

# ARCHIVED REPORT

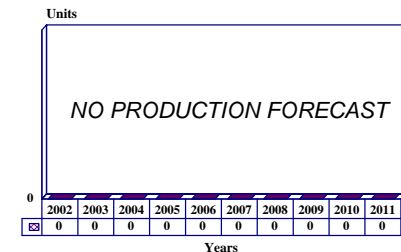
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## Boeing MD-11 - Archived 4/2003

### Outlook

- Production has been completed
- A total of 200 MD-11s was produced

10 Year Unit Production Forecast  
2002 - 2011



### Orientation

**Description.** Very-long-range, high-capacity, widebody commercial transport aircraft.

**Sponsor.** Privately sponsored by Boeing Company.

**Contractors.** Boeing Company; Long Beach, California, USA. The MD-11 was developed and initially produced by McDonnell Douglas Corp which, in 1997, merged with Boeing.

**Status.** Production ended in 2000. Two MD-11Fs produced in 2000 were delivered in early 2001.

**Total Produced.** A total of 200 MD-11s was produced.

**Application.** Transoceanic and transcontinental scheduled passenger transportation on routes between 5,000 and 7,000 nautical miles; dedicated freighter/package express carrier; combination passenger/freight transportation.

**Price Range.** MD-11, \$132.0-\$147.5 million in 1999 US dollars.

### Technical Data

(MD-11)

**Design Features.** Cantilever low-swept-wing monoplane with all-moving horizontal tail and single swept fin mounted integrally with the No. 2 powerplant. The MD-11 incorporates an 18.6-foot stretch over its DC-10 predecessor, has a maximum gross weight of over 600,000 pounds, and has a design range of 7,630 nautical miles (standard version). The aircraft also features a two-pilot, glass cockpit with an FAA Category IIIB auto-land system. The aircraft uses winglets which were originally tested aboard a DC-10 under a NASA-sponsored program, a redesigned wing trailing edge, a smaller horizontal tail (with integral fuel

tanks) than the DC-10, and an extended tail cone. The use of weight-saving materials and improvements in aerodynamic design provide the MD-11 with a 17-20 percent fuel savings per trip, 16 percent lower direct operating costs, and significant improvement in range compared with the DC-10-30 model. Composite materials account for more than 5,200 pounds of airframe weight. Composite materials are used in the nose cone, wing root fairings, engine nacelles, winglets, and landing gear doors. The undercarriage is tricycle type with twin four-wheel main units and an additional

two-wheel unit on the fuselage centerline. The nose gear is a two-wheel unit.

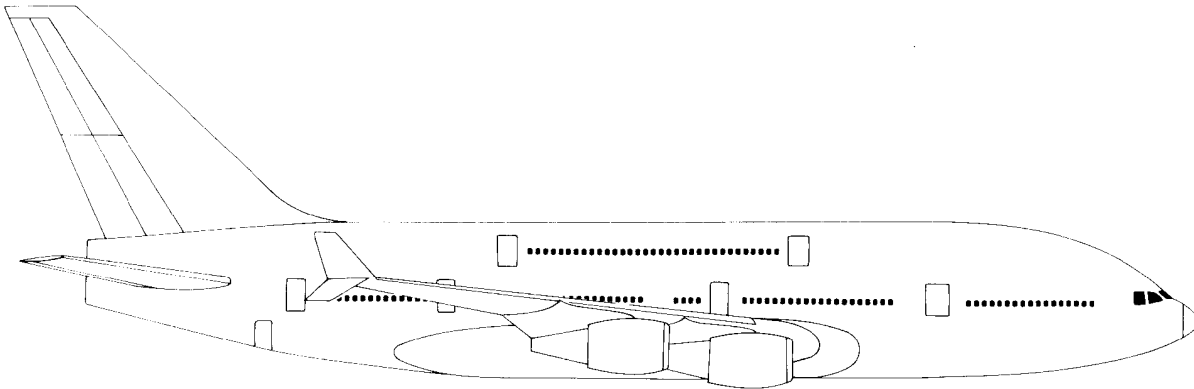
	<u>Metric</u>	<u>US</u>
<b>Dimensions</b>		
Length overall (with Pratt engines)	61.24 m	200.92 ft
Height overall	17.65 m	57.92 ft
Wingspan	51.77 m	169.83 ft
Cabin length	46.51 m	152.60 ft
Cabin max width	5.72 m	18.75 ft
<b>Weight</b>		
Max take-off weight		
standard	273,290 kg	602,500 lb
optional	285,990 kg	630,500 lb
<b>Capacities</b>		
Max fuel capacity	146,155 liters	38,615 US gallons
Lower deck cargo volume	194.0 cu m	6,850 cu ft
<b>Performance</b>		
Design range		
standard	12,270 km	7,630 nm
optional	13,230 km	8,225 nm

#### **Propulsion**

MD-11	(3)	UTC Pratt & Whitney PW4460 two-spool, high-bypass advanced-technology turbofan engines rated 266.9 kN (60,000 lbst) each; or
	(3)	UTC Pratt & Whitney PW4462 turbofan engines rated 276.0 kN (62,000 lbst) each; or
	(3)	GE Aircraft Engines CF6-80C2 twin-spool, axial-flow high-bypass turbofan engines rated 273.6 kN (61,500 lbst) each.

#### **Seating**

MD-11: Standard seating is for 250 passengers in a three-class configuration, 298 passengers in a two-class layout, and up to 410 passengers (FAA-approved in January 1993) in a single-class, high-density seating arrangement.



MD-12

Source: Forecast International



MD-11

Source: Boeing

## Variants/Upgrades

MD-11 STD. Standard passenger version. It was the subject of an extensive product improvement program introduced in stages. Improvements included airframe weight reduction, an increase in maximum take-off weight, drag reduction, take-off distance restoration, optional auxiliary fuel tanks, and engine improvements.

MD-11ER. McDonnell Douglas launched an MD-11ER variant in early 1994 featuring a range of 7,240 nautical miles (with 298 passengers). Initial delivery of the new variant occurred in 1996. The MD-11ER was marketed in passenger, freighter, combi, and convertible freighter versions.

MD-11 Stretch. Not to be confused with later proposed MD-11 stretched versions, this was an early predecessor design to the envisioned four-engine MD-12. This derivative was to be a simple airframe stretch incorporating two fuselage plugs for a total length addition of 35 feet, seating 368 in a three-class configuration, and providing a maximum full passenger range of between 5,000 and 5,500 nautical miles. It was also called the Domestic Stretch. The same MD-11 wing was to be employed and gross weight would remain approximately the same as for the standard trijet.

Douglas said that several major US and international airlines were interested in this model. One or more Asian operators were also seriously considering this version in 1990, with the panoramic lower deck seating up to 94 additional passengers. Standard three-class seating and high-density seating with the panoramic lower deck was 450 and 600, respectively.

MD-12. Prior to its 1992 redesign, the MD-12 was intended to be the most ambitious stretch considered by Douglas. It was known as the MD-12X and was to employ a 35-foot fuselage stretch and an entirely new wing with a span of 213 feet. At this span, range would be 8,000 nautical miles. Douglas said that a new wing would require more than \$1.0 billion to develop. It would carry about 375 passengers in a three-class configuration and up to 520 in an all-economy layout.

In early 1992, Douglas announced a major configuration change to the MD-12. It would now be a four-engine, double-deck aircraft designed to compete directly with the Boeing 747-400. The aircraft would feature a longer fuselage than the MD-11, fly-by-wire flight controls, a 229-foot-span wing with increased area, and four 60,000-64,000 lbst powerplants. Possible

engines included the Pratt & Whitney PW4460, the GE CF6-80C2, and the Rolls-Royce Trent 764.

Several MD-12 versions were planned. A long-range version would carry 481 passengers and have a range of 8,090 nautical miles. A high-capacity variant would carry 579 passengers and have a range of 7,130 nautical miles. A freighter version and a combi version were also planned. The company also studied a stretch version that would carry over 600 passengers, and a twin-engine model with a capacity of approximately 500 passengers.

MD-11 Combi. This variant has a mixed passenger/cargo configuration with a capacity for 181 passengers in three classes and six cargo pallets on the main deck. It can also be configured as an all-passenger aircraft carrying 285 passengers in a three-class layout.

MD-11F. This is a dedicated freight carrier. It has 447 cubic meters (15,530 cubic feet) of cargo volume on the main deck plus the standard 194 cubic meters (6,850 cubic feet) in the lower hold. A 102-inch-tall cargo

door is installed in the forward fuselage. Weight-limited payload is 90,787 kilograms (200,151 pounds).

MD-11CF Convertible Freighter. Convertible freighter version of the MD-11. It was launched in August 1991.

MD-11 Twin. McDonnell Douglas studied a proposed twin-engine, medium-range MD-11 called the Twin MR. The Twin MR would have used a pair of 70,000-lb engines, and have a range of 4,500-6,000 nautical miles. The aircraft would have carried 220-260 passengers. The MD-11 Twin would have had the same cross section and wing area as the current MD-11 but would have had a slightly shorter fuselage and an engineless tail. Maximum take-off gross weight would have been approximately 560,000 pounds.

Douglas also considered a long-range version of the Twin (the Twin LR) powered by 90,000 lb engines. For further down the road, a stretched version of the medium-range Twin was also under consideration. The Twin Stretch MR would have had a 5.6-meter fuselage plug forward of the wing and a 5.2-meter plug aft.

## Program Review

**Background.** The formal launch of the MD-11 in 1986 followed exactly 20 years after the launch of its predecessor, the widebody DC-10 trijet.

The initial MD-11 order was placed by British Caledonian, for nine aircraft, in December 1986. Later that same month, Mitsui & Company of Japan purchased five, and SAS bought 12. SAS later declined to convert a letter of intent for its 12 MD-11s, and British Caledonian relinquished its delivery positions when it was acquired by British Airways in 1988. The British Caledonian slots were subsequently picked up by American Airlines in early February 1989 when it placed an order for eight MD-11s along with options for an additional 42 aircraft. In that same month, McDonnell Douglas announced firm orders for 11 MD-11s and options for 15 more of the long-range transports from Air Europe, Aero Lloyd, Finnair, and ZAS of Egypt.

The prospect of selling 76 of the DC-10 follow-on airliners in one month was viewed by financial analysts as an extraordinary rebound for a program that had languished in the shadow of massive Boeing 747 sales. In fact, some analysts erroneously attributed the American Airlines MD-11 orders to the fact that Boeing had sold so many 747s that deliveries were backed up into the mid-1990s. However, the MD-11, with a range very close to that of the 747-400, was considered more suitable to America's use of hubs such as Dallas and Chicago to serve destinations in Europe and the Pacific.

Air Europe's order included six MD-11s, powered by Rolls-Royce RB211 engines, as well as options on 12 more. The European carrier, in fact, was the launch customer for the Rolls-Royce RB211-524L, rated at 65,000 lb and specifically designed to power the widebody transports of the 1990s. Rolls-Royce and Douglas eventually terminated their agreement on the MD-11, and instead turned their attention to the MD-12.

International Participation. Douglas was initially successful in securing the interest of Asian investors in the MD-12 project. In late 1991, McDonnell Douglas and a new firm called Taiwan Aerospace signed a preliminary accord which called for Taiwan Aerospace to take a 40 percent equity share in Douglas Aircraft Company. That share was equivalent to approximately \$2.0 billion and would have essentially been used to pay down McDonnell Douglas' debt.

During the summer of 1992, however, Taiwan Aerospace's interest in the project began to wane, and it instead signed an MoU with British Aerospace involving joint development, production, and marketing of the 146/RJ family, thus signaling the end of any significant near-term Taiwanese investment and/or participation in the MD-12. McDonnell Douglas then continued to search for partners for the MD-12 effort.

MD-11 Fuselage Production. Production of MD-11 fuselage sections at the Douglas Aircraft plant in Long Beach, California, began in late 1995. The sections are over 5.5 meters (18.0 feet) in diameter and up to 18.3

meters (60.0 feet) in length. The first Long Beach-produced fuselage was completed in July 1996. Until production began in Long Beach, the fuselage sections had been produced in San Diego at the Convair Division of General Dynamics Corp. However, in 1994, General Dynamics announced that it had decided to withdraw from the business. While plans were being formulated for placing the fuselage production elsewhere, workers at Douglas proposed bringing it to Long Beach, where MD-11 design and final assembly had already occurred.

Accounting Change. Due to a change in accounting procedures regarding the MD-11 program, McDonnell Douglas took a pre-tax charge of \$1.838 billion to fourth quarter 1995 operations. This change was made because the company could not reasonably estimate costs and revenues over the life of the MD-11 program. Effective October 1, 1995, McDonnell Douglas changed its accounting for the program from a program basis of accounting to a specific unit basis.

Under the program basis, costs for delivered MD-11s were charged to cost of sales based on the estimated average unit cost for the entire program. Actual costs over the program average were deferred and were to be recovered by future delivery of lower-than-average-cost units. Under the new specific unit basis, MD-11 costs were to be charged to cost of sales based on the actual unit cost of the delivered aircraft. Costs would no longer be deferred to be recovered on future deliveries. The \$1.8 billion pre-tax charge resulting from the accounting change was a one-time charge to operations for deferred production costs and for a reduction in the valuation of support and tooling cost. The accounting change can be viewed as effectively an admission that the MD-11 might not have a long production run.

New Versions. In recent years, McDonnell Douglas studied several possible MD-11 variants. In early 1994, it introduced the MD-11ER, an extended-range variant capable of flying 7,200 nautical miles. The company marketed the MD-11ER as a low-cost alternative to the Boeing 747-400. It also can be seen as Douglas' answer to the Airbus A340.

McDonnell Douglas also studied MD-11 versions with an all-new wing. The MD-11LR would have had a range of over 8,000 nautical miles and was envisioned

as a competitor to the A340 and the Boeing 777. Besides the new wing, the MD-11LR would also have featured an advanced flight control system, a four-wheel central landing gear, a six-wheel wing landing gear, and engines rated at over 65,000 lbst. Its fuselage would have been the same length as that of the standard MD-11. The MD-11 Stretch was to be similar to the MD-11LR but have a 9.45-meter (31-foot) longer fuselage.

The MD-11LR/MD-11 Stretch eventually became known as the MD-XX. Planned for introduction in the year 2000, the MD-XX was intended to replace the current MD-11 on the Long Beach production line. Two versions of the MD-XX were proposed, both using a new wing larger than the current MD-11 wing. One was a stretched, 375-passenger aircraft with a range of up to 7,200 nautical miles. This version, called simply the MD-XX, was intended for the Boeing 747-200/300 replacement market.

The second version, called the MD-XXLR, had a range of over 8,000 nautical miles and a 310-passenger capacity. It was to compete with the A340 and the 777.

Ultimately, the MD-XX was never formally launched by McDonnell Douglas. In October 1996, the company's board of directors canceled the program. The cost and the timing of the MD-XX program were seen as major problems.

The MD-XX had considerable promise and could well have become the linchpin of a strategy to shore up, and even expand, the company's share of the large commercial transport market. The initial development costs for the MD-XX were estimated to be \$2.0 billion, a relatively affordable amount. However, the ultimate cost of developing a completely new product line, including the MD-XX, was estimated at \$15 billion over a period of 10 years. In addition, studies by McDonnell Douglas concluded that the MD-XX would probably miss the current cycle of resurgent worldwide demand for commercial jets.

Essentially, though, the decision not to proceed with the MD-XX would have relegated McDonnell Douglas, perhaps permanently, to niche player status in the commercial aircraft market. The company's market share would likely have continued to decline as well.

## Funding

All MD-11 funding was provided internally by McDonnell Douglas and its risk-sharing partners.

## Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
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<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Jan	1986	MD-11 design firmed up
Dec	1986	MD-11 formally launched
Mar	1987	Component fabrication began
Mar	1988	MD-11 assembly began
Sep	1989	MD-11 prototype rollout
Jan	1990	MD-11 first flight
Nov/Dec	1990	Certification of GE and P&W-powered MD-11; Initial deliveries to Finnair (1) and Delta (2 - Mitsui lease)
Aug	1991	Launch of MD-11CF convertible freighter
Apr	1992	Four-engine MD-12 design announced
Jun	1993	100th MD-11 delivered
Oct	2000	MD-11 production ended

## Worldwide Distribution

See the World Airline Inventories appendix.

## Forecast Rationale

Boeing rolled out the final two MD-11s in October 2000. The two aircraft were MD-11F freighters for Lufthansa Cargo. One was delivered to the carrier in January 2001, and the second followed the next month.

Boeing had decided in June 1998 to terminate MD-11 production due to poor sales. Few orders had been recorded during the previous 12 months, and many of these were follow-on orders from existing MD-11 operators.

Only a few months earlier, in November 1997, Boeing had appeared optimistic about MD-11 sales prospects and had been expecting demand for at least 300 MD-11s during the next 20 years, with 80 percent of the orders expected from cargo customers. The company

had been planning to continue production of the MD-11 in both passenger and freighter versions for the foreseeable future. It had planned to focus its marketing efforts on the freighter. However, MD-11 orders continued to materialize very slowly, and Boeing quickly changed its plans.

New orders from potential customers for the passenger version of the MD-11 had been going primarily to Boeing's own 777 as well as to the Airbus A340. In addition, the MD-11F freighter was competing against used passenger transports, including used MD-11s, that could be purchased and then converted to a freighter configuration at less than the cost of a new-production MD-11F.

## Ten-Year Outlook

### ESTIMATED CALENDAR YEAR PRODUCTION

Aircraft	(Engine)	High Confidence Level				Good Confidence Level			Speculative			Total 02-11	
		thru 01	02	03	04	05	06	07	08	09	10		11
BOEING													
MD-11	CF6-80C2	123	0	0	0	0	0	0	0	0	0	0	0
MD-11	PW4000	77	0	0	0	0	0	0	0	0	0	0	0
Subtotal - BOEING		200	0	0	0	0	0	0	0	0	0	0	0
MCDONNELL DOUGLAS CORPORATION													
DC-10-10	CF6-6D	126	0	0	0	0	0	0	0	0	0	0	0
DC-10-15	CF6-50C2F	7	0	0	0	0	0	0	0	0	0	0	0
DC-10-20	JT9D-20	22	0	0	0	0	0	0	0	0	0	0	0
DC-10-30	CF6-50C2	213	0	0	0	0	0	0	0	0	0	0	0
DC-10-40	JT9D-59A	18	0	0	0	0	0	0	0	0	0	0	0
Subtotal - MCDONNELL DOUGLAS CORPORATION		386	0	0	0	0	0	0	0	0	0	0	0
Total Production		586	0	0	0	0	0	0	0	0	0	0	0