

# ARCHIVED REPORT

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## Boeing C-17

### Outlook

- C-17 production ended in November 2015
- The last available C-17 was delivered in 2019 to the Indian Air Force

### Orientation

**Description.** Four-engine, heavy-lift, long-range military transport aircraft.

**Sponsor.** U.S. Air Force Life Cycle Management Center, Wright-Patterson AFB, Ohio, USA.

**Status.** Production of the C-17 ended in November 2015.

**Total Produced.** Boeing produced 277 C-17s, including T-1, the prototype. This total does not include two structural test airframes.

**Application.** Long-range, heavy-lift intertheater cargo/personnel transportation with intratheater applications.

**Price Range.** \$225 million in 2015 U.S. dollars.



C-17A Globemaster III

Source: Boeing

**Boeing C-17****Contractors****Prime**

<b>Boeing Defense, Space &amp; Security, Military Aircraft, Mobility Division</b>	<a href="http://www.boeing.com/defense">http://www.boeing.com/defense</a> , 2401 E Wardlow Rd, Long Beach, CA 90807 United States, Tel: + 1 (562) 593-5511, Prime
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<b>M.C. Gill Corp</b>	<a href="http://www.mcgillcorp.com">http://www.mcgillcorp.com</a> , 4056 Easy St, El Monte, CA 91731 United States, Tel: + 1 (626) 443-4022, Fax: + 1 (626) 350-5880, Email: <a href="mailto:info@mcgillcorp.com">info@mcgillcorp.com</a> (Passenger Flooring; Crew Flooring)
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## Technical Data

**Design Features.** High-wing, T-tail, widebody monoplane. The C-17 Globemaster III was a long-range airlifter with short takeoff and landing capability. Design features included superplastic bonding/diffusion forming of four flat sheets of titanium into three-dimensional parts for the flaps and engine nacelles. Other features included externally blown flaps utilizing engine exhaust to increase lift for short-field takeoff and landing; direct-flow thrust reversers exiting the engine cowling upward and forward to aid in short-field

landing; winglets to decrease drag and increase lift; multiple bogey main landing gear for rough field operations; high bypass engines; and a cockpit with four multitask CRT displays, quadruplex fly-by-wire controls, and two full capability head-up displays. The wing was of supercritical design with a 25-degree sweep. The aircraft had 12-wheel main landing gear (with two three-wheeled struts on each side) and a twin-wheel nose unit.

	<u>Metric</u>	<u>U.S.</u>
<b>Dimensions</b>		
Length	53.04 m	174.0 ft
Height	16.79 m	55.08 ft
Wingspan	51.75 m	169.80 ft
Cargo compartment		
Length	26.82 m	88.0 ft
Width	5.48 m	18.0 ft
Height	3.76 m	12.33 ft
<b>Weight</b>		
Max takeoff weight	265,352 kg	585,000 lb
Max payload	77,519 kg	170,900 lb
<b>Performance</b>		
Range with 160,000-lb payload	4,482 km	2,420 nm

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### Propulsion

C-17 (4) Pratt & Whitney F117-PW-100 turbofans rated 179.9 kN (40,440 lbf) each.

### Crew

Crew of three: pilot, copilot, and loadmaster.

## Variants/Upgrades

**BC-17X.** Previously called the MD-17, the BC-17X was a proposed commercial version of the C-17 intended for dedicated civil freight applications. Its maximum payload was 78,609 kilograms (173,300 lb). Range with maximum payload was 4,630 kilometers (2,500 nm).

According to Boeing, incorporation of a 37,853-liter (10,000-U.S.-gal) center-wing fuel tank would have increased the range capability of the BC-17X significantly at typical payloads.

**C-17B.** Proposed intratheater transport version of the C-17. The C-17B featured more powerful engines, additional landing gear, redesigned powered lift flaps, and enhanced short takeoff and landing capability. Estimated development cost was \$2.0 billion.

The C-17B was essentially replaced by the C-17FE proposal.

**C-17FE.** In mid-2010, Boeing unveiled a proposal for a new C-17 variant called the C-17FE (for Fuel Efficiency). This model retained the wing, T-tail, and

engines of the existing C-17A, but incorporated a fuselage narrowed by 1.2 meters (4.0 ft). The cross-section of the aircraft was the minimum required to accommodate a fully armored Stryker vehicle. Composites would have been used to reduce the structural weight of the aircraft.

**KC-17.** Proposed tanker/transport version. Additional fuel would have been carried in a 37,853-liter (10,000-U.S.-gal) wing center-section tank and/or a 25,362-liter (6,700-U.S.-gal) palletized cargo hold tank. Refueling equipment was fitted to a cargo hold upper door. Underwing hose-drum pods would have been optional.

**Other Versions.** McDonnell Douglas engineers had worked on a number of multimission C-17 designs that could alternately serve as tankers, flying hospitals, or AWACS platforms. The company's long-term plans had also included a stretched C-17 that could replace the Lockheed C-5 transport in USAF service. However, McDonnell Douglas said in 1996 that the Air Force had not expressed any interest in a stretched C-17.

## Program Review

**Background.** In July 1979, the U.S. Air Force decided to incorporate a strategic airlift capability into its Advanced Medium STOL Transport (AMST) to augment the C-5A fleet. The following December, though, the AMST project was dropped in favor of a new strategic airlifter designated CX. A Request for Proposals was issued in October 1980, with responses due in January 1981. Boeing, Lockheed, and McDonnell Douglas submitted proposals, and the Air Force announced McDonnell Douglas as the winner in August 1981.

However, the program remained in low-level development as USAF re-examined its overall airlift needs. The Air Force subsequently opted to procure 50 Lockheed C-5B transports and increased its McDonnell Douglas KC-10 buy to 60 units. The C-17 was then designated as the follow-on to the Lockheed C-141, but with an additional intratheater capability.

### *An Aircraft of Considerable Versatility*

The C-17 had the capability to carry outsized combat equipment that could be carried by the larger C-5. In the cargo compartment, the C-17 could carry U.S. Army wheeled vehicles such as 5-ton expandable vans in two side-by-side rows or jeeps in triple rows. The aircraft could airdrop outsized firepower such as the service's Bradley infantry fighting vehicle (three of these armored vehicles composed one deployment load). In addition, the M1 Abrams main battle tank could be carried in conjunction with other vehicles.

The C-17 employed an externally blown flap system to greatly reduce final approach and landing speeds for routine short-field landings. With the powered lift system, the engine thrust was directed to double-slotted flaps to produce additional lifting forces. The flaps and closure assembly panels for the engine cowlings were

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made of titanium, using superplastic forming/bonding techniques. The aircraft was designed to be operated by a crew of two and a single loadmaster.

**USAF Program Buy.** The initial two production C-17s were funded in FY88, followed by four in FY89. Four additional aircraft were funded in FY90. The Pentagon's FY92 budget request was for six aircraft, but Congress reduced the total to four. Congress subsequently approved a further six for FY93, an additional six for FY94, six more for FY95, eight for FY96, eight for FY97, nine for FY98, 13 for FY99, 15 for FY00, 12 for FY01, 15 for FY02, 15 for FY03, 11 for FY04, 15 for FY05, 15 for FY06, 22 for FY07, 15 for FY08, eight for FY09, 10 for FY10, and one for FY12.

**Early Difficulties.** The Air Force originally planned to procure 210 C-17s, which would have enabled it to reach and maintain its goal of a long-range airlift capability of 66 million ton-miles per day. In April 1990, however, Defense Secretary Richard Cheney told the House Armed Services Committee that the circumstances that had led to that goal had changed. The secretary concluded that only 120 C-17s would be needed, rather than 210.

In December 1993, Defense Secretary Les Aspin and Under Secretary of Defense for Acquisition John Deutch announced that the Air Force would procure a total of 40 C-17s, with production then halted if McDonnell Douglas could not sufficiently improve the program. If the C-17 were to be canceled after 40 aircraft, the Pentagon would provide additional airlift capacity by purchasing commercial widebody jets or by reviving production of the Lockheed C-5. A study was initiated to determine the best backup solution. This C-17 alternative became known as the Non-Developmental Airlift Aircraft (NDAA).

At the time of the announcement, Secretary Aspin and Under Secretary Deutch said that McDonnell Douglas had been offered a comprehensive settlement of all management and contract issues. The company had also been offered a proposal for building 12 aircraft over a two-year period (six to be funded in each of FY94 and FY95). These 12 plus the 20 production aircraft already under contract and eight FY95 advance procurement aircraft totaled 40 aircraft. The contractor accepted the agreement in principle, and a final agreement was hammered out by January 1994.

The final agreement called for McDonnell Douglas to drop various claims against the government totaling over \$1.0 billion. The company was also to spend \$454 million on flight testing and various other items, including \$100 million on product improvement measures.

***Settlement Brought Technical Changes***

The agreement also called for McDonnell Douglas to make a series of technical improvements to the C-17. At its own cost, the company was to redesign the aircraft wing to eliminate the need for straps. The estimated cost of the wing redesign was \$32 million.

Also as part of the agreement, the Pentagon eased several performance specifications regarding the C-17. Among other changes, the ferry range of the aircraft was reduced to 4,300 nautical miles from 4,600 nautical miles, and maximum payload was dropped to 169,000 pounds from 172,200 pounds.

The settlement was approved by congressional authorizers in mid-1994, despite criticism of the agreement from the General Accounting Office (GAO). The agency said in April 1994 that the settlement was not in the best interest of the U.S. government for a number of reasons, including that the validity of McDonnell Douglas' potential claims against the government had not been determined. Nevertheless, approval of the settlement was included in the FY95 defense authorization bill.

According to the Pentagon, the C-17 program had faced a number of difficulties, including failure to meet specification requirements for payloads delivered at various ranges, structural failures during ground testing, delay in the ground and flight testing schedule, late deliveries, and increased costs.

**Significant Progress.** The C-17 program made considerable progress in 1994, culminating in the January 1995 declaration of Initial Operational Capability (IOC) for the first USAF C-17 squadron. Declaration of IOC meant that the C-17 was now part of the service's operational inventory and that aircraft from the first squadron were ready for any type of military mission.

Another C-17 milestone occurred in October 1994 when the aircraft performed its first operational missions. Two C-17s flew nonstop from Langley Air Force Base, Virginia, to the Arabian Peninsula carrying outsized U.S. Army vehicles as well as troops and equipment.

In July-August 1995, the C-17 underwent a 30-day reliability, maintainability, and availability (RM&A) evaluation under which the fleet was tested under peacetime and simulated wartime emergency conditions. The evaluation was designed to compare actual performance with design requirements and goals. During the evaluation, the C-17 had an aircraft departure reliability rate of over 98 percent.

**DAB Decision.** The early 1994 C-17 agreement between the Pentagon and McDonnell Douglas in effect

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placed the company in a kind of probationary period. The Pentagon agreed to procure a minimum of 40 C-17s. If USAF procurement had ended at 40 aircraft, an NDAA would have been selected and procured to provide additional airlift capability. The NDAA would have been chosen from commercially available and/or non-developmental freighter-type aircraft to fill outsize and oversize cargo requirements. (Outsize cargo is that which does not fit within the cargo box of the C-141, and oversize cargo is material larger than USAF's standard 4,536-kg pallet.)

Potential NDAA candidates included the Boeing 747-400, the Lockheed C-5D, the McDonnell Douglas MD-11, and a number of updated, used freighters, including the DC-10, the L-1011, and earlier 747 models. The NDAA was pursued on two tracks: a C-XX commercial aircraft derivative and a C-XY existing military transport. However, only one aircraft would have been chosen.

In November 1995, the Pentagon announced that the Defense Acquisition Board (DAB) had determined that planning for a buy of 120 C-17s provided the best value and the best means to improve the ability to rapidly apply U.S. military power throughout the world. The Pentagon would plan and budget for 120 C-17s. Further effort on a modified 747-400 NDAA was deferred.

**Multiyear Purchase.** In February 1996, the Pentagon announced that it would recommend to Congress a plan to buy the remaining 80 C-17s over a seven-year period for \$16.6 billion. Forty production C-17s had been funded previously.

In April 1996, U.S. President Bill Clinton signed into law a budget accord that contained language approving the multiyear purchase. The following May, Air Force Secretary Sheila Widnall signed letters of transmittal to McDonnell Douglas and engine manufacturer Pratt & Whitney to build 80 C-17 aircraft and their engines over a period of seven years.

McDonnell Douglas received a \$14.2 billion, seven-year contract from the Air Force for the 80 C-17s. Combined with a separate contract to Pratt for the engines, the 80 aircraft were to cost approximately \$16.2 billion.

Boeing delivered the 41st production C-17 to the Air Force in August 1998. This aircraft was the first delivered under the \$14.2 billion contract.

**British Acquisition.** In May 2000, the U.K. announced plans for the lease of four C-17s. The lease contract for the four aircraft was signed in September 2000. The contract was worth approximately \$725 million. Delivery of the first aircraft occurred in May 2001. All four aircraft were delivered by August 2001.

The U.K. purchased the four C-17s outright in 2008, when the lease deal with Boeing expired. The U.K. eventually acquired four additional C-17s, including two delivered in 2008, one in 2010, and one in 2012.

### *A Commercial C-17*

**BC-17X.** In December 2000, Boeing and the U.S. Air Force issued a Request for Information (RFI) proposing a joint government/industry purchasing strategy for the BC-17X, a commercial version of the C-17. The acquisition strategy involved both government investment and private financing to purchase the aircraft. The BC-17Xs would have been operated by one or more commercial cargo operators but could have been used in an emergency by the U.S. Department of Defense.

Production of additional aircraft would also have reduced the unit cost for both the military and commercial C-17 versions.

In the year prior to the issuance of the RFI, the Air Force had conducted a study on the Commercial Application of Military Airlift Aircraft (CAMAA). The results convinced both the Air Force and Boeing that commercial opportunities for the BC-17X existed. According to the study's findings, the heavy outsize and oversize cargo markets were growing faster than the general cargo market.

Ultimately, no BC-17X aircraft were ever sold or produced.

**New Multiyear Buy.** In August 2002, Boeing and the U.S. Air Force announced the signing of a \$9.8 billion contract for 60 additional production C-17s. This brought the total number of production C-17s under contract for the Air Force to 180.

### *Congress Adds 10*

Unwilling to let the C-17 go out of production, the U.S. Congress added funding for procurement of 10 aircraft, not requested by the Air Force, during FY07 budgetary action. In its FY07 budget request, the Air Force had sought approval for only 12 C-17s, representing the final aircraft of the service's then-planned 180-unit purchase. Boeing was scheduled to complete delivery of the 180 C-17s in the spring of 2008.

However, the 10 aircraft added by Congress resulted in 22 C-17s being procured for FY07 and upped the Air Force's total C-17 acquisition to 190 production aircraft. In December 2006, Boeing was awarded a \$2.0 billion USAF contract for the 10 additional aircraft.

Manufacture of the 10 additional USAF C-17s extended C-17 production to mid-2009.

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### *Fifteen More*

During action on the FY08 warfighting supplemental appropriations bill, congressional lawmakers initially added \$3.6 billion for the procurement of 15 C-17s for the Air Force. The 15 aircraft had not been requested by the service. However, prior to final passage of the legislation in June 2008, Congress made a \$3.6 billion across-the-board reduction to overall FY08 war funding.

For several months, it remained unclear exactly how this across-the-board cut would affect the C-17, including whether fewer than 15 C-17s would ultimately be funded. Finally, in November 2008, the Air Force said that it would order all 15 aircraft, using leftover FY07 funds to make up for the last-minute reduction to the FY08 supplemental appropriations. Boeing received a contract for the 15 aircraft in February 2009.

The 15 additional aircraft brought the Air Force's total planned buy to 205 production C-17s and extended C-17 production into 2010.

### *Nineteen Added*

On two separate occasions in 2009, Congress stepped in to fund procurement of additional USAF C-17s. In mid-2009, Congress added funding for eight C-17s to the FY09 warfighting supplemental appropriations bill. The eight aircraft, which had not been requested by the Air Force, brought the service's total planned buy to 213 production C-17s.

Meanwhile, the Air Force had not requested funding for any C-17s in its FY10 budget request and, instead, asked for funds to shut down the production line. However, Congress once again saved the program. In late 2009, Congress added funding for 10 C-17s to the FY10 defense appropriations bill.

This move put Congress in opposition to itself, as no C-17s had been included in the FY10 defense authorization bill. Despite the differences between the two bills, the appropriations measure prevailed. Thus, the Air Force's planned buy rose to 223 production C-17s.

In late 2011, Congress added funding for one C-17 to the FY12 defense appropriations bill. The Air Force had not requested funding for any. Consequently, the service's total planned buy now increased to 224 production C-17s.

### *Export Deals*

In July 2006, Boeing received a \$780 million USAF contract to provide four C-17s to the Royal Australian Air Force (RAAF). Boeing delivered the first aircraft to

the RAAF in November 2006 and the remaining three aircraft followed by February 2008.

The RAAF later received four more C-17s, bringing its fleet to eight aircraft. The service took delivery of its fifth C-17 in September 2011, its sixth in November 2012, its seventh in July 2015, and its eighth in September 2015.

In February 2007, the government of Canada awarded a contract to Boeing for the supply of four C-17s. The first two aircraft were delivered in 2007; the final two were delivered in 2008. A fifth Canadian C-17, purchased under a later deal, was delivered in March 2015.

Qatar signed an agreement with Boeing in July 2008 for two C-17s, plus options for two additional aircraft. The initial aircraft was delivered in August 2009, and the second followed in September 2009. Both options were eventually exercised, and the two additional C-17s were delivered in 2012.

Subsequently, four additional C-17s were ordered for Qatar. The four aircraft, all of which were completed by November 2015, were delivered in 2016.

In May 2011, Boeing delivered the first of six C-17s to the UAE Air Force and Air Defense. Three more aircraft followed by the end of the year. The two remaining C-17s were delivered in 2012. Subsequently, the service acquired two additional C-17s under a February 2015 deal. These two aircraft were delivered by September 2015.

The Kuwaiti Air Force acquired two C-17s. The first was delivered in February 2014 and the second followed later that year.

Boeing delivered 10 C-17s to the Indian Air Force in the 2013-2014 timeframe, and an 11th in 2019.

### *SAC Consortium*

Under a deal reached in November 2008, a group of 10 NATO member nations and two other countries acquired three C-17s in order to establish a joint airlift capability. The aircraft are operated on a pooled basis, similar to the NATO fleet of Boeing E-3 AWACS aircraft. The 10 NATO nations are Bulgaria, Estonia, Hungary, Lithuania, the Netherlands, Norway, Poland, Romania, Slovenia, and the U.S. The two non-NATO countries are Finland and Sweden. The group of nations is collectively known as the Strategic Airlift Capability (SAC) consortium.

One of the three C-17s was a new aircraft contributed by the U.S. from the USAF buy of production C-17s. This aircraft was delivered new to the SAC consortium

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in July 2009. SAC's remaining two C-17s were purchased directly from Boeing. They were delivered in September 2009 and October 2009, respectively.

The three aircraft are assigned to SAC's Heavy Airlift Wing and are jointly operated by the SAC nations from Papa Air Base in Hungary. The NATO Support and Procurement Agency is responsible for management and support of the C-17s on behalf of the SAC countries.

### *Final USAF Delivery*

Boeing delivered the U.S. Air Force's final C-17 in September 2013. This aircraft was the 223rd production C-17 delivered to the service.

While 224 production C-17s had been funded for the Air Force, one of these aircraft was actually delivered to the multinational SAC consortium, as indicated above.

## Funding

### U.S. FUNDING

	FY17 <u>QTY</u>	FY17 <u>AMT</u>	FY18 <u>QTY</u>	FY18 <u>AMT</u>	FY19 <u>QTY</u>	FY19 <u>AMT</u>	FY20 (Req) <u>QTY</u>	FY20 (Req) <u>AMT</u>
C-17 Mods	-	17.5	-	96.4	-	77.2	-	60.2
C-17 RDT&E (PE#0401130F)	-	12.0	-	21.7	-	48.3	-	25.1

All \$ are in millions.

## Contracts/Orders & Options

Contractor	Award (\$ millions)	Date/Description
Boeing	9,762.0	Aug 2002 – Contract from USAF to provide 60 C-17 aircraft (P-121 to P-180).
Boeing	780.0	Jul 2006 – Contract from USAF to provide four C-17 aircraft to the Royal Australian Air Force.
Boeing	2,000.0	Dec 2006 – Contract from USAF for the acquisition of 10 Block 18-configured C-17 aircraft. The 10 aircraft were a follow-on acquisition to the original 180 C-17 production aircraft.
Boeing	2,950.0	Feb 2009 – Contract from USAF for procurement of 15 C-17 aircraft.
Boeing	400.0	May 2009 – Contract from USAF for procurement of two FMS C-17 aircraft.
Boeing	1,528.5	Jun 2010 – Contract modification from USAF to procure eight C-17 aircraft.
Boeing	962.5	May 2011 – Delivery order from USAF against the basic C-17 production contract to procure the first five aircraft of the FY10 USAF C-17 requirement.
Boeing	195.7	Jun 2011 – Delivery order from USAF against the basic C-17 production contract to procure one C-17 aircraft. This effort supported Foreign Military Sales to the government of Australia.
Boeing	693.4	Jan 2012 – Contract from USAF for a modification to a delivery order against the basic C-17 production contract to procure five additional USAF C-17 aircraft.
Boeing	1,781.4	Feb 2012 – Contract modification from USAF for an FMS requirement for the Indian Air Force (IAF). Ten C-17 aircraft were procured for the IAF.
Boeing	171.5	Jun 2012 – Contract from USAF to procure one C-17 aircraft.
Boeing	169.8	Jun 2012 – Contract from USAF to procure one C-17 replacement aircraft.
Boeing	500.0	Jul 2012 – Contract from USAF for the C-17 transition to post-production, providing for orderly transfer of C-17 production assets.
Boeing	895.0	Dec 2012 – Contract from USAF for C-17 operational enhancements to provide integrated software, hardware upgrades, and development efforts for the C-17 weapon system.
Boeing	7,127.0	Aug 2017 – Contract modification from USAF for an increase to the indefinite delivery/indefinite quantity (IDIQ) ceiling for C-17 sustainment.



## Boeing C-17

Contractor	Award (\$ millions)	Date/Description
Boeing	262.0	Mar 2018 – Not-to-exceed undefinitized contract action from USAF for one C-17 aircraft in the India-unique configuration.

## Timetable

Month	Year	Major Development
Jul	1979	USAF opts for strategic capability for AMST aircraft
Dec	1979	AMST canceled; CX effort launched
Oct	1980	RFP issued
Aug	1981	McDonnell Douglas selected as winner
Jul	1982	McDonnell Douglas awarded first R&D contract
Dec	1988	FAA certification of F117-PW-100 turbofan engine
Sep	1991	C-17 prototype (T-1) first flight
May	1992	First flight of initial production aircraft
Jun	1992	First flight of second production aircraft
May	1993	Initial C-17 airdrop
Jan	1995	Initial Operational Capability
Sep	2013	Final USAF C-17 delivered
Nov	2015	C-17 production ended
Aug	2019	Final C-17 delivered

## Worldwide Distribution/Inventories

(as of February 2020)

Operator	Designation	Quantity
Australia Air Force	C-17A	8
Canadian Forces	C-17A	5
India Air Force	C-17A	11
Kuwait Air Force	C-17A	2
Qatar Air Force	C-17A	8
Strategic Airlift Capability Consortium	C-17A	3
United Arab Emirates Air Force	C-17A	8
United Kingdom Air Force	C-17A	8
United States Air Force	C-17A	222

## Forecast Rationale

The last available C-17 was delivered to the Indian Air Force in August 2019. The aircraft was built in 2014 as a white tail, and had been placed into storage at Boeing facilities in San Antonio, Texas. It remained unsold until 2018. In the meantime, C-17 production came to an end in November 2015.

The delivery brought the Indian Air Force's C-17 fleet to 11 aircraft.

Over the life of the program, Boeing built a total of 277 C-17s, plus two structural test airframes.

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