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UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

DEFENSE DIVISION

B-152600

JAN 19 1972

Dear Mr. Secretary:

The General Accounting Office (GAO) has looked at the procedures used by the Air Force to achieve reliability in aviation equipment. Aware that a low level of reliability was being experienced on some equipment, GAO wanted to know why.

We examined the performance records of selected subsystems and compared these with reliability test requirements incorporated in the procurement contracts. Our work was performed at the Ogden, Oklahoma City, Warner Robins, and San Antonio Air Materiel Areas; the Air Force Logistics Command; and the Air Force Systems Command.

The Air Force buys and accepts subsystems from contractors on the basis of reliability demonstrated in tests. There is little, or no, direct correlation, however, between the reliability achieved in tests and that experienced during actual operations. When installed in aircraft, these subsystems are usually much less reliable.

The quality of maintenance performed in the field, the type of missions the equipment is used on, the skill with which it is used and how the equipment interfaces with other subsystems all affect its reliability. For these reasons, it is understandable that reliability in actual use will be somewhat less than in test conditions. However, because such extensive differences are being experienced by the Air Force, we believe there are weaknesses in the testing methods or criteria being used.

Test results compared with operational experience

One measure of reliability of equipment is the length of time that it will perform satisfactorily without failing. This interval of time is called "mean time between failures" (MTBF). The Air Force and the Naval Air Systems Command contracts specify a minimum acceptable interval that must be achieved in reliability testing.

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Comparisons were made of actual operating performances of subsystems with the minimums used in the testing programs, and wide differences were noted. The bomb navigation system of the A-7D attack aircraft illustrates this.

The bomb navigation system integrates various avionic subsystems which provide (1) navigation to the target, (2) a computerized run on the target, (3) weapon release, and (4) return navigation from the target. The failure of any one of the major subsystems detrimentally affects the accuracy of the system. The following table shows the minimum acceptable reliability, which was met during test, and the actual mean time between failures experienced. Additional comparisons for F-4 aircraft systems are shown in an attachment.

	MEAN TIME BETWEEN FAILURES (in hours)	
Major subsystems of the bomb navigation system	Minimum acceptable demonstrated by test	Experienced during actual operations
Forward looking radar[a/]	125	20
Weapon delivery computer	650	95
Air data computer	500	175
Doppler radar	250	48
Head up display	350	88
Inertial measurement	325	77

[a/] At the time of our review the forward looking radar had not passed the minimum acceptable reliability qualification test.

Need for better testing

Reliability is a system performance characteristic which must be considered when the effectiveness of a weapon system is being determined. This characteristic, therefore, is as important in designing new weapon systems as other performance parameters such as range, speed, or payload weight. The decisionmaker must decide whether more

time and money should be spent for additional research, or to accept equipment with the possibility of incurring additional costs for subsequent modifications and logistical support. However, the reliability information available--on which decisions are based--does not permit realistic prediction of reliability. We believe that better testing will provide a more realistic prediction of reliability.

A Military Standard (781B) has been issued to facilitate the development of factors for realistic correlation of test and operational levels of reliability. According to an Air Force Systems Command official, there is no correlation between test and operational MTBF's primarily because tests do not simulate environmental conditions and do not assure that the components are compatible with other equipment. Also, important test requirements are sometimes waived. It is the opinion of Air Force Logistics Command personnel that tests, if properly planned and administered, will show a correlation between test and operational levels of reliability. Operational levels of reliability averaged over a large number of units could be within 20 to 30 percent of the reliability specified in tests. To support their opinion, they referred to a study by Air Research, Incorporated, on the Navy's P-3C aircraft program, which showed that in the majority of cases the minimum acceptable level of reliability was achieved in operations when good test plans were implemented and enforced.

Conclusions and Recommendations

Acceptance of subsystems after they have demonstrated reliability not only in laboratory tests but also in actual use would be the preferred method of acquiring subsystems. Until that type of procurement becomes a reality it appears that better testing will limit the deviations between test results and actual use. We believe that better testing will provide subsystems which will perform closer to acceptable limits.

We recommend that the Air Force adopt procedures to (1) assure a correlation of test and operational MTBF's and (2) assure that the predictions of operational reliabilities are within known confidence limits.

The above recommendations are subject to the provisions of Section 236 of the Legislative Reorganization Act of 1970. We will appreciate receiving copies of the statements you furnish the specified committees in accordance with these provisions.

If you desire, we will be glad to discuss these matters in greater detail with you or with your staff.

Sincerely yours,

R. W. Gutmann

Acting Director

Attachment

The Honorable
The Secretary of the Air Force

ATTACHMENT

Major subsystems of the F-4 aircraft	MEAN TIME BETWEEN FAILURES (in hours) Minimum acceptable required by test	Experienced during actual operations
Radio Navigation System		
Navigation Computer Set (RF-4C)	320	40
Navigation Computer Set (F-4E)	320	87
Inertial Navigation System (RF-4C)	175	38
Inertial Navigation System (F-4E)	180	62
LORAN (RF-4C)	50	25
Integrated Electronic Central (F-4C)	50	17
Integrated Electronic Central (F-4E)	50	32
Radar Navigation System		
Radar Altimeter (RF-4C)	400	26
Radar Mapping System		
Forward Looking Radar (RF-4C)	90	15
Side Looking Radar (RF-4C)	56	12
Bombing Navigation System		
Attitude Reference Bomb Computer Set (F-4D)	173	93
Computer System (F-4D)	250	246
Fire Control System		
Radar Set (F-4E)	9	12
Tuning Drive (F-4E)	600[a/]	632
Lead Computing Sight (F-4E)	300	430

a/ Specifications were not available, therefore, Air Force officials estimated the minimum acceptable figure.