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Report to the Chairman, Committee on Armed Services, House of Representatives

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STRATEGIC BOMBERS

B-1B Parts Problems Continue to Impede Operations

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National Security and
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The Honorable Les Aspin
Chairman, Committee on Armed Services
House of Representatives

Dear Mr. Chairman:

In our June 1987 report,[1] we stated that spare parts shortages were causing the temporary grounding of B-1B aircraft. In response to your request to continue monitoring B-1B supportability, maintainability, and readiness, we have updated and reviewed the status of problem spare parts and other selected supply management issues. The objectives, scope, and methodology of our review are described in appendix I. As discussed with your Office, we are planning to report separately on the other aspects of B-1B supportability, maintainability, and readiness.

The Air Force is experiencing significant logistics challenges that require extraordinary efforts to support limited B-1B operations. Specifically,

- spare parts shortages continue to seriously limit aircraft availability;
- the Air Force is relying on extensive cannibalization (use of parts from grounded aircraft) to continue operations;
- the Air Force, even with its extraordinary efforts, has not been able to meet training and readiness objectives;
- reliability shortfalls (parts failing faster than expected) continue to be a major cause of spare parts shortages, with other causes contributing to the problems;
- the Air Force's and contractor's attention to priority parts has resolved some parts problems, but a more systematic approach would ensure early and appropriate attention to the problem parts; and
- opportunities for reductions and cost savings might be found if the Air Force reviewed and reassessed the quantities ordered for parts that (1) have been or are undergoing reliability improvements, (2) are used on unstable/undeveloped systems such as defensive avionics, (3) are intended to be used as Single Integrated Operational Plan[2] spares, and (4) have potential excess quantities on order.

[1]Strategic Forces: Supportability, Maintainability, and Readiness of the B-1B Bomber (GAO/NSIAD-87-171BR, June 26, 1987).

[2]This is the plan that provides for the wartime use of the B-1B.

A more detailed discussion of the results of our review is provided in the appendixes and includes the following information.

Parts Shortages Continue

The majority of the B-1B fleet is being temporarily grounded on a daily basis because of continuing parts shortages and other parts problems. The impact of parts shortages on aircraft availability may be seen in measures of high-priority requisitions, cannibalization, and not mission capable rates. Because the B-1B is an immature system, the Air Force has not yet set goals in areas such as not mission capable and cannibalization rates.

High-Priority Requisitions

High-priority requisitions are issued when mission critical parts such as generators, windshields, and batteries fail and are not available from base supply. High-priority requisitions increased from a daily average of about 200 in March 1987 to a daily average of about 600 in January 1988 (about 200 percent), after reaching a high of about 1,000 in September 1987. In comparison, the number of delivered aircraft increased from 40 to 83 (about 100 percent) during the same period. For about 60 percent of these requisitions, the missing parts (called grounding parts) ground the aircraft. Each day about 50 B-1Bs had high-priority requisitions for grounding parts. This meant that each aircraft was not ready for flight for at least some portion of the day or, as a minimum, was not capable of performing some missions. DOD officials commented that, in some cases, aircraft grounded because of certain missing parts might be flown for some missions not requiring those parts.

Cannibalization

To reduce the number of grounded aircraft, the Air Force cannibalizes parts from other grounded B-1Bs. The cannibalization rate for all Air Force aircraft was about 3 to 4 per 100 flying hours,[3] whereas the B-1B rate was about 32 per 100 flying hours in the quarter ending December 1987. Because of continuing parts shortages, cannibalization has resulted in some aircraft requiring large numbers of parts. In December 1987, at Dyess and Ellsworth Air Force Bases (AFBs), 6 B-1Bs had more than 100 orders for grounding parts, and 1 B-1B with 262 orders for grounding parts had not been flown since July 1987.

[3]This rate includes mature systems. It is presented as a benchmark to indicate the status of logistical support for the B-1B, not as a basis to determine what the current rate for the B-1B should be.

Mission Capable Rates

The portion of time that aircraft are available and capable of carrying out their missions is called the mission capable rate. The Air Force uses mission capable and not mission capable rates to evaluate how well units are supporting operations. The mission capable rate for the B-1B has been about one-half the rates for mature Strategic Air Command (SAC) bombers. In August 1987 the B-1B Follow-on Operation Test and Evaluation Team reported a serious problem with the mission capability status of the B-1B. At Dyess AFB, the B-1Bs were reported as not mission capable because of supply (needed parts were not available) about 40 percent of the time they were supposed to be available for flight from September 1987 through January 1988.

Shortages Limit Training and Alert Aircraft

The Air Force's progress in training its crews to the desired readiness level and in bringing more B-1Bs onto alert has been slowed by its inability to logistically support those aircraft with spares.

Training

Despite extensive cannibalization to provide timely training flights, B-1B crew members have not completed required training events in the time frames necessary to be certified mission ready. At Dyess AFB, for example, 7 of 13 B-1B pilots assigned to the bombardment squadron were not certified mission ready for the 6-month training period ending June 30, 1987, because aircraft were not available for needed training primarily due to part shortages.

SAC, recognizing the long-term implications of aircraft availability on crew training, reduced the planned number of mission ready crews for an indefinite period. DOD commented that this reduction was a result of a heavy modification schedule, not because of parts shortages. Although modifications was the factor cited in SAC's decision, training reports cited parts shortages as the primary cause of the training limitations we noted. SAC stated that 12 to 14 aircraft will not be available during the remainder of fiscal years 1988 and 1989 because of cannibalizations due to parts shortages. The SAC Commander, in his decision to reduce the number of crews, stated that the number would not return to the desired level until needed logistical support exists.

Alert Aircraft

In addition to reducing training requirements by decreasing the number of crews, SAC has decreased its projections of the number of aircraft

planned for alert at various dates. SAC's plans for putting more B-1Bs on alert were based on achieving certain operational levels, which have not been achieved. SAC officials stated that decisions to place aircraft on alert will be based on logistics capability, aircrew training requirements, and force maturity. SAC officials further stated that if world conditions warranted, training could be curtailed, and additional aircraft could be placed on alert.

Low Reliability and Other Factors Contribute to Parts Problems

Shortages continue to result from higher-than-anticipated demands for parts caused by reliability shortfalls and false failures (initial tests showed a failure, but subsequent tests showed no failure) and from unscheduled and delinquent deliveries. Additionally, deficiency acceptance waivers, concurrent production requirements, and design change backlogs have contributed to shortages.

Low Reliability

Many B-1B parts continue to experience higher-than-anticipated failure rates. Of the 20 problem parts discussed in our June 1987 report, 18 had failed sooner than the contractors or the Air Force estimated. Reliability shortfalls continue to be experienced for these parts. In addition, reliability shortfalls were experienced on 37 of 58 B-1B parts designated by SAC for high-level priority management attention.

False Test Failures

Our prior report noted that 17 of the 20 problem parts were experiencing false failures. Of SAC's designated 58 priority parts, 31 had false failures. For 7 of the 31, more than 40 percent of the test failures were false.

Delivery Schedules Not Established

About 75 percent of the parts purchased to support the B-1B aircraft have not been delivered. In a few cases contractors are delinquent, but, more often, delivery schedules have not been established. For example, 12 of SAC's designated 58 priority parts had no delivery schedules established for significant quantities of the parts on order. Contract officials said that, in some cases, contracts have not been finalized because parts are undergoing design changes. SAC and Air Logistics Command officials said that their ability to expedite delivery is limited without contract delivery schedules.

Other Contributors to Spare Parts Shortages

In addition to the above causes of shortages, other contributors included waivers, competing production requirements, and design change notices. For example, the Air Force

- waived requirements and accepted the delivery of B-1Bs with parts missing and with parts not conforming to specifications;
- initiated Project 100 to complete production of the 100th B-1B ahead of schedule, which supported the production line with delivered spares and, if necessary, with cannibalization of parts from delivered aircraft; and
- has a backlog of design change notices for B-1B parts, which slows deliveries because contractors are not authorized to ship parts until notice processing is complete or a waiver is obtained.

Efforts and Opportunities to Improve Parts Management

The Air Force has initiated several special programs to work on parts problems. For example, in addition to the Air Force's designating parts to receive priority management attention, contractors have been tasked to track some part failures and to identify areas for improvement. Furthermore, the Air Force is expediting deliveries and repairs of some needed parts.

The Air Force has had some success with its programs. For example, Air Force records show that problems associated with 8 of the 58 priority parts have been resolved. Also, the backlog of design change notices have been reduced, deliveries of some spares have been expedited, and contractor efforts are resolving some part problems.

However, the Air Force acknowledges numerous other problem parts are not on the priority list because of the process used to develop the list. The list of 58 parts was to identify B-1B parts causing the most serious shortage and maintenance problems at one point in time and at one base. A more structured approach, periodically and systematically updating a list of serious problem parts, would enable the Air Force to take timely, aggressive top management corrective actions. In addition, tracking the causes of false failures could help in further resolving parts problems by determining whether causes relate to test equipment or other factors and then identifying solutions.

The Air Force has purchased millions of dollars of B-1B parts based on assumptions that have changed. Accordingly, Air Force review and reassessment of quantities on order could identify opportunities for reductions. For example, the Air Force has or is ordering quantities of some

parts based on low reliability when improvements to address the low reliability are completed or underway. In addition, the Air Force has not evaluated terminating potential excess on-order quantities of B-1B parts. Normal procedures, which would require such evaluations, were not followed due to the misinterpretation of a 1984 letter on the initial parts procurements.

Agency Comments

In its comments on a draft of this report (see app. VI), DOD stated that the B-1B program history is one of achieving challenges. It noted that the Air Force accepted the 100th and last B-1B aircraft on April 29, 1988—2 months ahead of schedule. With the completion of the B-1B production effort, DOD noted that diverting the industrial capacity that sustained production to supply parts is expected to remedy the B-1B parts shortfall by early 1989.

DOD stated that experience shows a positive steady trend in all logistical measures of performance. It stated that

- cannibalization, which adversely affected aircraft availability rates, stabilized as a result of growth in spares inventories,
- the percentage of high-priority requisitions on back order has been reduced, and
- mission capable rates as reported at Dyess AFB show steady improvements.

DOD stated that (1) the real measure of logistics performance is the generation of sorties in support of aircrew training and (2) the B-1B logistics system is successfully sustaining aircrew training.

Except for its assessment concerning aircrew training, DOD's general comments are consistent with the information we obtained during our review. Our work and SAC's documents showed that logistical support factors have limited and will continue to limit training. We should note that although logistical support has improved, aircrew training and the number of alert aircraft are below the levels that the Air Force expected to now be achieving.

As arranged with your Office, unless you publicly announce its contents earlier, we will not distribute this report until 30 days after its issue

date. At that time copies will be made available to appropriate congressional committees; the Director, Office of Management and Budget; the Secretaries of Defense and the Air Force; and other interested parties.

Sincerely yours,

Frank C. Conahan
Assistant Comptroller General

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Abbreviations

AFB	Air Force Base
AFLC	Air Force Logistics Command
ALC	Air Logistics Center
CITS	central integrated test system
SAC	Strategic Air Command
SIOP	Single Integrated Operational Plan

Introduction

The decision to procure the B-1B was made in October 1981. At that time, an initial operational capability (IOC) date was set for October 1, 1986—when the 15th aircraft was to be delivered to the Strategic Air Command (SAC) with sufficient support resources to carry out its mission. The October 1986 date was considered achievable based on experience gained in the earlier B-1A program. The Air Force recognized that achieving this date would require a high degree of concurrent development and production. In fact, some development and production contracts were signed on the same day. Program costs were capped by the Congress, and the President certified in writing that the program could be completed within the estimated time.

The Air Force contracted for the production of 100 B-1B aircraft. The last aircraft was accepted in April 1988, ahead of the contract delivery schedule of June 1988. As of June 30, 1988, 3 were assigned to Edwards Air Force Base (AFB) for testing, 30 to Dyess AFB, 33 to Ellsworth AFB, 16 to Grand Forks AFB, 17 to McConnell AFB, and 1 was destroyed in a crash. The Oklahoma City Air Logistics Center (ALC) is responsible for managing maintenance and logistical support for the B-1B.

Spare Parts

The B-1B aircraft has over 500,000 different parts. Varying quantities of about 25,000 unique parts are bought and stored by the Air Force as spare parts, about 9,000 of which can be repaired and reused after failure.[4] Each time a part breaks or wears out, a failure is recorded and used in determining quantities of spare parts needed in the future. If a part fails more frequently than predicted, additional parts must be either bought or repaired to satisfy the increased usage. On the other hand, if a part lasts longer than predicted, fewer spares are needed. Air Force regulations require evaluation in such cases to determine if opportunities exist to save procurement dollars by reducing planned procurements or terminating undelivered quantities previously ordered.

The Air Force Logistics Command (AFLC) used a concept called expanded advance buy to acquire spare parts for the B-1B. This involved procuring combined initial and replenishment parts requirements in quantities anticipated to support B-1B aircraft for 4 years. The Air Force used estimated service life of the parts, expressed as mean time between

[4]Aircraft parts can be divided into two categories: those that are thrown away after they are used and fail and those that are repaired and reused. The latter category is referred to as "reparable parts."

demand, to calculate the quantity of parts needed. The shorter the mean time between demand, the larger the quantities of parts required.

The Air Force also ordered quantities of B-1B parts for use as Single Integrated Operational Plan (SIOP) additive support spares. In its comments on a draft of this report, DOD objected to our reference to these parts as wartime spares, noting that the SIOP additive support spares are peacetime operating stocks and are not wartime spares. DOD cited two bases for its objection: wartime spares have not been authorized for the B-1B, and the Air Force manual states the SIOP spares are peacetime operating stocks. We had referred to these spares as wartime spares to clarify that these are not normal quantities of peacetime stocks. The SIOP is a wartime plan, and the additive support spares, like war readiness spares for tactical aircraft, are insulated from normal peacetime operations to improve the probability that strategic bombers will carry out these plans. Air Force regulations only authorize SIOP spares "to bomber units that are not otherwise authorized additive war readiness spares kits." We have deleted references to wartime spares and now refer to them as SIOP spares.

Table I.1 shows estimated cost (includes expenditures and obligations on definitized and undefinitized contracts) for initial provisioning, safety, and SIOP spares by aircraft system or component as of January 1988.

Table I.1: B-1B Spares Cost

Dollars in millions

System or component	Estimated cost
Aircraft	$672
Offensive avionics	268
Defensive avionics	742
Engine spares	139
Spare engines	265
Other components	116
Total	**$2,202**

Additional peacetime replenishment spares have been ordered to compensate for underestimating needed quantities and for normal wear out of parts. The cost of follow-on B-1B replenishment spares purchases was not readily available.

A B-1B part that breaks or wears out is replaced with a serviceable part from base supply if one is available. If base supply does not have the

part in stock and the part affects mission capability, a high-priority requisition is forwarded to the B-1B Logistics Action Center at the Oklahoma City ALC. The center is responsible for locating the part and expediting its delivery from a prime contractor, manufacturer, repair source, or another AFB.

Meanwhile, base maintenance may cannibalize the needed part from another aircraft to make an aircraft flyable. Cannibalization increases the risk of breakage and the maintenance time because of the need to remove and reinstall the part. In cases of severe and persistent parts shortages, it can result in aircraft having numerous missing parts.

Objectives, Scope, and Methodology

Our objectives were to update the status of B-1B spare parts problems and to examine other supply management issues. We reviewed Air Force policies, procedures, and practices at the B-1B System Program Office, the Aeronautical Systems Division, and the AFLC, Wright-Patterson AFB, Ohio; SAC Headquarters, Offutt AFB, Nebraska; Oklahoma City ALC, Oklahoma; Warner Robins ALC, Georgia; and Dyess AFB, Texas. At each location, we interviewed officials responsible for spare parts support.

In reviewing problem parts, we updated the status of the 20 parts identified in our June 1987 report. We also reviewed 58 parts causing maintenance or grounding problems for the B-1B, which SAC identified for priority management attention. Selecting these known problem parts enabled us to focus on Air Force efforts to improve parts reliability and to overcome parts shortages.

We reviewed information on high-priority requisitions for B-1B parts from July 25 to September 15, 1987, to determine the extent that other parts were causing aircraft groundings. We identified the 539 parts that grounded the B-1B during this period. From these 539 parts, we judgmentally selected those parts with 6 or more aircraft groundings. This resulted in 50 parts being identified for further review.

To determine whether the Air Force was taking advantage of opportunities to reduce high-dollar-value parts, we first analyzed data showing the quantities of all reparable B-1B parts ordered as of March 31, 1987. From this analysis we identified 31 parts with on-order quantities valued at more than $2 million and 10 additional parts peculiar to the defensive avionics system with high-dollar-value on-order quantities. We selected these parts because they represent significant expenditures and they receive the most management attention.

At SAC Headquarters, we obtained and reviewed regulations, reports, and other data about the effect of parts shortages on training and mission capability. The data included training requirements, level of training completed, number of aircraft and qualified crew members at the operating bases, waivers from training requirements, mission capable rates, and aircraft on alert.

Our work was conducted from August 1987 through January 1988 in accordance with generally accepted government auditing standards.

Parts Shortages Continue

Since the start of B-1B operations at Dyess AFB in 1985, parts shortages have presented difficulties in supporting and maintaining the aircraft. Measuring the extent and severity of these shortages is difficult. However, high-priority requisitions, mission capable and not mission capable rates, and cannibalization statistics are useful indicators.

High-Priority Requisitions

The daily average of high-priority requisitions for parts, those parts that affect mission capability, increased from about 200 in March 1987 to about 600 in January 1988, after reaching a high of about 1,000 in September 1987. During this period the number of delivered aircraft increased from 40 to 83. As shown by figure II.1, data from the Air Force's high-priority requisitions system showed that for about 60 percent of the requisitions, the missing part was one that would ground the aircraft.

Figure II.1: High-Priority and Grounding Requisitions

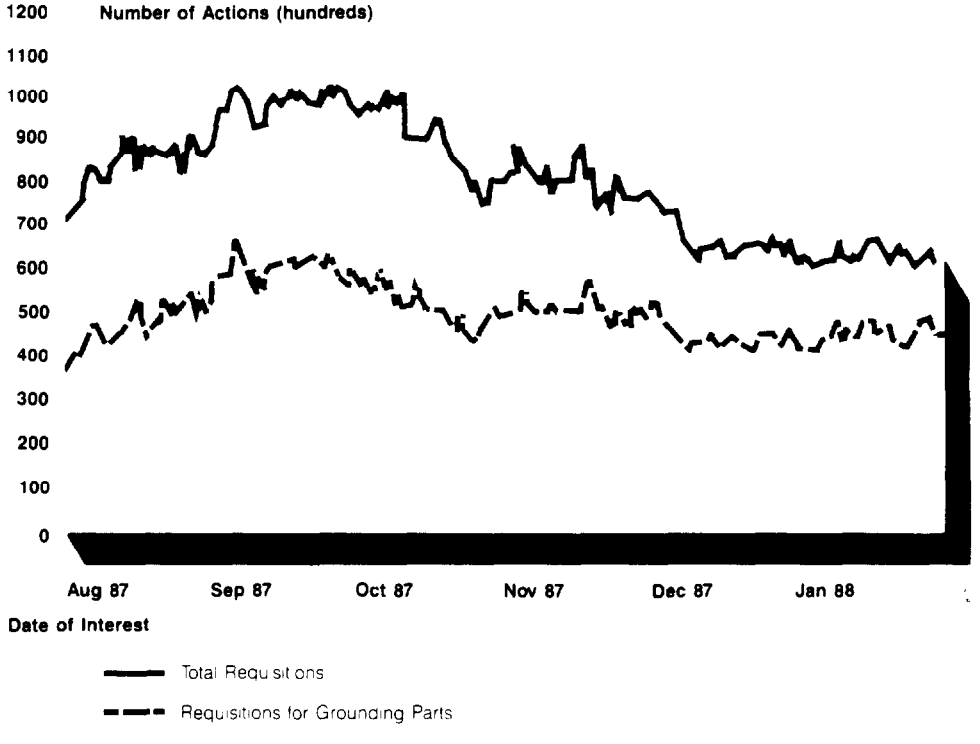
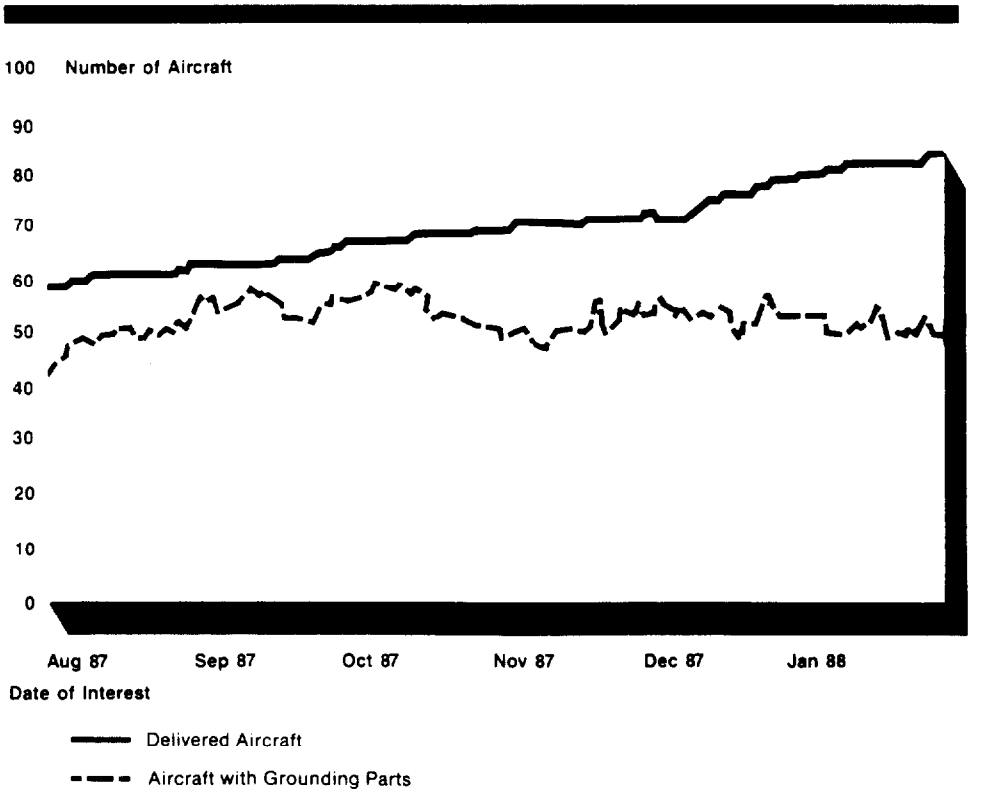


Figure II.2 shows, on a daily basis, the number of delivered aircraft that had grounding parts on order from August 1, 1987, through January 31, 1988. In general, about 50 aircraft had grounding parts on order. This means that each of the 50 aircraft was not ready for flight for at least some portion of the day or, as a minimum, was not capable of performing some missions.

Figure II.2: Aircraft With Grounding Parts On Order



In some cases, aircraft are grounded because of only one missing part. Accordingly, the aircraft may either be flyable in wartime or quickly made flyable for peacetime operations. DOD officials commented that, in some cases, aircraft grounded because of certain parts might be flown for missions not requiring those parts.

On December 22, 1987, 16 of the 79 delivered aircraft had 5 or more grounding requisitions. More effort would be required for an aircraft that is missing many parts to become flyable. Air Force officials said

some of these aircraft are undergoing heavy maintenance or modification (while awaiting parts) and would not be flyable even if the missing parts were available.

In its comments on a draft of this report, DOD said that our statement that 50 aircraft had grounding parts on order and could not fly for at least some portion of the day is misleading. DOD stated that the vast majority of those aircraft were capable of flying a number of their assigned missions. Our statement was based on an Air Force definition of grounding parts as parts that not only limit mission capability but preclude flying the aircraft for peacetime mission. Air Force data did not show the number of grounded aircraft that could be used or the missions that such aircraft could fly. Decisions on such usage would be based on individual aircraft and missions. However, we have revised the report to recognize DOD's comment that some of these aircraft could fly at least some of their assigned missions.

Mission Capable Rates

The Air Force uses mission capable and not mission capable rates to evaluate how well units are supporting operations. The mission capable rate is that portion of total aircraft time that the aircraft is available to perform its mission. The not mission capable rate includes not mission capable, supply (the aircraft was not available while awaiting parts); not mission capable, maintenance; (the aircraft was not available because of scheduled or unscheduled maintenance); and not mission capable, both (the aircraft was awaiting parts and maintenance). The rate for not mission capable, supply and not mission capable, both needs to be combined to determine the total rate for not mission capable because of supply.

The Air Force generally sets mission capable goals for its aircraft. For example, the Air Force goal is that the B-52 should be mission capable at least 75 percent of the time and that the FB-111 should be mission capable at least 70 percent of the time.

B-1B mission capable rates have been below those for mature systems, such as the B-52 or FB-111, primarily because of problems caused by parts shortages. The mission capable rates for the B-1B have ranged from a low of 17 percent in January 1987 to a high of 42 percent in July 1987 and have averaged about 31 percent for the 9-month period from January through September 1987. After reviewing data on the mission capable and not mission capable status of the B-1B, the B-1B Follow-on

Operation Test and Evaluation Team at Dyess AFB reported in August 1987 that the mission capability status was a serious problem.

The total rate for not mission capable because of supply shows the percentage of time aircraft were not available while awaiting parts. Table II.1 shows that the rate has improved at Dyess AFB from September 1987 through January 1988.

Table II.1: Not Mission Capable Because of Supply Rate at Dyess AFB

Month and year	Percent
September 1987	48
October 1987	43
November 1987	48
December 1987	42
January 1988	37

In its comments on our draft report, DOD stated that a newly fielded system should not be likened to mature weapon systems because every newly fielded system experiences problems until maturity. DOD also stated that it is not appropriate to establish command standards for mission capable rates until maturity but that interim goals are being considered. We use the comparison of B-1B to mature systems such as the B-52 and the FB-111 as shown in Air Force documents not to suggest that B-1B should be comparable to mature systems, but to provide benchmarks to use in assessing the status of the B-1B.

Cannibalization

Statistics related to cannibalization activity also provide insights into the effect of parts shortages. Cannibalization of parts from other grounded aircraft is used to reduce the number of grounded aircraft on a short-term basis. The extent of B-1B cannibalization is shown by comparing B-1B cannibalization rates to rates for all Air Force aircraft. The rate for all Air Force aircraft has been about 3 to 4 cannibalizations per 100 flying hours. B-1B cannibalization rates have ranged from 24 to 41 per 100 flying hours, as shown in table II.2. Air Force officials told us that high cannibalization rates are to be expected for new aircraft.

Table II.2: B-1B Cannibalizations per 100 Flying Hours

Quarter ending	Number
December 31, 1986	41
March 31, 1987	24
June 30, 1987	24
September 30, 1987	29
December 31, 1987	32

The extent of cannibalizations is also shown by the numbers of spare parts needed for some of the aircraft. For example, 6 aircraft, which were frequently cannibalized, had more than 100 orders each for grounding parts between July 25 and December 22, 1987, as shown in table II.3.

Table II.3: Aircraft Frequently Cannibalized Between July 25 and December 22, 1987

Aircraft no.	AFB	Requisitions for grounding parts	Date last flown as of December 22, 1987
850060	Dyess	262	July 23, 1987
840051	Dyess	236	June 19, 1987
840054	Dyess	111	October 30, 1987
860100	Ellsworth	169	Not available
850085	Ellsworth	153	Not available
850092	Ellsworth	116	Not available

On November 17, 1987, the B-1B Follow-on Operation Test and Evaluation Team reported that because of the lack of spare parts the cannibalization rates at Dyess and Ellsworth AFBs were unacceptable and getting worse, with no improvement in sight.

In its comments, DOD expressed concern about comparing the B-1B to mature systems. Cannibalization rates on all Air Force systems are presented to provide a benchmark to be used in assessing the B-1B status. DOD further commented that cannibalization rates have improved and that as parts inventories increase and experience is gained, B-1B cannibalization rates should decrease further.

Parts Shortages Contribute to Low Mission Capability Rate Which Impedes Training and Alert Plans

Parts shortages contributed to the B-1B's low mission capability rate, which adversely affected the Air Force's ability to meet its training and alert aircraft goals. SAC sets B-1B goals for training and plans for alert aircraft commitments. In October 1987 SAC reduced the number of mission ready crews to be trained. It has also reduced the number of B-1Bs planned for alert at various times.

Parts Shortages Inhibit Training

Most B-1B pilots assigned to the bombardment squadron[5] at Dyess AFB were unable to complete all of their training requirements for the 6-month training period ended June 30, 1987, primarily because of the lack of aircraft availability due to parts shortages. Of 13 aircraft commanders (pilots) at Dyess, 11 were unable to complete SAC's flight training requirements. For 7 of these 11 pilots, the deficiencies were severe enough that the pilots were classified as not mission ready at the end of the training period. Therefore, they could not be placed on alert status without waivers. The Dyess training report dated July 1987 identified lack of available aircraft due to maintenance and parts shortages as the reason pilots could not complete the required training.

SAC cited a heavy modification schedule in its October 1987 decision to reduce the number of mission ready crews it plans to train by December 1988 from 1.31 per aircraft[6] to 1.1 per aircraft. SAC's Commander said that the 1.1 ratio will continue until logistical support is capable of meeting the continuation training and alert commitments of a mature system. Although SAC officials declined to estimate when the logistical conditions are expected to enable a 1.31 ratio, they did say that the 1.31 ratio will be needed to meet full alert commitments for the B-1B. DOD commented that a build to the 1.31 ratio will resume in 1991. Table III.1, detailing the number of assigned aircraft and qualified crews at each operating base, shows that SAC has 0.9 qualified crews per aircraft.

[5]The bombardment squadron, an operational squadron, is one of two squadrons at Dyess AFB. The other squadron is a training squadron for new pilots.

[6]Before January 4, 1988, the goal was 1.37 crews per aircraft. The change to 1.31 was made after a detailed review of requirements by SAC staff.

Table III.1: Assigned Aircraft and Qualified Crews as of November 30, 1987

AFB	Assigned aircraft	Qualified crews	Crews per aircraft
Dyess	28[a]	32[b]	1.14
Ellsworth	34	30	0.88
Grand Forks	9	2	0.22
McConnell	0	0	
Total	**71**	**64**	**0.90**

[a]Of the 28 aircraft assigned to Dyess, the bombardment squadron will have 16 aircraft, the training squadron will have 10 aircraft, and 2 aircraft will be designated as backup aircraft inventory. As of January 1988, the bombardment squadron had been assigned 11 aircraft.

[b]The 32 qualified crews at Dyess includes 18 academic instructors who would serve as co-pilots in wartime but are not qualified co-pilots.

In addition to parts shortages impeding training, other operational limitations and restrictions have prevented the Air Force from training crews to use the full, planned capability of the B-1B. SAC has waived completion of several training requirements, such as heavy weight takeoff, heavy weight air refueling, airborne instrument landing approach, autopilot instrument landing approach, night terrain following, and electronic counter measures. The waivers will remain in effect until future modifications are made to the aircraft.

After the crash of a B-1B in September 1987, SAC imposed limits on low-altitude training, which further delayed the full training of crews. No low-level terrain-following activity will be performed by a B-1B until the Air Force completes a modification to strengthen it against damage from bird strikes. In its comments on the report, DOD said that the modification has been completed on six aircraft as of April 1988 and that the aircraft are being used to train crews in low-level maneuvers. The goal is to modify all aircraft by February 1989. Air Force officials said that training for low-level terrain following, critical to B-1B penetration of hostile airspace, will return to the desired level in 1988.

In its comments DOD said the draft report linked the parts shortages problem with the Air Force's decision to temporarily reduce the crew force ratio from 1.31 to 1.1. The decision to reduce the crew force ratio, according to DOD, was based upon the need to make more aircraft available for several ongoing modification efforts, not because of parts shortages. We have modified the report to state that the decision cited a heavy modification schedule. The parts shortages, however, were affecting training before the decision to reduce the crew force ratio, and it appears likely that the combined effect brought about the decision. More

importantly, the reduced ratio will continue until logistical support is capable of meeting the continuation training and alert commitments of a mature system.

Alert Aircraft Projections Reduced

SAC's general criterion on the number of bombers for an alert force is 30 percent of the bombers assigned to the strategic bombardment wings. SAC officials said that, in the event of a surprise nuclear attack, aircraft not on alert are likely to be destroyed before they can be loaded with munitions and fuel and launched. SAC would need to place 24 B-1Bs on alert (30 percent of the 80 aircraft to be assigned to bombardment wings after delivery of the last aircraft).

SAC's projections as to the possible number of B-1Bs on alert have been based on the projected number of effective sorties that can be achieved. Logistics problems, as evidenced by mission capable and cannibalization rates and other priority activities such as modifications and technical order verifications, have reduced aircraft availability and the number of effective sorties that can be achieved. As a result, SAC's projected number of alert B-1Bs for various dates has been reduced. SAC officials stated that decisions to place aircraft on alert will be based on the logistics capability, sortie generation capability, aircrew training requirements, and force maturity.

In comments on our draft report, DOD stated that although logistics capability is a determinant in the number of alert aircraft, the major factor is aircraft availability. Planned modifications are mentioned as a major factor. In addition DOD said that SAC does not have a schedule for putting aircraft on alert. Our work showed that before the heavy modification plans mentioned by DOD, logistics problems were a major factor limiting aircraft availability and additional alert aircraft. We agree that SAC does not have a rigid schedule that dictates the number of alert aircraft, but it does have plans for putting B-1Bs on alert based on achieving designated operating levels. The plans set forth expected dates when operating levels will be achieved that will permit additional alert aircraft. These levels have not been achieved by the expected dates.

Reliability Shortfalls and Other Factors Contribute to Shortages

Reliability shortfalls, false failures, and delivery problems continue to cause spare parts shortages. Other factors, including waivers, production requirements, and design change backlogs contribute to the problems.

Continuing Reliability Shortfalls

The B-1B fleet continues to experience faster-than-anticipated failures on many parts (i.e., mean times between demand that are less than anticipated). These failures can be attributed to a number of different causes including design or material deficiencies, inaccurate estimates of reliabilities, induced failures caused by vibration or improper maintenance, and false test failures. Eighteen of the 20 problem parts discussed in our June 1987 report had failed faster than contractors had predicted or the Air Force had estimated. Although a few improvements have occurred, reliability for these parts continues to be less than Air Force estimates.

Our analysis of reliability for the 58 problem parts that had been designated for priority attention showed that 37 had reliability shortfalls similar to those shown in our prior report. Of these 37, 17 had shortfalls exceeding 30 percent of the Air Force estimate. The remaining 21 parts did not have reliability shortfalls but became problems because of limited deliveries of new or repaired parts. Air Force data on the mean time between demand for 37 parts with reliability shortfalls are shown in table IV.1.

Table IV.1: Mean Time Between Demand for Parts With Reliability Shortfalls

Time in hours

Part	Mean time between demand		
	Contractor projected	Air Force estimate	Actual as of 9/30/87
Aural tone generator	2,703	2,703	538
Auxiliary accumulator motor	4,000	4,000	1,008
Control and display panel	752	400	196
Constant speed drive	537	1,000	398
Crew air turbo compressor	530	1,493	539
Data acquisition unit	1,325	3,776	618
Digital discreet box	2,364	1,277	1,057[a]
Electrical heating controller	2,551	2,551	396[a]
Electromechanical actuator	315	1,000	424
Electronic display unit	1,000	300	236[a]
Emergency generator motor	[b]	5,000	453
Engine nacelle actuator	2,000	2,000	890
Engine nozzle divergent flap	1,000	1,000	442
Engine nozzle outer flap	2,000	2,000	442
Environmental control blower	357	357	287[a]
Fan temperature control unit	1,923	1,923	150[a]
Fan temperature control unit	1,923	1,923	332[a]
Flap/slat power drive unit	4,329	3,125	1,433
Fuel boost pump	55,555	10,000	3,333
Fuel transfer pump	2,500	1,000	475
Generator control unit	[b]	2,500	654
Generator control unit	[b]	2,500	654
Hydraulic suction coupling	4,000	4,000	875
Left wing strobe light	5,495	5,495	426
Left wing tip position light	5,525	5,525	1,500
Power control assembly	13,514	1,307	917
Primary generator	1,147	1,147	469
Right wing strobe light	5,495	5,495	426
Right wing tip position light	5,525	5,525	1,500
Seat positioning actuator	[b]	7,519	1,258
Serial multiplexing assembly	5,000	3,003	1,100
Spoiler computer	1,000	541	172[a]
Stability system actuator	275	2,000	324[a]
Strobe light power supply	565	1,000	800
Tail strobe light	5,495	5,495	236
Vertical situation indicator	329	329	269[a]
Wing sweep control shafts	7,751	5,000	1,319

[a]This part was included in our original review.

[b]Not available.

The B-1B parts reliability problem is not limited to parts in short supply. If unexpected failures occur on parts with sufficient quantities either on hand or that can be resupplied in a short period of time, a shortage does not result. However, such failures cause increased maintenance and additional expenditures. For example, although the Air Force expected about 120 landings on a set of B-1B tires, only about 60 landings were being achieved. Factors the Air Force identified as contributing to the excessive wear included design and composition of tires, hard landings and heavy braking by inexperienced pilots, and low tire pressure. Because replacement tires were available, failures faster than expected did not cause aircraft groundings. However, more frequent tire changes increased the work load for base maintenance and the cost for spares and operations. The Air Force is developing a new tire design for the B-1B.

Air Force officials, although recognizing that B-1B parts continue to experience less-than-desired reliability because of the concurrent development and production, believe a steady increase in overall reliability is occurring.

In commenting on the draft report, DOD noted that the vast majority of B-1B parts are working satisfactorily. It also said it could not agree that the 58 parts we reviewed were a representative sample. Data were not available on the percent of B-1B parts that are working satisfactorily. We therefore cannot comment on DOD's statement. Our work, as discussed in the objectives, scope, and methodology section, was clearly focused on problem parts. These parts are not a representative sample of all B-1B parts.

Continuing False Failures

A significant number of B-1B parts failures were not actual failures, but false test failures. A false test failure occurs when a part is removed because test results show the part has failed, but subsequent tests show the part has not failed. When a part is removed from an aircraft, whether defective or only a false test failure, replacement spares are needed.

Of the 20 problem parts discussed in our prior report, 17 were experiencing false test failures. Air Force officials said false test failures can result from faulty test equipment, improper use of test equipment, incomplete or inadequate support equipment and technical orders, and temporary conditions in flight or during ground testing. In September 1987, the percent of false test failures had improved on 10 of the 17

parts discussed in our prior report, but it had not improved on the remaining 7. Of the 58 parts on SAC's priority list, 31 were experiencing false test failures. Table IV.2 shows the rate of false failures for these parts.

Table IV.2: Number and Percent of False Failures as of September 30, 1987

Part	Test failures	False failures	Percent false failures
Actuator	46	2	4
Actuator generator	63	3	5
Airspeed/mach indicator	27	1	4
Band 8 transmitter	25	8	32
Band 8 transmitter	10	3	30
Blower assembly	54	7	13
Central air data computer	9	5	56
Control and display panel	35	9	26
Data acquisition unit	71	51	72
Digital discreet box	77	23	30
Distribution box	36	4	11
Electrical heating controller	25	12	48
Electronic actuator	37	2	5
Electronic display unit	79	14	18[a]
Fan temperature control unit	90	30	33[a]
Fuel boost pump	8	2	25
Fuel center	31	4	13
Fuel transfer pump	13	6	46
Generator control unit	32	11	34
Hydraulic pressure transducer	7	2	29
Inertial navigation unit	45	26	58
Integrated drive generator	54	7	13
Right wing strobe light	4	1	25
Scavenger pump	2	1	50
Serial multiplexing assembly	299	54	18
Servocylinder assembly	49	1	2
Spoiler computer	45	5	11
Stability system controller	25	10	40
Strobe light	43	4	9
Strobe light power supply	11	3	27
Vertical display unit	68	7	10

[a]This part was included in our prior report.

In its comments on our draft, DOD said that at the time of our review the situation concerning false failures was as reported, and noted that false failure rates of 30 to 40 percent are not uncommon for complex weapon systems at this early stage of system maturity.

Deliveries Not Scheduled

In many cases, B-1Bs were grounded because deliveries of needed parts had not occurred. About 75 percent of the spare parts purchased to support the B-1B aircraft had not been delivered by the end of 1987. In some cases, contractors were delinquent, but, more often, delivery schedules had not been established. Until delivery schedules are established, SAC and ALC officials said they could do little to expedite the delivery of the quantities ordered. Delivery schedules are established during negotiation of parts contracts, and, because many contracts have not been finalized, schedules have not been established. In some cases, contracts cannot be definitized because the parts are continuing to undergo design changes. This has also resulted in a large number of design change notices that generally must be processed before parts are shipped. Table IV.3 shows the parts on SAC's priority list that had delinquent or unscheduled deliveries.

Table IV.3: Priority List Parts With Delinquent or Unscheduled Deliveries as of January 19, 1988

			Undelivered				
						Scheduled	
Part	Ordered	Delivered	Total	Delinquent	Unscheduled	No.	Date
Accessory drive gearbox	50	13	37	0	37	0	
Airspeed/mach indicator	48	5	43	0	43	0	
Band 8 transmitter	79	6	73	0	73	0	
Digital discreet box	54	35	19	0	6	13	8/88–8/89
Electronic display unit	83	5	78	0	78	0	
Engine nozzle divergent flap	714	360	354	0	354	0	
Engine nozzle outer flap	495	350	145	0	145	0	
Environmental control blower	74	25	49	3	8	38	4/89
Fan temperature control unit	34	16	18	0	18	0	
Gravity system fuel center	28	10	18	0	18	0	
Inertial navigation unit	96	34	62	0	62	0	
Primary generator	48	17	31	3	3	25	3/88–12/88
Spoiler computer	22	13	9	2	3	4	1/88–3/89
Stability system controller	39	23	16	0	16	0	
Strobe light power supply	28	16	12	0	12	0	
Vertical situation indicator	54	21	33	0	23	10	8/88–11/88
Wing sweep control shafts	28	9	19	0	19	0	
Total	**1,974**	**958**	**1,016**	**8**	**918**	**90**	

The number of grounding requisitions for these parts from July 25, 1987, to November 13, 1987, are shown in table IV.4.

Table IV.4: Grounding Requisitions for Priority List Parts With Delinquent or Unscheduled Deliveries

Part	Grounding requisitions
Accessory drive gearbox	7
Airspeed/mach indicator	4
Band 8 transmitter	0
Digital discreet box	1
Electronic display unit	15
Engine nozzle divergent flap	71
Engine nozzle outer flap	166
Environmental control blower	0
Fan temperature control unit	21
Gravity system fuel center	3
Inertial navigation unit	1
Primary generator	43
Spoiler computer	26
Stability system controller	3
Strobe light power supply	11
Vertical situation indicator	28
Wing sweep control shafts	6
Total	**406**

DOD commented that although contractually binding schedules are not established until negotiations are completed, projected need dates are established much earlier, and extraordinary actions are taken, when prudent, to expedite processing and delivery. As discussed in appendix V, we noted that the Air Force was expediting high-priority requisitions for individual parts that were grounding aircraft. However, our review of problem parts showed that the Air Force had not negotiated delivery schedules in many cases and that officials responsible for obtaining the parts believed their actions were restricted without delivery schedules.

Parts Waivers Granted

The Air Force has accepted B-1Bs with parts that were missing, parts that have not met configuration or test specifications, and parts that have not fully met performance requirements. The Air Force granted the contractors' requests for waivers to prevent production delays.[7]

[7] Requests granted before manufacture of the part are called deviations; requests granted after manufacture are called waivers.

Under waivers, the Air Force has accepted B-1B aircraft with parts that (1) have not had test results accepted by the Air Force, (2) have failed a specified test, (3) are nonstandard, (4) do not meet configuration specifications, or (5) have experienced some performance anomaly. As of January 7, 1988, the program office had granted over 1,000 waivers to B-1B contractors.

Some of the parts granted waivers have caused aircraft groundings and the purchase of additional spares. For example, the Air Force accepted delivery of 57 B-1Bs with windshields having distortions, night glare, scratches, or delaminations. Defective windshields have subsequently caused aircraft groundings. Because only a few failures were expected, 10 windshields were included in the initial buy. The Air Force purchased 217 additional windshields at a cost of about $13 million.

Waivers have been granted for many of the problem parts, including 5 of the 20 problem parts discussed in our prior report, 15 of the 58 parts on SAC's priority list, and 9 of 20 additional problem parts we reviewed.

In its comments, DOD noted that there was no correlation between the granting of waivers and the potential failure of parts. The purpose of this section was not to show that there was a correlation, but to note that the use of waivers contributed to parts problems.

Competing Production Demands

The Air Force initiated Project 100 to complete production and delivery of the 100th B-1B by April 1988. To accomplish this objective, the Air Force supported the production line as needed with delivered spares and, if necessary, cannibalization of parts from aircraft already delivered.

As of November 2, 1987, the prime contractor had requested 91 parts under Project 100. After the Air Force's review of these requests, 37 were approved, 28 were disapproved, and 26 were pending. Examples of completed Project 100 actions include prepositioning 10 spare engines at a contractor's plant and removing parts from the B-1A currently on display at the Air Force museum.

Under Project 100, if a part was needed both for deployed aircraft and the production line, the part would go to the production line. ALC officials said that Project 100 required parts that were needed to operate the B-1B. For example, the Air Force approved sending the next available vertical situation display indicator (stock no. 6610-01-147-8346), a

part on SAC's priority list, to the production line, even though two grounded aircraft needed this part as of November 13, 1987. However, installing the display indicators on these two aircraft would not have made them immediately flyable because other grounding parts were not available.

In its comments, DOD agreed that the production had received priority, but it added that it was not aware of an aircraft that remained grounded solely for a part used to support production. With aircraft grounded because of a large number of parts, we agree that it is unlikely that an aircraft would remain grounded solely for a part to support production. This does not diminish the fact that competing production demand contributed to parts shortages.

Design Changes Slow Deliveries

At the time of our earlier review, a backlog of design change notices was slowing the delivery of redesigned parts to the field. Contractors are not authorized to ship parts until a design change is approved or a special waiver is granted. The cause of the backlog was the unanticipated volume of design changes in the B-1B. For example, in 1985 the Air Force projected 34,250 design changes in the B-1B program. However, as of January 1988, the Air Force had already received 187,455 design changes from contractors. The Air Force has periodically revised its estimate of anticipated design changes. In January 1988, the Air Force estimated a total of about 207,000 design changes.

To reduce the 29,400 design change notices in process in June 1987 at the Oklahoma City ALC, officials distributed the work load among the five ALCs. At the end of January 1988, the number of design changes in process was about 22,400, a decline of about 24 percent.

The value of parts on order with design change notices in process has also declined. Between April 1 and December 3, 1987, the value decreased from about $226 million to about $153 million. ALC officials attributed this decrease to their program, which gives processing priority to design change notices for the highest-cost parts. Officials said that they expect the backlog to be eliminated by September 1988. However, the administrative work load of processing design changes is expected to continue for several years.

DOD commented that design change notices have not caused any significant delays in shipping parts to users because the Air Force established

a quick reaction system to approve those notices that had critical impacts on schedule or operational support.

Efforts and Opportunities to Improve Parts Management

The Air Force has initiated actions that are resolving numerous B-1B parts shortages problems. Additionally, we have identified opportunities to improve some areas of B-1B parts management.

Air Force Efforts to Resolve Problems

The Air Force has aggressively cannibalized aircraft for parts needed to continue flying until adequate quantities of parts are available. Also, the Air Force has established a central B-1B group to locate and expedite delivery of parts requested on high-priority requisitions. This group's efforts have contributed to closing about 200 high-priority requisitions daily. At the same time, in an effort to resolve the causes of parts shortages, the Air Force resolves parts problems on a case-by-case basis. These efforts involve identifying and giving priority attention to a number of the more serious problem parts.

At the time of our prior review, the Air Force had established a list of 25 parts causing the most number of aircraft groundings and was giving special attention to obtaining more of these parts and to implementing long-term solutions. In May 1987, the maintenance chief at Dyess AFB prepared a list of 58 parts that were causing maintenance problems and grounding the most aircraft at Dyess AFB. These parts became SAC's priority list and are receiving executive attention from a B-1B General Officer's Steering Group.

The Air Force began giving priority attention to the SAC list in June 1987, and, by September 1987, data had been assembled and the problems defined for each of the 58 parts. Corrective actions are being identified and coordinated among responsible officials of the Oklahoma City ALC, B-1B System Program Office, SAC, and contractors and subcontractors. These parts are given the highest priority in obtaining delivery and repair actions and in identifying and executing solutions, such as redesign and improved manufacturing processes, to reliability shortfalls.

Priority attention to selected parts has helped bring coordinated actions to some of the most serious problem parts. System program officials said that as of January 1988, 8 parts were no longer problem parts. The causes had been identified and fixed. The following examples illustrate Air Force actions.

- Stock no. 5930-01-252-9249, an oil pressure switch for the accessory drive gearbox. Failure of this switch causes an oil pressure light to come on in the cockpit and forces the crew to shut down the engine and abort the mission. The oil pressure switch was the highest cause of mission

aborts, with 38 aircraft groundings by September 1987. Only 29 of the 62 spare switches ordered were delivered by September 1987.

Management emphasis resulted in delivery of all 62 spares, and, as of January 19, 1988, 37 failed switches, which are not normally repaired, were repaired to meet urgent needs. Meanwhile, investigation revealed that switch failures were caused by vibrations experienced during flight, and an urgent engineering change was approved to relocate the switch to an area with lower vibrations. A retrofit program, with a cost not to exceed $602,708, was started in November 1987 and is expected to eliminate the problem.

- Stock no. 3040-01-245-3064, an upper link on the underwing fairing pivoting wedge. The link was failing due to a material deficiency. As of September 15, 1987, shortages of spare links caused 14 aircraft groundings. At that time, the 26 links on order had an urgent lead time of 90 days. To support field failures, the ALC manufactured 28 additional upper links. Meanwhile, an engineering change was approved to make the links out of stronger material. Retrofitting delivered aircraft with the stronger links will cost about $135,000 and will begin in August 1988.

The Air Force has also tasked contractors to monitor, analyze, and correct premature and false failures. Under these contracts, 48 parts have been identified for investigation and corrective action. Some of these parts are on SAC's priority list. The contractors' work on problem parts has helped resolve both reliability and false failure problems.

Opportunities to Improve Management

We identified the following opportunities for Air Force management to improve parts management for the B-1B.

- The Air Force could improve its process for giving problem parts priority attention with a structured approach that uses existing data systems to more quickly identify parts repeatedly grounding the aircraft and that systematically and periodically updates the list of parts afforded priority attention.
- The Air Force could improve action on false test failures by tracking failures through the process by which they were identified to determine whether causes relate to test equipment or other factors, and then by identifying solutions.
- The Air Force should review and reassess the quantities ordered for parts that (1) have been or are undergoing reliability improvements, (2)

are used on unstable/undeveloped systems such as defensive avionics, (3) are intended to be used as SIOP spares, and (4) have potential excess quantities on order.

Early and Systematic Identification of Problem Parts

The Air Force's action to give priority attention by a high-level review group on 58 problem parts identified by the maintenance chief at Dyess AFB has helped to bring coordinated actions on serious B-1B problem parts. This list, however, was developed in an ad hoc manner, was developed using parts problems at one base, and had not been updated through December 1987. It included some parts which the Air Force later determined were not problems. A more structured approach to systematically and periodically identify problem parts would help ensure priority attention to all problem parts.

In October 1987, Dyess AFB officials said that no parts had been added to or deleted from the SAC priority list. Dyess officials said they could think of two or three additional parts that could qualify as problems since the list was prepared. Our review showed serious parts problems are not receiving high-level attention. Using data on high-priority requisitions grounding the B-1B during the period July 25 to September 15, 1987, we identified 50 parts with 6 or more requisitions, including 26 on SAC's list of 58. After researching the remaining 24 parts, Dyess AFB officials said that 20 of the parts had serious problems and were not receiving high-level attention. A number of logistics actions are initiated as a result of part failures. However, high-level attention is needed to focus coordinated action by the ALC, program office, contractors, and SAC on resolving the parts problems. Such attention should help ensure that (1) priority is given to engineering action that will identify causes and find solutions and (2) deliveries of these parts will receive priority processing.

Of the 20 parts that were identified as being serious problems but were not receiving high-level attention, 9 had reliability problems, as shown in table V.1.

Table V.1: Parts With Reliability Shortfalls Not Receiving Top Management Attention

Time in hours

Part	Mean time between demand		
	Contractor	Air Force estimate	Actual 9/30/87
Brake assembly	1,290	775	455
Ladder actuator	4,504	4,504	1,721
Line assembly	71,429	33,333	2,833
Over wing fairing actuator	3,058	3,058	1,773
Regulator	11,111	6,667	128
Rotary pump lube	10,000	10,000	2,041
Signal conditioner	915	915	614
Spoiler controller	2,257	1,002	600
Temperature controller	7,143	5,051	536

Officials said the SAC priority list of 58 problem parts was not intended to be a current list of problem parts; rather, it presented problem parts at Dyess AFB in May 1987. Since then, additional aircraft have been delivered to new main operating bases at Ellsworth AFB, South Dakota, and Grand Forks AFB, North Dakota, increasing the demand for problem parts and causing serious shortages of additional parts grounding the B-1B. However, as of December 31, 1987, no parts had been added or deleted from the SAC priority list. In January 1988 the ALC began giving attention to seven additional problem parts.

DOD agreed with the need for a more systematic and structured approach to resolving parts problems and stated that since our field work was completed, the Air Force had made the priority parts list a dynamic list, adding and deleting parts as appropriate.

Tracking False Failures

False test failures, as discussed in appendix IV, continue to be a major cause of parts shortages for the B-1B. Removing parts because of false test failures adds to the parts shortage problems and increases parts requirements. To determine the effect of false test failures on spare parts requirements, we judgmentally selected 10 parts experiencing false failures more than 30 percent of the time. Eliminating false failures from the past failures used in the Air Force's requirements computations would reduce future buy quantities for the 10 parts by $18.2 million and would reduce estimated repair costs by $31.1 million. Thus, reducing false test failures can avoid significant expenditures.

The Air Force continues efforts that should reduce the number of unnecessarily removed parts. Air Force officials said false test failures can never be totally eliminated because of the variety of causes. However, a program to specifically track individual parts failures using the process by which they were identified would be important in isolating causes and identifying solutions.

The B-1B has a built-in test system called the central integrated test system (CITS). This system identifies various failures of parts or systems on the aircraft. We provided Dyess AFB officials with a list of 15 parts on the SAC priority list that had false test failures over 25 percent and asked them if the false failures could be traced to a potential problem with CITS. After researching the parts, Dyess AFB officials said that they could not determine whether high false failures were specifically related to CITS or were being addressed by CITS improvements. Officials said that no programs exist to identify specific parts with high false test failures and determine the causes of the failures. Efforts are now underway on a few selected parts.

Overall, the program office believes that as CITS, technical orders, and test equipment mature, along with increased technicians' training levels, the false test failure rate should improve.

In comments on our draft report, DOD said that information about false failures is routinely available. DOD also said that a system under development, which is expected to be available in fiscal year 1989, should greatly reduce the incidence of false failures.

Reviewing and Reassessing Quantities of Parts on Order

The Air Force has ordered millions of dollars of B-1B parts based on assumptions that may no longer be valid. The purchased quantities of some B-1B parts are questionable because

- quantities are based on low reliability when improvements to reliability are either completed or underway;
- large quantities of defensive avionics spares are on order while the system is unstable and undergoing modification;
- quantities include SIOP spares, which could be premature given the level of initial spares and the system's lack of maturity; and
- potential excess on-order quantities have not been evaluated for termination or reduction.

Correcting Reliability Shortfalls

We previously reported that improvements in parts reliability could totally or partially negate the need to order additional parts due to reliability shortfalls. Also, ordering additional parts generally will not have an effect on shortages because deliveries might not occur for several years. As previously discussed, delivery dates for many B-1B parts have not been scheduled. However, the Air Force continues to purchase additional spare parts based on early failure rates, although engineering changes correcting the causes of failures are completed or underway. As a result of reliability shortfalls, orders totaling $10 million as of November 1987 were made for SAC's 58 priority parts.

The following example shows a purchase when the need is based on a past failure rate that should no longer exist. Accordingly, projected demand should be less than the quantity ordered.

- Stock no. 6610-01-147-8345, an electrical multiplexing digital discreet box. This part was included on the SAC priority list. The ALC initially ordered 15 spares. Because of this part's reliability shortfalls, 27 additional spares were ordered at a total cost of $2.4 million. Investigation disclosed water intrusion in the forward equipment bay was causing this part's electrical problems and failures. A new gasket was installed in production for the 64th and subsequent aircraft, and retrofits were completed in October 1987 for the aircraft already delivered. In December 1987, the item manager, unaware that the program office had corrected the reliability problems, said 18 of the 27 additional spares had been delivered. An ALC official said that the part's past failure rate will be used to determine quantities for the next order.

Large Quantities of Defensive Avionics Parts on Order

The Air Force has purchased about $742 million in parts for the B-1B defensive avionics system. Air Force records show that the quantities of spares purchased included (1) initial provisioning in which the Air Force bought long lead time parts and an estimated 4-year supply of spares under the expanded advance buy, (2) safety level stocks, and (3) SIOP spares. In addition to the $742 million, other replenishment spares have been procured. Many of the defensive avionics system's parts already delivered are unusable or could be made unusable by the continuing development of the system. Unusable parts, at a minimum, will require additional funds to modify. Many of the parts on order and undelivered are in addition to the estimated 4-year supply bought initially.

Air Force officials said that because additional expenditures for parts for troubled portions of the B-1B aircraft were questioned in the fiscal

year 1988 appropriation hearings, no additional quantities of these parts would be purchased unless authorized by the Congress. They also said that reductions have not been made to the quantities of defensive avionics parts on order.

To determine the validity of quantities on order, we obtained Air Force data on a sample of 10 defensive avionics parts with the largest dollar value on order. These 10 parts accounted for orders totaling $339 million. Table V.2 shows the quantities of each part by category and its total dollar value.

Table V.2: Quantities Ordered for 10 Defensive Avionics Parts

Dollars in millions

Part	Initial quantity	Safety levels	SIOP spares	Add-on spares	Total Quantity	Total Value
Frequency source	63	20	16	30	129	$161.8
Transmitter	46	17	16	0	79	39.2
Transmitter	31	11	16	10	68	30.3
Transmitter	38	13	16	5	72	32.1
Driver	27	9	8	17	61	16.2
Receiver	13	3	16	8	40	15.4
Receiver/ antenna	6	0	16	2	24	10.4
Encoder	24	3	16	16	59	9.2
Frequency source	40	10	16	16	82	15.6
Driver	16	5	8	39	68	8.7
Total	**304**	**91**	**144**	**143**	**682**	**$338.9**

Some quantities of the above parts are becoming unusable as defensive avionics system modifications are made. To gain initial control over changes to the defensive avionics system, the Air Force, in August 1986, adopted a baseline configuration referred to as mod zero. To achieve this baseline, 23 of the systems' 55 unique parts had to be modified. For those parts in our sample, 60 of the quantities already shipped became unusable as a result of mod zero. An additional 33 became unusable after an engineering change to 1 part.

The B-1B program office is negotiating another major change to the defensive avionics system called mod two.[8] Of the system's parts, 14 are being considered for change. Although quantities of defensive avionics

[8]As of July 1988, test results raised significant questions about the performance and capability of the system. Accordingly, the status of the system, particularly mod two, is uncertain.

parts are becoming unusable, many have not been delivered. For the 10 parts we reviewed, most of the initial quantity had been shipped as of January 12, 1988 (232 shipped of 304 ordered). However, most of the quantities ordered for safety levels, SIOP spares, and add-on spares had not been shipped (130 shipped of 378 ordered).

Data on the quantities for the most expensive part in our sample, the radio frequency source for band 8, which costs $1.2 million each, are as follows:

- 129 were on order, which is more than double the initial 4-year quantity;
- 69 were shipped, 63 for the initial quantity and 6 for safety level stock;
- none of the 16 for SIOP spares or 30 for add-on spares had been shipped;
- 14 of the 20 ordered for safety levels were not shipped; and
- 48 in the initial quantities were unusable.

In addition, this part is being considered for a change under mod two.

Purchase of SIOP Spares

The Air Force, using peacetime operating funds, made special purchases, totaling $395 million for four SIOP spares kits and requested $98 million for an additional kit in fiscal year 1988. These spares represent parts required, in addition to peacetime operating stock, to support the activities reflected in the Air Force War and Mobilization Plan. Specifically, the parts are to be used to generate the B-1B fleet for war, and any remaining parts are to be packaged into transportable kits for use in reconstituting the B-1B fleet after nuclear wartime missions. The kits were requested by SAC Headquarters, approved and directed by Air Force Headquarters, and ordered by the ALC. However, the need for these parts becomes questionable, given the level of initial spares and the system's lack of maturity. Many of the parts are for the defensive avionics system.

In February 1987, SAC reevaluated the composition and quantities of parts needed for these kits. According to ALC officials, a revised requirement has reduced the value of parts needed in the kits. The revised kit is now valued at $85 million, or $13 million less per kit. Therefore, the total value of all five kits would be $65 million less. ALC officials said SAC had not requested that quantities on order be reduced.

Excess On-Order Quantities

Of the B-1B parts managed by the Oklahoma City ALC, we identified 31 that had quantities on order valued at more than $2 million. The Air Force system showed 5 of the 31 parts as having potential excess on-order[9] material totaling $13.4 million.

The AFLC process for review of potential excess on-order material is not being followed for these parts. The parts requirement system generates tentative termination recommendations each quarter for on-order spare parts that appear to exceed current needs. Item managers, using AFLC Regulations 57-4 and 57-19, are to review the system recommendations for possible reduction or termination of on-order material. In making the reviews, they are to validate the accuracy of the system data used to compute the amount of apparent excess material on order and consider various costs and other factors in evaluating whether to recommend termination. After this evaluation and a supervisory review, the item managers' termination actions are forwarded for further review and a final decision as to whether termination is in the government's best interest.

The above process is not being followed for B-1B parts because of a July 8, 1984, AFLC letter instructing managers not to terminate or reduce B-1B on-order quantities. AFLC's rationale for the letter was that the quantities of spares computed for the B-1B represented a 48-month requirement to take advantage of savings associated with buying spares and production parts. It said that termination would negate any advantages gained by using the concept. However, AFLC officials said the letter was never intended to apply to follow-on purchases of replenishment spares, which are included in the termination recommendations.

DOD agreed that the Air Force needed to improve its termination procedures and practices, but said that our report tended to view terminations as largely a question of economics even though other supply factors such as demand stability, planned requirements, projected production plans, and the impact on defense readiness must also be considered.

DOD noted that the ALQ-161 was a fielded system and that the parts on order were needed to support the current configuration of the system. It stated that an Air Force review of the parts identified in our report determined that none of the parts would be discarded, but would be modified to the proper configuration and used on the B-1B. DOD said the

[9]Excess on-order parts are those quantities that exceed about a 4-year supply.

contractor had provided a not-to-exceed cost estimate of $105 million for all spares upgrades.

We did not intend to imply in any way that the mission realities should be ignored or that economics should be given a higher priority. The purpose of this section of our report was simply to point out that (1) many of the parts on order were in addition to an initial 4 years of supply, (2) configuration changes are making the parts already delivered obsolete, (3) more changes are anticipated, and (4) testing has not been completed. Under the circumstances we concluded that the Air Force should reassess the quantities of parts on order.

Comments From the Assistant Secretary of Defense for Production and Logistics

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301-8000

PRODUCTION AND
LOGISTICS
(P&L/L)

JUN 3 1988

Mr. Frank C. Conahan
Assistant Comptroller General
National Security and
International Affairs Division
Washington, D.C. 20548

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "STRATEGIC BOMBERS: B-1B Parts Problems Continue To Impede Operations," dated March 29, 1988 (GAO Code 392357), OSD Case 7578.

The B-1B program history is one of achieving challenges, some very difficult. On April 29, 1988, the Air Force achieved a notable milestone with the acceptance of the 100th and last B-1B aircraft--two months ahead of schedule. With the completion of the B-1B production effort, the industrial capability that sustained the production line at a rate of four aircraft a month can be diverted to supply spares. This is expected to remedy the B-1B parts shortfall by early 1989.

Since Initial Operational Capability, the Air Force has made measured progress in rising to the logistical challenges of initially deploying the B-1B weapon system. Experience shows a positive steady trend in all logistical measures of performance.

In early 1987, the B-1B was experiencing high cannibalization rates caused by low spares supply levels. This situation adversely impacted aircraft availability rates. In February 1987, the cannibalization rate was 2.6 cannibalizations per sortie; by January 1988, experience showed a 60 percent improvement in this condition, reducing the rate to 1.0 cannibalization per sortie. The problem is now stabilized as a result of growth in the spares inventories.

In June 1987, over 50 percent of the assigned aircraft had high priority requisition parts on back order; by February 1988, this percentage had been reduced to approximately 20 percent of the aircraft as a result of supply inventory improvements.

Mission capable rates of the B-1B show steady improvement as more experience is gained and the operational and logistical systems mature. In the April 1988 Air Force Operational Test and Evaluation Center report, the combined fully and partial mission capable rate for Dyess Air Force Base (AFB), Texas, was 45.9 percent--which compares favorably with the GAO reported rates.

The real measure of logistics performance is, however, the ability of the logistics organization to generate sorties in support of aircrew training. In the period between October 1987 and January 1988, operational sortie requirements for Dyess and Ellsworth AFBs totalled 1,124 sorties--the logistical system delivered 1,013 sorties for a 90 percent success rate. The B-1B logistics system is, despite numerous challenges, successfully sustaining aircrew training.

Although currently not fully mature, the B-1B logistics system has overcome the initial challenges of fielding this complex major weapon system. The Department recognizes that the job is not yet complete. Full maturity is currently defined as 200,000 flying hours, which should be reached in 1993. Intense management efforts at all levels will continue until system maturity is successfully achieved.

The DoD appreciates the opportunity to comment on the draft report.

Sincerely,

Enclosure

Jack Katzen

GAO DRAFT REPORT - DATED MARCH 29, 1988
(GAO CODE 392357) OSD CASE 7578

"STRATEGIC BOMBERS: B-1B PARTS PROBLEMS CONTINUE TO IMPEDE OPERATIONS"

DEPARTMENT OF DEFENSE COMMENTS

* * * * *

FINDINGS

- FINDING A: B-1B Spare Parts. The GAO observed that more than 500,000 different parts are used in the B-1B aircraft, including varying quantities of about 25,000 unique parts designated as spare parts. About 9,000 of these unique parts can be repaired and reused after failure. The GAO observed that, in order to determine the quantities of spare parts needed in the future, failure rates are maintained--i.e., if a part fails more often than predicted, additional parts are either bought or repaired to satisfy the increase in usage, but if parts last longer than predicted, fewer spares are needed. The GAO found that the Air Force Logistics Command (AFLC) used a concept called "expanded advance buy" to acquire spare parts for the B-1B. According to the GAO, this involved procuring combined initial and replenishment spare requirements in quantities anticipated to support the B-1B. The GAO also found that, in addition, the Air Force ordered quantities of B-1B parts for use as safety and wartime stocks. The GAO explained that the Air Force used the parts estimated service life, expressed as meantime between demand (MTBD), to calculate the quantity of parts needed--the shorter the MTBD, the larger the quantities of parts required. The GAO reported that the estimated cost for initial B-1B provisioning, safety and wartime needs totaled $2,202 million. The GAO noted that broken or worn out parts are replaced with serviceable parts from base supply, if available; however, if the part is not in stock and it affects mission capability, a high-priority requisition is forwarded to the B-1B Logistics Action Center at the Oklahoma City Air Logistics Center (ALC) where personnel locate and expedite the delivery of the needed part--whether from a prime contractor, the manufacturer, a repair source, or another Air Force base. The GAO observed that, in the meantime, base maintenance may cannibalize the needed part from another aircraft to make an aircraft flyable. The GAO concluded, however, that cannibalization

ENCLOSURE

Now on pp. 10-12.

increases the risk of breakage and maintenance time because of the need to remove and reinstall the part and, in cases of severe and persistent parts shortages, it can result in an aircraft having numerous missing parts. (pp. 16-18/GAO Draft Report)

DoD Response: Partially concur. The GAO has correctly described some of the standard, common practices and procedures employed by the Air Force in initially supporting a new weapon system (e.g., requirements formulation, provisioning, maintenance, etc.) Additionally, the GAO highlights the Air Force use of an Expanded Advance Buy (EAB) on the B-1B. This process combined four years of initial and replenishment spare requirements to take advantage of Spares Acquisition Integrated With Production (SAIP) (as recommended for the B-1B by the House Committee on Appropriations).

The DoD does not agree, however, that the Air Force is buying wartime stocks for the B-1B. The Air Force has never authorized the procurement of wartime spares for the B-1B. The GAO has mistakenly concluded that the purchase of Single Integrated Operational Plan (SIOP) Additive Support Spares (SASS) kits constitute wartime spares. Air Force Manual 67-1, Volume II, Part Two, Chapter 14, Section C, describes SASS as additional peacetime operating stocks (emphasis added) to support a higher level of readiness for strategic bombers committed to the SIOP.

- **FINDING B: High Priority Requisitions.** The GAO reported that the daily average of high-priority requisitions for B-1B spare parts increased from about 200 in March 1987, to about 600 in January 1988, even though the number of delivered aircraft only increased from 40 to 83 during the same period. The GAO reported that, for about 60 percent of the high-priority requisitions, lack of the part would ground the aircraft. The GAO concluded that, since about 50 aircraft had grounding parts on order, each of the 50 aircraft was not ready for flight for at least some portion of the day. The GAO found that, in some cases, aircraft are grounded because of only one missing part and may either be flyable in wartime or quickly made flyable for peacetime operations. The GAO pointed out, however, that more effort would be required for an aircraft that is missing many parts to become flyable. The GAO reported that as of December 22, 1987, 16 of the 79 delivered aircraft had 5 or more grounding requisitions. (p. 3, pp. 21-24/GAO Draft Report).

Now on pp. 2, 14-16.

DoD Response: Partially concur. Although a number of

aircraft have "grounding," or Mission Capable (MICAP) parts on order, most of these aircraft are, in fact, capable of flying some of their assigned missions. An aircraft with a MICAP requirement may fly numerous peacetime and wartime missions. The fact that a MICAP exists simply means that an aircraft is not perfect and capable of flying every possible mission. In addition, once MICAP orders are placed with the supply system, on site logistics managers consolidate total parts requirements through an accepted technique called cannibalization. This process ensures that the maximum number of aircraft are flyable by concentrating parts shortages in a few aircraft. The GAO allegation that 50 aircraft had "grounding" parts on order and could not fly for at least some portion of the day is misleading. The vast majority of these 50 aircraft were fully capable of executing a number of peacetime and wartime missions.

- **FINDING C: Mission Capable Rates.** The GAO reported that the mission capable rate is that portion of time the aircraft is available and capable of performing its mission. Accordingly to the GAO, the "not mission capable" rate includes the time the aircraft was not available because of parts problems, maintenance or both. The GAO commented that, generally, mission capable goals are set by the Air Force for its aircraft. The GAO observed, however, that goals for the B-1B have not yet been established because the system is immature and parts deliveries have not been completed. The GAO concluded that B-1B mission capable rates, primarily because of problems caused by parts shortages, have been about one-half the rates for mature systems, ranging from a low of 17 percent in January 1987 to a high of 42 percent in July 1987, and averaging about 31 percent for the 9-month period from January through September 1987. The GAO reported that, after reviewing data on the "mission capable" and "not mission capable" status of the B-1B, the B-1B Follow-On Operation Test and Evaluation (FOT&E) Team at Dyess AFB concluded that the mission capability status was a serious problem. (pp. 3-4, pp. 24-26/GAO Draft Report)

Now on pp. 3, 16-17.

DoD Response: Partially concur. A newly fielded weapons system, especially one as complex as the B-1B, should not be likened to mature weapon systems. Every newly fielded system experiences growing pains until maturity is attained. For example, the F-111, a less complex system than the B-1B, has experienced a 69 percent improvement in mission capable rates--from approximately 43 percent in 1978, to 73 percent in 1987. The DoD anticipates the same improvement for the

B-1B. It is true that there are no official established mission capable goals for the B-1B. It is not, however, appropriate to establish command standards until the B-1B reaches maturity. Currently, interim goals for mission capable and nonmission capable rates are being coordinated at the Strategic Air Command (SAC) Headquarters.

Although the B-1B has experienced parts shortages from the beginning, followon test and evaluation monthly summaries reflect declining Non Mission Capable (NMCS) rates through the end of Calendar Year 1987. In the April 1988 Air Force Operation Test and Evaluation Center (AFOTEC) report, the combined fully and partial mission capable rate for Dyess AFB, TX, is 45.9 percent--this compares favorably with the GAO reported rates. This improvement continues as aircrews and maintenance personnel gain experience and spare parts funded earlier are delivered.

- **FINDING D: Cannibalization.** The GAO reported that, to reduce on a short-term basis the number of grounded aircraft, the Air Force cannibalizes parts from other grounded aircraft. The GAO found that the cannibalization rate for all Air Force aircraft has been about 3 to 4 for each 100 flying hours, while B-1B cannibalization rates have ranged from 24 to 41 for each 100 flying hours. The GAO further reported that the extent of cannibalization is also illustrated by the numbers of spare parts needed for some of the aircraft, and cited six aircraft that were frequently cannibalized, which had more than 100 orders each for grounding parts between July 25 and December 22, 1987. The GAO also reported that one B-1B had 262 orders for grounding parts and had not been flown since July 1987. (pp. 2-4, pp. 26-27/GAO Draft Report)

Now on pp. 2, 17-18.

DoD Response: Partially concur. It is emphasized that the cannibalization rates for the B-1B should not be compared to mature Air Force aircraft. Relating B-1B rates to a fleet that is (on the average) much less complex and has the benefit of many years of operational experience is not valid. Data on cannibalization rates for a system such as the F-111 during the early stages of its deployment are not available. However, not operationally ready for supply rates (NORS) for the B-1B, compare favorably to those of the FB-111 after its initial deployment. Production of the FB-111 began in 1968. From December 1969 to July 1970, all FB-111s were grounded. During that time the aircraft inventory grew to nine. At that time the NORS rate was 18.9; the B-1B at a comparable point in its deployment was 15.4. In the First Tactical Fighter Wing F-15 activation in 1978, the cannibalization rate was 25.5 per 100 flying hours, while in

FY 1987 that rate had been reduced to only nine per 100 flying hours. Again, as parts inventories continue to increase and more fielding experience with the B-1B is gained the DoD anticipates similar reductions in the B-1B cannibalization rates.

- **FINDING E: Parts Shortages and B-1B Crash Inhibit Training.** The GAO concluded that, despite extensive cannibalization to provide timely training flights, B-1B crew members have not completed required training events in the time frames necessary to be certified mission ready. The GAO concluded that this is due to the fact aircraft were not available because of maintenance problems and parts shortages. The GAO observed that the SAC initial operational goal for the B-1B was to provide 1.31 mission ready crews per aircraft by December 1988. The GAO further observed that the SAC has reduced the number of mission ready crews it plans to train to 1.1 per aircraft for an indefinite period, until logistical support is capable of meeting the training and alert commitments of a mature system. According to the GAO, SAC officials declined to estimate when the logistical conditions are expected to enable a return to the 1.31 ratio, which will be needed to meet full alert commitments for the B-1B. The GAO also noted that the SAC has waived completion of several training requirements, such as heavy weight takeoff, heavy weight air refueling, airborne instrument landing approach, autopilot instrument landing approach, night terrain following, and electronic counter measures until future modifications are made to the aircraft. According to the GAO, after the crash of a B-1B in September 1987, the SAC imposed limits on low-altitude training until the Air Force completes a modification to strengthen it against damage from bird strikes, which is estimated to be completed by February 1989. The GAO also reported that training for low-level terrain following, critical to B-1B penetration of hostile airspace, will not return to the desired level until 1989. (pp. 5-6, pp. 28-31/GAO Draft Report)

Now on pp. 3-4, 21.

DoD Response: Nonconcur. The GAO assertion links parts shortages and maintenance problems to a reduced level of aircrew training and a consequential reduction in the crew force ratio. The decision to reduce crew force ratios from 1.31 to the temporary level of 1.1 was based upon the need to make more aircraft available for several ongoing modification efforts--not because of parts shortages. This necessarily resulted in less aircraft available for training sorties. The SAC intends to remain level at the 1.1 crew ratio until the second quarter of FY 1991, when the build to 1.31 will resume.

As a result of the concurrent nature of B-1B flight test and deployment, certain flight restrictions have been imposed on the SAC until flight test efforts are concluded. As a result, certain flight maneuvers have not been released to the SAC and have resulted in waivers to training events.

When an aircraft is modified with the Bird Strike vulnerablility reduction modifications, it is cleared for low level high speed flight and low level training. As of April 1988, the modification has been completed on six aircraft, which are once again being used to train crews in the low level maneuvers. All B-1B aircraft will be modified by February 1989.

- **FINDING F: Alert Aircraft Projections.** The GAO reported that the general SAC criterion on the number of bombers on alert force is 30 percent of the bombers assigned to the strategic bombardment wings. The GAO also explained the SAC officials' assumption that, in the event of a surprise nuclear attack, aircraft not on alert are likely to be destroyed before they could be loaded with munitions and fuel and launched. The GAO reported that the SAC would need to place 24 B-1B aircraft on alert (i.e., 30 percent of the 80 aircraft to be assigned to bombardment wings after delivery of the last aircraft). The GAO reported that SAC projections of the number of B-1Bs on alert have been based on the projected number of effective sorties that can be achieved. Because the described logistics problems have reduced the number of effective sorties that can be accomplished, the GAO reported that the SAC projected number of alert B-1Bs, as of various dates, have been reduced. The GAO observed that SAC decisions to place aircraft on alert will be based on logistics capability, aircrew training requirements, and force maturity. The GAO concluded, however, if world conditions warranted, training could be curtailed and additional aircraft placed on alert. (p. 6, pp. 31-32/GAO Draft Report)

Now on pp. 3, 19-21.

DoD Response: Nonconcur. While logistics capability is indeed a part of the equation used to determine the number of aircraft on alert, the major input to that equation remains the current aircraft availability. With up to 20 aircraft undergoing planned modifications at a time, the number of aircraft remaining available for aircrew training has been reduced. This was an informed decision made by the

SAC to expedite aircraft modification efforts. This decision resulted in the temporary leveling of the crew ratio at 1.1; the build to the 1.31 crew ratio will resume in the second quarter of FY 1991. The SAC does not have a schedule for putting B-1Bs on alert. Instead, the SAC periodically reviews the described criteria to determine the number of aircraft placed on alert.

- **FINDING G: Reliability Shortfalls.** The GAO found that the faster-than anticipated failures on many B-1B parts can be attributed to design or material deficiencies, inaccurate estimates of reliabilities, induced failures caused by vibration or improper maintenance, and false test failures. The GAO noted that with respect to the problem parts discussed in a prior GAO report 1/, 18 of 20 had failed faster than contractors had predicted or the Air Force had estimated and, although a few improvements have occurred, reliability for these parts continues to be less than Air Force estimates. A GAO analysis of reliability for the 58 items on the SAC priority list showed that 37 had reliability shortfalls similar to those shown in the earlier report; and of the 37, 17 had shortfalls exceeding 30 percent of the Air Force estimate. According to the GAO, the remaining 21 items became problems because of limited deliveries of new or repaired parts. The GAO noted that, if unexpected failures occur on parts with sufficient quantities either on hand or that can be resupplied in a short period of time, a shortage does not necessarily result but it does cause increased maintenance and additional expenditures. (pp. 6-7, pp. 33-36/GAO Draft Report)

Now on pp. 4, 22-24.

DOD Response: Partially concur. The B-1B has approximately 25,000 parts, the vast majority of which are working satisfactorily. Some, but not many, of these parts exceed anticipated failure rates. The DoD does not agree that the 58 parts are a representative sample. The 58 items mentioned by the GAO were identified by the Air Force, which is taking vigorous action to resolve problems. Reliability shortfalls are being worked by the B-1B System Program

1/ GAO Report GAO/NSIAD-87-177BR, "STRATEGIC FORCES: Supportability, Maintainability and Readiness of the B-1B Bomber, dated June 26, 1987 (OSD Case 7343)

Office with assistance from the AFLC and the SAC, as appropriate. Limited deliveries of parts remains a problem. The program is receiving emphasis by all levels at the aircraft depot and improvements are expected now that aircraft production has been completed.

- **FINDING H: False Failures.** The GAO explained that false test failures occur when a part is removed from an aircraft because test results show the part has failed, but subsequent tests show the part actually had not failed. According to the GAO, of the 20 problem parts discussed in its prior report, 17 were experiencing false test failures. The GAO observed that false test failures can result from faulty test equipment, improper use of test equipment, incomplete or inadequate support equipment and technical orders, and temporary conditions in flight or during ground testing. The GAO found that, as of September 1987, the percent of false test failures had improved on 10 of the 17 items, but had not improved on the remaining 7 items. The GAO further found that, in addition, 31 of the 58 items on the SAC priority list were experiencing false test failures, including 26 items with false failures greater than 15 percent of all failures and 7 with false failures greater than 40 percent. The GAO concluded that improved action on false test failures could result by tracking failures through the process by which they were identified to determine whether causes relate to test equipment or other factors. (p. 7, pp. 36-38, p. 49/GAO Draft Report)

Now on pp. 4, 24-26.

DoD Response: Concur. At the time of the GAO review the situation was as reported. The Central Integrated Test System (CITS) is, however, improving and becoming a good diagnostic tool. Although some false failures are still occurring, on the average, the B-1B false failure rates are in the normal range for a modern weapon system. False failure rates of 30 to 40 percent for complex weapon systems are not uncommon at this early stage of system maturity.

- **FINDING I: Parts Deliveries.** The GAO found that about 75 percent of the spare parts purchased to support the B-1B aircraft had not been delivered by the end of 1987, which resulted in B-1B aircraft being grounded. According to the GAO, in some cases contractors were delinquent but, more often, delivery schedules had simply not been established. The GAO concluded that until delivery schedules are established, there is little that SAC or AFLC officials can

Now on pp. 4, 26-28.

do to expedite the delivery of the quantities ordered. The GAO observed that delivery schedules are generally established during negotiation of parts contracts but, because many B-1B contracts have not been finalized, schedules have not been established. The GAO further observed that, in some cases, contracts cannot be definitized because the parts are continuing to undergo design changes. (p. 8, pp. 39-41/GAO Draft Report)

DoD Response: Partially concur. Contractual delivery schedules are established through negotiations among the Air Force Plant Representative Office (AFPRO), the Air Force Systems Command (AFSC) and the contractor. The fact that schedules have not been negotiated does not deter delivery. The need dates are established by the AFLC when Provisioned Item Orders (PIOs) are submitted. Contractors then propose schedules in response to the PIOs, which are then negotiated. Although contractually binding schedules are not established until negotiations are completed, projected need dates are established much earlier and extraordinary actions are taken, where prudent, to expedite processing and delivery. Moreover, the Air Force Contract Management Division has placed added emphasis on definitizing PIOs for all systems and, as a result, the on hand backlog has been reduced as of April 30 to $814 million, of which the largest portion is related to the B-1B. In addition, while several thousand Design Change Notices (DCNs) continue to be received each month, some of which affect actual design and some that are administrative in nature, the DCN processing has greatly improved. The AFPRO works closely with the Air Logistics Center through quarterly and sometimes monthly meetings to ensure DCN-generated definitization problems are resolved.

- **FINDING J: Waivers.** The GAO explained that the Air Force grants contractor requests for waivers to prevent production delays and, as of January 7, 1988, more that 1,000 waivers had been granted to B-1B contractors. The GAO found that, as a result of these waivers, B-1B parts have been accepted that:

  - have not had test results accepted by the Air Force;
  - have failed a specified test;
  - are nonstandard;
  - do not meet configuration specifications; and/or
  - have experienced some performance anomaly.

Now on pp. 5, 28-29.

The GAO reported that, of the 20 problem parts discussed in its prior report, 5 were granted waivers. The GAO further reported that, of the 58 parts on the SAC priority list, 15 were granted waivers. The GAO concluded that, as a result of granting waivers to spare parts contractors, B-1B aircraft have been grounded and additional parts had to be purchased. (pp. 8-9, pp. 41-42/GAO Draft Report)

DoD Response: Partially concur. There is no correlation between the granting of waivers and the potential failure of parts. Waivers are granted after review by the Configuration Control Board. Decisions on waivers are based on engineering analysis and other program considerations. All waivers/deviations must be fixed by the contractor, either through demonstrating compliance with the specifications or requesting relief from the contractual requirements. Relief from contractual specification requires consideration (i.e., something of value) to flow to the Government.

Now on pp. 5, 29-30.

- **FINDING K: Production Demands.** The GAO observed that the Air Force initiated Project 100 to complete production and delivery of the 100th B-1B by April 1988 (which is ahead of schedule). The GAO found that the Air Force plans to support the production line, as needed, with delivered spare parts and, if necessary, with parts cannibalized from aircraft that have already been delivered. The GAO noted that if a part is needed both for a deployed aircraft and the production line, the part will go to the production line. Noting 37 of the 91 items requested under Project 100 have been approved (as of November 2, 1987), the GAO concluded that this practice has also contributed to the parts shortages for deployed aircraft. (p. 9, pp. 42-43/GAO Draft Report)

  DoD Response: Concur. While it is true that Project 100 requirements reduced the number of spare parts available to support SAC aircraft, the DoD is not aware of a case where an aircraft remained grounded solely for a part used to support production.

- **FINDING L: Design Changes.** The GAO found that the backlog of design change notices for B-1B parts has slowed deliveries because contractors are not authorized to ship parts until notice processing is complete or a waiver obtained. The GAO concluded that the backlog was caused by the unanticipated volume of design changes. According to the GAO, as of January 1988, a total of 187,455 design changes had been received from the contractor. The GAO commented that, in June 1987, in order to reduce the 29,400 design change notices in process at the Oklahoma City ALC,

the work load was distributed among the five ALCs. As a result of this redistribution, the GAO found that, by the end of January 1988, the number of design changes in process was about 22,400--a decline of about 24 percent. The GAO also found that the value of parts on order with design change notices in process has decreased from about $226 million in April 1987, to about $153 million as of December 1987. The GAO concluded that this dollar reduction is due to the fact design change notices for the highest-cost items are given processing priority. (p. 9, pp. 43-45/GAO Draft Report)

Now on pp. 5, 30-31.

DoD Response: Partially concur. The DoD agrees that a large amount of the DCNs were generated as a result of the B-1B program. The DoD does not agree, however, that these DCNs caused any significant delays in shipping parts to using activities since, early on, the Air Force established a quick reaction system to approve those DCNs that had critical impacts to schedule or operational support. The processing of the DCNs has been greatly improved since the distribution of the processing workload to the five Air Logistics Centers, as evidenced by the following:

Date	Number of Design Change Notices in Process
June 1987	29,400
January 1988	22,400
April 1988	21,117

FINDING M: Efforts to Resolve Problems. The GAO reported that, at the time of the prior GAO review, the Air Force had established a list of 25 items causing the most number of aircraft groundings and was giving special attention to obtaining more parts and to implementing long-term solutions on most of the 25 items. The GAO found that, in May 1987, a list of 58 items was compiled at Dyess AFB identifying those parts causing maintenance problems and grounding the most aircraft. According to the GAO, these items became the SAC priority list and are receiving executive attention from a B-1B General Officer Steering Group. The GAO reported that these items are given the highest priority in obtaining delivery and repair actions. The GAO concluded that priority attention to selected parts has helped to bring coordinated actions to some of the most serious problem parts (for example, as of January 1988, 8 items were no longer problem parts because the causes of the problems and been identified and fixed). The GAO also found that the Air

Force has tasked contractors to monitor, analyze, and correct premature and false failures on 48 parts, some of which are also on the SAC priority list. The GAO concluded that, as a result of contractor work in this area, some reliability and false failure problems have been resolved. (pp. 9-10, pp. 46-49/GAO Draft Report)

Now on pp. 5, 32-33.

DoD Response: Concur.

- **FINDING N: Opportunities to Improve Management: Early and Systematic Identification of Problem Parts**. The GAO reiterated that the Air Force action to give priority attention by a high-level review group to the 58 problem parts identified by the Chief of Maintenance at Dyess Air Force Base has helped to bring coordinated action on serious B-1B problem parts. The GAO pointed out, however, that this list was developed in an ad hoc manner and included some parts the Air Force later determined were not problems. The GAO further pointed out that the list was developed using parts problems at only one base and had not been updated through December 1987. The GAO concluded that a more structured approach to systematically and periodically identifying B-1B problem parts would help ensure priority attention to all problem parts. The GAO observed high-level attention is needed to focus coordinated action by the ALC, the program office, and the contractors to ensure priority is given to engineering action that will identify causes and find solutions, as well as assuring deliveries of the parts receive priority processing. (pp. 9-10, pp. 49-51/GAO Draft Report)

Now on pp. 5, 34-35.

DoD Response: Concur. The list of problem parts, as identified by the SAC, originally contained 58 items. This was the case when the GAO conducted its on-site audit work. Now, however, the list is dynamic, with items being added when required and removed as problems are resolved. For example, six new items were added to the list in November, 1987, and three (pilot's window, co-pilot's window, and gyro reference unit) of the six have already been worked, resolved, and removed from the list. The other three items added (load arrestor, pilot probe, and aircraft battery) still present problems and are receiving Air Force attention. The user (SAC) identifies the candidate parts, which are then worked by the System Program Office (SPO), the AFLC, and the SAC. Other items are handled by the Product Improvement Working Group and/or formalized by the AFLC Critical Items Program, as appropriate.

- **FINDING O: Opportunity to Improve Management: Tracking False Failures.** As indicated earlier, the GAO observed that false test failures continue as a major cause of parts shortages for the B-1B. Having to remove parts because of false test failures adds to the parts shortage problem and increases parts requirements. The GAO reported that, in order to determine the effect of false test failures on spare parts requirements, it judgementally selected ten parts experiencing false failures more than 30 percent of the time and then eliminated the false failures from the requirements computations. The GAO found that eliminating the false failures from the part failures used in the Air Force requirements computation would reduce future buy quantities for the ten parts by $18.2 million and would reduce estimated repair costs by $31.1. The GAO concluded, therefore, that reducing false test failures can avoid significant expenditures. While noting Air Force continuing efforts should reduce the number of unnecessarily removed parts, the GAO pointed out that these programs are not specifically directed at reducing false test failures but, instead, are directed at improving problem parts on the test system. Noting Air Force officials claim false test failures can never be totally eliminated because of the variety of causes, the GAO nevertheless concluded a program to specifically track failures of individual parts through the process by which they were identified would be important in isolating causes and identifying solutions. (pp. 9-10, pp. 52-53/GAO Draft Report)

Now on pp. 5, 35-36.

DoD Response. Concur. The DoD emphasizes, however, that information about false failures (retest OK) (RETOKs) is routinely available to item managers. The RETOKs are used by item managers for judgemental decisions as part of their requirements computation process. In addition, the B-1B program office is in the final development stage of an Artificial Intelligence (A1) system called the (CITS) Expert Parameter System (CEPS), which will enhance The Unit Diagnostic Capability tremendously and will greatly reduce the incidence of false faiulres. The system should be available by FY 1989.

- **FINDING P: Opportunity to Improve Management: Parts on Order.** The GAO found that some B-1B parts have been purchased based on assumptions that may not be valid. The GAO reported that, as of November 1987, the Air Force ordered spare parts costing about $10 million for the SAC priority items, with the purchases based on the need generated by a past failure rate that should no longer be experienced because of engineering changes that are already completed or underway. The GAO also found that about

$742 million in spare parts for the B-1B defensive avionics system were purchased, many of the parts that have been delivered are already unusable or could be made unusable by the continuing development of the system. The GAO concluded that opportunities might exist for some of the orders to be terminated since the system is unstable and undergoing modification. In addition, the GAO found that the Air Force used peacetime operating funds to make special purchases of four wartime spares kits at a cost of $395 million and has requested an additional $98 million to purchase another kit in FY 1988. Because of the level of initial spares and the systems lack of maturity, the GAO concluded that these purchases could be premature. The GAO also observed B-1B parts exceeding a 4-year supply are on order that may be in excess. According to the GAO, this occurred because the AFLC process for review of potential excess material is not being followed. (The GAO noted that this is as a result of 1984 AFLC direction, which instructed managers not to terminate or reduce B-1B on-order quantities.) (pp. 9-10, p. 49, pp. 54-62/GAO Draft Report)

Now on pp. 5-6, 36-41.

DoD Response: Partially concur. On-order assets referred to in the report should not be terminated. In the case of the ALQ-161, the report indicated that $742 million of spare parts have been purchased, with many of the delivered parts "already unusable or could be made unusable" by the changes being made to the system. The report does not acknowledge the mission support realities of the situation. The ALQ-161 is a fielded system today. It must be supported with spares. With no ALQ-161 spares being bought in FY 1988 or FY 1989 (per congressional direction), these on-order spares are needed to support today's configuration of the ALQ-161. Further, the Air Force has reviewed the individual parts and determined none of the items cited by the GAO will be discarded; all will be modified to the proper configuration and used on the B-1B. A not-to-exceed cost estimate provided by the contractor for all spares upgrades is $105.0 million. (Only certain other items, which are Shop Replaceable Units, will become "unusable." These are valued at approximately $1 million. A stop work order has been issued for units to be scrapped.) In addition, all on-order items delivered after April 1989 will be delivered in the Modification 2 configuration. To terminate on-orders and start over would be of questionable economic value. It would force the Air Force to waste thousands of manhours and months of administrative leadtime. It would also risk extended periods of non-support to this critical weapon system, which stands on alert today.

The report tends to view terminations as largely a question of economics, while the DoD maintains that other supply factors such as demand stability, planned requirements, projected production plans for the next higher assembly and the impact on defense readiness must also be considered.

While the DoD acknowledges the need for the Air Force to improve its termination procedures and practices (this is being accomplished as evidenced by terminations increasing from three percent in FY 1986 to 13 percent in FY 1987), the DoD also maintains that the GAO needs to expand its focus on this issue to acknowledge mission support realities.

The report again addresses the issue concerning wartime spares. As outlined in the DoD response to Finding A, while the EAB was a best estimate of a required four-year buy, no wartime spares have ever been authorized for the B-1B; SASS kits are peacetime readiness spares purchased with peacetime operating stock funds.

RECOMMENDATIONS

- **NONE**

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