-9C system. Presently, there are 1164 AIM-9C guidance and control sections in Fleet inventory. All other components of the missile are interchangeable with the AIM-9D. In general, it is the opinion of knowledgeable Fleet personnel that AIM-9C capability should be removed from inventory.

Conclusion

The F-8/AIM-9C SIDEWINDER system is not in a combat ready status throughout the Fleet due to the absence of maintenance training, current technical manuals, shortage of SSE and general lack of interest. While generally considered a "dead" program to which further funding will not be provided, the capability and the readiness requirement have not been eliminated from F-8 squadrons. A decision is required.

Recommendations

1. Remove the AIM-9C SIDEWINDER capability from the F-8 aircraft and use existing components (other than guidance and control section) to increase AIM-9D assets.

2. An alternate recommendation is to take immediate action to update the AIM-9C system by providing the following items at an estimated cost of 2000K dollars.

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a. Establish NAMTRADET operational and maintenance training courses. Time requirement approximately 80 hours.

b. Establish RCVW OJT course for maintenance, loading, landing, and system checkout. Time requirement approximately 40 hours.

c. Establish formal NAMTRADET MK-401 GCG test set operational and maintenance course. Time requirement approximately 40 hours.

d. Staff CVA and air station missile shops with AT or AQ personnel for maintenance and operation of MK-401 test set. Two men per shop required.

e. Procure additional special test and support equipment for new and existing F-8E, F-8H, F-8J squadrons. Equipment required:

(1) Test set, computer, deviated pursuit, AN/APM-207.

(2) Test set, missile tuning amplifier, CV-21-206103-1.

(3) Test set, missile gate delay, AN/APM-215.

(4) Test set, electrical synchronizer, TS-1394.

(5) Special test set, cross pointer, NWC China Lake supplied.

f. Update, rewrite and write new publications covering maintenance, tactics, NATOPS handling, loading, etc.

g. Establish formal AIM-9C pilot training in the RCVW to include training firings against suitable drone targets such as specially-augmented AQM-37 and BQM-34 target drones.

h. Allow operational squadrons expenditures of at least one AIM-9C missile against suitable targets.

i. Develop and procure suitable telemetering equipment for use on training firings.

VII. SUPPORT EQUIPMENT

INTRODUCTION

There are numerous problems in the design, updating and support of AMCS and missile support equipments.

A. SPARROW Shipboard Handling and Loading Equipment

Discussion

No shipboard loading equipment is available for the SPARROW missile. Missiles are presently loaded by hand. The existing AERO 16B skid and its replacement, the AERO 21A weapons skid, are both adequate for shipboard missile handling, but the missile must be manually lifted from the skid and loaded onto the aircraft. NASC has procured 150 AERO 67A loaders for a planned engineering evaluation. NAVMISCEN at the request of NASCREPAC has developed a shipboard loader consisting of an AERO 21AX loading adapter installed on an AERO 21A weapons skid that will transport and load all weapons under 2000 pounds on all operational aircraft in a shipboard environment. The AERO 21AX loading mechanism is similar to the AERO 52B mechanism which has been proven successful in shore based application.

Conclusion

There is no adequate shipboard handling and loading equipment for the SPARROW missile. Two possibilities consisting of the AERO 67A and AERO 21AX are planned for evaluation.

Recommendations

1. NAVAIRSYSCOM expedite engineering evaluation of the AERO 21AX loading adapter and the AERO 67A loader.

2. NAVAIRSYSCOM provision the selected loader for all CVA's with SPARROW capability.

B. SPARROW Ground Handling Equipment

Discussion

Existing missile ground handling equipment at MCAS and NAS represents many locally fabricated or modified equipments which subject missiles to handling damage and create safety hazards. NAVMISCEN has developed a suitable shore based transporter/loader adequate for the SPARROW, SHRIKE, and BULLPUP A designated the AERO 52B. Four units have been evaluated by the Marines under operational conditions at DaNang and have been recommended for all MCAS's. NAVAIRSYSCOM has funded NAVMISCEN for procurement of 30 additional units and delivery will commence 1 December 1968. The AERO 52B is also considered adequate for transporting and loading at the NAS.

Conclusion

There is no standard SPARROW missile ground handling equipment for shore based activities. The AERO 52B has been evaluated and accepted by the USMC and is equally suited for Navy shore based activities.

Recommendations

1. Type Commanders submit requirements to NAVAIRSYSCOM for shore based SPARROW transporter/loader.

2. NAVAIRSYSCOM procure the AERO 52B as the standard SPARROW shore based transporter/loader.

C. Calibration and Repair of Missile Test Sets

Discussion

Missile Test Sets on CVA's require calibration and repair in order to ensure proper operation.

Recommendation

COMNAVAIRPAC/LANT ensure that an O&R field team visits each CVA and repair and calibrate Missile Test Sets within 30 days prior to deployment.

D. AWM-15/AWA-6 Rework

Discussion

The AWM-15 Test Set, Missile Control System and the AWA-6 Cooling-Pumping Group have not been regularly inducted into rework facilities. The majority of this equipment was procured between 1958 and 1961. Procedures are in existence for inducting the AWM-15 into rework; however, very few have actually been reworked. There is no provision for inducting the AWA-6 into rework.

Conclusion

Provisions for rework of AWM-15 and AWA-6 carts have been made but require implementation.

Recommendations

1. NAVAIRSYSCOMREPAC/LANT establish a rework program for the AWA-6.

2. NAVAIRSYSCOMREPAC/LANT schedule both the AWA-6 and AWM-15 through rework immediately.

3. NAVAIRSYSCOM ensure that funds are available to provide adequate spares for these rework programs.

4. NAVAIRSYSCOM solicit Raytheon for a proposal to replace the spiral ring air hoses on both the AWM-15 and AWA-6 with an inflatable air hose.

5. NAVAIRSYSCOMREPAC/LANT screen all F-4J/AWG-10 GSE for rework requirements.

E. Support Equipment for F-4J Umbilical Checks

Discussion

1. The test equipment supplied to check missile functions at the umbilical of the F-4J aircraft is not satisfactory. At present six TS 2515A/AWM-22's must be connected to the aircraft, one to each station, in order to perform these tests. At present users are not performing these required checks for the following reasons:

a. The TS 2515A/AWM-22 has not worked as advertised. Incorporation of Westinghouse Electric Corporation ECP's S16, S39, S40, S1R1 and S51 (all approved), together with use of 1.5 series Built-in Test Tapes and latest procedures, will eliminate these deficiencies. An additional ECP (SM99) is required for compatibility with AIM-7E-2.

b. It is often impractical to connect all six testers to the aircraft because the aircraft wing stations are configured with bomb racks or without missile pylons. Fleet activities are not willing to configure the aircraft just for test.

2. An existing MSTS (Missile Station Test Set) has been in use for some time to perform similar checks on the F-4B. This test set is capable of checking a single station at a time. Several modifications to the MSTS are required to make it compatible with the AIM-7E-2 missile. The NAVMISCEN, at NASC direction, has identified the necessary modifications and submitted them to NARF North Island for production of a prototype modified MSTS. If the prototype is satisfactory, it is planned that 200 modified MSTS's will be built.

Conclusion

The test equipment supplied to check missile functions at the umbilical of the F-4J aircraft is not satisfactory for daily use. Test equipment used for similar checks of the F-4B would be satisfactory provided it is modified for compatibility with AIM-7E-2.

Recommendations

1. NAVAIRSYSCOM expedite issuance of SEC's to cover the following ECP's, S16, S39, S40, S1R1, and S51, into all TS 2515A/AWM-22's.

2. Expedite approval and incorporation of ECP SM99.

3. NAVAIRSYSCOM provide funding for production, documentation and support of 200 modified MSTS's and modification of existing MSTS's.

4. NAVMISCEN deliver procedures for use of modified MSTS's to McDonnell Douglas Corporation for incorporation into handbooks.

5. With availability of the modified MSTS's, the following check-out policy is recommended for the F-4J:

a. Use the modified MSTS's for daily and preflight checks.

b. Use the TS 2512A/AWM-22, which performs a more thorough check, for periodic (calendar) checks of the missile functions at the umbilical.

F. CW Illumination Test Equipment for the AN/AWG-10

Discussion

1. The RFNA (Radio Frequency Noise Analyzer) is not presently used for performing organizational level CW illuminator checks of the AN/AWG-10. The RFNA requires updating for these tests; calibration and operational procedures need updating, and insufficient numbers of RFNA's have been allocated. The most critical problem with the RFNA is that it is too large for organizational level use aboard a CVA.

2. Westinghouse Electric Corporation is currently investigating two approaches to a "suitcase" size RFNA, which would be of more satisfactory size for shipboard use. One approach would package the existing RFNA without the spectrum analyzer into a "suitcase" tester and would use the Doppler Spectrum Analyzer in the AN/AWG-10 as a replacement for the spectrum analyzer. The other approach would utilize existing AN/AWG-10 circuitry with the exception of an external Stable Local Oscillator which would be packaged into a "suitcase" size tester.

Conclusion

No satisfactory short term solution to the problem of CW illumination test equipment is apparent.

Recommendation

NAVAIRSYSCOM assign a high priority to the rapid development and procurement of a satisfactory suitcase-type tester to perform noise checks on the CW illuminator of the AN/AWG-10 at the Organizational Maintenance Activity level.

G. F-4/AERO 7A Ejection Launcher Dynamic Testing (Pit Testing)

Discussion

1. F-4/AERO 7A ejection launcher dynamic testing is a method of dynamically testing the AERO 7A launchers and SPARROW firing circuits of the F-4B/J aircraft. Dynamic testing was devised as a means of detecting malfunctions in the AERO 7A launcher, which would otherwise go undetected by the prescribed "E" level check, thereby reducing the number of SPARROW misfire incidents. Since the original test was devised, the pit testing program has grown into a tool for checking firing circuit parameters as well as the launcher and is probably used more at present for this secondary purpose than for the original. Dynamic testing is performed by actually ejecting an instrumented missile from the aircraft into an arresting device and recording the firing circuit parameters. The recording is then examined for out-of-tolerance indications, for loss of signal, and for sequence and timing of the signals.

2. Pit testing was made a required check for all F-4 squadrons at NAS Miramar by COMFAIR Miramar in August of 1965 and has produced significant results as reported by FMSAEG's Technical Memorandum E5-680 of August 1967. The report shows that those squadrons which did not pit test have a misfire rate of 14.9%, whereas those squadrons which did pit test have a misfire rate of 4.9%. These figures indicate that pit testing does achieve the desired result, i.e., reducing the misfire rate. In addition to the above, there are intangible benefits such as squadron personnel becoming more familiar with the weapon system, loading crew training, enforced launcher maintenance, etc. All of these contribute to a successful launch.

3. Pit testing has been recognized as a valuable tool by both COMNAVAIRLANT and COMNAVAIRPAC. However, there has been no formal funding, manpower, or logistic support for the pit facilities. This situation imposes the responsibility on the COMFAIR's and NAS's, who must use operating funds and available personnel for this purpose. Logistic support (spare parts and consumable supplies) must also be provided by open purchase, since the facilities are not provisioned by SPCC.

4. There are no publications which provide complete operating and maintenance instructions.

5. A missile change which would initiate motor fire through the umbilical instead of through the motor fire connector has been proposed. This change should have little or no impact on the pit testing program since the emphasis is on the firing circuits more than on the launcher.

6. An advanced instrumentation package is being developed by the NAVMISCEN to supplement or replace existing instrumentation. This new equipment is expected to be comparable in performance to the existing equipment at less cost.

Conclusion

The F-4/AERO 7A ejection launcher dynamic test (pit test) is not adequately supported by funding, manpower, or logistics. In addition, there are no publications which give complete operating and maintenance instructions. Existing installations are not adequate to support Fleet requirements.

Recommendations

1. Immediate

a. COMNAVAIRLANT/PAC establish/implement manpower requirements.

b. NAVMISCEN test and evaluate the advanced instrumentation package now in prototype stage at the NAVMISCEN (funds already provided).

c. NAVMISCEN prepare Aviation Armament Bulletin promulgating test procedures.

d. NAVAIRSYSCOM expedite ECP 940.

2. Short Range

a. NAVAIRSYSCOM (AIR-4107/5108) give formal recognition to the pit testing program and provide funds to support the existing instrumentation packages. Estimated cost: $36,000 (three facilities).

b. NAVAIRSYSCOM (AIR-4107/5108) task the NAVMISCEN to develop a data package for the pit instrumentation. Estimated cost: $20,000.

c. NAVMISCEN standardize existing instrumentation packages to one configuration. Estimated cost: $5,000.

d. NAVMISCEN prepare and distribute interim handbooks until final handbooks can be obtained. Estimated cost: $10,000.

e. SPCC convene provisioning conference using preceding data package.

f. COMNAVAIRLANT/PAC determine requirements and funding for additional pit testing facilities.

g. Aircraft Handbooks be revised to include testing procedure.

VIII. POLICY

INTRODUCTION

A review of air-to-air missile system design, reliability and support areas has revealed three important problems relating to Navy policy. The majority of the problems discussed in the CVA section of this report have become problems because of Navy policy, or lack of policy, in the following three areas.

A. Air-to-Air Missile System Reviews

Discussion

A lack of communication exists between support activities and the Fleet pertaining to the support and operation of the air-to-air weapons systems. Program reviews such as the A-4 and A-7 weapons system reviews have proven to be beneficial in the discussion and most importantly, the solution of system problems. NAVAIR 4103 presently sponsors a semi-annual Fleet support symposium; however, the limited representation of NAVAIR and lack of representation of CNO precludes management decisions.

Conclusion

Periodic review of air-to-air weapons programs is required with representation from CNO and NAVAIR decision making management.

Recommendation

CNO select a review team composed of a member and alternate from the support and Fleet activities engaged in the operation and maintenance of the air-to-air weapons systems, the review to be accomplished as a minimum on a semi-annual basis. The first order of business of this team to be monitoring the progress of the recommendations of this report.

B. Fleet Maintainability and Reliability Problems

Discussion

1. The majority of problems that occur during Fleet operation of air-to-air missile systems are in the area of maintainability and reliability. During the Cuban crisis (November 1962) the excessive flight times

imposed on the missiles revealed sway brace damage problems and moisture intrusion problems. Before funding and approval to correct these problems were obtained, the Cuban crisis was over and funds and interest were again focused on performance improvements. After 3 years of SEA operation, the sway brace damage problem has been corrected but the moisture intrusion problem still does not have an approved solution. The priority of performance over maintainability and reliability was evident throughout the writing of the AIM-7F specifications.

TAB K is a general discussion of maintainability and reliability trends in air-launched weapons and control systems which are in use or planned by the Navy, and the impact of these trends on future systems.

Conclusion

A higher priority should be assigned to the investigation and correction of Fleet maintainability and reliability problems.

Recommendations

Immediate

1. Review and re-emphasize maintainability and reliability in the AIM-7F specifications.

2. Write a MIL-Standard for maintainability to govern missiles and missile support equipment.

3. Provide a reliability and maintainability incentive to the contractor similar to value engineering incentives.

4. CNO/NAVAIRSYSCOM assign a higher priority (including funding) to the early resolution of Fleet maintenance and reliability problems.

C. F-4 Employment Policy

Discussion

Insufficient emphasis and priority is placed on maintaining the aircraft weapons control system in a completely operational ready status.

Conclusion

Historically, the philosophy of placing priority on conventional weapons (iron bombs) employment of the F-4 aircraft at the expense of properly maintaining the missile control systems has materially contributed to overall poor missile system performance.

Recommendation

CNO (Chief of Naval Operations) support a policy of increased emphasis on the air-to-air capability of the F-4 aircraft.

NAMTRADET TRAINING EQUIPMENT REQUIREMENTS

1. SPARROW Requirements

a. AERO 7A launcher cleaning stand.

b. Training films.

c. Cutaway missile sections and components showing internal arrangement.

d. 5 MK-38 training motors complete with inert MK-265 ignitor and S&A mech. and ignitor cable - MK-52 motor with MK-274 ignitor (inert).

e. 5 MK-4 inert warheads with inert MK-38 booster and MK-5 S&A.

f. 5 G&C sections, AIM-7E preferably; these need not be R.F.I. but do need an actual set of wing hubs, tunnel covers, and head and rear antenna connections.

g. 5 NAVMISCEN/AIM-7/13J6 test adapters are needed to perform no voltage checks on G&C prior to warhead connection. This equipment must be made available to NAMTRADET's at NAS Miramar, NAS North Island, NAS Alameda, NAS Norfolk, and NAS Jacksonville.

2. SIDEWINDER Requirements

a. CVA-CVS Conv. Ord. Tra. Det. (Norfolk, Jacksonville, Alameda, North Island

AIM-9B

1 ea Mk-17 Mod 5 dummy motor
1 ea NPU (non-propulsive unit)
1 set wing rolleron assembly (canted hinge)
1 set wing rolleron assembly (straight hinge)
1 ea dummy MK-303 influence fuze
1 ea live MK-303 influence fuze (slotted thread)
1 ea Mk-304 contact fuze (dummy booster)
1 ea dummy warhead
1 ea MK-1 Mod 9-14 G&C section
1 ea dummy MK-1 G&C section

b. AIM-9C, D

2 ea MK-36 Mod 5 dummy rocket motor
2 sets MK-1 Mod 0 wing rolleron assembly

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2 ea MK-48 dummy warhead
2 ea dummy MK-15 or -24 TDD's
1 ea cutaway MK-15 Mod 1, 2, or 3 TDD
1 ea cutaway MK-24 Mod 1 TDD
1 ea dummy MK-18 GCG
1 ea live MK-18 Mod 2 GCG
1 ea dummy MK-12 GCG
1 ea live MK-12 Mod 2 GCG
2 sets MK-18 canard fin assembly
2 sets MK-12 canard fin assembly

c. Support Equipment

1 ea missile assembly stand
1 set AIM-9B assembly tools
2 sets AIM-9C, D assembly tools
1 ea MK-409 GCG test set (AIM-9D)
1 ea MK-401 GCG test set (AIM-9C)(North Island and Alameda only)
3 ea AIM-9B, C, and D missile dome covers
3 ea AIM-9B, D fuze covers
1 ea AERO 12B bomb skid
Air and Electrical sources as required for the support of test sets
1 ea AERO 30A-2 vibration isolator
1 ea AERO 8C-1 missile holder
1 ea AERO 39-A bottle storage rack

d. F-4B/F-4J NAMTRADET's 1013, 1014 (Miramar, Oceana, Key West, Cherry Point, El Toro

1 ea AN/ASM-20B guided missile test set
1 ea cutaway LAU-7/A with PP2581/A power supply missile launcher
1 ea Type III AIM-9D missile
1 ea Type III AIM-9B missile

e. F-8H/F-8J NAMTRADET 1098 (Miramar)

1 ea AN/ASM-20B guided missile test set
1 ea cutaway LAU-7/A with PP2315/A power supply missile launcher
1 ea Type III AIM-9B, C, D
1 ea F-8 aircraft mock-up/radar attached

f. A-4/A-6/A-7 NAMTRADET's (Lemoore, Cecil Field, Whidbey Island, Oceana)

1 ea AN/ASM-20B guided missile test set
1 ea cutaway LAU-7/A with PP2581/A launcher

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1 ea Type III AIM-9B, D
1 ea AERO 1A adapter
1 ea ADU-299E adapter

g. All aircraft NAMTRADET's should have complete AIM-9D/LAU-7/A repair tools and equipment as spelled out in LAU-7/A manual.

3. APG-59 Training Aid Requirements

It is suggested that the following items be prepared in the form of visual aid charts approximately 3 x 4 feet:

A. Antenna
  (1) Positioning characteristics
    (a) Geographical
    (b) Space
    (c) Drift
    (d) Antenna
    (e) Interceptor

  (2) Patterns
    (a) Cosecant squared
    (b) Nutated
    (c) Pencil beam
    (d) Band Leader
    (e) Hi Map

B. Transmitter
  (1) Modes of operation
    (a) Pulsed doppler
    (b) CW
    (c) Pulse
      a. Monopulse
      b. Chirp

  (2) Radio Frequency

  (3) Radio Frequency Oscillator

C. Indicators
  (1) Dust
    (a) Grid Layouts
    (b) Operating Characteristics

D. (2) "A" Gun
  (a) Symbols presented
  (b) Time sharing logic

(3) "B" Gun
  (a) Symbols presented
  (b) Time sharing logic
  (c) Deflection signals

(4) Displays
  (a) Search
    a. Pulse
    b. Pulse doppler
  (b) Track
  (c) Sectored PPI
  (d) Pulsed doppler
    a. Pause-to-range
    b. Auto-Acquisition

E. Selector Test Programmer
(1) Move tape functions
  (a) Tape transport
  (b) Tape threading

(2) Testing Function
  (a) Light sensitive transistors
  (b) Test selection logic
  (c) Fibre Optics effects

F. Missile Tie-Ins
(1) CW guidance
(2) Head Aim and Lead Angle Error
(3) Altitude Commands
  (a) Altitude - 1
  (b) Altitude - 2
  (c) SWAB (Switch After Boost)
(4) Roll Command

(5) Launch Characteristics
  (1) Launch envelopes
    (a) AIM-7
    (b) AIM-9

  (2) Launch Zones
    (a) Head-On (Collision)
    (b) Tail (Pure Pursuit)
    (c) Beam (Lead Pursuit/Lead Pursuit to Lead Collision)

4. The following items are also being submitted for consideration:

   A. Training film, animated type, depicting pulse doppler as utilized by the AWG-10, operating modes and related displays, missile functions produced by the radar, and launch conditions in several different environments.

   B. An aircraft mock-up complete with gyro stabilization, servo systems, and functioning antenna. When the gyro is operating, the platform can be maneuvered to demonstrate the effects of antenna stabilization in search and track.

INDOCTRINATION COURSE
FOR
PROSPECTIVE MISSILE/ORDNANCE OFFICERS

OUTLINE OF TRAINING 2 WEEKS

A. SPARROW 12 hours

1. Block diagram theory
   Basic data flow of missile circuitry
2. Major components and nomenclature
3. Major differences between AIM-7D, 7E, 7E-2, and 7F missiles
   Discussion of the major changes to the AIM-7D to make the AIM-7E, 7E-2, and 7F
4. Shipboard handling and storage
5. AMCS AERO 1A/AWG-10 data flow to the missile
   Basic data flow which will show the over-all tie-in of major system components which comprise the missile control system
6. Present and future ALMC's
   Discussion of changes to missile components and identification
7. Assembly and disassembly of missile components
   Discussion of procedures for mating and unmating of G&C's, W/H and motors
8. Shipment of missile components
   Discussion of storage procedures, handling of containers and security of same

B. TEST EQUIPMENT (DSM-32/DPM-14) 16 hours

1. Block diagram theory
   Basic data flow between major circuits of test sets
2. Maintenance procedures and problems
   Discussion of maintenance procedures and standard problems on test sets
3. Present and future SEC's
   Discussion of reasons for incorporation of SEC's and future SEC's to be incorporated
4. Calibration and repair of test sets
   Discussion of pertinent and alternate test equipment used in repairing and calibrating test sets
5. Missile test procedures
   Perform a few familiarization tests on SPARROW III missiles

C. SIDEWINDER 8-10 hours

1. Block diagram theory
   Basic data flow of missile circuitry
2. Major components and nomenclature
3. Major differences between AIM-9B, 9C, and 9D
   Discussion of major changes of the AIM-9B to make the AIM-9C and AIM-9D
4. Shipboard handling and storage
5. AMCS AERO 1A/AWG-10 data flow to the missile
   Basic data flow which will show the tie-in of major system components which comprise the missile control system
6. Present and future ALMC's
   Discussion of changes to missile components and identification of such
7. Assembly and disassembly of missile components
   Discussion of procedures for mating and unmating of G&C's, W/H and motors
8. Shipment of missile components
   Discussion of storage procedures, handling of containers and security of same

D. F-4B WEAPONS SYSTEM 8 hours (Squadron Ordnance Officers)

1. F-4B/J firing circuits for SPARROW and SIDEWINDER
   Brief discussion of operation of circuit from pickle-push to missile launch
2. F-8 firing circuits for SIDEWINDER
   Brief discussion of operation of circuits from pickle-push to missile launch
3. Missile firing sequence
   Discussion of firing order for certain block aircraft
4. Procedures for loading mixed loads
   Discussion of procedures of loading AIM-9B, C, or D with AIM-7D and E's or AIM-7D's or AIM-7E's
5. Weapons system tests
   Discussion of use of E and F level and MSTS tests on system
6. AMCS AERO 1A and MCS AWG-10 differences
   Discussion of differences in missile firing procedures
7. Launcher rack maintenance
   Discussion of frequency and methods in performance of rack maintenance

E. PIT TESTING THE F-4B/J 4-6 hours (Squadron Ordnance Officers)

1. Definition
   Discussion of the reason and procedures for pit testing

2. Pit test read-outs
   Discussion of specification and procedures for reading monitored results
3. Pit test performance
   Perform an actual pit test of an aircraft

F. SERVICEABILITY (Missile Officers)

1. Discussion of Fleet missile problems
2. Discussion on BULLPUP, SHRIKE, WALLEYE and Standard Arm missiles
   Discussion of nomenclature, storage and handling, assembly and disassembly of missile components

G. TAWS/PEP BRANCH 4 hours (Missile Officers)

Briefing on F-4 weapons system problems and corrections of same

H. PUBLICATIONS AND CHANGES 4 hours (Missile Officers)

Receive and discuss a listing of pertinent publications and changes to SPARROW and SIDEWINDER missiles, which is followed by a discussion on the DOD code book

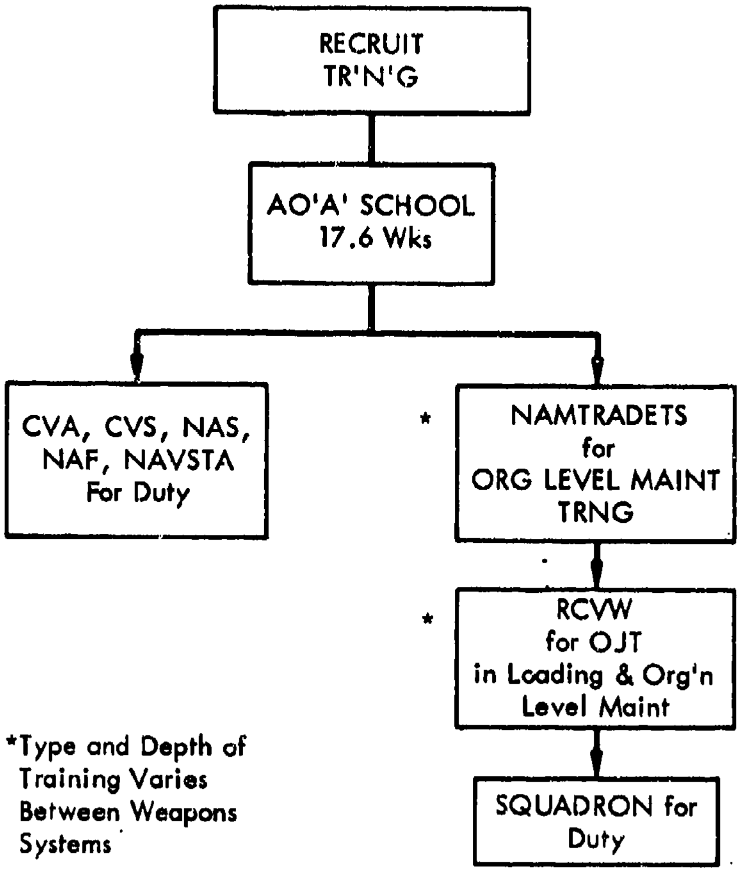
I. SPARROW LOGBOOK AND REPORTS 3 hours (Missile Officers)

Discussion of procedures in the use and disposition of missile test, firing and logbooks

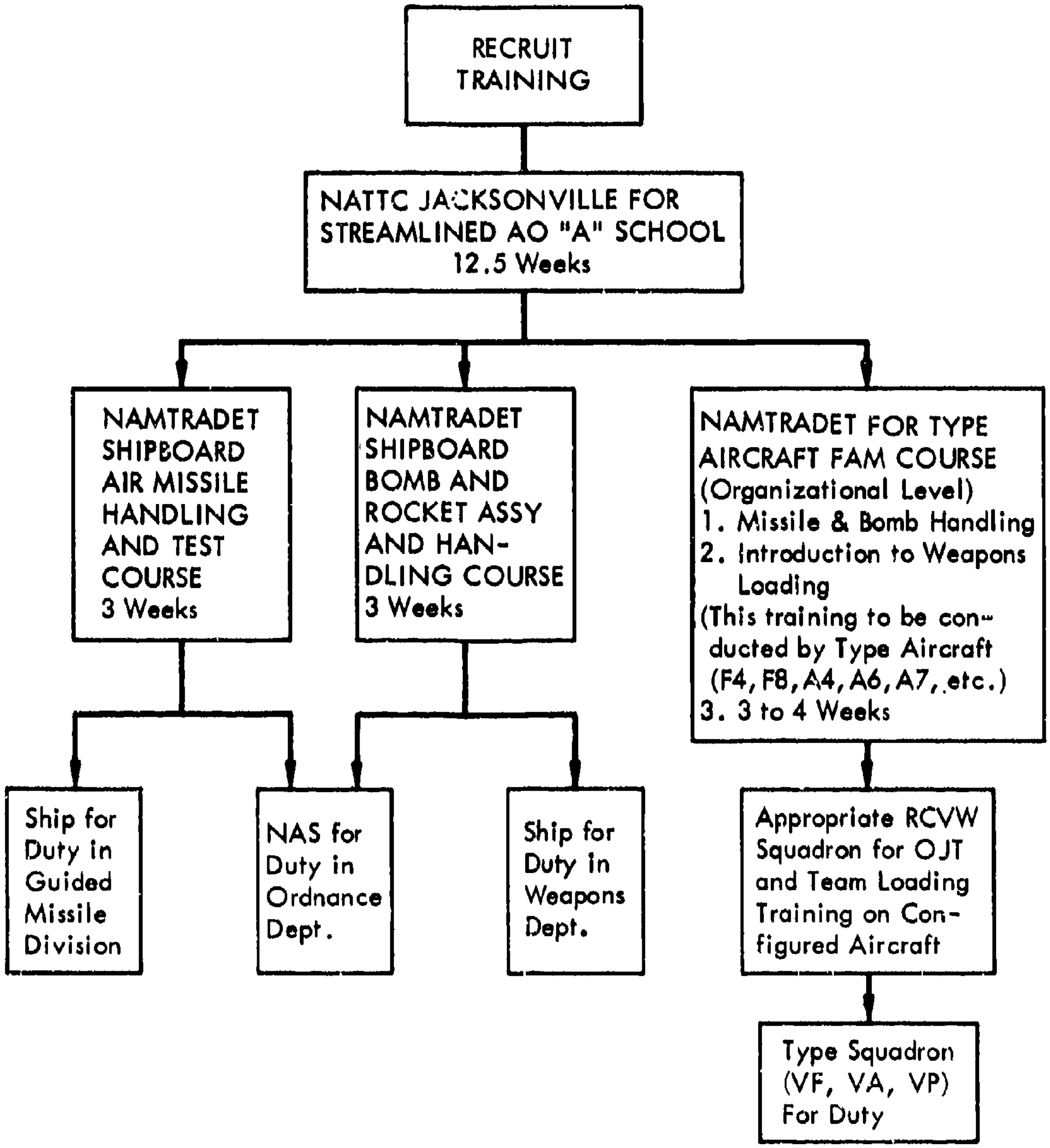
J. TELEMETRY 3 hours (Missile Officers)

Discuss the modification to, installation of and the information available from the XN-6 TM pack

PRESENT AO TRAINING FLOW



RECOMMENDED AO TRAINING FLOW



MISSILE MALFUNCTION REPORTS AND REFERENCES

The various reports that may be caused by an air-to-air missile malfunction are found in the table below.

Type of Report		Form of Report	Instruction for Use
Accident	Explosive	Message Format	NAVORD Inst. 8025.1
	Aircraft	Message Format	OPNAV Inst. 3750.6
Incident	Explosive	Message Format	NAVORD Inst. 8025.1
	Aircraft	Message Format	NAVAIR Inst. 4700.2 (Combined Safety U.R.)
		Message Format	OPNAV Inst. 3750.6
Ordnance Malfunction	Major	Message Format	NAVORD Inst. 8025.1
	Minor	Message Format	NAVORD Inst. 8025.1
		NAVAIR Form 13070/5	NAVAIR Inst. 4700.2 (Combined Safety U.R.)
Safety Unsatisfactory Material/Condition Report (Safety U.R.)		Message Format	(Combined Safety U.R.)
		NAVAIR Form 13070/5	NAVAIR Inst. 4700.2
Special Unsatisfactory Material/Condition Report (Special U.R.)		NAVAIR Form 13070/5	NAVAIR Inst. 4700.2
Air-to-Air Missile Weapon System Flight Report (AAMREP)		NAVWEPS Form 8811/4 Type 1	BUWEPS Inst. 8810.2
		NAVWEPS Form 8811/5 Type II	
Air-to-Air Missile Weapon System Flight Report Captive Flights only (AAMREP-Captive flight)		11ND-FMSAEG 8811/5 Type I	FMSAEG Tech Inst. E-5-68-1 Ch 1
		11ND-FMSAEG 8811/4 Type II	
Guided Missile Service Record (GMSR)		NAVWEPS Form 8800/2	FMSAEG Tech Inst. E-5-68-1 Ch 1
Logbook			

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NAVAL WEAPONS EVALUATION FACILITY

Proposed manning chart for Ordnance Technical Publications Department

Existing

8	Naval Officers
8	Naval Enlisted
8	Civil Service
4	Civil Service (approved for hire)
28	Total

Proposed manning requirement breakdown

Military

1	Commander
4	Lieutenant Commanders
13	Lieutenants
14	Chief Petty Officers
32	Total

TOTAL MANNING

35 Civilians
32 Military
67

Civilian

1	GS-13	Engineer
4	GS-12	Engineers or Engineering Technicians
1	GS-9/11	Engineer or Engineering Technician
13	GS-9	Engineer or Engrg Techs
8	GS-7	3 Computer Programmers 5 Illustrators
1	GS-4	Secretary
7	GS-3	Clerk/Stenographers
35	Total	

Cost

Present Budget	$324,000
Proposed Additional	400,000
Total annual cost	$724,000
Cost for Increased Facilities	$600,000

This increase in facilities is needed to provide additional working spaces, and alleviate existing crowded conditions.

TAB III-E

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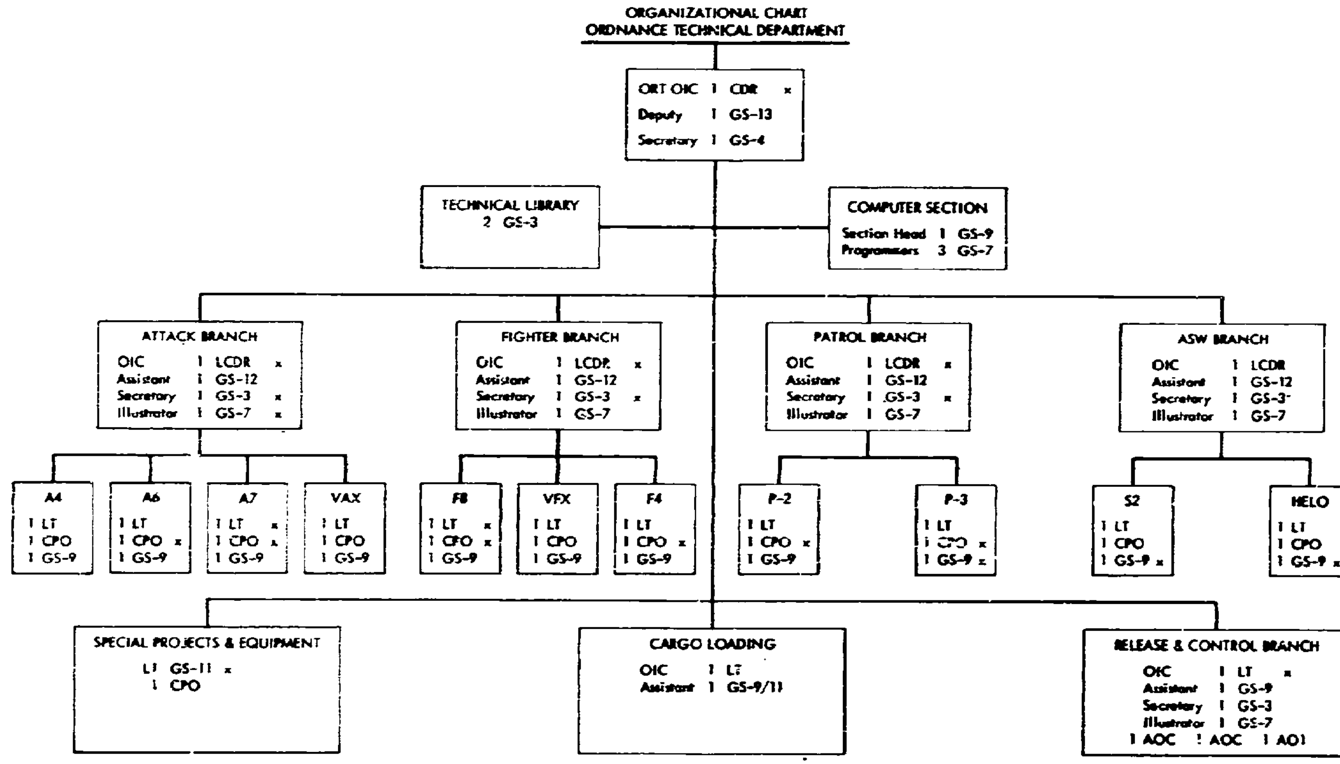

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Page 2 of 2

***DEPLOYING CVA SPARROW WEAPON SYSTEM**
INSPECTION WORK SHEET

1. To conduct an orderly and complete pre-deployment SPARROW Weapon System Inspection, the following format will be followed. When the attached work sheets are completed, they will be returned to the inspection team leader.

2. The enclosed work sheets are intended as a guide for a qualified SPARROW representative with field experience.

3. Formal schooling as used here is defined as one of the following:

   a. An accredited service school.

   b. An accredited commercial company school.

   c. A course of instruction consisting of a minimum of 40 classroom hours given by a NAVMISCEN NCTS SPARROW Field Representative.

   d. A course of instruction consisting of a minimum of 40 classroom hours given by a NAESU CETS/NETS Fire Control Representative.

   e. A course of instruction consisting of a minimum of 40 classroom hours given by a 2nd Class Petty Officer, or above, who has attended or instructed one of the above.

4. The SPARROW weapon system, testing, handling, assembly, storage and safety, minus the fire control system, are the responsibility of Ships Missile Division.

*SPARROW Missile Representative Inspection Work Sheet excluding the fire control system.

TAB III-F

UNCLASSIFIED [redacted]

I. PUBLICATIONS

a. Are required publications on hand and updated with latest revisions? ____________

List missing pubs by number from required list below:

b. Are required publications available in the missile shop or office? ____________

c. Are SPARROW missile testing, assembly and handling crews aware of publications and have easy access to them? ____________

d. Is a mandatory reading list for SPARROW crews maintained and current, including the publications listed below? ____________

REQUIRED SPARROW PUBLICATIONS

[redacted] UNCLASSIFIED

II. TRAINING

a. The minimum acceptable number of SPARROW orientated missile shop crews is two (2); each crew's nucleus content shall meet a minimum standard training requirement as defined below:

1. Crew leader of PO1 or PO2 in rate, and a graduate of formal schooling, both operator and maintenance, on assigned test AN/DSM-32 or AN/DPM-9 and, either formal schooling or one previous deployment as SPARROW crew member on handling and assembly.

2. Two (2) crew members having formal schooling or one (1) previous WESTPAC deployment as SPARROW crew member on handling and assembly. ____________

3. One (1) Petty Officer in crew with previous experience in underway replenishment. ____________

b. Does an on-the-job training (OJT) program exist? ____________

c. Verify crew competence by observing the following:

1. Is assembly accomplished in an efficient manner? ____________

2. Are authorized check sheets followed? ____________

3. Is proper handling procedures and equipment used in transport from magazine to flight deck? ____________

4. Are SAFETY precautions observed at all times? ____________

5. Is missile testing accomplished in an efficient manner? ____________

6. Are authorized testing procedures followed? ____________

7. Does test instructor have adequate knowledge of test equipment operation and maintenance? ____________

III. HANDLING EQUIPMENT

AERO-16B Skid allowance____________ on hand____________

AERO-42A Adapter allowance____________ on hand____________

AERO-49A Adpater allowance____________ on hand____________

IV. TEST EQUIPMENT

AN/DSM-32

a. Condition (general)

b. In calibration

c. Test area (general)

AN/DPM-9

a. Condition (general)

b. In calibration

c. Test area (general)

Squid Circuit Tester

a. Condition (general)

b. In calibration

Is standard test equipment, such as meters, readily available for missile shop use?

V. STORAGE AREAS AND MISSILE SHOP SPACES

a. Safety equipment

b. Compatibility

c. Housekeeping

d. Comments and/or recommendations

VI. SUMMARY OF SPARROW OVERALL COMBAT READINESS

(Make recommendation for improvement)

*DEPLOYING VF SQUADRON SPARROW WEAPON SYSTEM INSPECTION WORK SHEET

1. To conduct an orderly and complete pre-deployment SPARROW Weapon System Inspection, the following format will be followed. When the attached work sheets are completed, they will be returned to the inspection team leader.

2. The enclosed work sheets are intended as a guide for a qualified SPARROW representative with field experience.

3. Formal schooling as used here is defined as one of the following:

a. An accredited service school.

b. An accredited commercial company school.

c. A course of instruction consisting of a minimum of 40 classroom hours given by a NAVMISCEN NCTS SPARROW Field Representative.

d. A course of instruction consisting of a minimum of 40 classroom hours given by a NAESU CETS/NETS Fire Control Representative.

e. A course of instruction consisting of a minimum of 40 classroom hours given by a 2nd Class Petty Officer, or above, who has attended or instructed one of the above.

4. The SPARROW weapon system handling, assembly, loading, no voltage checks, and SAFETY are the responsibility of the squadron ordnance shop.

*SPARROW Missile Representative Inspection Work Sheet excluding the fire control system.

I. PUBLICATIONS

a. Are required publications on hand and updated with the latest revisions? ____________________
List missing pubs by number from required list below:

____

____

b. Are required publications available in the squadron missile shop or office? ____________________

c. Are SPARROW Ordnance crews aware of publications and have they easy access to them? ____________________

d. Is a mandatory reading list for SPARROW crews, including the publications listed below, maintained and current? __________

REQUIRED SPARROW PUBLICATIONS

SPARROW Safety Manual	OP3365	1 May 1966	______
Maintenance Instruction Manual F-4 Aircraft Armament System	NAVAIR 01-245FDB-2-7	Jun 1968	______
Conventional Weapons Loading Checklist F-4 Aircraft Guided Missile Combined AIM-7, AIM-9	NAVWEPS 01-245FDB-75-3		______

II. TRAINING

a. The minimum acceptable number of SPARROW orientated ordnance shop crews is two (2); each crew nucleus content shall meet a minimum standard training requirement as defined below:

1. Crew leader of PO1 or PO2 in rate and a graduate of formal schooling of F-4 Armament Systems and missile handling and assembly. ____________________

2. Two (2) crew members having formal schooling or one (1) previous WESTPAC deployment as a SPARROW crew member.

b. Does an on-the-job training program exist? ____________________

c. Verify crew competence by observing the following:

1. Is proper transport and loading equipment used including adapters? ____________

2. Are authorized assembly and loading procedures followed in an efficient manner? ____________

3. Are SAFE practices observed including cockpit switch settings, launcher SAFETY pin installation, and rocket motor SAFETY pin installation? ____________

4. Are "No Voltage" checks properly performed? ____________

5. Is proper installation of Mark 9 Ejector Cartridges verified? ____________

6. Is an authorized arming sequence followed (dry run acceptable)? ____________

7. Does crew have a working knowledge of F-4 Aircraft Armament System including ability to "fault isolate" malfunctions? ____________

III. AIRCRAFT STATUS

a. Select three (3) aircraft at random and check the following:

1. Are all SPARROW required changes and modifications installed? ____________

2. General condition of launchers? ____________

3. Pit checks of aircraft updated? ____________

4. Is a launcher cleaning stand available for squadron use? ____________

IV. TEST EQUIPMENT

a. Rocket Launcher Firing Circuit Tester P/N 53A53D1 with SEC 813A incorporated? ____________

1. Condition (general) ____________

b. Is standard test equipment such as meters readily available for ordnance shop use? ____________

V. ORDNANCE SHOP SPACES

a. Sound Attenuators available? ____________

b. Compatibility ____________

c. Housekeeping ____________

d. Test equipment stowage ____________

e. Comments and/or recommendations ____________

VI. SUMMARY OF OVERALL SPARROW COMBAT READINESS (Make recommendations for improvement.) ____________

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TAB III-H

SPARROW MISSILE DEGRADATION DURING SERVICE LIFE

INTRODUCTION

During the past several years, the NAVMISCEN has collected extensive Fleet data pertaining to the operational experience of the SPARROW missile. The purpose of this report is to summarize this data which describes the service life of the missile and the degradation in availability and reliability that occurs during Fleet operations. The primary objective of this investigation was to aid in the development of operating procedures that will optimize the effectiveness of the SPARROW weapon system in combat operations; a secondary objective was to provide information useful in the design of new systems.

BACKGROUND

a. CVA SPARROW Operating Procedures: At present, each CVA is equipped with two DSM-32 missile test sets for conducting shipboard testing of the missile G&C. Under current procedures the missiles are subjected to an AT (acceptance test) and a PT (periodic test) following a specific number of captive flights. All missiles tested NO-GO are given an additional RAF (retest after failure) and if still indicating NO-GO, the seeker and control sections are interchanged between missiles and an RAR (retest after remate) is conducted. During captive flights, missiles not evidencing a select light are subjected to an RAF.

The CVA maintains approximately 75 missiles assembled with warhead and motor in ready service storage with the remainder stored by section in deep stowage. Missiles testing NO-GO are removed to deep stowage and are offloaded to an NWS. This procedure is depicted in Figure 1.

b. During the past four years, there have been minor changes in shipboard operating procedures, primarily in changing the test frequency by increasing the number of allowable captive flights between periodic tests. At the beginning of extensive SPARROW operations in SEA, the allowable number of captive flights between periodic tests was 10 to 15, depending upon the severity of landing. Following preliminary investigations into missile availability, the NAVMISCEN recommended an increase of flights from 10 to 30.

During the past two years, all CVA's in WESTPAC have been using the 30-flight criteria. To verify the feasibility of eliminating shipboard testing, the USS FRANKLIN D. ROOSEVELT was deployed to WESTPAC under a no-shipboard trial in 1967. The data used as a basis for this report represents a cross section of missile experience obtained from CVA's operating under the above variations in test frequencies, including shore based operations.

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DISCUSSION

a. Missile Degradation During Fleet Operations: The SPARROW missile, during Fleet operations, is subjected to the following environmental conditions:

1. Captive Flight - During captive flight, the missile is electrically energized during the major portion of the flight. It is subjected to vibration, physical damage, and moisture intrusion; this phase is defined to include the loading and unloading of the missile onto the aircraft.

2. Testing - Testing is defined as the entire process of unloading, strikedown, application of energy during testing, reassembly, and loading back on the aircraft.

3. Handling - Handling includes all missile assembly, disassembly, movement to and from storage to support operations.

4. Stowage - Stowage is primarily inert stowage by section in the magazine where the environment consists of shipboard vibration and moisture intrusion.

From examination of the shipboard environment, it is concluded that the primary reasons for missile failures during captive flight and testing are energized time and physical degradation. The primary cause for failure during handling is attributed to physical damage. It is concluded in the next section that there is no significant missile degradation due to shipboard stowage.

b. Data Sources: The importance of the sources of missile experience data cannot be overemphasized. The first complete and accurate information describing missile experience was obtained from the USS RANGER, following a WESTPAC deployment in 1966. Representatives of the NAVMISCEN visited the RANGER and concluded that the data was valid, was recorded conscientiously, and originated from a missile shop that operated in an outstanding manner. The data contained the results of 7,225 captive flights and 2,851 missile tests. The USS RANGER followed the operating procedures shown in Figure 1, and had an average test frequency of seven captive flights per missile test. The RANGER off-load was processed by NWS Concord and the DSM-32 shipboard test results were verified by the DPM-7 testing during NWS processing. The records were changed to reflect the DPM-7 test results. From the RANGER data, much information was obtained such as the acceptance rate of the missile load-out, the reject rate of the acceptance testing, the percentage of missiles rejected by the select light, the false reject rate of the select light, the false reject rate of shipboard testing and the percentage of failures incorrectly indicated by the select light.

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The RANGER data was used as the basis for much of this report and was verified by the data obtained from the other following sources:

1. USS FRANKLIN D. ROOSEVELT - Extensive data was obtained from a deployment operating on a no-test plan with procedures shown in Figure 2. The missile load-out was processed by a team from NARF Norfolk, and at the completion of the deployment the identical team processed the off-load. All missiles that failed during the deployment, as evidenced by loss of the select light, were shipped to QEL Concord for evaluation.

2. USS CORAL SEA - Data was obtained from two separate deployments of the USS CORAL SEA. During one deployment the test frequency was 10 to 15 flights per test, and during the other deployment was approximately 30 flights per test.

3. USS KITTY HAWK - The data obtained from the USS KITTY HAWK was recorded while operating on a test frequency of 10 to 15 captive flights per test.

4. VMFA-531 - Data obtained from VMFA-531 describes a shore based environment operating under a no missile test procedure utilizing the aircraft select light to determine missile status. The missile population consisted of new production AIM-7E's. A large sample of the missiles were shipped to the NAVMISCEN for evaluation following the reported deployment.

In addition to the above, spot checks of other CVA's have been performed during the past several years whenever data has been available.

c. Results:

1. Missile Degradation Due to Captive Flight - Missile degradation due to captive flight alone is shown on Figure 3. The curve represents the probability of survival versus the number of captive flights. The curve closely follows an exponential distribution indicating a constant failure rate (λ) as would be expected for an electronic device not significantly affected by aging or use. The curve represents the USS RANGER experience verified by all of the other data sources.

2. Missile Degradation Due to Captive Flight and Missile Test - The failure rate (λ) due to missile testing was calculated to be .0348 missiles per test. Using this failure rate, a series of curves was plotted on Figure 4 representing the combined effect of missile testing and captive flight. The curves were verified from the data sources that were operating under the indicated test frequency.

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3. Missile Degradation Due to Physical Damage - Missile degradation due to all forms of physical damage is shown in Figure 5 as the probability of survival versus loadings and unloadings. This information is not considered further and is only provided for information. The curve was plotted from data obtained during the USS FRANKLIN D. ROOSEVELT deployment and would vary widely between CVA's depending upon the care and attention of the operating activities in sway brace adjustment and missile handling.

4. Missile Degradation Due to Stowage - Inputs from NWS personnel have indicated that AE off-loadings of SPARROW missiles that had been at sea for extended periods of time indicated a very low rate during NWS processing. The only factual information to substantiate these inputs was obtained following the FRANKLIN D. ROOSEVELT no-test deployment. A sample of 48 AIM-7E's processed at the completion had zero flight time and was only subjected to shipboard storage. The reject rate of this sample was approximately 4 percent, which compares favorably with the reject rate of new production missiles. It was therefore concluded that the shipboard stowage had a negligible effect on missile degradation.

d. Missile Reliability: All of the previous discussion has been in terms of missile availability or probability of survival versus captive flights. The important question to be answered is the effect of test frequency on missile free flight guidance reliability. If the missile is tested prior to each captive flight, we would be assured of maximum missile reliability. During PMT firings at the NAVMISCEN, this is exactly the case. All firings are preceded by a missile test with expert technicians using the DPM-7 test set. A select light is maintained during captive flight and the launch is performed under controlled conditions by an experienced SPARROW pilot. The average reliability maintained over the years for successful guidance is approximately 71 percent. This number is then assumed to be the maximum inherent reliability that could be attained. If the missile is flown on additional captive flights without testing, then certainly there would be a decrease in reliability versus captive flights with the curve starting at the maximum reliability of 71 percent. The curve is a compilation of all of the preceding data and represents undetected missile failures occurring during captive flight while a select light is maintained. From observations of Figure 6, the probability of the missile successfully guiding on a target following 30 captive flights is approximately 55 percent.

To determine the change in reliability due to test frequency, the average missile reliability for missiles tested every 10 captive flights was compared to the average missile reliability for testing every 30 captive flights; there is a theoretical decrease of 4 percent in reliability by extending the test frequency to 30 flights. The term theoretical is used because the decrease in reliability does not consider errors, false reject rate, and missile degradation caused by testing.

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CONCLUSIONS

a. Missile Degradation During Fleet Operations: It is concluded that the SPARROW missile, in Fleet operations, degrades at a constant failure rate due to captive flight and testing. A compilation of all of the data indicates no significant change in failure rate during the past several years. The missile degradation due to physical damage is variable depending upon the using activity and indicates an increasing failure rate with increasing missile loadings. The degradation due to inert storage in a shipboard environment is negligible. There is no measurable difference in the missile failure rate between shore based and CVA operations.

b. Missile Reliability: The theoretical decrease in missile reliability of 4 percent, caused by extending the test frequency from 10 to 30 flights, does not consider any other aspects of the system, such as the accuracy of the test equipment.

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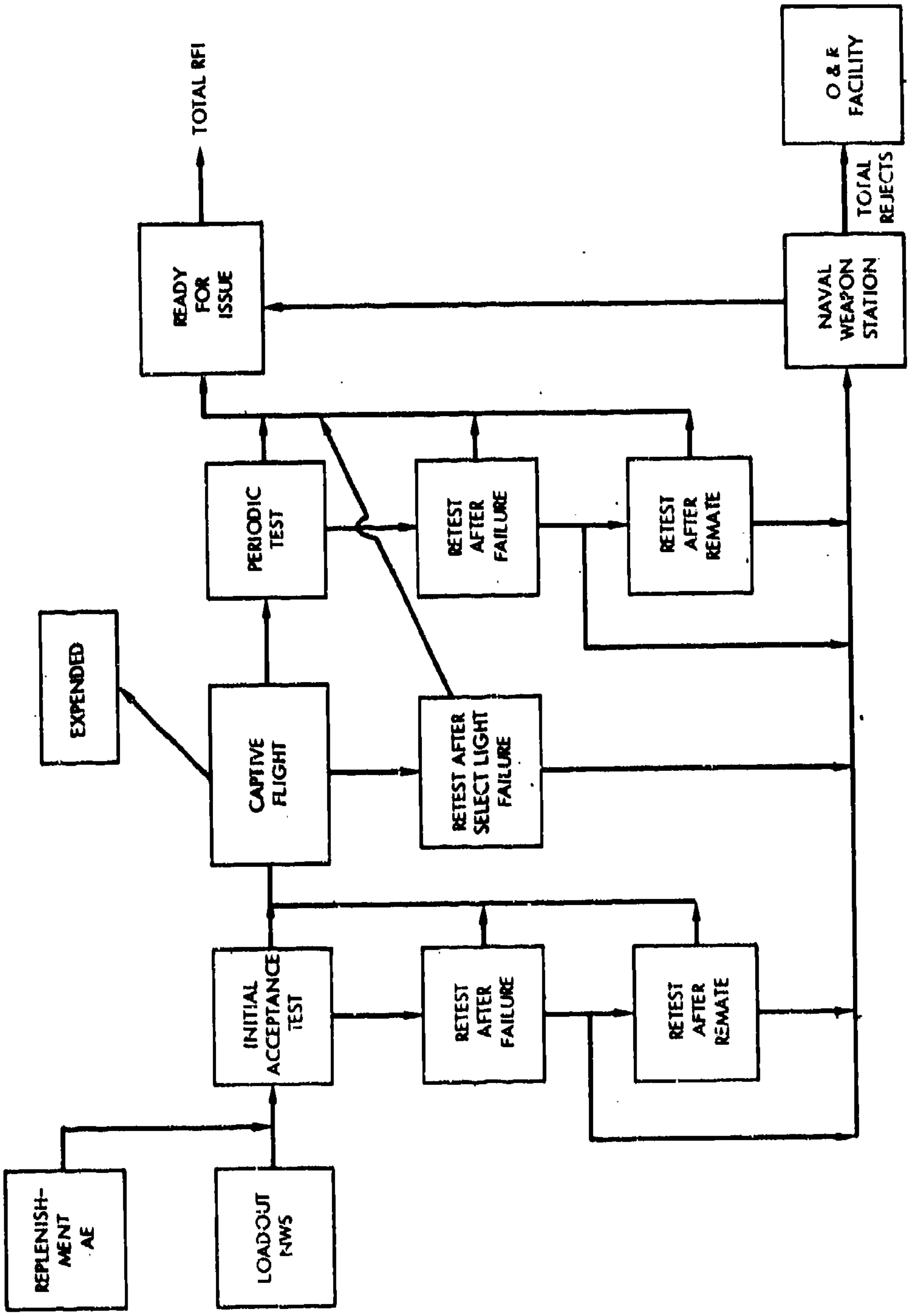

Figure 1. SPARROW Logistics

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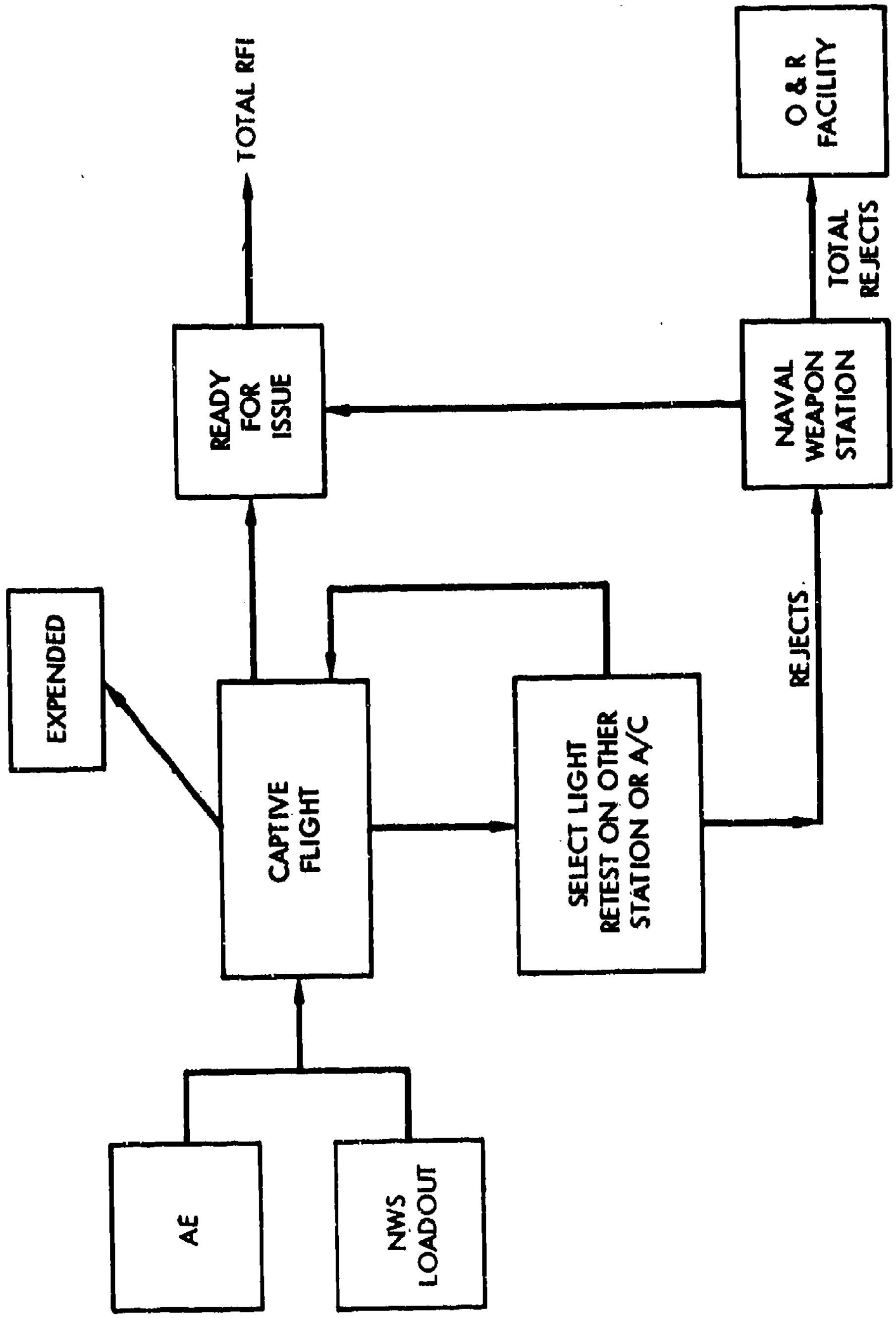

Figure 2. FDR Logistics

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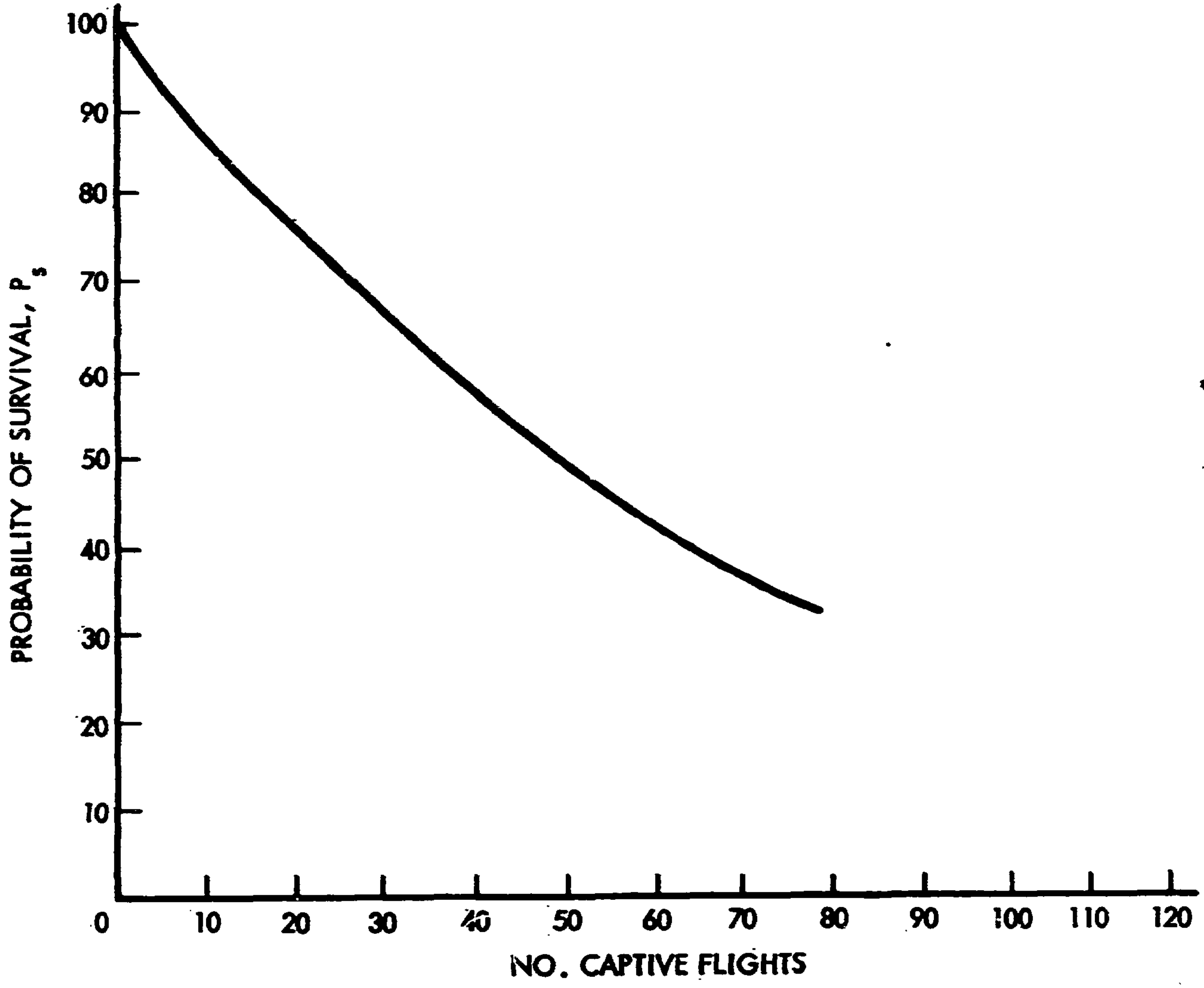

Figure 3. Missile Degradation due to Captive Flight

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[redacted]

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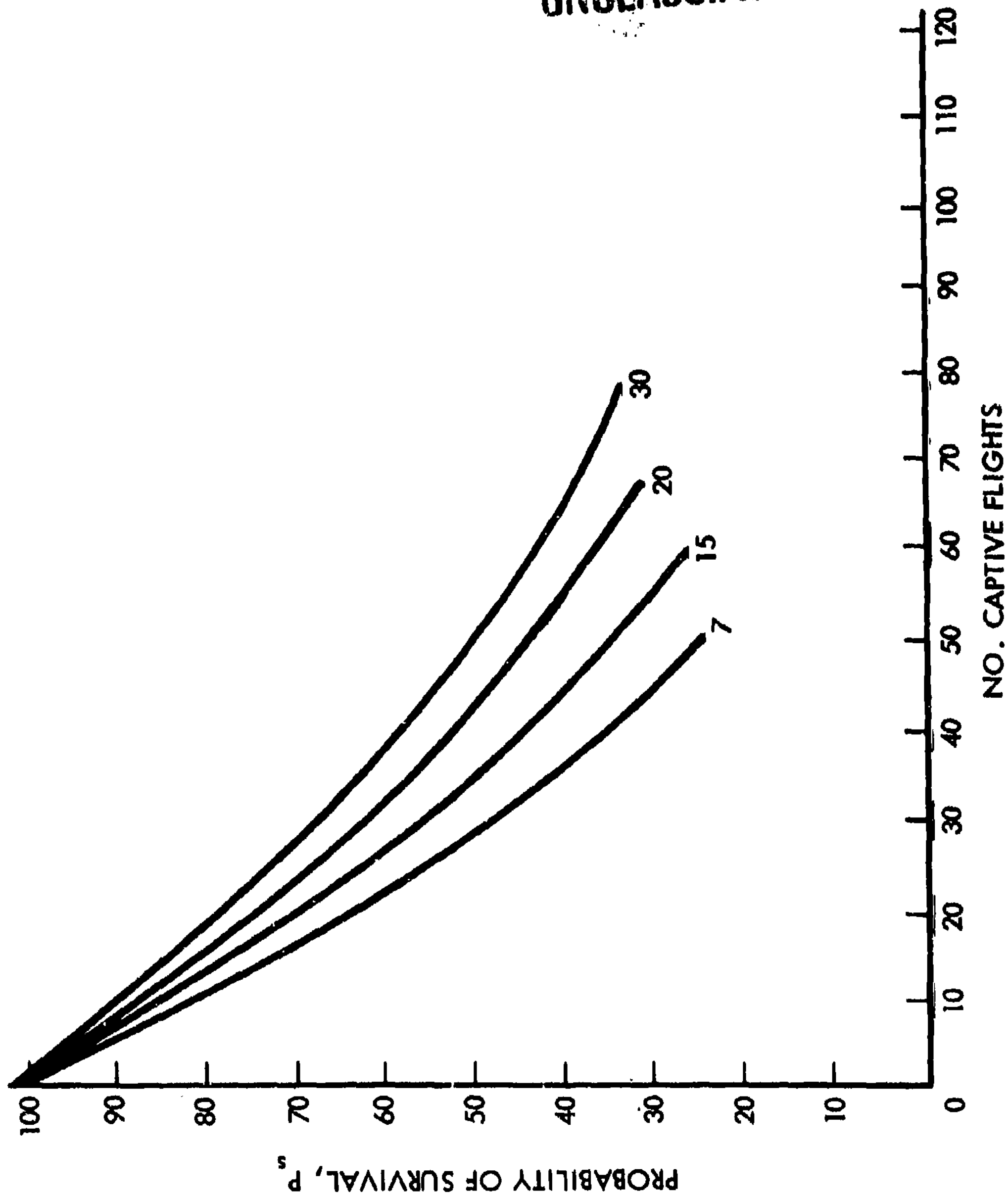

Figure 4. Missile Degradation due to Test and Captive Flight

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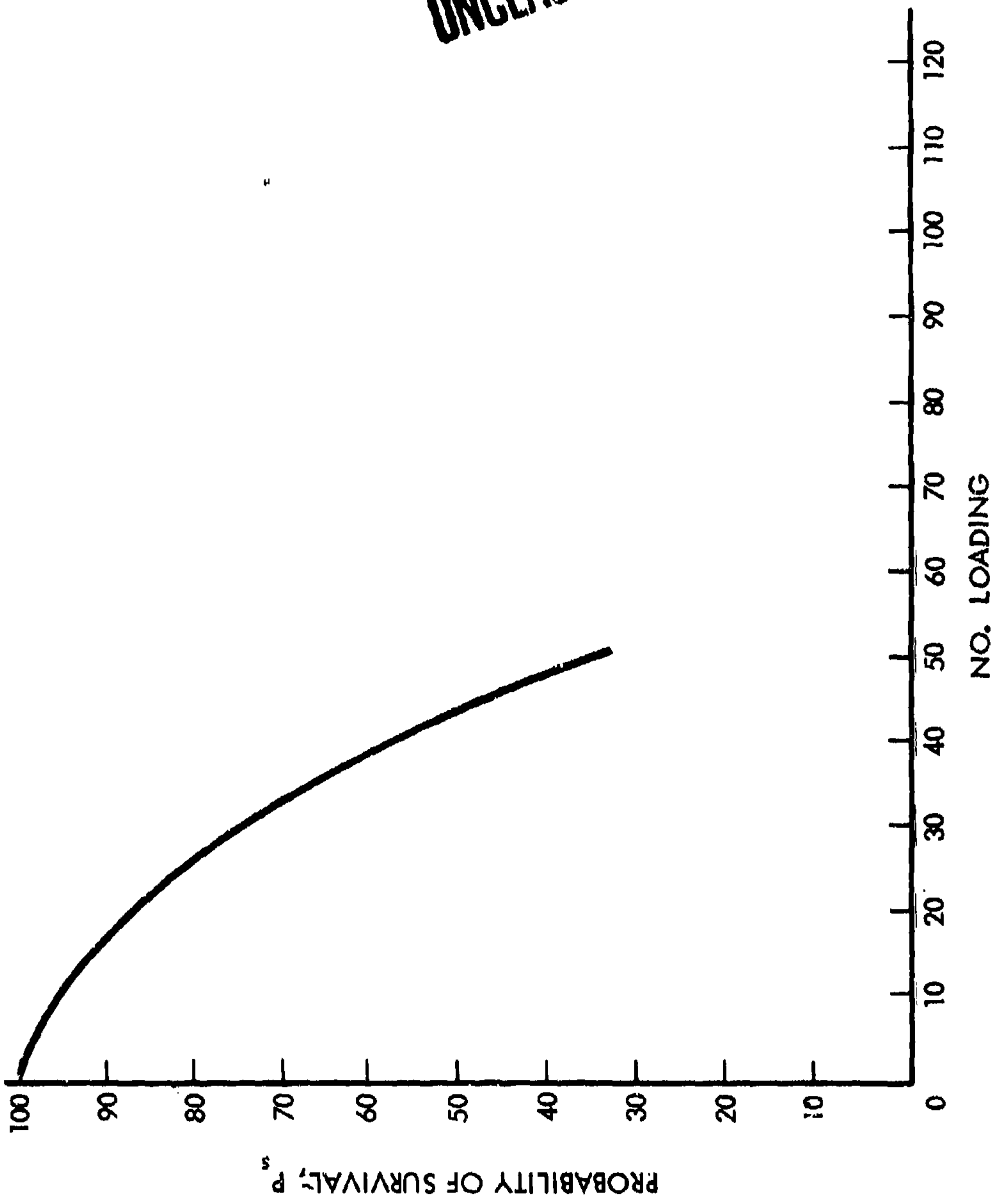

Figure 5. Missile Degradation due to Physical Damage

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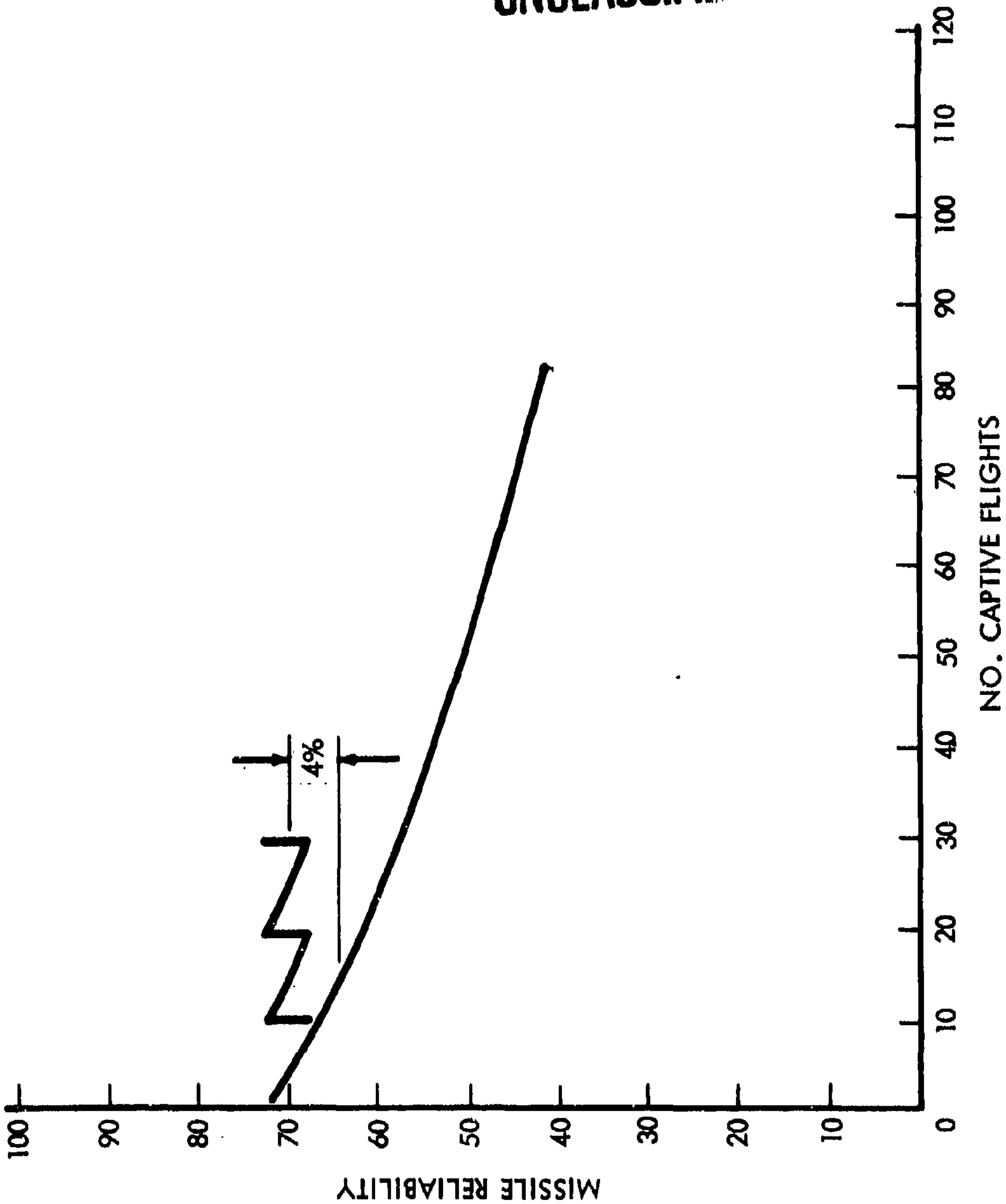

Figure 6. Missile Reliability versus Captive Flight

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SPARROW SHIPBOARD PROCEDURE

The following is proposed as the allowable procedure to permit SPARROW missiles to remain on aircraft overnight aboard ship. Compliance with this procedure would not create a safety hazard and would eliminate extensive missile handling and loading.

1. Aircraft

   a. Electrical/Avionics maintenance will NOT be performed.

   b. Master Armament switch to OFF.

   c. Missile Power switch to OFF.

   d. Selective Missile Jettison switch to OFF.

   e. Missile Control Safe/Arm switch to SAFE.

   f. Generator Control switches to OFF.

   g. Missile Control Interlock IN.

   h. Armament Safety Override switch OUT.

2. Missile/Launcher

   a. Motor Safe/Arm switch to SAFE and red pennant attached.

   b. Launcher safety pin installed.

AIR-TO-AIR GUIDED MISSILE SAFETY STUDY

A weapons system, in addition to its primary purpose, must provide protection to personnel, equipment, and property, and must prevent such inadvertent events as launch, release, arming, or detonation. Two basic methods are available for providing the required safety - features designed into the system and administrative control over the system. Design is the more desirable method of achieving the required safety; however, effective human engineering can reduce a safety problem considerably.

Much of the needed safety can be designed into the system, but where design safety is not possible, reliance must be placed on administrative control and strict adherence to operational procedures. The system must be safe; however, it must also be useful. In conducting an analysis or evaluation, maximum safety consistent with operational requirements must be recognized and taken into account. Hazards should be identified and eliminated when possible, or controlled if they cannot be eliminated.

The scope for this safety study shall include the weapon, delivery vehicle, fire control system, ancillary equipment, and documents. Appropriate Navy safety manuals, Navy safety standards, and weapons manuals will be used as guidelines to determine if safety requirements have been met.

When a study group determines that safety requirements are inadequate or cannot be compiled with, procedures should be recommended to provide administrative safety in lieu of the desired safety requirements. Administrative safety procedures will be used as interim requirements until official action has been taken.

Composition of Study Group

The Air-to-Air Guided Missile Study Group shall be organized with one member from each of the following organizations:

- NWEF, Chairman
- CNO
- NAVAIRSYSCOM
- CAW's/CVA's
- COMNAVAIRLANT
- COMNAVAIRPAC
- NAVAIRSYSCOMREPLANT
- NAVAIRSYSCOMREPAC
- OPTEVFOR
- Marine Corps
- NWS's
- NWL Dahlgren
- NAVMISCEN
- NWC China Lake
- NAVAVNSAFCEN
- NATC
- NAMTG
- NAVORDSYSCOM
- Contractors

The designated representative from each command is expected to be cognizant of his command's position, policies, plans, and responsibilities relative to the weapon systems and to be the voice for that command in these areas. Study Group members are encouraged to bring advisors to provide technical information for consideration by the Group.

The NWEF project engineer is responsible for coordinating the plans and the preparations prior to the study and for the timely dissemination of the Group findings upon completion of the study.

Conduct of the Safety Study

General requirements shall be prepared and a planning letter sent to all interested activities stating the general purpose, scope, and intent. Items for review in addition to those outlined in the letter shall be requested.

An analysis of troublesome safety problems encountered, unsatisfactory reports, ordnance incident reports, failure reports, and Board of Inspection and Survey Trials, will be performed by the Study Group to obtain an over-all view of a weapon system's operational history. Presentations from various ships and stations shall be obtained to determine areas of design, documentation, personnel, or operations that pertain to safety and are of a constructive nature, in addition to undesirable or unsatisfactory conditions.

Demonstrations in handling, storage, maintenance, and launch/firing preparation of a weapon or system shall be required by the Study Group when necessary. Evaluation, for possible safety influence, shall be made of technical manuals, procedures, and practices in their actual environment.

The Study Group shall relate a system's operational history to weaknesses observed during the safety study to determine if design improvements are required to maintain an adequate margin of safety.

Study Group Evaluation Guides

The listings which follow are minimum features which should be observed for evaluation of a system's safety. Additional items may become necessary, depending on the system being considered.

1. Publications

2. Handling Equipment

3. Test Equipment

4. Operational Safety Procedures

5. HERO

6. Shipboard Safety Procedures
7. Stray Voltage Tests
8. Firing Circuit Tests
9. Loading Procedures
10. Built-in Safety Features
11. Personnel Training
12. Igniter/Pyrotechnic Characteristics
13. Storage

Maintainability and Reliability Trends of Air-launched Weapons and Weapon Control Systems

INTRODUCTION

The purpose of this paper is to provide information on the current maintenance and reliability trends of Navy air-launched weapons and weapon control systems and some estimates on how microelectronics could affect these trends.

Addressed herein are current and planned weapons systems, especially SIDEWINDER, SPARROW, BULLPUP, WALLEYE, SHRIKE, PHOENIX, and CONDOR, and primarily the two existing weapon control systems in the F-4 aircraft, namely the AERO 1A and AN/AWG-10. Data are not tied to a specific weapon system and trends are presented instead of specific values.

To determine the impact of microelectronics on current trends, the following factors are considered as advantages of microelectronics:

Increased reliability

Decreased size, weight, and cost.

MAINTENANCE

The general trend in Navy weapon systems today is an increasing awareness of maintainability. When combat aircraft face problems in an aircraft carrier because of the increasing requirements for avionics maintenance spaces, the subject of maintainability obtains command attention. A program called "Improved Rearming Rates" has as one of its objectives to handle all air-launched weapons as "all-up-rounds". For the past several years much work has been done in container design and logistic planning, and by 1970 the weapons will be shipped and handled as complete rounds with a minimum of maintenance requirements.

There are three levels of maintenance - organizational, intermediate, and depot. In the logistics cycle of weapons the levels of maintenance are:

	Past	Present	Future
Ship	Test	1/2 Test	None
NWS	Repair	Test	Test
NAVAIREWORKFAC	Overhaul	Repair	Repair

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The NWS in addition to testing the G&C includes physical inspection of all components. The NAVAIREWORKFAC overhaul consists of refurbishing mechanical portions, adjusting the weapon to production specifications, and replacement of failed components.

The weapon control systems are also maintained at three levels:

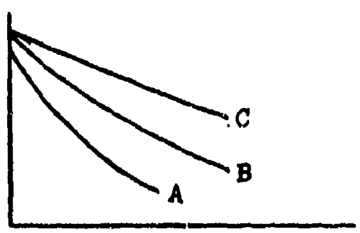
	Past	Present	Future
Squadron	Repair/Replace/Harmonize	Replace	Replace
Ship	Repair	Repair/Replace	Replace/Repair
NAVAIREWORKFAC	Overhaul	Overhaul	Overhaul

The trend here is clearly toward replacement only in the field, with very little actual repair. This trend will be increased by increasing use of microcircuitry, for obvious reasons, but a need for repairing connectors, wiring bundles, and the like will remain. In addition to these three formal levels of maintenance there is really a fourth consisting of an in-flight test of the system, using on-board or built-in test equipment for which the trend is toward highly automated, rapid verification of the performance of the weapon control system. These tests, together with operator complaints and periodic ground tests, are used to determine when maintenance is necessary.

TESTING

The first element of maintenance to be considered is testing. The only purpose of weapon testing at the organizational and IMA level is to verify status, since repair is not accomplished at these levels. The following is typical of the trend in weapon testing:

P_s
Probability
of Survival



Time ⟶

A-Periodic Testing

B-No Test

C-No Test with limited on-aircraft test

The curves are extracted from a comprehensive study completed on weapon availability. It was concluded to fly X number of flights with the missile without periodic testing and send the weapons to an NWS for testing.

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None of the attributes of microelectronics would affect this trend toward less testing. Increased reliability, if attained, would accelerate the trend to eliminate testing, if anything.

While missiles are receiving fewer tests, the weapon control systems are being tested more frequently and in more detail. These tests are normally required to perform two functions - determine the operational status of the weapon system (performance verification or confidence testing) and, in the event of a failure in the weapon system, to locate or assist in locating the fault.

The performance verification function normally provides for a detailed periodic ground test of the status of the weapon system and for a rapid and less detailed in-flight status check. The in-flight check, in the event of a failure, or degraded performance, should provide enough information to permit the selection of an alternate mode of usage for the weapon system while the aircraft is on the way to the target. This in-flight status requirement makes some sort of built-in test a necessity. Microcircuitry appears well adapted to built-in test requirements.

BITE (built-in test equipment) is also used to assist in the "fault isolation" function of the maintenance task. While, in fighter or interceptor aircraft, the replacement of faulty black boxes must be done on the ground, the fault isolation can be done while the aircraft is airborne, using BITE. However, if the BITE is programmed to play the percentages and locate the most frequently expected, predictable failures it is of little use unless it is also programmed to solve the difficult trouble-shooting problems. As an example, one complex airborne fire control system which has been in the Navy inventory for several years has long been considered a maintenance problem. The average time spent trouble-shooting this system exceeds 30 minutes per symptom. This average would be higher were it not for the fact that trouble-shooting attempts for non-critical faults are often stopped if the source of the trouble cannot be found in a few hours. Nevertheless, 50 percent of the trouble-shooting actions are completed in less than 10 minutes, and a great many take no time whatsoever since the failure can be located immediately based on the nature of the symptom and the technician's experience. Were an automatic fault isolating aid to be applied to this system, it would have to correctly locate considerably more than the 50 percent of the faults which are now found in 10 minutes in order for it to be worthwhile from the standpoint of time savings. As more and more functions are packaged into a single replaceable module, or unit, the old-fashioned method of trouble-shooting by trial and error may prove to be as efficient as more technologically advanced methods.

REPAIR

The other elements of maintenance to be discussed are repair and overhaul, which for weapons are essentially the same process. All weapons that are rejected during the operational cycle are processed to a NAVAIREWORKFAC from an NWS for repair. As stated, some mechanical portions are refurbished and all failed components are replaced. To date there is no evidence to indicate that any of the systems have entered the wearout portion of their life, and several systems studied demonstrate a constant failure rate. With minor exceptions, there are no limited duty components that are replaced periodically. All work is accomplished by civilians in a production facility. It is difficult to see how microelectronics would affect the repair cycle. One system presently under evaluation is probably indicative of the trend. This particular system is of solid state design. The decrease in size and weight over its cordwood predecessor allowed a larger motor to be utilized, and much of the remaining available space was utilized for additional circuitry to increase weapon capability. The microelectronics components in this system are potted throwaway units, and due to the state-of-the-art in qualification testing, the components are not qualified, meaning they are single source components. The trend therefore is that the weight and space savings provided through improved techniques is utilized to increase weapon capability rather than maintainability.

The trend to throwaway modules naturally greatly reduces the amount of actual repair which must be done in the intermediate maintenance shop aboard ship. Here, as at the squadron level, the time and manpower consuming effort is devoted to trouble-shooting rather than repair. Because of this, the requirements for avionics maintenance spaces aboard an attack carrier are greatly expanding due to the ever-increasing amounts of specialized test and trouble-shooting equipment being procured. To reverse this trend, much effort is being devoted to the development of systems such as VAST (Versatile Avionic Ship Test System) which will provide testing, fault isolation, and checkout of a great variety of avionics equipments, systems, universal Line Replaceable Units, and modules, through use of a centralized test facility. It is presently the policy of the Navy that all new system developments and acquisitions shall have appropriate sensors and test points incorporated so as to be compatible with these centralized automated test systems (reference NAVMATINST 3960.4 of 31 July 1967). This requirement must be considered in the design of any new system and in the design of microcircuits themselves.

RELIABILITY

The reliability of Navy weapon systems has not changed significantly during the past four to six years. The emphasis has been on increasing performance and capability. As component reliability increases, the addition of functions to the weapon keeps the overall reliability essentially the same. On one air-to-air system the Navy is presently evaluating the fourth generation of the original weapon. The performance envelope and increased capabilities have been greatly extended; however, the single-shot kill probability of the overall system will show little change. The maintenance requirements have changed, but the change has been independent of design and is attributed to changing policy in the Navy. A new air-to-surface weapon recently introduced can be compared to a system that has been operational for seven years. Due to breakthroughs in technology, the accuracy of the new system is significantly greater; however, the two systems are comparable in reliability despite incorporation of state-of-the-art design and manufacturing techniques.

As with the missile, the emphasis in weapon control systems over the last number of years has been on increased performance and capability and on providing several alternative modes in which the system can be used. This ability to select any of several modes, based on the operational status of the weapon control system at that time, has increased the reliability of the overall system; however, the total number of maintenance actions required to keep the system at or near a 100 percent "up" status has not significantly changed, so that maintenance and logistics problems have not been appreciably eased by this increased reliability. If this trend toward added complexity continues, it can be expected that the much-heralded reliability of microelectronics will have little overall effect on the Navy's maintenance and logistics burden.

FAILURE MODES

Having treated maintenance and reliability of current weapon systems, the effect of microelectronics on reliability, will be addressed by a brief look at the types of failures experienced in operational use.

Between the air-to-surface and the air-to-air systems, two separate environments are experienced. An air-to-air weapon is flown on an aircraft as an integral part of the system to be available on short notice at some time on some flight. Captive flight cycles of 50-100 flights of several hours duration would not be unusual, while an air-to-surface weapon is loaded on an aircraft for a planned, specific target at a specific point in the flight. Seldom are air-to-surface weapons flown more than one captive flight. Considering the two different requirements, the types of failures being experienced can be predicted:

a. <u>Air-to-Air</u> - Moisture, corrosion, physical wear, and damaged connectors are the primary problems. After significant improvements in electronic design, a $20K missile requires the installation of $.22 of tape about 20 feet long to keep the accumulated moisture out prior to flight.

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b. Air-to-Surface - The majority of weapon system failures of air-to-surface weapons can be attributed to the aircraft, which is subjected to the moisture problems of the air-to-air weapon. The one major problem of the weapon itself would probably be quality control.

In general, the problems could be summarized by stating that they are not component failures but problems that probably plagued Edison - connections, interconnecting wires, aging wire bundles, all complicated by moisture and corrosion. During the recent introduction of a new aircraft incorporating very sophisticated systems, an entire squadron was temporarily out of action due to rain's shorting out the electrical system caused by one connector in the aircraft wing.

CONCLUSIONS

It is concluded that maintenance concepts, and not design, govern the maintenance requirements.

Improved techniques such as microelectronics could provide greater choice of maintenance concepts; however, to date the advantages of micro-electronics have been utilized to increase performance and capability with little application to maintenance or reliability.

The trends discussed indicate that maintenance at the organizational level is decreasing, but not as a result of changes in technology.

Deficiencies in avionic systems still consist of the age-old problems of interconnecting circuitry and quality control.

It is concluded that overall weapon reliability is remaining essentially constant even though component reliability has significantly increased due to improvements in technology.

Fire control system reliability could be described as increased because of the redundancy provided by additional modes available; however, Mean Time Between Maintenance Actions stays essentially the same for old and new systems.

In closing, the final conclusion is that microelectronics and other improvements in electronic design can undoubtedly increase system maintenance and reliability. The inherent reliability of microelectronic circuits together with redundancy permitted by the decreased size and weight could significantly decrease the maintenance burden on the Navy; however, there is no evidence at this time that this is occurring.

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Funding Estimates

1. All of the recommendations of Task Team Three are considered adequately covered within fiscal planning for current programs with the exception of the following:

a. Items for which funding estimates are possible:

Paragraph	Subject	Costs (x 1000) Initial	Recurring
I. C.	Training Equip. for NAMTRADETS	60	6
II. A.	Aircraft/AMCS Maint. Pubs.	500	-
II. C.	Loading Manuals/Check Lists	100	10
III. C.	Augmented Maint. Support	300	300
V. A.	Safety Review	200	-
VI. A.	AIM7/AIM-9C Logistics	2,500	100
VII. A.	AIM-7 Handling Equip. (Ships)	10	10
VII. B.	AIM-7 Handling Equip. (Shore)	60	6
VII. F.	RFNA for AWG-10	4,136	100
VII. G.	F 4/AERO-7A Pit Checks	235	50
	TOTALS	8,101	582

*Includes $2,000K for AIM-9C if retained in inventory.

b. Items for which further investigation is required:

I. G. Programmed Instruction

VII. E. Missile System Test Sets

REPORT

OF THE

AIR-TO-AIR MISSILE SYSTEM

CAPABILITY REVIEW (U)

JULY–NOVEMBER 1968

APPENDIX IV

APPENDIX IV

NAVAL AIR SYSTEMS COMMAND

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APPENDIX IV

REPORT OF TASK TEAM FOUR

Chairman: Captain M. H. Gorder, U.S. Navy
Office of the Chief of Naval Operations (Op 561E)

"Does the combat aircrew fully understand and exploit the capabilities of the aircraft-missile system?"

"Is the aircraft-missile system properly designed and configured for the air-to-air mission?"

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INTRODUCTION

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A. The mission of Task Team Four was to determine if combat aircrews understand and exploit the capabilities of F4 and F8 aircraft-missile systems and if the aircraft-missile system is properly configured for the air-to-air mission. In addition to the problems discussed at the air-to-air symposium, Captain Ault and the task leader visited all U.S. Navy and Marine training and support bases in CONUS as well as NAS Roosevelt Roads, NAS Cubi Pt., USAF 6400 Test Squadron at Clark AFB, USS America (CVA 66), USS Coral Sea (CVA 43), USS Inteprid (CVS 11), USS Hancock (CVA 19) and USS Constellation (CVA 64). All associated personnel involved in the training and fleet fighter squadrons, homeported or embarked in these bases, were consulted concerning problems, conclusions or recommendations concerning aircraft missile system employment and configuration as well as aircrew performance.

B. The major portions of the report and the reported problem areas pertain to combat readiness, aircraft-missile system performance and aircrew performance.

C. In order to evaluate the relative importance of the problem areas and to determine the point in the operational cycle that the problems occur, the following data was used to describe the SPARROW system reliability.

	New[1] Production	Fleet[2] CONUS	Combat[3]
I AMCS	.87	.57	Cannot distinguish missile failure from AMCS failure.
II Missile	.82	.65	
III (I X II) (Product)	.72	.37	.34
IV Misfire	.98	.87	.75
V Aircrew	.99	.96	.68
VI Fuzing	.81	.73	.74
Total	.57	.23	.13

[1]PMT data from NAVMISCEN
[2]SPARROW shoot data from FMSAEG
[3]"Red Baron" data augmented with last Navy firings.

D. Similar information was used to evaluate the SIDEWINDER system reliability.

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E. All associated areas such as training and readiness procedures, predicted missile envelopes, training aids, human engineering, cockpit displays, and aircraft-missile system designs were studied in order not only to do better what we are doing, but to do it differently if the sensitivity analysis showed that a new approach or procedure would increase aircraft-missile system and aircrew reliability.

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I. TRAINING AND READINESS

A. Availability of Assets During CONUS Turnaround

Conclusions

1. At present F4/F8 squadrons have insufficient aircraft and personnel to train fully in the air-to-air missile environment. Assignments of deployment aircraft come late in the turn-around cycle, without sufficient time to conduct aircraft/system check-out and missile firings. Training commitments for the air-to-ground mission for VF squadrons further complicate the problem.

2. Increased air-to-air/ACM/Missile training is required during turn-around cycles for aircrews and enlisted personnel.

3. By October 1968, the F4 rework/MOD program had improved sufficiently to permit assignments of all aircraft to ENTERPRISE F4 fighter squadrons (VF92/96). All subsequently deploying F4 squadrons (e.g., those in Kitty Hawk/JFK/Saratoga) will have all assigned aircraft in sufficient time to conduct adequate aircrew training. The F8 MOD/rework program will not have improved sufficiently to permit F8 fighter squadrons to have all assigned aircraft until after January 1969. COMSEVENTHFLT has indicated a desire to reduce the air-to-ground commitments for VF squadrons.

Recommendation

CNO and Fleet and Task Force Commanders re-examine the necessity for continuing commitment of VF squadrons to air-to-ground missions in Southeast Asia and re-emphasize the fighter mission for fighters. The bombing pause in SEA, coupled with the increased ordnance carrying capabilities of the A7 and A6 squadrons, could make possible the reduction of VF ground attack mission commitments as VA aircraft become available in sufficient numbers and thereby permit primary emphasis by VF squadrons, on the air-to-air mission.

B. Forward Area Operational Training

Discussion

As a result of the Navy's air-to-air missile system performance in combat in SEA, CTF-77 has issued a directive re-emphasizing the requirement for conducting air-to-air missile training in the forward area in order to achieve improved readiness through strict adherence to prescribed maintenance procedures, aircrew continuing review of weapons systems capabilities and limitations, air combat maneuvering training, and periodic missile firings while deployed. The Commander SIXTH Fleet is presently exploiting the USAF Wheelus complex in an effort to exercise all VF squadrons while deployed in the Mediterranean.

Review of Fleet firings indicates that there are frequent cases where only a limited number of aircraft assigned to a squadron are utilized during missile training exercises. It appears that the primary emphasis is placed on qualifying aircrews and expending missile allowances rather than on <u>qualifying all squadron aircraft</u>.

<u>Conclusions</u>

1. Air-to-air combat readiness in the forward areas must be sustained to at least CONUS levels and enhanced, if possible.

2. No program is in existence to ensure that all squadron aircraft have been fully certified as able to launch and guide missiles.

<u>Recommendations</u>

1. Conduct firing programs at the Atlantic Fleet Weapon Range, Wheelus, the Pacific Missile Range, at Okinawa and at the USAF Poro Point, R.P., firing range. Place sufficient support equipment and personnel at Wheelus, Naval Air Station Cubi Point, and Naha to monitor and provide technical assistance. FMSAEG assist with telemetry and analysis as required.

2. Certify an aircraft as qualified only when it has successfully launched missiles which intercept the target within the lethal radius of the missile warhead. Require all aircraft to continue launching missiles until this is accomplished.

3. USN: Qualify each squadron aircraft and aircrew upon arrival at WESTPAC and once subsequently during WESTPAC deployment.

USMC: Qualify aircraft upon arrival into SEA (Southeast Asia) and at least once a year thereafter.

4. COMSIXTHFLT conduct similar qualification firings at range facilities available in the Mediterranean.

5. CTF 77 and COMFAIRWESTPAC investigate the need for a maintenance team to assist squadron personnel in "peaking" aircraft for firing upon arrival at Cubi Point. This team could be comprised as follows:

1 NAVISCEN Representative
1 Raytheon Representative
1 McDonnell-Douglas Representative
1 Westinghouse Representative
3 Navy AQ Ratings
2 Navy AO Ratings

6. Type, Fleet, and Task Force Commanders establish procedures to ensure the missile qualifications of all assigned fighter weapon systems as well as aircrews.

7. FMSEAG institute a special analytical program to evaluate forward area training firings in order to:

(a) Provide meaningful data on training results for Fleet use.

(b) Assist in monitoring progress with aircrew/aircraft missile qualification.

(c) Provide data on training/qualification results needed for justification of the forward area training program to OSD and elsewhere.

C. Live Missile Training Allowances

Conclusions

Presently the Non-Nuclear Ordnance Requirements (NNOR) Manual provides each operational pilot with two missiles per year of each type carried. This is not a sufficient missile allowance to meet the expenditures realistically needed for training. F4 aircrews should be provided with one Sparrow (AIM-7D/E) and one Sidewinder (AIM-9B/D) in the Carrier Replacement Wing (RCVW). The training allowance should also provide two Sparrows (AIM-7D/E) and two Sidewinders (AIM-9B/D) per year per pilot in fleet squadrons. F8 pilots should be provided with one Sidewinder (AIM-9B) in the RCVW and two Sidewinders (AIM-9B/D) per year in fleet squadrons. These should be exclusive of ORI, ORE, air demonstrations and other requirements.

Recommendations

1. CNO revise the NNOR based on the above requirements and adjust current missile allocation on an individual basis in order to meet all CINCPACFLT and CINCLANTFLT requirements. Squadrons should give higher priority to missile firing in order to insure total system reliability. It must be recognized that in order to provide total system reliability, a concentrated effort must be applied in the firing area.

2. To optimize the utilization of assets, priority should be given to the expenditure, in training, of the older missile in the inventory (i.e., AIM-9B and AIM-7D). AIM-9D's and AIM-7E's should be expended only where clearly justified by reason of training benefit to be derived (e.g., AIM-7E against BQM-34(IMK)). AIM-7E-2's should not be expended in training until considerable improvement in the current asset situation is realized.

3. Dummy warheads and telemetry packs should be programmed on a one-for-one basis for each live training missile programmed.

D. Inert Training Missile Allowances

Conclusion

There are presently insufficient Sidewinder (AIM-9D) inert captive missiles available in the fleet to meet squadron and RCVW training requirements.

Recommendation

Each VF squadron's inert captive missile training allowance should be four AIM-9D's and each VF RCVW squadron's inert captive missile training allowance should be eighteen AIM-9D's. This air-to-air missile training deficiency should be resolved at the earliest possible date.

E. Post Graduate Fighter Weapons School

Conclusion

Since the Fleet Air Gunnery Unit (FAGU) was decommissioned in 1960, there has been a great loss of expertise and continuity in the air-to-air weapons systems capability within Navy fighter squadrons. There is a need to establish a fighter weapons school to reverse this trend and to eliminate aircrew and ground personnel error in weapons system and air-to-air missile performance. TAB A expands on this concept.

Recommendations

Establish a fighter weapons school in the RCVW at NAS Miramar to train Weapons Training Officers and supervisory personnel of all fighter squadrons. This training should be conducted during the squadron turn-around training cycle.

F. Air Combat Maneuvering Range (ACMR)

Conclusion

Close-in aerial engagements in Southeast Asia (SEA) have imposed upon aircrews (F4 and F8) the requirement to visually estimate "in range" firing parameters for air-to-air missiles in "heads-up" engagements below 10,000 feet against highly maneuvering targets (MIG 17/21). Rule of thumb missile firing envelopes based on a high state aircrew interpretation of target crossing angles (TCA), differential range (DR), altitude (A), and target closing velocity (V_c) are required to employ the Sidewinder and Sparrow III missiles as well as 20MM guns. A large number of missiles have been fired in SEA using visual range and target aspects estimations with marginal success. Firing out of range or outside the missile envelope are common aircrew errors in SEA engagements. During September and October 1968 COMOPTEVFOR and APL/JHU conducted a study directed to system definition, requirements, and estimated costs for a facility, to provide air combat maneuvering training on an instrumented range.

Recommendations

Establish instrumented ACM ranges, East and West Coast, to provide "realtime" readout and flight path recording to aircrews during simulated missile firings while engaging in air combat maneuvering flights. TAB B provides details on the ACMR.

G. Fleet Readiness/Training Manuals

Conclusions

Presently there are differences in the training requirements of the two air Type Commanders. These manuals should reflect the best methods and procedures for both.

Recommendations

COMNAVAIRLANT and COMNAVAIRPAC revise and standardize Readiness and Training Manuals.

II. MISSILE ENVELOPES

A. Maximum and Minimum Range Envelopes for AIM-7E/E-2

Conclusion

Maximum and minimum range envelopes for AIM-7E/E-2 for both maneuvering and non-maneuvering targets are required to present the entire spectrum of launch range parameters to aircrews. Present launch zone information needs to be up-dated, printed, and distributed to operational units.

Launch envelopes for 5K-15K and 25K with target G's from 0 to 4.5 have been produced and will be incorporated in the F4 tactical manual presently being revised. Additional envelopes are required to complete sensitivity studies on heading error, launch speeds, target speeds and track crossing angles.

Funding for this additional effort is estimated at 150K.

Recommendation

The launch envelopes should include altitudes from sea-level to 45,000 feet, at 5,000 foot intervals, target speeds from sub-sonic to super-sonic, launch speeds to vary from speed disadvantage, to co-speed, to speed advantages. Additionally, P_k values, both theoretical and combat by general aspect should be provided on the launch envelopes. Relative P_k indications by quadrant would be adequate. This program is presently underway at Raytheon Company and a proposal for funding will be submitted in November 1968. Representative envelopes for 5,000 and 25,000 feet, respectively, appear in TAB C.

B. SIDEWINDER (AIM-9D) Envelope Studies

Conclusion

The present Naval Weapons Center (NWC) kinematic maximum range envelopes for the Sidewinder AIM-9D are inadequate and not up-to-date. A computer study similar to the Raytheon Sparrow AIM-7E maximum range study is required so that reliable missile envelopes can be distributed to fleet units. An elaborate study proposal consisting of more data than is necessary has been submitted by NWC to NAVAIRSYSCOM for approval.

Recommendation

NAVAIRSYSCOM, employing the criteria set for AIM-7E/E-2 envelope studies, direct the NWC China Lake to produce similar parametric data for the AIM-9D and fund this effort to the extent required.

III. TRAINING TARGET SYSTEMS/AIDS

A. Improved Target Drone Capability

Conclusion

Present visual augmentation (smoke) of the BQM-34(IMK) during maneuvering target exercises does not provide required safety throughout all parameters of a simulated close-in aerial engagement. There is a requirement to improve the visual augmentation of the BQM-34(IMK) in order to provide training for close-in aerial engagements with adequate safety protection throughout all exercises.

Recommendations

Composite Squadron THREE Detachment at NMC, Pt. Mugu is presently experimenting with "strobe light" augmentation to the BQM-34(IMK) drone. NAVAIRSYSCOM should examine this proposal as well as follow-on drone visual augmentation requirements.

B. Target Drone Launch Vehicles

Conclusion

The DP-2E's are old and unreliable for drone carriage and require replacement. Valuable training time is being lost because about fifty percent of all DP-2E launches are aborted due to aircraft systems failures. DC-130 launch vehicles, with double the drone carrying capacity and out-of-sight control capability, are required to replace the obsolete DP-2E's presently being used as drone launch vehicles. Further, shore-based drone launch facilities (Poro Pt, R.P.) impose line-of-sight and other constraints on drone control and telemetry support which can largely be obviated by the employment of airborne launch and control facilities.

Recommendation

A program change request (PCR) has been submitted by CNO for seven DC-130 aircraft to replace all DP-2E's currently in the fleet. OSD has tentatively approved two DC-130s for delivery in FY69 with subsequent approval of the remaining aircraft based on utilization data of the initial two aircraft. Greater priority is required to expedite the acquisition of adequate numbers of improved target drone (BQM-34(IMK)) launch vehicles (DC-130) for the fleet.

C. Drone Recovery Vehicles

Conclusion

Training operations (both CONUS and forward areas) are inhibited by the availability of suitable recovery vehicles for the BQM-34. The H-34 helicopter normally used is limited in range and lift capabilities and must be replaced. Surface craft are usually not suitable for BQM-34 recovery.

Recommendation

CNO examine the Navy's BQM-34 recovery capabilities, world-wide, justify to OSD the need for drone recovery vehicles, and direct the Chief of Naval Material to initiate any necessary procurement action.

D. AIM-7E-2 SPARROW Aircrew Training Film

Conclusion

The updating of the Sparrow Aircrew (Pilot and RIO) training film must be accomplished to include the AIM-7E2 and the weapons system presently in use in the F4J aircraft. This training film will provide basic indoctrination for the aircrew, and be presented prior to the formal training on the Sparrow Missile and the AWG-10 Weapons System.

Recommendation

The AIM-7E-2/AWG-10 Weapons System Training Film for Pilot and RIO will be produced by Raytheon Company at no cost to the Navy. This training film will be mission-oriented and will include Aircraft/Missile pre-flight, pre-start checks, pre-take-off checks, including switch actions. The intercept phase will pre-launch maneuvering, missile firing, post-launch procedures, and finally, the post-flight procedures. This film will be reviewed by Westinghouse, McDonnell, NAVAIRSYSCOM and the Naval Missile Center prior to release. This training film should be completed as soon as possible and distribution controlled by the Chief of Naval Operations (OP-563).

E. AIM-7E2 Envelope Training Film

Conclusion

As an aid to aircrew training in the Air Combat Maneuvering (ACM) environment, a presentation of missile envelopes, combining the distortion that occurs against a maneuvering target, is required. While a general understanding of maneuvering target envelopes exists, a detailed presentation of fighter to target relationships with track crossing angles, overtake, and ranges, correlated with envelopes in the same time frame will provide aircrews with a better appreciation of the ACM problems.

Recommendation

A proposal from Raytheon Company to produce a training film with maneuvering target envelopes will be submitted in November 1968. This film should be in full animation to best present the fighter to target relationships and to depict, in the same time frame, the distortion of the Sparrow firing envelopes. This presentation should include both minimum and maximum firing envelopes, and should include, if possible, actual photography of MIG 17's and MIG 21's.

F. In Flight Simulator/Evaluator/Recorder for F4 Weapons System

Conclusion

There is presently no simulator, evaluator and recording device in the Navy capable of testing the F4 weapons system or missile stations as well as aircrew performance while in flight. Mate II, ACEARTS and AWM-19 are presently industry proposals that have merit and should be examined at the earliest possible date. Such a device would be a genuine asset in the forward area as a tool for sustaining combat readiness through realistic airborne training as well as an efficient shipboard maintenance aid.

Recommendation

NAVMISCEN and NAVAIRDEVCEN evaluate these proposals and report results.

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IV. HUMAN ENGINEERING

A. F8H/J Aircraft Fire Control Switch and Advisory Lights

Conclusion

The SEAM lock button and the fire control advisory lights in the F8H/J airplane are presently located in undesirable positions. The pilot must take his hand off the flight control stick or throttle to initiate a SEAM lock. He must look down low into the cockpit, and around the flight control stick pedestal to determine if he has a SEAM lock and to see what weapon he has selected. The radar lock and the in envelope advisory lights are not in his peripheral view. The range meter is poorly located and obscures a portion of the forward wind screen.

VX-4 is presently mechanizing an AFCS advisory light heads-up display in the pilot's field of view that does not obscure any of the wind screen. An in-flight evaluation of this display and a Parker Instrument E-45 range meter is underway at this time. The results of these flight tests will be reported to CNO and NAVAIRSYSCOM.

In-flight tests of a new position for the SEAM button is in progress at VX-4. The results of these tests will be reported to CNO and NAVAIRSYSCOM.

Recommendation

Reposition the SEAM lock button so that the pilot does not have to remove his hand from the throttle or flight control stick to initiate a SEAM lock in the ACM environment. The SEAM lock button could be placed where the present auto-pilot engage/disengage button is now positioned. In this arrangement, when the auto-pilot power switch is off and the SEAM mode switch is off, the auto-pilot engage/disengage switch would function as an auto-pilot switch. The F8H/J fire control system advisory lights should be positioned in a heads-up display above the front wind screen frame brace. The ID-1485 Sidewinder firing indicator should be removed from the cockpit and replaced with a small flat range meter similar to the Parker Instrument Company's Model E-45.

B. F4 Cockpit Range Meter/"In-Envelope" Indicator

Conclusion

Firing out of range or outside the missile envelope are common F4 aircrew errors, in SEA engagement. A direct readout range meter, complemented, if possible, by an "in-envelope" indicator, is required as soon as possible. These would provide a semi "heads-up" display and "shoot-no shoot" indication to the pilot during a "heads-up" engagement. Although any "in-envelope"

[redacted]

indicator at low altitude would necessarily be mechanized to a limited portion of the total envelope available, its use in connection with a range meter should reduce the number of out-of-envelope firings in combat.

Recommendation

VX-4, with Westinghouse assistance has been assigned a project to evaluate a range/in-envelope meter for all F4 aircraft. This meter will be available for testing by VX-4 by January 1969 and, subject to favorable results, the range/in-envelope meter will be submitted to NAVAIRSYSCOM., for approval, retrofit, and follow-on installation in all F4B/J aircraft.

C. F4 Cockpit Display

Conclusion

The F4 cockpit display is designed for a "heads-down" engagement against a high level bomber in an all weather environment. F4 aircrews in SEA are required to fight the enemy in a "heads-up" environment with a "heads-down" cockpit display. A fully "heads-up" display is needed in all follow-on F4J aircraft.

Recommendations

McDonnell Aircraft Company conduct a controlled display review of the present F4B/J cockpits in December 1968 at St. Louis with appropriate NAVAIRSYSCOM and Type Commander representation. This display review will make recommendations concerning changes in the present F4B/J cockpit display and changes for future cockpit display for F4J follow-on aircraft.

V. COMBAT EVALUATION

A. Combat Telemetry

Discussion

Examination of "RED BARON" and other combat evaluation reports reveals that processes for combat performance data collection depend mostly on aircrew debrief and interrogation and similar inherently inexact sources. This, in turn, is reflected in the quality of the analyses derived from such data. In a resources limited world it is important to identify the critical performance elements of the air-to-air missile system in combat in order to direct funds and effort to the potentially most fruitful areas for exploitation. It is important, for instance, that analysis segregate the respective contributions of the missile, the air crew, and the missile fire control system with respect to the failure of a missile to guide and fuze as required for a MIG kill. It is unlikely that this will ever be done well enough by "eyeball" reports and adjective descriptions.

[redacted]

Conclusions

1. Combat telemetry would be an extremely useful tool for the combat analyst and offers important improvements over present data collection techniques.

2. From a cost effectiveness standpoint combat telemetry could probably be justified by a demonstrably more efficient application of funds and effort to specific deficiency areas which could be delineated by better analyses of total systems performance in combat.

Recommendation

NAVAIR and FMSAEG explore the technical, economic, and operational feasibility of a combat telemetry program in Southeast Asia.

VI. DESIGN

A. Aircraft/AMCS Design

The aircraft/AMCS problems contained in this section have been encountered during CVA operations in Southeast Asia.

1. F4B/AERO 1A

a. AN/APQ-72 Antenna Polarization Switch Failure (U)

Discussion

(1) The AN/APQ-72 antenna incorporates a quarter-wave plate and magnetic switching mechanism for changing the polarization of the radiated signal. This switching mechanism has proven to be unreliable and is mechanized in such a way that the position of the quarter-wave plate and the resultant polarization cannot be determined in the event of failure. Failure, in some cases, can preclude proper operation of the SPARROW missile. To prevent this type of failure, Fleet aircraft presently have the switching mechanism completely disabled.

(2) Westinghouse ECP 165, which improves the reliability of the switching mechanism, was approved on 26 September 1966; however, the retrofit kits (Avionics Change 514) have not yet been installed.

(3) Westinghouse has also recently submitted an ECP to the Air Force which would provide for antenna and radar set improvements to the AN/APQ-100. This change would, among other desirable improvements, provide a polarization sensor and a positive indication to the flight crew of the polarization. Change kits for the AN/APQ-72 would be identical to those for the AN/APQ-100; thus non-recurring engineering costs could be shared by the Air Force and the Navy.

Conclusion

The AN/APQ-72 polarization switching mechanism is unreliable and has been disabled in Fleet configured aircraft. Engineering changes are required to improve the reliability and to give aircrews a positive indication of polarization.

Recommendations

(1) Expedite incorporation of WEC-ECP-165.

(2) NAVAIRSYSCOMHQ solicit Westinghouse Company for an ECP for the Navy similar to WEC-ECP-WXAA-72-204 submitted to the USAF.

b. Hydraulic Fluid Contamination in AN/APQ-72 Antenna System

Discussion

(1) Contaminated hydraulic fluid from the F-4B aircraft utility hydraulic system is degrading aircraft radar system angle track response and accelerating antenna component failure.

(2) It has been proposed that a self-contained hydraulic source be installed in each F-4B aircraft. The system as proposed is isolated from the aircraft utility hydraulic system, thus preventing contamination from being introduced into the radar servo loop; however, a separate system of this type would have the following disadvantages:

a. High initial cost
b. Additional weight
c. Added spares/logistic costs
d. Aircraft modification required
e. Requires system/aircraft compatibility testing for vibration, temperature, and electromagnetic interference.
f. Requires changes in maintenance procedures

(3) Another solution to AN/APQ-72 hydraulic system contamination problems involves the use of servo valves and hydraulic actuators which are considerably less susceptible to hydraulic system contaminants. Such servo valves and actuators have been developed for the Air Force, for use on the AN/APQ-109 antenna, and are readily adaptable to the AN/APQ-72 antenna at less cost and with few of the disadvantages offered by the self contained hydraulic system.

Conclusion

The APQ-72 antenna hydraulic system was not designed to operate with the vdraulic oil contaminant level experienced in the aircraft utility system.

Recommendation

NAVAIRSYSCOMHQ investigate the feasibility of an alternate servo valve/filtration system such as is presently used in the AN/APQ-109, AN/APQ-120, and AN/AWG-10 systems. Cost, time, and operational life of the system are constraints in considering implementation of this change.

2. F4J/AWG-10

a. AN/AWG-10 Cooling

Discussion

(1) The cooling provided for the AN/AWG-10 is inadequate, forcing deployed squadrons to refrain from turning their radars on until after catapult. Because of this, AN/AWG-10 and missile status cannot be determined until 5-1/2 minutes after launch. In addition, maintenance is severely hampered by a lack of sufficient air conditioners for organizational level use, and by a lack of clear definition of cooling limitations in appropriate handbooks.

(2) Interim Avionics Change (IAVC) 973, Westinghouse ECP-69, and McDonnell-Douglas ECP-927 have all been proposed to alleviate this problem. IAVC-973 provides for incorporation of an interim "B+ off" switch which will permit operation of the system for maintenance with B+ power turned off. This change is currently being incorporated into Fleet aircraft. ECP-69, submitted by Westinghouse in June 1968, would provide the ability to turn the transmitter off during test. ECP-927 has been approved and provides more cooling air to the pulse transmitter.

(3) The lack of air conditioners for organizational use can be eliminated by procuring more NR2B cooling carts and their associated equipment and by investigating the feasibility of developing an F-4J oriented air conditioner.

Conclusion

The cooling provided for the AN/AWG-10 is inadequate, thus hampering maintenance and precluding preflight checks of AWG-10 and missile status.

Recommendations

(1) Incorporate "B+ off" IAVC-973 as soon as possible.

(2) Expedite consideration of Westinghouse Corporation ECP-69.

(3) Procure more NR2B cooling carts and associated equipment for CVA's.

(4) Develop an F-4J-oriented conditioner.

(5) Address the cooling problem early in the design phase of future fighter systems.

(6) Define cooling limitations in Maintenance Instruction Manuals.

b. AN/AWG-10 Built-in-Test Improvements

Discussion

(1) The AN/AWG-10 is a new Missile Control System which has recently been introduced into the Fleet. As is common with a newly introduced system of this complexity, the time and manpower required to properly maintain the system is inordinately long. This is due to several factors, including lack of experience in this particular system; lack of sufficient spares; lack of, and inaccuracies in, handbooks; numerous configuration changes required to eliminate design deficiencies or incorporate improvements; and an inadequate BIT (Built-in-Test). While most of these factors can be expected to improve with time and experience, improvement of the BIT requires special emphasis. During a study conducted by the NAVMISCEN at Naval Air Station Miramar, it was found that, while BIT is intended to be the primary means of fault detection and isolation, only 20% of maintenance actions were initiated by BIT indications, and that BIT was successful in isolating the fault to a removable assembly only 18% of the time. Since 46% of active maintenance time was taken up by verifying and isolating a fault, an improvement in the efficiency of BIT could result in a considerable saving in maintenance time and manpower, with an attendant improvement in the over-all maintenance of the weapon system. It is anticipated that the 1.5 series BIT tape, presently available, will provide considerable improvement in this area.

(2) In an effort to improve the maintainability, the contractor (Westinghouse) is attempting to further improve the effectiveness of BIT.

(3) An appropriate Naval engineering activity (e.g., the Naval Air Development Center, the Naval Air Engineering Center, or the NAVMISCEN) should be tasked to provide a continuing review, updating, and improvement of BIT hardware and programming for AN/AWG-10 and future systems (such as AN/AWG-9) which incorporate a BIT.

Conclusion

The AN/AWG-10 Built-in-Test (BIT) has not performed satisfactorily. A new BIT tape, now available, and further contractor improvement should considerably improve BIT effectiveness; however, there is a need for continuing review, updating and improvement of BIT for AN/AWG-10 and for future systems.

Recommendation

NAVAIRSYSCOMHQ task an appropriate Naval engineering activity to provide for a continuing review, update and improvement in BIT hardware and programming.

3. F4B/F4J

a. F-4 Firing Circuit Changes

Discussion

The F-4 weapons control system firing circuits require changes to accommodate the AIM-7E2 missile, to provide for more meaningful SELECT light, and to eliminate the need for the pseudo signal. Several ECP's (Engineering Change Proposals) have been submitted to NAVAIRSYSCOM to provide these changes; however, these ECP's conflict in some areas and require coordination in others. A conference was held at NAVAIRSYSCOM on 17 September 1968 for the purpose of resolving conflicts and determining which ECP's should be incorporated. The decision made at the conference regarding these ECP's and the present status are given in Table 1.

Conclusion

The F-4 weapons control system firing circuits require changes to accommodate the AIM-7E-2 missile to provide for meaningful SELECT lights and to eliminate the need for pseudo signals.

Recommendation

NAVAIRSYSCOMHQ expedite action contained in Table 1.

b. Inadequate CW Illumination in ACM Environment

Discussion

It is extremely difficult to keep a target illuminated in the boresight mode due to the narrow beam width of the radar antenna when in an ACM engagement. This problem can be minimized by radiating CW energy through a flood antenna when in the ACM mode.

Conclusion

More adequate CW illumination of the target in the ACM environment may be accomplished by incorporation of the flood antenna into the F-4 weapons system.

Table 1. F-4 Firing Circuit Changes Required

CHANGE	STATUS	ACTION REQUIRED
For F-4B		
1. (a) RAY-ECP-28 (Phase I) (b) IAFC-421	Approved. 100 kits produced.	Update to Change No.2 or No.3
2. (a) RAY-ECP-28 (Phase II) (b) AFC-421	Submitted. Not approved.	Approval of either Change No.2 or No.3. Change No.3 is preferable if it can be accomplished in timely manner.
3. (a) RAY-ECP-28 (Phase II) (b) MDC-ECP-912	Submitted. Not Approved.	Approval of either Change No.2 or No.3. Change No.3 is preferable if it can be accomplished in timely manner.
For F-4J		
4. (a) MDC-ECP-912	Approved for production beginning w/block No. 36.	Approval/funding for retrofit.
(b) ECP-RAY-OA6822/AWG-10-2 (c) WEC-ECP-99	Submitted. Not approved.	Approval/funding for both production and retrofit.

Recommendation

NAVAIRSYSCOM review and evaluate U.S. Air Force and Raytheon flight test of flood antenna to determine acceptability for ACM use.

c. Commit Time on AIM-7 Missile

Discussion

The 2 second radar settling time and the 1.8 second missile commit time and the 1.4 second launch delay add up to 5.2 seconds of total commit time. This time delay may cause missed opportunity to fire a missile. These times should be reduced if possible.

Conclusion

Investigation should be undertaken to reduce the Commit time for the AIM-7 missile.

Recommendations

(1) NAVAIRSYSCOMHQ expedite consideration of the following ECP's to reduce Commit time:

For F-4B

MDC 912-S2 (delays application of the sweep select signal to 0.5 seconds after trigger pull)

For F-4J

MDC 912-S2 (same as F-4B above)

WEC M-99 (accomplishes circuit changes to reduce AN/AWG-10 system Commit time)

(2) Raytheon investigate APA-157 computer settling time, etc., to determine if reduction is possible.

d. Air Crew Launch Zone Indication

Discussion and Conclusion

There are no indications to the aircrew for the launch zones of the minimum range SPARROW missile. Several of these missiles have been combat fired well out of range.

Recommendations

(1) Near term - Provide aircrews with rules of thumb for AIM-7E2 launch zones. (This is currently being accomplished by Raytheon team visits to Fleet activities.) Investigate the feasibility of providing a simple "heads-up" range meter and/or "in envelope" indication for the F-4.

(2) Mid-term - Evaluate changes to the existing analog computer to provide an in-range indication for the AIM-7E2 at low, intermediate, and high altitudes.

(3) Long term - Provide the AWG-10 with a digital computer for AIM-7E2 and AIM-7F employment. Provide for a heads-up display.

e. F-4B, F-4J/SHOEHORN Compatibility

Discussion

F-4B/F-4J/SHOEHORN electrical and mechanical interface compatibility has not been completely investigated.

Conclusion

F-4B/F-4J compatibility with SHOEHORN requires investigation.

Recommendation

Expedite completion of the present maximum level AIRTASK at NAVMISCEN (Naval Missile Center). NAVAIRSYSCOM provide required SHOEHORN equipment to accomplish the F-4B/SHOEHORN compatibility evaluation.

4. Configuration Control (F-4)

a. F4B-AERO-1A

Discussion

(1) Changes have been introduced into Fleet operating airborne weapon systems without adequate test and evaluation, and without adequate spares, publications and training.

(2) Repeated configuration changes in the AERO-1A AMCS have complicated Navy support on the areas of spares, publications, training, etc.

Conclusion

Support of the AERO-1A AMCS has been hampered by repeated configuration changes to the extent that Configuration Control and freezing of the design are necessary.

Recommendation

(1) Vest Configuration Control responsibilities in NAVAIRSYSCOM HQ, Air 05.

(2) Prefaced on a compatible, cost-effective interface between the F4/AERO-1A AMCS rework program and the F4B service life and inventory, the following immediate configuration freeze is recommended:

DESCRIPTION	AIRCRAFT	APQ-72	APA-157	GSE
PLM (Pilot Lock-on Mode)	ECP-911 IAFC-424	ECP-200 IAVC-862	NA	ECP-185-6
AIM-7E-2 Compatibility	ECP-912 IAFC-421	NA	ECP-28 IAVC-860	SEC-1267 SEC-1268 SEC-1270
Solid State Tuning Drive	NA	NA	ECP-30	NA
Select "G"'s *No Manual Switch	NA	ECP-169*	NA	ECP-185-11
Antenna Polarization		ECP-204	NA	Not requested

(3) As a second block configuration change, recommend investigate the following for incorporation in a Final Configuration Freeze:

ACEARTS/MATE II/AWM-19
CW Flood Antenna (dogfight)
Steering Equations (Ray-ECP-157-20)
AIM-7F Compatibility (Ray-ECP-157-26) (MDC-ECP-850)
APQ-72 Antenna Hydraulic System Improvement
APA-157 Computer Simulated Doppler Settling Time
SIDEWINDER Expanded Acquisition Mode (SEAM)

(4) Investigation reveals that many different configurations of the AERO-1A AMCS are employed throughout the fleet. While items (2) and (3) above define what changes should be considered in the recommended freeze, the problem of standardization beyond those changes described above requires a more thorough study than can be accomplished in this committee. It is, therefore, recommended that NAVAIRSYSCOM schedule a meeting immediately, of the appropriate contractor and Navy personnel to define and prescribe necessary action to standardize the AERO-1A AMCS, related systems, and support equipment.

(5) The institution of AERO-1A rework during PAR in July 1968 provides an excellent means of standardization. Recommend that NARFS develop the AERO-1A rework plan based on the Standard Configuration.

b. AN/AWG-10

Discussion

(1) Changes have been introduced into Fleet operational airborne weapon systems without adequate test and evaluation and without adequate spares, publications, built-in-test, and training.

(2) Because of repeated configuration block changes in the AN/AWG-10 spares, publications, built-in-test, training, etc. AN/AWG-10 assets, people, spares, test equipment, and facilities are tied up by a succession of modification team efforts further detracting from Fleet support of operational aircraft.

Conclusion

Support of the AN/AWG-10 system has been hampered by repeated configuration changes to the extent that Configuration Control and freezing of the design are necessary.

Recommendations

(1) Vest Configuration Control responsibilities in NAVAIRSYSCOMHQ Code 05.

(2) Freeze the configuration of the AN/AWG-10 to the 1472 block configuration defined as the 1207 block configuration with the additions of the following compatibility and improvement ECP's:

DESCRIPTION	AN/AWG-10	AIRCRAFT	RAYTHEON TUNER	GSE
APX-76/ALQ-91 Compatibility	ECP-46	ECP-840 ECP-758	NA	ECP-SM-46
Antenna feedhorn nutations in Range I & visident	ECP-50/ IAVC-834	NA	NA	NA

DESCRIPTION	AN/AWG-10	AIRCRAFT	RAYTHEON TUNER	GSE
Increase antenna slew rate & remove range rate circle delay	ECP-64/ IAVC-833	NA	NA	NA
Independent bezel lighting	ECP-79	ECP-822	NA	ECP-SM-79
Bit RF generator, M.D.S. in short pulse & chirp	ECP-75	NA	NA	NA
Low Voltage power supply start-up current	ECP-87	NA	NA	NA
Auto acquisition from wide scan search	ECP-101	NA	NA	NA
Improved shock mounts	ECP-100	NA	NA	NA
TR tube connectors	ECP-113/ IAVC-874	NA	NA	NA
Antenna servo high temp.	ECP-111	NA	NA	NA
*Independent navigation computer operation	ECP-21	Not requested	NA	ECP-SM-21
*Cooling, B plus off transmitter warning light etc	ECP-69	ECP-834 ECP-927	NA	NA
*PLM (Pilot Lock-on Mode)	ECP-83	ECP-911 ALT No. 1 VX-4 ALT No. 2 MDC	NA	ECP-SMA-83 SMB-83 SMC-83

[redacted]

DESCRIPTION	AN/AWG-10	AIRCRAFT	RAYTHEON TUNER	GSE
*AIM-7E-2 Compatibility	ECP-99	ECP-912	ECP-OA6822 /AWG-10-2	ECP-SMA-99 SMB-99 SMC-99
*Full lock-on from boresight	ECP-106	NA	NA	NA
*Solid state tuner	NA	NA	ECP-30	NA

* Not currently defined by NAVAIRSYSCOM as included in 1472, but recommended.

Note (1): Some form of an in-range indication device is desired in the same time frame.
Note (2): SEAM provisions required and should be expedited.

This configuration should remain fixed to allow all equipments, spares, training, publications, and BIT to catch up and stabilize. The next generation configuration should make provisions for a digital computer and new performance and reliability ECP's.

The companion and/or applicable McDonnell Douglas Corporation ECP's will be required upon approval of this recommended AN/AWG-10 configuration freeze.

(3) Allocate the first kits produced or systems delivered to NAVAIRTESTCEN, NAVMISCEN, AIRDEVRON FOUR, NAMTRADETS, Training Squadrons (in that order) so as to insure an adequate evaluation and training on the configuration prior to the outfitting of operational squadrons.

5. (F8H/J)

A. BAT Altitude Line Elimination

Conclusion

The BAT system does not inhibit altitude line lock-on and requires the pilot to analyze his radar scope presentation to determine if the radar has locked-on the target or the altitude line. At a meeting at NAVAIRSYSCOM on 24 October 1968, two solutions to this problem were discussed and it was disclosed that λ2,000,000 has been requested in FY 1970 to fund an altitude line elimination for F8H/J radars. VX-4 is presently evaluating and will report findings to NAVAIRSYSCOM and CNO.

Recommendation

A system to inhibit altitude line lock-on when the BAT mode of operation is employed be developed. The methods to accomplish this are: (1) varying gain and STC (Sensitivity Time Constant) to reduce the ground radar return to a level low enough to preclude lock-on, and (2) by installing a separate radar receiver antenna in the airplane to receive the radar ground return and then send this information to the radar to gate out the ground return being received by the radar. This method is referred to as ALE (Altitude Line Eraser).

B. Missile Design

The missile design problems contained in this section have been encountered during CVA operations and are mainly caused by the requirement for repetitive captive flight cycling in the Southeast Asia combat environment.

1. AIM 7E (SPARROW)

a. Missile Head Droop

Discussion

The SPARROW missile antenna (head) will droop following repetitive captive flights causing failure of the missile to auto-tune when, in fact, the aircraft and missile are in the GO status. IALMC-37 provides for a styrofoam ring to hold the head in a boresight position, as an interim fix, until pseudo is removed in proposed changes. The styrofoam ring provides a less than optimum solution. Raytheon Company is investigating an interim solution for the F-4B consisting of a change in the modulator which involves replacing one resistor.

Conclusion

The loss of the aircraft select light due to the drooping of the SPARROW antenna has been alleviated by the introduction of Interim ALMC-37. An interim solution that does not place a maintenance burden on the operating activities is desirable. A permanent solution is required.

Recommendations

(1) NAVAIRSYSCOM (Code AIR-5333B2) request Raytheon/NAVMISCEN verify that changing resistor 3A8R2 from 620K to 270K does not degrade system performance (F-4B only).

(2) Upon verification take appropriate action to expedite incorporation.

(3) Expedite removal of pseudo for all F-4 aircraft.

(a) F-4B - Raytheon ECP 157-28 (II)
MDC 912 or IAFC 421 (NAVAIRSYSCOM decision required)

(b) F-4J - Raytheon 0A6822/AWG-10-2
MDC 912 and M-99

b. Time Delay in Firing

Discussion

There is an excessive time delay (1.4 seconds) from trigger squeeze to missile away in the F-4/SPARROW Weapon System. This delay is caused, in part, by the missile EPU (electrical power unit) settling time; however, investigation indicates that the EPU settling time is not the governing constraint.

Conclusion

The time delay from trigger squeeze to missile away of 1.4 seconds is excessive. Reduction in time delay will not affect the missile reliability but will increase the firing opportunity to the pilot. The time delay should be decreased to a minimum.

Recommendation

Raytheon Company review the other constraints and submit recommendations to NAVAIRSYSCOM (Code AIR-5108) to reduce missile away time to a minimum. NAVAIRSYSCOM (AIR-5108C) evaluate and expedite incorporation of required changes.

c. Difficulty in Wing Removal

Discussion

The SPARROW wing locking mechanism is difficult to unlock for wing removal; consequently, wings are frequently damaged by the missile handling crews by using improper tools, i.e., screwdrivers, hammers, and aircraft chocks, during removal.

Conclusion

The difficulty encountered in removing the wings from the SPARROW III missile during unloading and shipboard handling has contributed to an excessive number of damaged components. This damage does not significantly affect missile flight reliability but, rather, is a logistics problem due to the requirement for new components.

Recommendations

(1) NAVAIRSYSCOM (AIR-4107) expedite procurement and distribution of adequate wing lock pliers as recommended by NAVMISCEN letter serial 353 of 14 February 1968.

(2) Provide improved wing lock mechanisms for future missiles to expediate field assembly and disassembly. (Raytheon is presently investigating a design that will not require special tools and that will be compatible with existing AIM-7 missiles.)

d. Non-standard Missile Section Screws

Discussion

Non-standardization of section screws and joints between the air launched missiles and between sections on the same missile has created problem areas. The SPARROW missile is held together by special purpose screws with a NYLOC locking feature which deteriorates with repeated use, yet the screws must be removed for repeated missile test and assembly. Deviation in production quality has required investigation and correction of Fleet problems in both the SPARROW and SIDEWINDER during the past two years. One SPARROW missile in-flight breakup has been attributed to improper section screws.

Conclusion

There is no standardization of missile joints or section screws. The special purpose screws are expensive and not of standard quality. The section screws and the missile joints should be standardized to decrease training requirements, decrease assembly errors, reduce costs, and prevent missile breakup in flight.

Recommendations

(1) Immediate

NAVAIRSYSCOM (AIR-4107) issue amendment to ALMC-16 specifying one time use of section screws for SPARROW missile. SPCC (Ships Parts Control Center) assure adequate spares in stock for a significant increase in usage rate.

(2) Long Term

Standardize missile joints and section screws between all future air launched missiles.

[redacted]

e. Safe/Arm Switch on MK 265-0 Igniter

Discussion

(1) The Safe/Arm Switch on the MK 265-0 igniter is frequently broken during handling operations. While it is recognized that the prime reason for this occurrence is due to repetitive handling, it is felt that the affected part could be made stronger or possibly replaced with a, different handle.

(2) An improved S&A (Safe/Arm) device will be incorporated in follow-on production of SPARROW motors. The improved design provides a recessed S & A switch activated by an Allen wrench that is removed after activation. There are no projections of the switch beyond the missile skin. The MK 174 igniter on the MK 52 motor and the proposed MK 38-4 motor both incorporate this design. While an improvement over the present design, however, the new S & A device is still less than ideal and ready availability of the Allen wrench when needed, will create some problems.

Conclusion

The S&A switch on the MK265-0 igniter is frequently broken during missile handling. The switch has been redesigned and will be incorporated in future production. The new switch requires further improvement, however.

Recommendations

(1) That NAVAIRSYSCOM investigate the feasibility of incorporating the improved S&A device during periodic rework on Mk38-2 motors.

(2) That work be started now on further redesign of the new S&A device.

f. Moisture Intrusion

Discussion

During extensive captive flight operations in SEA, SPARROW missile failures are caused by moisture intrusion of the electronic circuitry. The problem is caused by free moisture from rain and clouds entering the missile through unsealed areas. Proposals from NAVMISCEN and Raytheon have been in review for three years. ALMC 17, requiring the squadron to tape the tunnel covers, has eliminated a major portion of the failures; however, this is an unnecessary maintenance burden to place on the operating activities.

Conclusion

Moisture intrusion degrades missile reliability by shorting out electronic components. An interim solution is required for existing missiles.

Recommendation

Expedite approval and installation of Raytheon ECP 47.

g. Failures of Side Receiver System (SRS) Crystals

Discussion

(1) Both NARF, Alameda, and NARF, Norfolk have observed a high rate of failed SRS crystals in Fleet returned SPARROW missiles. There is no test of this system except at the NARF's. It is suspected that RF radiation is damaging these crystals.

(2) NAVMISCEN and Raytheon are investigating to determine the cause, and recommend solutions.

Conclusion

An investigation of the SRS crystal failure rate is required, and the SRS should be evaluated for the need of more or improved tests to be made at NARF or field levels.

Recommendation

Raytheon and NAVMISCEN expedite completion of SRS crystal failure investigation.

h. SPARROW Desiccant Containers

Discussion

SPARROW G&C Section desiccant containers place an unnecessary maintenance burden on shipboard maintenance. Recent studies indicate that the requirement for continued use of these desiccant containers does not exist.

Recommendation

NAVAIRSYSCOM (AIR-5108C) expedite review of NAVMISCEN recommendations and approve the ALMB to delete the desiccant containers.

i. Missile Handling Damage

(1) Exterior portions of the missile are sensitive to damage during normal shipboard handling.

(2) Air-to-air missiles are presently designed and produced to the same general specifications as are air-to-surface missiles, yet the inherent requirement for a defensive weapon requires repetitive loadings

and captive flights while an attack weapon is primarily a one-shot device. External components or appendages on air-to-air weapons are not designed to withstand shipboard handling. On the SPARROW, the EPU chimney, tunnel covers and radomes are frequently damaged resulting in a no-go missile. The rollerons on the SIDEWINDER missile are extremely sensitive not only to damage but to salt air corrosion.

Conclusion

Because of the requirement for repeated captive flights for air-to-air missiles, the exterior components and appendages are subjected to extensive physical damage during shipboard handling. The difference between air-to-air and air-to-surface missiles must be considered during the missile design.

Recommendations

(1) Raytheon investigate design of an EPU chimney for the AIM-7E missile, less susceptible to damage.

(2) Review and modify AIM-7F specifications to reduce susceptibility to handling damage.

(3) Establish minimum design criteria for future systems.

J. SPARROW Missile Reliability

Discussion

All areas of shipboard operations were examined for possible degradation of missile reliability. It was concluded that the missile free flight guidance and fuzing reliability is not significantly degraded by shipboard operations, excluding captive flights, but is initially low when received and is further degraded during required captive flight cycling. There are no outstanding ECP's that will increase the missile reliability and the performance ECP's that have been incorporated, due to the increased complexity of the missile, have tended to lower the reliability. Substantial reliability improvements are required before definitive design information can be derived and the missile configuration can be standardized.

Conclusion

SPARROW missile free flight guidance and fuzing reliability is not significantly degraded during shipboard operations. It is low when received. A reliability improvement program is required prior to standardization of the missile.

Recommendations

(1) NAVAIRSYSCOM direct Raytheon to conduct a priority reliability improvement program that can be incorporated during periodic rework.

(2) Following qualification at NAVMISCEN, incorporate reliability improvements in all AIM-7E missiles at the NARF during periodic rework.

(3) NAVAIRSYSCOM institute and fund a continuing SPARROW reliability improvement program.

2. AIM 7F (SPARROW)

Discussion

The AIM-7F, like its predecessors, will be a semi-active, radar-homing, air-to-air missile, retaining essentially the same external configuration. However, advanced packaging techniques have resulted in a substantial reduction in the volume of missile electronics, permitting a significant increase in the size of the motor and warhead. Numerous improvements are being designed into the AIM-7F missile; the most notable of which are:

a. Reduced minimum launch range providing an effective dog-fight mode
b. Increased maximum range
c. Improved ECCM capability
d. Improved capability against multiple targets
e. Operation with either CW or PD illumination
f. Snap start
g. No field test required
h. Improved reliability
i. Increased P ssk
j. Relative range mechanization to increase number of engagements per pass

Fleet introduction of the AIM-7F missile is estimated for mid 1970 or early 1971. Table I is a summarization of comparative AIM-7E/AIM-7F performance capabilities.

Included is a comparison of the AIM-7F performance capabilities available when utilized with an aircraft weapon system modified or not modified for complete AIM-7F compatibility.

[redacted]

	[1] AIM-7E-2	AIM-7F		
		[1] F-4B/J Unmodified	[2] F-4B Modified	[3] F-4J Modified
Rmin (Low Alt) Rmax (tail)	[4] 2,000 ft 11,000 ft	[4] 1,000 ft 26,000 ft	1,000 ft 26,000 ft	1,000 ft 26,000 ft
[7] Rmax (HO)	13.5 nm	13.5 nm/22.0 nm	22.0 nm	[5] 22.0 nm/27.0 nm
Maneuverability	25 g's	25 g's	25 g's	25 g's
Commit. Time	1.4 secs	1.4 secs	[9] 0.6 secs/1.7 secs	[9] 0.6 secs/1.7 secs
Sub Clutter Vis.	40 db	50 db	50 db	50 db
Lethality Fuzing Warhead	AIM-7E improved 65 lbs/30 ft	New fuze 90 lbs/40 ft	New fuze 90 lbs/40 ft	New fuze 90 lbs/40 ft
ECM	HOJ/FOJ	Improved	Improved	Improved
ASE	15°	15°	25°	25°
[8] Reliability	30 captive flights	75 captive flights	200 captive flights	200 captive flights
Aero Range (Hi Alt)	27 nm	53 nm	53 nm	53 nm
Differential alt	40 K ft	40 K ft	50 K ft	50 K ft
Mult target		Improved	Improved	Improved
Motor	Single Igniter	Dual Igniter	Dual Igniter	Dual Igniter
Contact Sensor		Improved	Improved	Improved
Altitude switching	Yes	Yes	Optimized	Optimized

Notes:

(1) Assumes AIM-7E-2 Dogfight changes have been made to aircraft.

(2) F-4B modification consists of AIM-7F changes and improved low altitude mechanization of non-maneuvering targets for AIM-7E-2.

(3) F-4J modification consists of digital AWG-10 with mechanization for maneuvering targets with Head-Up Display.

(4) Non mechanized - interlocks out.

(5) Interlocks in/Interlock out.

(6) Mechanized for both PD/CW.

(7) Seeker range for 2M² target, 200 W CW, 440 W PD.

(8) AIM-7F on unmodified aircraft have the gyros running. Missile operates completely snap start on modified aircraft except in dogfight mode where the gyros are running.

(9) Dogfight mode/Normal mode.

[redacted]

[redacted]

Contractor development flight tests at NMC Pt. Mugu [illegible]/have revealed several design deficiencies requiring correction before release to production. These are being addressed by NAVAIRSYSCOM, NAVMISCEN, and Raytheon.

Conclusions

a. The AIM 7F is a necessary and important addition to the Sparrow inventory from the standpoint of maintainability, reliability, and performance.

b. The AIM 7F is not yet ready for production and correction of design deficiencies now known may require additional research and development extending into mid or late calendar year 1969.

c. F4B/AIM 7F compatibility, while not yet fully explored, appears difficult to achieve and may not be reasonable from a cost-effectiveness standpoint.

d. F-4J modification, including a digital computer for the AWG-10 mechanized for maneuvering targets at all altitudes in a heads up display, is required to realize the full capabilities of the AIM 7F.

Recommendations

a. Delay AIM 7F production, substituting a continuing buy of AIM 7E2's on at least a one-for-one basis, until assured that the design is satisfactory and that missile performance is as originally predicted and expected.

b. Examine the cost effectiveness of modification of the F4B for full AIM 7F capability versus acceptance of limited AIM 7F capability on F4B aircraft configured for the AIM 7E 2.

c. Proceed with the orderly implementation of a plan to fully modify the F4J for AIM 7F carriage and delivery, such modification to include a digital computer for the AWG 10 and mechanization for maneuvering targets at all altitudes in a heads up display.

3. AIM-9 (SIDEWINDER)

A. Missile Breakup

Discussion

The primary problem currently being encountered with SIDEWINDER is that of AIM-9D breakup. Possibilities for failure are all under examination - such as - joints at all sections; clamp rings, depth of joint groove, launcher lugs, locks, and latches, and loading and handling procedures. Current status of work tasks is as follows:

[redacted]

(1) Revised launcher inspection criteria were distributed on 11 October 1968.

(2) A new coupling ring design was selected in October; torquing and assembly techniques were finalized.

(3) An improved warhead is now in production and should reach the Fleet in late November.

(4) Tests of a five-point launch improvement program are in progress.

(5) Environmental flight tests, somewhat delayed by F8 availability, are about 90% complete.

(6) An on-site quality review has been conducted at the site of the launcher manufacturer (VARO).

(7) Engineering and technical personnel are trouble shooting aboard the CVA's.

Conclusion

The AIM-9 breakup problem is a serious one, is not yet solved, but all possible steps toward solution are being essayed.

Recommendation

Press to earliest conclusion those actions now in process to solve the AIM-9 breakup problem.

B. AIM-9D Improvements

Discussion

The following improvements to the AIM-9D are scheduled:

(1) SKAMP - Improved fuze will provide increased kill probability against a fighter target. Scheduled for Fleet introduction July 1969.

(2) Large Canards - will provide increased missile maneuverability in a dogfight. Fleet introduction scheduled for July 1969.

(3) SEAM (Sidewinder Expanded Acquisition Mode) Slaves missile seeker head to aircraft radar. Increased look angle over standard AIM-9D. In Fleet now but programmer for F8's are slow in arriving. Test and evaluation program not yet completed at NMC, Pt. Mugu, and logistic support items (test equipment, publications, etc) lagging the hardware. Very little progress on F4 compatibility investigation.

Conclusion

The above improvement programs for the AIM-9D are all well in hand with the exception of SEAM Fleet introduction.

Recommendation

Expedite all aspects of a full Fleet operational capability for the AIM-9D (SEAM) to include both the F8 and the F4.

C. Solid State Electronics for AIM-9D

Discussion

NAVAIRS FY70 budget submission would provide about 185 units to the Fleet commencing in Sept 1970. Should improve off-axis tracking rate from 12°/sec to 20°/sec. Most important gains would be: improved producibility, 80% reduction in labor costs in rework, and 150% increase in reliability. As a longer term gain, space saved in the GCG (Guidance Control Group) as a result of transistorization could be exploited by providing a larger (about 50%) warhead.

Conclusion

The solid state Sidewinder is needed in the Fleet inventory, primarily on the basis of increased reliability, the most consistently missing quality in the current family of missiles.

Recommendation

CNO support the solid state Sidewinder program.

D. AIM-9C

Discussion

The AIM-9C is tied exclusively to the F8 radar and fire control system and is deployed only in the 27C class CVA. Low altitude performance is inhibited by the altitude line and performance below 10,000 feet is marginal. No further procurement is planned. A filter modification program (to provide high altitude capability up to 60,000 feet) in units being reworked is the only planned modification program. Fleet confidence in the AIM-9C is spotty. Logistics support is deteriorating.

Conclusion

Due to lack of need and emphasis the AIM-9C capability is slowly deteriorating and is a questionable commodity.

Recommendation

CNO reexamine the requirement for the AIM-9C and either remove it from the inventory or rejuvenate the support needed to render it a more effective weapon.

E. Non-Propulsive Attachment (NPA) for AIM-9B

Discussion

Ref: (a) COMNWC Ltr Ser 1928 of 17 May 1967

a. The Sidewinder AIM-9A missile was placed in Fleet use in 1956. A non-propulsive attachment (NPA) for the MK 15 motor was provided on the assumption that the assembled missile would be less hazardous to personnel and material, if the rocket motor were inadvertently ignited. The same NPA was used in the AIM-9B version of Sidewinder. This NPA has always been a source of confusion and argument.

b. The Sidewinder Weapons System Safety Manual requires installation of the NPA on the AIM-9B during assembly of the missile and authorizes removal of the NPA just prior to missile being loaded on the aircraft launcher. This rule requires that the NPA be brought to the flight deck on the missile, and removed and handled on the flight deck. The NPA thus becomes a FOD hazard. When missiles are downloaded the NPA is again installed. In some Fleet units, the NPA is installed at any time the missile is loaded on an aircraft and the aircraft is on the deck, and is removed just prior to flight. There have been several instances where the NPA's were left on missiles and in-flight firings were attempted, resulting in the loss of, or extensive fire damage to the aircraft. In one instance it resulted in the loss of a pilot.

c. The requirement for the NPA is inconsistent with requirements of AIM-9C and AIM-9D Sidewinder missiles which do not use NPA's. The use of the NPA is also inconsistent with all other air-launched missiles in Fleet inventory. The NWC (Naval Weapons Center) China Lake recommended removal of the NPA from Fleet inventory by reference (a); however, there was no action taken on the recommendation.

Conclusion

The utilization of a non-propulsive attachment (NPA) on the AIM-9B missile has created safety of flight problems and is inconsistent with the AIM-9C and -9D missiles.

Recommendation

Remove AIM-9B non-propulsive attachment from Fleet inventory and delete requirement from existing publications.

[redacted]

4. Design Evaluation

a. Surveillance Program

Discussion

ECP 50 has been proposed to incorporate elapsed time meters in the seeker and control sections of the AIM-7E missile. Because of the incompleteness of the missile logbooks, the elapsed time meters are essential for a component reliability monitoring program to relate operating time to component failure. However, such a program does not presently exist and is essential prior to any reliability improvement programs. Components cannot be improved or replaced until a failure rate can be established that is a function of operating time. AIM-9 surveillance efforts are better than those for AIM-7, but are not closely spelled out or supervised by NAVAIRSYSCOM.

Recommendations

(1) NAVAIRSYSCOM approve ECP 50 for retrofit in all AIM-7E missiles.

(2) NAVAIRSYSCOM direct the NARF's to immediately establish a reporting system that relates AIM-7 G&C serial number and recorded operating time (from the logbook until ECP 50 is incorporated) with major components replaced during rework.

(3) NAVAIRSYSCOM institute a failure investigation program for both AIM-7 and AIM-9. All failed components from the NARF Fleet Field Stations, etc., will be identified by missile serial number and sent to a QEL for failure mode investigations.

b. Evaluation of Ordnance Components

Discussion

Ordnance components of the Air-Launched Missiles are produced and delivered to the Fleet with inadequate engineering evaluation. Missiles are subjected to an extensive Navy Technical Evaluation following development including the motor, ignitor and safe and arm device. Subsequent developments, however, have been released for production with little or no evaluation. Approximately 2,000 MK-52 motors have recently been delivered to the Naval Weapons Stations. Following production, NAVMISCEN was requested to flight test several motors; however, neither the safe and arm device nor the ignitor have been evaluated.

Conclusion

Ordnance components introduced into the system subsequent to the Navy Technical Evaluation are not evaluated prior to Fleet use.

[redacted]

Recommendations

(1) NAVAIRSYSCOM direct NAVMISCEN to conduct an engineering evaluation of the MK-52 motor and associated components.

(2) NAVAIRSYSCOM initiate a NAVAIRINST defining the scope of the Navy Technical Evaluation that is required as a mandatory checkpoint prior to Fleet introduction of missile systems and subsystems.

5. Configuration Control

a. AIM-7E (Sparrow)

Conclusion

The AIM-7E configuration cannot be frozen at this time because several problems require solution prior to configuration freeze.

Recommendations

(1) Vest configuration control in NAVAIRSYSCOM (Air 05)

(2) Incorporate in all AIM-7E's:

(a) ECP-54 AIM-7E2 Modification
(b) ECP-47 Moisture Intrusion Fix
(c) ECP-50 Elapsed Time Meters

(3) Request ECP's from contractor and incorporate to provide:

(a) Decrease time from Trigger Squeeze to Launch (EPU Settling Time)
(b) Improved EPU Chimney
(c) Correction to SRS Crystal Failure
(d) Incorporate Internal Motor Fire

(4) Eliminate all AIM-7C Missiles from inventory, publications and training.

(5) Restrict all AIM-7D Missiles to training operations only.

B. AIM-7F (Sparrow)

Conclusion

The AIM-7F design cannot be frozen at this time due to design problems uncovered and still unresolved in contractor flight demonstrations.

[redacted]

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Recommendations

(1) Prosecute to satisfactory conclusion those design changes/ modifications required to achieve predicted and desired AIM-7F performance.

(2) Delay production of the AIM-7F until present problems are resolved and design can be frozen.

C. AIM-9 (SIDEWINDER)

(1) AIM-9B

Discussion

Out of production. Design is frozen. Reworked missiles are at a standard configuration.

Recommendation

Retain present configuration.

(2) AIM-9C

Discussion

Out of production. Missile should either be fully supported or eliminated from the inventory. Any change in configuration is contingent on plans for future operational deployment.

Recommendation

CNO re-evaluate requirements for current and future employment of the AIM-9C. In interim, maintain present configuration.

(3) AIM-9D

Discussion

Present improvement program is sensible, orderly, and necessary.

Recommendation

Recommended configuration is:

MK18	Mod 2	GCG
MK15	Mod 4	Skamp
MK12	Alternate canards.	

Maintain this design configuration until solid state produceability and reliability improvements can be made.

[redacted]

C. Launchers

The Launcher problems can be attributed both to design as well as to repetitive captive flight cycling during extensive combat operations. Only 3 current launcher design problems are reported; however, their importance should be emphasized in that a launcher failure not only degrades system performance, but negates it, resulting in a fail to launch or no motor fire.

1. Sparrow Motor Fire

Discussion

The misfire rate of the Sparrow missile increases from 2% during controlled firings at NAVMISCEN to approximately 25% during combat firings. Extensive redesign of the launching system has failed to eliminate or decrease the high misfire rate. The other ejection launched missiles in operation maintain a motor fire reliability of 97-98% with the primary difference being in the method of applying motor fire. The Sparrow misfire problems are attributed to the reel and connectors providing the motor fire pulse to the rocket motor during ejection. All other ejection launched missiles provide motor fire from internal missile power and avoid this complexity.

Conclusion

The Sparrow motor fire is unreliable due to the complexity of the motor fire connection between the missile and launcher.

Recommendations

a. NAVAIRSYSCOM issue an urgent IALMB again re-emphasizing importance of launcher maintenance to system operation.

b. NAVAIRSYSCOM expedite procurement of improved lower motor fire connector (MDC P/N 32-94758-17).

c. NAVAIRSYSCOM institute priority redesign of missile and launcher providing initiation of motor fire through the umbilical.

2. Sparrow Umbilical Plug Disconnect and Shorting Problems

Discussion

Recent Fleet reports indicate problems of the umbilical plug disengaging in flight and pins shorting to the launcher after missile launch.

Recommendation

NAVAIRSYSCOM (AIR-5102F) expedite approval and incorporation of McDonnell-Douglas Corporation ECP-929.

3. LAU-7 Sidewinder Launcher Effects on Missile Vibration During Captive Flight

Discussion

Extensive Sidewinder missile breakups occurring in SEA have been attributed, in part, to improper snubbing of the missile on the Varo-produced LAU-7 launcher.

Recommendation

NAVWEPCEN China Lake expedite the investigation and resolution of the current LAU-7 problems.

4. AERO-7A Ejector Foot Pads

Discussion

Existing procedures require installation of a rubber pad between the ejector foot and the AIM-7 missile during loading. The pad is frequently omitted. Permanent bonding to the foot does not seem desirable because of deterioration of the rubber over extended periods.

Conclusion

A rubber pad or similar device that can be easily fastened and removed from the ejector foot is required.

Recommendation

NAVAIRSYSCOM request an ECP from MDC for shock mitigating attachment to the AERO-7A ejection foot that can be readily replaced by deploying activities.

POST GRADUATE FIGHTER WEAPONS SCHOOL

Detailed conclusions and recommendations

A Post Graduate Fighter Weapons School (FWS) is required to train selected pilots and supervisory personnel of all fighter squadrons. The Fighter Weapons School requirement would be to train 20 aircrews in the F4 per year and 10 pilots in the F8 per year. The aircrew syllabus should consist of 25 hours per pilot/aircrew in the F8 or F4 aircraft, 75 hours of classroom and a course duration of four weeks. Based on current F4/F8 aircraft utilization, the total aircraft necessary to support this advanced FWS syllabus, and train 30 pilots/aircrews at NAS MIRAMAR is 3 F4s and 2 F8s aircraft per year. The instructor/detachment officer requirement is as follows:

1 Officer-in-charge (F4 or F8 pilot)
3 F4 pilot instructors
3 F4 RIO instructors
3 F8 pilot instructors
1 Aviation Ordnance Officer

Enlisted instructor requirements will be based on the number of supervisory enlisted personnel to be trained.

Status

The FWS at NAS MIRAMAR will train the first class of F8 Weapons Training Officers commencing 2 December 1968. Aircraft for this FWS class will be supported by the individual's squadron assets. F4 FWS will be operational in January 1969. VF-121 should be augmented by 3 F8 aircraft to support annual FWS requirements. Organization of FWS and billet requirements will be submitted to CNO for approval by 1 January 1969.

In addition to the training of aircrews in weapons employment, the Fighter Weapons School will provide the vehicle to accomplish some additional functions. These will include, but are not limited to, the following:

BRIEFING TEAMS

Because of the expert weapons employment/system knowledge, the Fighter Weapons School would provide a briefing team to visit shorebased and deployed squadrons thereby keeping them updated on the latest weapons systems information. In connection with visits to deployed squadrons it is highly desirable to have the FWS representatives fly with the squadron. This would provide the latest techniques and allow the FWS to be updated to new operational requirements.

FWS NEWSLETTER

New developments in weapons or in tactics should be made available to all operational units as soon as possible. This could be accomplished through a newsletter type of publication. In addition, the distribution of AEN's, and other newsletter publications should be controlled through the Fighter Weapons School.

AIRCREW MISSILE EXAM

Presently there is no system in effect to determine the level of weapons system knowledge of the aircrews. A ground weapons system proficiency and flight is required. The FWS should have the responsibility to prepare the examination and spot checks aircrews within squadrons.

TECHNICAL CLEARING HOUSE

There are a great number of technical publications produced by various agencies on the same weapons system. These technical publications need to be reviewed by the FWS to insure that they are correct and indeed are required. The FWS should have this responsibility.

TACTICS DEVELOPMENT

The FWS should have the responsibility to verify current fighter tactics and develope new air-to-air and air-to-ground tactics for the fighter tactical manuals.

AIR COMBAT MANEUVERING RANGE

Detailed Conclusions and Recommendations

Air Combat Maneuvering Ranges (ACMR) are required to train aircrews in the employment of Sparrow (AIM 7D/E), Sidewinder (AIM 9B/D) and 20 MM guns in close-in air-to-air combat where visual recognition of firing parameters is required. Air Combat Maneuvering Ranges are required in the Virginia Capes and the Yuma/El Centro areas. The facilities consist primarily of two ground based tracking radars and a digital computer. The computer uses the radar tracking data and stored data describing permissible missile firing envelopes to score missile launches. A conventional aircraft communications channel provides the computer with missile launch time and, within two seconds of simulated launch (pickle push), the pilot is informed as to the accuracy of his visual interpretation of the missile firing envelope. The ACMR is not designed to eliminate the requirements of periodic missile firings by flight crews but to provide significantly more training without the expenditure of additional missiles.

a. ACMR Requirements

(1) Air Space Requirements - For the simultaneous conduct of two distinct and separate air engagements by exisitng and future supersonic aircraft, and unrestricted air space of approximately 80 nm by 80 nm by 30,000 ft is required.

(2) Aircraft Tracking Requirements - The range must be capable of handling up to two aircraft each capable of 6G maneuvers.

(3) Data Accuracy Requirements - The following maximum tolerances on the ACMR output Data:

TCA	within 5° rms
R	within ± 10%
V_c	within ± 10%
Fighter/Target climb or Dive Angle	within ± 10° from 0 to ± 60°

(4) Computation Requirements - The computation of the required parameters and their comparison to the missile firing envelope boundaries must be accomplished within two seconds of receipt of "fox" signal.

(5) Range Development Completion Date - The ranges should be completed by November 1969.

b. The Air Combat Maneuvering Range (ACMR) Technical Development Plan prepared by Johns Hopkins University - Applied Physics Laboratory provided a detailed analysis of ACMR requirements.

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SPARROW AIM-7E/E2 MISSILE ENVELOPES

1. The fire control mechanization for the F4/SPARROW Weapons System was optimized for the Fleet Air Defense environment. The equations were determined and mechanized for a medium altitude engagement against a non-maneuvering target. This mechanization compensates for altitude and closing velocity, to provide acceptable firing parameters throughout the entire altitude regime. The mechanization cannot depict the firing parameters for a maneuvering target because of the changing size and shape of the maneuvering target envelope.

2. The attached AIM-7E/E2 SPARROW envelopes depict the missile performance capabilities computed for "PIPPER ON" (0° Lead Angle) and "TRIGGER SQUEEZE" for maximum and minimum ranges at 5K feet and 25K feet altitudes. Target maneuvers of 0 lateral "G" (non-maneuvering), 3"G" and 4.5 "G" are depicted.

3. In addition to the envelopes printed, an overprint of the APA-157 computer mechanization has been provided to show the relationships to the missile capability. The outside mechanization line labeled "APA-157 RMAX" is shown to the aircrew as an "in range" light. The center mechanization line labeled "MAX ASE" is presented to the aircrew as the maximum dilation of the allowable steering error (ASE) circle. The inside mechanization line labeled "RMIN" is presented to the aircrew as a "BREAK-AWAY X".

4. A brief review of the 5K feet maximum range envelopes reveals that the RMAX "in range" indication to the aircrew is valid for a non-maneuvering target and within the missile performance capability from the head-on position to approximately 60° either side of the head-on position. Beyond that, the "in range" light will come on, but the missile does not have the capability to intercept the target. The best way for the aircrew to determine RMAX for the remainder of the envelope is to use the maximum dilation of the ASE circle.

When the target maneuvers at 3 or 4.5 "G", the envelopes change both size and shape. The APA-157 mechanization must be understood in order to give the aircrew some indication of position in the missile performance envelopes.

5. A maximum range, maneuvering target study recommended that the maximum range of the SPARROW missile against maneuvering targets was .4 of the maximum aerodynamic range (R_A). This point occurs at one half of the range between maximum dilation of the ASE circle and the Break X. This insures that the missile has the capability of completing the intercept against a maneuvering target, and also points out that a maximum range "Rule of Thumb" exists: 2 miles on the tail, 3 miles on the beam, and 4 miles head-on.

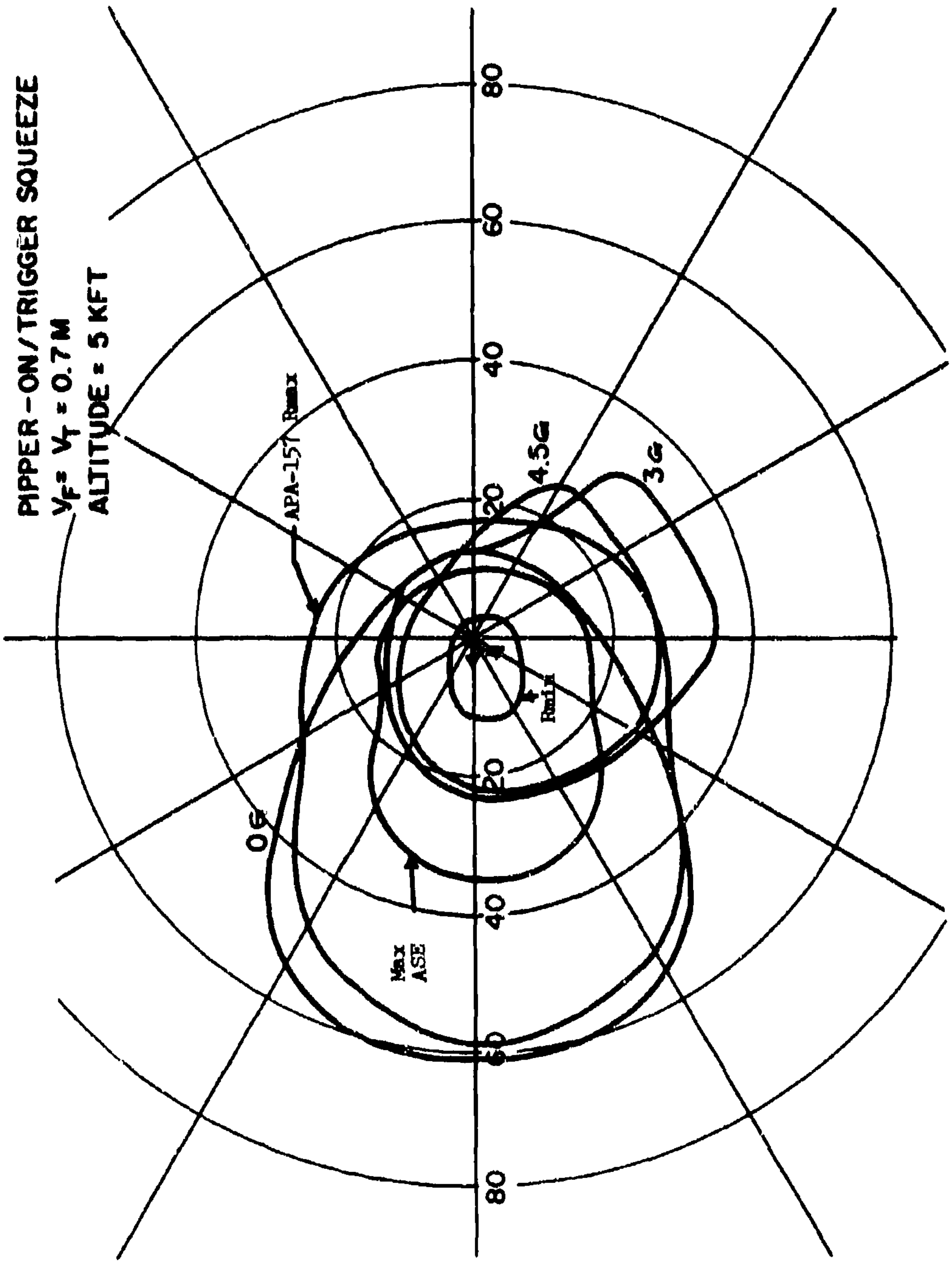
[redacted]

[redacted] UNCL

6. In the minimum range envelopes against a maneuvering target, a similar guide exists to enable the aircrew to position itself in the envelope. The Break X (RMIN) was mechanized in the APA-157 for the AIM-7E against non-maneuvering targets. The AIM-7E2, with its reduced minimum range capability, now has the ability to intercept the maneuvering target when fired at the mechanized RMIN. This Break X also happens to occur at approximately the minimum-range "Rule of Thumb": 1/2 miles on the tail, 1 mile on the beam, and 2 miles head-on.

7. These envelopes are a preliminary look at the missile/weapons sensitivities and mechanization. Additional study of the SPARROW envelopes has been proposed.

[redacted]


PIPPER-ON/TRIGGER SQUEEZE
V_F = V_T = 0.7 M
ALTITUDE = 5 KFT
APA-157 Rmax
4.5G
3G
0G
Rmin
Max ASE
80
60
40
20
20
40
60
80

TAB IV-C

[redacted]

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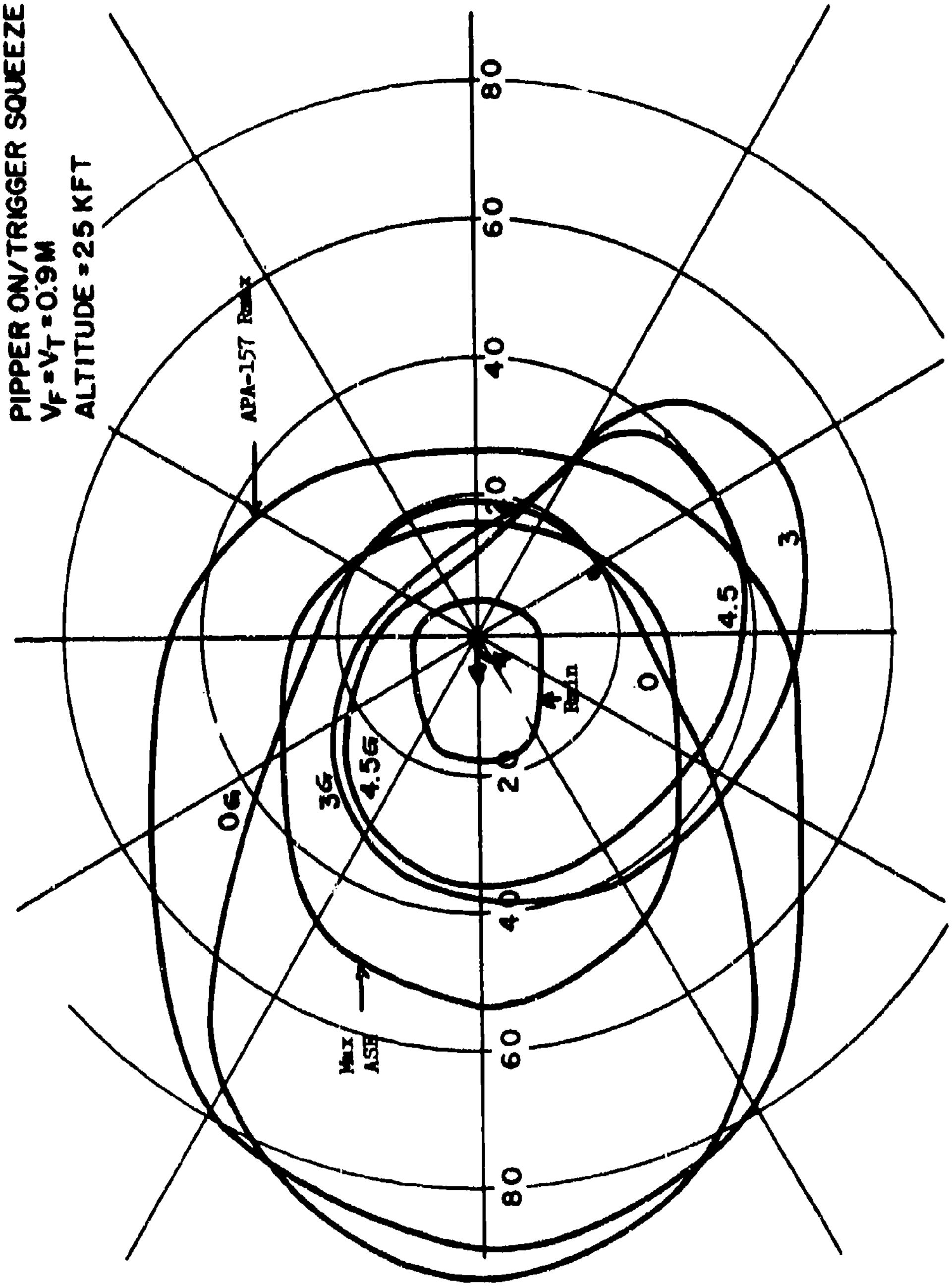
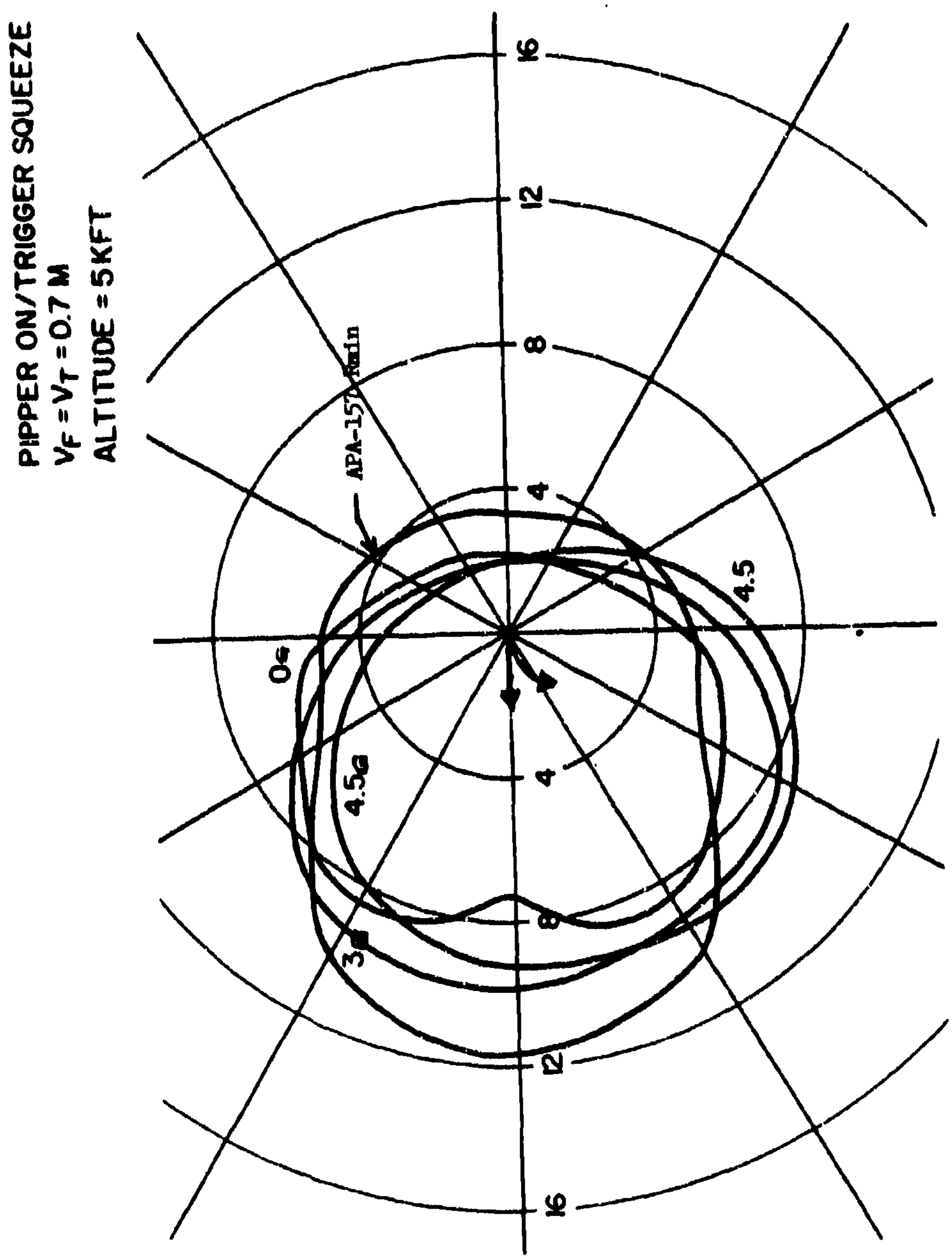
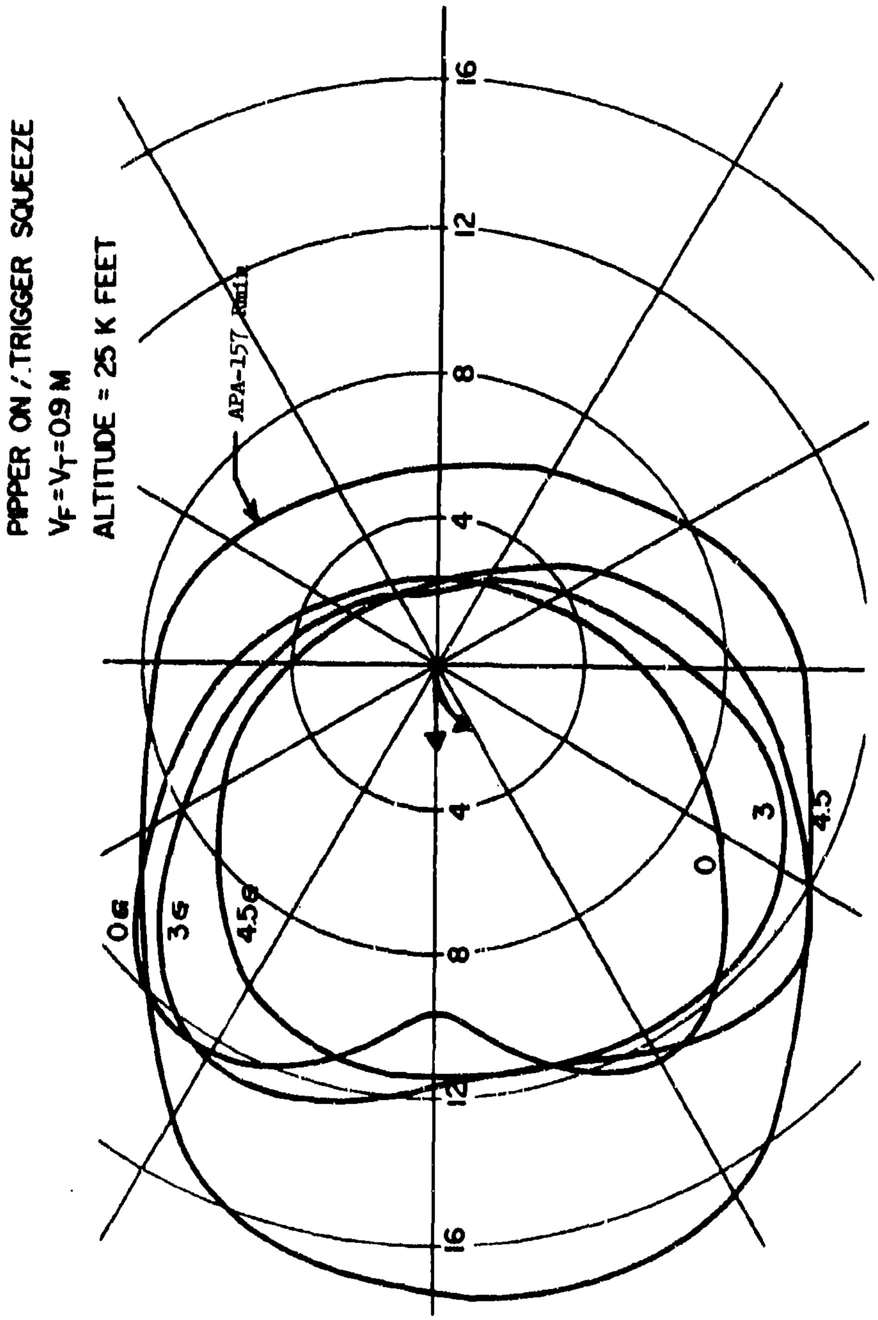


[redacted]


PIPPER ON/TRIGGER SQUEEZE
$V_F = V_T = 0.7$ M
ALTITUDE = 5KFT
APA-157
0G
4.5G
3G
4.5
4
8
12
16

[redacted]



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Funding Estimates

1. All of the recommendations of Task Team Four are considered covered within fiscal planning for current programs, except for the following:

a. Items for which funding estimates are possible:

Paragraph	Subject	Costs (x 1000) Initial	Costs (x 1000) Recurring
I. B.	Forward Area Firing Program	6,000	6,000
I. D.	Inert Training Missile Allowances	250	50
I. F.	Air Combat Maneuvering Ranges*	7,950	2,000
II. A.	AIM-7 Envelope Studies	150	--
II. B.	AIM-9 Envelope Studies	75	--
III. B.	DC-130's	3,500	--
III. E.	AIM 7 Training Film	40	--
III. F.	In-flight Simulator	100	4,000**
VI. A.4	F4B Configuration	3,476	--
VI. A.4	F4J Configuration	9,378	--
VI. B.1	AIM-7 Head Droop	565	--
VI. B.5	AIM-7/9 Configuration	8,469	--
VI. C.1	SPARROW Motor Fire	900	--
VI. C.2	SPARROW Umbilical	67	--
	TOTALS	40,940	12,050

* Will provide one range for each coast.

** Based on amortizing development costs and production buy of 40-50 per year for five years.

b. Items for which further investigation is required:

I. E.	Post Graduate Fighter Weapons School
III. C.	Drone Recovery Vehicles
IV. A.	F8H/J Cockpit Advisory Lights
IV. B.	F4 Range Meter
IV. C.	F4 Cockpit Display
V. A.	Combat Telemetry
VI. C.3.	LAU-7 SIDEWINDER Launcher
VI. C.4.	AERO 7A Ejector Foot Pads

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REPORT

OF THE

AIR-TO-AIR MISSILE SYSTEM

CAPABILITY REVIEW (U)

JULY–NOVEMBER 1968

APPENDIX V

NAVAL AIR SYSTEMS COMMAND

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APPENDIX V

REPORT OF TASK TEAM FIVE

Chairman: Mr. O. C. Robbins, Naval Air Systems Command
Representative Pacific

"Is the Air-to-Air Missile System Repair and Rework Program
Returning a Quality Product to the Fleet?"

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INTRODUCTION

A. The mission of TASK Team Five was to determine whether or not the NARF's (Naval Air Rework Facilities) are returning a quality product to the Fleet. In examining this question, the Team visited NARF Norfolk, Cherry Point, North Island, and Alameda. In addition, the Team consulted with contractor representatives from McDonnell, Raytheon, and Westinghouse. Every level of management associated with the pertinent functions of concern to this Team was consulted during the visits to these activities.

B. In answer to the above question, the NARF's, in general, provide a product that compares favorably with the new product from industry, but the evidence indicates that both must be improved. The Team Five Report discusses 23 specific areas which will effect drastic improvements in not only the rework process, but all aspects of developing, purchasing, using, and maintaining a weapon system.

C. Team Five unanimously feels that considerable improvements can be achieved in the rework area if the management structure now available were more effectively employed. In general, it is felt that the Naval Air Systems Command Headquarters should retain the over-all policy direction, funding, and the exercise of any necessary management controls. Specifically, the Team proposes that management and procedures be improved by:

1. Using the Program Managers' charters to exercise firm control over all elements of the system.

2. Delegating In-Service Engineering responsibilities to competent field activities for all engineering elements of the air-to-air missile systems.

3. Placing in the formal rework cycle all special support equipment and ground support equipment used to support the air-to-air missile systems.

4. Establishing a rework plan, validating this plan using a joint Navy-Industry Team, and later following up this validation by periodic audits of the rework process.

5. Instituting an evaluation program for the reworked missile and missile system components that would routinely and regularly measure the quality of the rework.

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I MANAGEMENT AND SUPERVISION

A. Program Management

Conclusion

It is the unanimous view of Team Five that the majority of improvements necessary in the rework area can be achieved by more effective use of the management tools now available.

Recommendation

Without changing the present functional NAVAIRSYSCOM (Naval Air Systems Command) organization, provide the Program Managers the staff to fulfill managerial functions. Provide them sufficient control over the appropriate desks. Have them designate In-Service Engineering activities as well as cognizant and participating field activities for all the air-to-air missile systems' components. Insist that the Program Managers manage the air-to-air missile programs.

B. Management Techniques and Maintenance Policy

Conclusion

Air-launched weapons as well as all other aeronautical material should be maintained using the same management techniques. NAVAIRINST 4700.2, "Naval Aircraft Maintenance Program," should be revised to reflect this philosophy. Appropriate sections should include airborne weapons. The instruction should also be directed to all users of the weapon system, Marine Corps as well as Navy.

Recommendation

Revise NAVAIRINST 4700.2 as an instruction entitled "Aeronautical Material Maintenance Manual." Reissuance as an OPNAV Instruction should be considered.

C. IN-SERVICE ENGINEERING

Conclusion

There is a definite lack of external engineering control over the work performed in the NARF's (Naval Air Rework Facilities). Too many activities are involved in decisions and changes in the area of engineering control. Assignment of responsibilities is not clear. There is no single engineering activity to which the NARF, other Field Activities, or the Fleet may turn for quick, responsive, and continuing assistance in solving engineering problems or in securing technical direction.

Recommendation

Delegate In-Service Engineering authority and responsibility, not Basic Engineering, to activities as determined by NAVAIRSYSCOM. The delegations to the most logical activities would include (not necessarily assigned to one activity) the In-Service Engineering authority and responsibility for all the various components of the air-to-air missile systems. See NAVAIRINST 5400.14 of 27 May 1967, which covers the policy and procedures for delegating authority and responsibility.

D. PROFICIENCY INSPECTIONS

Conclusion

A considerable difference exists in the rework process at different NARF's for the same product. There is a definite lack of test specifications, procedures, equipment, and qualified personnel to assure a high quality product is being delivered to the Fleet.

Recommendation

NAVAIRSYSCOM direct NAVAIRSYSCOMREPLANT/PAC to issue, prior to 1 January 1969, a joint instruction initiating an air-to-air weapon system proficiency inspection to be conducted annually or at such other intervals as may be deemed necessary, to insure quality products are being delivered to the Fleet. The instruction should be coordinated with appropriate NAVORD activities and initiate a similar inspection at appropriate NWS (Naval Weapon Station), (Air-Launched Missile Divisions) by NAVAIRSYSCOMREP Teams. Cognizant field activities (NAVMISCEN) (Naval Missile Center), NAVWEPCEN (Naval WEAPONS Center), QEL (Quality Evaluation Laboratory), FMSAEG (Fleet Missile Systems Analysis Evaluation Group), etc.) and contractor personnel will be requested to assist.

E. TECHNICALLY ORIENTED MANAGEMENT

Conclusion

Team Five found that NARF managements have not been able to efficiently staff themselves to effectively adjust to the changing workload which continues to become more technically oriented, with an ever increasing emphasis on sophisticated electronics.

Recommendation

NARF's re-examine their management needs, particularly as related to the effective administration of the increasingly complex technological workload. Structure, staffing, and emphasis are the prime areas of concern.

F. STOCKPILE TO TARGET SEQUENCES

Conclusion

If the STS (Stockpile to Target Sequence) procedures (Navy SWOP 50-20) are followed from the initial design through to production contracts, and anticipate the future operational use of a weapon, many Fleet problems should never occur.

Recommendation

That the concept of the Navy SWOP 50-20 (applicable to nuclear WEAPONS) be incorporated in all non-nuclear WEAPONS planning and contractural phases, envisioning, insofar as the planners can foresee, all the environmental factors that will face the WEAPON in service use.

II REWORK PROGRAM

A. REWORK PLAN

Conclusion

There is no comprehensive Rework Plan for the NARF's to use when reworking any of the in-service air-to-air missile system components, including AMCS, missiles, SSE, launchers, and aircraft.

Recommendation

NAVAIRSYSCOM direct an appropriate activity to develop comprehensive and standard rework plans. The team would be chaired as designated by NAVAIRSYSCOM. Team members would be furnished by the appropriate NARF's, appropriate contractors, and area representatives as directed by NAVAIRSYSCOM. When designated, the in-service engineering activity would also participate as directed by NAVAIRSYSCOM.

NAVAIRSYSCOM initially direct the formulation of rework plans for the AIM-7E-2 and AWG-10. Follow this initial step with teams for other air-to-air missile system constituents. The importance of such a "working plan" cannot be over emphasized.

B. REWORK VALIDATION PLAN

Conclusion

The NARF's do not have a validation plan for the rework of the AIM-7E-2 or the AWG-10 missile control system.

Recommendation

Set up a selected Navy/Industry small group to review the requirements for, and produce a validation plan that will include all the processes, plans, tests and inspections to insure that the NARF's will deliver a completely acceptable product to the Fleet. An activity outside the NARF's should represent NAVAIRSYSCOM; NARF's, however, should participate.

C. REWORK SCOPE

Conclusion

Team Five cannot confirm whether NAVAIRSYSCOM plans to continue rework of AERO-1A AMCS equipment concurrent with F4B PAR after the first year, second year, or throughout the active service life of the F4B/SPARROW III WEAPON system. (Refer NAVAIRSYSCOM letter 411211/42:JHK of 22 April 1968). Additionally, it should be noted that available test equipment is not adequate.

Recommendation

Team Five is unanimous in endorsement of a PAR policy for continued rework of the AERO-1A/F4B throughout the active service life of the system. Additionally, the PAR concept should be expanded to all air-to-air weapon system components.

D. DATA PACKAGE

Conclusion

Serious deficiencies generally exist in the control documentation received by the Navy when new material is introduced into the Fleet. This usually results from contractual weaknesses and creates a serious gap for the NARF's and other activities.

Recommendation

It is recommended that future contracts clearly state that the documentation must be in accordance with the requirements of MIL-D-8684(AER) and that contractual approval of documentation must be included through the use of a validation process made by an in-house technically competent team. To up-date present data packages, new contracts should be made to the manufacturers in accordance with the above philosophy. It is further recommended that a team of cognizant field personnel, NAVAIRSYSCOMREP's, In-Service Engineering, and NARF's, confer prior to final contract approval to discuss and approve contents of any addendum to MIL-D-8684(AER).

E. PARTS SUPPORT

Conclusion

There exists a critical shortage of specific parts within the NARF to support rework and modification programs. The quality of parts received from the supply system or on open-purchase and used by the NARF is questionable, even though the final product may pass all established test requirements.

Recommendations

The following recommendations will alleviate many of the parts problems:

(a) Adopt 3M reporting technique (see TAB W).

(b) Develop a meaningful ILSP (Integrated Logistics Support Plan).

(c) Maintain an updated QVL (Qualified Vendors' List).

(d) Procure stabilized components for critical circuit application.

(e) COMNAVAIRLANT (Commander, Naval Air Forces, Atlantic) and COMNAVAIRPAC (Commander, Naval Air Forces, Pacific) direct organizational and intermediate activities to deliver a complete assembly to the NARF's for rework if at all possible.

F. TECHNICAL DATA INTERCHANGE

Conclusion

Exchange of information between the NARF's involved in the air-to-air missile systems rework area varies from good to almost non-existent.

Recommendation

Interchange of common interest information be initiated or improved at all functional levels with an emphasis on small groups working to specific problems as they arise.

G. CONFIGURATION CONTROL

Conclusion

Air-to-air missile systems have a wide variation of configurations; this is especially so in the F-4 aircraft series. In many instances this has caused one or more of the systems to be degraded from "Mission Ready" to partially "Mission Capable."

[redacted]

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Recommendation

It is recommended that all air-to-air missiles systems equipment be updated to some specific configuration and a better method of kit and configuration control be established.

H. QUALITY ASSURANCE PLAN

Conclusion

The NARF's do not have a standardized, effective Quality Assurance Program or a Quality Assurance Plan for the rework performed on air-to-air missile system components.

Recommendation

NAVAIRSYSCOM task a Government team to develop an overall Quality Assurance Program (objectives) and a general Quality Assurance Plan for air-to-air missile system rework.

NAVAIRSYSCOM task a Government/Industry team to develop detailed Quality Assurance Plans for the specific items of the air-to-air missile system components, and to develop quality workmanship standards for these components.

I. EXPANDED PERFORMANCE EVALUATION PROGRAM

Conclusion

The NAVAIRSYSCOM PEP (Performance Evaluation Program) for SPARROW is adequately performing its purpose within its current restraints. The program requires expansion in order to more adequately measure rework quality of all air-to-air missile systems.

Recommendation

Expand the PEP to develop a periodic test program to evaluate the air-to-air missile systems from cockpit to target. Adequately telemeter and monitor the program so as to pinpoint deficiencies or problem areas. Provide feedback to the NARF's and to the in-service engineering activity with specific recommendations for improvement.

J. EARLY NARF PARTICIPATION

Conclusion

The NARFs' talent and experience are not being properly utilized in the development stages of new programs and modifications to existing programs simply because they are not brought into the rework picture soon enough.

[redacted]

Recommendation

NAVAIRSYSCOM Program Managers initiate positive action to assure appropriate NARF participation early enough in planned programs that will eventually effect rework assignments. Early participation would assure the consideration of NARF requirements and experience prior to decisions being made that would effect the rework and maintenance processes. Specified participation should be identified in the WEAPON Planning Document, NAVAIR Notice 013010.

K. NARF/CONTRACTOR COST COMPARISONS

Conclusion

At the present time, there is no method by which NAVAIR routinely reviews and compares its in-house repair and rework costs with that of commercial facilities.

Recommendation

NAVAIR set up a plan by which periodic direct cost comparisons of like work on like items are made between in-house and commercial facilities.

L. AERO-7A/AMCS TEST FACILITY

Conclusion

There is no way for the NARF's to check either the operating sequence or the timing of the various relays in the SPARROW III firing circuits of the F-4 aircraft.

Recommendation

Procure a dynamic AERO-7A launcher ejector test facility for each NARF (North Island and Cherry Point). Use instrumentation similar to that presently in use at MAS Miramar or new instrumentation currently in prototype stage at the NAVMISCEN. This facility should be made available to all F-4 aircraft commands ashore.

III SURVEILLANCE

A. SURVEILLANCE PLAN

Conclusion

Surveillance/Quality Evaluation of some air-to-air WEAPON system components has contributed greatly both to the rework process and in general to improved missile reliability. However, surveillance of some components (especially the AMCS and SPARROW) has not been implemented. This latter condition has allowed some deficiencies and aging problems to go undetected. There is a requirement to define the maximum number of captive flights allowable before the missile is reworked.

Recommendation

It is recommended that surveillance be given higher priority, additional funding, billeting and direction to expand existing quality evaluation programs and implement programs for AMCS and missile items which have demonstrated a history of unsatisfactory performance.

IV ENVIRONMENTAL TESTS

A. MARGINAL COMPONENT DETECTION

Conclusion

The application of relatively low level vibration to the SPARROW missile has indicated a strong possibility that marginal components may be induced to early failure without harming satisfactory items. Further tests are planned by NWS Concord to confirm the non-destructive nature of the technique. Temperature (particularly low) also shows promise in this application. Both approaches may be satisfactorily economical for 100% use by the NARF's if the required environmental parameters can de defined, and carefully selected engineering techniques are applied.

Recommendation

Pursue the planned NWS Concord investigation into the non-destructiveness of the present vibration technique. If satisfactory, endeavor to develop an economical means of mechanization and carefully define techniques to be used at the NARF's. Procure equipment and implement on a 100% basis. Investigate temperature as a possibly better and more economical means of obtaining marginal component failure.

V REPORTING

A. STANDARDIZED REPORTING PLAN

Conclusion

Numerous reports have repeatedly indicated various required corrective actions with little action resulting. These primarily consist of the non-standard analytical and engineering type reports. These reports with their lengthy distribution lists end up in various NAVAIRSYSCOM Codes which have neither an interest nor need for the information. The quantity creates a bottleneck and retards actions.

Recommendation

It is recommended that the In-Service Engineering activities be established and tasked to develop reporting plans with the single purpose of providing NAVAIRSYSCOM with the required information to make managerial decisions and to reduce the report traffic into NAVAIRSYSCOM to the essential.

It is further recommended that an Air Weapon ZIP Code be established giving adequate identification to steer reports to the action code(s).

B. 3M PLAN FOR REWORK FACILITIES

Conclusion

There is a definite need for the NARF's to join in early, full participation in the 3M (Navy Maintenance and Material Management) Reporting System.

Recommendation

NAVAIRSYSCOM task an appropriate field activity with developing a plan for the NARFs' full, early participation in the 3M Reporting System.

VI PUBLICATIONS

Conclusion

Publications have long been a problem and are usable only to a degree after being employed several years.

Recommendation

That the latest manual Military Specification (no number), titled "Manuals, Technical, Airborne Missiles" and the minutes of the SPARROW Technical Manual Management Team chaired by NAVAIR-4036 be distributed to all concerned for review and comment on a priority basis.

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COST ESTIMATES

		FY'69	FY'70	FY'71	FY'72	FY'73
I A.	Program Managers	None required within NAVAIRSYSCOM other than to cover expansion of Headquarters Staff.				
B.	Rewrite NAVAIRINST 4700.2	(Within present funding limitations)				
C.	In-Service Engineering (Add 150K/yr for Raytheon Assistance)	Obtain from field activities in their proposed transfer agreements.				
		SPARROW	500K	500K	400K	400K
		SIDEWINDER	300K	300K	300K	300K
D.	Air Launched Proficiency Inspections	10K	10K	10K	10K	
E.	Encouragement of Technically Oriented Management	Minimal, if any.				
F.	Stockpile to Target Sequence	(None required)				
II A.	Rework Plan	Indeterminate due to the wide variation of present situations on the various programs. The expenditure can normally be expected to be ammortized through resulting efficiencies on any continuing program. Top specification correction and fault isolation technique generation are particularly susceptible to wide variations in cost. Raytheon 230K for AERO 1A and AIM 7E, plans and documentation. Westinghouse estimate for rework plan is 150K. Fault isolation roughly estimated for AWG10 as 500K.				
B.	Rework Validation Plan	Obtain quotes from Industry. In-house participation estimated to cost 50K in FY'70. Westinghouse 40K, Raytheon 20K.				

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[redacted]

COST ESTIMATES
(Cont.)

	FY'69	FY'70	FY'71	FY'72	FY'73
C. Expand Rework Scope of Missile Systems. Improved parts to update AERO 1A:2,815K. Additional SSE:456K (Westinghouse)	3.5K** Rework AIM7E-2 3K/ Missile, Update each missile 3K each	3.5K**	About 1000 mhr/sys as experience is gained (F4). About 300 mhr/ sys for A4		
D. Data Package	500K	300K	200K(Figures include 225K for Raytheon)		
E. Parts Support	100K	100K	100K(Includes 40K for QVL on SPARROW)		
F. Technical Data Interchange Between NARF's	$40K per year over present expenditures, primarily for travel.				
G. Configuration Control	500K	--	--		
H. Quality Assurance Plan General Objectives and QA Plans (10 people - 5 teams, travel-per diem- -2 week's each)	25K	(within existing resources)			
Detailed QA Plan (10 people - 5 teams, travel-per diem--2 Week's each)	25K	(within existing resources)			
	Raytheon 30K, Westinghouse 185K, McDonnell Douglas participation 20K (All 3 phases)				
Quality Workmanship Document	** Already in process so presumably is already funded. Other system components, including wiring, launchers and both "E" and "F" level checkout carts require estimates from NARF's. 500K	--	--		

[redacted]

COST ESTIMATES
(Cont.)

		FY'69	FY'70	FY'71	FY'72	FY'73
I.	Expanded Performance Evaluation Program (Improved PEP)	100K	200K	180K	150K	120K
		(This includes 2/missile or 80K/yr for flight analysis)				
J.	Early NARF Participation	40K per year for travel purposes.				
K.	NARF/Contractor Cost Comparisons	NARF-none; for industry, request a quotation.				
L.	AERO-7A/AMCS Test Facility Old Installation (Pit)	78K	4K	4K		
	New Installation ("Catcher's Mitt")	46 *	2K	2K		
III A.	Surveillance Plan Additional over present	50K	400K	400K	500K	500K

* Includes 20K for development of data package.

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COST ESTIMATES
(Cont.)

	FY'69	FY'70	FY'71	FY'72	FY'73
IV A. Environmental Program for Detecting Marginal Components					
NORFOLK					
Equipment	5K	--	--	--	
Maintenance	5K	5K	5K	5K	
Test Personnel	54K	54K	54K	54K	
ALAMEDA					
Equipment	58K	--	--	--	
Maintenance	5K	5K	5K	5K	
Test Personnel	54K	54K	54K	54K	
TOTAL	181K	118K	118K	118K	

(This estimate presumes the application of a promising but unconfirmed vibration technique. Further investigation could easily disclose a much higher initial implementation figure.)

	FY'69	FY'70	FY'71	FY'72	FY'73
V A. Standardized Reporting Plan	10K	10K	7K	3K	
B. 3M Plan for Rework Facilities	100K	400K	300K	200K	

VI A. Publications — Funding requirements can be obtained from NAVAIRSYSCOMHQ Code

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PROGRAM MANAGERS

Detailed Conclusions and Recommendations

It was the unanimous view of Team Five that the majority of improvements necessary in the rework area can be achieved by more effective use of the management tools now available.

Additionally, the following is a series of quotations made by representatives from industry who assisted Team Five. It indicates how the NARF (Naval Air Rework Facility) management system appeared to them:

> "The chain of command which the NARF's must go through to be responsive is too cumbersome to expect any clear-cut direction in a timely manner or to enhance or motivate the NARF's to react effectively.
>
> "The most needed reform is to establish a weapons system project management team with broad enough powers to satisfy the needs of all participating activities of the Navy. Included within this management team should be members of the supporting NARF's to assist in the development of SSE, special purpose tooling for manufacturing and calibration, and technical data required to meet the needs and skills at a given NARF. ASO should also be an active member to see that adequate bits and pieces are procured to maintain the radar. ASO must consider transitional training and normal maintenance actions required to keep the radar operational, rather than wait for a demand usage to be developed.
>
> "Currently there are too many channels, which the NARF's must follow on every item thinkable.
>
> "Should the NARF's receive a defined effort and be permitted to be an active participant in early system development, a more concerned attitude would be apparent."

Without changing the present functional NAVAIRSYSCOM (Naval Air Systems Command) organization, COMNAVAIRSYSCOM should provide the Program Manager the staff to fulfill his managerial functions, provide him sufficient control over the appropriate desks, initiate immediate action to assign In-Service Engineering Activities, CFA's and PFA's in the air-to-air missile systems, and insist that the Program Managers manage the programs.

The draft copy of the F-4/RF-4/SPARROW III Weapon Systems Project Manager Charter now signed by RADM Townsend, but not yet signed (as of 23 September 1968) by his Air Force counterpart, would give the Program Manager ample authority to exercise firm direction of the SPARROW - F-4 - AMCS project and to correct all its present lack of cohesion. Similar broad charters should be provided to other Project Managers.

TAB D to this report discusses the assignment of In-Service Engineering to appropriate field activities. For example, In-Service Engineering activities should be able to boil down reliability information and furnish this to Program Managers. Examining the relevant reliability figures so obtained then becomes a routine task of the Program Managers' Office. He can then focus corrective effort on the low reliability items. A comparison of reliability figures of all elements of the system (guidance, AMCS, fuzing, aircrew training, launcher and aircraft circuitry) would clearly indicate wherein refocus on rework or on initial design is required. The comparatively low reliability of the AMCS in Fleet shoots should have a bearing on whether the rework is to continue beyond the presently planned rework update program. Fuzing failures should have instituted redesign several years ago.

TAB K of this report discusses some of the areas of Data Package deficiencies that should be corrected. The Program Manager should also insure close liaison between the In-Service Engineering Activity, NATSF, and the Supply Control Point, together with the cognizant desks in NAVAIRSYSCOM to insure that the Data Package is updated and latest configurations are incorporated in rework.

TAB G briefly discusses the Stockpile to Target Sequence. The Program Manager should also insure that new contracts and developments take under consideration environmental conditions that could be encountered. In retrospect, had it been envisioned that the SPARROW would be used as it is now employed and had these requirements been written into the contract, some problems would have been avoided. For example, the SPARROW G&C contract did not provide for radiation protection of the SRS.* The limitations of captive flights are not yet fully known. However, the point is that the Program Manager should insure that the most rigorous demands feasible and foreseen are written into new development contracts.

*Side Receiving System

[redacted]

The Program Manager should insure that the Long Range Development Plans are promulgated as early as possible so that the Area Representatives may sufficiently involve the NARF in its initial development of a rework line and in contracting for long lead-time facilities and equipment. This is in accordance with the Area Representatives Mission and Task Statement.

The preceding are only a few examples of areas in which the Program Manager should act to effectively manage. In summary, the Program Managers should retain over-all policy direction, control funding allocations, and exercise or direct any necessary management tools. Within all of this, only one type <u>weapons</u> management technique should be used - that used for all other aeronautical material. With only one type of aeronautical management tool, COMNAVAIRSYSCOM can more effectively control <u>all</u> his material.

MANAGEMENT TECHNIQUES AND MAINTENANCE POLICY

Detailed Conclusions and Recommendations

The Fleet has access to many documents, some cancelled, that provide conflicting maintenance instructions, the most recent being NAVORDINST 8025.1 which cancelled BUWEPSINST 8020.6B and is not in consonance with NAVAIRINST 4700.2. Since many activities are still reporting under these various instructions, delays up to 12 months have been encountered in the receipt of material involved in hazards directly affecting safety. (e.g. misfired BULLPUP missiles.)

In addition, since Marines as well as the Navy are users of aeronautical material for which OP-05 and the COMNAVAIRSYSCOM are responsible, it would appear appropriate that NAVAIRINST 4700.2 "Naval Aircraft Maintenance Program" could be rewritten as a CNO instruction. When rewritten it should include all aeronautical material -- aircraft as well as air-launched weapons. If the above action is taken and the title of the instruction changed to "Aeronautical Material Maintenance Manual" it would be applicable to all users of aeronautical material. Specific recommendations to include airborne weapons in the aeronautical maintenance management system are included in NAVAIRSYSCOMREPAC letter 3341/OCR:drs serial 99% 16 February 1968 and concurred with by NAVAIRSYSCOMREPLANT. Implementation of these recommendations would materially expedite logistics support of the Fleet.

In addition, the rewrite of 4700.2 should spell out specifically the three levels of maintenance for each element of the Missile System, including, specifically, the limiting number of captive flights per missile prior rework. See also TAB J.

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TAB V-D

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IN-SERVICE ENGINEERING

Detailed Conclusions and Recommendations

It is the unanimous opinion of the activities visited and Team Five members that there is an urgent requirement for the delegation of In-Service Engineering functions to field activities in accordance with the policy contained in paragraph 3 of the NAVAIRINST 5400.14 of 27 May 1967. Basically this feeling was generated by the lack of responsiveness of the present system.

Tremendous Navy talent is being wasted. This is evidenced by the numerous investigations and data analyses presented with good, sound conclusions and recommendations (including proposed changes), which have had little or no consideration or follow-up action. In short, the field and Fleet activities have had no overall effective engineering guidance.

Activities concerned with the SIDEWINDER missile need direction regarding rework specifications, test equipment, field specifications, manual up-dating, etc. At present there is no field activity with overall In-Service Engineering cognizance. NAVWEPCEN China Lake has assumed these responsibilities in lieu of being given this authority, primarily because no one else has, and also because China Lake designed the weapon and has the engineering experience necessary to perform this task. This unofficial responsibility, however, has built-in problems.

Activities concerned with the rework of the SPARROW III need faster resolution of their problems. For example, NARF Alameda letter NARF-324-CAH ser 2131 of 13 August 1968 presents two engineering investigation reports No. AL-13 and No. AL-14. AL-13 discusses the measurements conducted on the 10:1 probe used at Target Seeker Station No. 5 on the PLM line and recommends a required change. AL-14 discussed the frequency versus amplitude characteristics on the AC/DC converters used on the PLM facility and recommends a fix. Both of these reports illustrate PLM deficiencies which effect the missiles processed and should have been acted upon by this time.

The LAU-7A Pylon Launcher does not have the proper documentation for rework and test. An In-Service Engineering facility would be able to investigate and initiate the proper documentation action in a timely manner for this most important item in the air-to-air missile system.

Lack of effective engineering management has probably been the greatest obstacle in the F-4/SPARROW III Program. This has been the primary cause of inaction to improve the quality and reliability of the F-4/SPARROW III

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System. It is firmly believed that designating appropriate In-Service Engineering field activities would speed the solving of problems encountered in the field. Figure 1 is a schematic depicting the flow of functions, authority, and responsibility through a Cognizant Field Activity (CFA) performing In-Service Engineering tasks.

TAB V-D

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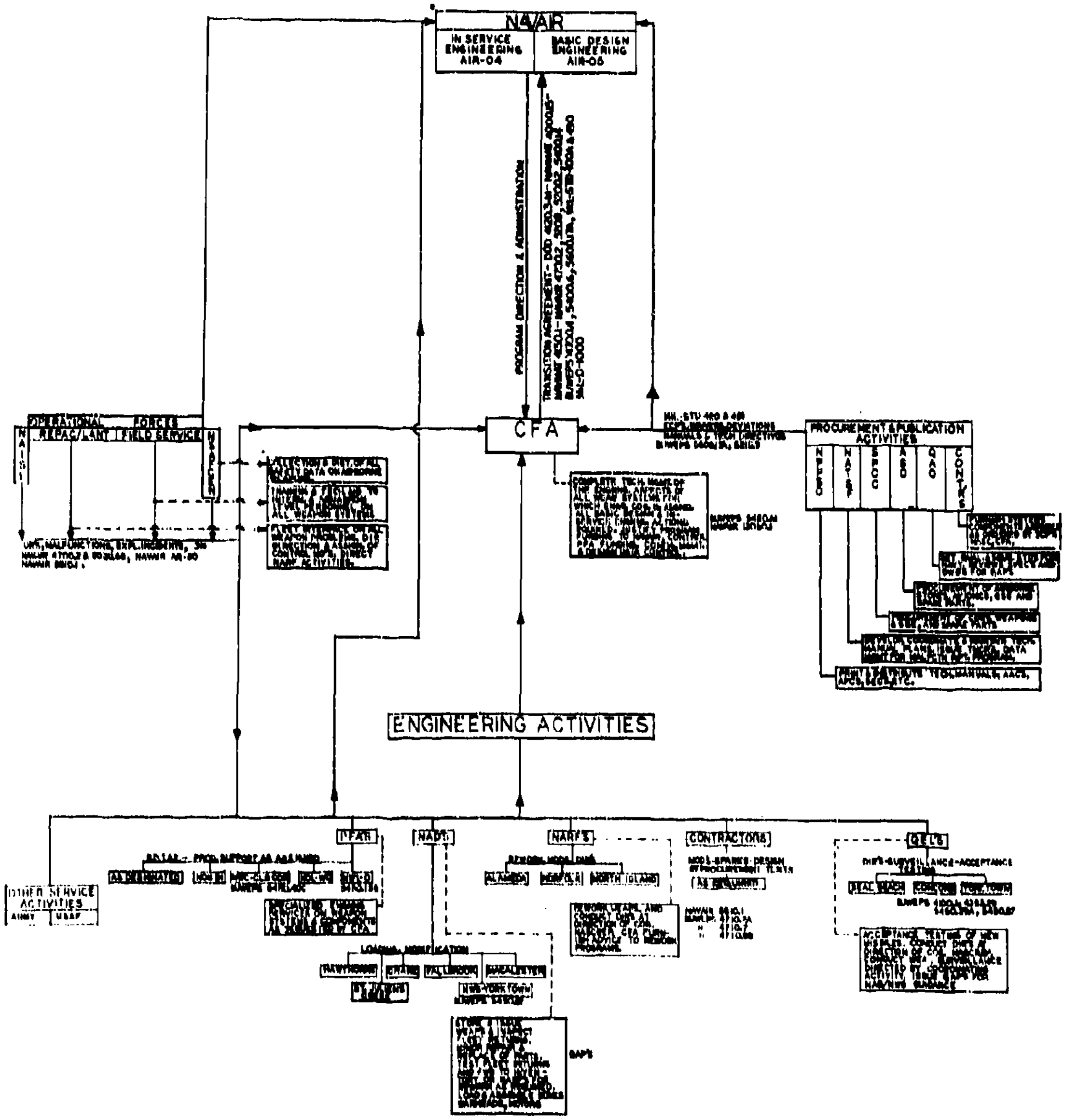

Figure 1

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TAB V-E

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AIR-LAUNCHED PROFICIENCY INSPECTIONS

Detailed Conclusions and Recommendations

The requirement for an annual detailed, comprehensive review of the NARF's is evident from the information contained in this report on visits to the NARF's; such as, "The NARF's cannot guarantee or predict uniform quality and performance since there are no detailed specifications, plans and procedures applicable to all NARF's assigned identical tasks; they depend almost entirely on handbooks which are not always up-to-date, very general and contain limited quality assurance." . . . "The poor performance of the SPARROW missile must be improved. It has not been determined, however, that the poor performance results from work performed by the NARF's; data suggests the real problem may be poor reliability inherent in the missile. Regardless of where the problem originates, the NARF's must be provided the capability to detect and correct such problems." The team's general conclusion was that AMCS being reworked in PAR were in satisfactory condition, although not of the same configuration due to lack of kits. The team was concerned, however, that adequate procedures, support equipment, parts, quality assurance/rework plans were not available to the NARF's that would continue this satisfactory level without the present complement of limited, highly qualified personnel involved in the process.

It is believed that a team composed of competent personnel reviewing the following areas annually would be able to greatly assist in improving the NARF rework: Areas of review--quality assurance, engineering, rework processes and procedures, facilities, data package, and logistics.

It is recommended that NAVAIRSYSCOM direct NAVAIRSYSCOMREPLANT/PAC to issue prior to 1 January 1969, a joint instruction initiating an air-to-air weapon system proficiency inspection to be conducted annually or at such other intervals as may be deemed necessary, to insure quality products are being delivered to the Fleet. The instruction should be coordinated with appropriate NAVORD activities and initiate a similar inspection at appropriate NWS, (Air-Launched Missile Divisions) by NAVAIRSYSCOMREP Teams. Cognizant field activities NAVMISCEN, NWC, QEL, FMSAEG and contractor personnel will be requested to assist.

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ENCOURAGEMENT OF TECHNICALLY ORIENTED MANAGEMENT

Detailed Conclusions and Recommendations

The NARF workload has evolved from basically overhaul and repair of aeronautical structures and engines to very complex weapon systems. NARF managements have not fully evolved along a parallel line. Additionally, quality relative to production must carry a much higher priority since field repair on many weapon system components has become impractical.

Two of the observations relevant to this condition and noted during the Team visits were:

a. Engineering support was not sufficient at all of the NARF's. For example, North Island reportedly had a professional engineering staff of 22 men to support 7,200 employees. Greater emphasis on the use of professional technical staff is believed to be required.

b. Very few electronics oriented personnel are included in the overall production management structure. Those with the necessary management skills, should be encouraged to enter management and advance to any level where their individual abilities allow them to function as competent managers with technical appreciation.

Finally, NAVAIRSYSCOM should assist the NARF's in upgrading their professional engineering billets.

STOCKPILE TO TARGET SEQUENCE

Detailed Conclusions and Recommendations

A brief summary of the contents of SWOP TP50-20, "Procedures for Preparation of Stockpile to Target Sequences (STS's) for Nuclear Weapons" (For Official Use Only):

A STS will be presented in a three-part format consisting of introduction, operational concepts and environment requirements.

a. INTRODUCTION - The introduction will identify the weapon system for which it has been prepared. It must include the means of revision appropriate for this particular application. A brief description of the purpose and scope of the STS and a description of the weapon system will be included.

b. OPERATIONAL CONCEPTS - This part of the STS will include a relative description of the logistics plan for the weapon and a description of the intended employment of the weapon as part of a weapon system. The employment concept will cover the configuration and geographical areas in which the weapon is expected to be operational. Targeting information, flight sequence or launch and trajectory sequence, mode of delivery, command and control, and types of firing shall be included as appropriate.

c. ENVIRONMENTAL REQUIREMENTS - This portion of the STS will include sections on general environmental requirements, logistics, delivery to the targets and supplemental data. Sections which do not apply for a particular section need not be included. Natural and intended environments will be included where applicable. Environmental levels presented are the extremes which the weapon is expected to experience. Environmental conditions which are imposed concurrently during the expected use of the weapon will be specified; that is, the temperature spectrum for simultaneous vibration or shock. Significant contractual and maintenance and events are depicted along with a description of these procedures and events: vulnerability and design criteria will be included. The application, configuration and the location of the environmental requirements will be specified. Supplemental data can consist of related information from other parts of the weapon system which may be of reference value to the designer.

It is recommended that NAVAIRSYSCOM prepare a NAVAIR Instruction requiring its Program Managers to incorporate the concepts of Navy SWOP TP50-20 in project development.

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REWORK PLAN

Detailed Conclusions and Recommendations

It was very apparent to the members of Team Five and contractor representatives that the four NARF's visited lacked a plan that specifies the rework to be accomplished. Such a plan would attempt to provide a standard configuration, where all approved Class 1 and 2 changes could be conveniently installed, thus upgrading the system by removing chronic failure parts and replacing with more reliable components.

A typical Air to Air Missile Rework Plan would cover the following areas as a minimum:

Master Flow and Schedule. This document is essentially the overall plan for a given system or component. It defines, in flow chart format, what should be done and where, with the processes called out and explained. All of this then is referenced against a time frame with appropriate sub-plans from Quality Assurance, Facilities Planning, and others. Also this plan will normally introduce the areas where change control and action must be injected into the NARF's effort along with reliability improvement through parts replacement, etc.

Top Specification. This document is mandatory, for many other facets of the plan hinge on it. It must be based on a reasonable allocation of system parameters with particular emphasis on field and other associated test set parameter relativity (i.e., the parameter allocation "wedge"). Presently, this document is minimal or non-existent in the air-to-air rework area. It must be developed.

Test Procedure. These are presently in the form of Handbook of Overhaul Instructions or in-house generated documents. Serious problems exist in keeping these current. This problem should be resolved by generating either corrected manuals or, more appropriately, specific, controlled procedures for each program. This should be done by an in-service engineering activity.

Shop Practices and Workmanship Documentation. In general, no such formal guidelines exist, except in the area of solderfication. This tends to not be the most recent data.

Rework Test Plan. This document generally does not exist today and where it does, it is not generally available at working levels. It should, as a minimum, call out all test equipments (military, special, and commercial), procedures, tools and fixtures, and miscellaneous processes, in a flow chart format.

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Test Equipment Validation and Calibration Plan. This plan almost always exists at the NARF's, although the formalization and mechanization varies widely. It should include an original checkout and validation procedure for each piece of test equipment, a means of insuring calibration accuracy (normally through a recall system), and a feedback system to refine the plan.

Fault Isolation Techniques. This area is presently entirely in the hands of the troubleshooter who uses deductive reasoning, some handbook information, and experience to define and correct malfunctions. As systems become more complex this approach will become even less desirable. There are several reasonably good manual fault isolation techniques being pursued by both private industry and military activities. Westinghouse and Raytheon are both contributors to this art.

Test Equipment Maintenance. This effort is usually left to the judgement and talent of superior mechanics and technicians. This, in general, is a sound approach when viewed from an economic and effectiveness point of view. However, the inclusion of a routine preventive maintenance program, where indicated, and overall guidelines, tend to improve the situation.

Training Plan. The NARF's are, in general, holding their own, or slowly loosing ground, in their efforts to hire and retain qualified line workers. Apprentice and on-the-job training is the mainstay of the present efforts, though their application varies widely from NARF to NARF. Level, depth and type of training must be injected into the rework plan to carry out the objectives of the basic rework philosophy with the least expenditure of manhours and money.

Overall Feedback. As an outcome of all the foregoing, a feedback system must be tailored into the above plans. In general, this will vary from job to job, but is paramount in the effort to obtain the greatest effectiveness of the planning process. This feedback is particularly associated with equipment preventative maintenance, reliability improvement, and detailed scheduling and flow.

In order for any rework plan to become effective within a NARF, NAVAIRSYSCOM must:

a. Establish a prime designated overhaul point for each air to air missile system component.

b. Establish an in-service engineering activity for each air to air missile system component that will be responsive to NARF rework technical needs, in a timely manner.

REWORK VALIDATION PLAN

Detailed Conclusions and Recommendations

The NARF's require a validation plan that includes all the requirements for reworking a unit or system in such a manner that assures the return to the Fleet of a fully acceptable, reliable product.

The validation plan must look at the entire data package, the incoming inspection, examination and evaluation, change configuration, repair and test, rework plan, quality verification plan, reliability, availability of proper parts, proper test equipment, calibration, workmanship, formalized and on-the-job training requirements, availability of manpower, skills and resources. The plan must include management techniques and also provide for periodic audits by outside Naval activities (AIRSYSCOMREPAC/REPLANT). See TAB E.

The validation plan that is developed must take advantage of the experience gained by industry in the original manufacture and test of the units and/or systems, and also the experience and know-how of the NARF that has been directly concerned with the requirements of the Fleet, and is geared to handle their particular problem. The Navy/Industry team concept would be the most advantageous to the Navy since together they could make a very definite contribution.

REWORK SCOPE OF MISSILE SYSTEMS

Detailed Conclusions and Recommendations

AMCS performance can be and has been vastly improved by including it in the PAR program. This is decisively indicated by the following quotes from the Naval Missile Center:

> "Significant differences between performance reliability achieved in operational service and that observed in PMT at NAVMISCEN indicates that increase in reliability of AERO-1A is obtainable in rework.
>
> "Replaceable assemblies and qualified components and parts of APQ-109 and AWG-10, which have significantly higher reliability and are directly interchangeable in AERO-1A MCS should be procured as replacements, example is; Antenna Azimuth Actuator.
>
> "Replaceable assemblies should be requalified to factory acceptance criteria after rework and before integration into an AERO-1A MCS.
>
> "Incorporation of specific engineering changes to replaceable assemblies which are designed to increase reliability should be accomplished, example is; WECO ECP 126.
>
> "The hydraulic actuator on the APQ-120 and APQ-109 gives greater reliability than the actuators on the APQ-72. There are other parts which exist that could be interchanged during the rework cycle".

The demonstrated low fleet reliability of the AERO-1A and low probability of mission success dictates continued PAR for the AMCS.

The rework activity at Cherry Point does not have a depot level test capability for final check of the AERO-1A system. The final check of this system must be at a level above that of the IMA equipment ("E" level cart) that is used. At NARF, North Island, depot level test equipment for unit test, system integration test, and final check is lacking. Should the rework of AERO-1A during PAR continue, both NARF's should be provided with adequate and sufficient equipment for test and alignment.

Additionally, weapon suspension equipment (Racks and Launchers) associated with air-to-air missile systems should be reworked during the aircraft PAR cycle. Finally spare Weapon Replaceable Assemblies (WRA) should be

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immediately reworked by NARF's in sufficient quantities to maintain AERO-1A system integrity.

Recommendations

Rework the entire AMCS, SPARROW and SIDEWINDER during each PAR cycle. At that time replace the less reliable parts with more reliable parts. Similarly update the SPARROW Missile during rework. Rework integral launchers at each PAR and other launchers by the NARFS on a routine calendar basis. Test aircraft missile wiring and replace any wiring showing evidence of deterioration. Check the entire SPARROW Missile System, after rework, with an instrumented ejection of dummy missiles. See TAB S.

NARFS should rework the special Support Equipment and ground Support Equipment on a calendar basis. Rework missiles after a specified number of captive flights. This number must be determined by NAVAIRSYSCOM.

AERO-1A

Replace unreliable AERO-1A parts with more reliable AWG-10/APQ 109/APQ 120 parts: (Quotes are sufficient to rework 500 systems).

ECP 126	400K	(1) Westinghouse
ECP 204	1,000K	(2) Westinghouse
ECP 206	150K	(2) Westinghouse
Az and El Actuators	1,115K	Westinghouse
Overload Switch	150K	

Notes:

(1) Approved by the Navy, but not funded.
(2) ECP is presently awaiting approval by USAF. The costs quoted assume that non-recurring costs will be funded by the USAF.

AWG-10

Both NARF'S reworking the AWG-10 expressed a need for the following additional SSE: (Quotes are sufficient to complete the outfitting requested).

2 Each	Indicator Test Sets	142K
2 Each	Scan Pattern Test Sets	87K
1 Each	1F Test Set	47K
2 Each	1871 Test Sets	64K

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SPARROW

Raytheon will submit a list of specific reliability improvements to NAVAIR 5108 for approval. Meanwhile, the following specific improvements should be incorporated during NARF rework. A directive from NAVAIRSYSCOM is recommended:

1. ECO-H-9174 (Circuit Change). Add a resistor to protect 3CR103 and 3CR105 diodes from current surges. Production incorporated at Serial R-6601-6.

2. ECO-J-1027 (Component Change). Improved klystron tube coarse tuning mechanism. Production incorporated at Serial R-12136-6. (O&R retrofit program is firmly scheduled).

3. Improved quality of 5Y101 Crystal, effective at production Serial approximately R-500-6. Missiles prior to this Serial (R-500-6) should have 5Y101 crystal replaced.

4. Improved quality of electro-mechanical relays (Hi-G, Inc., and Couch Vendors) effective at production Serial approximately R-6000-6.

5. Erratic routing of wiring over module 7T105 frequently resulted in serious pinching. Production correction effective at approximately Serial R-5000-6. All missiles prior to this serial should be carefully inspected at this location, and leads replaced if necessary.

SPARROW REWORK LINE

Add a final System test at Station No. 14, Target Seeker Line, for Alameda and Norfolk lines similar to the one in use at Raytheon.

DATA PACKAGE

Detailed Conclusions and Recommendations

Serious deficiencies generally exist in the control documentation received by the Navy when new material is introduced into the Fleet. This usually results from contractual weaknesses and creates a serious gap for the NARF's and other activities.

These deficiencies create difficulties in failure analysis, fault isolation, calibration and about every area of the NARF effort. This results in "back engineering" which is wasteful and slows down the corrective effort of the NARF's and the QEL's.

The minimum data package requirements are represented by Military Specification "Data, Design, Contract Requirements for Guided Missile Systems (MIL-D-8684 (AER))." MIL-G-23986, the detail specification for the AIM-9D Guidance and Control Section, is an example of a document which meets the above requirement. This document provides a complete, detailed specification for the end item. In addition, it provides drawing lists, applicable military specifications, weapons requirements, ordnance documents, etc. It contains everything needed for a manufacturer who is interested to bid and produce the hardware.

The existing SPARROW documentation does not measure up to this standard. To update the SPARROW package would require considerable refinement and additions to the existing specifications and drawings. The Team feels that the updating requirements are so extensive with so many proprietory drawings and information that Raytheon would have to provide the service necessary to update the package; however, it is urged that a competent "in-house" field team review and validate the data package as well as the addendum to Mil-D-8684 (AER) as being acceptable.

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Detailed Conclusions and Recommendations

There is no ultimate solution to solve all existing and future problems regarding parts. However, if the recommendations detailed herein are adopted, the results should provide significant improvements within "real world" funding limitations.

a. Parts procurement is based on inventory withdrawal and not on 3M data which reflects actual usage. Base spare parts procurement on 3M data.

b. A need exists to define all elements of parts logistics required to support present and proposed work loads in the NARF's. Sufficient information must be collected from all facets of the programs and channeled to an ICP (Inventory Control Point) in order to have spare parts contracts negotiated and material available when needed. It is therefore recommended that a comprehensive ILSP (Integrated Logistics Support Plan) be developed for all air-to-air weapon systems and components. The plan must be supported with timely funding and must cover all phases of the effort. For example, spares requirements need to be integrated to cover not only SPARROW Navy rework, but Air Force, United Kingdom, and Iranian rework as well.

c. Parts for NARF rework programs are being purchased from vendors that have been removed from the original contractor's QVL (Qualified Vendor's List). ASO and SPCC have made efforts to adhere to the QVL but it is not updated on out-of-production equipment. It is therefore recommended that QVL's be provided to, and maintained for, the NAVY both on older air-to-air missile system components as well as new, by contractural agreement with the prime contractor. It is further recommended that QVL maintenance for components out-of-production be made an in-service engineering activity function when an activity is designated.

d. Aging of components to achieve circuit stability is a valid and economical method to obtain equipment reliability. It is, therefore, recommended that the prime contractors be required to develop identification of components as to type and circuit location that would be substantially improved through aging. When these improved components enter the supply system, particular care should be taken to identify them separately from their counterparts. Vacuum tubes will be especially involved in this effort but other component types should also be included.

e. Incomplete air-to-air missile system assemblies are being returned to the NARF's for rework. This results in parts shortages, delays in shipping and substantially increased rework costs. It is recommended that organizational and intermediate activities be directed to send complete assemblies

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to the NARF whether or not some portions may be serviceable. Many unserviceable auxiliary items such as the SIDEWINDER umbilicals can be inexpensively repaired but are costly to reprocure.

f. There is at present no contract vehicle providing incentive for the vendors to produce a better product. If a vendor meets the QVL or is qualified to produce an end item his maximum profit is achieved if he barely meets these requirements. It is recommended that an incentive program be established so that it will motivate the vendor to produce a better, more reliable product on a continuing basis. In summary the rework parts effort offers a prime area for innovation and new looks at old problems. The criticalness and magnitude of the operation makes ample opportunity for large cost savings.

However, it should be noted that emphasis on savings, often at the expense of quality, can be more expensive in the long run. One such idea which shows potential to substantially improve equipment is the use of vendor incentives to upgrade the reliability and acceptance rates of components. This and other like items should be vigorously pursued by groups such as in-service engineering activities, the NARF's, QEL's, etc.

TECHNICAL DATA INTERCHANGE BETWEEN NARF'S

Detailed Conclusions and Recommendations

For several years, the SPARROW rework program has used the Engineering Symposium approach as a means of interchanging information between the "missile NARF's." However, the scope and attendance has grown from the first meetings which were directed to test equipment and standardization, to cover many other aspects of the program. Other exchanges, both formal and informal, have also been used.

The Missile Control Systems, Weapon Suspension Equipment, etc., have also experienced various degrees of interchange among the involved NARF's but no formal symposium approach has been used. Communication effectiveness appears to be substantially less in these areas.

It is, therefore, recommended that the required interchange be achieved through two basic means. Both should be conducted under the auspices of the NAVAIRSYSCOMREPS (NAVAIRINST 5451.60) with the cognizant in-service engineering activity chairing.

(1) The symposium approach should be instituted throughout the Air-to-Air Missile Systems Programs. However, several smaller symposiums should be conducted addressing more specific areas. For example, Test Equipment would include such subjects as calibration, test procedure adequacy and change, test set parts provisioning, special facilities requirements, etc. These symposiums should be SCHEDULED on a routine basis, at least annually.

(2) Specific meetings (not symposiums) should be called when problems arise that warrant immediate resolution through this means.

At the conclusion of these meetings the cognizant in-service engineering activity should assume responsibility for follow-up to assure that the action items were successfully resolved. Meetings can never replace good management follow-up and control.

The expanded use of the above scheduled and called meetings should not preclude the use of other means of information exchange, but should greatly lessen the requirement for them.

CONFIGURATION CONTROL

Detailed Conclusions and Recommendations

Air-to-air missile systems have a wide variation as to specific configurations, especially in the F4 aircraft series. In many instances, this has degraded the systems from "Mission Ready" to partially "Mission Capable."

To alleviate existing configuration control problems all systems need to be updated to an approved configuration. To avoid future similar configuration control problems, BUWEPSINST 5200.20 (1) should be closely adhered to in identifying Class II type changes. Finally, a configuration document for each major assembly similar to Westinghouse Drawing 514R300 (Configuration Document) for the AWG-10 should be provided.

The inherent complexity and diversity of modern weapons demands timely and accurate configuration statistic accounting capability for management decisions, particularly in the area of support equipment, components, and air-borne weapons systems.

There is a pressing need to update all systems, sub-assemblies, and launchers to a specific configuration because a large number of both Class I and Class II changes have been introduced resulting in systems and sub-assemblies that are not identifiable (externally) as to their configuration. Often it is not possible to determine if a sub-assembly will function until it is installed in the aircraft and an operational check is attempted.

It is recommended that each system, sub-assembly and launcher be programmed through the NARF for updating. Additionally, in order to update the systems, sufficient quantities of parts and kits must be procured for each change. A major complaint has been that the NARF's are unable to obtain kits to meet configuration requirements. Single kits that have been reported issued to operating squadrons are unobtainable during the PAR cycle. It is mandatory that BUWEPSINST 13052.1A (2) and 5218.8 (3) (MIL-T-23336) (4) on kit control be complied with to prevent the above situations from occuring.

Many changes are incorporated into equipment introduced as Class II changes that are in reality Class I changes. Such changes do not have the logistic support required and they are not fully documented. In such cases the change is first apparent when an interface, a failure, or a test equipment incompatibility problem presents itself. Time consuming delays are incurred while the squadron, AMD or NARF personnel procure the necessary documentation and/or parts to support the unit containing such changes. An additional problem is introduced even when the Class II change is properly labeled. For example, the reasonably simple LAU-7A Launcher has over 400 Class II changes, none of which are available at the NARF, yet the combined changes preclude repeatable test results. To avoid future configuration control problems, BUWEPSINST 5200.20 (1) must be closely adhered to in identifying Class II type changes.

LES's normally fall well within the Class II change category; therefore, it is recommended that NAVAIRINST 5215.6A (5) be revised by the Program Managers to provide the NARF's with a format tailored to MIL-T-23336 and that a numbering system be established which can be better controlled and identified.

NAVAIR-4026 has under consideration a proposed NAVAIRINST "Configuration Status Accounting Systems" which should cover many of the above problems. It establishes a system utilizing configuration data from all pertinent sources as a management tool for control and analyses of weapons systems' requirements and capabilities. Consideration should be given to its early promulgation.

(1) BUWEPSINST 5200..20 of 29 April 1963, "Weapons Systems Configuration Control Manual"
(2) BUWEPSINST 13052.1A of 8 April 1964, "Aircraft and Their Related Equipment and Material; Procedures for Preparation, Distribution, Incorporation and Distribution of Changes To"
(3) BUWEPSINST 5215.8A of 30 January, "Letter Type Technical Directive System; Establishment of"
(4) MIL-T-23336(WEP) of 20 June 1962 "Technical Directive (Letter Type); Preparation of"
(5) NAVAIRINST 5215.6A of 27 November 1967, "Local Engineering Directives Prepared by Naval Air Rework Facilities"

QUALITY ASSURANCE PLAN

Detailed Conclusions and Recommendations

The NARF's visited by Team Five did not have effective Quality Assurance Programs or Plans developed specifically for the air to air missile system. In order to deliver good quality hardware, the NARF's Quality Assurance Organization must have overall management objectives (Quality Assurance Program) and a standardized method to implement these objectives (General and Detailed Quality Assurance Plans).

Recommend that NAVAIRSYSCOM task Government teams composed of NARF quality assurance and engineering representatives and chaired by NAVAIRSYSCOM to meet at the NARF's presently reworking each weapon system component. These teams should formulate quality assurance objectives and general quality assurance plans for each item reworked (AWG-10, AERO-1A, SPARROW, SIDEWINDER, various launchers). NAVAIRSYSCOM should arbitrate all disagreement, make final approval on all planning produced at these meetings, and direct final implementation by the NARF's concerned. These teams should utilize the minimum requirements for quality assurance objectives and for a general quality assurance plan as shown in paragraphs three and four.

Minimum objectives for a specific air to air missile system Quality Assurance Program include:

a. The overall objective that only good hardware is delivered from the NARF's.

b. The associated objective to evaluate and assess production, inspection and testing procedures, techniques, process controls, and related documentation for adequacy and effectiveness.

c. The associated objective to assess product quality and reliability in quantitative terms.

d. The associated objective to advise in writing responsible authority of deficiencies uncovered.

e. The associated objective to prevent shipment of material to using activities that does not conform to established standards (NARF Rework Plan) of quality and reliability.

Minimum requirements for a General Quality Assurance Plan are as follows:

a. Statement of the purpose and scope of the plan, including nomenclature of the particular weapon system component involved.

b. Quality assurance organization involved for operating the plan. Include the required minimum quality assurance personnel required for specified amounts of hardware reworked tc effectively do the quality assurance task.

c. Training. Include all on-the-job, Government sponsored, and factory training required for quality assurance and production personnel such as: soldering, welding, non-destructive testing, potting, special testing, management training, etc.

d. Product Verification. This includes physical inspection and witnessing inspection in the following areas:

(1) Incoming material inspection to the extent necessary. (Example: Qualified Vendor Lists.)

(2) Sampling inspection.

(3) Assembly inspection.

(4) Final acceptance/test inspection.

(5) Environmental testing.

(6) Preservation and packaging.

(7) Indication of inspection status.

e. Process Control. State the amount of quality assurance verification required to adequately control all processes.

f. Specifications. State the applicable quality standards involved, including all test specifications and specification changes.

g. Personnel Certification. State all the requirements for certification in special processes and non-destructive testing.

h. Material Review Board. State the Material Review Board authority proposed for use.

i. Documentation Control. State the review authority expected from quality assurance personnel regarding all product and procurement documentation and configuration control requirements.

j. Data Gathering and Analysis.

The reporting of suspected or discrepant materials in house must be required in order that failure modes, trends, and causes can be established. Cataloguing and correlating this data systematically will enhance problem identification and also aid in initiation of corrective action. In addition to NARF use, this information should be reported to the 3M system for developing usage and reliability data. The reduced data should be analyzed by the responsible in-service engineering activity of the prime designated overhaul point with assistance to be furnished as may be necessary from the contractor.

To properly identify the failure cause, and in-depth analysis of failed parts must be performed by the in-service engineering activity, QEIS, prime designated overhaul point, or the contractor as necessary to provide accurate information for initiating effective corrective actions back to the NARF's.

k. Corrective Action. State the flow of the internal NARF corrective action cycle.

l. Quality Audits and Process Reviews. State the reason for performing audits and set up an audit schedule to be followed.

m. Controlled Storage. State controlled storage conditions and how non-conforming material is segregated, identified, and controlled.

n. Calibration Requirements. State how all test and measuring equipment and tools are controlled.

o. Reference Documents. Include all references that are pertinent to the Quality Assurance Plan.

Recommend that NAVAIRSYSCOM task Government/Industry teams composed of NAVAIRSYSCOM quality assurance management as chairman, NARF engineering, quality assurance representatives, in-service engineering activity representatives, and appropriate industry quality assurance engineering representatives. One team should meet for each basic hardware item reworked (e.g., AWG-10, AERO-1A, SPARROW, SIDEWINDER, launchers). The basic team objectives should be to develop a standard, pictorially highlighted, workmanship document for the specific hardware being reworked; and also to develop specific Detailed Quality Assurance Plans. The Detailed Quality Assurance Plan should consist of:

a. QCL's (Quality Characteristic Lists) of all portions of hardware being reworked or soon to be reworked at the NARF's involved.

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b. Acceptance and rejection criteria for this hardware.

c. AQL's (Acceptable Quality Levels) expected of the reworked hardware. (Recommended sampling AQL for air to air missile system hardware is 95 percent for outgoing material, and 90 percent for reworked material at the receiving activities.) Sampling AQL must be defined for each type of component reworked.

The NAVAIRSYSCOM chairman should arbitrate all disputes during these meetings, and be authorized to negotiate for the industry input (contractor workmanship documentation and contractor established QCL's). He should be responsible for final review and acceptance of all teams' input to the NARF's. Finally the Detailed Quality Assurance Plans should be married with the General Quality Assurance Plans at the NARF's, and periodically updated, maintained, and used by the NARF's after receipt. The quality workmanship document should also be periodically updated by the contractors when major changes occur to them.

In the future, recommend that the quality assurance provisions for all air launched hardware be initially developed by the NAVAIRSYSCOM design engineering activity. Further recommend that these quality assurance provisions be maintained and updated by the NAVAIRSYSCOM in-service engineering activity.

In conclusion, Team Five feels that if these recommendations are undertaken, the quality of all reworked air to air missile hardware will be significantly improved.

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EXPANDED PERFORMANCE EVALUATION PROGRAM

Detailed Conclusions and Recommendations

The PEP should be expanded. The basic approaches of PMT are good, but the contractual requirements limit its effectiveness. Therefore, instead of PMT, Team Five proposes the following course of action:

a. The NARF's PEP should be continued at or above the present sampling rate.

b. Testing activity should submit one of the accepted missiles from the above sample to the QEL for environmental testing (vibration and temperature cycling), for detailed visual inspection and for complete testing of all circuits.

c. Testing activities should continue to send all failed missiles to QEL for analysis and feedback.

d. One missile per sampling lot should be fired at a realistic target within realistic parameters for better test results. It should be fired under full telemetry.

e. Insure NARF and in-service engineering activity take positive follow-up action and notify all concerned of their action.

In order to supplement the above changes in the present PEP program, it is recommended that NAVAIRSYSCOMHQ direct NAVAIRSYSCOMREPLANT/PAC to revise their current joint REPLANT/PAC PEP instruction using inputs from QEL's, NARF's, NAVMISCEN, FMSAEG and Raytheon.

EARLY NARF PARTICIPATION

Detailed Conclusions and Recommendations

Present NARF participation is basically limited to spare parts identification and procurement. This effort should be expanded to participation in the MEAR's (Maintenance Engineering Analysis Reviews) including selection of SSE, contractor support, training and publication procurement, as per the current Integrated Maintenance Management WR-30.

Early participation is particularly required in the areas of major facility changes, calibration of equipment considerations, general testing philosophy and mechanization. Modifications in many cases must be considered as new programs and they should be reviewed by the NARF's for the necessary interchange of information and coordination in the future rework process.

Most early information gained has been through informal contacts, but very little of this can be considered official; however, it is often the only information available to the NARF to determine whether or not an equipment or facility problem exists. Although the AWG-10, for example, has shown some improvements in this area, the trend should be strengthened. At the early stage in a project, the NARF can contribute many inputs to the contractor that may easily be incorporated, resulting in saving funds, manhours and elapsed time through the use of presently available experience, equipment, techniques and procedures. As an example, if special environmental controlled space is required, and assuming space is available within existing buildings, a minimum of one year would be required to obtain such a facility; if facility requirements fall into the Military Construction category (including additional utilities to existing buildings), one to three years would be required.

In the past emergency measures have had to be used to provide the required lighting, power, work spaces, space, etc., simply because the NARF was not aware of the size or requirements of the program. This could reduce the efficiency and adequacy of the facility and could effect the timeliness and/or quality of support.

The need for early participation is particularly important when two NARF's are to rework the same equipment. The test equipment, philosophies, and facility should be the same; but if some differences do exist, the reasons should be valid and clearly understood by all parties. It should be noted that the AWG-10 has several differences in test equipment, philosophy and mechanization in the NARF's with less than complete justification.

Several problems observed due to lack of early involvement were noted as follows:

a. The NARF did not receive the correct equipment causing in-house build-up or modification of existing equipments. This equipment is now a problem area in future modification efforts.

b. Major facilities such as radar ranges, environmental chambers, clean room facilities, etc., required long lead-time for completion.

c. Calibration equipment, specifications and instructions are areas that tend to be de-emphasized until the project starts in the NARF.

d. General purpose automated test equipment available to the NARF (or will be in the immediate future) is not adequately considered for use on new programs.

e. Failure to develop a comprehensive rework and quality control plan. This basic management tool to optimal processing is, in general, lacking in content or non-existent in the AMCS or missile rework efforts observed.

It should be noted when missiles are procured with WR-1, WR-2 and WR-5* as the contracting requirements, there are no provisions for NARF participation in determining the maintenance concept, technical data and support equipment requirements. An example of a smooth running program with a quality product is the SHRIKE program. NARF Alameda had a definite say in the type and depth of technical data and type of test equipment to be provided.

NARF engineering and production personnel should be permitted to be active team members of the IMM teams and MEAR's review teams in accordance with WR-30*. These team members would be able to make important contributions to depot level maintenance concepts, define depot level technical data requirements, and assure that the level of test equipment is adequate for depot level rework and can be integrated with existing facilities at the NARF.

If WR-30 logistic support elements are considered properly by NAVAIRSYSCOM during the development stages of an air-to-air program, the problems down stream would be taken care of.

*WR-1 "Supply Item Provisioning for Bureau of Naval Weapons Contracts"
WR-2 "Contract Support for Bureau of Naval Weapons Contracts"
WR-5 "Support Equipment Design, Approval Selection and Ordering for Bureau of Naval Weapons Contracts"
WR-30 "Integrated Maintenance Management for Aeronautical Weapons and Weapon System Related Equipment"

Who knows better than the NARF's, the depot maintenance problems, the type and depth of technical data required for depot support of the AMCS and missile, and the type of test equipment that will best integrate with existing NARF's?

NARF/CONTRACTOR COST COMPARISONS

Detailed Conclusions and Recommendations

The assignment of rework responsibilities for air-launched missiles and components to Navy in-house facilities is based primarily upon the strategic and operational aspects of logistic support of Mission Essential equipment. This is in line with DOD Instruction 4151.1 which states that each service will develop and maintain an organic (in-house) maintenance production function for mission essential equipment. The referenced DOD Instruction, however, does not preclude the use of contract support as an additional source. The determination of whether or not rework will be supported in-house is based upon a subjective reasoning process which includes measurable considerations along with risks and uncertainties.. Included in any such determination must be the responsiveness of each to rapidly changing Fleet demands, the technical capabilities of each, and of course, direct comparisons of costs. Technical know-how is centralized at the prime contractor's facility while the hardware is in production. The data package is kept current at the prime and configuration control can easily be maintained between new production and rework. On the other hand the in-house facilities can more readily adapt to changing workloads and changing priorities and in these respects are much more responsive to the Navy's needs, especially in a war or crisis situation. In other words, the Navy has direct control over the priorities it assigns to its in-house facilities, and can ask for and get immediate response to its changing demands.

With regard to cost, there has been, from time to time, comparison studies conducted by the Navy. One such study, the Navy Aeronautical Depot Maintenance Cost Comparison Study of 23 February 1965, evaluated a total of 39 components overhauled by both the Navy O&R and commercial facilities. It revealed that in 34 cases, the average cost to the Navy was lower in its in-house facility. These studies are performed infrequently, however, and at present there are no commercial contracts that would provide a basis for a direct cost comparison study. In the planning stage, however, is a requirement for the repair, rework, and installation of Engineering Change Proposal No. 54 in AIM-7E missiles. A contract (Air Force) has been let to the Raytheon Company for this work at a unit price of $3800. In the meantime, NARF, NORVA has priced out this work at $3064 each.

If it is determined that a private contractor should become involved in a rework effort, one approach toward leveling off the varying workload of repair units at the contractor's facility would be to contract for the rework in two stages. First, award incentive type continuing contracts for defect analysis and repair appraisal and second, after sufficient units had accumulated, to award a fixed price contract for repair of a specific number of appraised units.

Another consideration that must be made in the Navy's determination of where repair is to take place is the problem that arises when the hardware to be repaired is no longer in production. It has often been the case that when the contractor completes production of an item, he rapidly loses interest in the rework function. If the Navy has large stores of this item and requires a continuing rework function, repair costs can rise significantly without an in-house repair capability.

By means of comparing contractor proposals to in-house costs, and weighing the above subjective factors, the Navy can measure the relative merits of contractor versus in-house repair and rework costs. It is recommended by this team that the Program Managers set up a plan by which such direct cost comparisons are made on a routine, periodic basis as early in each program as feasible.

AERO-7A/AMCS TEST FACILITY

Detailed Conclusions and Recommendations

In the checkout of the firing functions of the F-4 aircraft, there is a weakness which reduces the reliability of the entire system, i.e., the inability of checkout personnel to test the sequence, timing, amplitude, and duration of events from trigger pull to missile separation. This is true at the NARF's as well as in the Fleet since the same test set and procedures are used by all. A dynamic type test (pit test) which overcomes the weakness of, and supplements, the static "E" level test was devised for use by Fleet units. The dynamic testing consists of actually ejecting a dummy missile from each launcher into an arresting device and recording the firing circuit sequences. By examining the recording, the technician can verify the serviceability of unit or problems in the firing circuits which otherwise would go undetected. In August of 1965 a program was established at NAS Miramar to dynamically check as many squadron aircraft as possible. The testing has produced significant results as documented by FMSAEG's Technical Memorandum E5-680 of August 1967 which reports the results of F/O 213 "SPARROW Shoot." Among other things, FMSAEG's data shows that those squadrons which did not have dynamic testing had a misfire rate of 14.9%, whereas those squadrons which did have dynamic testing had a misfire rate of 4.9%. FMSAEG concludes that these figures demonstrate "the importance of usefulness" of dynamic testing. Since the NARF's do not now have dynamic testing capability, it is logical to assume that some aircraft are "sold" with undetected discrepancies in the firing circuits which could preclude a successful SPARROW III launch.

In order that the NARF's might turn out a more "mission ready" aircraft, it is recommended that dynamic testing be done at the NARF's as part of the final checkout of the aircraft. Dynamic testing can be implemented in one of the following ways:

1. Procure instrumentation as currently installed at NAS Miramar, NAS Oceana, and NAS Cubi Point. This consists of a Honeywell Model 1108 Visicorder, a signal conditioning and timing unit, and instrumented dummy missiles. This type instrumentation can be built by the NAVMISCEN, Point Mugu, at a cost of $25K to $30K, depending on requirements of the particular installation. This requires a six-month lead time after maney is made available.

In addition to the instrumentation package, some sort of arresting device is required for retrieval of the ejected dummy missiles. NAS Miramar and Oceana use pits filled with straw; NAS Cubi Point uses portable "catcher's mitts" designed and built by the NAVMISCEN. These are no longer available from the NAVMISCEN, but a data package has been produced and turned over to SPCC so that more may be obtained through normal supply channels. The cost of the "catcher's mitt" will probably be about $1500 each. Four are required to check all ejection launchers on an aircraft at one time.

A cleaning stand for the AERO 7A launcher is also required since the launcher ejection cartridges must be fired to fully accomplish the checkout. An EL-540A cleaning stand manufactured by Raytheon is recommended. This is the same stand which is being procured for Fleet use. The cost under the present contract is about $2500 each.

The total initial cost of the above test set-up will be about $38,500, or about the cost of ONE complete SPARROW III missile.

2. Procure the "next generation" instrumentation package which is in the prototype stage at the NAVMISCEN. This unit is a solid state test set in a suitcase which gives performance comparable to the Visicorder but which is easier to use and maintain. It is also much less costly, the prototype costing about $1000. The prototype is not built to Mil standards so the cost for a Mil standard version is expected to be in the range of $2000 to $3000 each. About six months lead time will be required after a data package is developed. The data package will cost approximately $20,000.

The arresting devices and cleaning stand are required with this instrumentation, as are the dummy missiles, which will bring the total cost of the package to about $13,000, plus $20,000 for the data package.

3. The NARF's will also need to program approximately 8 manhours, additional labor per aircraft to cover checkout, cleaning, and reinstallation of the launchers.

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SURVEILLANCE PLAN

Detailed Conclusions and Recommendations

Surveillance of air-to-air weapon system components has not been totally effective. Surveillance has generally been limited to weapon components available at the NWS's. Existing programs have been developed on a low priority basis and in some cases test equipment and test samples have been difficult to get. Additionally environmental test requirements have not been well defined and this technique has been limited to special situations, primarily because of insufficient manpower and to some extent, equipment.

It is recommended that a relatively higher priority and more emphasis be given to surveillance of air-to-air missile system components, especially the AMCS and weapons suspension equipment which have demonstrated unsatisfactory performance. Additional funding, billets and direction should be made available to:

a. Accelerate those programs not yet functional.

b. Institute new programs and expand existing ones as deemed necessary.

c. Define sample requirements including environmental testing.

d. Make special malfunction investigations as the need arises.

e. Evaluate reasons for high failure and replacement rate components.

This program should include:

a. Periodic surveillance of the stockpile.

b. Fleet return surveillance.

c. Weapon system performance and captive flight data reporting.

d. Surveillance of test equipment calibration data.

e. NWS/Ammunition Depots/Naval Magazines test and inspection.

f. Shipboard tests and inspection data.

g. Rework data reports.

h. Flight tests of repaired items.

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i. Review of failure report information.

This program is designed to define problem areas so that air-to-air weapons and weapon components may demonstrate acceptable quality and reliability. This program will further provide necessary data on which decisions will be made concerning maintenance, rework, corrective action, and final disposition action for air-to-air weapons material.

This program would also serve to define the number of captive flights allowable before rework.

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ENVIRONMENTAL PROGRAM FOR DETECTING MARGINAL COMPONENTS

Detailed Conclusions and Recommendations

Several basic facts should be recognized concerning the concept of using environmental techniques to induce early marginal component failures:

a. The approach does not primarily detect workmanship faults. Care must be taken to assure that this technique does not become a "crutch" to the bench mechanic.

b. Additional in-process time will be required if vibration techniques are proven and then introduced. However, the reworked missiles will have a higher readiness availability in the Fleet

c. Although not a primary purpose of the effort, some design deficiencies will be uncovered through this technique. Programs such as the Design Margin Evaluation conducted by NAVMISCEN Point Mugu, provide the basic inputs in this area.

d. Improper application of the technique can cause serious damage to the missile.

e. The technique is not a screening device nor a "test."

Before any consideration can be given to NARF implementation of these techniques, the quite valid question of whether repeated vibration of a missile will result in a constant failure rate, must be answered. If the rate remains essentially constant, the technique is destructive and must be re-evaluated along one or more of the following lines:

(1) Correction of design deficiency.

(2) Consideration of application of a lower level stimuli.

(3) Further investigation of applying a low temperature environment to induce the desired faults.

If the rate decreases, then an engineering determination of what factors are significant and a means of economical NARF implementation should be determined. It is recommended that this determination be jointly performed by NWS, Concord; the NAVMISCEN, Point Mugu; with the NARF's. The prime factors to be determined are the applicability of sine wave in lieu of random excitation, spectrum, fixturing, monitoring points, stimuli control point, and the testing/vibration sequence. It should be remembered that NARF NORVA presently has only a sine wave capability (random scheduled

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for delivery Spring of 1969) and that NARF Alameda has no vibration capability assignable to SPARROW along with a severe space problem.

The NAVMISCEN has proposed that in order to eliminate the requirement for a noise generator and a spectrum analyzer at the NARF's the random vibration input for the shaker could be provided by a prerecorded FM magnetic tape. The tape would be prepared by NAVMISCEN after determining the characteristics of the system to be used. For calibration of the system the shaker output would be recorded periodically and sent to NAVMISCEN for analysis. If the shaker output were discovered to be outside of the desired range, a new tape would be prepared for that system. Based on what is known today, the proposal has potential and should be investigated thoroughly.

If a low frequency, multiple unit, vibration mechanization could be developed, substantial first and continuing cost savings should result. However, it must be kept in mind that when using inexpensive environmental techniques, one must have an extremely well defined and controlled situation and goal. This information does not exist today.

It should be noted that the key to the direction of the entire effort hinges on the results of the NWS Concord Study to determine the non-destructive character of the present vibration parameters. This additional testing has not yet been initiated due to load out requirements. It is therefore recommended, that adequate priority be given the investigation.

The possibility of implementing environmental techniques on other air-to-air systems was pursued at the NARF's. Although there was some interest expressed, such an action appears to be contraindicated at this time.

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STANDARDIZED REPORTING PLAN

Detailed Conclusions and Recommendations

The NAVAIRSYSCOM (as well as other activities) has been saturated with reports and other forms of communications much of which is not relevant to the requirements of NAVAIRSYSCOM. In general, these reports contain much detail and are often clear only to the originator or his technical equivalent. They generally do not contain the type of information nor the format which enables NAVAIRSYSCOM to make timely response. To get action, the originating activity often adds all codes associated in any way with the component involved thus frustrating the system and plugging the communication channels.

It is recommended that the In-Service Engineering activities be established and tasked to develop reporting plans to provide NAVAIRSYSCOM with the required information to make prompt decisions and to reduce the report traffic into NAVAIRSYSCOM to the essential. Some of the considerations for these plans are:

a. Provide a substantially single channel action communication system between NAVAIRSYSCOM and the In-Service Engineering activity, thereby reducing the number of activities the appropriate NAVAIRSYSCOM Code AIR-04 must deal with.

b. Establish the required NAVAIRSYSCOM information and format for various types of reports.

c. Take advantage of and complement the 3M/UR reporting system. That is, standardize and incorporate engineering and analytical reports into these systems where feasible.

d. Attempt to define reporting requirements of the various participating activities (NARF's, QEL's FMSAEG, Field Reps (Mugu, NARF, contractor), etc.) in terms of required content, format, timing and distribution. Perhaps most of the non-routine reports could be based on a task assignment system which pre-defines some of these requirements.

Additionally at a higher level, all the report plans for a given weapon system should be coordinated for simplicity and similarity.

Finally, an Air Weapons "ZIP Code" should be considered to provide sufficient identification to aid in communication routing and retrieval and especially to enable the reader to ascertain his interest. Such things to be included would be: component identification and breakdown, safety, funding, report type, activities affected, etc.

3M PLAN FOR REWORK FACILITIES

Detailed Conclusions and Recommendations

The activity tasked by NAVAIRSYSCOM for developing a plan for the NARF's full, early participation in the 3M Reporting System should evaluate and determine the possible inclusion of the following reporting formats already present in the Navy system:

- Existing 3M Data
- Failure/Malfunction Reports (UR, ADR)
- Contractor reports
- NAESU reports
- NAVMISCEN Point Mugu reports
- QEL reports
- Participating Field Activity (Crane, Indian Head, etc.) reports
- NARF Field Team reports

PUBLICATIONS

Detailed Conclusions and Recommendations

Publications have long been a problem in spite of the large expenditures for documentation.

Handbooks are changed so frequently that users do not have sufficient time to provide comments or changes within the existing manual before another is printed. Recent equipment changes are not documented in the manuals and in general, the manuals are usable only to a degree after being employed several years and are never considered adequate for a standard.

There have been numerous efforts to correct handbooks, but these have met with little success and this includes the use of the UR. As an example; NARF Alameda wrote a UR against the AN/DPN-14 SPARROW III missile test set manual over a year ago and as of this writing, it has just been received by Raytheon for possible adoption.

The SPARROW III missile and its rework have not changed appreciably over the last five years. The rework handbook has been revised every six months and even been reissued. It is still unsatisfactory for use as a standard or even as a good reference document.

It is recognized that the seven working groups of the "Ordnance/Armament Technical Manual" Ad Hoc Committee* discussed manual deficiencies and made specific recommendations for improvement of manuals and the manual updating methods. These recommendations have been only partly formalized. Criticism of publications is still directed toward those manuals presently in existence that have not incorporated the newly developed methods and format.

It is recommended that NAVAIRSYSCOM (AIR-4036) be directed to provide the NARF with the (proposed) Military Specification (no number) titled Manuals, Technical, Airborne Missile and the minutes of the SPARROW III Technical Manual Management Team (chaired by AIR-4036), and comments be solicited. It is recommended that manual contracts be written so that it will be the responsibility of the contractor to insure that the manual is free of errors, other than personal interpretations, after one year of use. After the first year any manual change other than changes resulting from equipment or specification changes, shall be initiated by a UR and should be accomplished at no cost to the Government.

*Meeting held on 4-6 September 1968 as directed by NATSF message 161322Z August, 1968.

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APPENDIX VI

REPORT

OF THE

AIR-TO-AIR MISSILE SYSTEM

CAPABILITY REVIEW (U)

JULY–NOVEMBER 1968

APPENDIX VI

NAVAL AIR SYSTEMS COMMAND

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APPENDIX VI

FMSAEG SUPPORT OF AIR-TO-AIR MISSILE SYSTEMS
PROGRAM REQUIREMENTS

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FMSAEG SUPPORT OF AIR-TO-AIR MISSILE SYSTEMS PROGRAM REQUIREMENTS

1. For more than ten years FMSAEG has been collecting, processing, analyzing and evaluating the quality, reliability, readiness and performance of all Navy air-to-air guided missile weapons systems. The results of FMSAEG's efforts have been published periodically including information on systems troubles and failures. Based on its experience with the air-to-air missile program, FMSAEG believes that the following functions have been seriously neglected and must be implemented on an urgent basis and at a substantial level of effort:

a. Develop and implement a deficiency/failure corrective action program.

A "Quick-look" at the AAM Systems Committee reports reveals that a large number of the existing weapons systems problems have been known for some time but no apparent action has been taken to investigate and correct them. It is obvious that a need exists for a dynamic system to be developed and implemented to monitor a corrective action program. Two such systems, which were originally developed by FMSAEG, are being conducted. One of these is the Deficiency Corrective Action Program (DCAP) which is being conducted for SMS Projects Office by the Naval Ship Missile Systems Engineering Station (see Item 1, TAB A). The FBMWS Trouble and Failure Report Program is being conducted for the Strategic Systems Project Office by FMSAEG. (see Item 2, TAB A).

b. Assignment of In-Service Engineering Responsibility to a cognizant Field Activity for each Weapon System.

A critical need exists for a field activity to be provided the necessary responsibility, authority, and the associated resources to perform in-service engineering functions for air-to-air missile systems in accordance with the NAVAIR Instruction listed as Item 3 on TAB A. Such an activity could then close the loop on those troubles, failures and deficiencies identified and monitored by the system proposed in paragraph 1 (a) above.

c. Establish a requirement for periodic reports to cognizant activities by Commanding Officers of squadrons firing guided missiles.

The SMS Project Office requires that the Commanding Officers of guided missile ships provide periodic narrative reports on the performance of their guided missile systems (see Item 4 on TAB A.) The information submitted in these reports is often not documented in any other form and provides valuable information on the performance of these systems, the problems encountered, and suggestions for changes and improvements. It is recommended that the aircraft squadron commander provide similar reports on their AAM systems.

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d. Use of Telemetry Packs

When an air-to-air missile is fired in training, in combat or for special evaluation, it is imperative that the maximum amount of information be collected and evaluated. Accordingly it is recommended that TLM packs be used in firings of all air-to-air missiles including those configured with warheads.

2. In addition to those functions vital to a successful AAM Systems program, which are discussed in paragraph 1, FMSAEG is conducting other important functions pertinent to this program within its assigned mission and tasks. Specifically the tasks which FMSAEG is performing for NAVAIR are discussed in the letter listed as Item 5, TAB A. Although the funds provided in FY 1969 are significantly less than those requested, especially in the fleet support area (Code AIR-04A2), FMSAEG is assigning some effort to most of the FY 1969 described areas. In brief they are:

a. Evaluation of weapon station data collected during checkout of missile rounds or missile sub-assemblies; e.g., G&C sections. Reports of these evaluations are provided NAVAIR and cognizant field stations and missile contractors.

b. Evaluation of data recorded by the pilots during all missile firings is collected, assessed and analyzed as well as the telemetered results obtained by FMSAEG for most SPARROW III firings. Periodic summary and special reports of the firing results are provided cognizant activities.

c. Data is being obtained, on a somewhat informal basis, from the repair and rework facilities (NAVAIREWORKFACS) at Alameda and Norfolk during their work on missile guidance and control sections. This data is analyzed and provides valuable information concerning the quality and reliability of the components and parts of the G&C's. Accordingly, FMSAEG reports provide failure trend information and was most recently used to identify specific SPARROW III seeker and control sections by serial number containing faulty potentiometers for both Navy and Air Force. It is recommended that the collection and analysis of this data be formalized and expanded to cover the complete round and other parts of the weapon system as appropriate.

d. Periodically the Quality Evaluation Laboratories conduct extensive destructive and non-destructive tests of missile round assemblies and subassemblies. These tests are usually performed on samples taken from the stockpile. Results of these tests are reported by the cognizant coordinating QEL for round sub-assemblies and by FMSAEG for the missile rounds. In addition to the above surveillance tests the QEL's perform failure diagnosis on defective rounds returned from the squadrons. The results of these failure diagnoses are incorporated in both QEL and FMSAEG reports.

e. During such special evaluation exercises as "SPARROW shoot" FMSAEG has provided field engineers to assist in the installation of TLM packs,

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checkout of the weapon systems on the aircraft before take-off, and the "quick-look" analyses of TLM data during missile captive flights and firings. This service to the squadrons has been particularly well received. Accordingly, in addition to the extensive TLM recording, processing and analysis facilities maintained and operated by FMSAEG at Roos. Rds., P.R., for AFWR; TLM recording and processing facilities (installed in trailers) are currently being maintained and operated, when needed, at Cherry Point; Beaufort, S.C.; and Key West. Another facility is being prepared for use at Oceana and it is expected similar advance base type facilities will soon be in operation in Okinawa and later in the Philippines. Since TLM data is obtained at those sites, actual weapon systems and round performance data can be evaluated under more realistic tactical environments.

f. During the past eighteen months FMSAEG has been developing and is now starting to implement a Serialized Missile Accounting Control System (SMACS) for air launched missiles. Although aimed primarily toward solving inventory and logistics problems, it also will provide valuable information on the configuration of the missiles in use or in the stockpile and their current physical location.

g. Over the past fifteen years that FMSAEG has been collecting, processing and analyzing guided missile quality, reliability and performance data, it has developed a very flexible and versatile digital computer information storage and retrieval system. It is identified as the "VIP" (Variable Information Processing) system and is described in the Technical Memo listed as Item 6, Tab A. It is now being used with FMSAEG's present 2nd generation computer system; IBM 7074 and IBM 360/30. This computer system will be replaced by a third generation computer with much greater capacity and flexibility, during the 4th quarter FY 1969 or 1st quarter, FY 1970.

h. FMSAEG conducts evaluations, correlations and certifications of certain missile round test and check-out systems used in the factories, depots, stations and fleet. To date this effort has been limited primarily to missile sub-assembly test and check-out systems investigations at the factory and QEL levels. A detailed investigation is being conducted now of the SPARROW G&C test equipment used by the NAVAIREWORKFAC's and at the Naval Air Stations, and on the Carriers. Additional effort is badly needed to insure adequate test and checkout capability for the aircraft installed system, for all-up missile testing and sub-assemblies as appropriate.

i. Since the beginning of the PIT testing program at Naval Air Station, Point Mugu, FMSAEG has collected the test results from such tests at many other locations and evaluated the data for significant trends. Several reports have been issued by FMSAEG giving the results of the analyses. This program has been conducted on a more or less unofficial basis and should be formalized and made a mandatory requirement so that all aircraft will receive a PIT test prior to any training firing or tactical deployment.

3. In summary, it is recommended that cognizant field activities be tasked and provided sufficient resources to:

a. Develop and implement an effective trouble/failure corrective action system.

b. Conduct in-service engineering for each tactical weapon system.

c. Develop and provide telemetry packs and require their use in all missiles during firing exercises.

d. Insure telemetry data recording, procuring and "quick-look" analysis facilities are established and operated at all air-to-air missile firing ranges.

Further, it is recommended that the following actions be taken:

e. Commanding Officers of Aircraft Squadrons equipped with guided missiles be required to submit periodic narrative reports on performance of their missile systems.

f. Provide additional resources (funds and billets) to FMSAEG to support the fleet support tasks at the level proposed in its FY 1969 budget (see Item 5, TAB A).

g. Provide additional support as needed for additional resources for the depots, weapon stations, rework and repair facilities, fleet support offices and the quality evaluation laboratories to insure an optimum level of effort on the subject program.

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TAB VI-A

UNCLASS

20 November 1968

LIST OF REFERENCED LETTERS AND DOCUMENTS

Item 1. SMS INSTR 8810.1A of 4 March 1968
Subj: SMS Proficiency Corrective Action Program

Item 2. SP INSTR 3100.1B of 1 March 1966
Subj: FBMWS Trouble and Failure Report Programs

Item 3. NAVAIR INSTR 5400.1A of 27 May 1968
Subj: Engineering functions for designated service equipments; policy and procedures for delegation: of authority and assignment of responsibility to field activities for the performance of

Item 4. NAVORD INSTR 4355.2 of 15 April 1966
Subj: Surveillance program for Navy guided missiles

Item 5. FMSAEG ltr Ser. E-03-1040 to NAVORD of 25 April 1968
Subj: FMSAEG proposed five year budget plan FY-1969 - 73 for tasks anticipated from NAVORD, NAVAIR, and others

Item 6. FMSAEG Tech Memo E-3-648 of 15 January 1968
Subj: Variable information processing for digital computers

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