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REPORT BY THE

Comptroller General

OF THE UNITED STATES

Centralizing Air Force Aircraft Component Repair In The Field Can Provide Significant Savings

This report to the Subcommittee on Defense, House Committee on Appropriations, explains how the Air Force can use its field component repair resources more efficiently and effectively by centralizing such repair among units with common aircraft. Savings can be achieved in operating and maintenance costs, spare parts, equipment, and facilities.

LCD-79-409

MARCH 28, 1979

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-163762

The Honorable Joseph P. Addabbo
Chairman, Subcommittee on Defense
Committee on Appropriations
House of Representatives

Dear Mr. Chairman:

This report discusses the potential for the Department of the Air Force to reduce the resources needed to repair aircraft components in the field.

We made this review at the request of your office and as a result of an Air Force test in the Pacific which indicated that centralizing component repair may save resources.

During this review, the Air Force was studying the potential for centralizing component repair in Europe. Because the Air Force did not share its findings nor issue its report during our review, we were unable to evaluate the Air Force's conclusions. We did, however, discuss our report with Department of Defense and Air Force officials and incorporated their comments where appropriate.

As arranged with your office, we are sending copies to the Departments of Defense and Air Force. Unless you publicly announce its contents earlier, no further distribution of this report will be made until 30 days from the date of the report.

Sincerely yours,

Comptroller General
of the United States

COMPTROLLER GENERAL'S REPORT TO THE SUBCOMMITTEE ON DEFENSE HOUSE COMMITTEE ON APPROPRIATIONS

CENTRALIZING AIR FORCE AIRCRAFT COMPONENT REPAIR IN THE FIELD CAN PROVIDE SIGNIFICANT SAVINGS

D I G E S T

The Air Force has overemphasized the need for flying units to be self-sufficient in terms of component repair capability. If it would centralize component repair overseas and in the United States, significant savings throughout the Air Force could be gained annually.

The Air Force has about 9,240 aircraft with components requiring repair or maintenance periodically by military personnel at field bases. It spends about $400 million annually in operating and maintenance costs for field component repair and hundreds of millions of dollars for repair equipment and facilities, such as for the F-15 and F-16.

The Congress and GAO have encouraged the Air Force to eliminate duplication among its support activities. The Air Force has successfully centralized component repair

--among F-4 aircraft tactical units in the Pacific (see p. 57),

--with certain engines used by the Military Airlift Command (see p. 55), and

--for overseas requirements of the C-141 and C-5A aircraft (see p. 55).

LCD-79-409

There remains many more opportunities to economize by eliminating duplications among activities in the United States and overseas. By consolidating workloads and resources, economies of scale can be achieved in manpower, equipment, spare parts, and facilities (see pp. 4 to 10).

The Air Force uses a decentralized component repair structure in its planning for the European wartime scenario. As a result, tactical units in the United States that might deploy to Europe must retain excess capability so they can disperse.

Centralizing F-15 component repair in Europe can minimize the resources required there, which in turn reduces the resources needed in the United States for deployment. The reduction in Europe in avionics equipment alone could reach $24 million (see p. 16). About $16 million of this equipment could be made available among units stationed in the southwestern part of the United States (see p. 37).

The Air Force is uncertain as to where and by whom some of the F-16 intermediate support will be provided. Unless it establishes a policy against self-sufficiency of each unit, however, there is the possibility that requirements, again in terms of avionics equipment, will be overstated by as much as $20 million in Europe (see p. 16).

Concern over factors such as the following inhibit centralizing component repair in Europe for the F-15 and F-16 aircraft:

--Vulnerability, mobility, and flexibility (see pp. 17 to 20);

--Intratheater airlift transportation (see p. 20); and

--Spare parts requirements (see pp. 22 to 24).

GAO, however, believes that these factors can be effectively dealt with under alternative centralized component repair structures.

By centralizing, GAO believes

--resistance to threat can be improved (see p. 18);

--mobility and flexibility can be enhanced (see p. 19);

--intratheater transportation can be coordinated with existing airlift requirements (see p. 28); and

--increases in some spare parts requirements can be offset by potential reductions resulting from the many benefits from centralizing (see p. 22).

Alternatives for centralizing component repair in Europe during wartime include

--a single centralized intermediate repair facility for each type of aircraft;

--centralized repair facilities at the U.S. bases as repair centers for F-15 and F-16 aircraft assigned throughout Europe; and

--centralized repair at U.S. bases with a contingency site off of the European mainland such as in England (see p. 27).

Further economies of scale are available among older nontactical aircraft component support activities, such as with the F-106, B-52, and KC-135 in the United States. If these economies are to be achieved, strategies other than a central repair facility may be required, because much of the shop equipment is required at the flying unit to identify the failed components and the staffing cannot be economically segregated between work on the aircraft and work in the shops.

The potential savings for older nontactical aircraft would be achievable if

--common aircraft types are collocated at the same base and

--centralized component repair is used as an alternative to future resource acquisitions (see p. 31).

We recommend that the Secretary of the Air Force, to the extent consistent with mission requirements, achieve more effective use of field component repair resources by

--centralizing F-15 and F-16 component repair overseas and in the United States;

--collocating common types of aircraft when assigning or transferring aircraft or flying organizations; and

--centralizing component repair as a means of minimizing requirements when updating, replacing, or acquiring new resources.

Air Force representatives commented as follows:

--The Air Force recognizes there are savings and other benefits available from centralizing component repair and it has centralized in some cases. Centralizing, however, is a very complex issue. Costs and other disadvantages as well as the potential benefits need to be more fully examined before implementing the recommendations in this report.

--The Air Force is seriously examining the potential for centralizing F-15 and F-16 component repair in Europe. It hopes to shed more light on the supply, transportation, vulnerability, and mission uncertainties and provide the basis for a decision.

--The Air Force believes the current component repair system works well and would prefer not to take a chance on degrading it or incurring an intermediate period of disruption unless the uncertainties involved in such a change are minimized.

While GAO recognizes that centralizing component repair involves complex issues, it believes the information in this report will assist the Subcommittee in evaluating future Air Force efforts to minimize aircraft component repair resources.

Contents

ABBREVIATIONS

AIS	avionics integrated system
BLSS	base level self-sufficiency spares
GAO	General Accounting Office
MAC	Military Airlift Command
SAC	Strategic Air Command
WRSK	war readiness spares kit

CHAPTER 1

INTRODUCTION

In 1978 the Air Force had about 9,240 aircraft which required regular maintenance to keep them ready to meet contingency and war mission needs. Some of this maintenance is sufficiently complex to be classed as depot level and is performed by civilians at logistics centers or by contractors at a cost of over $1 billion annually. The rest of the maintenance is base level and is generally performed by military personnel at the command which owns the aircraft. The Air Force spends about $2 billion annually for base maintenance.

In 1978 we reported 1/ on depot maintenance pointing out that economies of scale were available from centralizing depot management throughout the Department of Defense. This report covers our evaluation of the potential for centralizing aircraft component repair, which accounts for about 20 percent of the $2 billion or $400 million of the annual cost of Air Force base maintenance. In addition, hundreds of millions of dollars are spent for repair equipment and facilities. For example, the cost of component repair equipment for the F-15 is about $250 million, and for the F-16, avionics test equipment alone is estimated to cost $277 million.

The component repair process generally works like this. When an aircraft component fails, a mechanic or technician replaces it with a good component obtained from base supply and then takes the failed component to a shop. In the shop, technicians identify the failed subcomponent, replace it with a good one and then give the repaired component to base supply for later reissue. Sometimes the repair is too complex or is temporarily beyond the capability of the base unit. In this case the component is shipped to a depot activity for repair. Repair at the base is more desirable, if practical, because it can return the component to service faster. This is critical during wartime.

1/"Aircraft Depot Maintenance: A Single Manager Is Needed To Stop Waste" (LCD-78-406, July 12, 1978).

The typical base organization which will have component repair shops is the wing. 1/ Generally a wing will have a shop to repair or maintain avionics components, aircraft accessories and jet engines, and a precision measurement equipment laboratory. These repair shops, especially for avionics, are quite expensive. For example, facilities for an F-15 wing's component repair squadron cost about $6 million and the equipment costs about $23 million. Avionics shop equipment costs $17 million, 74 percent of the total equipment expenditure.

SCOPE

In light of the high cost of component repair, we wanted to determine whether centralized shops serving a number of wings could achieve significant savings through economies of scale and still meet the needed component repair effectiveness.

We considered centralizing shops only serving common aircraft types, including the F-15, F-16, F-106, B-52, and KC-135 aircraft. The new A-10 is being deployed by the Air Force under a centralized logistics concept, which we are reviewing separately.

Because Air Force wartime operations in Europe are the primary basis for the existing decentralized structure of component repair, we attempted to focus on centralizing in the U.S. Air Force, Europe, as augmented during wartime. The U.S. Air Force, Europe, however, refused to provide key information relevant to our review. The U.S. Air Force, Europe stipulated that it would not provide any information regarding centralization in Europe until its own study report is issued. At the end of our review, this report was in the command review stages.

While we were otherwise able to obtain sufficient information to reach conclusions about centralization, we could not evaluate the assumptions and conclusions in the U.S. Air Force, Europe, study.

Chapters 4 and 5 provide case studies involving common aircraft assigned to different bases in relative proximity of one another.

1/A wing is an operating command generally composed of three flying squadrons and three or four support squadrons.

We made our review at the following locations:

--Headquarters, Department of Defense, the Pentagon.

--Headquarters, U.S. Air Force, the Pentagon.

--Tactical Air Command, Langley Air Force Base, Virginia.

--Strategic Air Command, Offutt Air Force Base, Nebraska.

--Military Airlift Command, Scott Air Force Base, Illinois.

--Air Force Logistics Command, Wright-Patterson Air Force Base, Ohio.

--Warner-Robins Air Logistics Center, Georgia.

--Nellis Air Force Base, Nevada.

--Davis-Monthan Air Force Base, Arizona.

--Luke Air Force Base, Arizona.

--Holloman Air Force Base, New Mexico.

--Travis Air Force Base, California.

--Beale Air Force Base, California.

--Castle Air Force Base, California.

--Mather Air Force Base, California.

--California Air National Guard, Fresno Airport, California.

--Headquarters, U.S. Air Force, Europe, Ramstein Air Base, Germany.

--Bitburg Air Base, Germany.

CHAPTER 2

CENTRALIZATION CAN PRODUCE SIGNIFICANT SAVINGS

By centralizing field aircraft component repair, the Air Force can achieve significant savings in resources and operating and maintenance costs. Component repair, especially for avionics components, requires shops with expensive sophisticated equipment and highly trained technicians. These shops are generally part of the support structure for a fixed number of aircraft at a given location. Because the aircraft component repair requirements to be supported often do not fully utilize the shop resources, even during wartime, consolidation of workloads and shops can reduce the total number of resources required without degrading readiness.

WHAT ARE THE BENEFITS FROM CENTRALIZING?

Centralization of aircraft intermediate maintenance can provide economies of scale which reduce resource requirements. As the number of aircraft to be supported increases, for instance, there is often less than a proportional increase in staffing, equipment, facilities, and spare parts needs. Thus, a centralized maintenance activity supporting a number of flying organizations would require less resources than if each organization supports itself. Furthermore, the centralized shop environment can lead to other benefits, such as can accrue from higher specialization among the work force.

Economies of scale

Economies of scale can occur where resource use is improved through consolidations which result in better matching of resource requirements with the workloads they are to support. Often a particular skill or piece of equipment is required whether there are a few items or many items to maintain. Thus, for example, three organizations would require three of the resource while a central organization having the same total workload may require only one. This is illustrated with Air Force data below.

Staffing

With respect to staffing, there are potential economies in overhead as well as shop personnel. Although the Air Force staffing data below tends to be tentative or outdated due to recent organizational changes, it does show there are staffing economies of scale as follows.

Staffing Requirements by Number of Aircraft

	24 aircraft (note a)	Decentralized 72 aircraft (note b)	Centralized 72 aircraft (note c)	Economy of scale	Percent reduction
Overhead (note d):					
A-7 avionics maintenance squadron	9	27	15	12	44
A-10 avionics maintenance squadron	6	18	e/15	3	17
F-16 avionics maintenance squadron	5	15	7	8	53
Shop personnel:					
A-10 communications/ navigation	26	78	e/62	16	21
F-16 communications, navigation and penetration aids	28	84	e/68	16	19

a/One self-sufficient squadron.

b/Three dispersed self-sufficient squadrons of 24 aircraft each. (This is the quantity for one squadron times 3.)

c/Three squadrons having centralized support.

d/Includes squadron headquarters personnel only.

e/The Air Force had figures for only up to 48 aircraft. This figure is the sum for 24 and 48 aircraft. For 72 aircraft it would probably be lower.

The apparent staff savings were borne out in a recent centralization of avionics component repair among three F-4 aircraft organizations in the Pacific. A study of the centralization indicated that about 27 positions, mostly overhead, were saved.

Equipment

Economies in equipment are especially significant because much of it is very expensive. For example, the shop equipment for one 72 aircraft F-15 wing can cost as much as $24 million. Savings in equipment can generate further economies in staffing and facilities. Savings in staffing would occur because less equipment results in less maintenance and calibration and possibly equipment operators. Further, less equipment would require less facility square footage to house it.

Equipment economies of scale are available for two reasons:

1. Authorized wing equipment is capable of supporting more aircraft than assigned to the wing.

2. The Air Force requires each wing to have two equipment complements so the wing can deploy in two noncollocated groups, if necessary.

The potential economies can be illustrated with the F-15 wing avionics repair branch 1/ which, with two equipment sets costing about $8 million each, accounts for the majority of the equipment costs. Generally, one shop can support 48 aircraft; however, the basic F-15 wing has 66 to 72 aircraft. Therefore an F-15 wing requires the capability for two avionics shops, one for 48 aircraft and the other for the remaining 18 to 24. Further, each shop capability must have the minimum equipment required due to the deployment requirements. The impact on the amount of equipment required of various 144 aircraft structures is shown below.

1/The avionics repair branch is responsible for maintaining aircraft avionics and electrical systems and for maintaining aircrew training devices. The branch might contain the following shops: communications, navigation, electronic warfare, inertial navigation, weapons control, sensorcamera, instruments, automatic flight control, electrical systems, avionics aerospace ground equipment, and aircrew training devices.

	Two collocated F-15 wings		Two dispersed F-15 wings		Dispersal in two squadron groups		Individual squadron dispersal	
	Number of aircraft	Approximate equipment cost (millions)	Number of aircraft	Approximate equipment cost (millions)	Number of aircraft	Approximate equipment cost (millions)	Number of aircraft	Approximate equipment cost (millions)
	144	$24	72	$16	48	$ 8	24	$ 8
							24	8
					48	8	24	8
			72	16			24	8
					48	8	24	8
							24	8
Total	144	$24	144	$32	144	$24	144	$48

Equipment economies of scale can further be demonstrated with actual Air Force experience as follows.

--When the Air Force consolidated F-4 aircraft avionics component repair in the Pacific, it reported savings of $2.2 million in maintenance equipment.

--In an Air Force intermediate maintenance consolidation test among two B-52 and KC-135 aircraft organizations in the United States an equipment reduction of about $1.3 million was reported.

--Information from the Air Force's Military Airlift Command (MAC) indicates that centralized intermediate maintenance of the T-56 engine (used on the C-130 aircraft) requires significantly less equipment per aircraft. For example, the Little Rock Air Force Base, Arkansas, central T-56 repair facility requires about $9,500 in equipment per aircraft, while organizations not centralized, such as in the reserves, require about $32,000.

Facilities

Facilities are a function of staffing and equipment, among other factors. Reductions in these factors will reduce the amount of facilities required. At an average cost of about $60 per square foot, such economies of scale in intermediate maintenance facilities can be significant. The F-15 shop size standards provide examples of economies of scale as follows:

--To support 48 aircraft an avionics shop must have about 5,070 square feet minimum. By adding another 48 aircraft to the support requirement, the square footage increases by 3,790. Thus the consolidation of two 48-aircraft groups would result in an economy of 1,280 square feet, or 13 percent.

--The engine shop requires about 5,000 square feet minimum to support one to six aircraft. For each additional six aircraft the square footage requirement increases by 1,780 feet.

--The machine shop requires 2,124 square feet minimum to support from 1 to 108 aircraft. Beyond 108 aircraft, small increases in shop size would be needed.

As is apparent, there are facility space requirement savings inherent in supporting increasing number of aircraft at a site.

Spare parts

Economies in spare parts result from the favorable impact of centralization upon factors used to compute base stock requirements. The effects upon these factors include (1) decreases in time to repair items, (2) increases in base repair capabilities, and (3) decreases in daily demand rates.

Decreases in repair times provide economies and result from increased specialization in a production environment and improved equipment availability. With the use of more economical production methods in a larger repair facility, personnel can become more specialized and therefore, more proficient. Improved proficiency leads to faster repair. Furthermore, repair time can decrease when more test equipment is available as with a larger facility. For example, if one set of equipment is down 30 percent of the time, the probability of two such sets being down at the same time is only 9 percent. This could be the case with F-16 aircraft avionics test equipment, since it is designed to have a 70-percent probability of the equipment being operable and available to test a random major component.

Increases in base repair capabilities cause economies since the amount of spares needed to compensate for the shipment of spares between the repair facility and depot are reduced. Reasons for improved capabilities stem from better use of maintenance resources. For example, personnel become more specialized and thereby are able to perform repair formerly done at the depot.

Economies can also result with respect to subcomponents if repair facilities are consolidated. For example, when repair is decentralized each facility has its own safety level 1/ for each subcomponent; however, if the facilities are consolidated only one safety level, at the central facility, is required. On the other hand, if aircraft were also collocated, economies in components occur as demonstrated by F-16 initial support requirements below

Number of aircraft at one location	Number of line items	Dollar value	Percent increase in aircraft	Percent increase in dollar value
24	6,463	$ 7,910,037	-	-
48	6,463	11,385,978	100	44
72	6,463	16,953,439	200	114

Based on MAC's "queen bee" engine maintenance program and its forward supply system, the Air Force experienced economies in spares as a result of centralization. Under the queen bee program, savings resulted from consolidating intermediate maintenance for specific types of engines. For example, by consolidating J-60 engine intermediate maintenance for 15 locations, a reduction of 28 engines valued at $60,000 each resulted.

The Air Force also recognized economies of $15 million in spares from the forward supply system. This system provides centralized component repair at U.S. installations for C-5 and C-141 aircraft in support of overseas operations.

THE CONGRESS ENCOURAGES CENTRALIZATION

As far back as 1958, the Congress mandated the Secretary of Defense to eliminate duplication among support functions of the military services as part of an overall effort to improve effectiveness, efficiency, and economy (10 U.S.C. 125). With respect to maintenance, the Secretary set forth the objective as sustaining equipment readiness consistent with the mission requirements of the operating or tactical

1/The safety level is the assets required to be onhand to permit continuous operation in event of minor interruption of normal replenishment or unpredictable increases in demand.

elements at the least cost. In the related Defense policy statement, the military departments are to provide an adequate program for maintenance of assigned equipment to effectively and efficiently meet sustained readiness in accordance with responsibility for military missions.

The Air Force implements this policy by providing for support within its operating forces in various forms. These forms range from centralized support among several wings to decentralized support of specific squadrons within a wing.

OUR 1975 REPORT RECOMMENDED CONSOLIDATING REDUNDANT CAPABILITIES

Our 1975 report 1/ pointed out that the military services had not used their command maintenance capabilities as effectively as possible. There were opportunities to reduce their underused capacities through intraservice and interservice consolidations. We recommended that the Secretary of Defense encourage the services to consolidate their maintenance programs in order to maximize the use of their limited resources and to simultaneously achieve the desired readiness for national emergencies. The Department of Defense commented that it would continue to encourage consolidated maintenance where it would not adversely affect readiness. Since then, the Air Force has consolidated or centralized some of its intermediate maintenance capabilities and capacities.

OUR 1976 REPORT RECOMMENDED REDUCTIONS IN F-15 SUPPORT EQUIPMENT

Our 1976 report 2/ on the F-15 pointed out that the Air Force had not effectively matched avionics test equipment with its requirements. Basically the requirements were overstated because the Air Force did

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1/"Productivity of Military Below Depot Maintenance--Repairs Less Complex Than Depots--Can Be Improved" (LCD-75-422, July 29, 1975).

2/"The F-15 Is An Example of How Weapon System Support Cost Can Be Reduced" (LCD-76-403, Jan. 22, 1976).

not plan to fully use the test equipment and did not consider revised deployment plans. Subsequently the Air Force reduced its F-15 test equipment requirements by about $77 million; however, we contended that more reductions--at least $33 million--were possible. This was due to the close proximity of some of the bases and the potential for sharing equipment to achieve higher utilization.

We recommended that the Secretary of Defense require the Air Force to reexamine its needs for avionics intermediate test equipment and make the reductions. The Secretary responded that the Air Force would be asked to reexamine F-15 avionics test equipment requirements which it had already significantly reduced. He pointed out, though, that any further reductions must consider actual equipment performance in the field to insure that operational effectiveness can be maintained.

AIR FORCE CENTRALIZED COMPONENT REPAIR

The Air Force has studied several potential centralized component repair structures. In some cases, such as with MAC and the Pacific Air Force Command, centralization was subsequently implemented. In contrast, the Strategic Air Command (SAC), based on its 1977 study, concluded that centralized component repair would not be practical for its aircraft.

Further, the Air Force is using centralization with its implementation of the A-10 in Europe. In 1978, the Air Force studied the potential for centralization among F-4, F-111, F-15, and F-16 aircraft activities in Europe. (See app. I for details of the above Air Force activities.)

CONCLUSIONS

Economies of scale are available to the Air Force from centralizing shops for field repair and maintenance of components. These economies include savings in staffing, equipment, facilities, and spare parts.

Since 1958, the Congress, the Department of Defense, and our office have encouraged improving efficiency through centralizing support functions and otherwise eliminating duplications. The Air Force has centralized or considered centralizing intermediate component repair in a number of areas, including the Pacific, and with various airlift, strategic, and tactical aircraft organizations.

The following chapters examine key issues which have inhibited Air Force efforts to centralize component repair for F-15, F-16, B-52, KC-135, and F-106 aircraft and present alternatives which can provide the savings while preserving the necessary level of effectiveness.

CHAPTER 3

OPPORTUNITIES TO CENTRALIZE COMPONENT REPAIR

Greater (increased) centralization of component repair would provide considerable savings. Despite such savings, however, the Air Force contends that some tactical aircraft organizations must be self-supporting and ready to deploy anywhere. With the nontactical aircraft, it points out that these aircraft are older and have long since completed the acquisition phase. Therefore the potential for savings is minimal, and it may be exceeded by the cost of implementing or operating a centralized repair facility.

We recognize that the most potential savings are with the newer tactical aircraft such as the F-15 and F-16. By planning and developing a centralized component repair mode, the acquisition of resources can be minimized. The older aircraft do offer some potential, however, to conserve staffing, skills, and equipment as well as spare parts which may be out of production due to the age of the aircraft.

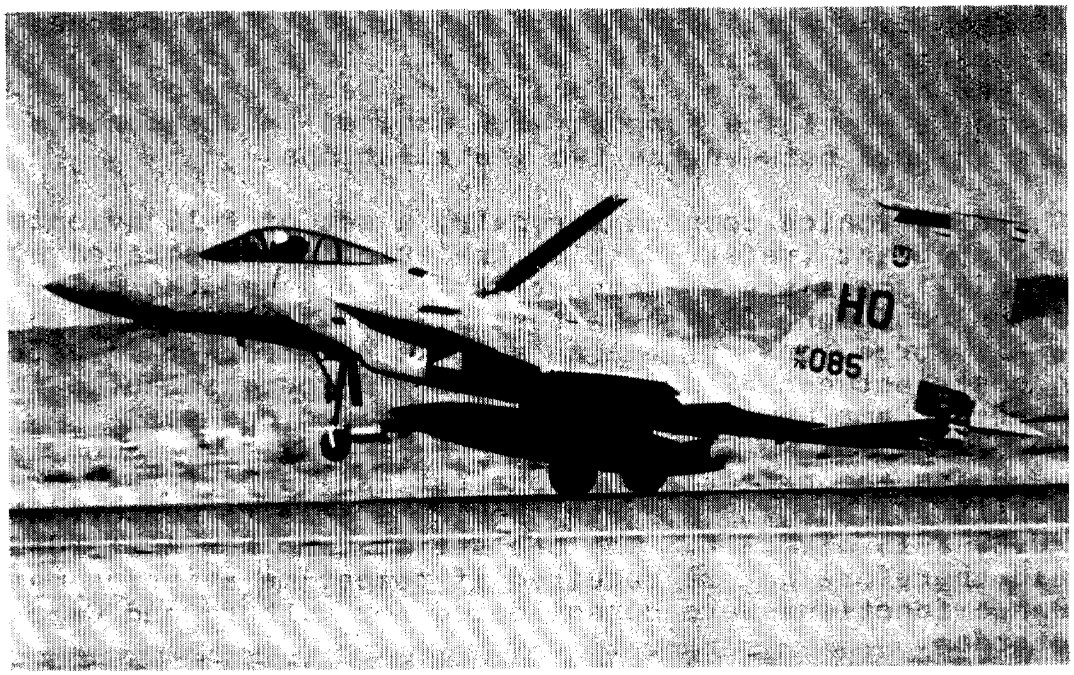
F-15 AND F-16 TACTICAL AIRCRAFT 1/

Component repair for F-15 and F-16 flying organizations is generally decentralized. Thus, the Air Force is foregoing some economies of scale in both its wartime and peacetime structure.

F-15 in Europe

During peacetime F-15 aircraft will operate from two U.S. bases in Europe: Bitburg Air Base, Germany and Camp New Amsterdam, the Netherlands. Bitburg has 72 F-15s and Camp New Amsterdam is going to receive 18 aircraft.

1/Because some of the information on F-15 and F-16 wartime operations and maintenance is classified, we are providing to the Subcommittee, under separate cover, a more detailed classified supplement to this report.



U.S. Air Force Photo

F-15 AIRCRAFT

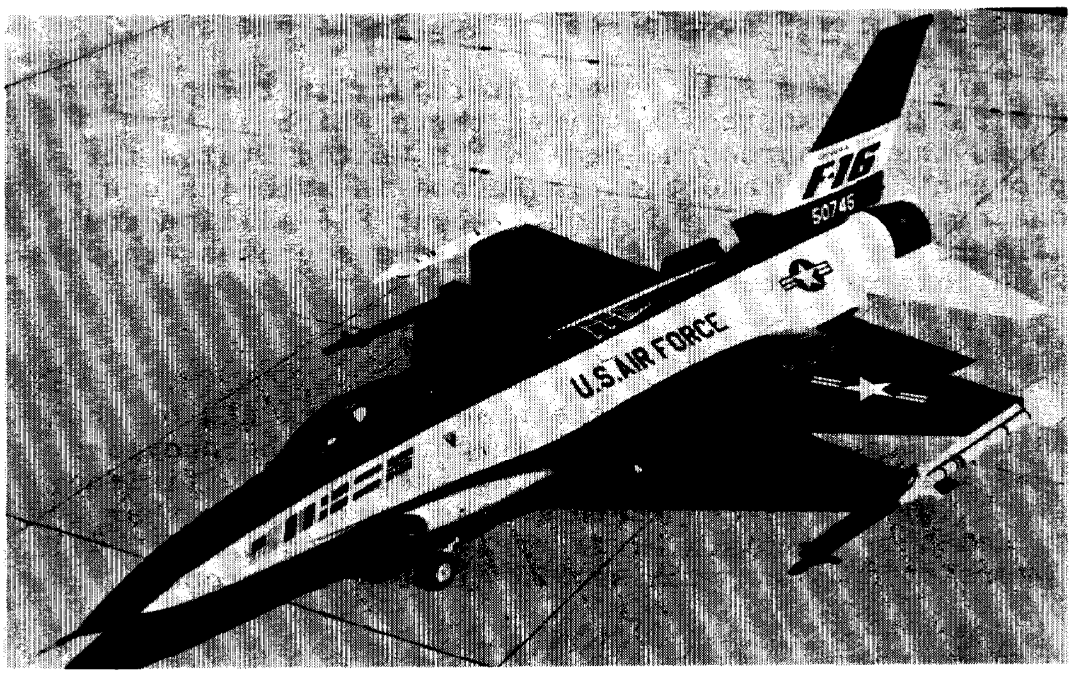


Photo Courtesy of the General Dynamics Corp.

F-16 AIRCRAFT

Each base will provide its own support from planned semihardened 1/ facilities, which will cost about $4.5 million per base. During the buildup of Camp New Amsterdam, Bitburg is providing support with engines and components being shipped between the two installations.

For avionics component repair, a set of F-15 avionics test equipment (referred to as the avionics integrated system [AIS]) consists of seven test stations and the calibration equipment for these test stations. According to the Air Force, one system can support 48 aircraft in wartime and costs between $7 and $8 million. Bitburg is authorized two sets, Camp New Amsterdam is authorized one set.

Using the criteria that one set can support 48 aircraft, Bitburg's two sets should be able to support all 90 U.S. F-15 aircraft. The one set at Camp New Amsterdam would therefore not be required if peacetime avionics maintenance functions were consolidated for Bitburg and Camp New Amsterdam.

In an European contingency, Air Force plans call for each wartime F-15 base to have its own avionics maintenance capability. As a result, tactical units in the United States that might deploy to Europe must retain excess capability so they can disperse if necessary.

Centralizing F-15 component repair in Europe can minimize the resources required there which in turn reduces the resources needed in the United States for deployment. The reduction in Europe in avionics equipment alone could reach $24 million. About $16 million could be available among units stationed in the southwestern part of the United States. (See p. 37.)

F-16 in Europe

The Air Force is uncertain as to where and by whom some of the F-16 intermediate support will be provided. Unless it establishes a policy against self-sufficiency of each unit, however, there is the possibility that requirements, again in terms of avionics equipment, will be overstated by as much as $20 million in Europe.

1/Semihardening is structuring above ground facilities with sufficient steel and reinforced concrete to withstand the impact of a specialized amount of explosives.

NONTACTICAL AIRCRAFT

Although nontactical aircraft organizations are generally not faced with a wartime mission to deploy into a decentralized support structure as with the F-15 and F-16 aircraft, the Air Force supports many such aircraft in the United States with a decentralized structure. One of the largest organizations involved is SAC which operates B-52 aircraft from 17 bases and KC-135 aircraft from 27 bases in the United States. Others are the Aerospace Defense Command and MAC.

This decentralized structure in the United States results in many cases where redundant intermediate maintenance and component repair support is being provided within close proximity. The Air Force contends that centralizing the support of older aircraft is too costly. The savings would be minimal because equiment and facilities, the largest area for savings, have already been acquired. Further, it contends that increased staffing and spare parts costs would more than offset any savings.

KEY CONSIDERATIONS WITH CENTRALIZATION

Although economies of scale are apparent from centralization, the following factors, which impact on support effectiveness and have inhibited centralizing, must be considered.

--Vulnerability of support capability.

--Mobility and flexibility of support resources.

--Availability of transportation.

--Spare parts requirements.

--War reserve material.

--Staffing.

--Alternative missions.

Vulnerability

Of major concern to the Air Force when considering centralizing maintenance overseas is the vulnerability of the total capability to loss from attack at a single location. An Air Force contention is that in Europe the intermediate component repair capability should be decentralized to enhance survivability. The Air Force, however, appears to be inconsistent regarding the vulnerability issue.

In the Pacific, for instance, the F-4 and F-15 aircraft component repair is being centralized at Okinawa, Japan, away from the area of potential conflict to reduce vulnerability. Further, in Europe, the A-10 aircraft component repair is being centralized in England. Since the Air Force has sanctioned centralizing component support for some of the primary tactical aircraft within overseas theaters, we question vulnerability as a reason for not centralizing others, such as the F-15 and F-16 in Europe.

The F-15 in peacetime Europe is to operate from U.S. bases in the Netherlands and in West Germany. The Air Force plans to semiharden the repair facilities at those locations. The wartime F-15 augmentation from the United States will deploy to an additional three bases in West Germany and one in the Netherlands. The component repair capability for the augmentation bases will be brought from the United States, and it will be established at each base to support aircraft assigned there. These facilities will not be semihardened and will therefore be less survivable from attack. Thus centralizing component repair at the semihardened United States bases may make it less vulnerable than it would be under current plans.

Should the Air Force lose intermediate repair capability, such as from destruction or capture, it would have to fall back on other existing bases for support. It could find itself trying to convert to a centralized component repair mode in the midst of a crisis. Transitioning to a new maintenance system in wartime may prove extremely difficult, particularly if some replacement resources are needed. One way to meet such a problem is to develop one to three well protected repair facilities located in less immediate threat areas, such as the Netherlands or England.

Although the support structure for the F-16 aircraft still needs to be defined, we believe the same vulnerability considerations apply. With respect to nontactical aircraft, however, vulnerability is not a key issue since these aircraft generally will not deploy their intermediate capability to overseas bases.

Mobility and flexibility

Related to the vulnerability issue and the need for overall mission effectiveness is the requirement for individual flying organizations to be mobile and flexible. They must be able to relocate to the war area where and when needed and within the area if their base is threatened. Such capability enhances mission effectiveness and survivability.

The planned decentralized component maintenance structure is a constraint on mobility and flexibility. Component repair, particularly avionics, requires special facilities, some of which need to be environmentally controlled. It also requires expensive special and sensitive test equipment and additional equipment to maintain the test equipment. In order to effectively move these maintenance resources from one location to another, timely ground and/or airlift transportation is required. Added to these constraints is the time required to disassemble, pack, transport, unpack, and reassemble intermediate maintenance equipment. Such factors as (1) the amount of warning time or leadtime a unit is given to relocate, (2) the availability of transportation, and (3) the availability of alternate facilites will determine the success and ability of organizations to relocate and set up their intermediate maintenance.

We believe that flying organizations would be much more mobile and flexible if they would not have to move their component repair shops. A central facility in England as is planned for the A-10, for example, could lessen this requirement for European deployments. The requirements of moving associated intermediate maintenance equipment places additional burdens on transatlantic airlift resources which the Air Force considers to be strained for European reinforcement. If augmentation units were to receive support from central facilities in

Europe, we believe the amount of equipment requiring transatlantic airlift could be reduced, thus freeing valuable airlift resources for other priority purposes.

In the Pacific, the Air Force views the central Okinawa facility as a benefit to mobility and flexibility. Units deploying from the United States will have some component support to immediately draw from rather than having to wait until their own capability can be established. Further, those units would only have to augment the central facility with the incremental resources required, rather than complete shop repair capability. We believe that similar benefits can be gained from centralizing in Europe.

As with vulnerability, mobility and flexibility are generally not a key centralization issue with nontactical aircraft organizations because they will not deploy intermediate maintenance capability into a decentralized overseas environment.

Transportation

Another very important issue requiring consideration when evaluating the potential for centralizing component repair is transportation: (1) whether there are sufficient transportation assets available (ground and air) to move components between the repair facility and the operating air bases, and (2) the cost effectiveness of such a transportation system.

The Air Force would not provide us with any detailed information on wartime intratheater European airlift and ground transportation requirements, capability or priorities until their own maintenance centralization study is approved.

The cost of transportation is uncertain; however, we believe it is not significant in relation to the benefits available from centralizing. The Air Force actually recognized a transportation cost savings in its study of the Pacific centralization project. This supposedly resulted because the central facility in Okinawa had improved repair capability and therefore less material had to be returned to the U.S. depots for repair. Air Force officials said that some of this improvement resulted from a maintenance level policy change concurrent with the facility's implementation, rather than the implementation itself; thus, the actual transportation cost impact is uncertain.

The SAC study of a centralized maintenance test between Seymour-Johnson Air Force Base, North Carolina, and Barksdale Air Force Base, Louisianna, concluded that shipment of engines and components between the two bases would cost the command from $300,000 to $400,000 annually per wing. The test used primarily LOGAIR 1/ contract flights which were not increased during the test. The study pointed out, however, that hidden costs were incurred because some LOGAIR space, dedicated to the project, probably caused "bumping" of other cargo that would normally have been carried. This apparently assumes that LOGAIR flights were used fully. We learned from the Air Force Logistics Command, however, that LOGAIR flights are used at about 73 percent capacity. Therefore, the bases were likely to have used airlift capacity the Air Force would pay for even if not used. The extent of this occurrence is uncertain, but it does raise a question as to what the transportation actually did cost the Government.

At first glance, centralizing component repair may appear to require significant additional transportation resources because movement of material between bases is increased. Such an increase can be minimized, however, if unused and paid-for capacity is already available, as with the LOGAIR contract system in the United States. Further, some of the increase can be offset with decreases in the transportation to and from the depots. This is because larger centralized intermediate facilities can have more specialization with higher technical skills and more sophisticated equipment which will enable it to perform some of the maintenance previously shipped to the depot. This is particularly important during wartime when returning equipment to operations quickly can be critical. Also, a central facility may be able to repair it quicker, therefore providing better service and possibly reducing the number of items in the maintenance float.

1/LOGAIR is an Air Force system for regular delivery of supply and maintenance items among bases in the continental United States using commercial contract aircraft.

Spare parts requirements

A primary concern when considering centralizing component repair is the impact on levels of spare parts required to sustain operations for a given organization. Generally, spare components are kept onhand to use if needed during the time like components are being repaired. When a centralized facility is used, units that are not collocated with the facility need additional time for repairs because of the time it takes to package and ship the components to and from the facility. This additional time causes increases in onhand spares to cover the expanded repair time. For example, an Air Force audit of the Pacific centralization reported that spare parts requirements increased by $2.2 million.

While the readily apparent impact of centralizing is to increase spare component levels, the following factors which can offset much, if not all, of the increase must also be recognized.

--Subcomponents used for repair would be managed at the central facility and because demand data and safety levels would be consolidated, the inventory levels would decrease. For example, we tested a sample of 78 high value, high demand F-15, B-52, KC-135 and F-106 avionics subcomponents and found that requirements under potential centralizations decreased from 17 to 51 percent.

--Increased proficiency through better production techniques and specialization can improve the quality of output causing reduced spare component demand and therefore reduced component inventories. In the Pacific test of centralization, for example, the Air Force found that the time between F-4 component failures increased 10 percent.

--Increased proficiency can also reduce the actual time it takes to repair a component. For example, among a number of bases the time for repair is likely to vary depending on the proficiency of the assigned staffing skills. Under a centralized operation, the better production techniques and specialization can minimize the time for all of the involved bases.

--Increased availability of critical skills and specialized equipment can increase the proportion of the workload reparable below the depot level. This reduces the overall time that the spare parts inventories must cover because it usually takes longer to receive repair support from the depot. This was a benefit identified in the Pacific test although its extent was uncertain.

--Increased availability of repair equipment can reduce repair time. For example, with the F-16, one avionics test set is operable and available for a randomly failed component 70 percent of the time; with two sets, at least one would be available 91 percent of the time; and with three sets, one would be available 97 percent of the time. Thus with the additional sets, there is likely to be less wait and therefore time to test and repair a component.

--The increase in spare components only applies to units not collocated with the central facility. The benefits apply to all the involved units.

--In wartime, aircraft attrition may decrease the level of spare components required, thereby reducing the amount of additional spares.

We tested 92 components assuming the round trip shipping time between the unit and a potential central facility as 2 days and 6 days. We further assumed that the central facilities would be able to equal the best repair record achieved among the bases we visited.

With the 2 days shipping time, we found that some F-15, B-52, and F-106 component inventory requirements decreased. With 6 days, however, they all increased. (See app. II for the results of our tests.) We did note that with older aircraft (B-52, KC-135, and F-106), there were significant increases in component requirements. This is due to problems isolating failed components without shop equipment being available. (See p. 52.)

We believe that any consideration of potential centralized component repair should evaluate the impact of at least the factors above. They can greatly offset the need for additional components to cover the time the workload is intransit to and from the central facility.

War reserves

Air Force flying organizations generally deploy with spare parts to meet their wartime needs for the 15- to 30-day interval before the logistics system can provide the needed support. These parts are referred to as either base level self-sufficiency spares (BLSS) or war readiness spares kits (WRKS).

A BLSS generally consists of components and sub-components sufficient to cover the increased level of wartime operations. It is generally provided to a unit that has repair capability and will have the same wartime and peacetime operating location. For example, the Bitburg and Camp New Amsterdam F-15 bases will have a BLSS for 72 and 18 aircraft respectively. The Bitburg BLSS costs approximately $40.8 million, and the Camp New Amsterdam BLSS costs an estimated $10.2 million.

A WRSK is primarily composed of components to support an organization while it temporarily lacks repair capability after it deploys to a new location in wartime. An F-15 war readiness spares kit, costing an estimated $47.4 million, is more expensive than a BLSS.

The impact on WRSK and BLSS must be considered when evaluating a centralized repair facility alternative. When looking at the potential Air Force repair in Europe during wartime, we noted that the impact of various support alternatives can be increases and decreases in requirements depending on the alternative being examined. Thus any decision must consider all the potential impacts on WRSK and BLSS. Further, the factors on pages 22 and 23 must also be examined as they relate to WRSK and BLSS.

We believe that increases in WRSK and BLSS may be materially offset by the factors discussed with spare parts requirements and that all such factors should be evaluated when considering any component repair structure.

Staffing

Despite the apparent staffing economies of scale from centralization illustrated in chapter 2 (see pp. 4 to 5), some of the nontactical aircraft organizations are likely to require additional personnel. This is particularly the case with B-52 and KC-135 support. The SAC study of the Barksdale/Seymour-Johnson test, for example, reported a potential increase of 70 to 182 positions. In contrast, savings in positions supporting tactical aircraft appear to occur, as confirmed by the Air Force F-4 test in the Pacific. The reasons for this inconsistency are differences in

--the capability to quickly identify failed major components,

--the basis for staffing, and

--the organizational structure.

More up-to-date operating and test systems on tactical aircraft generally permit failed components to be quickly identified on the aircraft and replaced. The part can then be shipped to a shop for repair. With older aircraft such as the B-52, this is not the case. Often several components must be tested in the shops before the failed one can be identified. Thus by centralizing, the command would have to

--ship several components to the repair facility which increases spare parts requirements or

--provide redundant test equipment and personnel at the operating organization and the repair facility thereby increasing personnel.

Another difference is the basis for staffing. Tactical support organizations are generally staffed based on potential wartime workloads and on the possibility of having to provide support at more than one location. As a result there are built-in staffing redundancies which can bring about economies of scale if the wartime support mode is centralized. Staffing in support of B-52/KC-135 organizations is primarily based on peacetime activity without providing for multiple location deployments. Thus, in relation to tactical organizations, these are staffed much lower, leaving less room for economies of scale.

To centralize component repair, there has to be a distinct separation of work on the aircraft and work in the shops. Tactical aircraft support organizations have or are implementing this organizational separation. SAC officials point out that the peacetime based B-52/KC-135 support staffing is insufficient to segregate on-aircraft and shop work. Mechanics, they contend, must be able to work in both modes to effectively support the aircraft with the number of people authorized. Thus under centralization, two people--one at the flight-line and one at the shop--would be needed to cover the area previously handled by one for many positions and skills. This is increased further if supervision is included.

In summary, increases in staffing may be required when centralizing support of older nontactical aircraft such as the B-52 and KC-135. Therefore, this is an important factor to consider when evaluating centralization alternatives.

Other missions

As previously mentioned, many of the economies from centralizing overseas component support would actually be realized by units in the United States during peacetime. They would no longer be required to have resources which would only be needed if deployed into a self-sufficient environment. Although the Air Force is centralizing tactical aircraft support in the Pacific and there is potential for wartime centralizing in Europe, we are faced with the question: Will other areas of possible wartime deployment preclude resource savings in the peacetime United States?

Tactical Air Command officials said their mission is to be ready to deploy anywhere in the world. This readiness includes the ability to provide intermediate maintenance support as needed. Does this stance justify every command wing having redundant and underused support resources, especially when they may not be needed in the current major (Pacific and European) planning scenarios? If this justification is sufficient irrespective of these major scenarios, then there are many questions that must be answered including:

--How many aircraft would be deployed elsewhere in light of U.S. commitments in the Pacific and Europe?

--Would deployment of shops be practical in light of the time frame of the contingency, available facilities, and operating environment?

--Could support be provided from an area central facility or existing U.S. or overseas facilities?

We believe the need for redundant component repair resources for potential deployment outside the major scenario areas should be specifically justified, including answers to questions such as those above. We recognize that there could be a need for tactical aircraft to deploy to meet brushfire contingencies. We would questions, however, provisioning all wings with shop deployment resources for this purpose.

ALTERNATIVE INTERMEDIATE COMPONENT REPAIR STRUCTURES

There are alternatives to the currently envisioned decentralized intermediate component repair structure for the F-15 and F-16 aircraft which can provide economies of scale and enhance overall support effectiveness. These alternatives are oriented to European wartime operations even though the ultimate savings are likely to be achieved during peacetime among units scheduled for wartime deployment to Europe. Chapter 4 demonstrates potential savings among F-15 organizations in the Southwest United States.

The alternatives for the F-15 and F-16 in Europe include

--single centralized intermediate repair facilities for each type of aircraft;

--using the U.S. bases in Europe as repair centers for aircraft assigned throughout Europe; and

--using U.S. bases and a site off of the mainland, such as in England.

With older nontactical aircraft, strategies different from centralizing just component repair shops may be necessary to achieve available economies of scale. For example, collocating common aircraft in the peacetime United States can provide virtually all the benefits from centralizing without the major economic and efficiency disadvantages. This applies to the tactical aircraft as well.

One central facility

A single repair facility, such as is used in the Pacific for F-4 aircraft and is planned for Europe with the A-10, would likely maximize economies of scale for F-15 and F-16 support. Another advantage would be the potential for reducing workloads returning to the depots in the Unites States because scarce resources are more likely to be available and the larger workloads and specialization may justify more sophisticated skills and equipment previously considered depot level. This can be an important benefit in wartime because of the need to quickly return equipment and spares to a ready status.

Vulnerability of a single facility is a critical consideration because if it were destroyed, the effectiveness of the entire weapon system could be significantly hampered. The location could affect the extent of the facility vulnerability. If situated on the European mainland, for example, it would be nearer to the conflict area and therefore be more subject to attack. Even if it is structurally well protected, there would be a possibility that the hostile force could destroy or capture the facility especially if located at an air base, which is likely to be a desirable target.

Should the F-15 and F-16 be component supported from England like the A-10, the threat level may be more acceptable than decentralized support as with the structure in the Pacific. Further, from England there may be an opportunity to coordinate transportation requirements with those of the A-10.

Repair centers at U.S. bases

Repair centers at U.S. bases can achieve economies of scale while providing redundant capability to reduce total component support vulnerability. With the F-15, for example, Bitburg Air Base, West Germany, and Camp New Amsterdam, the Netherlands, could be repair centers for aircraft there plus wartime augmentations.

During peacetime, component support could be centralized at Bitburg which has the capacity to support both locations. This would reduce the peacetime requirement for equipment in Europe by at least one avionics intermediate shop which costs about $8 million.

With wartime deployment from the United States, the additional equipment for component support of the augmentation force could be shipped to the two facilities so that together they could provide necessary theater-wide support. The Air Force currently plans to semiharden facilities at both of these locations.

Repair centers with backup in England

With England being geographically separated from the European mainland, bases located there face less of an immediate threat than those on the mainland. Therefore, to centralize while providing an acceptable resistance to threat, the Air Force could establish one or two repair centers on the mainland with a backup in England.

As with the previous alternative, the peacetime component repair could be handled from one location, such as the Bitburg Air Base. With the onset of hostilities, additional capability could be deployed to Bitburg or another mainland base such as Camp New Amsterdam, with some to an England facility. In any case, a facility in England capable of absorbing requirements and resources from mainland activities may be desirable. It provides a ready component repair fallback position if the mainland resources are threatened or lost.

Centralizing in the United States

Once component repair resources and requirements have been centralized for overseas wartime operations, the concept can be applied to activities in the peacetime United States. Then deploying units would be moving from a centralized component support environment to another centralized one. The need for mobility resources would be reduced to the amount needed to supplement the centralized overseas operations rather than for each unit to set up its own capability.

Centralizing in the United States can take two forms: (1) a facility at one base supporting common aircraft at a number of bases, or (2) collocation of common aircraft types at the same base.

A central component repair facility supporting common aircraft at a number of locations would provide economies of scale, however, if the equipment and facilities have already been acquired, economies may be offset or overcome by costs for increased major component spares and transportation. For new aircraft, such as the F-16, though, this method can produce significant savings because it can preclude acquisition of major capital resources. For example, one avionics intermediate shop costs an estimated $10 million.

For older and newer, tactical and nontactical aircraft, collocating the common aircraft can produce all the logistical economies of scale without the additional costs. For example, as is illustrated on page 7, the difference in F-15 avionics equipment alone between two collocated and two dispersed wings is $8 million. Further, there would be no requirement for additional transportation and not only would major spares inventories not increase, they would likely decrease because of the requirements consolidation.

This type of centralization does exist within the Department of Defense with the Navy. On the Pacific and Atlantic coasts of the United States there is one air station to perform intermediate maintenance for each type of aircraft. When aircraft carriers return from sea duty, the aircraft disperse by type to the appropriate station where they receive support until commencement of the next carrier assignment.

Before collocating common aircraft the following questions need to be answered:

--What is the optimum size--most efficient, economical, and effective--for the intermediate maintenance support function?

--How many aircraft can be supported from the optimum sized intermediate support activity?

--What are the limitations on the number of common aircraft that can be assigned to the same location?

CONCLUSIONS

The Air Force continues to decentralize much of its intermediate component repair because it believes that

--certain tactical aircraft units (i.e., F-15 and F-16) must have intermediate support at their wartime operating locations to effectively meet their missions and

--actual savings will be exceeded by the additional cost inherent with centralizing for aircraft which have completed the acquisition phase.

Tactical aircraft intermediate support has been or will be centralized in the Pacific (F-4 and F-15) and it is planned in Europe with the A-10. We believe that there are alternative centralized structures for the F-15 and F-16 in Europe which can provide effective wartime support and achieve the economic benefits among units in Europe and the United States. These alternatives involve centralizing component repair at one location in peacetime Europe and at one or two locations with possibly a backup in England during wartime. Centralization in Europe can minimize the resources required there which in turn reduces the resources needed in the United States for deployment.

Our examination of F-15 avionics shop equipment, by far the most expensive in intermediate maintenance, revealed that the amount of equipment in Europe could be reduced by as much as 38 percent, or $24 million. Such a reduction would also minimize the staffing and facilities required.

The Air Force is uncertain as to where and by whom some of the F-16 intermediate support will be provided. Unless the Air Force establishes a policy against self-sufficiency of each unit, there is the possibility that requirements, again in terms of avionics equipment, will be oversupported by as much as $20 million in Europe.

We recognize that with aircraft which have completed the acquisition phase, potential savings are likely to be significantly less from centralization. This is because capital resources have already been acquired. In light of potential operating and maintenance savings both among the operating units and at the depots, we believe centralization is still worth serious consideration.

In some cases, the additional costs from using a central facility--increased staffing, transportation, and spare parts--can exceed the economies of scale. This does not mean that the economies cannot be achieved, rather, that different strategies may be warranted. For example, one strategy is collocating common types of aircraft in quantities which will lead to more economical logistical support. Another would be to require that centralization be considered as an alternative to any major support resource acquisitions.

The potential for relocating established aircraft to achieve logistical economies was beyond the scope of this review and therefore will have to be evaluated separately. As the Air Force assigns new aircraft or transfers aircraft to new stations in the future, however, logistical economies would be available if common types of aircraft are collocated in greater quantities.

Further, when new component repair resources are needed to support new aircraft systems or to update or replace resources for older systems, serious consideration should be given to centralizing. Centralizing can reduce the amount of resources needed or eliminate the need altogether to replace existing resources.

For example, loss of a capability at one of four neighboring bases having common aircraft may enable that base to rely on its neighbors for support rather than replace the lost capability with new resources.

AGENCY COMMENTS

Air Force officials commented as follows:

--There is deep concern over the vulnerability issue of centralizing component repair in Europe. Vulnerability of a centralized repair facility that could be severely damaged or destroyed in a single attack, as well as the vulnerability of supporting transportation and communications networks is a serious concern to the Air Force.

--Headquarters, U.S. Air Force, Europe, believes the United Kingdom (England) is not a safe haven for basing a central repair facility. Although major repair will be centralized there for the A-10 aircraft, the A-10 has a different mission and less complex workload than the F-15 and F-16. Thus, centralizing F-15 and F-16 repair in England may not be appropriate.

--There is the growing belief in the Air Force that one AIS cannot support 48 aircraft due to AIS reliability problems. This problem is being studied. To accommodate this problem, the Air Force may have to (1) modify AIS, (2) increase AIS spares, or (3) centralize AIS support.

CHAPTER 4

CENTRALIZATION OF F-15 SUPPORT IN THE SOUTHWEST UNITED STATES

The Air Force provides F-15 aircraft component repair support at three Air Force bases in the Southwestern United States. In total, this support requires an estimated $68 million in equipment and facilities plus about $13.5 million annually in operating and maintenance costs. A consolidation of component repair among the three bases has potential for reducing capital resources by as much as $16 million and annual operating costs by approximately $1.9 million.

F-15 AIRCRAFT IN THE SOUTHWEST

The Air Force has assigned F-15 aircraft to three bases in the southwest: Nellis AFB, Nevada; Luke AFB, Arizona; and Holloman AFB, New Mexico. Geographically, the farthest apart are Nellis and Holloman, a distance of about 900 miles, and the shortest distance is from Luke to Nellis, approximately 285 miles. (See map on p. 34.)

At Luke and Nellis the F-15s are assigned along with other types of aircraft to training wings which have no mobility requirement. In contrast, Holloman has a tactical fighter wing of just F-15s which is subject to deployment.

The three wings are part of the Tactical Air Command, which for base level maintenance uses the Production Oriented Maintenance Organization. Under the organization an Aircraft generation squadron identifies and replaces failed components on the aircraft. They take the failed components to the component repair squadron which repairs the items by replacing subcomponents and then returns them to the base supply system.

LOCATION OF U.S. AIR FORCE F-15

BASES IN SOUTHWEST UNITED STATES

A typical component repair squadron has a headquarters and maintenance branches for simulators, accessories, avionics, and propulsion units, and a precision measurement equipment laboratory. At Luke and Nellis, the squadron supports the other training aircraft as well as the F-15s; while at Holloman, the squadron supports only F-15s. The following table summarizes the costs and distribution of component repair resources for the F-15 among the three Air Force bases.

	Holloman	Luke	Nellis	Total
Number of F-15s	66	72	14	152
Component Repair Squadron:				
Authorized personnel	309	a/284	a/130	723
Fiscal year 1978 operating and maintenance cost (millions)	$6.1	a/$5.5	a/$1.9	$13.5
Equipment (millions)	$23.4	$22.0	$9.8	$55.2
Facilities (millions)	$5.8	$4.9	b/$2.3	$13.0

a/Estimated based on Holloman and equipment data.

b/Estimated based on Holloman and Luke square footage and equipment data.

We evaluated the potential for centralizing component repair among the three bases. Avionics and engine repair were emphasized because they accounted for most of the cost. For example, avionics and engine repair equipment costs were $40.1 million and $8 million, respectively which combined accounts for 87 percent of the $55.2 million total cost for equipment.

Our evaluation required us to estimate operating and maintenance costs and staffing for Luke and Nellis, and facilities for Nellis for the F-15 because these were mixed with quantities applicable to other aircraft. These estimates were based on F-15 equipment value which could be identified and Holloman F-15 data which did not include other aircraft.

POTENTIAL SAVINGS FROM CENTRALIZED COMPONENT REPAIR

There are economies of scale available from centralizing the F-15 component repair requirements and resources of Holloman, Luke, and Nellis Air Force Bases. The savings are in operating and maintenance costs, equipment, facilities, and staffing.

Operation and maintenance costs

The savings in operating and maintenance costs is an estimated $1.9 million annually, as shown below. This is based on comparison of the cost per aircraft and assumes that a central facility would be able to achieve the minimum cost per aircraft already being experienced among the three bases. We believe this assumption is reasonable and is likely to be conservative in light of the equipment, staffing, and facility economies of scale identified on pages 4 to 10. Economies in operating and maintenance costs result from reductions in

--equipment because less equipment needs to be maintained and there are less work stations to staff;

--staffing which, in the form of labor costs, accounts for most of the component repair squadron operating and maintenance costs; and

--facilities because there is less need for utility overhead and general structural maintenance.

Estimate of Operating and Maintenance Cost Economies of Scale

Installations	Number of F-15s	FY 1978 operating cost	Operating and maintenance cost per aircraft (note a)	Lowest cost achieved (note b)	Difference (note c)	Potential savings (note d)
		(000 omitted)				
Holloman AFB	66	$ 6,100	$ 92	$ 76	$16	$1,056
Luke AFB	72	5,500	76	76	-	-
Nellis AFB	14	1,900	136	76	60	840
Total	152	$13,500				$1,896

a/FY 1978 operating costs divided by the number of F-15s.

b/Lowest cost among the FY 1978 costs per aircraft.

c/Cost per aircraft minus the lowest cost achieved (Luke AFB).

d/Difference multiplied by the number of aircraft.

Equipment

The potential economy of scale with equipment can exceed $16 million. This amount is based only on analysis of the need for avionics test sets which cost about $8 million each. Such a reduction in avionics equipment is likely to produce equipment savings in other areas, such as in the precision measurement equipment laboratory which calibrates and maintains test equipment.

As discussed on page 6, one complete avionics test set can support 48 aircraft in wartime. Currently the three subject bases have five sets to support their 152 aircraft. The combined computed requirement for avionics sets, however, would be three plus additional capacity for eight aircraft (152 aircraft divided by 48 aircraft capacity per set is a requirement for 3-1/6 sets).

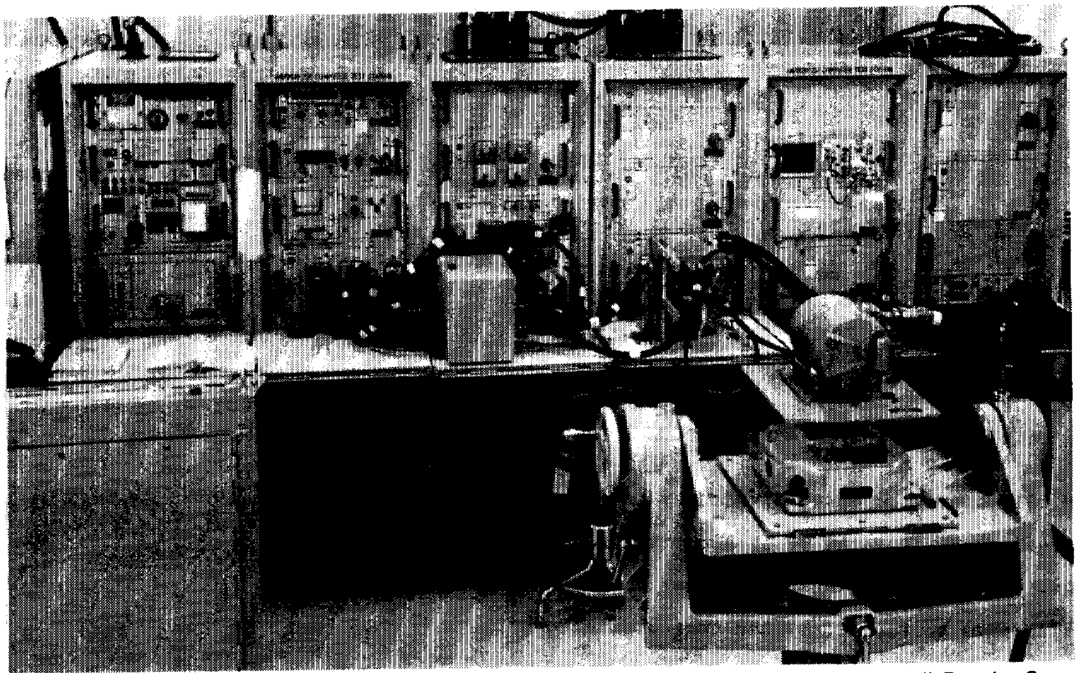


Photo Courtesy of McDonnell Douglas Corp.

AVIONICS COMPUTER TEST STATION, F-15 AIRCRAFT

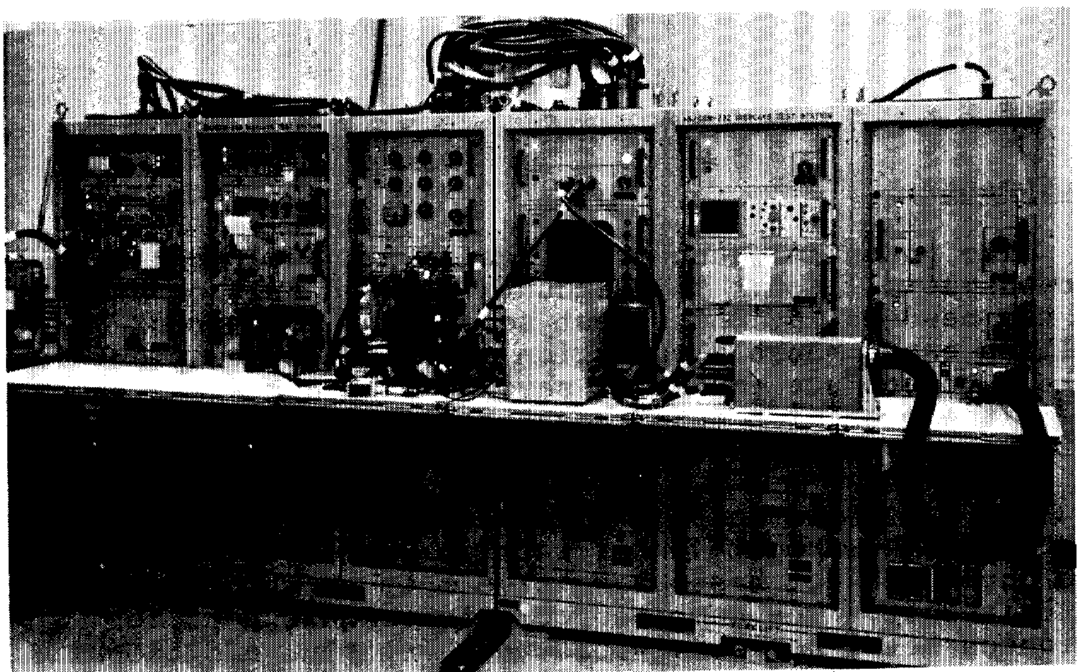


Photo Courtesy of McDonnell Douglas Corp.

AVIONICS DISPLAYS TEST STATION, F-15

We believe the additional eight aircraft can be supported within the capacity of three sets because during peacetime the Holloman aircraft would be flying much less than in wartime, and therefore would not be generating the quantity of repairs expected to fully use the avionics test capacity. Thus, we believe that savings of two sets is likely and at $8 million each, amounts to $16 million.

Facilities

We calculated the propulsion shop and avionics shop facility square footage requirements for the three bases using F-15 standards. Comparing the total for the three bases to the requirements for a consolidated facility revealed economies of scale of about 17,000 square feet and $876,000 as shown below.

Economies of Scale - Facilities

	Propulsion shop (note a)	Avionics shop (note a)	Total
	(square feet)		
Three separate facilities:			
Holloman AFB	22,800	8,860	
Luke AFB	24,580	8,860	
Nellis AFB	8,560	5,070	
Total	55,940	22,790	78,730
Consolidated	-44,500	-17,048	
Savings	11,440	5,742	17,182
Average value per square foot (note b)			$ 51
Savings in dollars			$876,282
Percent savings in square feet			22

a/Square footage was calculated using Air Force facility standards as discussed on page 8.

b/An average based on the Holloman AFB F-15 wing.

Staffing

To determine whether there would be economies of scale in terms of staffing, we examined the staffing authorized the two major work centers in the Avionics Branch--the largest branch in terms of staffing--for the three bases. These work centers are the automatic and manual avionics test units. Assuming a central facility could obtain the lowest equivalent staffing per aircraft ratio already achieved among the three bases, a staffing savings of 15 percent is apparent as shown on page 41.

This 15 percent staffing reduction tends to support the existence of savings in operating and maintenance costs (see p. 36) as staffing accounts for most of those costs. Further, this economy appears to be consistent with the potential reduction in shop personnel identified on page 4 based on Air Force standards.

KEY FACTORS INFLUENCING A DECISION TO CENTRALIZE

Although there are apparently economies of scale among repair activities at the three bases visited, there are certain key factors which must be scrutinized before centralizing. These include

--The effect on the Holloman wings mobility mission.

--The effect on the level of spare components required.

--The cost and availability of transportation among the bases.

--The cost of a centralized facility.

We believe that each of these factors can be sufficiently dealt with to enable the benefits of centralizing to be gained.

The mobility mission

The Holloman AFB F-15 wing has two squadrons of 24 aircraft each and one squadron with 18 aircraft for a total of 66 aircraft. The wing has two complements of component repair shop equipment to provide support under a potential two-way fragmentation of the wing. For example, two squadrons could deploy in one direction and the third squadron could deploy in another. Another possibility is that one or two squadrons may not deploy at all.

Estimate of Staffing Economies of Scale
Avionics Branch

Installation	Authorized positions: Number of F-15s	Automatic test unit	Manual test unit	Avionics branch (note a)	Equivalent staffing per aircraft (note b)	Lowest equivalent staffing (note c)	Difference (note d)	Potential position savings (note e)	Savings percent (note f)
Holloman AFB	66	47	33	80	1.2	1.2	-	-	
Luke AFB	72	51	51	102	1.4	1.2	.2	14.4	
Nellis AFB	14	20	15	35	2.5	1.2	1.3	18.2	
Total	152	118	99	217				32.6	15

a/Total of automatic and manual test units.

b/Avionics branch positions divided by the number of F-15s.

c/Lowest of the equivalent staffing per aircraft (Holloman).

d/Equivalent staffing per aircraft minus the lowest equivalent staffing.

e/Difference multiplied by the number of F-15s.

f/Total potential position savings divided by the total avionics branch positions.

If the shop equipment for all three bases were to be reduced to three complements, there could be only one available for deployment with the Holloman wing since two would be required to support the 86 aircraft at Luke and Nellis. Thus, the question: How could one set of shop equipment, capable of supporting 48 aircraft, adequately provide for mobility of 66 aircraft? The one set of support equipment would have to remain with the two squadron portion of the wing. The third squadron of 18 to 24 aircraft, if deployed to the Pacific or Europe, would be supported from a potential or existing central repair facility. Similar squadrons deploying from other bases in the United States would have support equipment to sufficiently augment the applicable central facility. For example, the Langley AFB F-15 wing has mobility equipment sets for one and two squadrons of 24 and 48 aircraft, respectively. Thus one set for 24 aircraft could support another 24 aircraft. Further, in view of the potential savings of equipment in Europe from centralizing (see pp. 14 to 16), there would be adequate resources available in the Air Force to support the Holloman squadron wherever it would deploy. Basically, the equipment does not have to be collocated with the unit, however, the needed resource coverage should be available somewhere in the maintenance structure.

Spare components

As discussed on pages 22 to 23 centralization can initially cause increased requirements for spare components. Some of this can be offset by benefits from centralizing. To illustrate, at the three bases we sampled 21 component and 22 subcomponent F-15 avionics high value, high demand items. We noted the following:

--Subcomponent requirements under centralization would decrease by about 39 items valued at $776,000.

--The average repair time among the bases ranged from 4.4 to 5.9 days. Assuming a central facility with improved proficiency can improve the overall time, some of the added component requirements can be offset.

--The percentage reparable at the bases, rather than depot, ranged from 67 to 90 percent. Again, assuming that a central facility can improve the overall rate, the time needed to return an item to service would be reduced, thereby offsetting some of the increased component spare parts requirements.

Other potential offsets would also be available, as covered on pages 22 to 23.

We calculated the effect of centralizing on component spares requirements assuming that the central facility could equal the lowest average repair time and highest percent reparable achieved among the three bases. Other potential offsets were not included. With an increase of 2 days in repair time to cover packaging and transportation, the component spares requirements actually decreased by 21 items valued at $1.8 million. With an increase of 6 days, however, the components increased by 20 items valued at $2 million.

Thus, the benefits from centralizing, as well as the increases in repair time due to transportation, can have significant effects on the amount of component spares needed. Timely movement of reparables from the aircraft to the repair shops is essential to the success of a centralized facility.

Transportation

In 1978 the LOGAIR contract air transportation service provided up to 3-day service among the bases visited and two Air Force depots. Air Force Logistics Command officials advised us that in early 1979, daily service is to be established involving the bases we visited. Further, the planned route is expected to operate at about 65-percent capacity. Since the cost of LOGAIR transportation is based on distance and the number of takeoffs and landings, most of the components, if not all, could possibly be shipped using the space available at virtually no additional cost.

The central facility

The existing facilities supporting F-15 component repair at the three bases account for about 230,000 square feet. This would be reduced to 179,000 for a central facility due to an estimated economy of scale of 22 percent. (See p. 39.) At a construction cost of $60 per square foot (provided by base civil engineering personnel) a new central facility would cost about $11 million.

We believe that there are alternatives other than constructing a new facility because some of the facilities currently being used would be available. For example, at Holloman, the component repair squadron has 113,500 square feet that is currently being used. If used for the central facility, the added square footage requirement would cost $4 million.

We further noted that a central facility at Holloman would preclude about $500,000 of facility construction at Nellis AFB. In addition, as much as 115,000 square feet of facilities would become available for other purposes at Luke and Nellis.

CONCLUSIONS

There is an opportunity to reduce the cost of F-15 component repair and maintenance in the southwestern part of the United States by centralizing the repair shops, especially avionics, among Holloman, Luke, and Nellis Air Force Bases. To implement a central facility, the Air Force will have to deal with such matters as providing facilities and timely transportation, assuring that the Holloman wing can meet its mobility mission, and adjusting the spare parts inventories. We believe that there are alternatives which can enable the Air Force to effectively deal with each of these matters while obtaining the economic and effectiveness benefits available from a central repair facility.

CHAPTER 5

OLDER AIRCRAFT MAY REQUIRE DIFFERENT STRATEGIES:

F-106, B-52, AND KC-135 CASE STUDIES

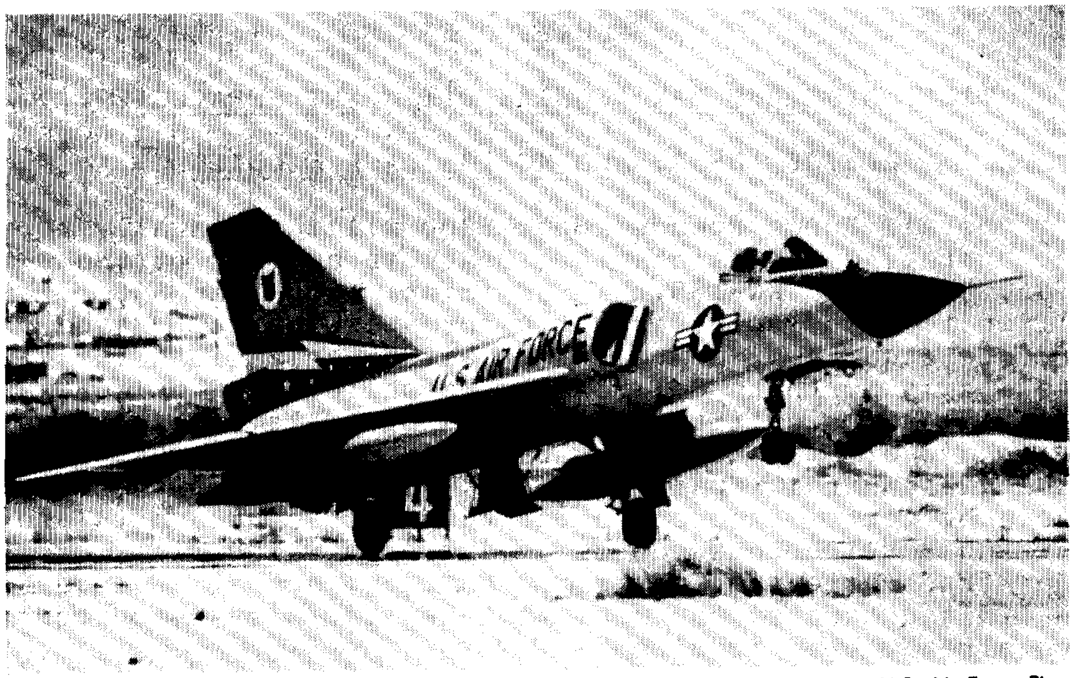
The Air Force spends about $300 million annually for base operating and maintenance costs in support of the F-106, B-52, and KC-135. In addition, more than $60 million is to be spent annually for spare parts. Based on our case studies of component repair organizations for these aircraft in Northern California, we believe there is potential for significant economies of scale. To achieve them, however, may require strategies other than establishing a central repair facility. This is because the effect of centralized component repair on spare parts and staffing requirements can be an increase which will more than offset potential savings. Further, actual savings are limited because the equipment and facility resources have already been acquired.

There are two strategies which can effectively achieve the economies:

--Increased collocation of common types of aircraft can provide the economies without the logistics drawbacks discussed in this report.

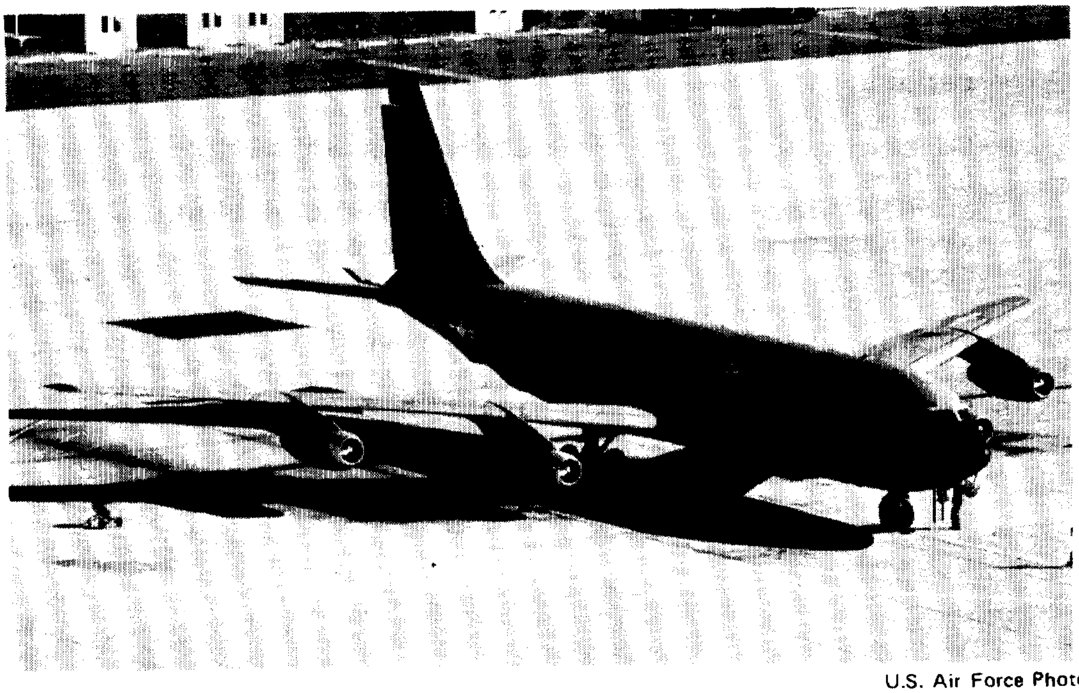
--Centralized component support as an alternative to future equipment and facility acquisition may preclude expenditures that are material enough to overcome any negative impacts.

Our case studies were conducted at five California installations located within an estimated 160 mile radius of Sacramento, California. These installations and their assigned aircraft are as follows:



U.S. Air Force Photo

F-106 AIRCRAFT



U.S. Air Force Photo

KC-135 AIRCRAFT

Number and Type of Aircraft

Installation	B-52G	B-52H	KC-135	F-106
Beale AFB	-	-	30	-
Castle AFB	15	8	38	19
Fresno Air National Guard Base	-	-	-	15
Mather AFB	20	-	14	-
Travis AFB	-	-	19	-
Total	35	8	101	34

The case studies concentrated on the avionics shops because they repair relatively high-cost components using relatively high-cost test equipment. These shops, therefore appeared to offer the most potential for savings from centralization. For example, the B-52 and KC-135 avionics maintenance squadron at Castle AFB had over $22 million in equipment. The specific work centers examined were as follows:

--Autopilot (B-52, KC-135, and F-106).

--Bomb navigation (B-52).

--Electronic counter measures (B-52).

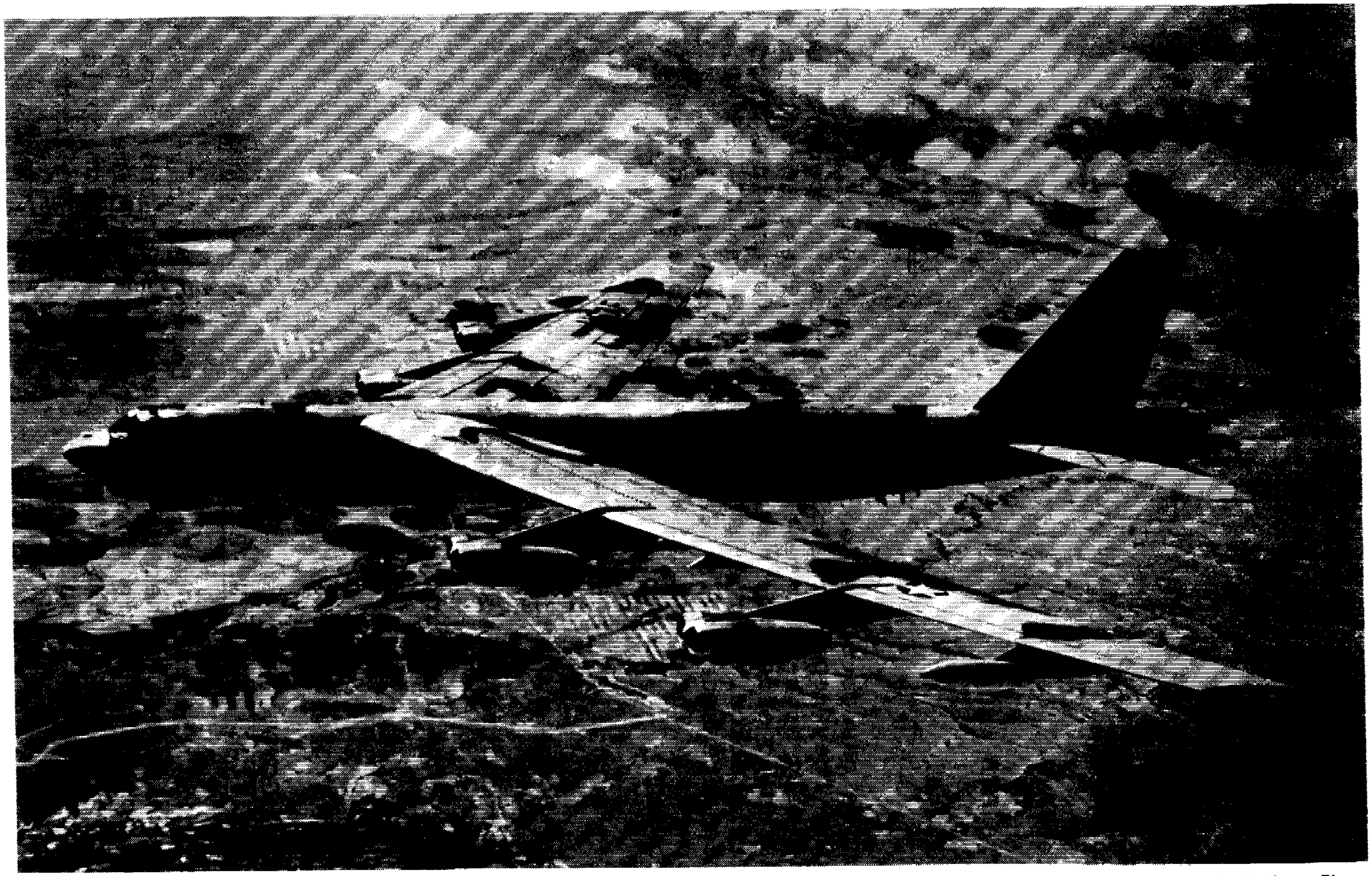
--Communication/navigation (F-106).

--Instruments (F-106).

--Fire control systems (F-106).

FACTORS CONDUCIVE TO CENTRALIZING COMPONENT REPAIR

Among the units visited, we found redundant capabilities at bases connected by major highways and, separated by at most 3 hours in ground transportation time. Thus, relatively less expensive ground transportation could probably provide daily shipment of components. We further noted that



U.S. Air Force Photo

B-52G AIRCRAFT

--some avionics test equipment was notably less than fully used,

--central management of subcomponent spares can reduce inventory levels, and

--the units' limited mobility mission would have little effect on centralized component repair.

Test equipment reductions

Our examination of avionics test equipment showed there is room for higher utilization and potential equipment reduction. A reduction in equipment can further lead to reductions in staffing and facilities, as discussed in chapter 4.

For the B-52 and KC-135, we calculated average unit costs and average annual test equipment utilization rates for selected equipment used in the autopilot, bomb navigation, and electronic countermeasure shops at one installation and found that the equipment could accommodate more workload, as indicated below.

Shop	Quantity of equipment	Average unit price	Hours available for use	Estimated hours used	Average annual utilization rate
			(annually)	(annually)	(percent)
Autopilot	12	$ 44,043	7,488	2,965	39.6
Bomb navigation	8	299,528	7,488	4,635	61.9
Electronic countermeasure	10	70,131	7,488	2,920	39.0

The ranges of the data from which these averages are derived are significant. The most expensive piece of test equipment used in the autopilot shop cost $137,164 and was used about 90 percent of the time. The bomb navigation shop, however, has two identical pieces of test equipment each costing $551,119 (one is not used at all and the other was used about 70 percent of the time).

We also examined the potential savings in equipment from a potential centralized repair posture among the two F-106 units. We analyzed the potential impact on up to 12 high-dollar items per shop. We asked the shop supervisors to estimate their requirements under a centralized concept. The following table summarizes the results of our examination.

POTENTIAL SAVINGS OF F-106
TEST EQUIPMENT

Shop	Value of equipment in the sample	Value of equipment required with centralization	Potential savings	Percent savings
	-----------(000 omitted)------------			
Fire control systems	$5,074	$2,882	$2,192	43
Communications/ navigation	653	398	255	39
Instruments	252	131	121	48
Total	$5,979	$3,411	$2,568	43

Reduced subcomponent spares

Subcomponent requirements are less when using a centralized component repair facility than when using a decentralized concept. We tested 56 high-value, high-demand subcomponents used among six B-52, KC-135, and F-106 shops and found that part's requirements decreased from 17 to 51 percent, depending on the shop.

Mobility mission unhampered

Centralizing component repair would have little effect on the mobility missions of the aircraft examined. This is because wartime deployment is planned to be

--within the United States,

--to a location using centralized support, or

--without accompaniment of the component repair capability.

As SAC pointed out in its Barksdale AFB/Seymour Johnson AFB centralization study: Both the wartime and peacetime missions of the units involved could be supported using the consolidated maintenance repair concept.

FACTORS INHIBITING CENTRALIZED COMPONENT REPAIR

Although there could be equipment and spare parts savings, there are a number of factors which severely inhibit such savings, as listed below.

Minimal dollar savings

The B-52, KC-135, and F-106 are older aircraft, and as such the equipment has already been purchased leaving little room for hard dollar savings. Further, much of the equipment (about 65 percent for the F-106) is unique and could not be used for other systems. We believe, however, that reductions in active equipment levels would (1) reduce operating and maintenance costs in terms of equipment maintenance and calibration and (2) provide an Air Force-wide pool of equipment and spare parts to be drawn from as needed.

Difficulty identifying failed components

These aircraft lack the sophisticated fault identification capability of the newer aircraft systems. Often several components must be removed from the aircraft and tested before the failed one can be identified. For central component repair, therefore, either some shop test equipment must stay with the unit or many more components must be shipped to the central facility. Retaining test equipment with the unit greatly reduces equipment savings. For example, the $2.6 million savings for the F-106 (see p. 50), is reduced to about $1 million.

On the other hand, by not keeping the test equipment at the units, requirements for spare components increase significantly. For example, with the KC-135 aircraft components tested, we found that the transfer of shop test equipment to another location caused demands to increase from 23 to 256 percent, depending on the particular component.

Spare parts increases

In addition to the potential increase in spare component requirements generated if test equipment is centralized, there would be increases due to the added time for shipping components to the central facility, (See p. 22.) There are a number of factors, listed on pages 22 to 23, which can offset much, if not all, of the increases. These offsets must be examined to effectively identify the real impact on component spares.

Possible increases in staffing

As discussed on pages 24 and 25, significant increases in manpower may be required when centralizing component repair support for older nontactical aircraft.

CONCLUSIONS

There are economies available in equipment, operating and maintenance costs, and spare parts among B-52, KC-135, and F-106 units in Northern California. For the most part, however, the actual savings in equipment are limited because, with these older aircraft systems, equipment is already paid for. Further the need to retain test equipment at all units for timely failed component identification would negate equipment savings and may increase them if more equipment would be needed at the central facility. The alternative to redundant equipment is apparently a substantial increase in spare components which in itself could economically prohibit a central component repair concept.

Any savings in operating and maintenance costs due to reducing the quantity of active equipment is likely to be significantly exceeded by increases in the cost of staffing which are needed to assure proper multiple shift flight-line and shop coverage.

The area with the largest probable impact concerns spare components and subcomponents. While component spares can increase due to the shipping time to the central repair facility, there are a number of reasons why total spares requirements can decrease with centralization. Two major reasons are that subcomponents would be centrally managed and more repair could be done below the depot level.

Although SAC decided centralization was not viable based on its Barksdale/Seymour-Johnson study, we believe bases, such as those in Northern California, provide better potential because they are much closer and, with the KC-135, there are more of them (four versus two).

Besides component repair centralization, there are other strategies which can provide economies without the logistical drawbacks discussed in this report. They are

--collocating common aircraft in quantities which promote more economical and efficient logistical support and

--centralizing as an alternative to major component repair resource acquisitions.

CHAPTER 6

RECOMMENDATIONS AND AGENCY COMMENTS

RECOMMENDATIONS

We recommend that the Secretary of the Air Force, to the extent consistent with mission requirements, achieve more effective use of field component repair resources by

--centralizing F-15 and F-16 component repair overseas and in the United States;

--centralizing common types of aircraft when assigning or transferring aircraft or flying organizations; and

--centralizing component repair as a means of minimizing requirements when updating, replacing, or acquiring new resources.

AGENCY COMMENTS

Air Force representatives commented as follows:

--The Air Force recognizes there are savings and other benefits available from centralizing component repair and it has centralized in some cases. Centralizing, however, is a very complex issue. Costs and other disadvantages as well as the potential benefits need to be more fully examined before implementing the recommendations in this report.

--The Air Force is seriously examining the potential for centralizing F-15 and F-16 component repair in Europe. It hopes to shed more light on the supply, transportation, vulnerability, and mission uncertainties and provide the basis for a decision.

--The Air Force believes the current component repair system works well and would prefer not to take a chance on degrading it or incurring an intermediate period of disruption unless the uncertainties involved in such a change are minimized.

CENTRALIZED COMPONENT REPAIR IN THE AIR FORCE

MILITARY AIRLIFT COMMAND

MAC uses centralized maintenance with its forward supply system and queen bee engine program. The MAC forward supply system was established to enhance enroute logistical support of strategic airlift aircraft. Previously such aircraft were frequently grounded at overseas locations several days awaiting spare parts. Basically, the system involves primary supply points in the United States which manage spares positioned at forward supply locations (enroute stations overseas). These stations remove and replace failed parts on the aircraft and then ship those that have failed to a central facility for repair. Repair facilities for the C-141 aircraft operating in the Pacific are at Norton Air Force Base, California, and Yokota Air Base, Japan, and in the Atlantic at McGuire Air Force Base, New Jersey, and Rhein Main Air Base, Germany. For the C-5A aircraft, spares repair is handled at Travis Air Force Base, California, for Pacific operations and at Dover Air Force Base, Delaware, for Atlantic. In total, the forward supply system involves 13 Pacific and 10 Atlantic locations.

In order to save repair and test equipment and spares, MAC developed a queen bee program for intermediate maintenance of its engines. Certain MAC-common engine types of other commands were later added to the MAC program. Basically under this program, certain installations' engine maintenance organizations are designated as "queen bees," and as such, are each to maintain engines for several installations. Engines due intermediate maintenance are removed from the aircraft and then are shipped to the responsible queen bee. To illustrate, the following are examples of current MAC queen bees:

Queen bee (Engine/aircraft)	Installations supported	Number of engines
Little Rock AFB, Arkansas (T-56/C-130)	Little Rock AFB, Arkansas	74
	Eglin AFB, Florida	17
	Keesler AFB, Mississippi	37
	Hurlbert Field, Florida	44
Total engines		172
Dyess AFB, Texas (T-56/C-130)	Dyess AFB, Texas	203
	Hill AFB, Utah	5
	McClellan AFB, California	17
	Kirtland AFB, New Mexico	17
Total engines		242
Scott AFB, Illinois (J-60/T-39)	Scott AFB, Illinois	29
	Wright-Patterson AFB, Ohio	20
	Peterson Field, Colorado	12
	Offutt AFB, Nebraska	27
	Barksdale AFB, Louisiana	9
	McConnell AFB, Kansas	5
Total engines		102

Note: The economies achieved are discussed on pages 8 and 10.

PACIFIC AIR FORCE COMMAND

Recently, the Air Force sanctioned the centralized component repair in the Pacific for F-4 and F-15 aircraft. The primary benefits the Air Force seeks are reduced vulnerability of the support activity to hostilities and improved productivity as a result of reduced staffing turnover.

The centralized repair facility was established at Kadena Air Base, Okinawa, Japan to support Kadena aircraft plus those at the Osan and Kunson Air Bases in Korea and Clark Air Base in the Phillipines. When many of the avionics components fail, they are replaced and then are airlifted to Kadena for repair and return to the applicable air base supply system. The facility is approximately 1,000 miles from Korea and therefore much of the intermediate capability is removed from potential mainland hostilities. Further, for military personnel the tour of duty at Okinawa is 3 years versus 1 year at Korea. Thus, there would be improved work force stability at the central facility.

THE A-10 AIRCRAFT IN EUROPE

In 1977 the Air Force undertook a centralized support concept involving the A-10 close air support aircraft in Europe. Although the aircraft are to operate from forward locations on the mainland, the intermediate maintenance support, including component repair, is to be accommodated at a base in the United Kingdom or by temporary teams dispatched from the United Kingdom base to the forward locations.

We are evaluating the extent the Air Force is taking advantage of economies available from this structure in another review. We are also examining the impact of this mode on operational effectiveness.

STRATEGIC AIR COMMAND TEST

In September 1977 the Air Force's SAC reported on its consolidated aircraft maintenance repair center concept test. The overall conclusion was that consolidated maintenance could support mission requirements, but with a significant increase in the cost of support. Therefore SAC dismissed the concept as an acceptable alternative.

Under the test, SAC consolidated intermediate maintenance of B-52/KC-135 bomb wings stationed at Barksdale Air Force Base, Louisiana, and Seymour-Johnson Air Force Base, North Carolina, which are about 800 miles apart. The Barksdale activity provided (1) phase inspections and corrosion control, (2) jet engine intermediate maintenance, and (3) component repair for both bases.

From the test, SAC concluded that

--there was a significant loss of flexibility in both aircrews and airframes;

--both the wartime and peacetime missions of the units involved could be supported using the consolidated maintenance repair concept;

--equipment reductions were possible, but not dollar savings because with these older systems the equipment had already been acquired;

--staff and transportation costs could increase by $1.2 to $2.6 million annually;

--longer pipelines and a maldistribution of assets would increase spare parts cost.

In our review, we examined the potential for centralizing avionics component repair among B-52/KC-135 activities which were more closely located in Northern California. This is presented as a case study with chapter 5.

U.S. AIR FORCE EUROPE STUDY

In 1978 the Air Force undertook a study to consider centralized component and engine repair among U.S. tactical aircraft (F-4, F-15, F-16, and F-111) stationed in Europe. The Air Force was unwilling to provide a draft of its report to us during our review. Therefore we were unable to evaluate the assumptions and conclusions contained in the study.

APPENDIX II

SUMMARY OF SPARE PARTS REQUIREMENTS ANALYSIS (note a)

Component repair shop	Assumed number of shops consoli- dated	Number of components items sampled	Number of subcomponents items sampled	Increase in component requirement quantities if round trip shipping time between repair facility and based is: 2 days Number	2 days Percent	6 days Number	6 days Percent	Decrease in subcomponent requirement quantities Number	Decrease in subcomponent requirement quantities Percent
B-52:									
Autopilot	2	10	9	-4	-8.8	2	4.4	4	17.3
Electronic counter- measures	2	9	10	0	0	16	39.0	8	20.0
Bomb/navigation	2	9	9	1	2.0	6	12.0	7	28.0
F-106:									
Communications/ navigation	2	11	10	2	6.9	7	24.0	6	25.0
Fire control mockup	2	10	8	5	16.0	15	48.0	7	36.8
Instruments	2	12	0	-3	-5.5	5	9.2	N/A	N/A
F-15 Avionics	3	21	22	-21	-13.0	20	12.3	39	32.2
KC-135 Autopilot:									
with shop test equip- ment at bases	4	10	10	-18	-26.0	3	4.0	24	51.0
without shop test equip- ment at bases	4	10	10	10	15.0	46	67.0	24	51.0

a/Assumes that a centralized repair facility will achieve the highest percent reparable and the shortest repair time for each item achieved by the shops reviewed.

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