

MD-11 family specifications

The MD-11 family is sub-divided into passenger & freighter aircraft and those with PW & GE engines.

The MD-11 was launched in 1986 as a replacement for the DC-10-30, and to provide airlines with higher capacity for growth on long-haul routes. The aircraft was also intended to have a range of about 7,000nm with a standard tri-class configuration of passengers. This would allow airlines to operate non-stop trans-Pacific routes, since it was anticipated that this market, and others, would experience liberalisation.

The MD-11's development was cut short by the initial performance shortfalls it suffered on entry into service, and from which it never really recovered. McDonnell Douglas (MDC) was able to provide performance improvement programmes to recover the originally intended performance, as well as later to increase the aircraft's performance.

The MD-11, however, was outperformed by the A340-300 which was launched in 1987, and then by the 777 launched in 1990. These two reduced orders for the MD-11 to a trickle, and caused outstanding commitments to be cancelled. Plans to develop stretch and longer-range versions of the MD-11 were scrapped, and the last aircraft were built in 2000, with total firm orders reaching 200.

The first MD-11s, belonging to American Airlines, were converted to freighters as early as 1996, with some of the aircraft being as young as five years old. American had clearly expressed its dissatisfaction with the MD-11, and quickly sold its 19 aircraft to FedEx. Korean Air also sold three of its fleet for freighter conversion at the same time. Although by this time the MD-11 had gained universal disapproval as a passenger aircraft, it became respected as a freighter, and demand from freight carriers has remained strong. Out of 200 aircraft ordered, 58 were specified as freighters and five as Combis, indicating that interest in the MD-11 as a passenger aircraft was always weak. The majority of passenger-configured aircraft have been modified to freighter, and there now remain only 26 passenger-configured aircraft potentially available for conversion to freighter (see *MD-11 fleet analysis*, page 14).

Initial development

Perhaps the MD-11's failing was the fact that it was a derivative of the DC-10, and not an all-new design. The MD-11 tri-jet features an 18-foot fuselage stretch over the DC-10, which allows a standard tri-class capacity of 298. This is a combination of 16 first-, 56 business- and 226 economy-class seats. The aircraft also offered a two-man flightdeck, a larger wing and fuel capacity than the DC-10-30, and the choice of PW4000-94 and CF6-80C2D1F engines.

The original aircraft had a maximum take-off weight (MTOW) of 602,500lbs, and fuel capacity of 38,615 US Gallons (USG). It was intended to have a range of 6,840-7,000nm with its standard load of passengers. Many early aircraft actually had their MTOWs certified at 605,000lbs.

The PW4000-94 engines available for the MD-11 were rated either at 60,000lbs thrust or 62,000lbs thrust and had full authority digital engine control (FADEC) as a standard feature. These engines are designated the PW4460 and PW4462.

The CF6-80C2 variant on offer is the -80C2D1F, rated at 61,500lbs thrust. The F suffix indicates that the engine has FADEC controls, which are standard on the CF6-80C2 powering the MD-11. The -80C2 family comes with or without FADEC controls.

Both engines are flat rated at 86 degrees Fahrenheit, equal to 30 degrees centigrade, which means that take-off thrust is held constant for an outside air temperature of up to 30 degrees, but then reduced for higher outside temperatures.

The first aircraft was delivered to Finnair in November 1990, and in early 1991 it was revealed that the MD-11's performance was short of its design specification. The aircraft had higher fuel burn, empty weight and airframe drag than the intended design specification and consequently suffered a range shortfall. PW4000-powered aircraft had 6.7-8.4% higher fuel burn and a reduced range of 6,270nm, and CF6-powered aircraft had a 4.5-5.3% higher fuel burn and a range of 6,460nm.

Besides passenger accommodation, the MD-11 can accommodate 32 LD-3

containers in its underfloor compartment. These are loaded in pairs, with 18 in the forward section and 14 in the aft. These each have an internal volume of 146 cubic feet, and so provide a total of 4,672 cubic feet (see *table*, page 13). The MD-11 also has a space for bulk freight at the rear of the fuselage which provides 510 cubic feet.

Passenger-configured aircraft have a maximum zero fuel weight (MZFW) of 400,000lbs and an operating empty weight (OEW) of 283,975lbs for the MD-11, and 291,120lbs for the MD-11ER. This gives the MD-11 a structural payload of 116,025lbs, and the MD-11ER a structural payload of 108,880lbs (see *table*, page 13). The tare weight of 6,880lbs for the 32 LD-3s should be deducted from this, giving the aircraft a net structural payload of about 109,000lbs and 102,000lbs.

A full load of passengers will have a payload of about 67,000lbs, and so the aircraft will be able to accommodate an additional freight payload of 35,000lbs.

Performance improvement

While receiving negative publicity, MDC overcame the MD-11's performance shortfalls with a series of performance improvement packages. The first step was a rise in MTOW to 618,000lbs, which was later increased in 1993 to 625,500lbs. MDC also offered a drag reduction programme, which increased the aircraft's range.

In 1994 MDC introduced the MD-11ER (extended range), which provided the aircraft with a range of up to 7,210nm. This involved a further increase of MTOW up to 630,500lbs, the option of installing two auxiliary fuel tanks which took fuel capacity up to 42,584 USG, a 1,500lbs reduction in operating empty weight and a series of aerodynamic improvements.

The majority of MD-11s now have MTOWs of 618,000lbs, 625,500lbs and 630,500lbs. Most aircraft have maintained the original fuel capacity of 38,615 USG, however, and have not selected the option of the two auxiliary tanks.

The several increases in MTOW did have the effect of improving the aircraft's range, and the aircraft with an MTOW of 630,500lbs has about a 300nm longer range than aircraft with the initial MTOW of 602,500lbs (see *table*, page 13). The effect of the single and double auxiliary fuel tanks was only to increase the range of the aircraft at the maximum fuel line portion of the aircraft's payload range curve. This means that range is only added when the aircraft is carrying a payload of about 250 passengers or fewer, which explains why few aircraft have had them installed.

Combi aircraft

Alitalia was the only airline to order the Combi variant. The aircraft had a freight door at the left rear of the fuselage which is 102 inches high and 160 inches wide. The size of the freight area on the maindeck varies. It can accommodate either two 88-inch wide or two 96-inch wide by 125-inch long freight containers at the rear, and then the same type of containers in pairs. The actual number depends on the length of the freight cabin, with two, three or four pairs of containers being provided, thereby allowing four, six, eight or 10 containers which provide 2,224, 3,342, 4,460 or 5,578 cubic feet of freight volume.

These containers result in a corresponding drop in the number of tri-class seats on the aircraft, varying from 129 to 202.

Freighter configuration

Of the 200 MD-11s built, 58 were factory freighters, although more 70 passenger aircraft have since been converted. The factory freighter (MD-11F) and converted freighter (MD-11CF) have the same specification weights and capacities for freight accommodation.

As with the passenger aircraft, the MD-11F and converted freighter can accommodate 32 LD-3 belly containers.

There are several loading options for the maindeck. The two most popular maindeck containers are the 88-inch and 96-inch wide containers, both of which are 97 inches tall and 125 inches long, and are contoured to the inside profile of the aircraft. The 88-inch wide containers have an internal volume of 568 cubic feet, and the 96-inch wide containers have an internal volume of 607 cubic feet. These provide a total of 13,632 cubic feet and 14,568 cubic feet. These are loaded in pairs, with a total of 24 containers taking up the length of the fuselage, except for two at the rear.

The two containers at the rear of the fuselage are 125 inches wide, 97 inches tall and either 88 or 96 inches long. These provide 553 cubic feet or 605 cubic feet of volume each, and so add 1,106 or 1,210 cubic feet to the maindeck volume.

Total maindeck volume is therefore 14,738 cubic feet with 88-inch wide containers, and 15,778 cubic feet with the 96-inch wide containers (see table, this page). The aircraft thus has a total freight volume of 19,410 cubic feet when using 88-inch wide containers on the maindeck, or a total of 20,450 cubic feet when using 96-inch wide containers (see table, this page).

The MD-11F/CF has a high MZFW. There are two MZFW options for the MD-11: 451,300lbs and 461,300lbs (see table, this page). The aircraft has an

MD-11 FAMILY SPECIFICATIONS

Variant	MD-11	MD-11	MD-11	MD-11ER
MTOWlbs	602,500	618,000	625,500	630,500
MZFWlbs	400,000	400,000	400,000	400,000
OEWlbs	283,975	283,975	283,975	291,120
Gross structural payload lbs	116,025	116,025	116,025	108,880
Fuel capacity USG	38,615	38,615	38,615	38,615/42,584
Seats	298	298	298	298
Range nm	6,300	6,500	6,600	6,600/7,210
Belly freight cu ft	4,672	4,672	4,672	4,672
Engine variant	PW4460/62 CF6-80C2D1F	PW4460/62 CF6-80C2D1F	PW4460/62 CF6-80C2D1F	PW4460/62 CF6-80C2D1F
Variant	MD-11F/CF	MD-11F/CF	MD-11F/CF	MD-11ERF/CF
MTOWlbs	602,500	618,000	625,500	630,500
MZFWlbs	451,300/ 461,300	451,300/ 461,300	451,300/ 461,300	451,300/ 461,300
OEWlbs	248,567	248,567	248,567	248,567
Gross structural payload lbs	202,733/ 212,733	202,733/ 212,733	202,733/ 212,733	202,733/ 212,733
Fuel capacity USG	38,615	38,615	38,615	38,615/ 42,584
Maindeck freight Container	96 in X 125 in			
Number	26	26	26	26
Volume cu ft	15,778	15,778	15,778	15,778
Belly freight Container	LD-3	LD-3	LD-3	LD-3
Number	32	32	32	32
Volume cu ft	4,672	4,672	4,672	4,672
Total volume cu ft	20,450	20,450	20,450	20,450
Container tare lbs	27,420	27,420	27,420	27,420
Net structural payload lbs	175,493/ 185,493	175,493/ 185,493	175,493/ 185,493	175,493/ 185,493

OEW of 248,567lbs. This leaves a gross structural payload of 202,733lbs and 212,733lbs.

The tare weight of containers has to be deducted from this. The LD-3s have a unit tare weight of 215lbs, and so have a total tare weight of 6,880lbs. The 96-inch wide by 125-inch long maindeck containers have a unit tare weight of 790lbs and so a total tare weight of 20,540lbs. The total container tare weight is therefore 27,420lbs. This leaves the aircraft with a net structural or revenue payload of 175,493lbs and 185,493lbs, depending on MZFW (see table, this page). This gives the aircraft a maximum packing density of 9.1-9.6lbs per cubic foot.

These specification MZFW, OEW and payload weights are the same for both factory and converted freighters.

Stage 3 & 4 compliance

Stage 3 and 4 compliance is an issue for operators and investors to consider.

Stage 3 compliance is the cumulative (total) of the three noise measurements, measured in equivalent perceived decibels (EPNdB), being lower than those permitted for an aircraft on its MTOW, maximum landing weight and engine number configuration. The permitted cumulative noise emissions are 306.9 EPNdB for aircraft with an MTOW of 602,500lbs, 307.3 EPNdB for an aircraft with an MTOW of 618,000lbs, and 307.6 EPNdB for an aircraft with an MTOW of 630,500lbs. These three gross weight variants have actual cumulative noise emissions 11.3-14.2 EPNdB lower than those permitted, giving them a comfortable Stage 3 compliance margin.

Stage 4 compliance requires the aircraft's cumulative noise emissions to be at least 10EPNdB lower than those permitted for Stage 3 compliance. All variants of the MD-11 therefore comply with Stage 4 emissions. [AC](#)

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