C-17 GLOBEMASTER III AIRLIFT AIRCRAFT

Air Force ACAT IC Program		**Prime Contractor**
Total Number of Systems:	134	Boeing
Total Program Cost (TY$):	$45,043M	
Average Unit Cost (TY$):	$232M	
Full-rate production:	1QFY96	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The C-17 is a four-engine turbofan aircraft capable of airlifting large payloads over intercontinental ranges without refueling. It is intended to allow delivery of outsize combat cargo and equipment directly into austere airfields. The C-17 is required to deliver passengers and cargo between continents, provide theater and strategic airlift in both airland and airdrop modes, and augment aeromedical evacuation and special operations missions.

Significant features of the C-17 include: supercritical wing design and winglets to reduce drag; in-flight refueling capability; externally blown flaps; direct lift control spoilers; high impact landing gear; a forward and upward thrust reverser system that provides backup capability; a cargo handling system that permits operation by a single loadmaster; a two-person cockpit; and maximum use of built-in test equipment to reduce maintenance troubleshooting times.

The C-17 supports the ***Joint Vision 2020*** operational concepts of ***dominant maneuver*** and ***focused logistics***.

BACKGROUND INFORMATION

IOT&E of the C-17 was conducted in four phases from May 1992-June 1995. Based upon results of IOT&E and live fire testing, DOT&E submitted an Operational and Live Fire Test and Evaluation Report (B-LRIP) to Congress in November 1995. The report assessed the operational effectiveness and suitability of the aircraft to conduct operational missions within the context of the existing airlift system. The C-17 was judged to be operationally effective (with limitations) and operationally suitable. Survivability was not sufficiently evaluated to make an assessment. A full-rate production decision, Milestone IIIB, was made in November 1995.

A three-year initial period of FOT&E commenced in June 1996. It was conducted by the Air Mobility Command (AMC), with management by the Headquarters, Test and Evaluation Directorate, Scott AFB, IL, and test execution by the Air Mobility Warfare Center's Flight Test Squadron (33 FLTS) at McGuire AFB, NJ, utilizing a detachment (Det 1) stationed at the test location, Charleston AFB, SC. The primary FOT&E objectives included completing tests deferred from IOT&E, developing and refining employment procedures and tactics, and addressing IOT&E deficiencies.

A major observation from IOT&E cited deficiencies associated with personnel airdrop, including equipment and procedural shortcomings. Specific areas requiring further evaluation during FOT&E included exit rate for static line personnel drops, combination paratrooper and bundle drops, and development/refinement of personnel airdrop formations.

The C-17A completed LFT&E in 1994. Since the completion of that testing, two major structural modifications have been incorporated that may require further LFT&E. The horizontal tail has been changed to a composite material construction, and an extended range fuel containment system has been added in the center-wing area of the fuselage. These changes could significantly affect aircraft survivability. Furthermore, based on the total cost of these changes, the upgrades could constitute a new program since their costs exceed that of a major system development. DOT&E has initiated a review of all changes made to the C-17 since the B-LRIP report was published in November 1995.

TEST & EVALUATION ACTIVITY

Initial FOT&E, which commenced in FY96, concluded in FY99. Detachment 5, AFOTEC, Edwards AFB will support continuing OT&E. Similarly, future DT&E by a combined Boeing and U.S. Air Force team at Edwards AFB will focus on aircraft modifications and upgrades.

Most of the sub-standard items identified in IOT&E have been closed. This includes "deficiencies" (did not meet Operational Requirements Document (ORD) criteria), "inadequacies" (qualitative assessment that failed), "recommendations" (met criteria but had problems which could be improved), and "deferrals" (test not accomplished during IOT&E). Although all deficiency items are considered closed, fault isolation procedures/manuals and built-in test equipment require improvements, and the Strategic Brigade Airdrop mission has operational limitations. Efforts to include dual row cargo/equipment airdrop are in progress to shorten the drop zone delivery time.

One high visibility FOT&E item still in progress is an improvement to the On-Board Inert-Gas Generating System (OBIGGS). A reliability improvement program on OBIGGS was completed; changes are being incorporated but have not been operationally evaluated at this time. Funding for a new OBIGGS program is being considered for FY03.

The C-17 passed the 214,000 flight-hour mark in August 2000. The Mission Capable (MC) and Fully Mission Capable (FMC) measures have been tabulated. Results of both measures, presented as a range of monthly averages over three different measurement periods, are shown below, together with standards from the 1993 ORD and the 1998 ORD.

C-17 Flight-Hour Mission Capable (MC) and Fully Mission Capable (FMC) Rates

Measured Values

	Jun 93-Aug 95	Sep 95-Aug 97	Sep 97-Sep 99	Oct 99-Sep 00
MC	30.5-83.5%	75.7-93.0%	81.7-91.1-%	78.6-85.9%
FMC	0-74.4%	7.8-75.0%	41.6-71.5%	37.6-64.3%

Standards

	1993 ORD	1998 ORD	AMC FY98 Standards
MC	82.5%	90.0%	87.5%
FMC	74.7%	80.0%	77.5%

Notes: Standards for MC are "threshold" (minimum acceptable) values while FMC standards are deemed "objective" values (goals).

Demonstrated values for MC surpassed the 100,000 flight-hour standard specified in 1993; however, the standard was increased in the 1998 ORD when higher rates appeared attainable. The MC rate hovered near 90 percent in 1997 before spare parts shortages and increasing depot maintenance caused it to drop. The measures for FMC, although well below the 1993 and 1998 ORD objectives, were initially trending upward, however due do recent failures of some key components, the trend has reversed. The Head-Up-Display (HUD), OBIGGS, the main landing gear, fuel system fittings, and navigation system software have impacted FMC. Extensive downtime has been attributed to a lack of equipment to re-boresight and realign HUD mounting trays, high failure rates for OBIGGS components, lack of durability in main landing gear parts, and inadequate integration of Global Positioning System (GPS) and inertial reference unit software. An OBIGGS improvement program is being considered for FY03. A HUD alignment program is in work. Landing gear durability tests are underway, and design changes are anticipated. New navigation software is being developed and tested.

Developmental Test and Evaluation will continue at Edwards AFB under the heading of the Follow-On Flight Test Program (FOFTP). AFOTEC-Det 5 at Edwards AFB will maintain involvement through ongoing communication with the Program Office and the C-17 Test Team resident at Edwards AFB.

TEST & EVALUATION ASSESSMENT

The apparent limited capability for dual-row airdrops (release of two rows of cargo platforms positioned side-by-side in the aircraft) may necessitate sequential (side by side) release of rather than

simultaneous release of the special 88-inch wide by 16-foot long platforms to prevent collisions after they exit the aircraft. The resultant effect is an increase in delivery time and required drop zone length; however, the total number of aircraft required to drop equipment for a brigade has been significantly reduced. At present, the combined effects of dual-row airdrop and aircraft spacing for personnel drops have positively impacted the strategic brigade airdrop execution time, which is getting nearer to the Army's goal.

The Program Office is revising the TEMP to better address continuing flight tests, particularly the Follow-On Flight Test Program at Edwards AFB and continued operational testing by the 33 FLTS at McGuire AFB. The current TEMP was approved in 1995, and contained substantial information on FOT&E. A revised TEMP will better address FOFTP at Edwards AFB and operational testing by AFOTEC and the 33 FLTS. In addition, an updated OT test plan will be submitted. The updated plan will focus on the transfer of OT management responsibility to the 33 FLTS and a more detailed scope of the proposed testing for the next four years. In addition, AFOTEC will have an increased role in future operational testing. The TEMP will also define the future LFT program.

The ARC-210 radio antennas and logic modules were being removed at a high rate because of diode failures not evident in previous components. Retrofit was completed in May 2000. Fuel system power wiring in Block 11 aircraft requires replacement upon delivery. Alignment deficiencies between the Head-Up Display (HUD) and the Inertial Reference Units (IRUs) is a deceptively complex issue that precludes safe assault landings on short airfields. In addition, Block 10/11 aircraft (one-third of the current fleet) were initially fielded IRU/GPS/MC software that experience navigation accuracy problems restricting aircraft to CONUS-only flight. The fix to CONUS restrictions is being evaluated. Root cause for the landing gear post problem is still being examined.

Regarding planned upgrades, Block 12 (which includes the extended range fuel tank and several Global Air Traffic Management functions) will be the most significant configuration change yet. Block 12 aircraft should begin delivery in February 2001. They will contain 280,000 different lines of software, and 33 percent of the line replaceable units will be different. A two-phase implementation (Blocks 12- and 12+) is being proposed. Block 12 software and sub-systems modifications appear to be more complex than Block 10, which produced an inordinate number of operational difficulties. Blocks 10/11 lacked appropriate spares, technical orders, and training for flight and ground crews. Problems are currently being addressed. With more key modifications and enhancements planned for Blocks 13 and 14, the need for OT&E to ensure the delivery of effective/suitable systems continues to increase.

Challenges to developmental and operational flight testing in 2001 and beyond include constraints to individual project budgets, test resources, and aircraft availability for test. Only a single dedicated aircraft exists for developmental flight testing. Requests for flight test time on operational aircraft are in stiff competition with high operational mission demands. Also, the large number of aircraft scheduled for modification has limited the available aircraft to perform mission requirements and testing. These challenges have affected the depth and duration of testing conducted following aircraft modification and upgrade.

CONCLUSIONS

A large measure of the C-17's documented operational success is attributable to T&E decisions by DOT&E and DEPSECDEF during EMD. At the same time, deficiencies identified during IOT&E still remain; i.e., OBIGGS. When prior deficiencies are combined with operational effectiveness and suitability problems identified since the C-17 Reliability, Maintainability and Availability evaluation, it

appears that greater resource allocations for deficiency correction and enhanced T&E priority after Milestone IIIB could have reduced or eliminated many current troubles.

In addition, policies and procedures flowing from the push toward commercial acquisition are leading the C-17 down a risky path. A lack of fiscal, technical, and testing realism may be creating fleets that cannot meet effectiveness, sustainability, or interoperability requirements. In the case of the C-17, data suggest that no more than three aircraft on any base are in the same configuration. This negatively impacts the logistics supportability and availability of the fleet. Moreover, the partially mission capable rates are now consistently below the command standard, and aircraft availability (because of constant modification) has become a significant issue.