

Artist's impression of a potential McDonnell Douglas HSCT 1997

Transport Aircraft; a brief description and drawing appear in the International section under Supersonic Airliner Studies.

UPDATED

McDONNELL DOUGLAS BLENDED WING/BODY STUDIES

The Advanced Transport Aircraft Systems group of Douglas, in conjunction with Stamford University and with NASA funding, is studying the feasibility of blended wing/body (BWB) concepts, comparing projected 800-passenger BWB

and conventional aircraft on technology keyed to service entry in 2010. BWB has been found to exhibit superior aerodynamic characteristics and performance resulting from single- and double-deck cabins extending farther spanwise than lengthwise, providing structural and aerodynamic overlap with wing, reducing total wetted area and permitting high aspect ratio to be achieved by means of stiff centrebody. Provisional data can be found in the International section entry for Ultra-High Capacity Airliner/Very Large Commercial Transport.

UPDATED

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During 1996, Douglas received orders for 29 MD-80/90s and nine MD-11s, delivering 36 and 15 over the same period. Backlog at 1 January 1997 was 134 MD-80/90s, 50 MD-95s and 15 MD-11s.

Douglas workforce 14,000 in early 1997, most at Long Beach. Company's 1996 revenue was \$3.3 billion compared with \$3.9 billion in 1995. MDC China opened new Spares Service Center in Beijing in June 1996.

In November 1996, Douglas and Hyundai Corporation announced that they were planning to develop a medium-sized passenger jet, but the following month MDC disclosed that it would collaborate with Boeing on the latter's future wide-body airliner programmes, starting with the 747-500X/600X; on 21 January 1997 work on these variants was halted and staff reassigned to 767 and 777 development.

UPDATED

McDONNELL DOUGLAS MD-80 SERIES

TYPE: Twin-turboprop short/medium-range airliner.

PROGRAMME: Began as Super 80 higher capacity variant of DC-9; first flight 18 October 1979; first flight of second and third prototypes (N1002G and N1002W) 6 December 1979 and 29 February 1980 respectively; FAA certification 26 August 1980; first delivery, to Swissair, 12 September 1980. By 1996 MD-80 Series fleet had logged over 48 million revenue hours and carried 2.9 billion passengers.

CURRENT VERSIONS: MD-81: Basic version with maximum seating for 172 passengers; P&W JT8D-209 engines with automatic power reserve; two-man crew; maximum five-abreast passenger seating.

MD-82: Announced 16 April 1979; powered by P&W JT8D-217s for hot and high performance and increased payload/range; same size cabin as MD-81 and -83; first flight 8 January 1981; certificated 31 July 1981 at maximum T-O weight 66,680 kg (147,000 lb); in service August 1981; same fuel capacity and landing weight as MD-81. Second version, certificated mid-1982, has JT8D-217As and higher maximum T-O weight.

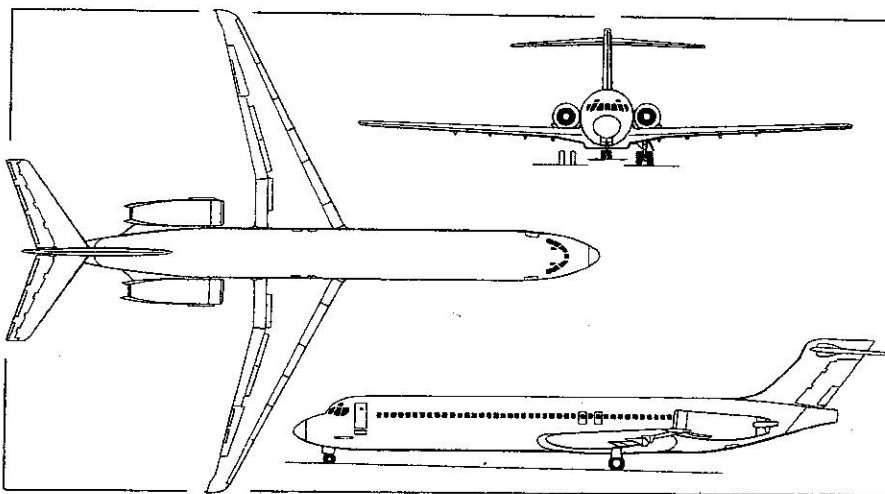
Chinese MD-82: Agreement signed 12 April 1985 for assembly by Shanghai Aviation Industrial Corporation (see SAMF in Chinese section) of 25 out of 26 MD-82s ordered by China; another five MD-82s and five MD-83s approved April 1990; US-built first aircraft delivered 30 September 1985; first flight of SAMF-assembled MD-82 2 July 1987; in service 4 August 1987; second aircraft delivered 18 December 1987; FAA certificate extended to Chinese-built aircraft 9 November 1987; 30 MD-82s delivered by SAMF by end 1994 (plus five MD-83, see Trunkliner below). Douglas interests vested in McDonnell Douglas Pacific & Asia Ltd; SAMF assembles aircraft and makes tailplane and landing gear doors; Chengdu Aircraft Industrial Corporation is second source for nose sections for China and USA (see also MD-90 Trunkliner variant).

MD-83: Extended-range version powered by JT8D-219s, announced 31 January 1983; 2 per cent lower fuel consumption than -217As; two extra fuel tanks in cargo compartment. Passenger capacity same as MD-81 and -82. First flight 17 December 1984; FAA certification

1985; in service Alaska Airlines and Finnair early 1986; on 14 November 1985, Finnair MD-83 made longest MD-80 flight covering 3,406 n miles (6,308 km; 3,920 miles) from Montreal to Helsinki in 7 hours 26 minutes; first revenue transatlantic service flown by Transwede between Stockholm and Fort Lauderdale, Florida, with stops at Oslo and Gander. Five MD-83s built in China by SAMF (see MD-82 entry above) completed by first quarter 1993.

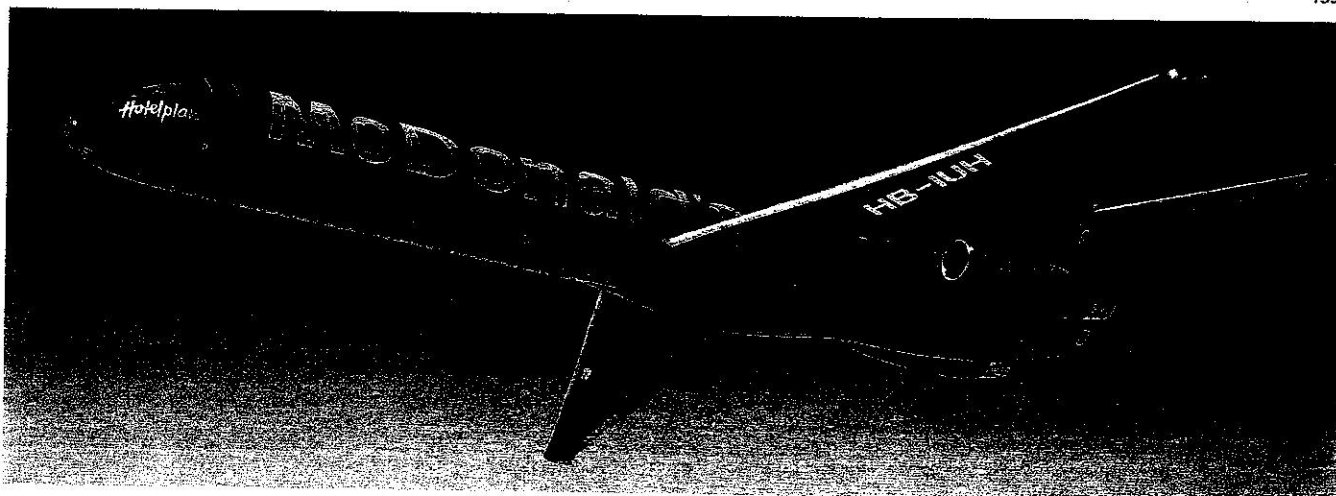
MD-87: Short-fuselage version for maximum 139 single-class passengers; fin height increased; powered by JT8D-217Cs with 2 per cent lower fuel consumption than 217As; other -200 series engines available; first flight 4 December 1986; certificated 21 October 1987; first deliveries to Finnair and Austrian Airlines; optional front and rear cargo compartment auxiliary fuel tanks each hold 2,139 litres (565 US gallons; 470.5 Imp gallons). MD-87 has MD-80 cruise performance improvement package including fillet fairing between engine pylons and fuselage, fairing on APU, improved sealing on horizontal tail, low-drag flap hinge fairings, and extended low-drag tailcone; MD-87 also first of series with EFIS, AHRS and HUD as standard.

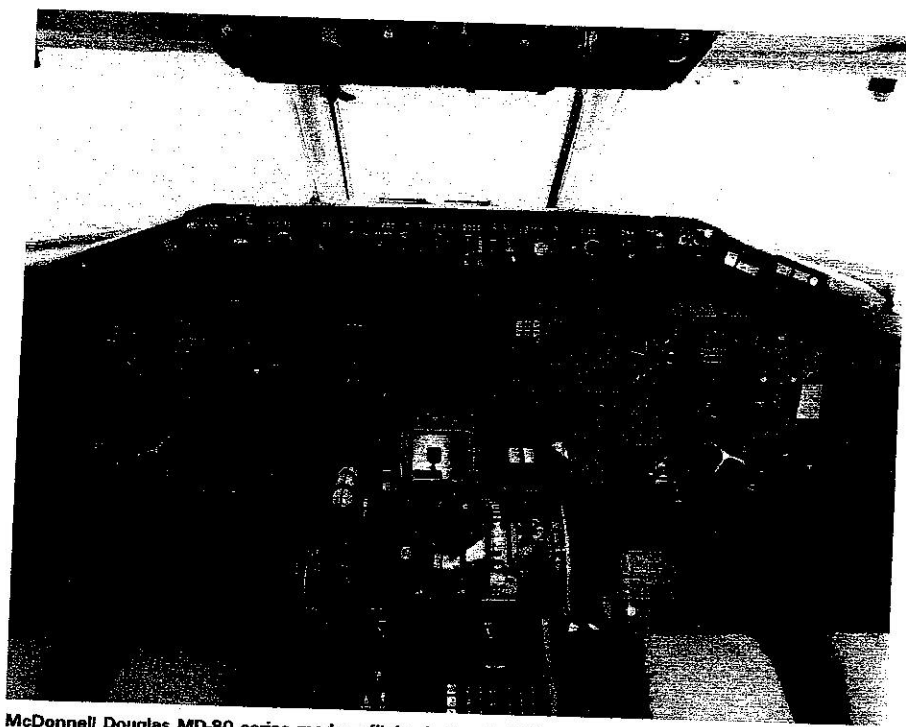
MD-88: Combines JT8D-219 power plant with EFIS cockpit displays, flight management system, onboard windshear detection system and increased use of composites in structure. Redesigned cabin interior for 142 passengers (14 first/128 coach class) five-abreast; wider aisle; redesigned overhead bins. First flight 15 August



McDonnell Douglas MD-87, a short-fuselage variant of the MD-80 series of airliners (Jane's/Dennis Punnett)

1993





McDonnell Douglas MD-80 series modern flight deck with EFIS panels, two flight management system control displays on centre console, weather radar screen, LED engine indicators and autopilot controls in the 1994

1987; FAA certification 9 December 1987; entered service 5 January 1988 with principal customer Delta Air Lines (125 ordered).

MD-80 Executive Jets: Corporate and executive versions of MD-83 and MD-87 offered; typically seating 20 passengers; MD-83 maximum range 4,100 n miles (7,593 km; 4,718 miles); MD-87 maximum range 4,500 n miles (8,334 km; 5,178 miles).

CUSTOMERS: 1,000th delivered 23 March 1992. Total of 1,175 ordered, of which more than 1,120 delivered, by mid-1996. Total of 61 operators includes Adria Airways, Aero Lloyd, Aerolineas Argentinas, Aeromexico, Aeropostal, Air Aruba, Air Liberté, Air Liberté Tunisia, Airtours, Alaska Airlines, Alitalia, ALM Antillean Airlines, American Airlines, AOM-Minerve, ATI, Austrian Airlines, Austral, Aviaero, Avianca, Balair, Beiya Airlines, Centennial Airlines, China Eastern, China Northern, Continental, CTA, Delta Air Lines, Eagle Airlines, Eurofly, Far Eastern Air Transport, Finnair, Great American Airways, Iberia, Japan Air System, Korean Air, Meridiana Italy, Midwest Express, National Airlines, Nordic East Airlines, North American Airlines, Northwest, Oasis, Onur Air, Reno Air, SAS, Spanair, Sun Jet International, Swissair, Transwede, Trinidad & Tobago, TWA, U-Land, USAir, Venus Air and ZAS Airline of Egypt.

DESIGN FEATURES: MD-80 has DC-9 wing span increased by centre-section plugs and 0.61 m (2 ft 0 in) wingtip extensions; fuselage extended by plugs fore and aft of wing; larger wing holds more fuel; wingtip winglets tested and rejected in early 1994; systems improvements include digital integrated flight guidance and control system, 'dial a flap' control for more accurate flap settings, flow-through cooling of avionics compartment, larger capacity APU, recirculation of ventilating air, and advanced digital fuel gauging system. Performance management system similar to that of DC-10 standard from April 1983; optional flight management system giving horizontal and vertical guidance. Other features include increased use of composites, such as Kevlar wing/fuselage fillets introduced 1983. Flight deck changes include advanced AHS, optional Honeywell EFIS, flat LED displays, alternative flight management systems, and Honeywell windshear guidance system (certificated June 1989; now standard on all new MD-80s and retrofittable).

Wing sweepback at quarter-chord 24° 30'; mean thickness/chord ratio 11.0 per cent; dihedral 3°; incidence 1° 15'.

FLYING CONTROLS: Manual ailerons; elevators with assister tabs; electrically actuated variable incidence tailplane; hydraulically actuated rudder with manual standby; automatic landing available; full-span, three-position leading-edge slats; three spoilers per wing, of which outboard two for flight and ground braking and one for lift dumping; hydraulically actuated double-slotted flaps cover 67 per cent of span; one underwing vortex fence on each wing.

STRUCTURE: All-metal two-spar wing with riveted spanwise stringers; glass fibre trailing-edges on wings, ailerons, flaps, elevators and rudder; detachable wingtips; most of

cabin floor made of balsa or Nomex core sandwich; engine pylons by Calcor and fuselage panels by Alenia.

LANDING GEAR: Retractable tricycle type of Cleveland Pneumatic manufacture, with steerable nosewheels (±27° on MD-81/82/87/88; ±25° on MD-83). Hydraulic retraction, nose unit forward, main units inward. Twin Goodyear wheels and tyres on each unit. Mainwheel tyres size 44.5 x 16.5-20, pressure 11.38 bars (165 lb/sq in). Nosewheel tyres size 26 x 6.6-14, pressure 10.34 bars (150 lb/sq in). Goodyear disc brakes. Hydro-Aire Mk IIIA anti-skid units. Douglas ram air brake cooling. Minimum ground turning radius: MD-81/82/83/88 about nosewheel 22.43 m (73 ft 7 1/4 in); MD-87 about nosewheel 19.54 m (64 ft 1 1/4 in); MD-81/82/83/88 about wingtip 20.04 m (65 ft 9 in); MD-87 about wingtip 19.63 m (64 ft 5 in).

POWER PLANT: Two Pratt & Whitney JT8D-209 turbofans in MD-81, pod-mounted one each side of rear fuselage, and each rated at 82.3 kN (18,500 lb st), with emergency thrust reserve of 3.34 kN (750 lb). MD-82 has JT8D-217s, each rated at 89.0 kN (20,000 lb st), with emergency thrust reserve of 3.78 kN (850 lb), or -217As of similar rating. MD-83 has JT8D-219 engines of 93.4 kN (21,000 lb st) with thrust reserve of 3.11 kN (700 lb). MD-87 has JT8D-217C engines of 89.0 kN (20,000 lb st), with an emergency thrust reserve of 3.78 kN (850 lb). MD-88 has 93.4 kN (21,000 lb st) JT8D-219 turbofans with thrust reserve of 3.11 kN (700 lb). Target type thrust reversers.

Standard fuel capacity in MD-81/82/87/88 is 22,107 litres (5,840 US gallons; 4,863 Imp gallons); increased in MD-83 (and, optionally, MD-87) to 26,498 litres (7,000 US gallons; 5,829 Imp gallons) by two 2,195 litre (580 US gallon; 483 Imp gallon) auxiliary tanks in cargo compartment. Pressure refuelling point in starboard wing leading-edge. Overwing gravity refuelling points.

ACCOMMODATION: Crew of two and observer seat on flight deck, plus cabin attendants. Seating arrangements are optional to meet specific airline requirements; maximum optional seating capacity is for 172 passengers (139 in MD-87). Fully pressurised and air conditioned; one toilet forward on port side, two at rear of cabin; provisions for galley at each end of cabin. Passenger door at front of cabin on port side, with built-in electrically operated airstairs, and rear hydraulically operated ventral stairway, are

emergency exit over retracted rear ventral stairway. Servicing and emergency exit doors at starboard forward end and port rear end of cabin. Three cargo doors for underfloor holds on starboard side. Overwing emergency exits, two each side.

SYSTEMS: AirResearch dual air cycle air conditioning and pressurisation system utilising engine bleed air, maximum differential 0.54 bar (7.77 lb/sq in). Two separate 207 bar (3,000 lb/sq in) hydraulic systems for operation of spoilers, flaps, slats, rudder, landing gear, nosewheel steering, brakes, thrust reversers and ventral stairway. Maximum flow rate 30.3 litres (8 US gallons; 6.7 Imp gallons)/min. Airless bootstrap type reservoirs, output pressure 2.07 bars (30 lb/sq in). Pneumatic system, for air conditioning/pressurisation, engine starting and ice protection, utilises 8th or 13th stage engine bleed air and/or APU. Electrical system includes three 40 kVA 120/208 V three-phase 400 Hz alternators, two engine-driven, one driven by APU. Oxygen system of diluter demand type for crew on flight deck; continuous flow chemical canister type with automatic mask presentation for passengers. Anti-icing of wing, engine inlets and tailplane by engine bleed air. Electric windscreen de-icing. Thermal anti-icing of leading-edges. TDG Aerospace NOFOD heater panel certificated by FAA as means of preventing 'cold corner' in inner wing fuel tank from forming ice on wing skin and shedding it into engine intakes. APU provides pneumatic and electrical power on ground, and electrical power in flight.

AVIONICS: Dual Honeywell integrated digital flight systems.

Radar: Colour weather radar standard.

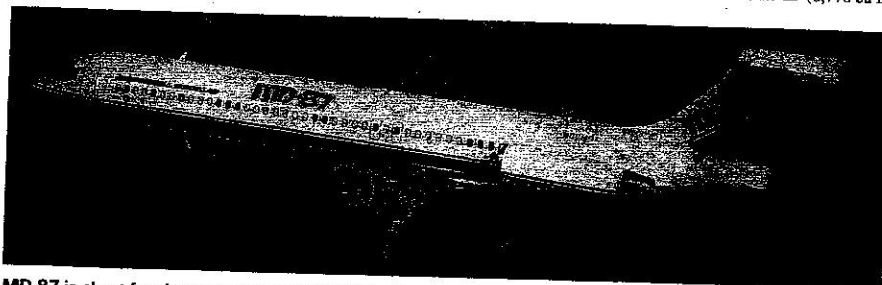
Flight: Dual Honeywell flight management systems (FMS), Cat. IIIa autoland; autopilot and stability augmentation; performance management system; speed command with digital full-time autothrottles; thrust rating indicator; dual Honeywell air data systems; Sundstrand HUD optional.

DIMENSIONS, EXTERNAL (all versions, except as indicated):

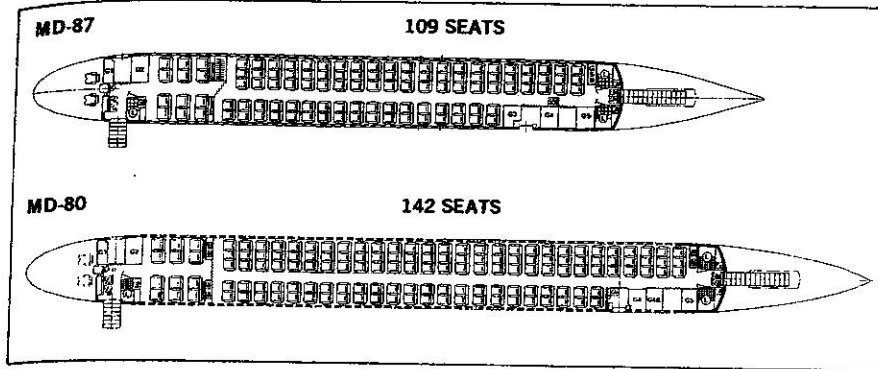
Wing span	32.87 m (107 ft 10 1/4 in)
Wing chord: at root	7.05 m (23 ft 1 1/2 in)
at tip	1.10 m (3 ft 7 1/2 in)
Wing aspect ratio	9.6
Length overall: except MD-87	45.06 m (147 ft 10 in)
MD-87	39.75 m (130 ft 5 in)
Length of fuselage: except MD-87	41.30 m (135 ft 6 in)
MD-87	36.30 m (119 ft 1 in)
Fuselage: Max diameter	3.61 m (11 ft 10 in)
Height overall: except MD-87	9.02 m (29 ft 7 1/4 in)
MD-87	9.30 m (30 ft 6 in)
Tailplane span	12.24 m (40 ft 2 in)
Wheel track	5.08 m (16 ft 8 in)
Wheelbase: except MD-87	22.07 m (72 ft 5 in)
MD-87	19.18 m (62 ft 11 in)
Passenger door (port, fwd):	
Height	1.83 m (6 ft 0 in)
Width	0.86 m (2 ft 10 in)
Height to sill	2.36 m (7 ft 9 in)
Service door (stbd, fwd):	
Height	1.22 m (4 ft 0 in)
Width	0.69 m (2 ft 3 in)
Height to sill	2.36 m (7 ft 9 in)
Service door (port, rear):	
Height	1.52 m (5 ft 0 in)
Width	0.69 m (2 ft 3 in)
Height to sill	2.82 m (9 ft 3 in)
Freight and baggage hold doors:	
Height	1.27 m (4 ft 2 in)
Width	1.35 m (4 ft 5 in)
Height to sill: fwd	1.47 m (4 ft 10 in)
centre	1.42 m (4 ft 8 in)
rear	1.65 m (5 ft 5 in)
Rear cargo door (MD-87):	
Height	1.27 m (4 ft 2 in)
Width	0.91 m (3 ft 0 in)
Height to sill	1.65 m (5 ft 5 in)
Emergency exits (overwing, port and stbd):	
Height	0.91 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck, incl toilets:	
Length	30.78 m (101 ft 0 in)
Max width	3.14 m (10 ft 3 3/4 in)
Max height	2.06 m (6 ft 9 in)
Floor area	89.7 m² (965 sq ft)
Volume	191.9 m³ (6,778 cu ft)



MD-87 is short-fuselage member of MD-80 family of jetliners



Typical mixed class seating arrangement in MD-80 and MD-87

1995

Freight holds (underfloor, MD-81/82):			
fwd	12.3 m ³ (434 cu ft)	-87 standard	17,566 kg (38,726 lb)
centre	10.7 m ³ (376 cu ft)	-87 optional fuel	16,837 kg (37,120 lb)
rear	12.5 m ³ (443 cu ft)	Max T-O weight: -81 (-217 engines), -87 standard	63,505 kg (140,000 lb)
Freight holds (underfloor, MD-83 with extra fuel tanks):			
total	28.7 m ³ (1,013 cu ft)	-81 (-217A engines), -82, -87 optional, -88 standard	67,810 kg (149,500 lb)
Freight holds (underfloor MD-87):			
total	26.5 m ³ (937 cu ft)	-83 optional	72,575 kg (160,000 lb)
with extra fuel tanks	19.7 m ³ (695 cu ft)	Max ramp weight: -81, -87	63,955 kg (141,000 lb)
AREAS:			
Wings, gross	112.32 m ² (1,209.0 sq ft)	-82, -88	68,265 kg (150,500 lb)
Ailerons (total)	3.53 m ² (38.00 sq ft)	-83	73,030 kg (161,000 lb)
Fin, excl dorsal fin (except -87)	9.51 m ² (102.40 sq ft)	Max zero-fuel weight: -81	53,525 kg (118,000 lb)
Rudder	6.07 m ² (65.30 sq ft)	-82, -83	55,340 kg (122,000 lb)
Tailplane	29.17 m ² (314.00 sq ft)	-87	53,525 kg (118,000 lb)
WEIGHTS AND LOADINGS			
Operating weight empty: -81	35,329 kg (77,888 lb)	Max landing weight:	
-82, -88	35,369 kg (77,976 lb)	-81, -87 standard	58,060 kg (128,000 lb)
-83 optional fuel	36,145 kg (79,686 lb)	-82, -87 optional, -88	58,965 kg (130,000 lb)
-87 standard fuel	33,237 kg (73,274 lb)	-83 optional	63,275 kg (139,500 lb)
-87 optional fuel	33,965 kg (74,880 lb)	Max wing loading:	
Fuel load:		-81, -87 standard	551.7 kg/m ² (112.99 lb/sq ft)
-81, -82, -87 standard	17,763 kg (39,162 lb)	-82, -87 optional, -88 standard	589.1 kg/m ² (120.66 lb/sq ft)
-83, -87 optional	21,216 kg (46,773 lb)	-83, -88 optional	630.5 kg/m ² (129.14 lb/sq ft)
Max structural payload:		Max power loading:	
-81	18,194 kg (40,112 lb)	-81, -82, -87 optional	381 kg/kN (3.74 lb/lb st)
-82, -88	19,969 kg (44,024 lb)	-83 optional	388 kg/kN (3.81 lb/lb st)
-83 optional fuel	19,193 kg (42,314 lb)	-87 standard	357 kg/kN (3.50 lb/lb st)
		-88	363 kg/kN (3.56 lb/lb st)

PERFORMANCE (at max T-O weight except where indicated):
 Max level speed: all 500 kt (925 km/h; 575 mph)
 Max cruising speed: all MO.76
 FAA T-O field length: -81 2,210 m (7,250 ft)
 -82 2,270 m (7,450 ft)
 -83 2,552 m (8,375 ft)
 -87 1,859 m (6,100 ft)
 FAA landing field length, at max landing weight:
 -81 1,478 m (4,850 ft)
 -82 1,500 m (4,920 ft)
 -83 1,585 m (5,200 ft)
 -87 1,429 m (4,690 ft)

Range with max fuel:
 -87 standard 2,980 n miles (5,522 km; 3,431 miles)
 -87 optional 3,650 n miles (6,764 km; 4,203 miles)
 Range -81, -82, -83 with 155 passengers, domestic reserves; -87 with 130 passengers, domestic reserves:
 -81 1,564 n miles (2,897 km; 1,800 miles)
 -82 2,050 n miles (3,798 km; 2,360 miles)
 -83 2,502 n miles (4,635 km; 2,880 miles)
 -87 standard 2,372 n miles (4,393 km; 2,730 miles)
 -87 optional 2,833 n miles (5,248 km; 3,261 miles)

OPERATIONAL NOISE LEVELS (FAR Pt 36):
 T-O: -81, -82, -83 90.4 EPNdB
 -87 estimated 88.7 EPNdB
 Sideline: -81, -82, -83 94.6 EPNdB
 -87 estimated 92.8 EPNdB
 Approach: -81, -82, -83 93.3 EPNdB
 -87 estimated 93.3 EPNdB

UPDATED

McDONNELL DOUGLAS MD-90

TYPE: Stretched MD-80 follow-on, powered by IAE V2500 turbofans.

PROGRAMME: Launched 14 November 1989; first flight of T1 prototype (N901DC) 22 February 1993; second aircraft (N902DC) made first flight three weeks early on 27 August 1993 and was used for avionics and systems tests, including automatic landing; first production aircraft flown 20 September 1994, three days ahead of schedule; FAA certification achieved 16 November 1994, by which time three MD-90s had flown 1,906 flight test hours in 1,450 flights; first delivery, N902DA (-30 version; 2,094th of DC-9/MD-80/MD-90 family) to Delta Air Lines, 24 February 1995; service entry 1 April 1995 on Dallas/Fort Worth—Newark, New Jersey, route. JAA certification received 16 October 1996; first European operator (SAS); entered European revenue service 11 November 1996.

CURRENT VERSIONS: **MD-90-30:** Has MD-80 fuselage lengthened by 1.45 m (4 ft 9 in) ahead of wing; same enlarged tail surfaces as MD-87; powered elevators; 153 two-class passengers, five-abreast; maximum 172 passengers limited by exit doors and hatches; two IAE V2525-D5 turbofans. Details below apply mainly to this version.

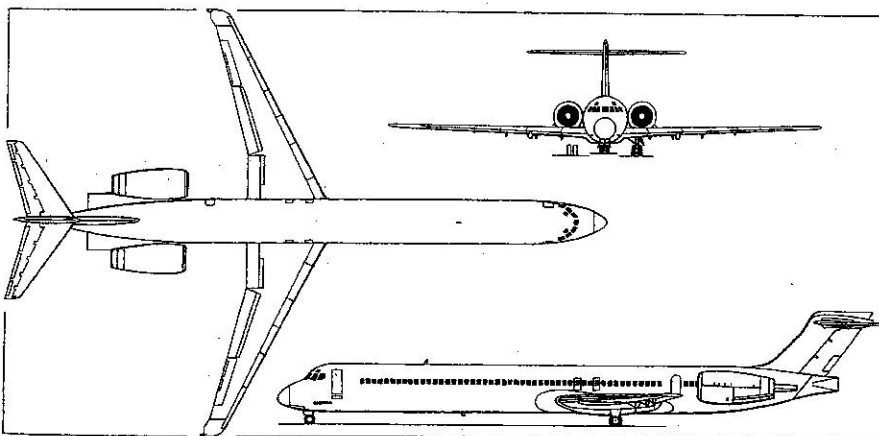
MD-90-30ER: Extended-range version with increased T-O weight and optional 2,139 litre (565 US gallon; 470 Imp gallon) auxiliary fuel tank. Typical passenger capacity is 170; launch customer AMC Aviation of Egypt announced purchase of two for delivery in August 1997 and October 1998.

MD-90 Trunkliner: Agreement worth \$1,000 million signed 25 June 1992 to produce three MD-82, 17 MD-82T and 20 MD-90-30T Trunkliners in China (which see under SAMF heading), but renegotiated mid-1994, and amended \$1,600 million contract signed 4 November 1994 for first 20 aircraft, a mix of MD-80s and MD-90s to be built by Douglas; subsequently renegotiated mid-1995 for 20 Douglas-built MD-90s. First aircraft, B-2250, delivered 26 July 1996. Chengdu Aircraft Industrial Corporation making nose sections, passenger and crew doors and airstairs and airstair doors for Trunkliners and US-built MD80/90s; Shenyang will be responsible for assembly of tail surfaces, incorporating SAMF tailplanes and elevators, electrical wiring, radio racks and electrical power centres, and Xian will make forward fuselages and wings; offset work will be offered on IAE V2500 engines. Delivery of first Shanghai Aviation Industrial Corporation (SAIC)-built MD-90 Trunkliners scheduled for April 1998.

MD-90-50: Provides 700 n miles (1,296 km; 805 miles) more range than MD-90-30 at same payload; maximum T-O weight increased to 78,245 kg (172,500 lb); wing, fuselage, tail surfaces, landing gear, wheels and brakes reinforced; provision for up to 6,738 litres (1,780 US gallons; 1,482 Imp gallons) of additional fuel; IAE V2528-D5 engines giving 124.5 kN (28,000 lb st) each.

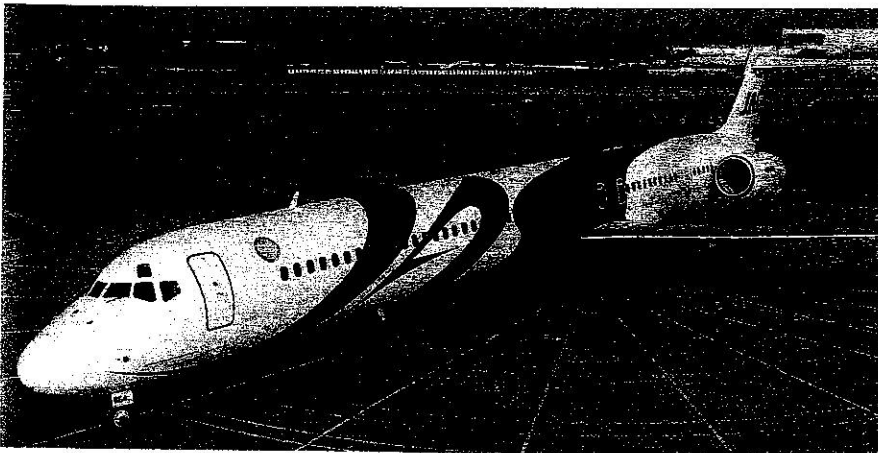
MD-90-55: Similar to MD-90-50 but with extra pair of doors in forward fuselage section to allow maximum 187 charter class passengers.

CUSTOMERS: Launch customer Delta Air Lines (50 ordered plus 115 on option, later reported as 31 firm and 106 options); other customers include China Eastern (nine), China Northern (11), EVA Air/UNI Airways of Taiwan (nine, plus three options), Great China Airlines (one), Heliopolis Airlines (one plus two options), Hwa-Hsia Leasing (three), Japan Air System (16, plus one option, of which one delivered 10 December 1996 and entered



McDonnell Douglas MD-90-30 airliner (two IAE V2525-D5 turbofans) (Jane's/Dennis Punnett)

1994





Flight deck of MD-90 showing two two-screen EFIS, LED matrix engine indicators, full flight management system panels on centre console and autopilot controllers under the glareshield

(three, the first of which entered service 4 April 1996), Saudi Arabian Airlines (29, for delivery commencing 1997), and Scandinavian Airlines System (eight, all to be in service by August 1997). By October 1996, 23 were in service plus 121 on firm order.

DESIGN FEATURES: Being built on MD-80 production line; powered by IAE V2500 engines rated by engine control system for power required by MD-90-30 and MD-90-50; 10 more two-class passengers than MD-80 accommodated by forward fuselage stretch of 1.37 m (4 ft 6 in) to compensate for higher engine weight; better power/weight ratio than MD-80; noise level expected to be 20 dB below Stage 3 and with very low emissions; improved cabin includes larger baggage bins, better lighting and handrail at bin level. Wing sweep at quarter-chord, 24° 30'.

FLYING CONTROLS: Powered elevators with dual actuators, and manual reversion with servo tabs, to cope with increased pitch-axis inertia caused by heavier engines and longer forward fuselage; double-slotted flaps; three-position leading-edge slats; spoilers for airbrake and lift dumping; flight deck similar to MD-88, but Douglas planning new six-screen layout similar to that of MD-11. Three-position leading-edge slats.

STRUCTURE: Structure broadly as late MD-80, but new modular manufacturing system, developed and tested on both prototypes, allows both types to be built on same production line and in about half the man-hours of earlier MD-80s; subassemblies contributed by Alenia, AeroSpace Technologies of Australia, Dassault Aerospace, CASA, Chengdu Aircraft Industrial Corporation (CAC), Shanghai Aviation Industrial Corporation (SAIC) and Shanghai Aircraft Manufacturing Factory (SAMF) are built up into fuselage modules in Salt Lake City.

LANDING GEAR: Retractable tricycle type with twin wheels on all units, as MD-80.

POWER PLANT: Two 111.2 kN (25,000 lb st) IAE V2525-D5 in MD-90-30; two 124.5 kN (28,000 lb st) V2528-D5 in MD-90-50 and -55; thrust maintained at S/L up to 30°C ambient temperature; power output determined by electronic engine control; cascade thrust reversers for use on ground only; MD-90-30 fuel tankage 22,107 litres (5,840 US gallons; 4,863 Imp gallons); MD-90-50 tankage 28,845 litres (7,620 US gallons; 6,345 Imp gallons) including 6,738 litres (1,780 US gallons; 1,482 Imp gallons) in extra tanks in baggage compartment.

ACCOMMODATION: Traditional Douglas five-abreast seating; two more seat rows than MD-80; larger and lighted overhead stowage bins; lighted full-grip handrail on stowage bins illuminates seat labels; new vacuum lavatories.

SYSTEMS: New system elements, compared with MD-80, include Bendix variable-speed, constant-frequency electrical generation, new AlliedSignal 421 kW (565 shp) GTCP131-9D APU to provide greater engine-starting power and 8,000 hour life, carbon wheel brakes with digital anti-skid saving 181 kg (400 lb) weight, centre-wing de-icing system using warmed fuel from engine oil cooler circulated through inboard fuel tanks, and new environmental control system providing higher flow rates.

AVIONICS: Flight: Honeywell electronic flight instruments, flight management system (FMS), digital flight guidance

system (DFGS) with auxiliary control system (ACS), new air data computer, and advanced inertial reference system based on ring laser gyro platform.

Instrumentation: LED displays for engine and system monitoring.

DIMENSIONS, EXTERNAL (all versions):

Wing span	32.87 m (107 ft 10 in)
Wing aspect ratio	9.6
Length overall	46.51 m (152 ft 7 in)
Length of fuselage	43.03 m (141 ft 2 in)
Height overall	9.33 m (30 ft 7 1/4 in)
Tailplane span	12.24 m (40 ft 2 in)
Wheel track	5.09 m (16 ft 8 1/2 in)
Wheelbase	23.52 m (77 ft 2 in)

DIMENSIONS, INTERNAL:

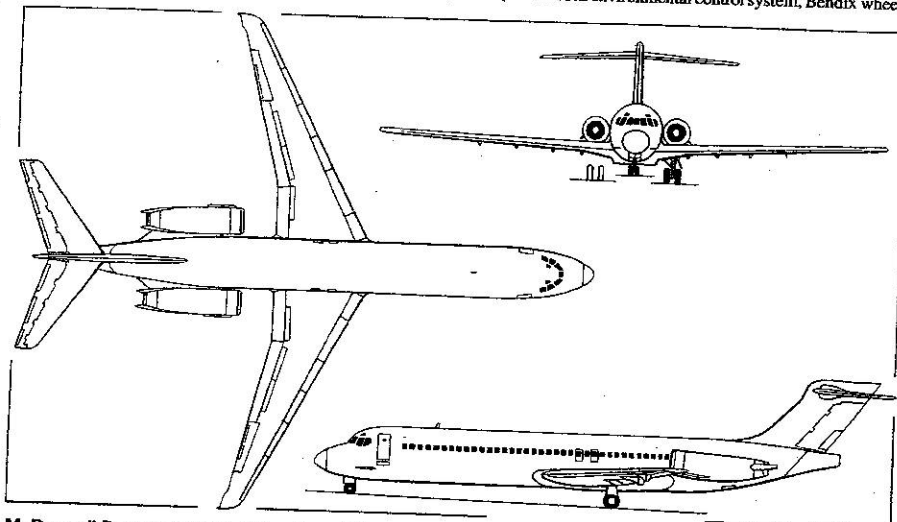
Baggage volume (total): -30	36.8 m³ (1,300 cu ft)
-50, -55 with optional fuel	23.3 m³ (822 cu ft)

AREAS:

Wings, gross: all	112.3 m² (1,209.0 sq ft)
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WEIGHTS AND LOADINGS:

Operating weight empty: -30	39,916 kg (88,000 lb)
-50	41,685 kg (91,900 lb)
Space limited payload: -30	17,350 kg (38,250 lb)
-50, -55 with extra tanks	15,195 kg (33,500 lb)
Max T-O weight: -30	70,760 kg (156,000 lb)
-50, -55	78,245 kg (172,500 lb)
Max ramp weight: -30	71,215 kg (157,000 lb)
-30ER	75,295 kg (166,000 lb)
-50, -55	78,700 kg (173,500 lb)
Max zero-fuel weight: -30	58,965 kg (130,000 lb)
-50, -55	61,235 kg (135,000 lb)
Max landing weight: -30	64,410 kg (142,000 lb)
-50, -55	71,210 kg (150,000 lb)



McDonnell Douglas MD-95 airliner (two BMW Rolls-Royce BR 715 turbfans) (Jane's/Dennis Punnett) 1993

Max power loading: -30	318 kg/kN (3.12 lb/lb st)
-50, -55	314 kg/kN (3.08 lb/lb st)

PERFORMANCE (estimated, at max T-O weight, ISA, except where indicated):

Cruising speed at 10,670 m (35,000 ft):	
all	437 kt (809 km/h; 503 mph) (M0.76)
FAA T-O field length: -30	2,166 m (7,105 ft)
-50, -55	2,435 m (7,990 ft)
FAA landing field length, at max landing weight:	
-30	1,600 m (5,250 ft)
-50, -55	1,670 m (5,480 ft)
Range, with international reserves (-30, -30ER and -50 with 153 passengers, -55 with 187 passengers):	
-30	2,085 n miles (3,862 km; 2,400 miles)
-30ER:	
standard	2,172 n miles (4,023 km; 2,500 miles)
long range	2,389 n miles (4,425 km; 2,750 miles)
-50	3,022 n miles (5,600 km; 3,480 miles)
-55	2,700 n miles (5,003 km; 3,109 miles)

UPDATED

MCDONNELL DOUGLAS MD-95

TYPE: 100-passenger twin-turboprop transport.

PROGRAMME: Announced at Paris Air Show 1991; potential airline customers briefed and manufacturing partners announced in Berlin, November 1994; modification of former Eastern Airlines DC-9-30 into development prototype began late 1994; three flight test aircraft (T1, T2 and T3), expected to fly in 1998; first flight of production aircraft due January 1999; joint JAA/FAA certification anticipated in April 1999; first customer delivery June 1999. First nose section (built by MDC) delivered to Huntington Beach on 11 December 1996 to begin assembly of T1, which will be 95 per cent complete by end of 1997.

CURRENT VERSIONS: MD-95-30: Initial production version.

MD-95-30ER: Extended-range version with additional fuselage fuel tank, capacity 4,277 litres (1,130 US gallons; 941 Imp gallons). Future versions under study in early 1996 included a stretched MD-95-50 to accommodate up to 130 passengers, and an 80-seat derivative.

CUSTOMERS: Launched 19 October 1995 with order for 50, plus 50 options, from ValuJet Airlines. McDonnell Douglas predicts requirements for 1,700 aircraft in this class over the next 20 years, with 300 to 500 MD-95 sales over life of programme.

COSTS: ValuJet order for 50 aircraft worth \$1 billion.

DESIGN FEATURES: Fuselage 1.45 m (4 ft 9 in) longer than DC-9-30; DC-9/MD-80 cross-section; DC-9-34 wing planform; systems and avionics are blend of low cost and advanced technology. Wing sweep 24° 30' at quarter-chord.

FLYING CONTROLS: Elevator and ailerons are manually actuated via cables; rudder powered hydraulically with manual reversion; double-slotted flaps; full-span two-position leading-edge slats; wing-mounted spoilers/speedbrakes.

STRUCTURE: Generally as MD-80/MD-90. Partners are: Alenia (fuselage sections), Korean Air Lines Aerospace Division (nose structure and main passenger door/entry area), Hyundai Space and Aircraft Co (wings, in conjunction with McDonnell Douglas Canada, which will build initial sets of wings for flight test aircraft and early production units), BMW Rolls-Royce (power plant), ShinMaywa Industries Ltd (horizontal tail surfaces and engine pylons), Fischer Advanced Composite Components GmbH (cabin furnishings), Israel Aircraft Industries SHL Servo Systems (landing gear), AlliedSignal Aerospace (AirResearch environmental control system, Bendix wheels

and brakes), Honeywell Inc (flight guidance and avionics systems), Sundstrand Aerospace (electrical power generating system), and (in partnership with Sundstrand) Auxiliary Power International Corporation (APU). Final assembly of MD-95s will be undertaken in Long Beach; nominal production rate one aircraft per week.

LANDING GEAR: Retractable tricycle with steerable nosewheels; twin wheels on all legs.

POWER PLANT: Two BMW Rolls-Royce BR 715 turbofans, each giving 82.3 kN (18,500 lb st) at T-O at 30°C ambient; 93.43 kN (21,000 lb st) rating optional for MD-95-30ER; single-pivot door type reversers for ground use only. Standard fuel capacity 13,892 litres (3,670 US gallons; 3,056 Imp gallons); ER 18,170 litres (4,800 US gallons; 3,997 Imp gallons).

ACCOMMODATION: Crew of two on advanced flight deck optimised for reduced parts count and high reliability. Flight deck features include MD-11 AFCS with glareshield-mounted controls enabling crew to fly the aircraft automatically with only push-button and thumbwheel inputs; modified control pedestal between seats with larger multifunction control display units and keyboards; and simplified overhead control panel with four LCDs replacing 13 gauges, meters and switch panels. Typical two-class seating for 106 passengers in five-abreast arrangement in new modern cabin designed with inputs from 500 airline executives, flight attendants and passengers; interior, manufactured by Fischer Advanced Composite Components of Austria, features wider and deeper overhead baggage bins, full-grip handrail throughout length of cabin, and optional video monitors that drop down from passenger service units on both sides of cabin at every third seat row. Cabin door behind flight deck on port side; emergency exit on opposite side, plus two above each wing.

AVIONICS: Honeywell Versatile Integrated Avionics V1A 2000 computer as core avionics management system.

Flight: Honeywell flight management system (FMS), inertial reference system (IRS), digital flight guidance system (DFGS), digital air data computer and windshear detection system.

Instrumentation: Six-tube EFIS with 203 x 203 mm (8 x 8 in) LCD screens providing navigation, flight management and systems data.

DIMENSIONS, EXTERNAL:

Wing span	28.44 m (93 ft 3 1/2 in)
Wing aspect ratio	8.7
Length: overall	37.81 m (124 ft 0 1/2 in)
fuselage	34.34 m (112 ft 8 in)
Height overall	8.86 m (29 ft 1 in)
Tailplane span	11.23 m (36 ft 10 1/4 in)
Wheel track	4.88 m (16 ft 0 in)
Wheelbase	17.60 m (57 ft 8 3/4 in)
Baggage door: forward:	
Height	1.27 m (4 ft 2 in)
Width	1.35 m (4 ft 5 in)
rear:	
Height	1.27 m (4 ft 2 in)
Width	0.91 m (3 ft 0 in)

DIMENSIONS, INTERNAL (S: standard, ER: with extended-range tank):

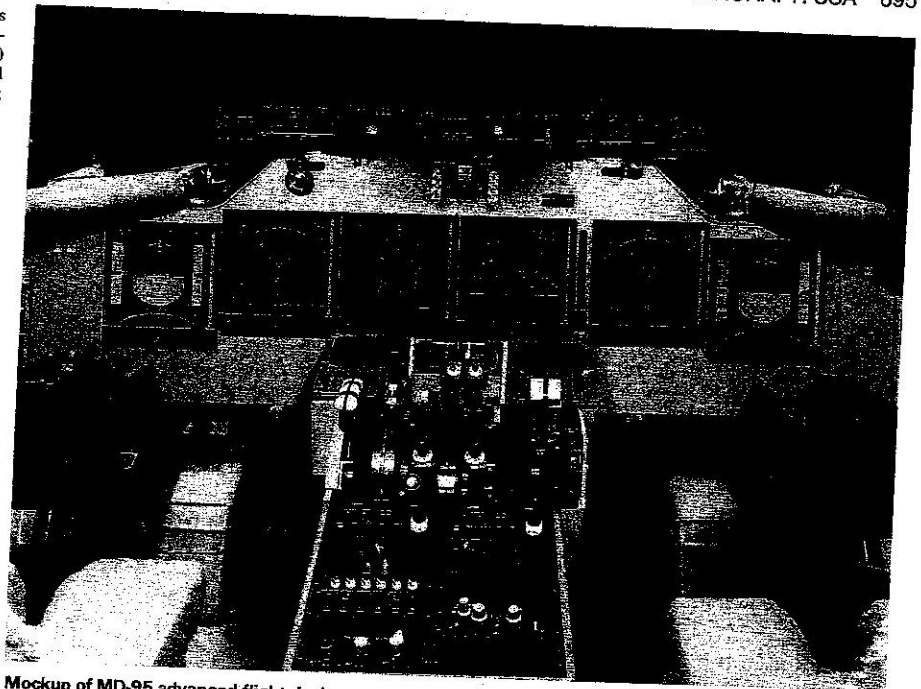
Freight hold volume (underfloor):	
S	26.8 m ³ (945 cu ft)
ER	19.5 m ³ (689 cu ft)

AREAS:

Wings, gross	92.97 m ² (1,000.7 sq ft)
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WEIGHTS AND LOADINGS (S: standard, ER: with extended-range tank):

Operating weight empty: S	30,785 kg (67,870 lb)
ER	31,480 kg (69,401 lb)
Space-limited payload: S	12,220 kg (26,940 lb)
ER	11,059 kg (24,380 lb)
Max T-O weight: S	51,710 kg (114,000 lb)
ER	54,885 kg (121,000 lb)
Max ramp weight: S	52,165 kg (115,000 lb)
ER	55,340 kg (122,000 lb)
Max landing weight: S	46,265 kg (102,000 lb)
ER	47,174 kg (104,000 lb)
Max zero-fuel weight: S	43,545 kg (96,000 lb)
ER	44,452 kg (98,000 lb)



Mockup of MD-95 advanced flight deck

Max wing loading: S	556.2 kg/m ² (113.92 lb/sq ft)
ER	590.4 kg/m ² (120.92 lb/sq ft)
Max power loading: S	314 kg/kN (3.08 lb/lb st)
ER	333 kg/kN (3.27 lb/lb st)

PERFORMANCE (estimated):

Max level speed: S, ER	438 kt (811 km/h; 504 mph) (M0.76)
FAA T-O field length at max T-O weight, S/L, 30°C:	
S	1,951 m (6,400 ft)
ER	2,012 m (6,600 ft)
FAA landing field length at max landing weight, S/L:	
S	1,445 m (4,740 ft)
ER	1,469 m (4,820 ft)
Design range, domestic reserves, 106 passengers and baggage:	
S	1,547 n miles (2,865 km; 1,780 miles)
ER	2,001 n miles (3,705 km; 2,302 miles)

UPDATED

McDONNELL DOUGLAS MD-XX

Following a six month review of potential risks and advantages, McDonnell Douglas announced on 28 October 1996 that it was terminating this advanced technology medium-range airliner. Details, an artist's impression and general arrangement drawing appeared in the 1996-97 edition.

UPDATED

McDONNELL DOUGLAS MD-10

Retrospective designation assigned in 1996 to the conversion of 60 DC-10s to a new freighter standard for Federal Express.

NEW ENTRY

McDONNELL DOUGLAS MD-11

TYPE: Medium/long-range airliner and freighter.

PROGRAMME: Follow-on to DC-10; revealed at Paris Air Show 1985; British Caledonian ordered nine 3 December 1986; official programme launch 30 December 1986; five aircraft in flight test programme (four with GE engines, one with P&W); first flight (N111MD) 10 January 1990 powered by CF6s; first flight of third prototype powered by P&W

PW4460s, 26 April 1990; certificated 8 November 1990; first delivery to Finnair 29 November 1990, entering service 20 December. Deliveries totalled three in 1990, 31 in 1991, 42 in 1992, 36 in 1993, 17 in 1994, 18 in 1995 and 15 in 1996. 100th MD-11 delivered 30 June 1993. Certification with R-R Trent 650 discontinued. By mid-1996 154 had been delivered. Fuselage production line moved from San Diego to Long Beach during early 1996.

CURRENT VERSIONS: MD-11: Standard passenger version for 298 passengers in three-class layout; maximum range 7,000 n miles (12,964 km; 8,055 miles) with maximum optional T-O weight. Planned production of all variants declined to about two per month in 1993; expected to increase again from 1996. *Detailed description applies to improved MD-11, MD-11F, MD-11 Combi and MD-11 convertible Freighter.*

MD-11 Performance Improvement Programme

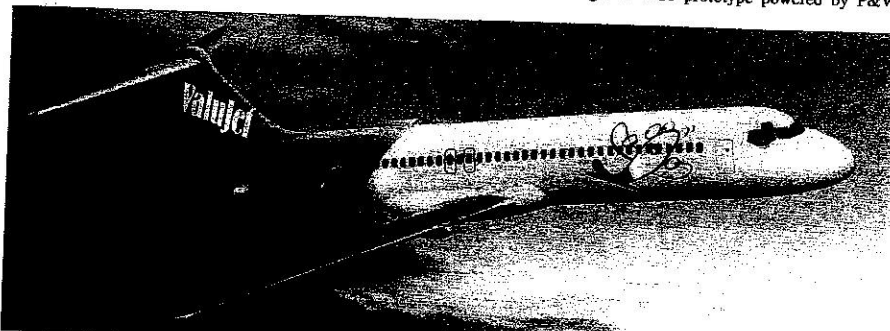
(PIP): Continuous improvement programme aimed at weight and drag reduction and extended range under way since 1990, resulting in recovery and extension of MD-11's design range. First delivery November 1990 with initial choice of gross weights between 273,289 kg (602,500 lb) and 276,691 kg (610,000 lb); range shortfall 440 n miles (815 km; 506 miles) with GE engines and 710 n miles (1,315 km; 817 miles) with P&W engines. Successive drag reduction, weight-saving and fuel consumption and engine installation improvements, introduced in stages by December 1994, included the following:

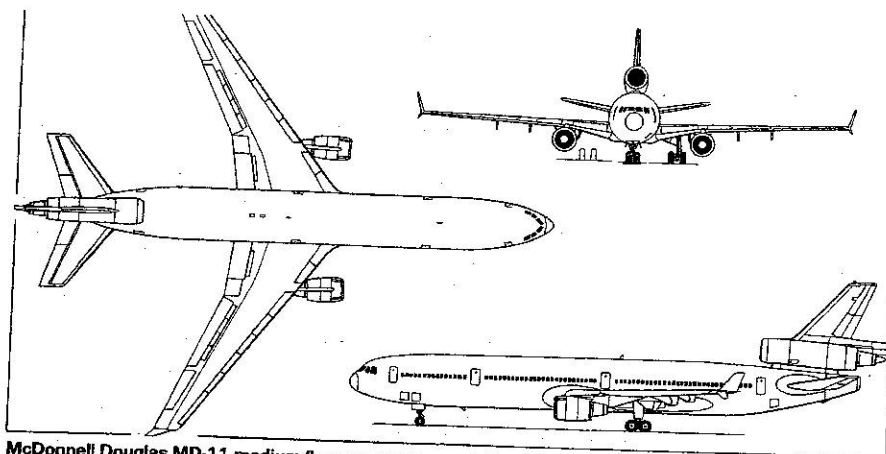
Weight reduction: Airframe weight reduced progressively by 1,020 kg (2,250 lb) by changes in cargo handling system, tailplane structure, composites centre engine inlet, cargo hold changes and new flooring materials.

T-O weight increases: Maximum T-O weight increased to 280,320 kg (618,000 lb) in January 1991; further optional increase to 283,720 kg (625,500 lb) in July 1993.

Drag reduction: Phase I, introduced before first delivery, saved 0.7 per cent drag by means of splitter plate preventing turbulence forming behind blunt wing trailing-edge; Phase II drag reduction, available from January 1992, saved another 1.5 per cent drag by sealing outboard slat gaps and drooping outboard ailerons by 4°. Phase III, introduced September 1993, eliminated another 0.1 per cent drag by applying endplates on wing adjacent ailerons and adding fillet to wing-mounted engine pylons. Modification of windscreen wipers and windscreen introduced December 1994 cuts another 0.3 per cent. Phase IV, introduced February 1995, eliminates further 1.2 per cent drag by means of a re-rigged elevator (to reduce incidence and produce a more cambered aerofoil), a diverter fillet around base of the centre engine inlet structure, redesign of flap hinge fairing and installation of wing and undercarriage door seals. Cumulative range improvement of all four phases extends range to more than 6,911 n miles (12,800 km; 7,953 miles) with 29,000 kg (63,934 lb) payload.

Added fuel: Auxiliary fuel tanks available from April 1992; one or two 7,472 litre (1,974 US gallon; 1,644 Imp gallon) tanks can be mounted in rear of forward underfloor cargo compartment, displacing two or four LD3 cargo





McDonnell Douglas MD-11 medium/long-range transport (Jane's/Dennis Punnett)

1994

T-O distance: Reduced by up to 137 m (450 ft) in order to accommodate increased T-O weight by deflecting inboard and outboard ailerons with flaps at take-off.

Engine improvements: Internal improvements by General Electric in the CF6-80C2 engine, introduced by mid-1993, have saved some 1.5 per cent fuel consumption, equivalent to about 1,360 kg (3,000 lb) of payload.

P&W applied a three-phase engine and intake improvement sequence, introduced in June 1992 and November 1993, which together gave 2.7 per cent improvement; in addition, P&W has certificated an optional thrust increase to 276 kN (62,000 lb st). Total range increase for these improvements is 600 n miles (1,111 km; 690 miles) for GE-powered aircraft and 690 n miles (1,278 km; 794 miles) for P&W-powered aircraft.

MD-11 Combi: Mixed cargo/passenger version for four to 10 cargo pallets and 168 to 240 passengers; ranges from 5,180 n miles (9,593 km; 5,961 miles) to 8,860 n miles (12,705 km; 7,894 miles). Main deck cargo door at rear on port side. Certificated April 1992 to latest FAA Class C smoke and fire containment requirements.

MD-11CF: Convertible freighter; launched August 1991 with order from Martinair-Holland (four firm orders for delivery 1994 and 1995, one on option). Main deck cargo door at front on port side.

MD-11F: All-freight version.

MD-11ER: Extended-range version launched February 1994; maximum T-O weight increased to 285,989 kg (630,500 lb) and fuel capacity increased by up to 11,583 litres (3,060 US gallons; 2,548 Imp gallons) in removable auxiliary tank in lower cargo compartment; offers either 480 n miles (889 km; 552 miles) greater range or 2,721 kg (6,000 lb) more payload; offered in passenger, Combi, convertible or all-freight versions; drag reduction and 680 kg (1,500 lb) weight saving will reduce fuel burn by 1.5 per cent; intended to provide lower costs on very long routes with lower passenger traffic; Douglas states MD-11ER costs 26 per cent less to operate than Boeing 747-400; MD-11ER extends MD-11 range with 298 passengers from 7,000 n miles (12,964 km; 8,055 miles) to 7,240 n miles (13,408 km; 8,331 miles), which is said to be very slightly greater than Boeing 747-400 with 421 passengers. Launch customers World Airways (two, on lease, with PW4462 engines; delivered on 11 March 1996), and Garuda (three, with CF6-80C2s, converted from MD-11 order, first delivery 19 December 1996 and one each due in second and third quarters of 1997).

CUSTOMERS: At 1 January 1997, 162 MD-11s had been delivered and order backlog was 15. Customers and operators then included, but were not limited to, Alitalia, American Airlines, China Airlines, China Eastern Airlines, CityBird, Delta Air Lines, EVA Air, Federal Express, Finnair, Garuda, GATX, International Lease Finance Corporation, Japan Airlines, KLM, Korean Air, Lufthansa Cargo, Malaysian Airline System, Martinair, Mitsui, Saudi Arabian Airlines, Swissair, Thai International, Varig, VASP and World Airways. Total of 51 orders from seven operators for MD-11F and MD-11CF by 1 January 1997; two ordered by EVA Air later that month.

DESIGN FEATURES: Compared with DC-10, MD-11 has winglets above and below each wingtip; tailplane has advanced cambered aerofoil, modified trailing-edge camber, reduced sweepback and 7,571 litre (2,000 US gallon; 1,665 Imp gallon) fuel trim tank; extended tailcone of low-drag chisel profile; two-crew all-digital flight deck; restyled interior; choice of GE CF6-80C2D1F and P&W PW4460 engines. Wing has Douglas aerofoil section; sweepback at quarter-chord 35°; dihedral 6°; incidence at root 5° 51'; tailplane sweepback 33°.

FLYING CONTROLS: Ailerons powered by Parker Hannifin actuators; electrohydraulically actuated variable incidence tailplane with slotted elevators in two sections each side powered by Parker Hannifin and Teijin Seiki actuators; inboard all-speed ailerons and outboard low-speed ailerons

droop with flaps on take-off; dual-section rudder split into vertical segments; near full-span leading-edge slats; double-slotted trailing-edge flaps with offset external hinges; five spoilers in groups of four and one on each wing. Cat. IIb automatic landing with ground roll control (certificated April 1991) standard.

STRUCTURE: Composites used in virtually all control surfaces, engine inlets and cowlings, and wing/fuselage fillets; wing has two-spar structural box with chordwise ribs and skins with spanwise stiffeners; upper winglet of ribs, spars and stiffened aluminium alloy skin with carbonfibre trailing-edge; lower winglet carbonfibre; inboard ailerons have metal structure with composites skin; outboard ailerons all-composites; inboard flaps composites-skinned metal;

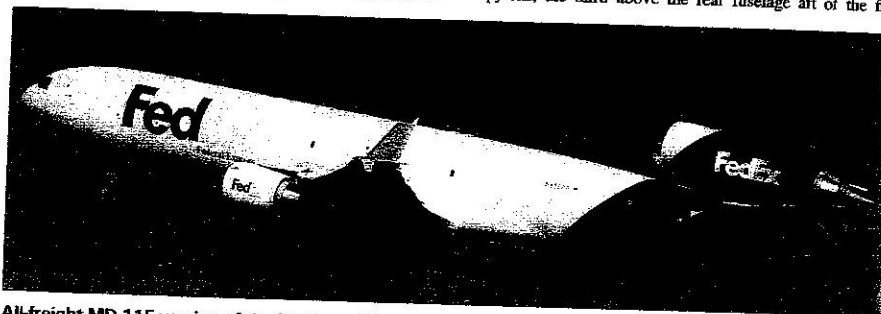
honeycomb and composites skin; tailplane has CFRP trailing-edge; elevators CFRP.

Rear engine inlet duct and fan cowl doors, and nose cowl outer barrels on wing-mounted engines, are of composites construction. Inner surfaces of engine nacelles are acoustically treated.

Suppliers include Alenia (fin, rudder, fuselage panels, winglets), AP Precision Hydraulics (centreline and nose landing gear), Bendix (mainwheels and carbon brakes), CASA (horizontal tail surfaces), Embraer (outboard flap sections), Fischer GmbH (composites flap hinge fairings), Pneumo Abex Corporation (main landing gear), Rohr Industries (engine pylons), Honeywell (advanced flight deck and avionics), and GKN Westland Aerospace (flap vane and inlet duct extension rings).

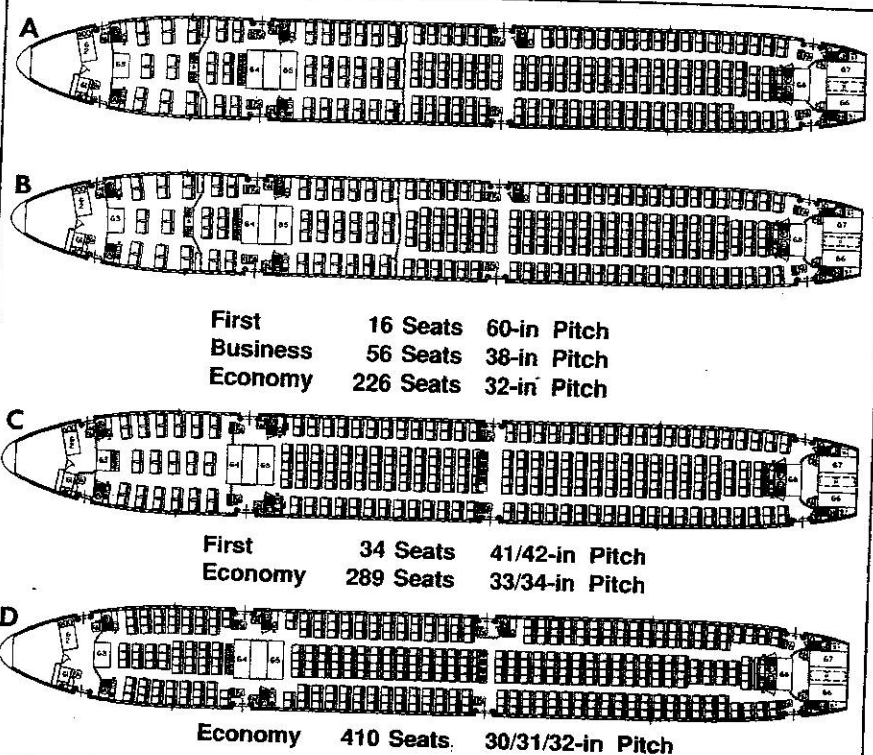
LANDING GEAR: Hydraulically retractable tricycle type, with additional twin-wheel main unit mounted on the fuselage centreline; heaviest proposed variants might have four-wheel centreline bogie; nosewheel and centreline units retract forward, main units inward into fuselage. Twin-wheel steerable nose unit ($\pm 70^\circ$). Main gear has four-wheel bogies. Oleo-pneumatic shock-absorbers in all units. Loral nosewheels and Goodyear tyres size 40 x 15.5-16, pressure 13.44 bars (195 lb/sq in). Main and centreline units have Bendix wheels and Goodyear tyres size 54 x 21-24, pressure 13.79 bars (200 lb/sq in). Bendix carbon brakes with air convection cooling; Loral anti-skid system. Minimum ground turning radius about nosewheels 26.67 m (87 ft 6 in); about wingtip 35.90 m (117 ft 9 in). Optional Taxi Brake Select system increases brake life by up to 40 per cent by cycling alternate brake pads during low-speed taxiing.

POWER PLANT: Three Pratt & Whitney PW4460 turbofans, each rated at 267 kN (60,000 lb st), or three PW4462 turbofans, each rated at 276 kN (62,000 lb st), or three General Electric CF6-80C2D1F turbofans, each rated at 274 kN (61,500 lb st); two engines mounted on underwing pylons, the third above the rear fuselage aft of the fin



All-freight MD-11F version of the McDonnell Douglas MD-11

1996



MD-11 alternative seating configurations. A, B: 298 passengers, including 226 economy class in 3-4-2 or 2-5-2 configurations; C: 323 passengers in two classes; D: 410 economy passengers

1997



McDonnell Douglas MD-11 of China Airlines

1996

torsion box. Refuelling point in leading-edge of each wing. Standard MD-11 fuel capacity 146,174 litres (38,615 US gallons; 32,154 imp gallons); one or two 7,472 litre (1,974 US gallon; 1,643 imp gallon) tanks can be added in cargo hold.

ACCOMMODATION: Crew of two, plus two observer seats. Standard class seating for 250, two-class for 298 and all-economy for up to 410; Combi carries 214 passengers. Crew door and three passenger doors each side, all eight of which open sliding inward and upward. Two rear doors are deactivated in Combi configuration. Two freight holds in lower deck, forward and aft of wing, and one bulk cargo compartment in rear fuselage. Forward freight hold is heated and ventilated; rear freight hold heated only. MD-11 Combi has a lower deck cargo door in centre compartment on starboard side of fuselage for loading of pallets, an upward-opening main deck cargo door on port side at rear of cabin. MD-11F/CF have port side forward main deck cargo door.

SYSTEMS: Air conditioning system includes three AiResearch air-bearing air cycle units with two automatic digital pressure controllers and electromechanical back-up. Cabin maximum pressure differential 0.59 bar (8.6 lb/sq in). Three independent hydraulic systems for operation of flight controls and braking, with motor/pump interconnects to allow one system to power another. Electrical system comprises three 400 Hz, 100/120 kVA integrated drive generators, one per engine; one 90 kVA generator in APU; 50 Ah battery; four transformer-rectifiers to convert AC power to DC; and 25 kVA drop-out air-driven emergency generator. Pneumatic system, maximum controlled pressure 3.17 bars (46 lb/sq in) at 230°C, supplies air conditioning, engine bleed air anti-icing for wing (outer slats) and tailplane leading-edges, galley vent jet pump, and cargo compartment floor heating. EROS plumbed gaseous oxygen system for crew; chemical oxygen generators with automatically deploying masks for passengers. Portable oxygen cylinders for attendants and

first aid. De-icing for windscreens, angle of attack sensors, TAT probe and static port plate. AlliedSignal TSCP700-4E APU.

AVIONICS: *Flight:* Avionics integrator, Honeywell, responsible for flight guidance/flight deck system consisting of 44 line-replaceable units. These include aircraft system controllers (ASC) that perform flight engineer control and monitoring functions, providing automated hydraulic, electrical, environmental and fuel systems; laser inertial

reference system (IRS) for navigation; digital air data computer (DADC). Flight control computer includes auto-throttle and longitudinal stability augmentation; windshear detection and guidance.

Instrumentation: Six-tube EFIS and systems displays; 'dark cockpit' philosophy with lights only showing to indicate abnormal states; no need to look on overhead panels to check systems status; hydraulic, electrical, environmental and fuel systems segregated and each system configured in normal and abnormal conditions by a pair of computers.

DIMENSIONS, EXTERNAL:

Wing span	51.66 m (169 ft 6 in)
Wing chord: at root	10.71 m (35 ft 1 1/4 in)
at tip	2.73 m (8 ft 11 1/2 in)
Wing aspect ratio	7.9
Length overall: with PW4460	61.21 m (200 ft 10 in)
with CF6-80	61.62 m (202 ft 2 in)
Fuselage: Length	58.65 m (192 ft 5 in)
Max diameter	6.02 m (19 ft 9 in)
Height overall	17.60 m (57 ft 9 in)
Tailplane span	18.03 m (59 ft 2 in)
Wheel track	10.56 m (34 ft 8 in)
Wheelbase	24.61 m (80 ft 9 in)
Crew doors (two, each): Height	1.93 m (6 ft 4 in)
Width	0.81 m (2 ft 8 in)
Passenger doors:	
Height: front pair	1.93 m (6 ft 4 in)
rear six doors	1.93 m (6 ft 4 in)
Width: front pair	0.81 m (2 ft 8 in)
rear six doors	1.07 m (3 ft 6 in)

*Lower deck forward freight door:

Height	1.68 m (5 ft 6 in)
Width	2.64 m (8 ft 8 in)

Lower deck centre freight door (standard):

Height	1.68 m (5 ft 6 in)
Width	1.78 m (5 ft 10 in)

Lower deck bulk cargo door: Height

0.91 m (3 ft 0 in)	
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Width	0.76 m (2 ft 6 in)
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Combi main deck cargo door (port, rear):

Height	2.59 m (8 ft 6 in)
Width	4.06 m (13 ft 4 in)

CF and F main deck cargo door (port, forward):

Height	2.59 m (8 ft 6 in)
Width	3.56 m (11 ft 8 in)

*Centre freight door of Combi also this size, available as an option on other models

DIMENSIONS, INTERNAL:

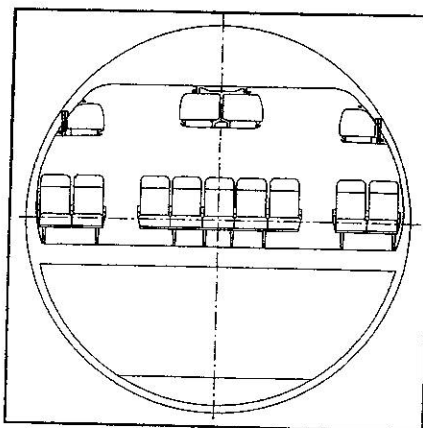
Cabin:	
Length, flight deck door to rear bulkhead	46.51 m (152 ft 7 1/4 in)
Max width	5.71 m (18 ft 9 in)
Max height	2.41 m (7 ft 11 in)
Floor area, incl galleys and toilets	244.7 m ² (2,634 sq ft)
Volume, incl galleys and toilets	599.3 m ³ (21,165 cu ft)
Lower deck freight holds, volume	194.0 m ³ (6,850 cu ft)
MD-11 freight volume total	633.7 m ³ (22,380 cu ft)

AREAS:

Wings, gross	338.91 m ² (3,648.0 sq ft)
Winglets (total)	7.42 m ² (80.00 sq ft)
Vertical tail surfaces (total)	56.21 m ² (605.00 sq ft)
Horizontal tail surfaces (total)	85.47 m ² (920.00 sq ft)

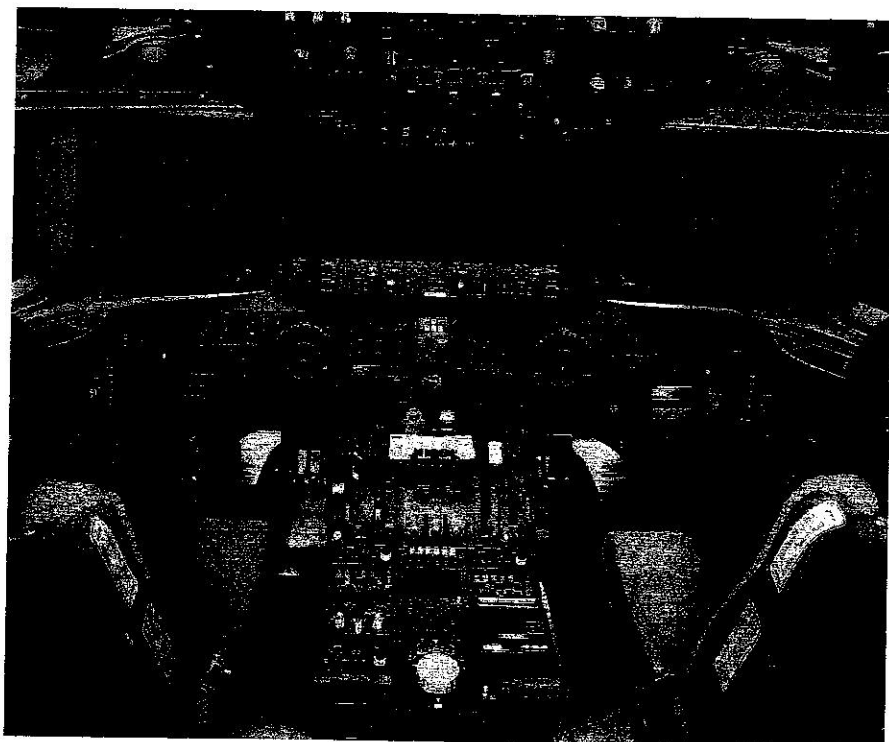
WEIGHTS AND LOADINGS:

*Operating weight empty: -11	130,165 kg (286,965 lb)
-11F	113,920 kg (251,150 lb)
-11 Combi	131,035 kg (288,885 lb)
-11CF passenger	131,525 kg (289,965 lb)
-11CF freight	115,380 kg (254,372 lb)
Weight-limited payload:	
-11	51,272 kg (113,035 lb)
-11F	90,787 kg (200,151 lb)
-11 Combi	64,009 kg (141,115 lb)
-11CF passenger	73,180 kg (161,335 lb)
-11CF freight	89,552 kg (197,428 lb)



Cabin cross-section of MD-11 in economy layout. Aisle width 48.3 cm (1 ft 7 in); height 241.3 cm (7 ft 11 in); seat width 45.7 cm (1 ft 6 in); overall width, two seats 106.7 cm (3 ft 6 in), five seats 259.1 cm (8 ft 6 in). Exterior diameter 6.02 m (19 ft 9 in)

1994



-11F, -11CF, standard 213,870 kg (471,500 lb)
 -11F, -11CF, optional 218,178 kg (481,000 lb)
 -11 Combi 207,745 kg (458,000 lb)
 Max zero-fuel weight: -11 181,435 kg (400,000 lb)
 -11F/-11CF 204,700 kg (451,300 lb)
 -11 Combi 195,040 kg (430,000 lb)
 Max wing loading:
 standard 806.5 kg/m² (165.17 lb/sq ft)
 optional 843.8 kg/m² (172.83 lb/sq ft)
 *Empty weights with P&W engines about 317 kg (700 lb)
 lower than with GE engines
 **All versions
PERFORMANCE:
 Max operating Mach No. (M_{MO}): all 0.945
 Max level speed at 9,450 m (31,000 ft):
 all M0.87 (511 kt; 945 km/h; 588 mph)
 FAA T-O field length, PW4462 engines, MTOW, S/L,
 30°C:
 all 3,115 m (10,220 ft)

-11 2,118 m (6,950 ft)
 -11F, -11CF 2,323 m (7,620 ft)
 -11 Combi 2,234 m (7,330 ft)
 Design range, FAA international reserve:
 -11, 298 passengers, three-class 6,821 n miles (12,633 km; 7,850 miles)
 -11F, with weight-limited payload: 3,910 n miles (7,242 km; 4,500 miles)
 -11 Combi, 183 passengers, three-class, plus six main deck freight pallets 6,691 n miles (12,392 km; 7,700 miles)
 -11CF, 298 passengers 6,795 n miles (12,585 km; 7,820 miles)
 -11CF, weight-limited freight 3,950 n miles (7,316 km; 4,546 miles)
 Design range, as above, but with 11,356 litre (3,000 US gallon; 2,498 Imp gallon) auxiliary fuel tank:
 -11 7,213 n miles (13,358 km; 8,300 miles)

5,735 n miles (10,622 km; 6,600 miles)

UPDATED

MCDONNELL DOUGLAS MD-17

Commercial freight version of the C-17 military transport (see description following that entry).

MCDONNELL DOUGLAS MD-20

Intended to fill the gap in the product line between the MD-90 and MD-11, the twin-engined MD-20 study marries a modified MD-11 wing with a new fuselage to produce a 250 to 270 seater. Preliminary studies are continuing.

NEW ENTRY

MERLIN

MERLIN AIRCRAFT INC

Hangar 1A, 509 Airport Road, Muskegon, Michigan 49441
 Tel: 1 (616) 798 1622
 Fax: 1 (616) 798 2370
 Email: MerlinAir@aol.com
 Website: http://MerlinAircraft.com
 VICE-PRESIDENT, OPERATIONS AND PRODUCTION: Kevin Adams
 DIRECTOR, INTERNATIONAL SALES: Terry M. Shepard

Merlin produces two-seat variants of the Macair Merlin light aircraft, previously produced by Macair Industries Inc of Baldwin, Ontario, Canada (which see in 1990-91 *Jane's*), and a four-seat version is currently under development.

UPDATED

MERLIN GT

TYPE: Side by side two-seat light aircraft.

CURRENT VERSIONS: Available as floatplane, trainer, agricultural sprayer.

CUSTOMERS: About 200 civil versions sold.

COSTS: Complete kits: Standard (with Rotax 582) \$18,750; Formula 110 powered version \$25,900; Rotax 912 powered version \$26,900 (1996).

DESIGN FEATURES: Strut-braced high wing, full-span flaperons, tailplane with separate elevator. Fuselage of welded 4130 chromoly steel tubing.

LANDING GEAR: Non-retractable mainwheels and tailwheel. Full Lotus floats optional.

POWER PLANT: One 74.6 kW (100 hp) Canadian Automotive (CAM) 100 engine, driving a two- or three-blade propeller; or a choice of 59.7 kW (80 hp) Rotax 912, 47.0 kW (63 hp) Rotax 582, 55.2 kW (74 hp) Rotax 618 or 82.0 kW (110 hp) Formula Power Subaru EA81 engines. Fuel capacity 49.2 litres (13 US gallons; 10.8 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span 9.14 m (30 ft 0 in)
 Wing chord, constant 1.52 m (5 ft 0 in)
 Wing aspect ratio 6.0
 Length overall 6.10 m (20 ft 0 in)

Merlin Explorer four-seat bushplane

Height overall 1.98 m (6 ft 6 in)
 Tailplane span 2.15 m (7 ft 0 1/2 in)
 Wheel track 2.21 m (7 ft 3 in)
 Wheelbase 6.10 m (20 ft 0 in)
 DIMENSIONS, INTERNAL:
 Cabin: Max width 1.04 m (3 ft 5 in)
 AREAS:
 Wings, gross 13.94 m² (150.0 sq ft)
 WEIGHTS AND LOADINGS (Rotax 912):
 Weight empty 257 kg (567 lb)
 Max T-O weight 590 kg (1,300 lb)
 Max wing loading 42.3 kg/m² (8.66 lb/sq ft)
 Max power loading 9.89 kg/kW (16.25 lb/hp)
 PERFORMANCE (Rotax 912):
 Max level speed 104 kt (193 km/h; 120 mph)
 Cruising speed 81 kt (150 km/h; 93 mph)
 Stalling speed 34 kt (63 km/h; 38 mph)
 Max rate of climb at S/L 455 m (1,500 ft)/min
 T-O distance 34 m (110 ft)
 Landing distance 53 m (175 ft)
 Max range 304 n miles (563 km; 350 miles)

UPDATED

STRUCTURE: Fuselage is mixture of glass fibre and 4130 welded chromoly frame. All-metal wing; covering can be either glass fibre or fabric.

LANDING GEAR: Conventional tailwheel layout. Main tyres 8.50-10. Bungee shock-absorbers. Steerable Scott 3200 tailwheel.

POWER PLANT: Early aircraft have 149 kW (200 hp) Textron Lycoming IO-360 engine. Later models will have 186 kW (250 hp) Mazda 13B rotary engine driving a two-blade McCauley propeller. Two wing tanks provide standard fuel capacity of 136 litres (36 US gallons; 30 Imp gallons); optional capacity 272 litres (72 US gallons; 60 Imp gallons) by adding two further wing tanks.

ACCOMMODATION: Pilot and three passengers in two pairs of side by side seats.

DIMENSIONS, EXTERNAL:

Wing span 11.89 m (39 ft 0 in)
 Wing aspect ratio 7.2

DIMENSIONS, INTERNAL:

Cabin: Max width 1.19 m (3 ft 11 in)

AREAS:

Wings, gross 19.51 m² (210.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty 671 kg (1,480 lb)
 Max T-O weight 1,361 kg (3,000 lb)
 Max wing loading 69.7 kg/m² (14.29 lb/sq ft)
 Max power loading (IO-360) 9.13 kg/kW (15.00 lb/hp)

PERFORMANCE:

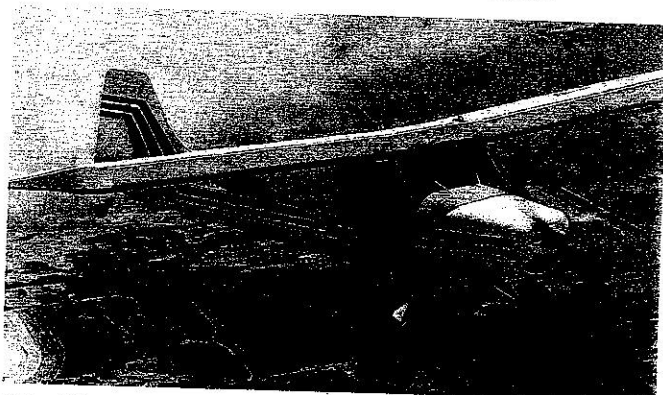
Never-exceed speed (V_{NE}) 130 kt (241 km/h; 150 mph)
 Max cruising speed 100 kt (185 km/h; 115 mph)
 Stalling speed: flaperons up 46 kt (86 km/h; 53 mph)
 flaperons down 40 kt (73 km/h; 45 mph)
 Max rate of climb at S/L 213 m (700 ft)/min
 T-O to, and landing from, 15 m (50 ft) 244 m (800 ft)
 g limits +4/-2

UPDATED



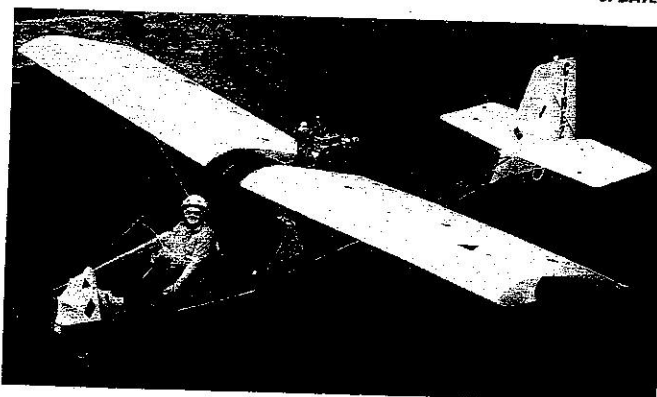
Floatplane version of Merlin GT

1996



Rotax 618-powered Merlin GT

1996



Merlin E-Z two-seat ultralight

1996