



United States General Accounting Office

Report to the Chairman, Subcommittee  
on Military Readiness, Committee on  
National Security, House of  
Representatives

November 1995

# STRATEGIC AIRLIFT

## Improvements in C-5 Mission Capability Can Help Meet Airlift Requirements



19951128 059

B-265876

November 20, 1995



The Honorable Herbert H. Bateman  
Chairman, Subcommittee on Military Readiness  
Committee on National Security  
House of Representatives

Dear Mr. Chairman:

Under the new national military strategy, the Department of Defense (DOD) must be capable of rapidly deploying armed forces to respond to contingency and humanitarian operations around the world. Military strategic airlift aircraft provide the capability to fly the critical, early arriving troops and cargo for overseas deployments. Since DOD is increasingly relying on the C-5 aircraft as its primary airlifter, we assessed the reliability and mission capability of the aircraft and DOD's current plan for modifying the C-5.

This review was requested by the Honorable Earl Hutto, former Chairman, Subcommittee on Readiness, House Committee on Armed Services. We are addressing this report to you as the current Chairman of the House Subcommittee on Military Readiness.

**Background**

The Air Force's Air Mobility Command (AMC) has 104 C-5, 199 C-141, and 16 C-17 strategic airlift aircraft in its fleet. It also has 54 KC-10 and 448 KC-135 tanker aircraft, which can carry cargo. The C-5 aircraft, the largest airlifter, can carry 73 troops and 36 standard cargo pallets or outside cargo, such as tanks and helicopters. The Air Force received its C-5A models from 1969 to 1973 and its C-5B models from 1986 to 1989. The C-5B model incorporates over 100 reliability and maintainability changes from the previous model and has substantially higher mission capable rates.

The C-5 has been used more than planned since Operation Desert Storm in response to various contingencies as well as shortages of C-141 aircraft and delays in C-17 deliveries. AMC developed a plan to guide the modernization of the C-5 aircraft into the next century and help ensure that the C-5 remains a viable mobility asset. AMC officials believe this modernization effort is important to address concerns regarding the aging aircraft and improve the aircraft's reliability and maintainability.

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In addition to being a major command of the Air Force, AMC is a component of the U.S. Transportation Command, a unified command that provides air, land, and sea transportation for DOD. As a component, AMC is responsible for providing global airlift services and air refueling operations. AMC developed a mission capability rate goal for the C-5 fleet of 75 percent, which means that C-5s must be able to perform one of their major missions 75 percent of the time.<sup>1</sup> Mission capability is a standard used on all military aircraft that allows for easier comparisons among aircraft. Although Air Force planners count on increasing aircraft mission availability in wartime by adding more maintenance personnel and deferring some maintenance inspections, little can be done to increase the spare parts initially available for each plane. Peacetime mission capability rates, especially as they are affected by adequate spare parts availability, are therefore good predictors of likely wartime aircraft mission capability. AMC currently estimates that C-5 aircraft can attain a 14.6 million ton miles per day airlift capability, which would represent almost one-half of the Air Force's total military aircraft airlift capacity.

## Results in Brief

DOD is counting on the C-5 to deliver almost half of the cargo carried by military aircraft in wartime, but its mission capable rates have generally been below AMC's 75 percent goal over the last several years. In addition, C-5 mission capable rates are considerably below those of other military airlift aircraft, including the C-141, KC-10, and KC-135. In recent years, between one-quarter and one-half of the C-5 total not mission capable time was due to the lack of spare parts. Officials from the C-5 manufacturer believe that improving the C-5 spares processes, particularly by scheduling repairs of spare parts based on their impact on mission capability, could substantially improve the mission capable rate.

The C-5 mission capable rate could also be improved if the Air Force conducted a readiness evaluation similar to one recently completed for the B-1B aircraft. That evaluation found that the B-1B's mission capable rates could increase if spare parts support were to improve. Air Force officials attribute the substantially improved mission capable rates recently achieved by the B-1B fleet (an increase of 9 percentage points) primarily to improved spares availability.

<sup>1</sup>We use mission capability in this report as the primary indicator of the C-5's ability to deliver cargo. We recognize that mission capability rates are not a perfect measure of an aircraft's ability to perform its mission. For example, an aircraft may be classified as mission capable but may break down during preflight checks, thus rendering the aircraft not mission capable.

The Air Force has not prioritized proposed C-5 modifications according to which one would contribute most to improving mission capability. As a result, decisionmakers cannot fully assess the impact proposed improvements could have on overall aircraft mission capability or total airlift capability.

Improving the C-5 spares program and reprioritizing C-5 modernization initiatives would increase C-5 mission capable rates. If peacetime C-5 mission capable rates could be raised to the current AMC goal of 75 percent, DOD could gain an additional 1.3 million ton miles per day of C-5 wartime airlift capability—the equivalent of 10 C-17s. As a result, DOD could come closer to meeting military airlift requirements.

## Mission Capable Rates Are Below Standard

Mission capable rates for AMC C-5 aircraft averaged just under 68 percent from July 1994 to June 1995.<sup>2</sup> These rates have been declining since Operation Desert Storm, when AMC achieved mission capable rates of 75 percent or higher. In addition, the C-5 mission capable rates were considerably below comparable airlift and tanker aircraft during the same period, as shown in table 1.1. For example, AMC C-5 mission capable rates averaged over 5 percentage points below those of the troubled C-141 aircraft, which is gradually being retired. Factors accounting for the relatively poorer C-5 mission capable rates included inadequate spare parts support, higher complexity associated with a large aircraft, and the generally poorer reliability characteristics of the older C-5A model aircraft.

**Table 1.1: Mission Capable Rates for AMC Aircraft From July 1994 to June 1995**

Figures in percent

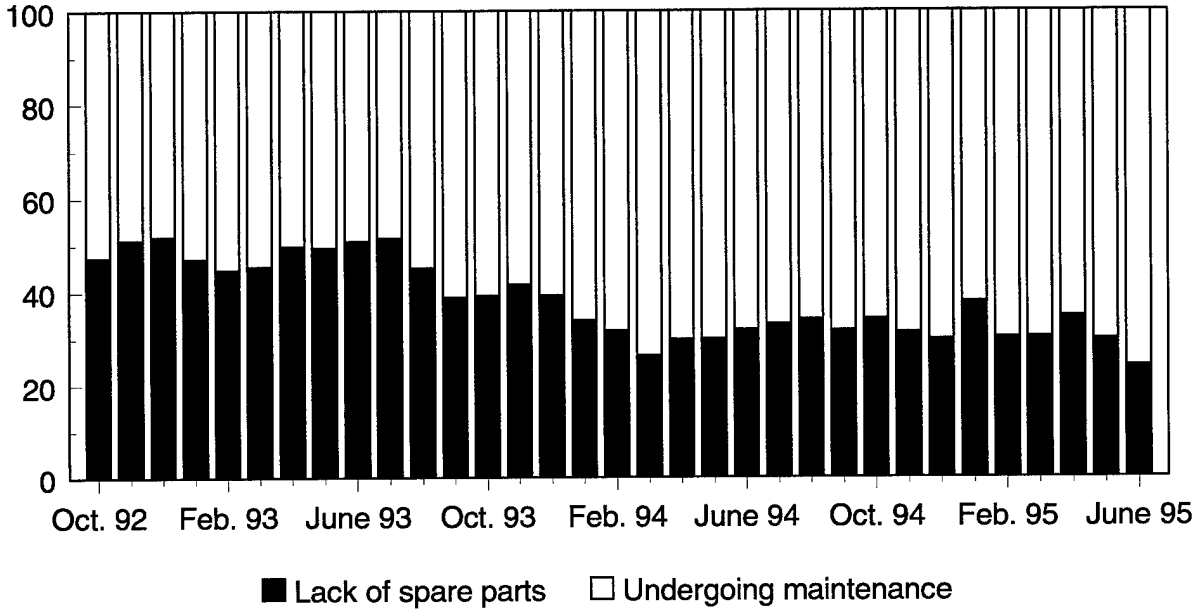
| Aircraft | Mission capable rate |
|----------|----------------------|
| C-5      | 67.9                 |
| C-141    | 73.2                 |
| KC-10    | 88.7                 |
| KC-135   | 85.5                 |

## Lack of Spares Affects Mission Capable Rate

C-5 aircraft are classified as not mission capable when they are either undergoing maintenance or lack spare parts. Between 25 and 50 percent of all not mission capable problems in recent years have been due to a lack of spare parts, as shown in figure 1.1.

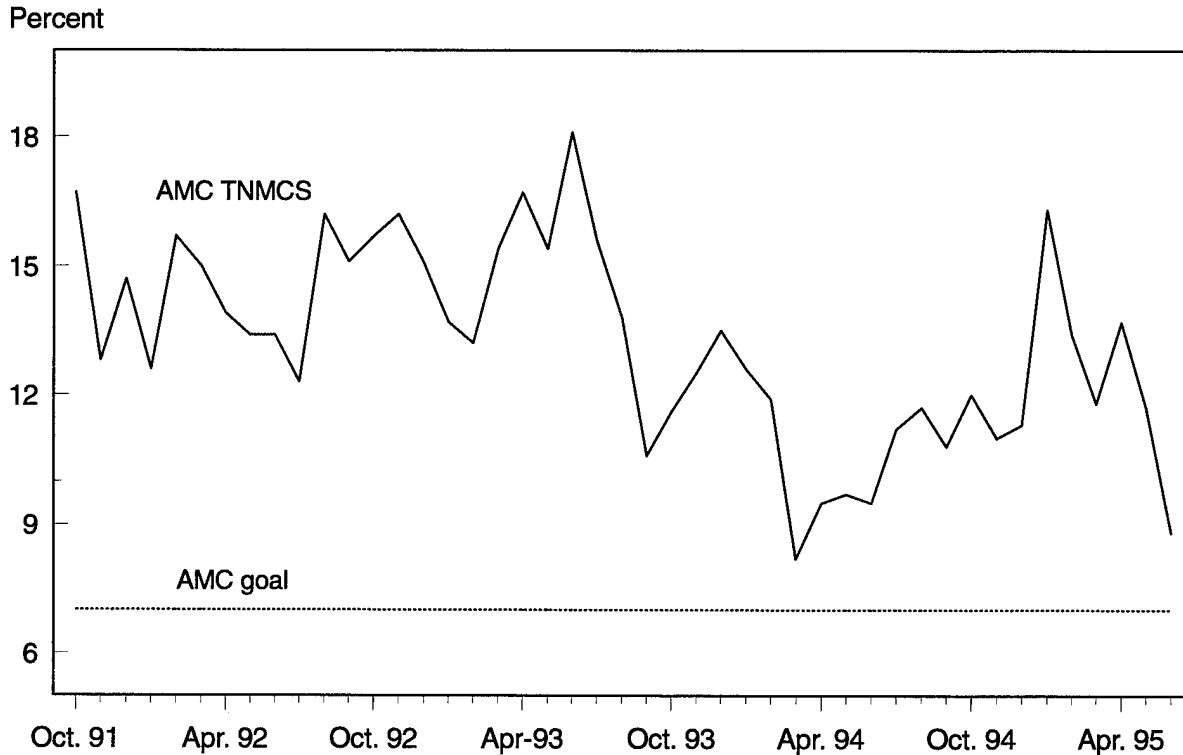
<sup>2</sup>During this same period, the mission capable rate for the entire Air Force C-5 fleet, including Reserve and National Guard aircraft, averaged about 65 percent.

**Figure 1.1: Percent of C-5 Not Mission Capable Rates Attributable to a Lack of Spare Parts From October 1992 to June 1995**  
Percent



AMC has established a goal that the total not mission capable supply (TNMCS) rate should not exceed 7 percent for its operational C-5 fleet. Although the TNMCS rate has shown some improvement in the last few years, it still remains considerably above AMC's goal, as shown in figure 1.2.

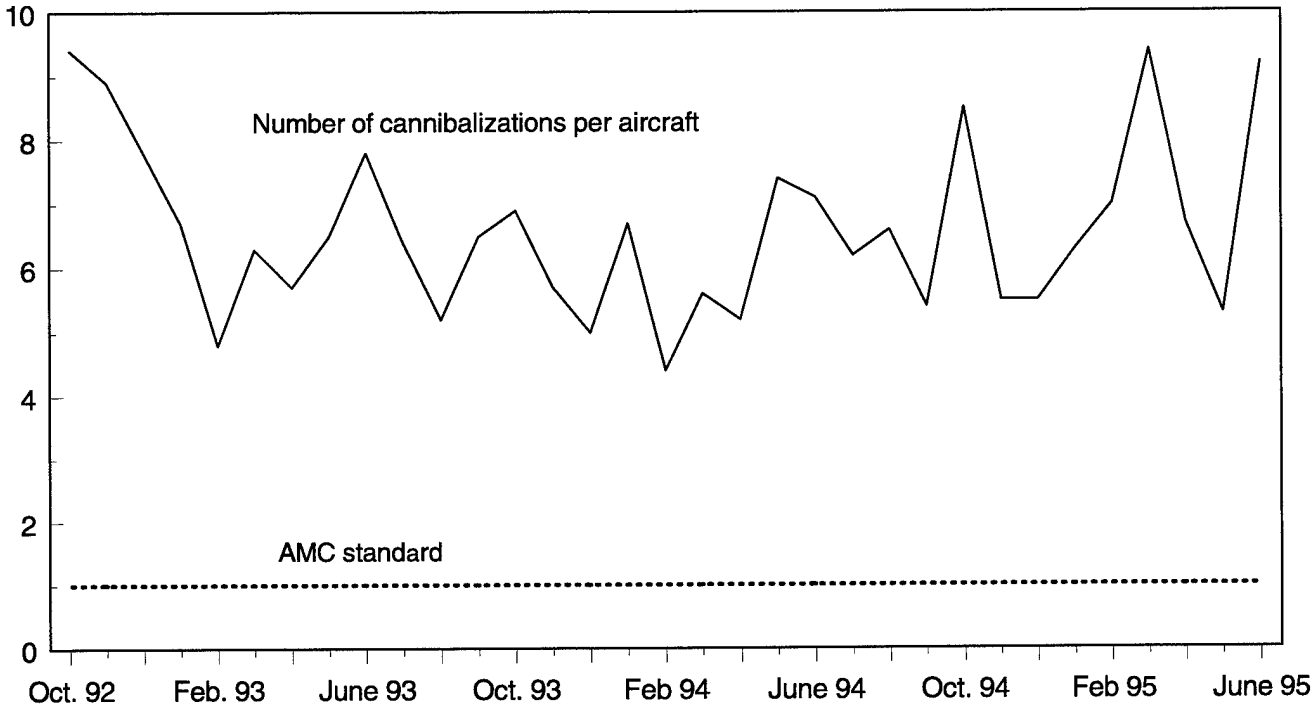
Figure 1.2: AMC C-5 TNMCS Rates From October 1991 to June 1995



Air Force officials said that the C-5 has historically not received enough spare parts primarily because spare parts procurement was budgeted and allocated based on the number of programmed flying hours. Also, the Air Force funds C-5 spares based on a projected 12.6-percent TNMCS rate. Since the C-5 has been exceeding the number of planned flying hours each year, fleetwide TNMCS rates have been even higher than 12.6 percent; in fiscal year 1994, for example, the rate was about 16.5 percent.

Air Force personnel are sometimes able to work around spare parts shortages by taking parts from one aircraft and using them for another (referred to as cannibalization). According to a recent C-5 Program Management Review, cannibalization tends to decrease the life expectancy of aircraft systems and consumes vast amounts of labor that could better be employed elsewhere. AMC's goal is one cannibalization action a month per aircraft. Figure 1.3 shows that AMC C-5 aircraft cannibalization actions have remained at a level well above the AMC standard for several years.

Figure 1.3: Cannibalizations Per AMC C-5 Aircraft From October 1992 to June 1995



To address the spare parts problem, the Air Force changed its calculation method for fiscal year 1994 to recognize that the C-5 has been flying more than its number of programmed hours. Also, for fiscal year 1994, the Air Force allowed some high-priority weapon systems, such as the C-5, to receive more spare parts funding than lower priority systems. These changes may have partly accounted for the improved TNMCS rate during fiscal year 1995. However, neither change had helped improve the cannibalization rate.

For fiscal year 1996, the Air Force has proposed raising C-5 spares funding to a level designed to achieve a 7.5-percent TNMCS rate rather than the current 12.6-percent goal. Air Force officials expect raising the spares support level will add about \$4.6 million to annual C-5 spares costs.

## A Readiness Evaluation Could Lead to Higher C-5 Mission Capability Rates

The C-5's mission capability rates could increase if the Air Force were to conduct a readiness evaluation similar to the operational readiness assessment conducted for B-1B bomber aircraft. That assessment, conducted by the Secretary of the Air Force at the direction of the 1994 National Defense Authorization Act, was to determine if the B-1B could sustain a 75-percent readiness rate, about 18 percentage points higher than it was achieving at that time. The Air Force Operational Test and Evaluation Center (AFOTEC) was enlisted as an independent agent to direct the test and report on the assessment activities. An AFOTEC official estimated the total costs of conducting the assessment was about \$2.2 million.

During the B-1B operational assessment, AFOTEC used the results from a test wing to project that the B-1B fleet could achieve mission capable rates of 75 percent by better managing spare parts repair cycles and making better use of existing spares with few new assets. AFOTEC also found that these changes would increase annual program funding by \$11 million to \$12 million over and above funds already committed for various improvements, initiatives, and spare parts. AFOTEC's findings were evaluated by the DOD Operational Test and Evaluation Agency as well as by us.<sup>3</sup> Both evaluations supported AFOTEC's conclusions.

After the assessment was completed, the test wing's mission capable rate rose to 84 percent, and the entire fleet mission capable rate rose to 66 percent. According to the DOD Operational Test and Evaluation Agency, the primary reason the mission capable rate increased was better spares support—that is, more spares available at the test location and faster turnaround at the intermediate or depot levels. Leadership attention and the significance of the test were important motivating factors, but the mission capable rate could not have been raised without spare parts improvements. Maintenance downtime was reduced when spares were immediately available, and more spares lessened the chance that parts would have to be cannibalized.

One of the major factors accounting for better B-1B spare parts support was the use of the Distribution and Repair in Variable Environments (DRIVE) model. DRIVE manages repair requirements by prioritizing repairs based on their effect on mission capable rates. Current systems, including the one used for the C-5, prioritize repairs based only on the amount of time the part has been in the repair process. In addition, a 1992 Rand

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<sup>3</sup>B-1B Bomber: Evaluation of Air Force Report on B-1B Operational Readiness Assessment (GAO/NSIAD-95-151, July 18, 1995).

report advocated using the DRIVE model to emphasize the effect of repairs on mission capability rather than relying on more traditional indicators.<sup>4</sup> The Air Force mandated use of the DRIVE system at its depots in January 1994, but the system has not yet been implemented by the San Antonio Air Logistics Center, the C-5 depot.

Although the C-5 and B-1B are different aircraft with different missions, we believe a C-5 readiness evaluation could yield similar results to those experienced during the B-1B evaluation. For example, both aircraft have had historically low mission capable rates and poor spare parts support. Also, before the B-1B test, Air Force officials did not think the mission capable rate for the B-1B could be raised nearly as high as the evaluation later demonstrated. However, the officials are now projecting a fleetwide increase in B-1B mission capable rates of 15 percentage points. Air Force airlift officials have stated that improvements to the spares process would have little impact on C-5 mission capability. However, we think improvements similar to the B-1B spare parts process changes could be applied to the C-5 spares process as well.

Officials from the C-5 manufacturer stated that improving the C-5 spares process by analyzing parts that most affect mission capable rates, similar to the DRIVE model philosophy, and improving the spare parts pipeline could result in a 40-percent reduction in TNMCS rates. That reduction would increase the mission capable rate fleetwide by about 6.6 percentage points. An increase of this magnitude would give DOD an additional 1.3 million ton miles a day of cargo-carrying capability—the equivalent of 10 C-17 aircraft.

AMC officials identified several difficulties in reducing TNMCS rates for the C-5 aircraft by 40 percent. Officials noted that the practical requirement to maintain an aircraft at each of the two active bases for cannibalization constitutes a significant portion of the TNMCS rate. They further noted that aircraft undergoing refurbishment or unit inspections also contribute to the TNMCS rate. Notwithstanding this position, we note that if AMC achieved its 7-percent TNMCS goal, it would have accomplished about a 40-percent reduction in the TNMCS rate—which C-5 manufacturer officials projected.

<sup>4</sup>DRIVE (Distribution and Repair in Variable Environments): Enhancing the Responsiveness of Depot Repair, Rand Corporation, 1992.

## C-5 Modernization Plan Needs Reprioritization

AMC established a C-5 modernization plan to increase mission capability rates and reduce personnel requirements and life-cycle costs. According to AMC officials, modification initiatives are generally prioritized based on potential reliability and maintainability improvements to the aircraft as well as cost. The resulting priorities are later modified and updated by various reviewing officials. AMC's top 10 proposed modifications, at the time of our review, and our estimate of their impact on mission capability, are shown in table 1.2. Many of these modifications will not be funded until at least the year 2000 and completed several years after that.

**Table 1.2: Impact of Top 10 Proposed Modifications to the C-5 Aircraft**

Dollars in millions

| Priority     | Modification                 | Cost           | Our estimate of increase in mission capability rate |
|--------------|------------------------------|----------------|---|
| 1            | Autopilot replacement        | \$263.2        | 0.5   |
| 2            | Engine turbine improvement   | 355.0          | 0.7   |
| 3            | Engine vapor barrier         | 5.0            | 0   |
| 4            | Floor corrosion prevention   | 6.2            | 0   |
| 5            | Courier compartment flooring | 86.1           | 0   |
| 6            | Cabin outflow drain pan      | 1.3            | 0   |
| 7            | D-sump lube line             | 0.6            | 0.1   |
| 8            | Smart engine diagnostics     | 9.0            | 0.3   |
| 9            | Nose landing gear door       | 0.3            | 0.1   |
| 10           | Hydraulic valve replacement  | 2.2            | 1.1   |
| <b>Total</b> |                              | <b>\$728.9</b> | <b>2.8</b>  |

Even though we were able to calculate potential mission capable rate increases for each of the top priority modifications, AMC has not analyzed how much the modifications would contribute to increasing mission capability. Until AMC does that analysis, decisionmakers cannot consider the impact that the proposed improvements could have on mission capability or total airlift capability. Also, if AMC considered mission capability increases as a key factor in prioritizing planned C-5 modifications, the current order of priorities would most likely change. However, we recognize that AMC might have to consider other factors, such as safety considerations, when it prioritizes modifications.

We identified the 10th-priority modification—hydraulic valve replacement—as being relatively low in cost but having the most potential for increasing aircraft mission capability. Failures associated with the C-5's hydraulic system are one of the leading causes of reliability

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problems. The hydraulic valve replacement is designed to eliminate surges when opening selector valves on the landing gear, cargo doors, and ramps. Because this modification was only recently identified as one of the top 10 priorities, it has not been scheduled for funding. However, AMC estimated that the modification could be funded as early as fiscal year 1997.

The C-5 manufacturer estimates that failures in hydraulic system plumbing, mounting fixtures, and components should decrease by two-thirds to three-fourths when the hydraulic valve modification is completed. More importantly, the 1.1-percentage point potential increase in C-5 mission capability resulting from the modification would provide DOD with an additional 0.18 million ton miles per day of cargo-carrying capability—equating to 1.4 C-17 aircraft.

In comparison, the two top priority modifications—autopilot replacement and engine turbine improvement—would likely only increase mission capability a little at a relatively large cost. Other high-priority efforts, such as floor corrosion prevention and courier compartment flooring, are improvements that would not result in any potential increase in aircraft mission capability.

DOD has not been providing adequate funding to meet the original schedule for proposed C-5 improvements. For example, two major upgrades to improve the C-5's reliability, the malfunction detection analysis and recording system and the main landing gear actuator, were first identified in fiscal year 1985 and scheduled to be completed by fiscal year 1994. However, funding delays have stretched these modifications by 4 years to fiscal year 1998. According to our 1992 report,<sup>5</sup> one of the major factors contributing to the C-141's recent severe problems was inadequate funding to implement necessary modifications. AMC stated in its 1995 Air Mobility Master Plan that not completing scheduled improvements would degrade capability and increase operating costs.

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## Recommendations

We recommend that the Secretary of Defense direct the Secretary of the Air Force to (1) conduct a readiness evaluation to determine how C-5 peacetime mission capability can be improved and the costs of such improvements and (2) assess the impact of proposed aircraft modifications on C-5 mission capability and then reprioritize the proposals according to the results of the assessment.

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<sup>5</sup>Military Airlift: Structural Problems Did Not Hamper C-141 Success in Desert Shield/Storm (GAO/NSIAD-93-75, Dec. 29, 1992).

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We also recommend that the Secretary direct the Commander in Chief, U.S. Transportation Command, to include in strategic mobility planning the potential increase in airlift cargo capability made possible by a higher C-5 mission capable rate.

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## Agency Comments and Our Evaluation

DOD partially concurred with our report (see app. I). DOD stated that it has initiated some actions that would satisfy the intent of our recommendation that the Air Force conduct a readiness evaluation. These actions include conducting a 1994 logistics demonstration project to improve and streamline the C-5 management structure and policies for handling spare parts and repairing components, as well as incorporating lessons learned from the B-1B operational readiness assessment to better manage the C-5 program. Although these actions are good first steps, DOD must ensure that they are fully implemented. In particular, DOD needs to use the DRIVE model, which was successfully demonstrated during the B-1B assessment, to allocate C-5 spare parts and prioritize their repair.

DOD agreed with our recommendation that the Air Force assess the impact of proposed aircraft modifications on mission capability and reprioritize the modifications accordingly. DOD noted that the San Antonio Air Logistics Center was developing a computer model that will be able to quantify the effects of proposed aircraft reliability improvements on mission capability. DOD expects this model, scheduled for completion in July 1996, to help improve the method for prioritizing C-5 modifications.

DOD did not agree with our recommendation that the Transportation Command's strategic mobility planning include the potential increase in C-5 cargo capability resulting from a higher mission capable rate. DOD stated that the potential cargo capability increase would not translate directly into increases in cargo delivered to a theater of conflict because of the limited airfield infrastructure (including ramp space, refueling facilities, and material handling equipment).

Although potential increases in cargo capability identified in our report may not translate directly into cargo delivered to the theater under some scenarios, the potential capability still exists under more unconstrained scenarios with many available airfields or fields with areas large enough to accommodate substantial numbers of C-5 aircraft. To maximize potential C-5 cargo deliveries, DOD should consider using C-5 aircraft in the more unconstrained scenarios. DOD bases many of its conclusions about a more capable C-5 aircraft on studies of buying additional quantities of a new

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C-5D aircraft, which has not yet been developed. These conclusions could be substantially different if DOD looked at current quantities of more capable existing C-5A and C-5B aircraft. Therefore, we continue to believe DOD should consider the implications of more capable existing C-5 aircraft in its modeling efforts and decisions on the mix of future aircraft.

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## Scope and Methodology

We conducted our review at AMC, Scott Air Force Base, Illinois; 436th Airlift Wing, Dover Air Force Base, Delaware; C-5 System Program Director's Office, San Antonio Air Logistics Center, Kelly Air Force Base, Texas; Lockheed Aeronautical Systems Company, Marietta, Georgia; and Air Force Headquarters, Washington, D.C. We interviewed various officials at these locations and reviewed pertinent regulations, guidance, and reports pertaining to the subject areas. We also interviewed officials regarding the B-1B readiness assessment and DRIVE model at the Air Force Operational Test and Evaluation Center, Kirtland Air Force Base, New Mexico; Air Combat Command Headquarters, Langley Air Force Base, Virginia; and Air Force Materiel Command, Wright-Patterson Air Force Base, Ohio.

To calculate potential aircraft availability and mission capability increases, we relied on Air Force and C-5 manufacturer estimates of increases in mission capable hours attributable to the proposed changes. We added the mission capable hours attributable to those improvements to the 1994 total fleet mission capable hours and calculated a revised mission capable rate. We used the revised mission capable rate to calculate a new aircraft utilization rate, which we used to recalculate a C-5 million ton mile per day cargo contribution. We divided increases in the C-5 cargo contribution by the currently estimated AMC million ton mile per day contribution of a C-17 to determine the equivalent number of C-17s.

We conducted our review from August 1994 to August 1995 in accordance with generally accepted government auditing standards.

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We are sending copies of this report to the Ranking Minority Member of your Subcommittee and the Chairmen and Ranking Minority Members of the Senate Committee on Armed Services, House Committee on National Security, and Senate and House Committees on Appropriations; the Secretaries of Defense, the Army, the Air Force, and the Navy; the Commandant of the Marine Corps; the Commander in Chief,

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U.S. Transportation Command; and the Director, Office of Management and Budget.

If you or your staff have any questions concerning this report, please contact me at (202) 512-5140. The major contributors to this report are listed in appendix II.

Sincerely yours,

A handwritten signature in black ink that reads "Mark E. Gebicke". The signature is written in a cursive style with a large, stylized 'M' and 'G'.

Mark E. Gebicke  
Director, Military Operations  
and Capabilities Issues

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## Abbreviations

|        |  |
|--------|--|
| AFOTEC | Air Force Operational Test and Evaluation Center |
| AMC    | Air Mobility Command                             |
| DOD    | Department of Defense                            |
| DRIVE  | Distribution and Repair in Variable Environments |
| TNMCS  | total not mission capable supply                 |



# Comments From the Department of Defense

Note: GAO's comment supplementing those in the report text appear at the end of this appendix.



ACQUISITION AND  
TECHNOLOGY

## OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON  
WASHINGTON DC 20301-3000



23 OCT 1995

Mr. Mark E. Gebicke  
Director, Military Operations and  
Capabilities Issues  
National Security and  
International Affairs Division  
U.S. General Accounting Office  
Washington, D.C. 20548

Dear Mr. Gebicke:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "STRATEGIC AIRLIFT: Improvements in C-5 Mission Capability Can Help Meet Airlift Requirements," Dated September 11, 1995 (GAO Code 703080), OSD Case 1018. The Department partially concurs with the report.

The Department concurs that the Air Mobility Command C-5 aircraft has not been achieving the current mission capable rate goal of 75 percent. It should be recognized, however, that the 75 percent goal is relatively new and that prior to August 1991 the aircraft's mission capable rate goal was 65 percent. The Department also concurs that recent initiatives to fully fund the C-5 aircraft's flight hour program and provide increased spares funding are expected to contribute to lower not mission capable supply rates and increased readiness. The implementation of improvements in spare parts handling and the repair process, resulting from a 1994 C-5 Lean Logistics Demonstration and lessons learned from the B-1B operational readiness evaluation, are also expected to contribute to increases in the C-5 mission capable rate.

The Department does not agree that it is necessary at this time to conduct a formal C-5 operational readiness evaluation to increase the mission capable rate. A C-5 Lean Logistics Demonstration has already been conducted to identify improvements in policies for handling spare parts and the repair of failed components. The results of the C-5 Lean Logistics Demonstration and lessons learned from the B-1B operational readiness evaluation were incorporated into the Air Force baseline Lean Logistics Master Plan and Road Map. These documents were published in January 1995 and implementation of their recommendations is expected to help Air Force better manage the C-5 program, obtain a higher mission capable rate, and reduce costs.

The Department concurs that the benefits of proposed C-5 modifications need to be better quantified to ensure that priority is given to funding reliability and maintainability modifications which yield the largest pay-off with the available funding. The San Antonio Air Logistics Center has already started developing a computer model which will be able to assess the effect of proposed C-5 reliability and maintainability improvements on system level indicators, such as availability and mission



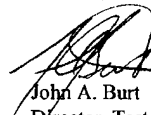
**Appendix I**  
**Comments From the Department of Defense**

capability. This model is expected to be completed in July 1996 and its use should help improve the method for prioritizing C-5 modifications.

The Department does not concur with the GAO recommendation that the U.S. Transportation Command should update its strategic mobility planning to reflect the increase in airlift cargo capability that could theoretically be made possible by a higher C-5 mission capable rate. The Department does not concur with the GAO conclusion that an increase in the C-5 mission capable rate above 75 percent will directly result in an increase in cargo delivered to a theater of conflict. The current strategic mobility planning factors include a C-5 mission capable rate goal of 75 percent, and analyses have shown that C-5 aircraft with a much higher mission capable rate would not necessarily improve the airlift system's ability to deliver cargo to theater because of limited airfield infrastructure (i.e., ramp space, refueling facilities, materials handling equipment, and maintenance). Mission capable rates are only one of the factors used to determine the overall airlift system's capability to meet the warfighter's needs. An analysis that simply links potential C-5 mission capable rate increases to changes in cargo delivered to the end user cannot replicate the complex interrelationships that exist within the entire airlift system.

The DoD detailed comments on the report findings and recommendations are enclosed. The Department appreciates the opportunity to comment on this draft report.

Sincerely,



John A. Burt  
Director, Test, Systems  
Engineering and Evaluation

Enclosure

GAO DRAFT REPORT--DATED SEPTEMBER 11, 1995  
(GAO CODE 703080) OSD CASE 1018

"STRATEGIC AIRLIFT: IMPROVEMENTS IN C-5 MISSION  
CAPABILITY CAN HELP MEET AIRLIFT REQUIREMENTS"

DEPARTMENT OF DEFENSE COMMENTS

\* \* \* \* \*

FINDINGS

**FINDING A: Mission Capable Rates Are Below Standard.** The GAO reported that the DoD is counting on the C-5 aircraft to deliver almost half of the military airlift cargo in wartime, but its mission capable rates have generally been below the Air Mobility Command (AMC) 75 percent goal over the last several years. The GAO explained that the mission capable rates for C-5 aircraft averaged just under 68 percent from July 1994 to June 1995, and noted that the rates have been declining since Operation Desert Storm when the AMC achieved rates of 75 percent or higher. The GAO also pointed out that the C-5 mission capable rates were considerably below comparable airlift and tanker aircraft during the same period.

The GAO found that nearly 25 to 50 percent of all not mission capable problems in recent years have been due to a lack of spare parts. According to the GAO, Air Force officials said the C-5 has historically not received enough spare parts, primarily because spare parts procurement was budgeted and allocated based on the number of programmed flying hours and the projected not mission capable supply (NMCS) rate. The GAO noted that the C-5 has been exceeding the number of planned flying hours each year and, therefore, has been exceeding the projected 12.6 percent NMCS rate.

To address the spare parts problem, the GAO reported the Air Force changed its calculation method for FY 1995 to recognize the C-5 has been flying more than its number of programmed hours and has allowed some high priority systems like the C-5 to receive more spare parts funding than lower priority systems. These changes may have partly accounted for the improved NMCS rate during FY 1995, but have not improved the cannibalization rate. For FY 1996, the Air Force has proposed raising C-5 spares funding to a level designed to achieve a 7.5 percent NMCS rate,

Enclosure

**Appendix I**  
**Comments From the Department of Defense**

rather than the 12.6 percent goal. Air Force officials expect raising the support level will add about \$4.6 million to the annual C-5 spares costs. (pp. 2-8/GAO Draft Report)

**DOD Response:** Concur. The Department concurs that the Air Mobility Command C-5 aircraft has not been achieving the current mission capable goal of 75 percent, but would like to clarify that the current Air Mobility Command mission capable goal of 75 percent is relatively new. The Air Mobility Command raised the goal from 65 to 70 percent in August 1991, and then from 70 to 75 percent in June 1992.

While the Department concurs that the lack of spare parts contributes to the C-5 NMCS rate, it should be recognized that the Air Mobility Command has been making progress in reducing the NMCS rate of their aircraft over the last 2 years. For example, while the C-5 NMCS rate was as high as 18 percent in 1993, the June 1995 C-5 NMCS rate was approximately 9.0 percent compared to its goal of 7.0 percent. The Department would also like to clarify that 54 percent of all aircraft groundings that result from the lack of parts are attributable to parts with very low failure rates ("demand history"). A decision has been made not to maintain a stock of all C-5 components at base level because of the low failure rates and the Department's inventory reduction initiatives. The Department expects the implementation of improvements in spare parts handling and the repair process resulting from a 1994 C-5 Lean Logistics Demonstration and lessons learned from the B-1B operational readiness assessment, will result in better use of the assets currently in the inventory, and hence, contribute to increases in the C-5 mission capable rate.

The Department also concurs that the Air Force has taken initiatives to improve the aircraft's readiness. Initiatives to: (1) fully fund the C-5 flight hour program; (2) provide increased spare parts funding to achieve a lower NMCS rate; and (3) fund reliability and maintainability modifications, are expected to contribute to increased readiness. The Department would also like to point out that, due to the leadtimes associated with the procurement of spare parts, the return on investment for procuring spare parts occurs over a four year period (8 percent, 25 percent, 38 percent and 29 percent, respectfully). Consequently, the increased spare parts funding in FY 1995 will not visibly impact parts availability and the C-5 NMCS rate until FY 1997.

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**FINDING B: An Operational Readiness Assessment Could Lead to Higher C-5 Mission Capability Rates.** The GAO concluded that the C-5 mission capability rates could increase if the Air Force were to conduct an operational readiness evaluation similar to the one conducted for the B-1B bomber aircraft. The GAO explained that the Air Force Operational Test and Evaluation Center (AFOTEC) conducted an assessment of the B-1B at a cost of about \$2.2 million, and used the results from a test wing to project that the B-1B fleet could achieve mission capable rates of 75 percent by better managing spare parts repair cycles and making better use of existing spares with few new assets. The AFOTEC determined that the changes would increase annual program funding by \$11 million to \$12 million. The GAO noted that after the assessment was completed, the test wing's mission capable rate had risen to 84 percent, and the entire fleet rate had risen to 66 percent.

The GAO concluded that although the C-5 and B-1B are different aircraft with different missions, a C-5 readiness evaluation could yield similar results. The GAO and Lockheed officials believe that improvements similar to the B-1B spare parts process changes could be applied to the C-5 spares process as well. The GAO reported that Lockheed officials stated that improving the C-5 spares process by analyzing parts that most contribute to supply problems and improving the spare parts pipeline could result in a 40 percent reduction in NMCS rates. The GAO observed that such a reduction would increase the mission capable rate fleetwide by about 6.6 percentage points, thereby providing the DoD an additional 1.3 million ton miles a day of cargo-carrying capability, equivalent to 10 C-17 aircraft.

The GAO reported that AMC officials disagree with the Lockheed projection, and believe the mission capable rate could be raised by only 1.6 percent at the most. The officials noted that the practical requirement to maintain an aircraft at each of the two active bases for cannibalization constitutes a significant portion of the NMCS rate. Further, aircraft count as NMCS while undergoing refurbishment or unit inspections, also contributing heavily to the NMCS rate. However, the GAO estimated that if the AMC achieved its 7 percent NMCS goal, it would equate to about a 40 percent reduction in the NMCS rate, which is what Lockheed officials projected. (p. 3, pp. 8-10/GAO Draft Report)

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**DoD Response:** Partially concur. The Department nonconcur that it is necessary to conduct a formal C-5 operational readiness evaluation on the C-5 aircraft in order to increase its mission capable rate. The benefits to be gained from such an evaluation were previously realized when a decision was made to implement lessons learned from the B-1B operational readiness evaluation and the C-5 Lean Logistics Demonstration.

The Air Force Material Command, Air Mobility Command, and RAND conducted a C-5 Lean Logistics Demonstration between May 1994 and September 1994. The objective of the demonstration was to improve and streamline the policy and management structure for spare parts handling and repair providing less costly weapon system support in both peacetime and wartime. The January 1995 Air Force baseline Lean Logistics Master Plan and Road Map has incorporated the results of the B-1B operational readiness evaluation and the C-5 demonstration. Both of these initiatives will help resolve systemic problems with the management of aircraft maintenance, the supply system, and the repair process so the Air Force can better manage the C-5 program. The implementation of these initiatives, as well as the funding of reliability and maintainability modifications to correct inherent reliability problems, is expected to lead to mission capability improvements.

The Department concurs, in general, that reductions in C-5 NMCS rates will increase the fleetwide C-5 mission capable rate. It should be recognized, however, that mission capable rates are not the only factors effecting the ability to provide additional airlift capability. Airlift capability is constrained by the available logistics infrastructure (i.e., ramp space, number of cargo loaders, maintenance capability, crew ratios, etc.) that is available for airlift aircraft. Therefore, potential increases in mission capable rates cannot be directly translated into increased cargo carrying capacity. Further, the Department cannot substantiate either the Lockheed estimate of how analyzing parts and improving the spare parts pipeline could reduce C-5 NMCS rates, or the GAO estimate of how these NMCS reductions could increase both the C-5 mission capable rate and cargo-carrying capability.

**FINDING C: The C-5 Modernization Plan Needs Reprioritization.**

The GAO reported that the AMC established a C-5 modernization plan to increase mission departure and mission capability rates and reduce personnel requirements and life cycle costs. The GAO

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noted the initiatives were generally prioritized based on potential reliability and maintainability improvements to the aircraft, as well as cost. The GAO found, however, that the AMC has not analyzed how much the modifications would contribute to increasing mission capability. The GAO concluded that as a result, decisionmakers cannot adequately assess the impact proposed improvements could have on overall aircraft reliability or total airlift capability. The GAO noted that if mission capability increases were considered as a key factor in prioritizing the C-5 modifications, the current order of priorities would most likely change.

The GAO also found that the DoD has not been providing funding adequate to meet the original schedule for proposed C-5 improvements. The GAO cited its December 1992 report on the C-141, which reported that one of the major factors contributing to recent severe problems with the C-141 was inadequate funding to implement necessary modifications. The GAO also cited the AMC 1995 Air Mobility Master Plan, which states that not completing scheduled improvements would degrade capability and increase operating costs.

Overall, the GAO concluded that improving the C-5 spares program and reprioritizing the C-5 modernization initiatives would increase C-5 mission capable rates. The GAO observed that if peacetime C-5 mission capable rates could be raised to the current AMC goal of 75 percent, the DoD could gain an additional 1.3 million ton miles per day of C-5 wartime airlift capability, which is equivalent to 10 C-17 aircraft. As a result, the DoD could come closer to meeting military aircraft requirements with the existing fleet. (p. 3, pp. 11-14/GAO Draft Report)

**DoD Response:** Partially concur. The Department partially concurs that the C-5 modernization plan is intended to provide increased capability and maintainability for the C-5 aircraft, and that proposed modifications are prioritized by the user based on the potential reliability and maintainability improvements, as well as cost. However, it should be recognized that the benefits of some modifications, such as the floor corrosion prevention and courier compartment flooring modification, are essential to preventing outyear structural and safety problems, as seen on the C-141 aircraft. The benefits of these types of structural, safety, and sustainment modifications cannot always be expressed in terms of reliability and maintainability improvements, but rather are intended

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to ensure that the C-5 can provide airlift capability into the 21st Century.

The Department also concurs that funding shortfalls have delayed the development and installation of some planned C-5 modifications. However, increased attention has been placed on grouping planned modifications as block upgrades to provide them with increased visibility during the review process. Considerable funding has also been programmed to support the funding of C-5 modifications between FY 1995 and FY 2000.

While the C-5 program currently does not have the capability to assess the contribution of proposed modifications to increasing mission capability, the San Antonio Air Logistics Center is currently developing the Complete Reliability Evaluation and Sensitivity Technique which is intended to provide this type of capability. The San Antonio Air Logistics Center model is expected to be operational in July 1996, and its use may result in the reprioritization of planned C-5 reliability and maintainability modifications.

The Department concurs that improving the C-5 spare parts handling process and ensuring that C-5 reliability and maintainability modifications are prioritized based on their potential pay-offs is expected to contribute to increased C-5 mission capable rates. However, the DoD does not concur that an increase in C-5 mission capable rates would necessarily result in a significant increase in cargo delivered to a theater during a contingency. The recently-completed Strategic Airlift Fleet Mix Analysis looked at the impact of adding additional improved C-5D aircraft to the airlift fleet. The analysis found that, even assuming a 90 percent mission capable rate for these aircraft, the increase in cargo delivery capability is less than one percent. The airlift system operating in wartime involves complex interactions between the activities associated with aircraft maintenance and the management of air base resources, such as ramp space, refueling facilities, materials handling equipment, and maintenance. In the case of the initial Strategic Airlift Fleet Mix Analysis, adding C-5s to the 104 Primary Aircraft Authorization available in today's fleet resulted in the saturation of enroute airfields which limited the productivity of the airlift system. Mobility planning factors are reviewed by the Air Mobility Command on a regular basis and can certainly be changed as improvements are made in the management and operation of the airlift system. Individual aircraft mission capable

rates, however, are only one of the factors used to determine the overall airlift system's capability. Airlift planning factors should be updated when it can be demonstrated that an improvement in one area, such as reliability, will result in an increase in system throughput under wartime conditions.

The Department cannot substantiate the GAO estimate that the achievement of the Air Mobility Command mission capable goal could provide the C-5 aircraft the capability to provide an additional 1.3 million ton miles per day of C-5 wartime airlift capability. As previously stated, mission capable rates are not the only factors effecting the ability to provide additional airlift capability. Therefore, potential increases in mission capable rates cannot be used to infer increased cargo carrying capacity.

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**RECOMMENDATIONS**

**RECOMMENDATION 1:** The GAO recommended that the Secretary of Defense direct the Secretary of the Air Force to (1) conduct a readiness evaluation to determine how C-5 peacetime mission capability can be improved and the costs of such improvements and (2) assess the impact of proposed aircraft modifications on C-5 mission capability and then reprioritize the proposals according to the results of the assessment. (p. 14/GAO Draft Report)

**DoD Response:** Partially concur. Although the DoD agrees with the thrust of the GAO recommendation, the Department does not concur that a readiness evaluation of the C-5 should be performed at this time. As discussed in the DoD response to Finding B, the benefits to be gained from such an assessment were previously realized when the Air Force Material Command, Air Mobility Command, and RAND conducted a C-5 Lean Logistics Demonstration between May 1994 and September 1994. The impetus of this review was the B-1B operational readiness evaluation findings which concluded that changes in practices involving aircraft maintenance, the supply system, as well as intermediate and depot maintenance, can yield increases in mission capability and make better use of the assets currently in the inventory. Accordingly, the objective of the C-5 Lean Logistics Demonstration was to improve and streamline the program's management structure and policies for handling spare parts and the repair of failed components in both peacetime and wartime.

See comment 1.

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The results of the B-1B operational readiness evaluation and the C-5 demonstration were incorporated into the Air Force baseline Lean Logistics Master Plan and Road Map. These documents were published in January 1995 and their implementation is expected to help the Air Force better manage the C-5 program and obtain higher mission capable rates and reduced costs. The final analysis of the overall savings that are expected to be achieved is not complete, but should be available by January 1998. However, budget estimates for the outyears are incorporating the reduced need for spares based on the lean logistics initiatives.

The Department concurs that additional emphasis needs to be placed on quantifying the benefits of proposed C-5 modifications in the future. Accordingly, the San Antonio Air Logistics Center is developing the Complete Reliability Evaluation and Sensitivity Technique to better quantify the effect of C-5 reliability and maintainability improvements on system level indicators, such as availability and mission capability. The San Antonio Air Logistics Center computer model is expected to be completed in July 1996. Since it has been the Department's intent to give priority to funding the reliability and maintainability modifications which yield the largest pay-off with the available funding, and the Complete Reliability Evaluation and Sensitivity Technique is being developed as a management tool to help in the assessment of proposed modifications, the Department expects that its use may result in the reprioritization of C-5 modifications.

**RECOMMENDATION 2:** The GAO recommended that the Commander-in-Chief, U.S. Transportation Command, include in its strategic mobility planning the increase in airlift cargo capability made possible by a higher C-5 mission capable rate. (p. 14/GAO Draft Report)

**DoD Response:** Nonconcur. The Department does not concur that the U.S. Transportation Command should be directed to update its strategic mobility planning to reflect the increase in airlift cargo capability that could be made possible by a higher C-5 mission capable rate. The current strategic mobility planning factors include a C-5 mission capable goal of 75 percent. As discussed in the DoD response to Finding C, an increase in C-5 mission capable rates above 75 percent would not necessarily result in an increase in airlift cargo capability due to the various complex interrelationships within the airlift system. Aircraft mission capable rates are not the only factors used to

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determine the capability of the overall airlift system to meet user needs.

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The following is our comment on the Department of Defense's (DOD) letter dated October 23, 1995.

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**GAO Comment**

1. DOD stated that it could not substantiate the additional 1.3 million ton miles per day of capability that we reported the C-5 aircraft could provide. Our calculation was based on the 40-percent improvement in total not mission capable supply (TNMCS) rate projected by the C-5 manufacturer. We discussed how we calculated utilization rates and million ton mile contributions in the Scope and Methodology section. We used standard Air Mobility Command (AMC) formulas in those calculations. In addition, as noted in the report, if AMC met its own 7-percent goal for TNMCS, it could achieve the 40-percent TNMCS reduction projected by the C-5 manufacturer.

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