

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.

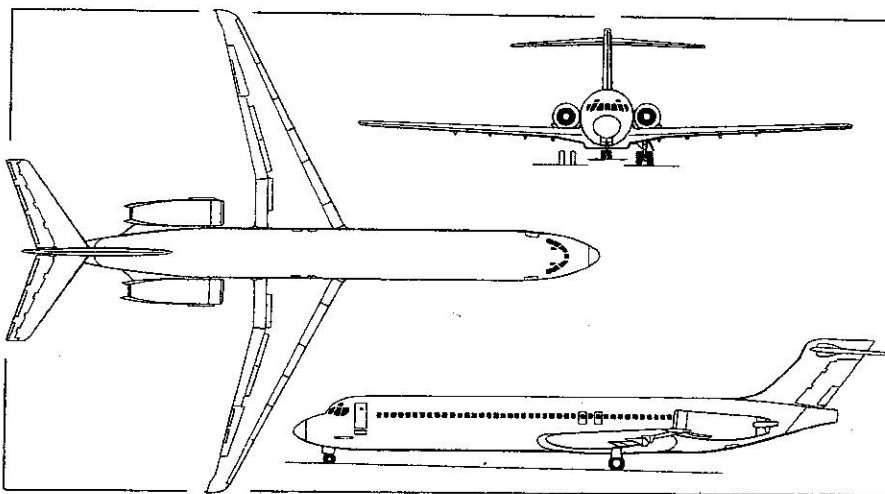
Chinese MD-82: Agreement signed 12 April 1985 for assembly by Shanghai Aviation Industrial Corporation (see SAMF in Chinese section) of 25 out of 26 MD-82s ordered by China; another five MD-82s and five MD-83s approved April 1990; US-built first aircraft delivered 30 September 1985; first flight of SAMF-assembled 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.

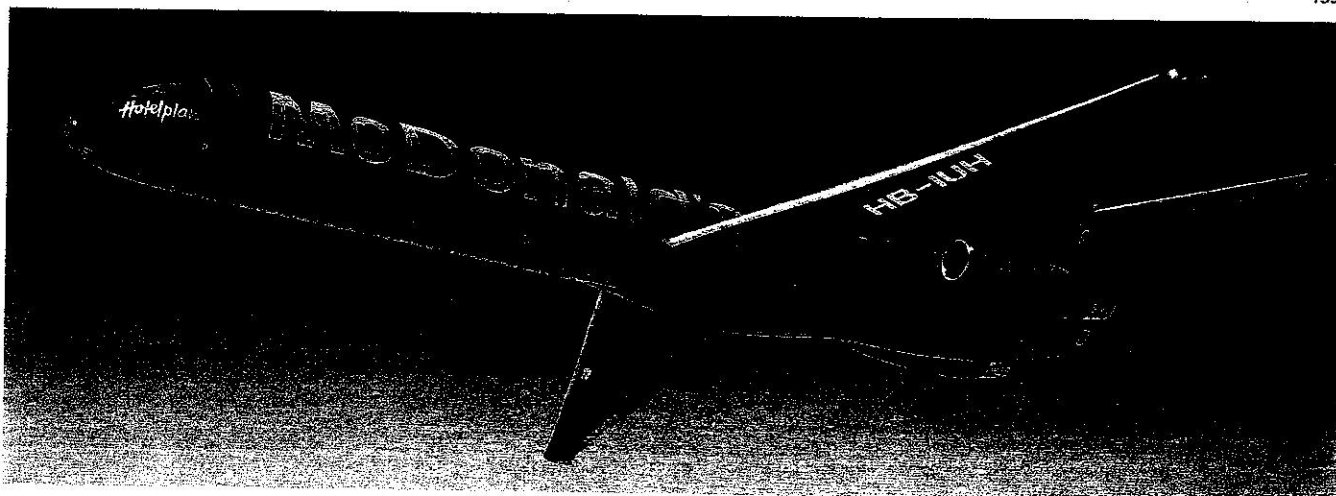
MD-87: Short-fuselage version for maximum 139 single-class passengers; fin height increased; powered by JT8D-217Cs with 2 per cent lower fuel consumption than 217As; other -200 series engines available; first flight 4 December 1986; certificated 21 October 1987; first deliveries to Finnair and Austrian 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.

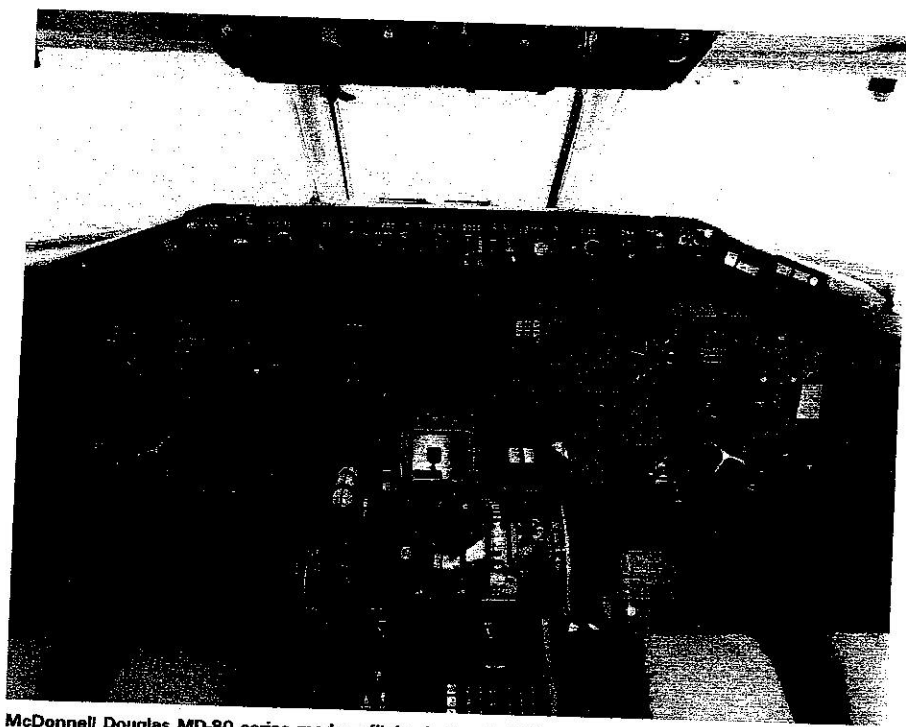
MD-88: Combines JT8D-219 power plant with EFIS cockpit displays, flight management system, onboard windshear detection system and increased use of composites in structure. Redesigned cabin interior for 142 passengers (14 first/128 coach class) five-abreast; wider aisle; redesigned overhead bins. First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

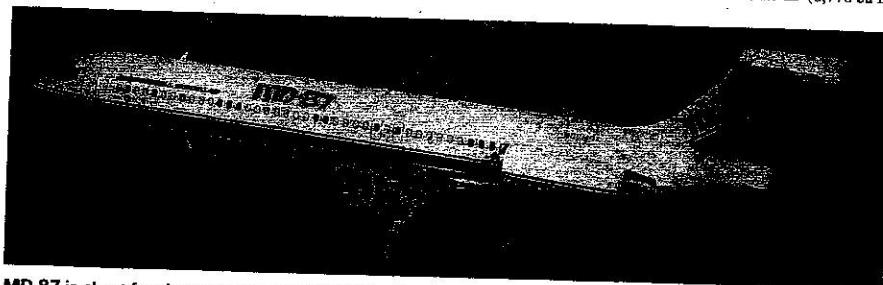
**Flight:** Dual Honeywell flight management systems (FMS), Cat. IIIa autoland; autopilot and stability augmentation; performance management system; speed command with digital full-time autothrottles; thrust rating indicator; dual Honeywell air data systems; Sundstrand HUD optional.

#### 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)

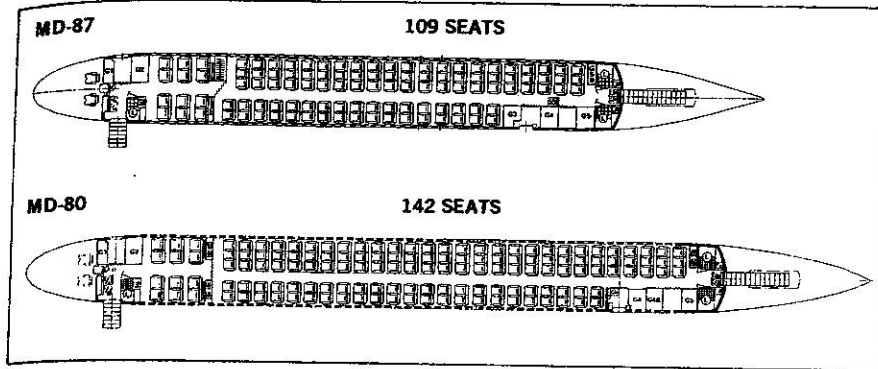
#### DIMENSIONS, INTERNAL:

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 <sup>3</sup> (434 cu ft)	-87 standard	17,566 kg (38,726 lb)
centre	10.7 m <sup>3</sup> (376 cu ft)	-87 optional fuel	16,837 kg (37,120 lb)
rear	12.5 m <sup>3</sup> (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 <sup>3</sup> (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 <sup>3</sup> (937 cu ft)	-83 optional	72,575 kg (160,000 lb)
with extra fuel tanks	19.7 m <sup>3</sup> (695 cu ft)	Max ramp weight: -81, -87	63,955 kg (141,000 lb)
AREAS:			
Wings, gross	112.32 m <sup>2</sup> (1,209.0 sq ft)	-82, -88	68,265 kg (150,500 lb)
Ailerons (total)	3.53 m <sup>2</sup> (38.00 sq ft)	-83	73,030 kg (161,000 lb)
Fin, excl dorsal fin (except -87)	9.51 m <sup>2</sup> (102.40 sq ft)	Max zero-fuel weight: -81	53,525 kg (118,000 lb)
Rudder	6.07 m <sup>2</sup> (65.30 sq ft)	-82, -83	55,340 kg (122,000 lb)
Tailplane	29.17 m <sup>2</sup> (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 <sup>2</sup> (112.99 lb/sq ft)
-81, -82, -87 standard	17,763 kg (39,162 lb)	-82, -87 optional, -88 standard	589.1 kg/m <sup>2</sup> (120.66 lb/sq ft)
-83, -87 optional	21,216 kg (46,773 lb)	-83, -88 optional	630.5 kg/m <sup>2</sup> (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.

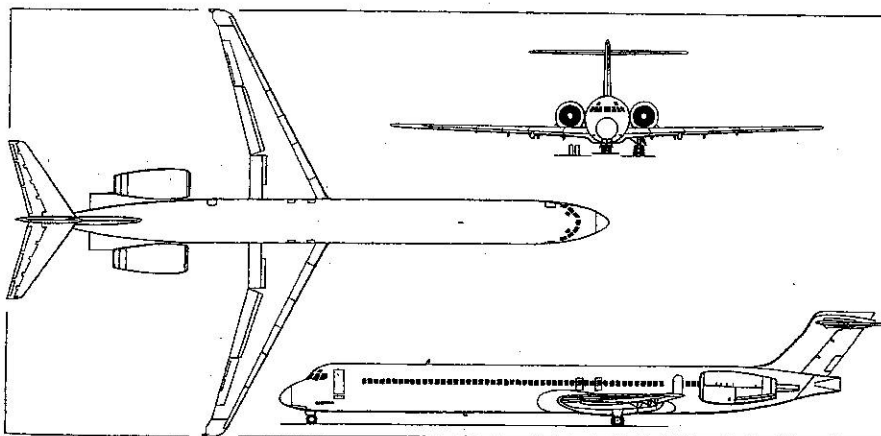
**MD-90-30ER:** Extended-range version with increased T-O weight and optional 2,139 litre (565 US gallon; 470 Imp gallon) auxiliary fuel tank. Typical passenger capacity is 170; launch customer AMC Aviation of Egypt announced purchase of two for delivery in August 1997 and October 1998.

**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.

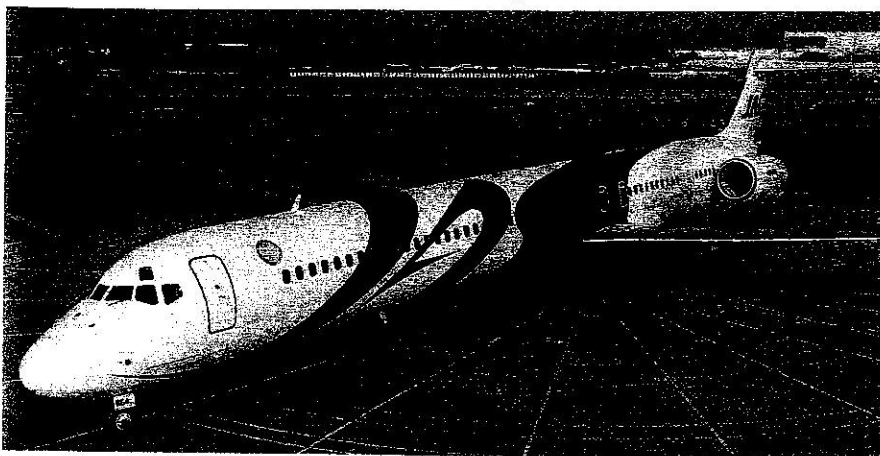
**MD-90-55:** Similar to MD-90-50 but with extra pair of doors in forward fuselage section to allow maximum 187 charter class passengers.

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:

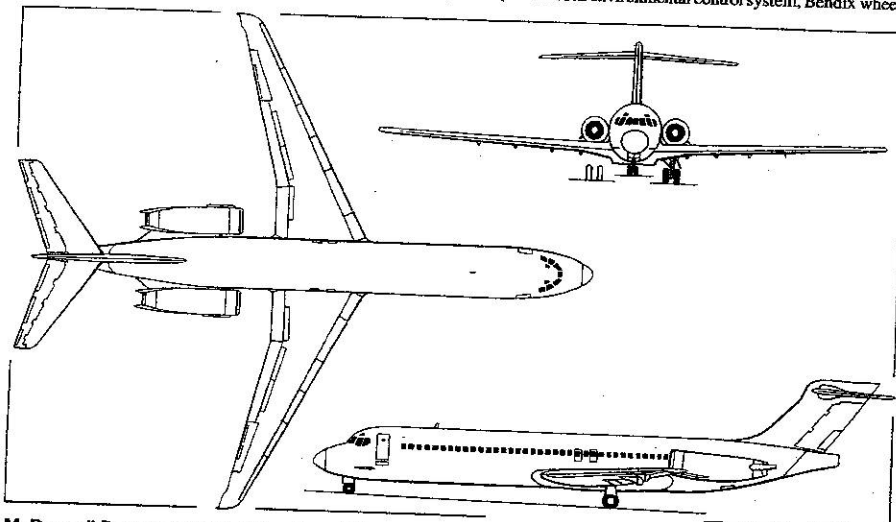
Baggage volume (total): -30	36.8 m³ (1,300 cu ft)
-50, -55 with optional fuel	23.3 m³ (822 cu ft)

#### 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 turbofans) (Jane's/Dennis Punnett) 1993

Max power loading: -30	090.0 kg/m² (14.2 lb/sq ft)
-50, -55	318 kg/kN (3.12 lb/lb st)
	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):

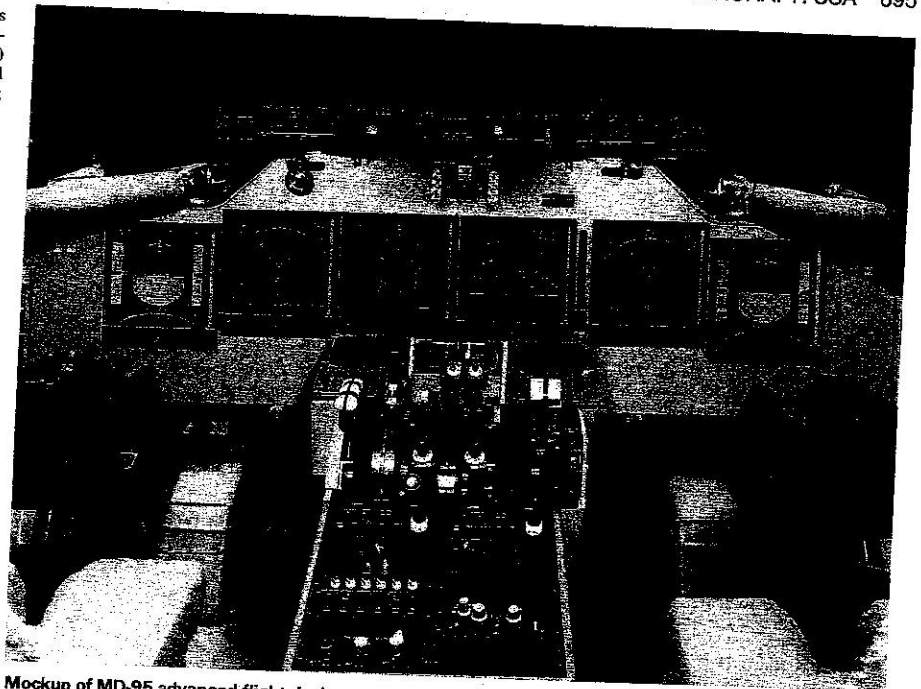
Freight hold volume (underfloor):	
S	26.8 m <sup>3</sup> (945 cu ft)
ER	19.5 m <sup>3</sup> (689 cu ft)

AREAS:

Wings, gross	92.97 m <sup>2</sup> (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 <sup>2</sup> (113.92 lb/sq ft)
ER	590.4 kg/m <sup>2</sup> (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

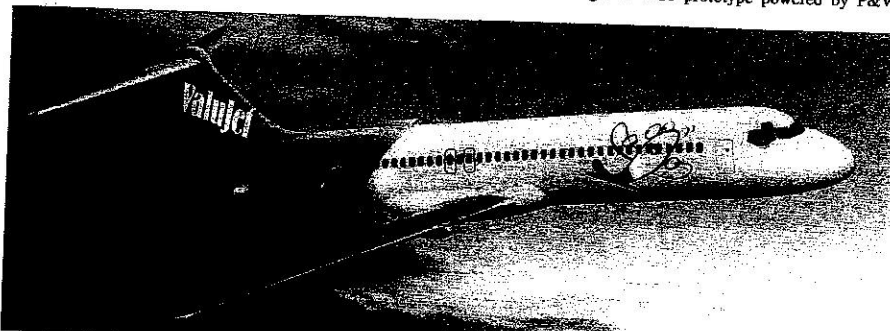
(PIP): Continuous improvement programme aimed at weight and drag reduction and extended range under way since 1990, resulting in recovery and extension of MD-11's design range. First delivery November 1990 with initial choice of gross weights between 273,289 kg (602,500 lb) and 276,691 kg (610,000 lb); 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.

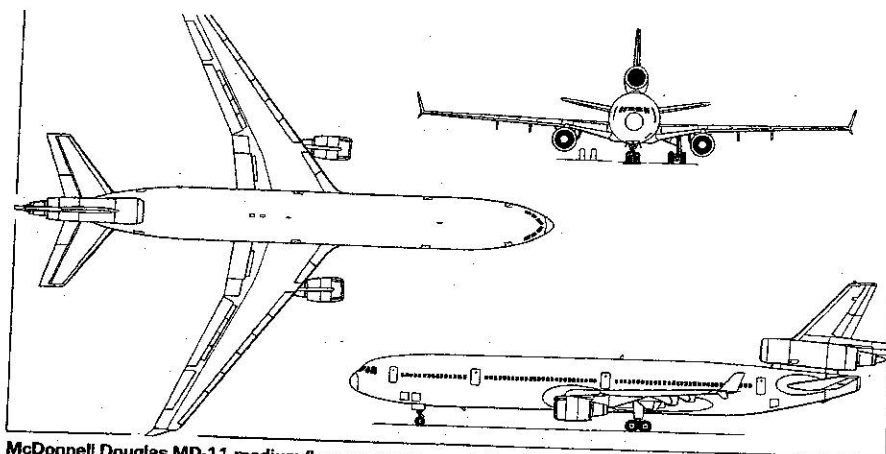
**T-O weight increases:** Maximum T-O weight increased to 280,320 kg (618,000 lb) in January 1991; further optional increase to 283,720 kg (625,500 lb) in July 1993.

**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;

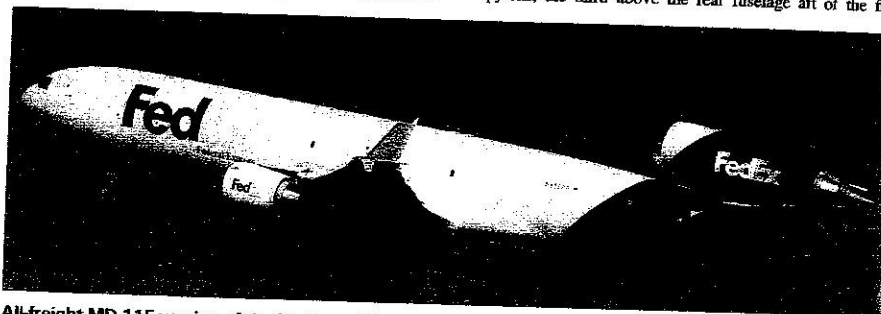
honeycomb and composites skin; tailplane has CFRP trailing-edge; elevators CFRP.

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).

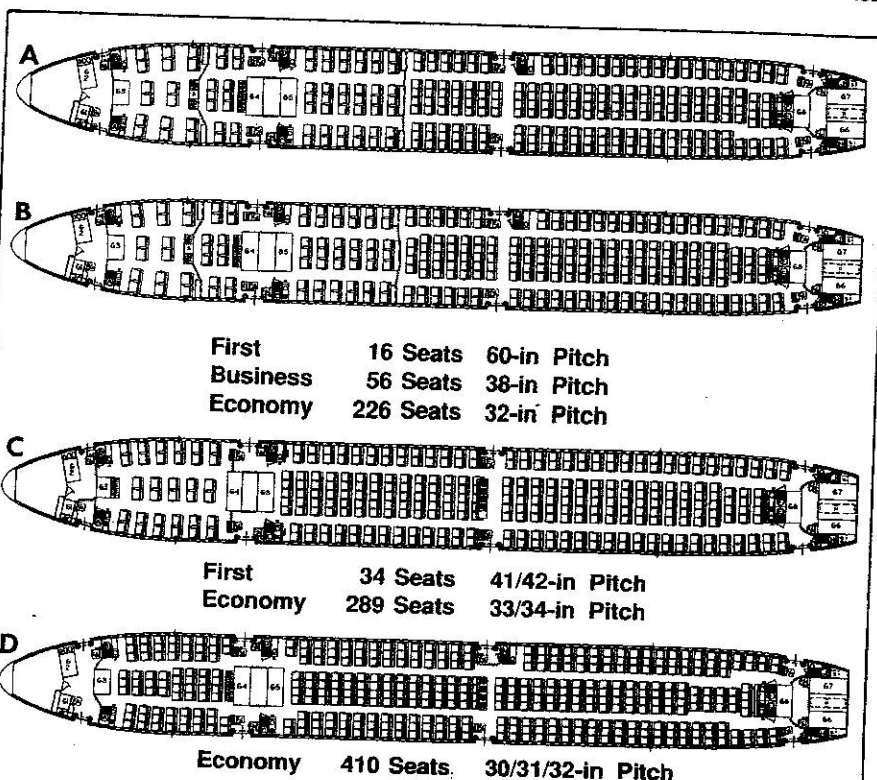
**LANDING GEAR:** Hydraulically retractable tricycle type, with additional twin-wheel main unit mounted on the fuselage centreline; heaviest proposed variants might have four-wheel centreline bogie; nosewheel and centreline units retract forward, main units inward into fuselage. Twin-wheel steerable 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 windcreens, 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:

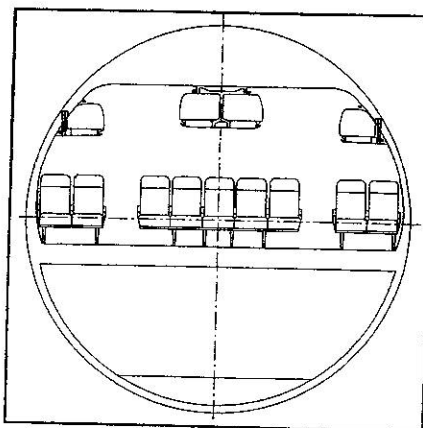
Cabin:	
Length, flight deck door to rear bulkhead	46.51 m (152 ft 7 1/4 in)
Max width	5.71 m (18 ft 9 in)
Max height	2.41 m (7 ft 11 in)
Floor area, incl galleys and toilets	244.7 m <sup>2</sup> (2,634 sq ft)
Volume, incl galleys and toilets	599.3 m <sup>3</sup> (21,165 cu ft)
Lower deck freight holds,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

#### AREAS:

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

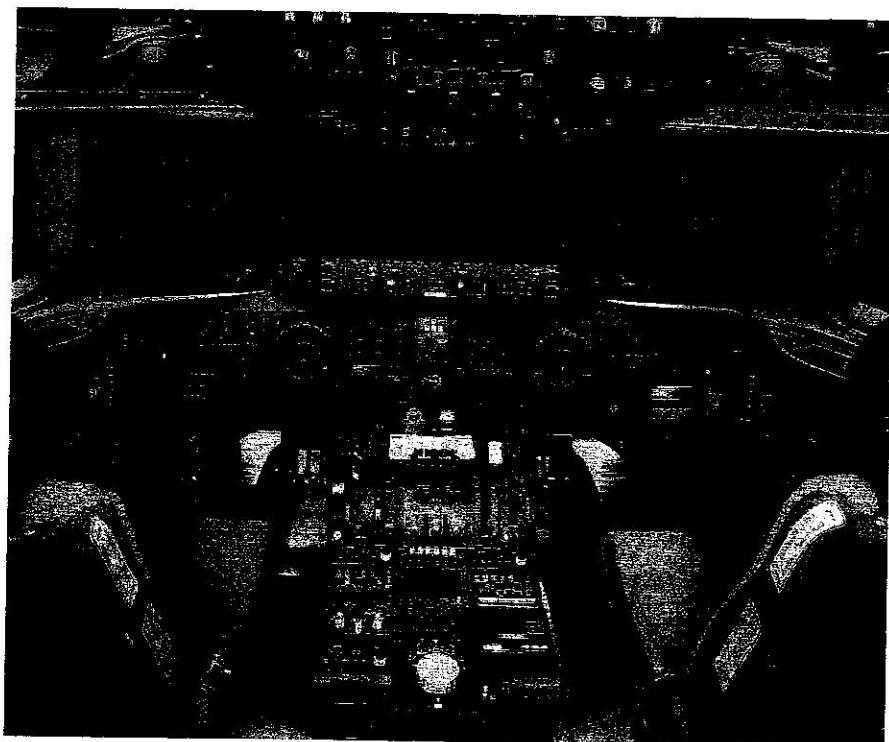
#### WEIGHTS AND LOADINGS:

*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/m<sup>2</sup> (165.17 lb/sq ft)  
 optional 843.8 kg/m<sup>2</sup> (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<sub>MO</sub>): 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 m<sup>2</sup> (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/m<sup>2</sup> (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 m<sup>2</sup> (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/m<sup>2</sup> (14.29 lb/sq ft)  
 Max power loading (IO-360) 9.13 kg/kW (15.00 lb/hp)

PERFORMANCE:

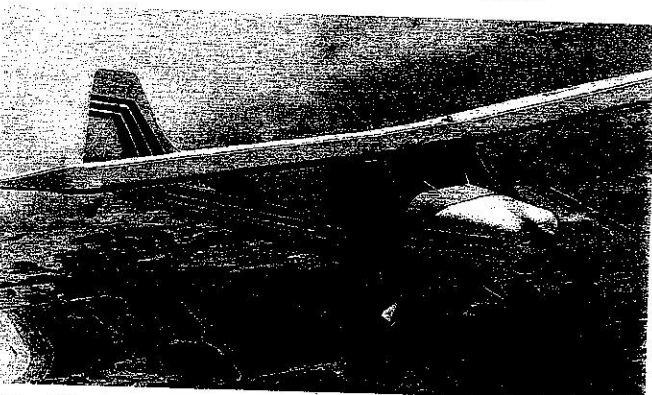
Never-exceed speed (V<sub>NE</sub>) 130 kt (241 km/h; 150 mph)  
 Max cruising speed 100 kt (185 km/h; 115 mph)  
 Stalling speed: flaperons up 46 kt (86 km/h; 53 mph)  
 flaperons down 40 kt (73 km/h; 45 mph)  
 Max rate of climb at S/L 213 m (700 ft)/min  
 T-O to, and landing from, 15 m (50 ft) 244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

UPDATED



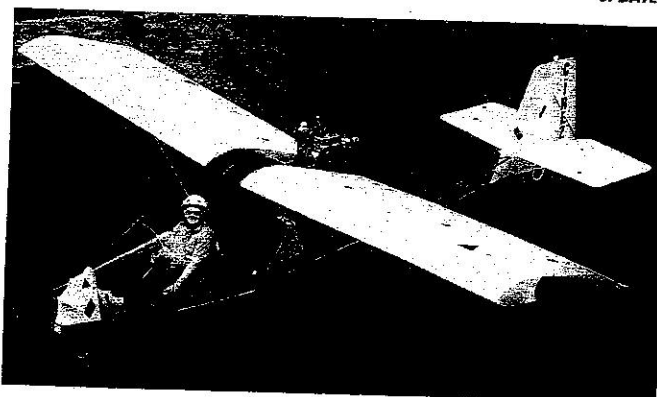
Floatplane version of Merlin GT

1996



Rotax 618-powered Merlin GT

1996



Merlin E-Z two-seat ultralight

1996



parachute separator (also available for KAH variant). Standard in MH-47E and optional in International Chinook are two AlliedSignal T55-L-714 turboshafts, each with a standard power rating of 3,108 kW (4,168 shp) continuous and emergency rating of 3,629 kW (4,867 shp). MH-47E normal fuel 7,828 litres (2,068 US gallons; 1,722 Imp gallons) but can also operate with three long-range tanks in cargo area, each containing 3,028 litres (800 US gallons; 666 Imp gallons), raising total fuel capacity to 16,913 litres (4,468 US gallons; 3,720 Imp gallons). MH-47D SOA and MH-47E have 8.97 m (29 ft 5 in) refuelling probe on starboard side of forward fuselage, which extends 5.41 m (17 ft 9 in) forward of the nose.

**ACCOMMODATION:** Two pilots on flight deck, with dual controls. Lighting compatible with pilots' NVGs (Nite-Op in RAF variant). Jump seat for crew chief or combat commander. Jettisonable door on each side of flight deck. Depending on seating arrangement, 33 to 55 troops can be accommodated in main cabin, or 24 litters plus two attendants, or (see under Current Versions) vehicles and freight. Rear-loading ramp can be left completely or partially open, to permit transport of extra-long cargo and in-flight parachute or free-drop delivery of cargo and equipment.

Main cabin door, at front on starboard side, comprises upper hinged section which can be opened in flight, and lower section with integral steps. Upper section has a panel with window that is jettisonable. Triple external cargo hook system, with centre hook rated to carry maximum load of 11,793 kg (26,000 lb) and the forward and rear hooks 7,711 kg (17,000 lb) each, or 10,433 kg (23,000 lb) in unison. Options are available for a power-down ramp and water dam to permit ramp operation on water, internal ferry fuel tanks, external rescue hoist, and windscreen washers.

**SYSTEMS:** Hydraulic system contains a utility system, a No. 1 flight control system and a No. 2 flight control system. Each includes a separate, variable delivery pump and a reservoir cooler module. Utility system contains a pressure control module and a return control module. Both flight control systems contain a power control module, incorporating pressure and return in one module for each system. Each flight control system can be driven by the utility system for ground checkout through a power transfer unit without intermixing of hydraulic fluids. All hydraulic systems have a pressurised reservoir to prevent pump cavitation and are serviced by a common filter.

The CH-47D has a significant reduction in the number of hydraulic lines and fittings; approximately 200 tubes and hoses eliminated, thereby obviating approximately 700 leak points. Majority of all lines now swaged together for permanent joining; Rosan fluid adapters for hardpoint connections. All systems capable of being monitored, both in flight and on the ground, for servicing prechecks and

demand; power transfer units now used for flight control ground system checkout. Electrical system includes two 40 kVA oil-cooled alternators driven by transmission drive system. Solar T62-T-2B APU drives a 20 kVA generator and hydraulic motor pump, providing electrical and hydraulic power for main engine start and system operation on the ground.

**AVIONICS:** (International CH-47D: US Army CH-47D assumed to be generally similar. Specific MH-47E avionics listed under that heading. Avionics for RAF HC. Mk 1 listed in 1985-86 and earlier editions. Netherlands aircraft have Honeywell Advanced Cockpit Management System (ACMS) and EFIS, latter adopted by Boeing as baseline for subsequent sales).

**Comms:** ARC-199 HF com radio, Collins ARC-186 UHF/AM-FM, Magnavox ARC-164 UHF/AM com; C-6533 intercom (Netherlands aircraft have Telephonic Corp STARCOM); Bendix/King AN/APX-100 IFF.

**Flight:** APN-209 radar altimeter; AN/ARN-89B ADF; AN/ARN-118 Tacan; AN/ARN-123 VOR/glide slope/ marker beacon receiver; and AN/ASN-43 gyromagnetic compass. AFCS maintains helicopter stability, eliminating the need for constant small correction inputs by the pilot to maintain desired attitude. The AFCS is a redundant system using two identical control units and two sets of stabilisation actuators.

**Instrumentation:** Flight instruments are standard for IFR, and include an AN/AQU-6A horizontal situation indicator.

**Mission:** Chelton 19-400 satellite communications antenna on some RAF helicopters.

**Self-defence:** RAF Chinooks have Tracor M-206/M-1 chaff/flare dispensers, GEC-Marconi ARI18228 RWR and (from 1990) Loral AN/ALQ-157 IR jammers, Honeywell AN/AAR-47 missile approach warning equipment and Rascal RNS252 Super TANS INS including GPS.

**EQUIPMENT:** Hydraulically powered winch for rescue and cargo handling, rearview mirror, plus integral work stands and step for maintenance.

**ARMAMENT:** Provision for two machine guns or miniguns in crew door (starboard) and forward hold window (port).

#### DIMENSIONS, EXTERNAL:

Rotor diameter (each)	18.29 m (60 ft 0 in)
Rotor blade chord (each)	0.81 m (2 ft 8 in)
Distance between rotor centres	11.94 m (39 ft 2 in)
Length: overall, rotors turning	30.14 m (98 ft 10 in)
fuselage: Army CH-47D	15.54 m (51 ft 0 in)
International CH-47D and MH-47E	15.87 m (52 ft 1 in)
MH-47D/E incl probe	21.29 m (69 ft 10 in)
Width, rotors removed: CH-47D	3.78 m (12 ft 5 in)
MH-47E	4.78 m (15 ft 8 in)
Height to top of rear rotor head:	
CH-47D	5.78 m (18 ft 11 in)
MH-47E	5.59 m (18 ft 4 in)

front approach	3.33 m (10 ft 11 in)
rear approach: CH-47D	5.79 m (19 ft 0 in)
MH-47E	5.59 m (18 ft 4 in)
Ground clearance, static, rear approach	4.90 m (16 ft 0 in)
Wheel track (c/l of shock-absorbers)	3.20 m (10 ft 6 in)
Wheelbase: CH-47D	6.86 m (22 ft 6 in)
MH-47E	7.87 m (25 ft 10 in)
Passenger door (fwd, stbd): Height	1.68 m (5 ft 6 in)
Width	0.91 m (3 ft 0 in)
Height to sill	1.09 m (3 ft 7 in)
Rear-loading ramp entrance: Height	1.98 m (6 ft 6 in)
Width	2.31 m (7 ft 7 in)
Height to sill	0.79 m (2 ft 7 in)

#### DIMENSIONS, INTERNAL:

Cabin, excl flight deck: Length	9.30 m (30 ft 6 in)
Width: mean	2.29 m (7 ft 6 in)
at floor	2.51 m (8 ft 3 in)
Height	1.98 m (6 ft 6 in)
Floor area	21.0 m <sup>2</sup> (226 sq ft)
Usable volume	41.7 m <sup>3</sup> (1,474 cu ft)

#### AREAS:

Rotor blades (each)	7.43 m <sup>2</sup> (80.0 sq ft)
Rotor discs (total)	525.3 m <sup>2</sup> (5,655 sq ft)

**WEIGHTS AND LOADINGS (CH-47D and International Chinook: see tables; MH-47E: as below):**

Weight empty	12,210 kg (26,918 lb)
Useful load	12,284 kg (27,082 lb)
Max fuel weight	6,815 kg (15,025 lb)
Max T-O weight	24,494 kg (54,000 lb)
Max transmission power loading	4.36 kW/kW (7.17 lb/shp)

**PERFORMANCE (CH-47D and International Chinook: see tables; MH-47E at 22,680 kg; 50,000 lb: as below):**

Max level speed	154 kt (285 km/h; 177 mph)
Max cruising speed at S/L	140 kt (259 km/h; 161 mph)
Max rate of climb	561 m (1,840 ft)/min
Service ceiling	3,095 m (10,150 ft)
Hovering ceiling: IGE	2,990 m (9,800 ft)
IGE, ISA + 20°C (68°F)	2,410 m (7,900 ft)
OGE	1,675 m (5,500 ft)
OGE, ISA + 20°C (68°F)	1,005 m (3,300 ft)
Radius of action, deploy special forces team (1,814 kg; 4,000 lb) at 1,220 m (4,000 ft), 35°C (95°F) ambient temperature	505 n miles (935 km; 581 miles)
Range, self-deployment at 24,494 kg (54,000 lb) T-O weight	1,260 n miles (2,333 km; 1,449 miles)

UPDATED

#### OTHER AIRCRAFT

Details of V-22 Osprey and Model 609 will be found under Bell Boeing entry; RAH-66 Comanche under Boeing Sikorsky.

UPDATED

#### BOEING COMMERCIAL AIRPLANE GROUP

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EXECUTIVE VICE-PRESIDENTS:

Richard R. Albrecht (Customers)

Robert L. Dryden (Airplane Production)

Thomas E. Schick (Deputy to the President)

SENIOR VICE-PRESIDENTS:

W. Daniel Heidt (Airplane Components)

Fred R. Howard (Business Resources)

Alan R. Mulally (Airplane Development and Definition)

VICE-PRESIDENT, COMMUNICATIONS: Pat Coulter

\*Also corporate Senior Vice-President, The Boeing Company

plus the fourth non-commercial 767 for modification to AWACS for Japan. Boeing's 8,000th commercial airliner, a 767-300ER for KLM, was delivered on 1 March 1996. The company expected to deliver some 340 commercial transports during 1997.

#### Boeing Business Jets

8285 Perimeter Road South, Renton, Seattle, Washington

PRESIDENT: Borge Boeskov

In July 1996 The Boeing Company and The General Electric Company announced formation of a joint venture, Boeing Business Jets, to develop and market a corporate version of the Next Generation 737. Company headquarters are at the corporate air services facility of Boeing Field's Flight Center.

UPDATED

#### NEW SMALL AIRPLANE (NSA)

Announced in May 1994 when Richard L. James was appointed Boeing vice-president New Small Airplane study; Boeing working with Japan Aircraft Development Corporation representatives and observers from China's CATIC to determine market requirement and potential configuration of a new twin-engined airliner, smaller than the 737, for service entry in 2002; Boeing expects retirement of noisier Stage 2 airliners in the 70- to 170-passenger category to lead to purchase of up to 3,000 new smaller airliners during next 20 years. Engine candidates announced in June 1995 are BMW Rolls-Royce BR 715, CFM International CFM56 Lite and Pratt & Whitney/MTU Thrust (MTFE).

VERIFIED

#### BOEING 737-100 and 737-200

USAF designation: CT-43A

First flight of 737-100, 9 April 1967; FAA certification 15 December 1967; 30 built. Superseded by 737-200; first flight 8 August 1967; added to 737-100 type certificate 21 December 1967; first delivery to United Air Lines 29

December 1967. Last of 1,114 Boeing 737-200s (and 30 737-100s) delivered August 1988; total includes 19 T-43A navigation trainers for US Air Force (subsequently redesignated CT-43A) and three Surveillers for Indonesian Air Force. Details of early versions and developments in 1974-75 *Jane's*; 737-200 last described in *Jane's* 1990-91.

UPDATED

#### BOEING 737-300

TYPE: Twin-turboprop airliner.

PROGRAMME: Production go-ahead for Series 300 given March 1981; first flight 24 February 1984; certificated 14 November 1984; first delivery (to USAir) 28 November 1984; 737-300 for Ansett Worldwide (and subsequent lease to British Midland Airways) rolled out at Renton 19 February 1990 (as 1,833rd 737); 737 orders passed 3,000 when Southwest Airlines ordered 34 in third quarter 1992. Approval for 120-minute ETOPS given November 1986, but withdrawn July 1989 due to concerns related to operation in heavy rain and hail; approval restored 14 September 1990. Commonwealth of Independent States Interstate Aviation Committee certificated Boeing 737 family with P&W or CFM engines 18 January 1993; first delivery for Russian Federation and Associated States (CIS) registration (737-300 to National State Aviacompany Turkmenistan) 12 November 1992. Production rate for 737 was 21 per month in early 1990s; progressively decreased to seven in November 1995; airliner business upturn saw increase to 8½ in last quarter of 1996, 10 in January 1997, and was scheduled to increase to 12 in second quarter of 1997, 17 in third quarter and 21 in fourth quarter. 2,500th 737 rolled out 16 June 1993; 1,500th current-generation 737 delivered 8 September 1994.

CURRENT VERSIONS: 737-300: Basic airliner, as detailed below. Other 737 variants are described in separate entries.

**Executive:** Typically for about 20 passengers, with conference room, bedroom, bathroom and full dining facilities. Three sold by 29 February 1992, including one to Royal Thai Air Force.

Boeing Commercial Airplane Group, headquarters at Renton, near Seattle. Renton Division produced 707 (until 1991) and 727 (until 1984), and produces 737 and 757; Everett Division produces 747, 767 and 777; Fabrication Division provides manufacturing for other divisions. Materiel Division, created 1984, covers purchasing, quality control and vendor supplies; Wichita, Kansas, Division produces fuselage, engine strut and nacelle components and is the principal site for commercial aircraft modifications. Formation was announced on 28 January 1997 of Boeing Enterprises, responsible for identification, evaluation and recommendation of specific opportunities for acquisitions, joint ventures and other business relationships.

Output in 1996 (1995 figures in parentheses) was 76 (89) 737s, 26 (25) 747s, 42 (43) 757s, 44 (36) 767s and 32 (13) 777s. Monthly production stood at 22.5 aircraft in January 1997, with planned increase to 40 per month in the last quarter of the year. Announced new orders in 1996 totalled 717 aircraft (449 737s, 75 747s, 59 757s, 44 767s and 90 777s) valued at \$53 billion — a claimed 64 per cent of the world market. First-quarter deliveries in 1997 totalled 68 airliners (25 737s, 10 747s, 12 757s, 11 767s and 10 777s),

**CUSTOMERS:** See table for orders/deliveries. Recent customers include Deutsche BA (seven, ordered on 10 March 1997), GB Airways (two, ordered on 7 March 1997) and Pembroke Capital Ltd of Ireland (four, ordered on 6 March 1997).

**COSTS:** Deutsche BA order for seven aircraft valued at \$287 million (1997).

**DESIGN FEATURES:** Fuselage stretched 2.64 m (8 ft 8 in) compared with 737-200, by means of 1.12 m (3 ft 8 in) plug forward of wing box and 1.52 m (5 ft 0 in) aft; underfloor freight volume increased by 5.5 m<sup>3</sup> (193 cu ft); wing aerofoil modified by 4.4 per cent extension of leading-edge outboard of engines; new slats; new flap sections and track fairings aft of engines; additional lateral control spoilers outboard; each wingtip extended by 28 cm (11 in); increased dorsal fin area and tailplane span.

**FLYING CONTROLS:** All surfaces powered by two independent hydraulic systems with manual reversion for ailerons and elevator; elevator servo tabs unlock on manual reversion;

rudder has standby hydraulic actuator and system. Three outboard powered overwing spoiler panels on each wing assist lateral control and also act as airbrakes. Variable incidence tailplane has two electric motors and manual standby.

Leading-edge Krueger flaps inboard and three sections of slats outboard of engines; two airbrake/lift dumper panels on each wing, inboard and outboard of engines; triple-slotted trailing-edge flaps inboard and outboard of engines.

FAA Cat. II landing minima system standard using SP-300 dual digital integrated flight director/autopilot; Cat. IIIa capability optional. Common pilot type ratings for 737-200, -300, -400 and -500.

**STRUCTURE:** Aluminium alloy dual-path fail-safe two-spar wing structure. Aluminium alloy two-spar tailplane. Graphite composite ailerons, elevators and rudder, latter built by Short Brothers (UK). Aluminium honeycomb spoiler/airbrake panels and trailing-edges of slats and

flaps. Fuselage structure fail-safe aluminium. Some fins made by Xian Aircraft Co in China. Elevators, rudder and ailerons contain graphite/Kevlar and CFRP; other unstressed components in GFRP and CFRP.

**LANDING GEAR:** Hydraulically retractable tricycle type, with Boeing oleo-pneumatic shock-absorbers; inward-retracting main units have no doors, wheels forming wheel well seal; nose unit retracts forward; free-fall emergency extension. Compared with 737-200, nose unit is repositioned downwards by 13 cm (5 in) and modified to ensure adequate ground clearance for larger engine nacelles. Twin nosewheels have tyre size 27 x 7.75. Main units have heavy-duty twin wheels, H40 x 14.5-19 heavy-duty tyres, and Bendix or Goodrich heavy-duty wheel brakes as standard. Mainwheel tyre pressure 13.45 to 14.00 bars (195 to 203 lb/sq in). Nosewheel tyre pressure 11.45 to 11.85 bars (166 to 172 lb/sq in).

**POWER PLANT:** Basic aircraft has two CFM International CFM56-3C-1 turbofans rated at either 89.0 kN (20,000 lb st) or 97.9 kN (22,000 lb st), introduced 1988. Engines pylon-mounted forward of wings, and higher than those of 737-200; each has external strake on inboard side. Standard fuel capacity up to 20,104 litres (5,311 US gallons; 4,422 Imp gallons), with integral fuel cells in wing centre-section and integral wing tanks. Fuel options up to 23,830 litres (6,295 US gallons; 5,242 Imp gallons) with Rogerson tanks in underfloor cargo bays (from 1989). Single-point pressure refuelling under leading-edge of starboard wing.

**ACCOMMODATION:** Crew of two side by side on flight deck.

Alternative cabin layouts seat from 128 to 149 passengers. Typical arrangements offer eight first class seats four-abreast at 91 cm (36 in) pitch and 120 tourist class seats six-abreast at 81 cm (32 in) in mixed class; and 141 or 149 all-tourist class at seat pitches of 81 cm (32 in) or 76 cm (30 in) respectively. One plug type door at each corner of cabin, with passenger doors on port side and service doors on starboard side. Airstair for forward cabin door optional. Overwing emergency exit on each side. One or two galleys and one lavatory forward, and one or two galleys and lavatories aft, depending on configuration. Lightweight interior, using advanced crushed core materials, providing total overhead baggage capacity of 6.8 m<sup>3</sup> (240 cu ft), equivalent to 0.048 m<sup>3</sup> (1.7 cu ft) per passenger. Underfloor freight holds forward and aft of wing, with doors on starboard side.

**SYSTEMS:** AirResearch bleed air control system for thermal anti-icing, air conditioning and pressurisation systems; maximum differential 0.52 bar (7.5 lb/sq in); two functionally independent hydraulic systems with a third standby system, using fire resistant hydraulic fluid, for flying controls, flaps, slats, landing gear, nosewheel steering and brakes; pressure 207 bars (3,000 lb/sq in). No pneumatic system. Electrical supply since 1991 from two 50 kVA variable-speed constant-frequency generators. AlliedSignal GTCP-5-129(C) APU (GTCP36-280 from 1988 and APS 2000 from 1991) for air supply and electrical power in flight and on ground as well as engine starting.

**AVIONICS:** Avionics fit is common to 737-300, -400 and -500.

**Radar:** Digital colour weather radar.

**Flight:** Flight management computer provides lateral, vertical and time navigation using pilot-set waypoints; dual digital flight management computers introduced 1993; dual ring laser gyro inertial system.

**Instrumentation:** EFIS screens show map, flight plan, full or partial compass rose, weather and, optionally, integrated airspeed scale; electronic engine instrument system has coloured LED dials, with secondary panel, secondary engine and hydraulics indications; windshear alerting with recovery guidance in attitude indicator; full flight regime autothrottle.

#### DIMENSIONS, EXTERNAL:

Wing span	28.88 m (94 ft 9 in)
Wing chord at root	4.71 m (15 ft 5½ in)
Wing aspect ratio	7.9
Length overall	33.40 m (109 ft 7 in)
Height overall	11.13 m (36 ft 6 in)
Tailplane span	12.70 m (41 ft 8 in)
Wheel track	5.23 m (17 ft 2 in)
Wheelbase	12.45 m (40 ft 10 in)
Main passenger door (port, fwd):	
Height	1.83 m (6 ft 0 in)
Width	0.86 m (2 ft 10 in)
Height to sill	2.62 m (8 ft 7 in)
Passenger door (port, rear):	
Height	1.83 m (6 ft 0 in)
Width	0.76 m (2 ft 6 in)
Height to sill	0.86 m (2 ft 10 in)
Height to sill	2.74 m (9 ft 0 in)
Emergency exits (overwing, port and stbd, each):	
Height	0.97 m (3 ft 2 in)
Width	0.51 m (1 ft 8 in)
Galley service door (stbd, fwd):	
Height	1.65 m (5 ft 5 in)
Width	0.76 m (2 ft 6 in)
Height to sill	2.62 m (8 ft 7 in)
Service door (stbd, rear):	
Height	1.65 m (5 ft 5 in)



Garuda Airlines Boeing 737-300 (CFM56 engines) (Paul Jackson)

1996

### BOEING COMMERCIAL AIRPLANE GROUP ORDERS, DELIVERIES AND BACKLOG\*

(at 1 January 1997)

	Orders		Deliveries		Backlog Announced
	1996	Total	1996	Total	
707	0	1,010	0	1,010	0
<b>Total</b>	<b>0</b>	<b>1,010</b>	<b>0</b>	<b>1,010</b>	<b>0</b>
727	0	1,831	0	1,831	0
<b>Total</b>	<b>0</b>	<b>1,831</b>	<b>0</b>	<b>1,831</b>	<b>0</b>
737-100	0	30	0	30	0
737-200	0	1,114	0	1,114	0
737-300	58	1,102	37	967	135
737-400	39	456	21	409	47
737-500	36	385	18	320	65
737-600	32	114	0	0	114
737-700	122	218	0	0	218
737-800	142	185	0	0	185
<b>Total</b>	<b>449</b>	<b>3,604</b>	<b>76</b>	<b>2,840</b>	<b>764</b>
747-100	0	250	0	250	0
747-200	0	393	0	393	0
747-300	0	81	0	81	0
747-400	67	437	18	291	146
747-400D	0	19	0	19	0
747-400F	0	21	3	14	7
747-400M	8	57	5	49	8
<b>Total</b>	<b>75</b>	<b>1,258</b>	<b>26</b>	<b>1,097</b>	<b>161</b>
757-200	42	777	37	670	107
757-200M	0	1	0	1	0
757-200PF	5	80	5	65	15
757-300	12	12	0	0	12
<b>Total</b>	<b>59</b>	<b>870</b>	<b>42</b>	<b>736</b>	<b>134</b>
767-200	0	128	0	128	0
767-200E	1	101	3**	99	2
767-300	5	105	1	88	17
767-300E	38	359	29	308	51
767-300F	0	32	11	16	16
<b>Total</b>	<b>44</b>	<b>725</b>	<b>44**</b>	<b>639</b>	<b>86</b>
777-200	77	269	32	45	224
777-300	13	49	0	0	49
<b>Total</b>	<b>90</b>	<b>318</b>	<b>32</b>	<b>45</b>	<b>273</b>
<b>Grand Totals</b>	<b>717</b>	<b>9,616</b>	<b>220</b>	<b>8,198</b>	<b>1,418</b>

\* Does not include one each of 727-100, 747-100, 757-200, 767-200 and 777-200 owned by Boeing

\*\* Includes two 767-200ER for modification to 767 AWACS

Height	1.22 m (4 ft 0 in)
Width	1.30 m (4 ft 3 in)
Height to sill	1.30 m (4 ft 3 in)
Freight hold door (stbd, rear):	
Height	1.22 m (4 ft 0 in)
Width	1.22 m (4 ft 0 in)
Height to sill	1.55 m (5 ft 1 in)

#### DIMENSIONS, INTERNAL:

Cabin, aft of flight deck to rear pressure bulkhead:

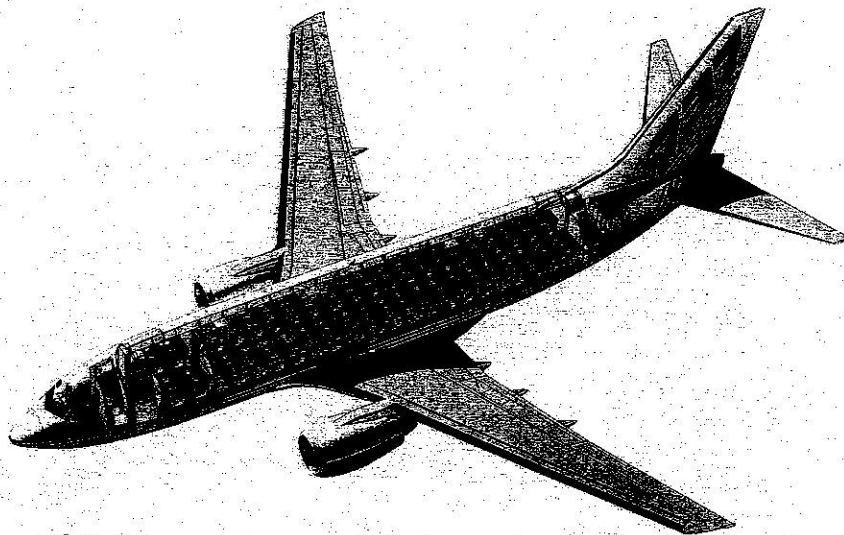
Length	24.18 m (79 ft 4 in)
Max width	3.53 m (11 ft 7 in)
Max height	2.13 m (7 ft 0 in)
Floor area	75.1 m <sup>2</sup> (808 sq ft)
Freight hold volume: basic	30.2 m <sup>3</sup> (1,068 cu ft)
with max optional fuel	22.4 m <sup>3</sup> (792 cu ft)

#### AREAS:

Wings, gross	105.4 m <sup>2</sup> (1,135.0 sq ft)
Ailerons (total)	2.49 m <sup>2</sup> (26.80 sq ft)
Trailing-edge flaps (total)	16.87 m <sup>2</sup> (181.60 sq ft)
Slats (total)	7.23 m <sup>2</sup> (77.80 sq ft)
Ground spoilers (total)	5.00 m <sup>2</sup> (53.80 sq ft)
Flight spoilers (total)	2.64 m <sup>2</sup> (28.40 sq ft)
Fin	23.13 m <sup>2</sup> (249.00 sq ft)
Rudder	5.22 m <sup>2</sup> (56.20 sq ft)
Tailplane	31.31 m <sup>2</sup> (337.00 sq ft)
Elevators, incl tabs (total)	6.55 m <sup>2</sup> (70.50 sq ft)

#### WEIGHTS AND LOADINGS (A: basic aircraft, B: long-range option):

Operating weight empty: A, B	32,881 kg (72,490 lb)
Max T-O weight: A	56,470 kg (124,500 lb)
B	up to 63,276 kg (139,500 lb)
Max ramp weight: A	56,700 kg (125,000 lb)
B	up to 63,500 kg (140,000 lb)
Max zero-fuel weight: A	47,625 kg (105,000 lb)
B	up to 49,715 kg (109,600 lb)
Max landing weight: A	51,720 kg (114,000 lb)
B	up to 52,890 kg (116,600 lb)
Max wing loading: A	535.6 kg/m <sup>2</sup> (109.69 lb/sq ft)
B	595.8 kg/m <sup>2</sup> (122.03 lb/sq ft)
Max power loading:	
A, 89.0 kN	317 kg/kN (3.11 lb/lb st)
A, 97.9 kN	289 kg/kN (2.83 lb/lb st)



Boeing 737-500 interior with 108 passengers in two classes

1997

B, 89.0 kN	356 kg/kN (3.49 lb/lb st)
B, 97.9 kN	323 kg/kN (3.17 lb/lb st)
PERFORMANCE: (A: at brake release weight of 56,470 kg; 124,500 lb, B: at optional brake release weight of 62,820 kg; 138,500 lb):	
Max operating Mach No. (Mmo)	0.82
Cruising speed	M0.745
Approach speed	135 kt (250 km/h; 155 mph)
Initial cruising altitude	10,190 m (33,440 ft)
Service ceiling, OEI	5,425 m (17,800 ft)

T-O field length, S/L, at 30°C (86°F):	
B	2,286 m (7,500 ft)
Landing field length at max landing weight	1,433 m (4,700 ft)
Still air range with 140 passengers, T-O at S/L:	
A	1,459 n miles (2,703 km; 1,680 miles)
B	2,233 n miles (4,136 km; 2,570 miles)
Design range, full passenger load, max T-O weight:	
	2,270 n miles (4,204 km; 2,612 miles)
OPERATIONAL NOISE LEVELS: 737-300, -400 and -500 only exceed FAR Pt 36, Stage 3/ICAO Annex 16 Chapter 3 noise in approach with 40° flap setting	

UPDATED

#### BOEING 737-400

TYPE: Twin-turboprop airliner; stretched version of 737-300.  
 PROGRAMME: Announced June 1986; rolled out 26 January 1988; first flight 19 February 1988; certificated for up to 188 passengers 2 September 1988; first delivery (to Piedmont Airlines) 15 September 1988. High gross weight structure variant rolled out 23 December 1988; certificated by FAA and delivered to first customer 21 March 1989. ETOPS approval granted 14 September 1990. Russian Federation and Associated States (CIS) certification with CFM engines 18 January 1993, as for 737-300. See production rates under 737-300.

CURRENT VERSIONS: Basic and long-range: As described.

High gross weight structure: Optional strengthened centre-fuselage, wing and landing gear, slats and Kruegers; increased fuel capacity by means of Rogerson tanks in aft cargo bay.

CUSTOMERS: See table for orders/deliveries.

DESIGN FEATURES: Incorporates all the new technology of 737-300. Fuselage has 1.83 m (6 ft 0 in) plug forward of wing and 1.22 m (4 ft 0 in) aft, totalling 3.05 m (10 ft 0 in); outer wings and landing gear strengthened for maximum landing weights from 54,885 to 56,245 kg (121,000 to 124,000 lb). Tail bumper standard on all 737-400s. At gross weights above 63,050 kg (139,000 lb) loading must be controlled to preserve CG. Avionics and systems as for 737-300 except for modified avionics software and improved environmental control system.

POWER PLANT: Two CFM56-3C-1 turboprops, each rated at 97.9 kN (22,000 lb st) or 104.5 kN (23,500 lb st). Basic fuel capacity 20,104 litres (5,311 US gallons; 4,422 Imp gallons); maximum long-range option fuel capacity 23,830 litres (6,295 US gallons; 5,242 Imp gallons).

ACCOMMODATION: As for 737-300 except: Alternative cabin layouts seat from 146 to 168 passengers. Typical arrangements offer 10 first class seats four abreast at 91 cm (36 in) pitch and 136 tourist class seats six abreast at 81 cm (32 in) pitch in mixed class; and 168 all-tourist class at 76 cm (30 in) pitch.

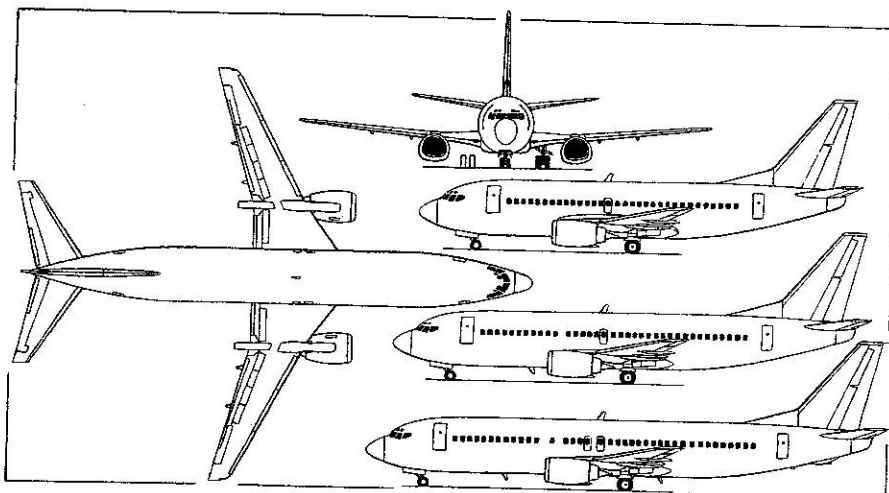
DIMENSIONS, EXTERNAL: As for 737-300 except:

Length overall	36.45 m (119 ft 7 in)
Main passenger door (port, fwd):	
Height to sill	2.59 m (8 ft 6 in)

DIMENSIONS, INTERNAL: As for 737-300 except:

Cabin, aft of flight deck to rear pressure bulkhead:	
Floor area	84.9 m <sup>2</sup> (914 sq ft)
Freight hold volume: basic	38.9 m <sup>3</sup> (1,373 cu ft)
with max optional fuel	31.1 m <sup>3</sup> (1,097 cu ft)

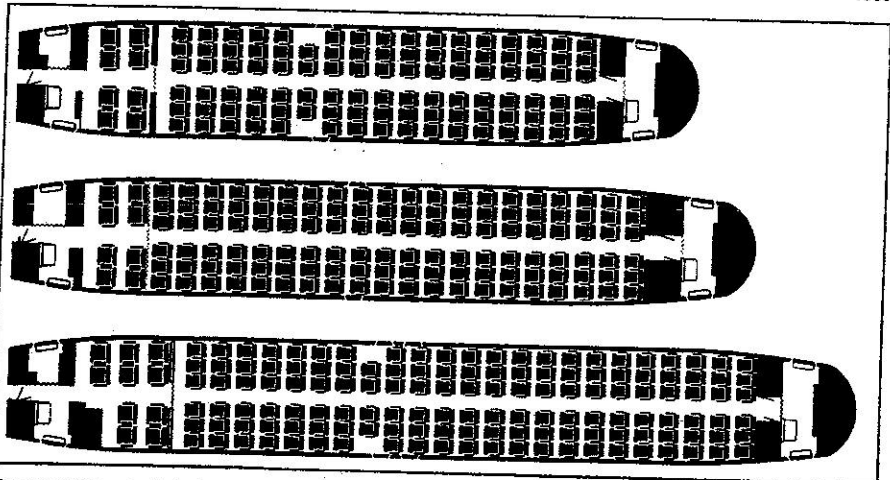
WEIGHTS AND LOADINGS (A: basic aircraft, B: long-range option):	
Operating weight empty: A	34,564 kg (76,200 lb)
B	34,827 kg (76,780 lb)



Three-view drawing of Boeing 737-400, with additional side views of 737-500 (top) and 737-300 (centre)

(Jane's/Dennis Punnett)

1988



Boeing 737 typical interior arrangements. Top: 737-500 with 108 passengers; centre: 737-300 with 128; bottom: 737-400 with 146. Seat pitches are 91 cm (36 in) for first class, 81 cm (32 in) for economy class

1996



Max T-O weight: A	62,820 kg (138,500 lb)
B	68,040 kg (150,000 lb)
Max ramp weight: A	63,050 kg (139,000 lb)
B	68,265 kg (150,500 lb)
Max zero-fuel weight: A	51,255 kg (113,000 lb)
B	53,070 kg (117,000 lb)
Max landing weight: A	54,885 kg (121,000 lb)
B	56,245 kg (124,000 lb)
Max wing loading: A	595.8 kg/m <sup>2</sup> (122.03 lb/sq ft)
B	645.3 kg/m <sup>2</sup> (132.16 lb/sq ft)
Max power loading:	
A, 97.9 kN	321 kg/kN (3.15 lb/lb st)
A, 104.5 kN	300 kg/kN (2.95 lb/lb st)
B, 97.9 kN	348 kg/kN (3.41 lb/lb st)
B, 104.5 kN	325 kg/kN (3.19 lb/lb st)
PERFORMANCE (with 136 passengers and T-O weight of 68,040 kg; 150,000 lb):	
Max operating Mach No. (MMO)	0.82
Cruising speed	M0.745
Approach speed	139 kt (257 km/h; 160 mph)
Initial cruising altitude	9,662 m (31,700 ft)
Service ceiling, OEI	5,273 m (17,300 ft)
T-O field length, S/L, at 30°C (86°F)	2,664 m (8,740 ft)
Landing field length at max landing weight	1,539 m (5,050 ft)
Design range, max passenger load	2,090 n miles (3,870 km; 2,405 miles)

UPDATED

**BOEING 737-500**

TYPE: Twin-turboprop; short-body version of 737-300, replacing 737-200.

PROGRAMME: Initially known as 737-1000; announced as 737-500 on 20 May 1987; first flight 20 June 1989; certificated 12 February 1990 after 375 hour test programme; first delivery (to Southwest Airlines) 28 February 1990; ETOPS approval 14 September 1990. Russian Federation and Associated States (CIS) certification with CFM engines 18 January 1993, as for 737-300 and -400. See 737-300 entry for production rates.

CURRENT VERSIONS: Maximum T-O weights ranging from 52,390 to 60,555 kg (115,500 to 133,500 lb).

CUSTOMERS: Launch customers were Braathens SAFE of Norway (25 firm) and Southwest Airlines (20 firm and 20 optioned); see table for orders and deliveries. Recent customers include the Chilean Air Force (one), Garuda Indonesian (five), GECAS (one) and Thai Airways International (two).

DESIGN FEATURES: Incorporates advanced technology of 737-300 and -400, but fuselage shortened. Engine thrust and fuel capacity options detailed below. New nosewheel tyres. Systems and avionics as for 737-300 with minor variations.

POWER PLANT: Two CFM International CFM56-3C-1 turboprops, each rated at 89.0 kN (20,000 lb st) or derated to 82.3 kN (18,500 lb st) according to gross weight. Electronic power control allows fixed-throttle climb and limits fan speed and EGT overshoots. Basic fuel capacity 20,104 litres (5,311 US gallons; 4,422 Imp gallons); long-range option fuel capacity 23,830 litres (6,295 US gallons; 5,242 Imp gallons).

ACCOMMODATION: As for 737-300 except that alternative cabin layouts seat from 108 to 138 passengers. Typical arrangements offer eight first class seats four-abreast at 91 cm (36 in) pitch and 100 tourist class seats six-abreast at 81 cm (32 in) pitch in mixed class; and 138 all-tourist class at 76 cm (30 in) pitch. Total overhead baggage capacity of 5.9 m<sup>3</sup> (208 cu ft), equivalent to 0.045 m<sup>3</sup> (1.6 cu ft) per passenger.

DIMENSIONS, EXTERNAL: As for 737-300 except:

Length overall 31.01 m (101 ft 9 in)

DIMENSIONS, INTERNAL: As for 737-300 except:

Cabin, aft of flight deck to rear pressure bulkhead:

Length 21.79 m (71 ft 6 in)

Floor area 67.4 m<sup>2</sup> (725 sq ft)

Freight hold volume: basic 23.3 m<sup>3</sup> (822 cu ft)

with max optional fuel 15.5 m<sup>3</sup> (546 cu ft)

WEIGHTS AND LOADINGS (A: basic aircraft, B: long-range option):

Operating weight empty: A, B 31,983 kg (70,510 lb)

Max T-O weight: A 52,390 kg (115,500 lb)

B 60,555 kg (133,500 lb)

Max ramp weight: A 52,615 kg (116,000 lb)

B 60,780 kg (134,000 lb)

Max zero-fuel weight: A 46,495 kg (102,500 lb)

B 46,720 kg (103,000 lb)

Max landing weight: A, B 49,895 kg (110,000 lb)

Max wing loading: A 496.8 kg/m<sup>2</sup> (101.76 lb/sq ft)

B 574.3 kg/m<sup>2</sup> (117.62 lb/sq ft)

Max power loading:

A, 82.3 kN 318 kg/kN (3.12 lb/lb st)

A, 89.0 kN 294 kg/kN (2.89 lb/lb st)

B, 82.3 kN 368 kg/kN (3.61 lb/lb st)

B, 89.0 kN 340 kg/kN (3.34 lb/lb st)

PERFORMANCE (with 108 passengers and T-O weight of 60,555 kg; 133,500 lb):

Max operating speed M0.82

**Boeing 737-300/400/500 series flight deck**

Initial cruising altitude	10,440 m (34,250 ft)
Service ceiling, OEI	5,608 m (18,400 ft)
T-O field length, S/L, at 30°C (86°F)	2,633 m (8,640 ft)
Landing field length, at max landing weight	1,356 m (4,450 ft)
Design range, max passenger load	2,420 n miles (4,481 km; 2,784 miles)

UPDATED

**BOEING 737-600, -700 and -800**

TYPE: Twin-turboprop; developments of 737 family. PROGRAMME: Originally called 737X; regarded as 'Next-Generation' 737s. Boeing asked more than 30 airlines to help define 737X in 1991; company board authorised offer

for sale June 1993; Southwest Airlines ordered 63 737-700s (32 converted from options for 737-300s) plus 63 new options 18 November 1993; roll-out (737-700) 8 December 1996; first flight (N737X) 9 February 1997; certification due July 1997, immediately followed by first deliveries; last of 63 Southwest aircraft to be delivered in 2001. CFM56-7B power plant first flew on Boeing 747 testbed on 16 January 1996. Flight test programme will involve 10 aircraft: four 737-700s, three 737-800s and three 737-600s.

CURRENT VERSIONS: Note: Unlike earlier 737s, the Next-Generation is numbered in ascending order of size; the smallest is designated 737-600.

737-600: Known as 737-500X until officially launched; smallest of family, seating 108 two-class

**BOEING 737 NEXT-GENERATION ORDER BOOK**  
(at 31 December 1996)

Customer	Variant	First order	Qty
Air Berlin	737-800	22 Dec 94	6
Air Europa	737-800	11 Jul 96	10
Air Pacific	737-700	5 Sep 96	3
American Airlines	737-800	21 Nov 96	75
Ansett Worldwide	737-700	2 Sep 96	10
Aviation Methods Inc	BBJ	21 Oct 96	1
Bavaria Fluggesellschaft	737-700	30 Jan 95	4
China Airlines	737-800	22 Dec 95	6
Continental Airlines	737-600	10 Oct 96	30
	737-800	25 Jul 96	18
EBA-Virgin Express	737-800	25 Jul 96	30
GATX Capital Corporation	737-800	11 Jun 95	2
General Electric	BBJ	31 Jul 96	10
GE Capital Aviation Services	737-600	2 Jul 96	2
Germania	737-700	22 Jan 96	2
Hapag-Lloyd Flug (737-800 launch customer)	737-700	22 Jan 96	78
International Lease Finance Corporation	737-800	28 Mar 95	12
	737-600	18 Nov 94	16
	737-700	25 Jul 95	41
Jet Airways	737-800	25 Jul 95	11
Lauda Air	737-800	25 Jul 95	3
LOT Polish Airlines	737-800	11 Dec 96	6
Maersk Air	737-800	11 Jun 95	2
Royal Air Maroc	737-700	9 Oct 96	2
SAS (737-600 launch customer)	737-800	16 Jun 94	6
Southwest Airlines (737-700 launch customer)	737-600	30 Aug 96	9
Tombo Aviation Services	737-700	14 Mar 95	41
Transavia Airlines	737-700	17 Nov 93	63
	737-800	31 Dec 96	10
		6 Nov 95	8



Computer-generated image of Next-Generation Boeing 737-600, -700 and -800

1997

passengers; roll-out scheduled for December 1997; first flight January 1998; certification July 1998; first delivery (to SAS) in second half of 1998.

**737-700:** First to be ordered and manufactured; mid-size version of family, equivalent to current 737-300, seating 128 two-class passengers; first delivery (to Southwest Airlines) October 1997. First aircraft (N737X) rolled out 8 December 1996; first flight 9 February 1997.

**737-800:** Known as 737-400X Stretch until launched in September 1994; largest variant, seating 162 two-class passengers; rolled-out 30 June 1997; first flight due in July; certification and first delivery (to Hapag Lloyd) early 1998.

**Boeing Business Jet (BBJ):** Corporate version, described separately.

**CUSTOMERS:** See table.

**COSTS:** Price quoted as \$36 million to \$40 million depending on configuration.

**DESIGN FEATURES:** Greater range and speed than previous 737s, with less noise and fewer emissions; wing area increased by some 25 per cent by means of approximately 0.46 m (1 ft 6 in) increase in wing chord and about 4.88 m (16 ft 0 in) increase in wing span; larger tail surfaces; increased tankage gives US transcontinental range; new aircraft can use same runways, taxiways, ramps and gates as preceding variants; new variant of CFM56 turbofan derated from nominal thrust to suit smaller versions of the family. Noise on ground reduced by approximately 12 dB by new diffuser duct and cooling vent silencer on APU, new ECS fan and duct and new electrical/electronics cooling fan.

**FLYING CONTROLS:** As earlier 737s.

**POWER PLANT:** Two CFM International CFM56-7B (formerly CFM56-3XS), each rated at 116.5 kN (26,200 lb st) for the 737-800, 106.8 kN (24,000 lb st) for the 737-700 and 97.9 kN (22,000 lb st) for the 737-600. CFM56-7 combines core of CFM56-5 with improved low-pressure compressor of CFM56-3 and 1.55 m (61 in) fan. Fuel capacity (all) 26,036 litres (6,878 US gallons; 5,727 Imp gallons).

**ACCOMMODATION:** All: Crew of two side by side on flight deck. One plug type door at each side of cabin, with passenger doors on port side and service doors on starboard side. Airstair for forward cabin door optional. Overwing emergency exit on each side. One or two galleys and one lavatory forward and one or two galleys and lavatories aft. New lightweight interior, using advanced crushed core materials, providing updated overhead stowage compartments, ceiling architecture, lighting and attendant stations.

**737-600:** Alternative cabin layouts seat from 108 to 132 passengers. Typical arrangements offer eight first class seats four-abreast at 91 cm (36 in) pitch and 100 tourist class seats six-abreast at 81 cm (32 in) pitch in mixed class; and 132 all-tourist class at 76 cm (30 in) pitch. Total overhead baggage capacity of 6.1 m<sup>3</sup> (216 cu ft), equivalent to 0.045 m<sup>3</sup> (1.6 cu ft) per passenger.

**737-700:** Alternative cabin layouts seat from 128 to 149 passengers. Typical arrangements offer eight first class seats four-abreast at 91 cm (36 in) pitch and 120 tourist class seats six-abreast at 81 cm (32 in) pitch in mixed class; and 149 all-tourist class at 76 cm (30 in) pitch. Total

overhead baggage capacity of 7.0 m<sup>3</sup> (248 cu ft), equivalent to 0.051 m<sup>3</sup> (1.8 cu ft) per passenger.

**737-800:** Alternative cabin layouts seat from 162 to 189 passengers. Typical arrangements offer 12 first class seats four-abreast at 91 cm (36 in) pitch and 150 tourist class seats six-abreast at 81 cm (32 in) pitch in mixed class; and

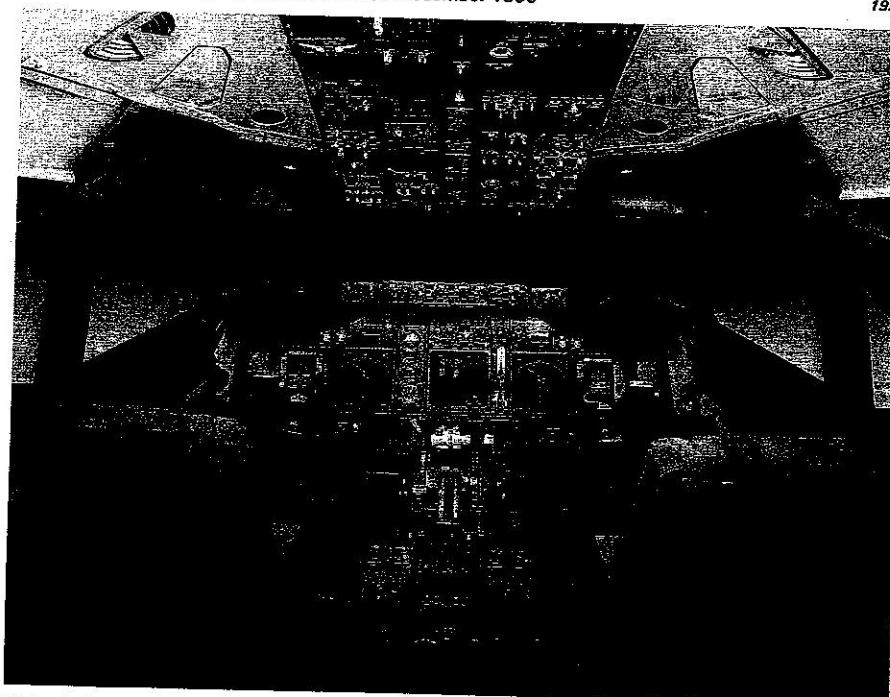
189 all-tourist class at 76 cm (30 in) pitch. Total overhead baggage capacity of 9.3 m<sup>3</sup> (328 cu ft), equivalent to 0.048 m<sup>3</sup> (1.7 cu ft) per passenger.

**AVIONICS:** Honeywell Air Transport Systems Common Display System (CDS) with six-screen flat-panel liquid crystal display (LCD) technology and programmable



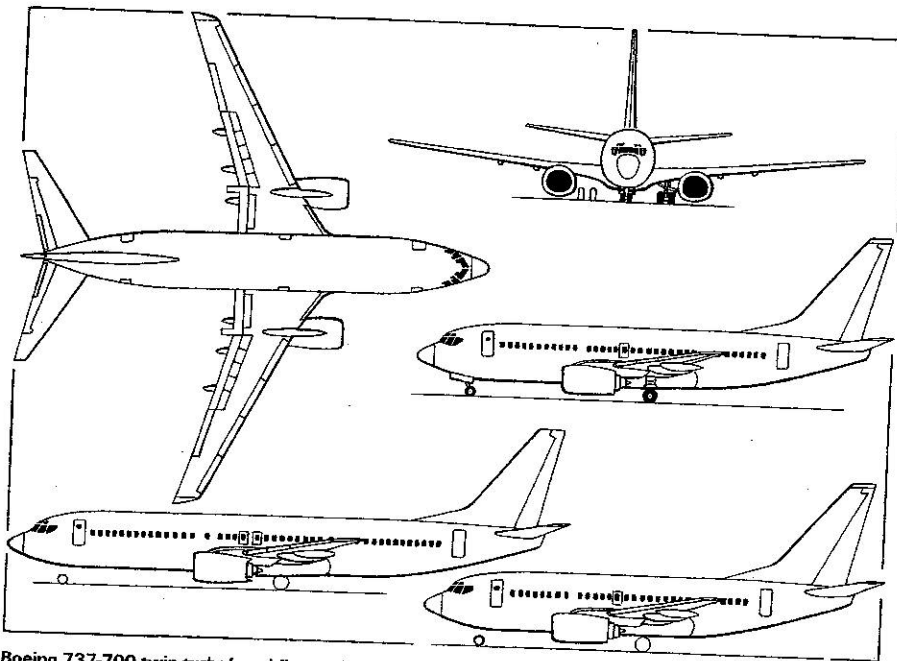
Roll-out of first Boeing 737-700 at Renton, 8 December 1996

1997



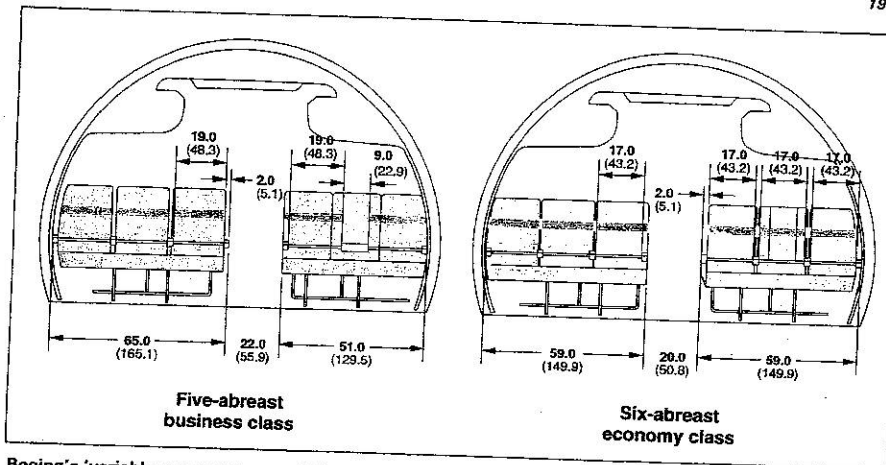
Flight deck of Boeing 737-700

1997



Boeing 737-700 twin-turboprop airliner, with additional side views of shorter -600 and stretched -800 (Jane's/James Goulding)

1997



Boeing's 'variable-geometry convertible seat' concept for the 737. Dimensions in inches (centimetres)

1997

software, will enable Next-Generation 737 operators to emulate existing 737 electronic flight instrument system (EFIS) and 747-400/777 primary flight display-navigation display (PFD-ND) flight deck formats.

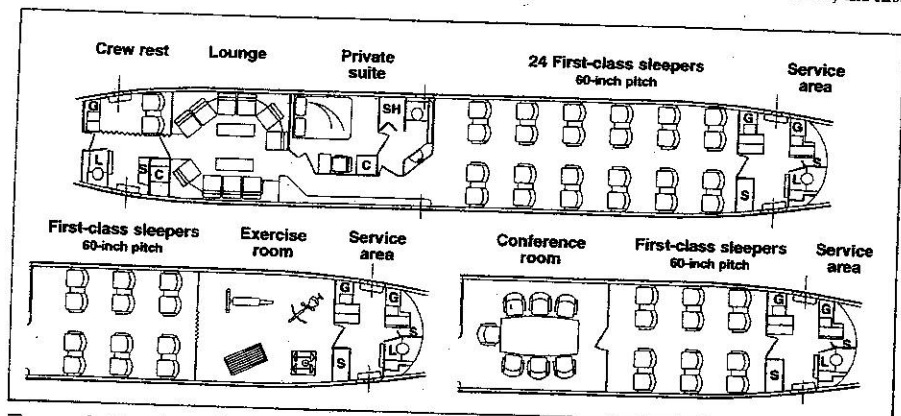
SYSTEMS: AlliedSignal 131-9(B) APU.

#### DIMENSIONS, EXTERNAL:

Wing span: all versions	34.31 m (112 ft 7 in)
Wing aspect ratio	9.4
Length overall: 737-600	31.24 m (102 ft 6 in)
737-700	33.63 m (110 ft 4 in)
737-800	39.47 m (129 ft 6 in)
Height overall: 737-600	12.57 m (41 ft 3 in)
737-700, -800	12.55 m (41 ft 2 in)
Tailplane span: all	14.35 m (47 ft 1 in)
Wheel track (c/l shock-struts): all	5.71 m (18 ft 9 in)
Main passenger door (port, fwd), all:	
Height	1.83 m (6 ft 0 in)
Width	0.86 m (2 ft 10 in)
Height to sill	2.64 m (8 ft 8 in)
Passenger door (port, rear):	
Height: all	1.83 m (6 ft 0 in)
Width: all	0.76 m (2 ft 6 in)
Height to sill: 737-600, -700	3.00 m (9 ft 10 in)
737-800	2.97 m (9 ft 9 in)
Emergency exits (overwing, port and stbd, each), all:	
Height	0.96 m (3 ft 2 in)
Width	0.51 m (1 ft 8 in)
Galley service door (stbd, fwd), all:	
Height	1.65 m (5 ft 5 in)
Width	0.76 m (2 ft 6 in)
Height to sill	2.64 m (8 ft 8 in)
Service door (stbd, rear):	
Height: all	1.65 m (5 ft 5 in)
Width: all	0.76 m (2 ft 6 in)
Height to sill: 737-600, -700	3.00 m (9 ft 10 in)
737-800	2.97 m (9 ft 9 in)
Freight hold door (stbd, fwd), all:	

Freight hold door (stbd, rear), all:

Height	1.22 m (4 ft 0 in)
Width	1.22 m (4 ft 0 in)
DIMENSIONS, INTERNAL:	
Cabin, aft of flight deck to rear pressure bulkhead:	
Length: 737-600	21.79 m (71 ft 6 in)
737-700	24.18 m (79 ft 4 in)
737-800	30.02 m (98 ft 6 in)
Max height: all	2.13 m (7 ft 0 in)
Floor area: 737-600	67.3 m <sup>2</sup> (725 sq ft)
737-700	75.1 m <sup>2</sup> (808 sq ft)
737-800	94.0 m <sup>2</sup> (1,012 sq ft)
Freight hold volume: 737-600	21.4 m <sup>3</sup> (756 cu ft)
737-700	28.4 m <sup>3</sup> (1,002 cu ft)
737-800	45.0 m <sup>3</sup> (1,591 cu ft)



#### AREAS:

Wings, gross	125.00 m <sup>2</sup> (1,345.5 sq ft)
Vertical tail surfaces (total)	26.40 m <sup>2</sup> (284.2 sq ft)
Horizontal tail surfaces (total)	32.80 m <sup>2</sup> (353.1 sq ft)

WEIGHTS AND LOADINGS (A: Basic, B: Long Range):

Operating weight empty:	
737-600, 108 passengers: A, B	36,954 kg (81,470 lb)
737-700, 128 passengers: A, B	38,006 kg (83,790 lb)
737-800, 162 passengers: A, B	41,554 kg (91,610 lb)
Max T-O weight: 737-600: A	56,245 kg (124,000 lb)
737-700: A	60,330 kg (133,000 lb)
B	70,305 kg (155,000 lb)
737-800: A	70,535 kg (155,500 lb)
Max landing weight: 737-600: A	54,655 kg (120,500 lb)
737-700: A	58,060 kg (128,000 lb)
B	58,605 kg (129,200 lb)
737-800: A	65,315 kg (144,000 lb)
Max zero-fuel weight:	
737-600: A	51,480 kg (113,500 lb)
737-700: A	54,655 kg (120,500 lb)
B	55,200 kg (121,700 lb)
737-800: A	61,690 kg (136,000 lb)
Max wing loading:	
737-600: A	450.0 kg/m <sup>2</sup> (92.16 lb/sq ft)
737-700: A	482.6 kg/m <sup>2</sup> (98.85 lb/sq ft)
B	562.5 kg/m <sup>2</sup> (115.20 lb/sq ft)
737-800: A	564.3 kg/m <sup>2</sup> (115.57 lb/sq ft)
Max power loading:	
737-600: A	287 kg/kN (2.82 lb/lb st)
737-700: A	283 kg/kN (2.77 lb/lb st)
B	329 kg/kN (3.23 lb/lb st)
737-800: A	303 kg/kN (2.97 lb/lb st)

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

Max operating Mach No. (Mmo): all	0.82
Cruising speed: all	M0.785
Approach speed: 737-600	126 kt (233 km/h; 145 mph)
737-700	131 kt (243 km/h; 151 mph)
737-800	139 kt (257 km/h; 160 mph)
Initial cruising altitude: 737-600	11,915 m (39,100 ft)
737-700	11,430 m (37,500 ft)
737-800	10,730 m (35,200 ft)
Service ceiling, OEI, ISA + 10°C:	
737-600	5,425 m (17,800 ft)
737-700	5,060 m (16,600 ft)
737-800	4,205 m (13,800 ft)
T-O field length, S/L, at 30°C (86°F):	
737-600	1,877 m (6,160 ft)
737-700	2,042 m (6,700 ft)
737-800	2,256 m (7,400 ft)
Landing field length at max landing weight:	
737-600	1,268 m (4,160 ft)
737-700	1,372 m (4,500 ft)
737-800	1,600 m (5,250 ft)
Design range, max passenger load:	
737-600	3,230 n miles (5,981 km; 3,717 miles)
737-700	3,224 n miles (5,970 km; 3,710 miles)
737-800	2,930 n miles (5,426 km; 3,371 miles)

UPDATED

#### BOEING BUSINESS JET (BBJ)

TYPE: Long-range corporate transport.

PROGRAMME: Launched July 1996, when Boeing Company and General Electric Company announced formation of joint venture company, Boeing Business Jets, to market a corporate version of the Next Generation 737. Aircraft will be assembled at Boeing Commercial Airplane Group's Renton facility and supplied to Boeing Business Jets, which will deliver them to the designated completion centres, K-C Aviation of Dallas and Jet Aviation of Basle, Switzerland, for interior outfitting and painting. Assembly of first aircraft scheduled for late 1997; roll-out and first flight in third quarter of 1998; certification (initially with 120-minute ETOPS, with 180-minute to follow) and first



for manufacture in first two years of production.

**CUSTOMERS:** Launch customer General Electric ordered two in July 1996, for delivery in 1998 and 1999; corporate aircraft management consultants, Aviation Methods Inc of San Francisco, ordered one on 21 October 1996 for delivery in late 1998 to an undisclosed Middle East customer. Eighteen firm orders recorded by late May 1997.

**COSTS:** \$32 million (1997). Target direct operating cost \$1,519 per hour based on utilisation of 500 hours per year.

**DESIGN FEATURES:** Combines fuselage of 737-700, strengthened in aft section, with centre-section, wing and landing gear of 737-800.

**POWER PLANT:** Two CFM International CFM56-7 turbofans, each rated at 117.4 kN (26,400 lb st). Fuel contained in wing and belly tanks, combined capacity 42,313 litres (11,178 US gallons; 9,308 Imp gallons).

**ACCOMMODATION:** To customer choice. Typical configuration includes forward lounge and private suite with double bed; mid-section conference room; 12 first class sleeper seats at 152 cm (60 in) pitch in two rows with centre aisle, and galley, lavatory and service area at rear, with crew rest area, galley and lavatory aft of flight deck. Alternative arrangements provide for exercise room/gymnasium, office, 24 first-class sleeper seats or high-density seating for up to 63 passengers, three abreast in two rows.

**DIMENSIONS, EXTERNAL AND AREAS:** Fuselage as for 737-700 and wing as for 737-800.

**DIMENSIONS, INTERNAL:**

**Cabin:** Length

24.13 m (79 ft 2 in)

Height

2.16 m (7 ft 1 in)

Width

3.53 m (11 ft 7 in)

Floor area

75.0 m<sup>2</sup> (807 sq ft)

Volume

148.7 m<sup>3</sup> (5,250 cu ft)

**WEIGHTS AND LOADINGS:**

Operating weight empty

42,638 kg (94,000 lb)

Max T-O weight

77,565 kg (171,000 lb)

Max landing weight

60,780 kg (134,000 lb)

Max zero-fuel weight

57,155 kg (126,000 lb)

Max wing loading

620.5 kg/m<sup>2</sup> (127.09 lb/sq ft)

Max power loading

330 kg/kN (3.24 lb/lb st)

## Boeing 747-400 advanced long-range airliner (General Electric CF6-80C2 engines) (Jane's/Dennis Punnett)

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

Max operating Mach No. (Mmo)

0.82

Cruising speed

M0.80

Approach speed

133 kt (246 km/h; 153 mph)

Initial cruising height

10,120 m (33,200 ft)

Service ceiling, OEL, ISA + 10°C, 1,000 n mile (1,852 km;

1,150 mile) mission

T-O field length, SL, 30°C

8,290 m (27,200 ft)

Landing field length at max landing weight

2,329 m (7,640 ft)

Design range, max passenger load

1,433 m (4,700 ft)

3,870 n miles (7,167 km; 4,453 miles)

Range with eight passengers, M0.80 cruise, NBAA IFR reserves 6,200 n miles (11,482 km; 7,134 miles)

1986

NEW ENTRY

## BOEING 747-400

**TYPE:** Wide-bodied airliner.

**PROGRAMME** (original): Announced 13 April 1966 (first ever wide-body jet airliner), with Pan American order for 25; official programme launch 25 July 1966; first flight 9 February 1969; FAA certification 30 December 1969; first delivery (to Pan Am) 12 December 1969; first route service New York-London flown 22 January 1970. 747-400 announced October 1985. In May 1990 Boeing decided to market only the -400; last -200 (a -200F Freighter for Nippon Cargo Air Lines) delivered 19 November 1991.

For all variants prior to 747-400, see *Jane's Aircraft Upgrades*. Production variants, listed in table on earlier page, totalled 724 (205 -100, 45 SP, 393 -200 and 81 -300). Nineteen Pan American 747s modified as passenger/cargo C-19As by Boeing Military Airplanes for Civil Reserve Air Fleet (see 1990-91 edition).

**PROGRAMME** (current): Series 400 announced October 1985 as 747 development with extended capacity and range; design go-ahead July 1985; roll-out 26 January 1988; first flight 29 April 1988; certificated with P&W PW4056 on 10 January 1989; certificated with GE CF6-80C2B1F on 8 May 1989; R-R RB211-524G on 8 June 1989; R-R RB211-524H on 11 May 1990. Since May 1990, -400 is the only 747 marketed. 1,100th 747 rolled out 16 December 1996 and delivered to ILFC/Virgin Atlantic in January 1997. Production reduced from five to three per month in February 1994 and two in March 1996 but rose to 3½ per month in fourth quarter of 1996 and was scheduled to rise to four per month in second quarter of 1997.

**CURRENT VERSIONS:** **747-400:** Basic passenger version; standard and three optional gross weights (see below). Detailed description applies to this version, except where indicated.

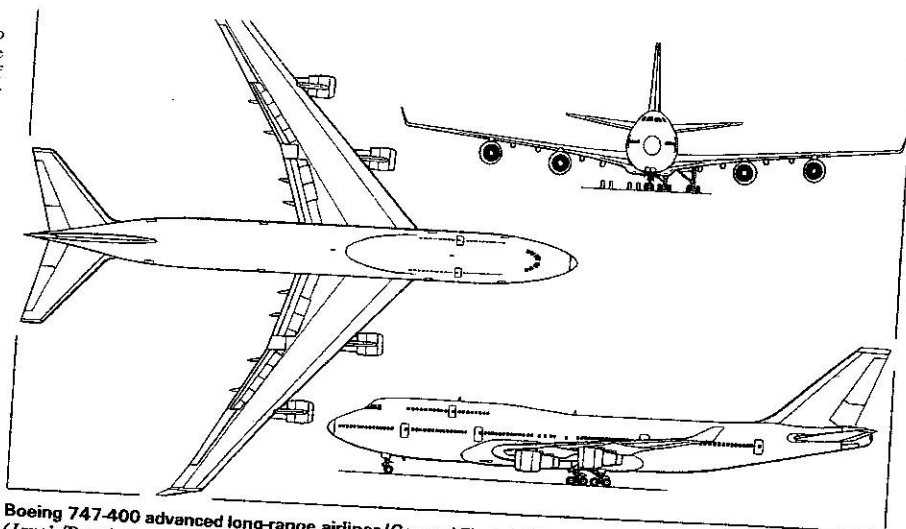
**747-400M Combi:** Passenger/freight version; certificated 1 September 1989; maximum 266 three-class passengers with freight, 413 without; port-side rear freight door; main deck limit is seven pallets at 27,215 kg (60,000 lb); underfloor and fuel capacities as for passenger 747; 49 delivered by 31 December 1996. For all gross weights, maximum landing weight 285,763 kg (630,000 lb) and maximum zero-fuel weight 256,280 kg (565,000 lb). All three engine options available.

**747-400F:** All-freight version. See separate entry.

**747-400 Domestic:** Special high-density two-class 568-passenger version; certificated 10 October 1991; ordered by Japan Air Lines (six), All Nippon (six) and Japan Air System (one). Maximum T-O weight 272,155 kg (600,000 lb) but can be certificated to 394,625 kg (870,000 lb). Structurally reinforced; no winglets; lower engine thrust; five more upper deck windows; revised avionics software and cabin pressure schedule; brake cooling fans; five pallets, 14 LD-1 containers and bulk cargo under floor; GE or P&W engines.

**747-400 Performance Improvement Package (PIP):** Announced April 1993, and first stage implemented in July 1993. Included gross weight increase of 2,268 kg (5,000 lb). Second stage implemented in December 1993 included longer-chord dorsal fin made of CFRP, and wing spoilers held down more tightly to reduce profile drag and leakage. These improvements were immediately applied to production aircraft and are retrofittable; PIP flight tested in leased United Airlines 747-400 May 1993.

**CUSTOMERS:** See table on earlier page. Launch customer Northwest Orient Airlines ordered 10 -400s with PW4000s



Boeing 747-400 Combi of Eva Airways of Taiwan



Boeing 747-400 flight deck

1996

and 420-passenger interior October 1985; first delivery 26 January 1989. Recent customers include Air China (three), EVA Airways (two for delivery in 1997), Philippine Airlines (seven, with CF6-80C2B1F engines, for delivery from mid-1998) and United Airlines (19).

**COSTS:** July 1996 Air China contract for three aircraft valued at \$510 million.

**DESIGN FEATURES:** Wing has Boeing aerofoil and 3.66 m (12 ft 0 in) greater span than 747-300; sweepback at quarter-chord 37° 30'; thickness/chord ratio 13.44 per cent inboard, 7.8 per cent at mid-span, 8 per cent outboard; dihedral at rest 7°; incidence 2°; winglets, canted 22° outward and swept 60°, increase range by 3 per cent; upper deck extended rearward by 7.11 m (23 ft 4 in).

**FLYING CONTROLS:** **Elevators:** Four elevator sections mechanically linked with breakable shear devices and controlled mechanically from the control columns; each elevator has dual hydraulic powered control units; control feel and three individual autopilot input servos mounted on central elevator quadrant; all surfaces have position transmitters; feel computer operated by pilot pressure and tailplane angle.

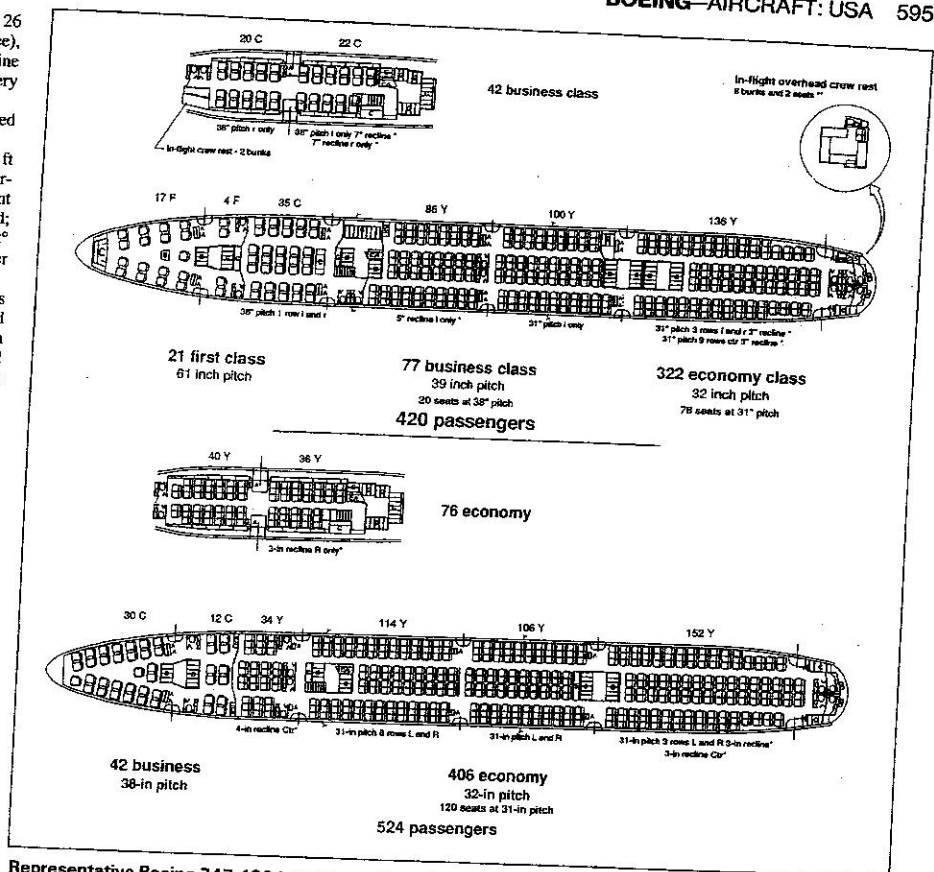
**Rudder:** Upper rudder surface operated by three hydraulic actuators served by two hydraulic systems, lower surface by two actuators fed by remaining two hydraulic systems; each rudder has separate yaw damper module; left and right digital air data computers provide signals for controlling rudder ratio changer on each rudder surface according to air data and tailplane angle; combined feel actuator, rudder centring and trim actuator in rear servo area; mechanical cable linkage between rudder pedals and aft actuator area; rudder trim control switches on centre console.

**Tailplane:** Tailplane angle set by hydraulic motor-driven shaft and ball screw with primary and secondary hydraulic brakes; flight control unit and air data computer signals sent to tailplane through dual stabiliser, trim and rudder ratio modules, which automatically apply Mach trim, and by dual stabiliser control modules; tailplane trim limits computed according to flap positions.

**Lateral control:** Pilot and co-pilot aileron linkage can be physically separated if necessary; all four ailerons operate at low speeds; outboard ailerons are locked out at cruising speed; the inboard spoiler panel on each wing used on ground only; remainder have variable ratio response and spoiler mixer units; there are trim, centring and feel units.

**Leading-edge and trailing-edge devices:** Krueger flaps inboard of engines; variable camber slats between and outboard of engines lie flat when retracted and adopt camber curvature when extended. Two flap assemblies on each wing, one inboard of engines and the other between engines; three sections, fore flap, mid-flap and aft flap, move rearwards as single flat panel up to 5° deflection; thereafter, three sections separate progressively to form three slots, and camber angles relative to each other increase progressively.

**Automatic flight control system:** Combines autopilot, flight director and automatic tailplane trim and sends commands through triple independent flight control computers; system automates all flight phases except take-off; dual digital air data computers; pilots' primary flight and navigation displays are large-size cathode-ray tubes; two engine indicating and crew alerting screens, one on main panels, one on console; three multifunction control and display panels control flight management system, navigation and communications; flight control computers (autopilot) and inertial reference units are triplicated; new features include full-time autothrottle and dual thrust management system included in flight management



Representative Boeing 747-400 interior configurations for dual- or multiple-class travel

1996

computer; integrated radio control panels and automatic start and shutdown of APU.

**STRUCTURE:** Wing and tail surfaces are aluminium alloy dual-path fail-safe structures; advanced aluminium alloys in wing torsion box save 2,721 kg (6,000 lb); advanced aluminium honeycomb spoiler panels; CFRP winglets and main deck floor panels; advanced graphite/phenolic and Kevlar/graphite in cabin fittings and engine nacelles; frame/stringer/stressed skin fuselage with some bonding. Improved corrosion protection and further coverage with compound introduced from 1993.

**LANDING GEAR:** Twin-wheel nose unit retracts forward; main gear consists of four four-wheel bogies; two, mounted side by side under fuselage at wing trailing-edge, retract forward; two, mounted under wings, retract inward; nosewheel steerable up to 70° left or right from tillers; full rudder pedal travel gives up to 7° for use at high speed; two centre main legs steer up to 13° when nosewheels are steered more than 20° and speed is less than 20 kt (37 km/h; 23 mph); carbon disc brakes on all mainwheels, with individually controlled digital anti-skid units; one of three brake pressure supplies automatically selected; mainwheel diameter increased to 56 cm (22 in); 125 cm (49 in) diameter low-profile tyres; new wheels save 816 kg

(1,800 lb) weight. Minimum ground turning radius, with body gear steering, is 48.46 m (159 ft 0 in) at wingtip and 27.73 m (91 ft 0 in) at nosewheels.

**POWER PLANT:** Four 252 kN (56,750 lb st) Pratt & Whitney PW4056, 252 kN (56,750 lb st) General Electric CF6-80C2B1F, 258 kN (58,000 lb st) Rolls-Royce RB211-524G or RB211-524H turbofans.

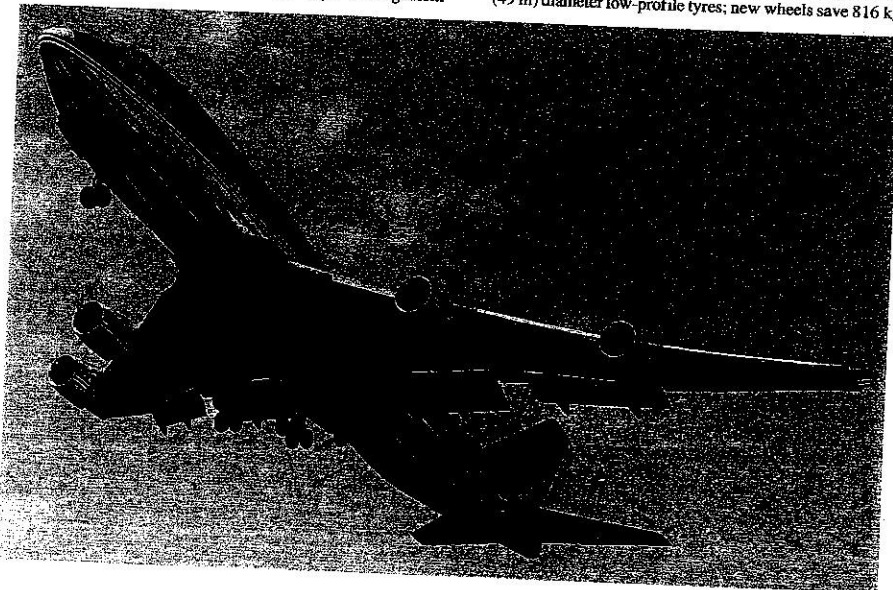
Further optional engines are 267 kN (60,000 lb st) PW4060, 276 kN (62,000 lb st) PW4062, 274 kN (61,500 lb st) CF6-80C2B1F1 or CF6-80C2B7F.

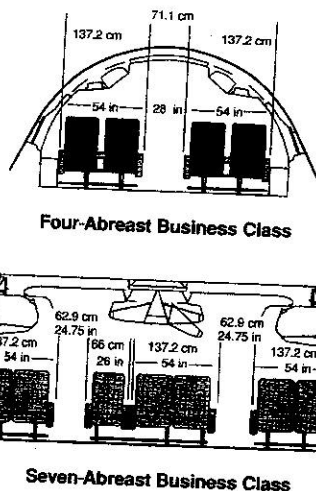
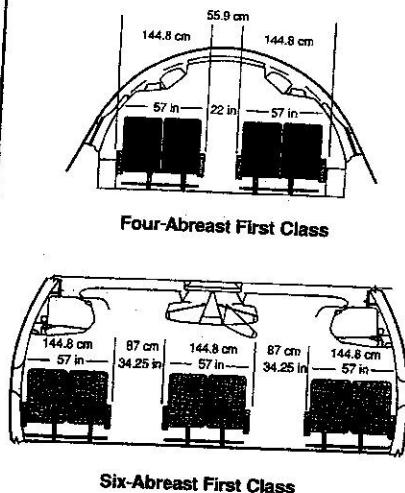
Fuel in four main tanks in wings can feed to any engine; in addition there are a centre-wing tank and reserve tanks in outer wing; optional tailplane tank; vent and surge tanks in outer wings and starboard tailplane; jettison pumps in inner main tanks; APU fed from port inner tank; automatic refuelling through two receptacles under each wing leading-edge between engines; automatic condensate scavenging and flame arresters in vent outlets.

Fuel capacity 204,355 litres (53,985 US gallons; 44,952 Imp gallons) with P&W and R-R engines; 203,523 litres (53,765 US gallons; 44,769 Imp gallons) with GE engines; at 377,840 kg (833,000 lb) and 394,625 kg (870,000 lb) T-O weights, fuel capacity including tailplane tank is 216,846 litres (57,285 US gallons; 47,700 Imp gallons) with P&W and R-R engines and 216,013 litres (57,065 US gallons; 47,516 Imp gallons) with GE engines; optional tailplane tank holds 12,492 litres (3,300 US gallons; 2,748 Imp gallons) transferable fuel (must be full for take-off at 394,625 kg; 870,000 lb gross weight).

**ACCOMMODATION:** Two-crew flight deck, with seats for two observers; two-bunk crew rest cabin accessible from flight deck. Optional overhead cabin crew rest compartments above rear of main deck cabin (four bunks, four seats; eight bunks, two seats; two bunks, two seats, five sleeper seats). Typical 421-seat three-class configuration accommodates 42 business class on upper deck; 24 first class in front cabin, 29 business class in middle cabin and 326 economy class in rear cabin on main deck. Maximum upper deck capacity 69 economy class. Centre overhead stowage bins 0.16 m<sup>3</sup> (5.7 cu ft) volume per 1.02 m (40 in) long bin; outboard bins 0.45 m<sup>3</sup> (15.9 cu ft) volume per 1.52 m (60 in) long bin; 0.083 m<sup>3</sup> (2.95 cu ft) bin volume per passenger (three-class). Two modular upper deck toilets, 14 on main deck, relocatable and vacuum-drained into four waste tanks. Basic galley configuration one on upper deck, seven centreline and two sidewall on main deck; toilets and galleys can be quickly relocated if required fittings are installed; advanced integrated audio/video/announcement system.

Underfloor freight: forward compartment, five 2.44 m (96 in) × 3.18 m (125 in) pallets or 16 LD-1 containers; aft compartment, 14 LD-1 containers and 23.6 m<sup>3</sup> (835 cu ft)





Cross-section of Boeing 747 showing low- and medium-density seating

1995

SYSTEMS: Each engine drives a hydraulic pump feeding an independent system; services are connected to supplies in such a way that loss of one supply cannot disable one system; two hydraulic systems also have air-driven pumps to maintain pressure and two have electric pumps; one electric pump can be run to provide braking when the aircraft is being towed on the ground; all four hydraulic reservoirs can be filled from a single location in the port main landing gear bay.

Hot air bled from the low-pressure and high-pressure compressors of all four engines is precooled by fan exit air and fed via a manifold to the cabin pressurisation and air conditioning system and to provide de-icing of wing leading-edge and engine nose cowl and to pressurise hydraulic tanks. Three conditioning packs in wing/fuselage fairing provide cabin air.

Each engine drives an integrated drive generator supplying 90 kVA power to respective AC buses; three generators are a dispatch item, but one will supply essential loads; APU drives two further generators; automatic start-up, load transfers and load shedding reduce crew workload; power systems may be isolated from each other for triple-channel Cat. III autoland.

Completely self-contained P&WC PW901A APU, mounted clear of all flight-critical structure and flight controls in the extreme tail, drives two 90 kVA generators that can supply electrical power for whole aircraft; also supplies compressed air to operate pneumatic components; can run at up to 6,100 m (20,000 ft) and supply compressed air below 4,575 m (15,000 ft).

Forward underfloor cargo compartment heated to 5°C by hot air exhausted from flight deck cooling equipment and avionics in main equipment centre, boosted as necessary by two electrical heaters; rear underfloor hold heated to minimum 5°C or 18°C (selected by crew) by engine bleed.

Overheat detection and automatic extinguishing provided in all toilets; APU automatically shut down and fire extinguisher bottles initiated on detection of fire; each engine has three dual fire detectors in series and a fourth detector for overheating. Underfloor freight compartments and upper deck hold of Combi have smoke detectors and extinguisher systems; wheel wells have overheat detectors.

AVIONICS: Boeing launched development of new Flight Management Computer software in January 1993 to match existing aircraft to international Future Air Navigation System (FANS) during 1995. Standard avionics fit as follows:

**Comms:** Dual VHF and HF transceivers with Selcal; dual transponders; flight intercom with air-to-ground facility, connectable also to satcom system; cabin entertainment and passenger address and service units.

**Radar:** Colour weather radar transmitting in I- and G-bands.

**Flight:** Dual VOR; triple ILS receivers with single marker beacon receiver; dual ADF; dual DME; all nav radios automatically tuned by flight management computer system (FMCS). Automatic flight control system (AFCS) integrates autopilot, flight director and automatic stabiliser trim functions; dual digital air data computers with dual selectable pressure sensors, angle of attack sensors and total air temperature probes; FMCS allows crew to preselect flight plan using standard air traffic control language; FMCS incorporates database, updated every 28 days, which includes data on waypoints, airports, standard instrument departures (SIDs), standard terminal arrival routes (STARs), airline routes and information on specific geographic areas; triple ring laser gyro inertial reference units provide navigation input on EFIS, flight management displays or radio magnetic

indicators; other systems include ground proximity warning, triple low-range radio altimeters and TCAS.

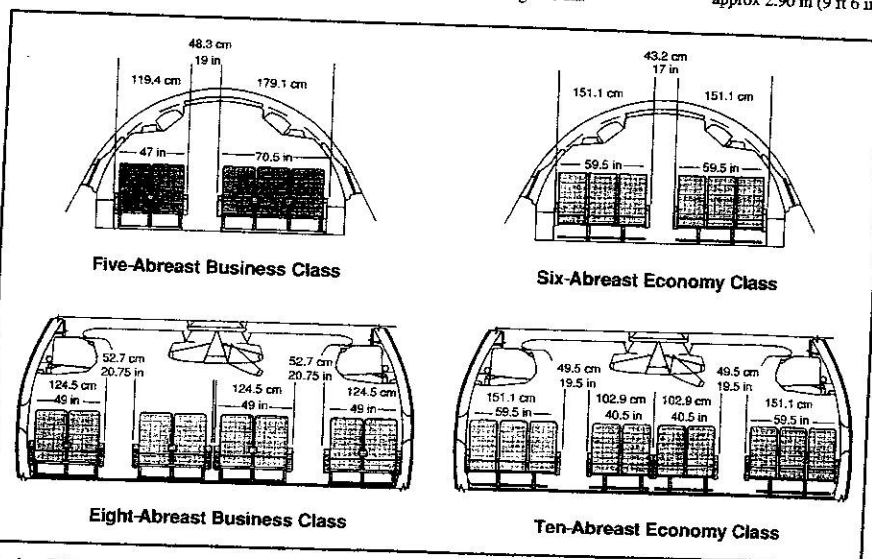
**Instrumentation:** Electronic flight instrument system (EFIS) comprising six (left/right inboard/outboard and central upper/lower) 20.3 x 20.3 cm (8 x 8 in) integrated display units (IDU), two each for primary flight display

crew alerting (EICAS) functions; all IDUs receive data from all three EFIS/EICAS interface units (EIU), updated via software data loader; PFD and EICAS primary formats automatically switch to inboard and lower IDUs respectively, with facility for manual selection of formats on different IDUs as required.

Central maintenance computer monitors electrical and electromechanical systems, performs tests and centralises maintenance data; failures are indicated in EICAS displays and stored for future reference for in-flight use or line or hangar maintenance.

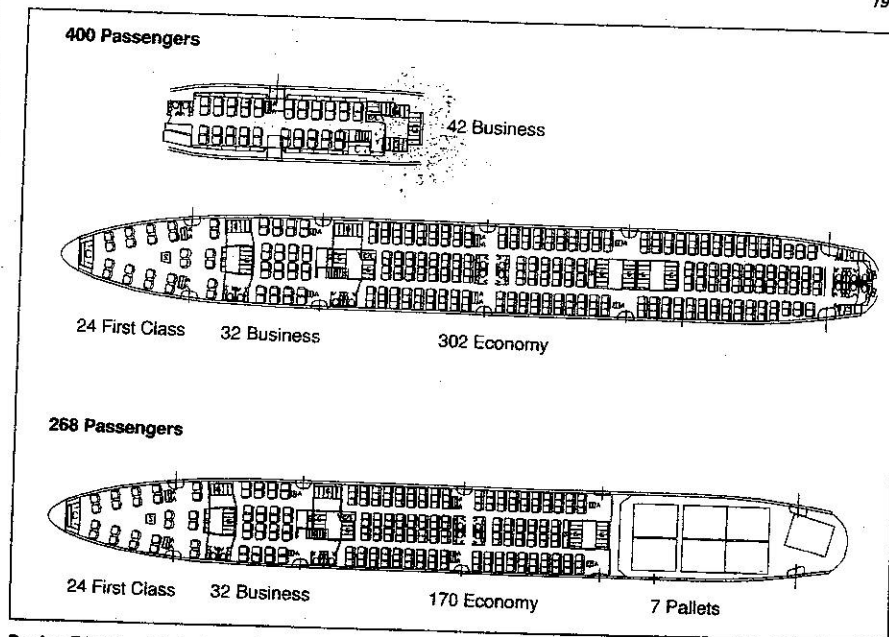
#### DIMENSIONS, EXTERNAL:

Wing span	64.44 m (211 ft 5 in)
Wing span, fully fuelled	64.92 m (213 ft 0 in)
Wing aspect ratio	7.7
Length: overall	70.66 m (231 ft 10 in)
fuselage	68.63 m (225 ft 2 in)
Height overall	19.41 m (63 ft 8 in)
Tailplane span	22.17 m (72 ft 9 in)
Wheel track	11.00 m (36 ft 1 in)
Wheelbase	25.60 m (84 ft 0 in)
Passenger doors (10, each): Height	1.93 m (6 ft 4 in)
Width	1.07 m (3 ft 6 in)
Height to sill	approx 4.88 m (16 ft 0 in)
Baggage door (front hold): Height	1.68 m (5 ft 6 in)
Width	2.64 m (8 ft 8 in)
Height to sill	approx 2.64 m (8 ft 8 in)
Baggage door (forward door, rear hold): Height	1.68 m (5 ft 6 in)
Width	2.64 m (8 ft 8 in)
Height to sill	approx 2.69 m (8 ft 10 in)
Bulk loading door (rear door, rear hold): Height	1.19 m (3 ft 11 in)
Width	1.12 m (3 ft 8 in)
Height to sill	approx 2.90 m (9 ft 6 in)



Boeing 747 medium- and high-density seating

1995



Boeing 747 Combi interiors, showing all-passenger and passenger/freight arrangements

1995



Freighter cargo door (port): Height 3.05 m (10 ft 0 in)  
 Width 3.40 m (11 ft 2 in)  
 Height to sill 4.87 m (16 ft 0 in)

## AREAS:

Wings, gross	541.16 m <sup>2</sup> (5,825.0 sq ft)
Ailerons (total)	20.90 m <sup>2</sup> (225.00 sq ft)
Trailing-edge flaps (total)	78.69 m <sup>2</sup> (847.00 sq ft)
Leading-edge flaps (total)	43.85 m <sup>2</sup> (472.00 sq ft)
Inboard spoilers (total)	12.78 m <sup>2</sup> (137.60 sq ft)
Outboard spoilers (total)	15.46 m <sup>2</sup> (166.40 sq ft)
Fin	77.11 m <sup>2</sup> (830.00 sq ft)
Rudder	21.37 m <sup>2</sup> (230.00 sq ft)
Tailplane	136.57 m <sup>2</sup> (1,470.00 sq ft)
Elevators (total, incl tabs)	30.38 m <sup>2</sup> (327.00 sq ft)

WEIGHTS AND LOADINGS (letters denote engine installations as follows: P: PW4056, C: CF6-80C2B1F, R: RB211-524GH):

Operating weight empty: P	180,985 kg (399,000 lb)
P at max optional T-O weight	181,485 kg (400,100 lb)
C	180,755 kg (398,500 lb)
C at max optional T-O weight	181,255 kg (399,600 lb)
R	181,755 kg (400,700 lb)
R at max optional T-O weight	182,255 kg (401,800 lb)
Max T-O weight: P, C, R	362,875 kg (800,000 lb)
or 385,555 kg (850,000 lb)	
or 396,895 kg (875,000 lb)	
Max ramp weight: P, C, R	364,235 kg (803,000 lb)
or 386,915 kg (853,000 lb)	
or 398,255 kg (878,000 lb)	
Max zero-fuel weight: P, C, R	242,670 kg (535,000 lb)
Max landing weight: at standard max T-O weight:	
P, C, R	260,360 kg (574,000 lb)
at alternative max T-O weights:	
P, C, R	285,765 kg (630,000 lb)
Max wing loading:	
P, C, R	670.5 kg/m <sup>2</sup> (137.34 lb/sq ft)
or 712.5 kg/m <sup>2</sup> (145.92 lb/sq ft)	
or 733.4 kg/m <sup>2</sup> (150.21 lb/sq ft)	

PERFORMANCE (engines as designated under Weights and Loadings):

Approach speed at basic landing weight:	
P, C, R	146 kt (270 km/h; 168 mph)
Approach speed at highest optional landing weight:	
P, C, R	153 kt (284 km/h; 176 mph)
Initial cruise altitude at highest optional T-O weight:	
P, C, R	10,000 m (32,800 ft)
FAR T-O field length at S/L, ISA, at highest optional T-O weight: P, C	3,352 m (11,000 ft)
R	3,383 m (11,100 ft)
FAR landing field length at max landing weight of 285,765 kg (630,000 lb): P, C, R	2,072 m (6,800 ft)
Design range, typical international routes, 420 three-class passengers, at highest optional T-O weight:	
P	7,284 n miles (13,491 km; 8,383 miles)
C	7,259 n miles (13,444 km; 8,354 miles)
R	7,135 n miles (13,214 km; 8,211 miles)

UPDATED

## BOEING 747-400F

USAF designation: AL-1A

TYPE: All-freight version of 747-400.

PROGRAMME: First flight (N6005C) 7 May 1993; FAA certification October 1993; JAR certification followed.

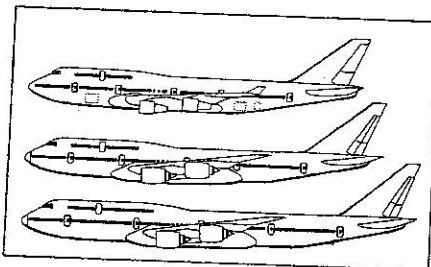
CURRENT VERSIONS: 747-400F: As described.

AL-1A: Anti-missile defence aircraft, equipped with TRW long-range laser and Lockheed Martin electro-optics and fire control. Intended to destroy ICBMs during their boost phase, but with additional capability against low-flying cruise missiles. Laser able to fire 30 times per mission. Prototype YAL-1A ordered in 1996 for delivery in 1999; first demonstration against a ballistic missile due 2002; first squadron of three operational by 2006; total fleet of seven by 2008. Programme cost \$5 billion (1997, estimated) includes one concept prototype, one EMD (both eventually to be fully upgraded) and five production aircraft.

CUSTOMERS: Six customers (Asiana, Cargolux, Cathay Pacific, KLM, Korean Air Lines and Singapore Airlines) ordered 20 aircraft by December 1996; first 747-400F delivered to Cargolux November 1993.

DESIGN FEATURES: 747-200F fuselage (short upper deck) with additional changes combined with stronger and larger 747-400 wing; strengthened floor of short upper deck, as offered for -200F, also integrated into 747-400F; further developed freight handling system; total cargo volume increased by 41.7 m<sup>3</sup> (1,473 cu ft); empty weight saving of 2,000 kg (4,409 lb) has raised maximum revenue freight load to about 113,000 kg (249,125 lb), at which range is 4,400 n miles (8,149 km; 5,063 miles); fuel consumption is 14.2 per cent lower than 747-200F. Same gross weights as passenger 747-400; maximum landing weight at optional T-O weight, 302,090 kg (666,000 lb); maximum zero-fuel weight, 276,690 kg (610,000 lb), can be increased on condition T-O weight is decreased.

ACCOMMODATION: Two-pilot crew, as 747-400. Upward-opening nose cargo door and optional port-side rear cargo



Terminated Boeing 747 variants, -500X (centre) and -600X (bottom), compared with the current -400 (Jane's/Paul Jackson) 1997

port. Capacity for 30 pallets on main deck and 32 LD-1 containers plus bulk cargo under floor.

UPDATED

## BOEING 747-500X and 747-600X

On 20 January 1997 Boeing announced that it was terminating development of these projected stretched versions of the 747-400 in favour of enhanced versions of the 767 and 777. Preliminary details of the 747-500X and 747-600X, as then envisaged, were given in the 1996-97 edition.

UPDATED

## BOEING 757-200

US Air Force designation: C-32A

TYPE: Medium-range twin-turboprop airliner.

PROGRAMME: New-technology family designated 757/767/777 announced early 1978; 757 has 707/727/737 fuselage cross-section and two large turbofans; Eastern Air Lines and British Airways ordered 21 firm and 24 optioned and 19+18 respectively 13 August 1978; first flight (N757A) 19 February 1982 powered by 166.4 kN (37,400 lb st) Rolls-Royce RB535Cs and designated 757-200; first Boeing airliner launched with foreign engine; FAA certification 21 December 1982; CAA certification 14 January 1983; revenue services began 1 January 1983 (EAL) and 9 February 1983 (BA). First flight of 757 powered by P&W PW2037s, 14 March 1984; certificated October 1984 and delivered to Delta; first 757 with RB535E4s delivered to EAL 10 October 1984; first extended-range model delivered to Royal Brunei Airlines May 1986; 757 with RB535E4 engines approved FAA ETOPS December 1986 (extended to 180 minutes July 1990); 757 with PW2037/2040 ETOPS approved April 1990 (180 minutes for PW2037 April 1992); Boeing windshear guidance and detection system approved by FAA January 1987. Certificated for operation in the Russian Federation and Associated States (CIS) September 1993.

First 757 kept by Boeing for flight test support; used as avionics testbed for Lockheed YF-22 (see below) and Boeing 777. Production rate of 757 reduced from eight and a half per month to seven in June 1993 (instead of

September) and then to five in October 1993 (instead of November), steady at four during 1995, reducing to three in September 1996, increasing to four in first quarter of 1997 and remaining steady at four during 1997.

CURRENT VERSIONS: 757-200: Initial production passenger airliner; extended range available. Main description applies to this version, except where indicated.

757-200PF Package Freighter: Developed for United Parcel Service. Large freight door forward, single crew door and no windows; up to 15 standard 2.24 x 3.18 m (88 x 125 in) cargo pallets on main deck; same higher operating weights as Freighters. UPS ordered 20 in 1985; total 80 ordered and 65 delivered by December 1996.

757-200M Combi: Boeing's mixed cargo/passenger configuration with windows; upward-opening cargo door to port (forward) 3.40 x 2.18 m (134 x 86 in); carries up to three 2.24 x 2.74 m (88 x 108 in) cargo containers and 150 passengers; one delivered to Royal Nepal Airlines.

757-200 Freighter: Developed by Pemco Aeroplex in 1992 as conversions of existing 757s; all-freight, combi and quick-change versions available; same weights as Boeing 757-200PF Package Freighter (see data below); choice of more powerful engines; large freight door forward on port side.

757-200 'Catfish': Boeing's own 757-200 (N757A) fitted with radar nose in Lockheed Martin F-22A profile and representative F-22A swept wing section above flight deck containing conformal radar antennae for advanced radar trials; first flight in this configuration expected 1998. See also Lockheed Martin entry.

757-200X: Projected extended-range version, affording 600 n mile (1,111 km; 690 mile) increase in maximum range.

757-300: Stretched version. Described separately.

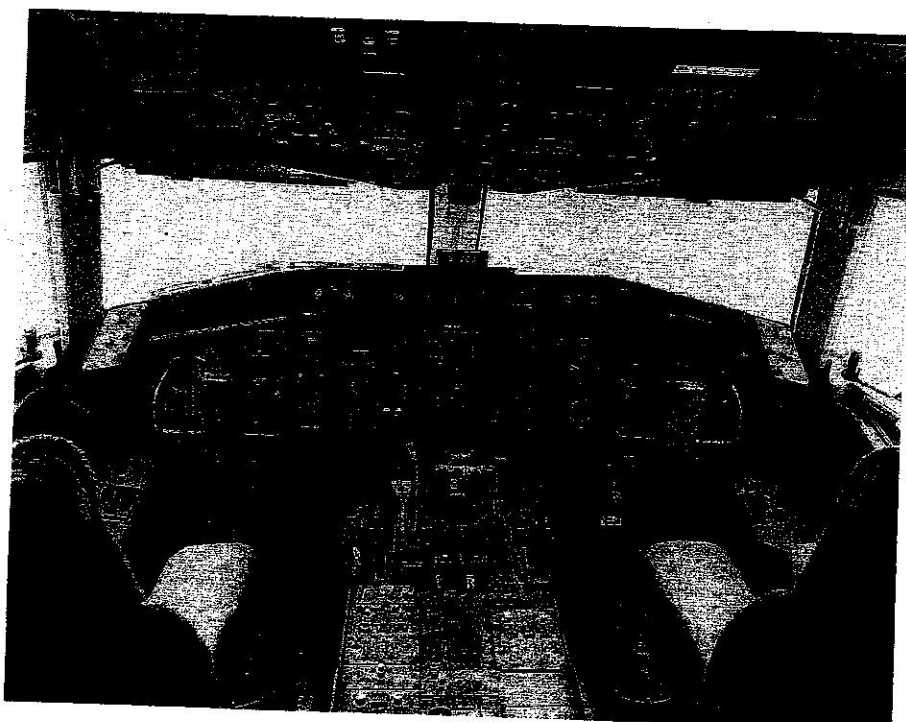
CUSTOMERS: See table at start of Boeing Commercial entry for orders/deliveries to 1 January 1997. Recent customers include American Airlines (12 757-200s for delivery in 1998 and 1999); British Airways (three 757-200s); Finnair (four 757-200s leased from ILFC, for service entry beginning September 1997); ILFC (five 757-200s); United Airlines (six 757-200s) and the US Air Force (four 757-200s with PW2040 engines ordered 8 August 1996 for delivery in 1998 under designation C-32A as replacements for VC-137s of 89th Airlift Wing at Andrews AFB, Maryland).

COSTS: Price of four 757s ordered by US Air Force in August 1996 reported at \$365 million.

DESIGN FEATURES: Boeing aerofoils; sweepback at quarter-chord 25°; dihedral 5°; incidence 3° 12'.

FLYING CONTROLS: All-speed fully powered outboard ailerons assisted by five flight spoilers on each wing also acting variously as airbrakes and ground spoilers; one additional ground spoiler inboard on each wing; elevators and rudder; double-slotted trailing-edge flaps; full-span leading-edge slats, five sections each wing; variable incidence tailplane.

STRUCTURE: Aluminium alloy two-spar fail-safe wing box; centre-section continuous through fuselage; ailerons, flaps and spoilers extensively of honeycomb, graphite composites and laminates; tailplane has full-span light alloy torque boxes; fin has three-spar dual cell light alloy



New wing would probably follow design approach of the 777, with more moderate sweep to afford good field performance and climb; cruising Mach number around 0.84; and fuel capacity of about 208,197 litres (55,000 US gallons; 45,797 Imp gallons). Seating for 500 or more passengers would be afforded by fuselage plugs forward and aft of wing, with forward plug extending both upper and main decks. Boeing says customers will determine any capacity or range stretch of 747-400.

UPDATED

## BOEING 757

TYPE: Medium-range twin-turboprop airliner.

PROGRAMME: New-technology family designated 757/767/777 announced early 1978; 757 has 707/727/737 fuselage cross-section and two large turbofans; Eastern Air Lines and British Airways ordered 21 firm and 24 optioned and 19+18 respectively 13 August 1978; first flight (N757A) 19 February 1982 powered by 166.4 kN (37,400 lb st) Rolls-Royce RB535Cs and designated 757-200; first Boeing airliner launched with foreign engine; FAA certification 21 December 1982; CAA certification 14 January 1983; revenue services began 1 January 1983 (EAL) and 9 February 1983 (BA). First flight of 757 powered by P&W PW2037s, 14 March 1984; certificated October 1984 and delivered to Delta; first 757 with RB535E4s delivered to EAL 10 October 1984; first extended-range model delivered to Royal Brunei Airlines May 1986; 757 with RB535E4 engines approved FAA ETOPS December 1986 (extended to 180 minutes July 1990); 757 with PW2037/2040 ETOPS approved April 1990 (180 minutes for PW2037 April 1992); Boeing windshear guidance and detection system approved by FAA January 1987. Certificated for operation in Russia and CIS September 1993.

First 757 kept by Boeing for flight test support; used as avionics testbed for Lockheed YF-22 (see below) and Boeing 777. Production rate of 757 reduced from 8½ per month to seven in June 1993 (instead of September) and then to five in October 1993 (instead of November), steady at four during 1995. Discussions in 1993 for possible assembly of 757 in China, leading towards full production; no decision announced.

CURRENT VERSIONS: 757-200: Initial production passenger airliner; extended range available. Main description applies to this version, except where indicated.

**757-200PF Package Freighter:** Developed for United Parcel Service. Large freight door forward, single crew door and no windows; up to 15 standard 2.24 × 3.18 m (88 × 125 in) cargo pallets on main deck; same higher operating weights as Freighters. UPS ordered 20 in 1985; total 65 ordered by December 1993 plus 36 on option; 52 delivered by February 1995.

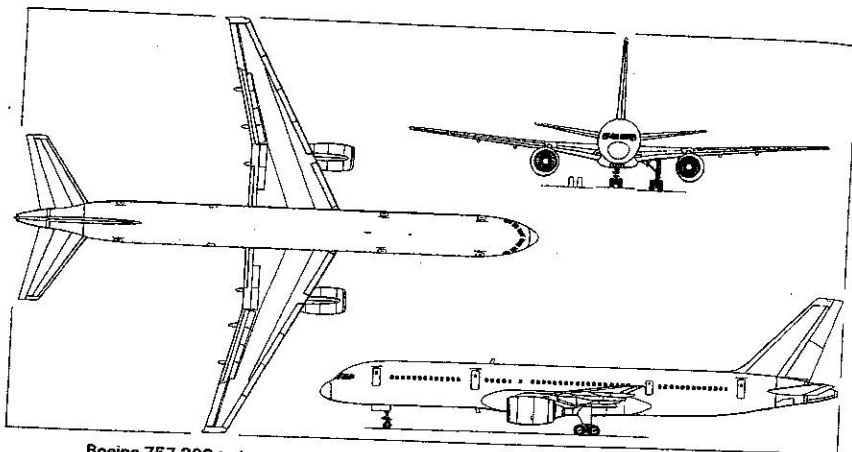
**757-200M Combi:** Boeing's mixed cargo/passenger configuration with windows; upward-opening cargo door to port (forward) 3.40 × 2.18 m (134 × 86 in); carries up to three 2.24 × 2.74 m (88 × 108 in) cargo containers and 150 passengers; one delivered to Royal Nepal Airlines.

**757-200 Freighter:** Developed by Pemco Aeroplex in 1992 as conversions of existing 757s; all-freight, combi and quick-change versions available; same weights as Boeing 757-200PF Package Freighter (see data below); choice of more powerful engines; large freight door forward on port side.

**757-200 'Catfish':** Boeing's own 757-200 (N757A) being fitted with radar nose in F-22 profile and representative F-22 swept wing section above flight deck containing conformal radar antennae for advanced radar trials; first flight expected 1997. See also Lockheed Martin entry.

CUSTOMERS: See table at start of Boeing Commercial entry for orders/deliveries.

COSTS: Price of four 757s ordered by Shorouk in November 1992 reported as \$240 million.



Boeing 757-200 twin-turboprop short/medium-range transport (Jane's/Dennis Punnett)

1983

DESIGN FEATURES: Boeing acrofoils; sweepback at quarter-chord 25°; dihedral 5°; incidence 3° 12'.

FLYING CONTROLS: All-speed fully powered outboard ailerons assisted by five flight spoilers on each wing also acting variously as airbrakes and ground spoilers; one additional ground spoiler inboard on each wing; elevators and rudder; double-slotted trailing-edge flaps; full-span leading-edge slats, five sections each wing; variable incidence tailplane.

STRUCTURE: Aluminium alloy two-spar fail-safe wing box; centre-section continuous through fuselage; ailerons, flaps and spoilers extensively of honeycomb, graphite composites and laminates; tailplane has full-span light alloy torque boxes; fin has three-spar dual cell light alloy torque box; elevators and rudder have graphite/epoxy honeycomb skins supported by honeycomb and laminated spar and rib assemblies; CFRP wing/fuselage and flap track fairings. All landing gear doors of CFRP/Kevlar.

Subcontractors include Hawker de Havilland (wing in-spar ribs), Shorts (inboard flaps), CASA (outboard flaps), Boeing Renton (leading-edge slats, main cabin sections), Boeing Helicopters (fixed leading-edges), Boeing Military Airplanes (flight deck), Heath Tecna (wing/fuselage and flap track fairings), Schweizer (wingtips), Vought Aircraft (fin and tailplane, extreme rear fuselage), Rohr Industries (engine support struts), LAI (dorsal fin), Fleet Industries (APU access doors).

LANDING GEAR: Retractable tricycle type, with main and nose units manufactured by Menasco. Each main unit carries a four-wheel bogie, fitted with Dunlop or Goodrich wheels, carbon brakes and tyres. Twin-wheel nose unit, also with Dunlop or Goodrich tyres. Minimum ground turning radius 21.64 m (71 ft) at nosewheels, 29.87 m (98 ft) at wingtip.

POWER PLANT: Two 166.4 kN (37,400 lb st) Rolls-Royce 535C, 170 kN (38,200 lb st) Pratt & Whitney PW2037, 178.4 kN (40,100 lb st) Rolls-Royce 535E4/E4-B, or 185.5 kN (41,700 lb st) Pratt & Whitney PW2040 turbofans, mounted in underwing pods; Rolls-Royce 535C not offered for Freighters. Fuel capacity 42,597 litres (11,253 US gallons; 9,370 Imp gallons); fuel capacity of Freighters 42,684 litres (11,276 US gallons; 9,389 Imp gallons).

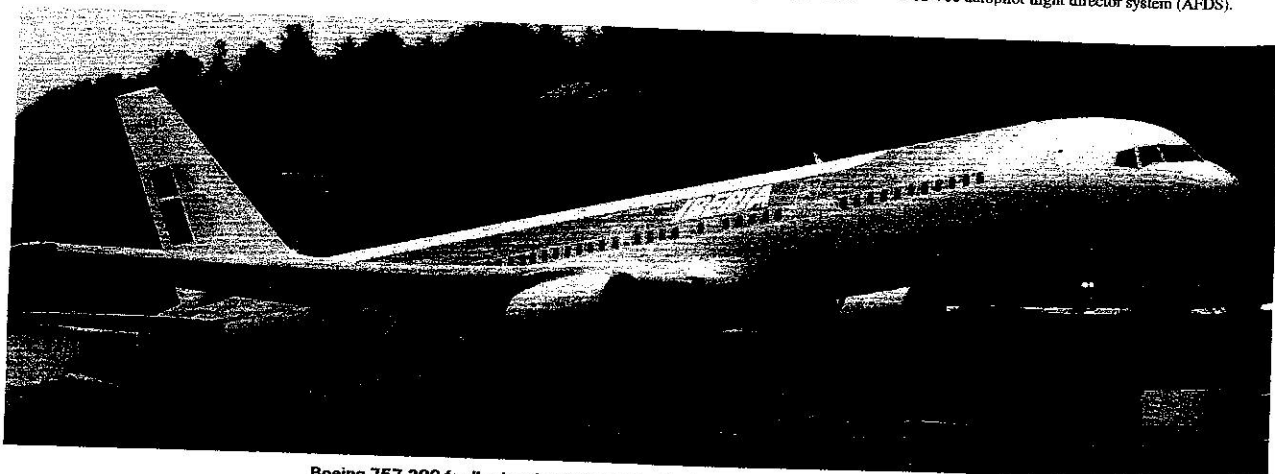
ACCOMMODATION: Crew of two on flight deck, with provision for an observer. Five to seven cabin attendants. Nine standard interior arrangements for 178 (16 first class/162 tourist), 186 (16 first class/170 tourist), 202 (12 first class/190 tourist), 208 (12 first class/196 tourist) mixed class

passengers, or 214, 220, 223, 224 or 239 all-tourist passengers. First class seats are four-abreast, at 96.5 cm (38 in) pitch; tourist seat pitch is 81 or 86 cm (32 or 34 in), mainly six-abreast, in mixed class arrangements. Large overhead bins of Kevlar provide approximately 0.054 m³ (1.9 cu ft) of stowage per passenger. Choice of two cabin door configurations, with either three passenger doors and two overwing emergency exits on each side (used with 186-, 208-, 220- and 224-seat interiors), or four doors on each side (used with 178-, 202-, 214-, 223- and 239-seat interiors). All versions have a galley at front on starboard side and another at rear (two on 178- and 186-passenger versions and three on 239 version plus one amidships); toilet at front on port side and three more at rear (186, 202, 208, 220, 224 passengers) or two at rear (239) or amidships (178, 214, 223 passengers). Coat closet at front of first class cabins and 214/220-passenger interiors. Baggage/cargo hold doors on starboard side.

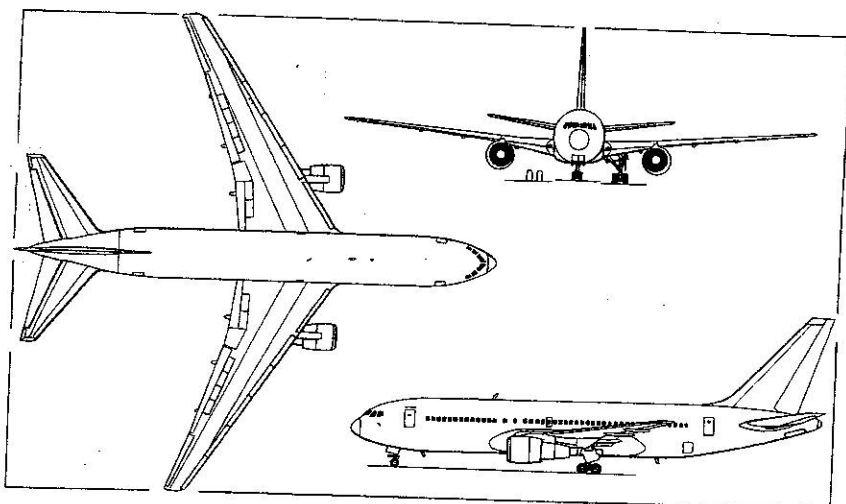
SYSTEMS: AiResearch ECS; General Electric engine thrust management system; Honeywell-Vickers engine-driven hydraulic pumps; four Abex electric hydraulic pumps. Hydraulic system maximum flow rate 140 litres (37 US gallons); 30.8 Imp gallons/min at T-O power on engine-driven pumps; 25.4 to 34.8 litres (6.7 to 9.2 US gallons; 5.6 to 7.7 Imp gallons)/min on electric motor pumps; 42.8 litres (11.3 US gallons; 9.4 Imp gallons)/min on ram air turbine. Independent reservoirs, pressurised by air from pneumatic system, maximum pressure 207 bars (3,000 lb/sq in) on primary pumps. Sundstrand electrical power generating system and ram air turbine; and Allied-Signal GTPC331-200 APU. Wing thermally anti-iced.

AVIONICS: Flight: Honeywell inertial reference system (IRS) (first commercial application of laser gyros); IRS provides position, velocity and attitude information to flight deck displays, and the flight management computer system (FMCS) and digital air data computer (DADC) supplied by Honeywell; FMCS provides automatic en route and terminal navigation capability, and also computes and commands both lateral and vertical flight profiles for optimum fuel efficiency, maximised by electronic linkage of the FMCS with automatic flight control and thrust management systems; Boeing windshear detection and guidance system is optional.

Instrumentation: Collins EFIS-700 with engine indication and crew alerting system (EICAS); Collins FCS-700 autopilot flight director system (AFDS).



Boeing 757-200 for Iberia takes off from the Boeing airfield at Renton, Washington



Boeing 767-200 wide-bodied airliner (Jane's/Dennis Punnett)

1995

**CURRENT VERSIONS: 767-200:** Basic model. Medium-range variant has reduced fuel; higher gross weight variant certificated June 1983. Description applies to basic 767-200, except where indicated.

**767-200ER:** Extended range version; first flight 6 March 1984; basic -200ER with centre-section tankage and gross weight increased to 156,490 kg (345,000 lb) first delivered to Ethiopian Airlines 23 May 1984; optional higher gross weights are 159,211 kg (351,000 lb), 172,365 kg (380,000 lb) and 175,540 kg (387,000 lb).

**767-300:** Stretched 269-passenger version, with 3.07 m (10 ft 1 in) plug forward of wing and 3.35 m (11 ft) plug aft, and same gross weight as 767-200; strengthened landing gear and thicker metal in parts of fuselage and underwing skin; same flight deck and systems as other 767s; same engine options as 767-200ER; first ordered 29 September 1983. First flight with JT9D-7R4D engines 30 January 1986; certificated with JT9D-7R4D and CF6-80A2 22 September 1986; British Airways ordered 11 in August 1987, later increased to total 25, with Rolls-Royce RB211-524H, for delivery from November 1989.

**767-300ER:** Extended range, higher gross weight version; development began January 1985; optional gross weights 172,365 kg (380,000 lb), 175,540 kg (387,000 lb) and 181,437 kg (400,000 lb); further increased centre-section tankage. Engine choice CF6-80C2, PW4000, RB211-524H; structural reinforcement; certificated late 1987. Launch customer American Airlines (15), delivered from February 1988.

**767ERX/ERY:** Possible long-range versions of 767-300. Boeing's initial 767ERX study of 1992 extended tailplane tankage to give additional 550 n mile (1,019 km; 633 mile) range; 767ERY would have wing area and tankage volume extended by increased wing chord, modified front spar, extended span and winglets; fuselage section 48, pressure bulkhead and landing gear would be reinforced; GE, P&W and RR studying 278.0 kN (62,500 lb st) engines; 767ERY could have payload improved by 5,987 kg (13,200 lb), range extended to more than 7,000 n miles (12,964 km; 8,055 miles), hot and high take-off performance improved and cruising speed pushed towards Mach 0.84. Boeing could produce 767-300ERX in two years and 767-300ERY in about three years from order.

**767-300 Freighter:** See separate entry.

**767 AWACS:** See Boeing 767 AWACS under Boeing Electronic Systems Division. Also under consideration are a tanker version for boom and hose-reel systems and a carrier for Joint-STARS radar; see Boeing Military Airplanes entry.

**CUSTOMERS:** See table on earlier page for orders/deliveries. Original prototype became 767 Airborne Surveillance Testbed (formerly AOA) for US Army (see 1991-92 Jane's). One reconfigured by E-Systems as medevac aircraft for Civil Reserve Air Fleet.

**COSTS:** Two 767-300ER ordered by Airtrons in August 1993 for delivery in Spring 1994, cost about \$200 million including spares and support.

**DESIGN FEATURES:** Boeing aeroflats; quarter-chord sweepback 31° 30'; thickness/chord ratio 15.1 per cent at root, 10.3 per cent at tip; dihedral 6°; incidence 4° 15'.

**FLYING CONTROLS:** Inboard all-speed and outboard low-speed ailerons supplemented by flight spoilers also acting as airbrakes and lift dumpers; single-slotted, linkage-supported outboard trailing-edge flaps, double-slotted inboard; track-mounted leading-edge slats; variable incidence tailplane; no trim tabs; all control surfaces hydraulically powered; roll and yaw trim through spring feed system; triple digital flight control computers and EFIS; Boeing windshear detection and guidance system optional.

**STRUCTURE:** Fail-safe structure; CFRP wing spoilers;

Subcontractors include Boeing Helicopters (wing fixed leading-edges); Northrop Grumman (wing centre-section and adjacent lower fuselage section; fuselage bulkheads); Vought Aircraft (horizontal tail); Canadair (rear fuselage); Alenia (wing control surfaces, flaps and leading-edge slats, wingtips, elevators, fin and rudder, nose radome); Fuji (wing fairings and main landing gear doors); Kawasaki (centre-fuselage body panels; exit hatches; wing in-spar ribs); Mitsubishi (rear fuselage body panels; stringers; passenger and cargo doors; dorsal fin).

**LANDING GEAR:** Hydraulically retractable tricycle type; Menasco twin-wheel nose unit retracts forward; Cleveland Pneumatic main gear, with two four-wheel bogies, retracts inward; oleo-pneumatic shock-absorbers; Bendix wheels and brakes; mainwheel tyres size 45 x 17-20, pressure 12.6 bars (183 lb/sq in); nosewheel tyres size 37 x 14-15, pressure 10.0 bars (145 lb/sq in); steel disc brakes on all mainwheels; electronically controlled anti-skid units.

**POWER PLANT:** Two high bypass turbofans in pods, pylon-mounted on the wing leading-edges. Alternative engines available for all models are General Electric CF6-80A and Pratt & Whitney JT9D-7R4D, both rated at 213.5 kN (48,000 lb st), and CF6-80A2, JT9D-7R4E and JT9D-7R4E4, rated at 222.4 kN (50,000 lb st). Additionally, 767-200, 767-200ER and 767-300 are available with Pratt & Whitney PW4050 rated at 222.4 kN (50,000 lb st), PW4052 rated at 231.3 kN (52,000 lb st) and General Electric CF6-80C2B2 rated at 233.5 kN (52,500 lb st). General Electric CF6-80C2B4, rated at 257.5 kN (57,900 lb st), available on 767-200ER, 767-300 and 767-300ER. Pratt & Whitney PW4056, rated at 252.4 kN (56,750 lb st), and PW4060 and General Electric CF6-80C2B6 rated at 266.9 kN (60,000 lb st), available only on extended range versions. Rolls-Royce RB211-524G, rated at 269.6 kN (60,600 lb st), available on 767s since early 1990. Fuel in one integral tank in each wing, and in centre tank, with total capacity of 63,216 litres (16,700 US gallons; 13,905 Imp gallons) in 200/300; 767-200ER has additional 14,195 litres (3,750 US gallons; 3,122 Imp gallons) in second centre-section tank, raising total capacity to 77,412 litres (20,450 US gallons; 17,028 Imp gallons). 767-300ER has further expanded wing centre-section tank (optional on -200ER), bringing total capacity to 91,039 litres (24,050 US gallons; 20,026 Imp gallons). Refuelling point in port outer wing.

**ACCOMMODATION:** Normal operating crew of two on flight deck, with third position optional. Basic accommodation in -200 models for 216 passengers, made up of 18 first class passengers forward in six-abreast seating at 96.5 cm (38 in) pitch, and 198 tourist class in mainly seven-abreast seating at 87 cm (34 in) pitch. Type A inward-opening plug doors provided at both front and rear of cabin on each side of fuselage, with Type III emergency exit over wing on each side. Total of five toilets installed, two centrally in main cabin, two aft in main cabin, and one forward in first class section. Galleys situated at forward and aft ends of cabin. Alternative single class layouts provide for 230 tourist passengers, seven-abreast at 86 cm (34 in) pitch; 242 passengers seven-abreast at 81 cm (32 in) pitch; 255 passengers mainly seven-abreast (two-three-two) at 76 cm (30 in) pitch, or eight-abreast (two-four-two) at 81 cm (32 in) pitch. Maximum seating capacity in -200 models (requiring additional overwing emergency exit) 290 passengers, mainly eight-abreast, at 76 cm (30 in) pitch; capacity in -300 is 290 passengers seven-abreast.

Underfloor cargo holds of -200 versions can accommodate, typically, up to 22 LD2 or 11 LD1 containers; 767-300 underfloor cargo holds can accommodate 30 LD2 or 15 LD1 containers. Starboard side forward and rear cargo doors of equal size standard on 767-200 and 767-300, but larger port-side forward cargo door standard on 767-200ER and 767-300ER and optional on 767-200 and 767-300, to permit loading of Type 2 pallets, three such pallets being accommodated in -200/200ER and four in -300/300ER. Bulk cargo door at rear on port side. Overhead stowage for carry-on baggage. Cabin air conditioned, cargo holds heated.

**SYSTEMS:** AirResearch dual air cycle air conditioning system. Pressure differential 0.59 bar (8.6 lb/sq in). Electrical supply from two engine-driven 90 kVA three-phase 400 Hz constant frequency AC generators, 115/200 V output. 90 kVA generator mounted on APU for ground operation or for emergency use in flight. Three hydraulic systems at 207 bars (3,000 lb/sq in), for flight control and utility functions, supplied from engine-driven pumps and an Allied-Signal bleed air powered hydraulic pump or from APU. Maximum generating capacity of port and starboard systems is 163 litres (43 US gallons; 35.8 Imp gallons)/min; centre system 185.5 litres (49 US gallons; 40.8 Imp gallons)/min, at 196.5 bars (2,850 lb/sq in). Reservoirs pressurised by engine bleed air via pressure regulation module. Reservoir relief valve pressure nominally 4.48 bars (65 lb/sq in). Additional hydraulic motor-driven generator, to provide essential functions for extended range operations, standard on 767-200ER and 767-300ER and optional on 767-200 and 767-300. Nitrogen chlorate oxygen generators in passenger cabin, plus gaseous oxygen for flight crew. APU in tailcone to provide ground and in-flight electrical power and pressurisation. Anti-icing for outboard wing leading-edges (none on tail surfaces), engine air inlets, air data sensors and windshield.

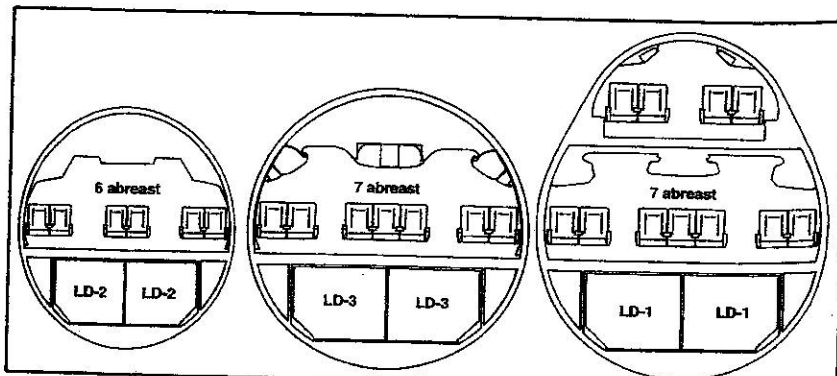
**AVIONICS:** Radar: Bendix/King RDR-4A colour weather radar in aircraft for All-Nippon, Britannia and Transbrasil.

**Flight:** Standard ARINC 700 series equipment, including Bendix/King VOR/L/S/marker beacon receivers, ADF, DME, RMI-743 radio magnetic indicator and radio altimeter. Honeywell IRS, FMCS and DADC, as described in Boeing 757 entry; dual digital flight management systems, and triple flight control computers, including FCS-700 flight control system; options include Boeing's windshear protection and guidance system.

**Instrumentation:** Bendix/King EFIS-700 electronic flight instrument system.

#### DIMENSIONS, EXTERNAL:

Wing span	47.57 m (156 ft 1 in)
Wing chord: at root	8.57 m (28 ft 1 1/4 in)
at tip	2.29 m (7 ft 6 in)
Wing aspect ratio	7.99
Length: overall: 200/200ER	48.51 m (159 ft 2 in)
300/300ER	54.94 m (180 ft 3 in)



Cabin cross-sections of Boeing 767 (left), 777 (centre) and 747 show progression in size designed to afford greater scope in seating layout. External diameter of Boeing 767 is 5.03 m (16 ft 6 in); Boeing 777 is 6.20 m (20 ft 4 in); and Boeing 747 is 6.49 m (21 ft 3 1/2 in). LD-1, -2 and -3 are international-size freight containers. Boeing 747 upper deck extends only part-way along the fuselage

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Boeing 757 twin-turboprop airliner

#### DIMENSIONS, EXTERNAL:

Wing span	38.05 m (124 ft 10 in)
Wing chord: at root	8.20 m (26 ft 11 in)
at tip	1.73 m (5 ft 8 in)
Wing aspect ratio	7.82
Length: overall	47.32 m (155 ft 3 in)
fuselage	46.96 m (154 ft 10 in)
Height overall	13.56 m (44 ft 6 in)
Tailplane span	15.21 m (49 ft 11 in)
Wheel track	7.32 m (24 ft 0 in)
Wheelbase	18.29 m (60 ft 0 in)
Passenger doors (two, fwd, port):	
Height	1.83 m (6 ft 0 in)
Width	0.84 m (2 ft 9 in)
Passenger door (rear, port): Height	1.83 m (6 ft 0 in)
Width	0.76 m (2 ft 6 in)
Service door (fwd, stbd): Height	1.65 m (5 ft 5 in)
Width	0.76 m (2 ft 6 in)
Service door (stbd, opposite second passenger door):	
Height	1.83 m (6 ft 0 in)
Width	0.84 m (2 ft 9 in)
Service door (rear, stbd): Height	1.83 m (6 ft 0 in)
Width	0.76 m (2 ft 6 in)
Emergency exits (four, overwing):	
Height	0.97 m (3 ft 2 in)
Width	0.51 m (1 ft 8 in)
Emergency exits, optional (two, aft of wings):	
Height	1.32 m (4 ft 4 in)
Width	0.61 m (2 ft 0 in)

#### DIMENSIONS, INTERNAL:

Cabin (aft of flight deck to rear pressure bulkhead):	
Length	36.09 m (118 ft 5 in)
Max width	3.53 m (11 ft 7 in)
Max height	2.13 m (7 ft 0 in)
Floor area	116.04 m <sup>2</sup> (1,249 sq ft)
Passenger section volume	230.50 m <sup>3</sup> (8,140 cu ft)
Underfloor cargo volume (bulk loading):	
fwd	19.82 m <sup>3</sup> (700 cu ft)
rear	30.87 m <sup>3</sup> (1,090 cu ft)
ARBAS:	
Wings, gross	185.25 m <sup>2</sup> (1,994.0 sq ft)
Ailerons (total)	4.46 m <sup>2</sup> (48.0 sq ft)
Trailing-edge flaps (total)	30.38 m <sup>2</sup> (327.0 sq ft)
Leading-edge slats (total)	18.39 m <sup>2</sup> (198.0 sq ft)
Flight spoilers (total)	10.96 m <sup>2</sup> (118.0 sq ft)
Ground spoilers (total)	12.82 m <sup>2</sup> (138.0 sq ft)
Fin	34.37 m <sup>2</sup> (370.0 sq ft)
Rudder	11.61 m <sup>2</sup> (125.0 sq ft)

Tailplane	50.35 m <sup>2</sup> (542.0 sq ft)
Elevators (total)	12.54 m <sup>2</sup> (135.0 sq ft)
WEIGHTS AND LOADINGS (with 186 passengers. A: 535E4 engines, B: PW2037s, C: PW2040s; F1: Freighter with P&W engines, F2: Freighter with RR engines):	
Operating weight empty: A	57,180 kg (126,060 lb)
B, C	57,040 kg (125,750 lb)
F1	50,960 kg (112,350 lb)
F2	51,165 kg (112,800 lb)
Freighter revenue payload: volume limited	32,755 kg (72,210 lb)
F1, F2	
Zero-fuel weight limited, containers	
F1	36,220 kg (79,850 lb)
F2	36,015 kg (79,400 lb)
Zero-fuel weight limited, pallets	
F1	38,260 kg (84,350 lb)
F2	38,055 kg (83,900 lb)
Max basic T-O weight: A, B, C	99,790 kg (220,000 lb)
Max T-O weight (medium-range):	
A, B, C	104,325 kg (230,000 lb)
F1, F2	113,400 kg (250,000 lb)
Max T-O weight (long-range):	
A, B, C	113,400 kg (250,000 lb)
F1, F2	115,665 kg (255,000 lb)
Max landing weight: A, B, C	89,810 kg (198,000 lb)
F1, F2	95,255 kg (210,000 lb)
Max zero-fuel weight: A, B, C	83,460 kg (184,000 lb)
F1, F2	90,720 kg (200,000 lb)
Max wing loading: A, B, C at max basic T-O weight	538.5 kg/m <sup>2</sup> (110.3 lb/sq ft)
A, B, C at long-range max T-O weight	587.8 kg/m <sup>2</sup> (120.4 lb/sq ft)
F1, F2 at long-range max T-O weight	624.3 kg/m <sup>2</sup> (127.8 lb/sq ft)

#### Max power loading:

at max basic T-O weight:	
A	279.68 kg/kN (2.74 lb/lb st)
B	293.5 kg/kN (2.88 lb/lb st)
C	268.97 kg/kN (2.64 lb/lb st)
at long-range max T-O weight:	
A	317.81 kg/kN (3.12 lb/lb st)
B	333.51 kg/kN (3.27 lb/lb st)
C	305.1 kg/kN (3.00 lb/lb st)
F1	311.8 kg/kN (3.05 lb/lb st)
F2	324.1 kg/kN (3.18 lb/lb st)

PERFORMANCE: (with 186 passengers; at max basic T-O weight except where indicated);  
Max operating speed: A, B, C

Mach 0.86

Cruising speed: A, B, C Mach 0.80  
Approach speed at S/L, flaps down, max landing weight: A, B, C 132 kts (245 km/h; 152 mph) EAS  
Initial cruising height: A 11,880 m (38,970 ft)  
B, C 11,675 m (38,300 ft)  
Runway LCN at ramp weight of 100,244 kg (221,000 lb), optimum tyre pressure and subgrade C flexible pavement: H40 x 14.5-19.0 tyres 36  
T-O field length (S/L, 29°C):  
at max basic T-O weight: A 1,646 m (5,400 ft)  
B 1,791 m (5,875 ft)  
C 1,637 m (5,370 ft)  
at long-range max T-O weight: A 2,134 m (7,000 ft)  
B 2,792 m (9,160 ft)  
C 2,118 m (6,950 ft)  
Landing field length at max landing weight:  
A 1,411 m (4,630 ft)  
B, C 1,460 m (4,790 ft)

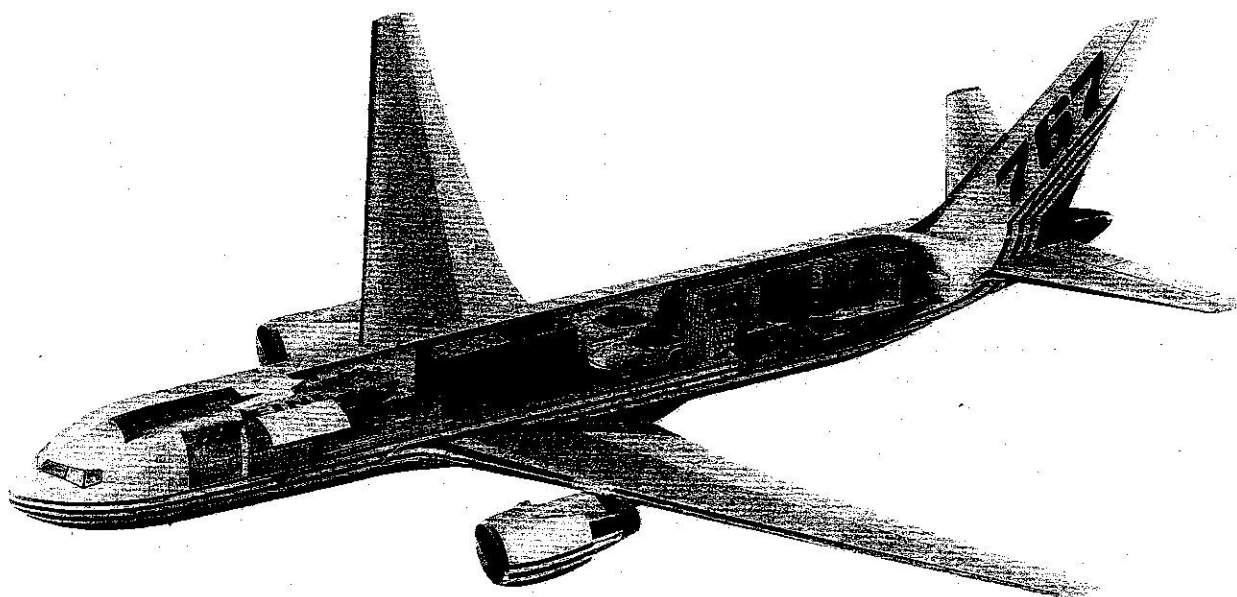
Range with 186 passengers:  
at max basic T-O weight:  
A 2,820 n miles (5,222 km; 3,245 miles)  
B, C 2,980 n miles (5,519 km; 3,429 miles)  
at long-range max T-O weight:  
A 3,820 n miles (7,074 km; 4,396 miles)  
B, C 4,000 n miles (7,408 km; 4,603 miles)  
757-200PF, max long-range T-O weight, 22,680 kg (50,000 lb) payload:  
A 3,700 n miles (6,852 km; 4,258 miles)  
B, C 3,885 n miles (7,195 km; 4,471 miles)  
OPERATIONAL NOISE LEVELS (FAR Pt 36 Stage 3):  
T-O, at max basic T-O weight, cutback power:  
A 82.2 EPNdB  
B 86.2 EPNdB  
C (estimated) 84.7 EPNdB  
Approach at max landing weight, 30° flap:  
A 95.0 EPNdB  
B, C 97.7 EPNdB  
Sidelobe: A 93.3 EPNdB  
B 94.0 EPNdB  
C (estimated) 94.6 EPNdB

UPDATED

#### BOEING 767

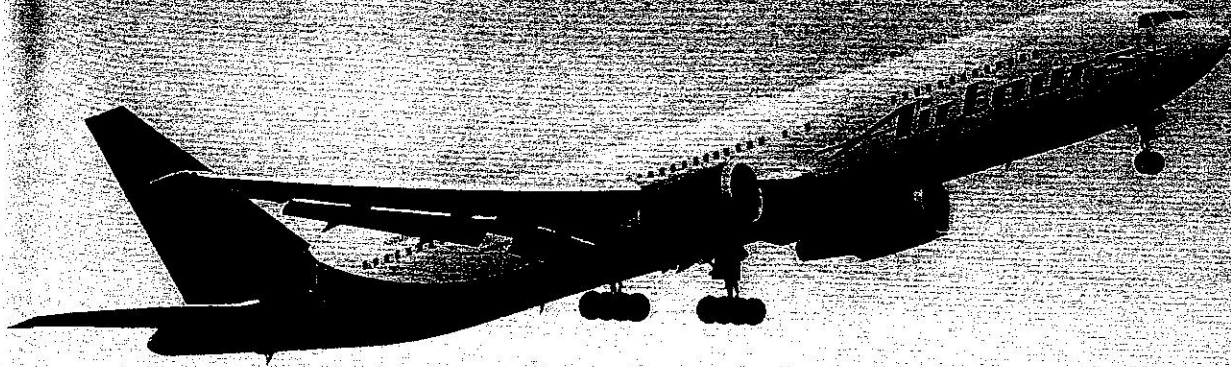
TYPE: Medium/long-range twin-turboprop airliner.  
PROGRAMME: Launched on receipt of United Air Lines order for 30 on 14 July 1978; construction of basic 220-passenger 767-200 began 6 July 1979; first flight (N767BA) 26 September 1981 with P&W JT9D turbofans; first flight fifth aircraft with GE CF6-80A 19 February 1982; 767 with JT9D-7R4D certificated 30 July 1982; with CF6-80A 30 September 1982.

First delivery with JT9D (United Air Lines) 19 August 1982; first delivery with CF6 (Delta) 25 October 1982. ETOPS approval for 767-200 with JT9D-7R4 or CF6-80A or -80A2 granted January 1987; ETOPS approval for 767-200 and -300 with PW4000 obtained April 1990; 180 min ETOPS approval with PW4000 engines obtained August 1993. Boeing windshear detection and guidance system FAA approved for 767-200 and -300 February 1987; production reduced from five per month to three in October 1993 (instead of four in November), rising to four in April 1995, then reducing to 3½ in December 1995.



Interior layout of Boeing 767-300 Freighter

1994



Boeing 767-300ER of Airtours International

1994

Fuselage: 200/200ER	47.24 m (155 ft 0 in)
300/300ER	53.67 m (176 ft 1 in)
Fuselage: Max width	5.03 m (16 ft 6 in)
Height overall	15.85 m (52 ft 0 in)
Tailplane span	18.62 m (61 ft 1 in)
Wheel track	9.30 m (30 ft 6 in)
Wheelbase: 200/200ER	19.69 m (64 ft 7 in)
300/300ER	22.76 m (74 ft 8 in)
Passenger doors (two, fwd and rear, port):	
Height	1.88 m (6 ft 2 in)
Width	1.07 m (3 ft 6 in)
Galley service door (two, fwd and rear, stbd):	
Height	1.83 m (6 ft 0 in)
Width	1.07 m (3 ft 6 in)
Emergency exits (two, each): Height	0.97 m (3 ft 2 in)
Width	0.51 m (1 ft 8 in)
Cargo doors (two, fwd and rear, stbd):	
Height	1.75 m (5 ft 9 in)
Width	1.78 m (5 ft 10 in)
* Larger cargo door (fwd, port):	
Height	1.75 m (5 ft 9 in)
Width	3.40 m (11 ft 2 in)
* Standard on ER models, optional for -200/300	
DIMENSIONS, INTERNAL:	
Cabin, excl flight deck:	
Length: 200/200ER	33.93 m (111 ft 4 in)
300/300ER	40.36 m (132 ft 5 in)
Max width	4.72 m (15 ft 6 in)
Max height	2.87 m (9 ft 5 in)
Floor area: 200/200ER	154.9 m <sup>2</sup> (1,667 sq ft)
300/300ER	184.0 m <sup>2</sup> (1,981 sq ft)
Volume: 200/200ER	428.2 m <sup>3</sup> (15,121 cu ft)
300/300ER	483.9 m <sup>3</sup> (17,088 cu ft)
Volume, flight deck	13.5 m <sup>3</sup> (478 cu ft)
Baggage holds (containerised), volume:	
200/200ER	74.8 m <sup>3</sup> (2,640 cu ft)
300/300ER	101.9 m <sup>3</sup> (3,600 cu ft)
Bulk cargo hold volume:	
all models	12.2 m <sup>3</sup> (430 cu ft)
Combined baggage hold/bulk cargo hold volume:	
200/200ER	87.0 m <sup>3</sup> (3,070 cu ft)
300/300ER	114.1 m <sup>3</sup> (4,030 cu ft)
Total cargo hold volume:	
200/200ER	111.3 m <sup>3</sup> (3,930 cu ft)
300/300ER	147.0 m <sup>3</sup> (5,190 cu ft)

#### AREAS:

Wings, gross	283.3 m <sup>2</sup> (3,050.0 sq ft)
Ailerons (total)	11.58 m <sup>2</sup> (124.6 sq ft)
Trailing-edge flaps (total)	36.88 m <sup>2</sup> (397.0 sq ft)
Leading-edge slats (total)	28.30 m <sup>2</sup> (304.6 sq ft)
Spoilers (total)	15.83 m <sup>2</sup> (170.4 sq ft)
Fin	30.19 m <sup>2</sup> (325.0 sq ft)
Rudder	15.95 m <sup>2</sup> (171.7 sq ft)
Tailplane	59.88 m <sup>2</sup> (644.5 sq ft)
Elevators (total)	17.81 m <sup>2</sup> (191.7 sq ft)

WEIGHTS AND LOADINGS (A: 767-200 basic/JT9D-7R4D engines, B: 767-200 basic/CF6-80A, C: medium-range version/JT9D-7R4D, D: medium-range version/CF6-80A, E: 767-200ER/PW4050, F: 767-200ER/CF6-80C2B2, G: 767-200ER/PW4050, H: 767-200ER/CF6-80C2B4, J: 767-300/PW4050, K: 767-300/CF6-80C2B2, L: 767-300 higher gross weight version/PW4050, M: 767-300 higher gross weight version/CF6-80C2B2, N: 767-300ER/PW4050, P: 767-300ER/CF6-80C2B4, Q: 767-300ER/PW4050):

Manufacturer's weight empty:	
A, C	74,750 kg (164,800 lb)
B, D	74,345 kg (163,900 lb)
E	76,340 kg (168,300 lb)
F	76,250 kg (168,100 lb)
G	76,565 kg (168,800 lb)
H	76,475 kg (168,600 lb)
J, L	79,560 kg (175,400 lb)

K, M	79,380 kg (175,000 lb)
N	80,785 kg (178,100 lb)
P	80,605 kg (177,700 lb)
Q	81,375 kg (179,400 lb)
Operating weight empty: A, C	80,920 kg (178,400 lb)
B, D	80,510 kg (177,500 lb)
E	83,550 kg (184,200 lb)
F	83,460 kg (184,000 lb)
G	83,780 kg (184,700 lb)
H	83,690 kg (184,500 lb)
J, L	87,135 kg (192,100 lb)
K, M	86,955 kg (191,700 lb)
N	89,310 kg (196,900 lb)
P	89,130 kg (196,500 lb)
Q	89,900 kg (198,200 lb)
Max payload (767-200, 216 passengers; 767-200ER, 174 passengers; 767-300, 261 passengers; 767-300ER, 210 passengers): A, B, C, D	19,595 kg (43,200 lb)
E, F, G, H	16,575 kg (36,540 lb)
J, K, L, M	23,675 kg (52,200 lb)
N, P, Q	20,005 kg (44,100 lb)

#### Max fuel weight:

A, B, C, D, J, K, L, M	51,130 kg (112,725 lb)
E, F	62,615 kg (138,040 lb)
G, H, N, P, Q	73,635 kg (162,340 lb)
Max T-O weight: A, B	136,080 kg (300,000 lb)
C, D	142,880 kg (315,000 lb)
E, F, J, K	156,490 kg (345,000 lb)
G, H, N, P	175,540 kg (387,000 lb)
L, M	159,210 kg (351,000 lb)
Q	181,435 kg (400,000 lb)
Max ramp weight: A, B	136,985 kg (302,000 lb)
C, D	143,790 kg (317,000 lb)
E, F, J, K	157,395 kg (347,000 lb)
G, H, N, P	175,995 kg (388,000 lb)
L, M	159,665 kg (352,000 lb)
Q	181,890 kg (401,000 lb)
Max zero-fuel weight: A, B	112,490 kg (248,000 lb)
C, D	113,400 kg (250,000 lb)
E, F	114,755 kg (253,000 lb)
G, H	117,935 kg (260,000 lb)
J, K, L, M, N, P	126,100 kg (278,000 lb)
Q	130,635 kg (288,000 lb)
C, D	122,470 kg (270,000 lb)
E, F	123,375 kg (272,000 lb)
G, H	126,100 kg (278,000 lb)
J, K, L, M, N, P	129,275 kg (285,000 lb)
Q	136,080 kg (300,000 lb)

#### Max wing loading: A, B

C, D	480.24 kg/m <sup>2</sup> (98.36 lb/sq ft)
E, F, J, K	504.26 kg/m <sup>2</sup> (103.28 lb/sq ft)
G, H, N, P	552.25 kg/m <sup>2</sup> (113.11 lb/sq ft)
L, M	619.53 kg/m <sup>2</sup> (126.89 lb/sq ft)
Q	561.87 kg/m <sup>2</sup> (115.08 lb/sq ft)
Q	640.33 kg/m <sup>2</sup> (131.15 lb/sq ft)

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

Normal cruising speed, all versions Mach 0.80

Approach speed at max landing weight:

A, B, C, D	136 kts (252 km/h; 157 mph)
E	138 kts (256 km/h; 159 mph)
F, G, H	140 kts (259 km/h; 161 mph)
J, K, L, M, N, P	141 kts (261 km/h; 162 mph)
Q	145 kts (269 km/h; 167 mph)

Initial cruise altitude: A

B	11,950 m (39,200 ft)
C	12,100 m (39,700 ft)
D	11,650 m (38,200 ft)
E	11,800 m (38,700 ft)
F	11,215 m (36,800 ft)
G	11,460 m (37,600 ft)
H	10,925 m (35,850 ft)
J, M	10,850 m (35,600 ft)
K	11,250 m (36,900 ft)
	11,340 m (37,200 ft)

L	11,125 m (36,500 ft)
N, P	10,600 m (34,800 ft)
Q	10,400 m (34,100 ft)
Service ceiling, OEI: A, C	6,525 m (21,400 ft)
B, D	6,430 m (21,100 ft)
E	6,850 m (22,500 ft)
F	7,200 m (23,600 ft)
G	7,250 m (23,800 ft)
H	7,375 m (24,200 ft)
J, L	6,035 m (19,800 ft)
K, M	6,150 m (20,200 ft)
N, P	6,615 m (21,700 ft)
Q	6,550 m (21,500 ft)
T-O field length: A, B	1,798 m (5,900 ft)
C	1,951 m (6,400 ft)
D	1,981 m (6,500 ft)
E	2,347 m (7,700 ft)
F	2,316 m (7,600 ft)
G, H	2,774 m (9,100 ft)
J	2,560 m (8,400 ft)
K	2,469 m (8,100 ft)
L, M	2,652 m (8,700 ft)
N	2,926 m (9,600 ft)
P	2,956 m (9,700 ft)
Q	2,774 m (9,100 ft)
Design range: A	3,160 n miles (5,852 km; 3,636 miles)
B	3,220 n miles (5,963 km; 3,705 miles)
C	3,795 n miles (7,028 km; 4,367 miles)
D	3,850 n miles (7,130 km; 4,430 miles)
E	5,365 n miles (9,936 km; 6,174 miles)
F	5,410 n miles (10,019 km; 6,225 miles)
G	6,770 n miles (12,538 km; 7,791 miles)
H	6,805 n miles (12,603 km; 7,831 miles)
J	4,000 n miles (7,408 km; 4,603 miles)
K	4,020 n miles (7,445 km; 4,626 miles)
L	4,230 n miles (7,834 km; 4,868 miles)
M	4,260 n miles (7,889 km; 4,902 miles)
N	5,740 n miles (10,630 km; 6,605 miles)
P	5,760 n miles (10,667 km; 6,628 miles)
Q	6,060 n miles (11,223 km; 6,974 miles)

OPERATIONAL NOISE LEVELS (FAR Pt 36, Stage 3):

T-O at max basic T-O weight: B	87.1 EPNdB
H	90.4 EPNdB
Approach at max landing weight: B	101.6 EPNdB
H	101.7 EPNdB
Sideline: B	95.4 EPNdB
H	96.6 EPNdB

UPDATED

### BOEING 767-300 FREIGHTER

TYPE: Freighter version of 767-300ER.

PROGRAMME: First 767 specialised package freighter launched January 1993 by United Parcel Service order, mockup completed early 1994; first flight expected second quarter 1995. The 767-300F for general operation was ordered by Asiana in November 1993 and differs from austere UPS version in having mechanical freight handling on main and lower decks, air conditioning for animals and perishables on main and forward lower decks and more elaborate crew facilities.

CUSTOMERS: UPS ordered 30 (plus 30 options) parcel freighters January 1993; first delivery due October 1995; 11 to follow in 1996. Asiana ordered two 767-300F in November 1993 for delivery in 1996 and 1998.

DESIGN FEATURES: Modifications include reinforced landing gear and internal wing structure; main deck floor strengthened to take 24 containers; no passenger windows; 2.67 x 3.4 m (8 ft 9 in x 11 ft 1 1/4 in) freight door forward to port; pilot type rating and extensive component commonality with 757 Freighter.

POWER PLANT: In competition between Rolls-Royce RB211-524G and variety of P&W JT9D and PW4000 and GE

centre was added to the Toulouse facilities during 1999 and was fully operational by end 2000. A training centre was opened in Miami, Florida, in October 1999.

In March 1994, Airbus signed an agreement with Indonesia's IPTN (now Dirgantara) to assist in flight testing of N-250 turboprop transport (see under Indonesia) up to certification. In July 1996, Airbus Training and Support Centre in Beijing was opened, becoming operational in October 1997.

Agreement of 1995 provides for Airbus Industrie to design, manufacture and market A400M military transport; Airbus Military Company (which see) established for that purpose in January 1999.

Refer also to SATIC (later in this section) for A300-608ST Super Transporter.

## UPDATED

## AIRBUS A300-600

TYPE: Wide-bodied airliner.

PROGRAMME: Launched 29 May 1969; initial variants were A300B1 (first flight 28 October 1972, service entry November 1974; see 1971-72 *Jane's* for details), A300B2 (first flight June 1973, service entry May 1974) and A300B4 (first flight December 1974, service entry June 1975; 248 built; see 1984-85 and previous editions). A300-600 go-ahead 16 December 1980; first flight (F-WZLR) 8 July 1983; certified (with JT9D-7RAH1 engines) 9 March 1984; first delivery (to Saudia) 26 March 1984.

Improved version with CF6-80C2 engines and other changes (see Current Versions) made first flight 20 March 1985; French certification for Cat. IIb take-offs and landings 26 March 1985; first delivery of improved version (to Thai Airways) 26 September 1985. Extended-range A300-600R (then known as -600ER) made first flight 9 December 1987, receiving European and FAA certification 10 and 28 March 1988 respectively, deliveries (to American Airlines) beginning 20 April 1988; A300-600 powered by GE CF6-80C2AS with FADEC granted 180-minute ETOPS April 1994. CIS certification granted May 1996.

CURRENT VERSIONS: A300-600: Advanced version of A300B4-200; major A300 version since early 1984. Passenger and freight capacity increased by fitting rear fuselage of A310 with pressure bulkhead moved aft; wings have simple Fowler flaps and increased trailing-edge camber; forward-facing two-person flight deck with EFIS; new digital avionics; new braking control system; new APU; simplified systems; weight saving by use of composites for some secondary structural components; payload/range performance and fuel economy improved by comprehensive drag clean-up. Cargo conversions of A300-600 and earlier A300B4 are offered, see *Jane's Aircraft Upgrades* for details.

Improved version: Introduced 1985. Has CF6-80C2 or PW4000 as engine options, carbon brakes, wingtip fences and 'New World' flight deck; basic equipment of aircraft delivered from late 1991 further improved by incorporating standard options.

Detailed description applies to improved version except where indicated.

A300-600R: Extended-range version of A300-600, differing mainly in having fuel trim tank in tailplane and higher maximum T-O weight.

A300-600 Convertible: Convertible passenger/cargo version, described separately.

A300-600 Freighter: Non-passenger version, described separately.

Airbus Super Transporter: A300-600R conversion as Super Guppy replacement; see under SATIC later in this section.

CUSTOMERS: Total of 580 of all A300 versions ordered, and 497 delivered, by 1 March 2001.

AIRBUS A300 ORDERS  
(at 1 March 2001)

Customer	Qty
Air Afrique	3
Air France	23
Air India	3
Air Inter Europe	8
Alitalia	8
American Airlines	35
Amiri Flight	2
Ansett	8
Australian Airlines	5
China Airlines	15
China Eastern Airlines	7
China Northern Airlines	6
China Northwest Airlines	3
CityBird	2
Continental Airlines	3
Cruzeiro	2
Eastern Airlines	34
Egyptair	17
Emirates	5
Federal Express	36
Finnair	2
Garuda	9
Hapag Lloyd	7
Iberia	6
Indian Airlines	10
ILFC	9
Iran Air	8
Japan Air System	29
Japan Fleet Service	2
Korean Air	32
Kuwait Airways	8
Laker	3
LaTur	2
Lufthansa	23
Malaysia Airlines	4
Monarch	4
Olympic	10
Pakistan International Airlines	4
Pan Am	12
Philippine Airlines	5
Polaris Aircraft Leasing	5
Saudi Arabian Airlines	11
SAS	4
Singapore Airlines	8
SOGERMA SOCEA	1
South African Airways	7
Thai Airways	33
Trans European Airways	1
Tunis Air	1
UPS	90
Varig	2
VASP	3
<b>Total</b>	<b>580</b>

DESIGN FEATURES: Mid-mounted wings with 10.5 per cent thickness/chord ratio, 28° sweepback at quarter-chord, and (since 1985) tip fences; circular-section pressurised fuselage; all-swept tail unit.

FLYING CONTROLS: Power-assisted. Each wing has three-segment, two-position (T-O/landing) leading-edge slats (no cutout over engine pylon), small Krueger flap at leading-edge wingroot, three cambered tabless flaps on trailing-edge, all-swept aileron between inboard flap and outer pair, and seven spoilers forward of flaps on each wing; flaps occupy 84 per cent of trailing-edge, increasing wing chord by 25 per cent when fully extended; ailerons deflect 9° 2' downward automatically when flaps are

deployed; all 14 spoilers used as lift dumpers: outboard 10 for roll control and inboard 10 as airbrakes; variable incidence tailplane. Ailerons/elevators/rudder fully powered by hydraulic servos (three per surface), controlled mechanically; secondary surfaces (spoilers/flaps/slats) fully powered hydraulically with electrical control, tailplane by two independent hydraulic motors electrically controlled with additional mechanical input; preselection of spoiler/lift dump lever permits automatic extension of lift dumpers on touchdown; flaps and slats have similar drive mechanisms, each powered by twin motors driving ball screwjacks on each surface with built-in protection against asymmetric operation.

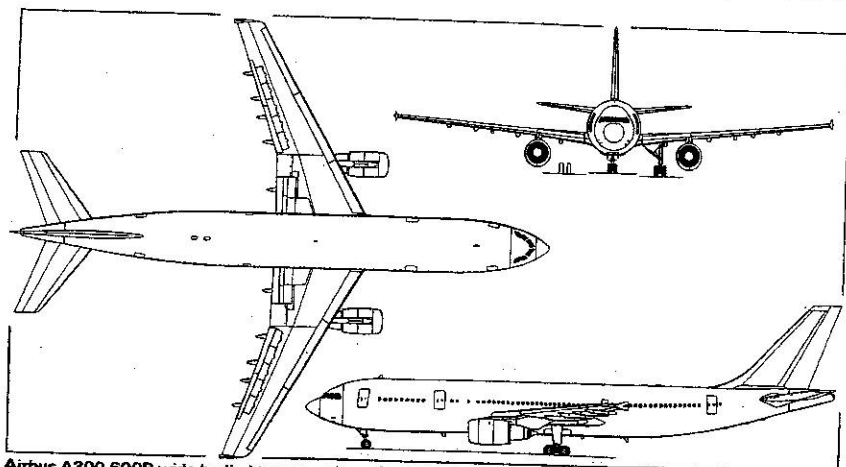
STRUCTURE: Two-spar main wing box, integral with fuselage and incorporating fail-safe principles; third spar across inboard sections; semi-monocoque fuselage (frames and open Z-section stringers), with integrally machined skin panels in high-stress areas; primary structure is of high-strength, damage-tolerant aluminium alloy, with steel or titanium for some critical fuselage components, honeycomb panels or selected glass fibre laminates for secondary structures; metal slats, flaps and ailerons. CFRP fins replaced aluminium alloy unit from 1988; secondary structure composites include AFRP for flap track fairings, rear wing/body fairings, cooling air inlet fairings and radome; GFRP for wing upper surface panels above mainwheel bays, fin leading/trailing-edges, fin-tip, fin/fuselage fairings, tailplane trailing-edges, elevator leading-edges, tailplane and elevator tips and elevator actuator access panel; carbon-reinforced GFRP for elevators and rudder; CFRP for spoilers, outer flap deflector doors and fin box; all CFRP moving surfaces have aluminium or titanium trailing-edges. Nosewheel doors and mainwheel leg fairing doors also of CFRP. Nose gear is structurally identical to that of B2/B4/A310; main gear is generally reinforced, with a new hinge arm and a new pitch damper hydraulic and electrical installation. Nacelles have CFRP cowling panels and are subcontracted to Rohr (California); pylon fairings are of AFRP.

Aerospaciale Matra builds nose (including flight deck), lower centre-fuselage, four inboard spoilers, wing/body fairings and engine pylons; Airbus Deutschland builds forward fuselage (flight deck to wing box), upper centre-fuselage, rear fuselage (including tailcone), vertical tail, 10 outboard spoilers and some cabin doors; it also equips wings and installs interiors and seats; BAE Systems (formerly BAe) designed wings and builds wing box; Airbus España manufactures horizontal tail, port and starboard forward passenger doors and mainwheel/nosewheel doors; Fokker produces wingtips, ailerons, flaps, slats and main gear leg fairings. Large, fully equipped and inspected airframe sections airlifted by Beluga to Aerospaciale Matra at Toulouse for assembly and painting, aircraft then being flown to Hamburg for outfitting and returned to Toulouse for customer acceptance.

LANDING GEAR: Hydraulically retractable tricycle type, of Messier-Bugatti design, with Messier-Bugatti/Liebherr/Dowty shock-absorbers and wheels standard; twin-wheel nose unit retracts forward, main units inward into fuselage; free-fall extension; has four-wheel main bogies interchangeable left with right. Standard bogie size is 927 x 1,397 mm (36½ x 55 in); wider bogie of 978 x 1,524 mm (38½ x 60 in) is optional. Mainwheel tyres size 49x17-20 or 49x17.0R20 (30 ply) (standard) or 49x19-20 (30 ply) (wide bogie), with respective pressures of 12.41 and 11.10 bars (180 and 161 lb/sq in). Nosewheel tyres size 40x14 or 40x14.0R16 (22 ply), pressure 9.38 bars (136 lb/sq in). Steering angles 65°/95°. Messier-Bugatti/Liebherr/Dowty hydraulic disc brakes standard on all mainwheels. Normal braking powered by 'green' hydraulic system, controlled electrically through two master valves and monitored by a brake system control box to provide anti-skid protection. Standby braking (powered automatically by 'yellow' hydraulic system if normal 'green' system supply fails) controlled through a dual metering valve; anti-skid protection is ensured through same box as normal system, with emergency pressure supplied to brakes by accumulators charged from 'yellow' system. Automatic braking system optional. Bendix or Goodrich wheels and brakes available optionally. Minimum ground turning radius (effective, aft CG) 22.00 m (72 ft 2¼ in) about nosewheel, 34.75 m (114 ft 0 in) about wingtips.

POWER PLANT: Two turbofans in underwing pods. A300-600 was launched with 249 kN (56,000 lb st) Pratt & Whitney JT9D-7RAH1 and currently available with 249 kN (56,000 lb st) Pratt & Whitney PW4156 or 262 kN (59,000 lb st) General Electric CF6-80C2A1. A300-600R is offered with 274 kN (61,500 lb st) CF6-80C2AS or 258 kN (58,000 lb st) PW4158. CF6-80C2AS and PW4158 also available as options on A300-600.

Fuel in two integral tanks in each wing, and fifth integral tank in wing centre-section, giving standard usable capacity of 62,000 litres (16,379 US gallons; 13,638 Imp gallons). Additional 6,150 litre (1,625 US gallon; 1,353 Imp gallon) fuel/trim tank in tailplane (-600R only) increases this total to 68,150 litres (18,004 US gallons; 14,991 Imp gallons). Optional extra fuel cell in aft cargo hold can increase total to 73,000 litres (19,285 US gallons; 16,058 Imp gallons) in -600R. Two standard refuelling



Airbus A300-600R wide-bodied transport (two GE CF6-80C2 turbofans) (Dennis Punnett/Jane's)

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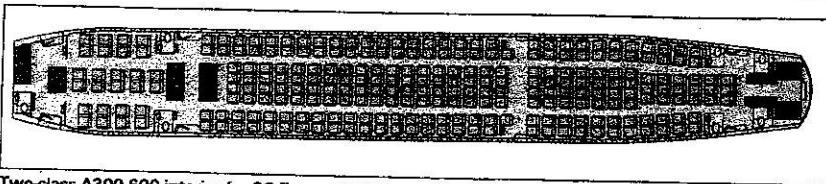
**ACCOMMODATION:** Crew of two on flight deck, plus two observers' seats. Passenger seating in main cabin in six-, seven-, eight- or nine-abreast layout with two aisles; typical mixed class layout has 266 seats (26 first class and 240 economy), six-eight-abreast at 96/86 cm (40/32 in) seat pitch with two galleys and one lavatory forward, one galley and two lavatories at Door 2 position, and one galley and four lavatories at rear; typical economy class layout for 285 passengers eight-abreast at 86 cm (34 in) pitch. Maximum capacity (subject to certification) 361 passengers. Closed overhead baggage lockers on each side (total capacity 10.5 m<sup>3</sup>; 370 cu ft) and in double-sided central 'super-bin' installation (total capacity 14.5 m<sup>3</sup>; 512 cu ft), giving 0.03 to 0.09 m<sup>3</sup> (1.2 to 3.2 cu ft) per passenger in typical economy layout.

Two outward parallel-opening Type A plug-type passenger doors ahead of wing on each side, and one on each side at rear. Type I emergency exit on each side aft of wing. Underfloor baggage/cargo holds fore and aft of wings, with doors on starboard side; forward hold can accommodate 12 LD3 containers, or four 2.24 x 3.17 m (88 x 125 in) pallets or, optionally, 2.43 x 3.17 m (96 x 125 in) pallets, or engine modules; rear hold can accommodate 10 LD3 containers; additional bulk loading of freight provided for in an extreme rear compartment with usable volume of 17.3 m<sup>3</sup> (611 cu ft); alternatively, rear hold can carry 11 LD3 containers, with bulk cargo capacity reduced to 9.0 m<sup>3</sup> (318 cu ft); bulk cargo compartment can be used to transport livestock. Entire accommodation is pressurised, including freight, baggage and avionics compartments.

**SYSTEMS:** Air supply for air conditioning system taken from engine bleed and/or APU via two high-pressure points; conditioned air can also be supplied direct to cabin by two low-pressure ground connections; ram air inlet for fresh air ventilation when packs not in use. Pressure control system (maximum differential 0.574 bar; 8.32 lb/sq in) consists of two identical, independent, automatic systems (one active, one standby); automatic switchover from one to other after each flight and in case of active system failure; in each system, pressure controlled by two electric outflow valves, function depending on preprogrammed cabin pressure altitude and rate of change of cabin pressure, aircraft altitude, and preselected landing airfield elevation. Automatic depressurisation of cabin before take-off, to prevent noticeable pressure fluctuation during take-off. Modular box system provides passenger oxygen to all installation areas.

Hydraulic system comprises three fully independent circuits, operating simultaneously; each system includes reservoir of direct air/fluid contact type, pressurised at 3.52 bars (51 lb/sq in); fire-resistant phosphate ester-type fluid; nominal output flow 136 litres (35.9 US gallons; 30 Imp gallons)/min delivered at 207 bars (3,000 lb/sq in) pressure; 'blue' and 'yellow' systems have one pump each, 'green' system has two pumps. The three circuits provide triplex power for primary flying controls; if any circuit fails, full control of aircraft is retained without any necessity for action by crew. All three circuits supply ailerons, rudder and spoilers; 'blue' circuit additionally supplies spoiler 7, spoiler/airbrake 4, airbrake 1, yaw damper and slats; 'green' circuit additionally supplies spoiler 6, flaps, Krueger flaps, slats, landing gear, wheel brakes, steering, tailplane trim, artificial feel, and roll/pitch/yaw autopilot; 'yellow' circuit additionally supplies spoiler 5, spoiler/airbrake 3, airbrake 2, flaps, wheel brakes, cargo doors, artificial feel, yaw damper, tailplane trim, and roll/pitch/yaw autopilot. Ram air turbine pump provides standby hydraulic power should both engines become inoperative.

Main electrical power supplied under normal flight conditions by two integrated drive generators, one on each engine; third (auxiliary) generator, driven by APU, can replace either of main generators, having same electromagnetic components but not constant-speed drive; each generator rated at 90 kVA, with overload ratings of 112.5 kVA for 5 minutes and 150 kVA for 5 seconds; APU generator driven at constant speed through gearbox. Three unregulated transformer-rectifier units (TRUs) supply 28 V DC power. Three 25 Ah Ni/Cd batteries used for emergency



Two-class A300-600 interior for 26 first and 240 economy class passengers

1999/004877

supply and APU starting; emergency electrical power taken from main aircraft batteries and emergency static inverter, providing single-phase 115 V 400 Hz output for flight instruments, navigation, communications and lighting when power not available from normal sources.

Hot air anti-icing of engines, engine air intakes, and outer segments of leading-edge slats; electrical heating for anti-icing flight deck front windshields, demisting flight deck side windows, and for sensors, pitot probes and static ports, and waste water drain masts.

Honeywell 331-250F APU in tailcone, exhausting upward; installation incorporates APU noise attenuation. Self-contained fire protection system, and firewall panels protect main structure from an APU fire. APU provides bleed air to pneumatic system, and drives auxiliary AC generator during ground and in-flight operation; APU drives 90 kVA oil-spray-cooled generator, and supplies bleed air for main engine start or air conditioning system. For current deliveries of A300-600, APU has improved reflight capability, and can be started throughout flight envelope.

For new A300-600s and -600Rs, two optional modifications offered for compliance with full extended-range twin-engine operations (ETOPS) requirements: hydraulically driven fourth generator and increased cargo hold fire suppression capability. ETOPS kit qualified for aircraft with CF6-80C2 and JT9D-7R series engines and, since mid-1988, for those with PW4000 series.

**AVIONICS:** Comms: Standard communications radios include two VHF, with provision for a third, two HF, two transponders, one Selcal, interphone and passenger address systems, ground crew call system and cockpit voice recorder. Provision for Mode S transponders.

**Radar:** Weather radar standard, with provision for second.

**Flight:** Radio navigation avionics include two VOR, two ILS, two DME, one ADF, two marker beacon receivers and two radio altimeters; TCAS and GPWS.

Most other avionics are to customer requirements, only those relating to the instrument landing system (Honeywell or Rockwell Collins ILS and Rockwell Collins or TRT radio altimeter) being selected and supplied by the manufacturer. Two Honeywell digital air data computers standard; basic digital AFCS has dual flight control computers (FCCs) for flight director and autopilot functions (for Cat. III automatic landings), single thrust control computer (TCC) for speed and thrust control, and two flight augmentation computers (FACs) to provide yaw damping, electric pitch trim, and flight envelope monitoring and protection. Options include second FCC (for Cat. III automatic landing); second TCC; two flight management computers (FMCs) and two control display units for full flight management system. Basic aircraft also fitted with ARINC 717 data recording system with digital flight data acquisition unit, digital flight data recorder and three-axis linear accelerometer; optional additional level of windshear protection is available. Honeywell Enhanced GPWS available from March 1997.

**Instrumentation:** Six identical and interchangeable CRT electronic displays (four electronic flight instrument system and two electronic centralised aircraft monitor), plus digitised electromechanical instruments with liquid crystal displays.

#### DIMENSIONS, EXTERNAL:

Wing span	44.84 m (147 ft 1 in)
Wing aspect ratio	7.7
Length overall	54.08 m (177 ft 5 in)
Fuselage: Length	53.30 m (174 ft 10 1/2 in)
Max diameter	5.64 m (18 ft 6 in)
Height overall	16.51 m (54 ft 2 in)
Tailplane span	16.26 m (53 ft 4 in)

Wheel track	9.60 m (31 ft 6 in)
Wheelbase (c/l of shock-absorbers)	18.62 m (61 ft 1 in)
Passenger doors (each): Height	1.93 m (6 ft 4 in)
Width	1.07 m (3 ft 6 in)
Height to sill: forward centre	4.60 m (15 ft 1 in)
rear	4.80 m (15 ft 7 in)
Emergency exits (each): Height	1.60 m (5 ft 3 in)
Width	0.61 m (2 ft 0 in)
Height to sill	4.87 m (15 ft 10 in)
Underfloor cargo door (forward): Height	1.71 m (5 ft 7 1/2 in)
Width	2.69 m (8 ft 10 in)
Height to sill	3.07 m (10 ft 1 in)
Underfloor cargo door (rear): Height	1.71 m (5 ft 7 1/2 in)
Width	1.81 m (5 ft 11 1/2 in)
Height to sill	3.41 m (11 ft 2 1/2 in)
Underfloor cargo door (extreme rear): Height (projected)	0.95 m (3 ft 1 in)
Width	0.95 m (3 ft 1 in)
Height to sill	3.56 m (11 ft 8 in)

#### DIMENSIONS, INTERNAL:

Cabin, excl flight deck: Length	40.70 m (133 ft 6 1/2 in)
Max width	5.28 m (17 ft 4 in)
Max height	2.54 m (8 ft 4 in)
Underfloor cargo hold: Length: forward	10.60 m (34 ft 9 1/2 in)
rear	7.95 m (26 ft 1 in)
extreme rear	3.40 m (11 ft 2 in)
Max height	1.76 m (5 ft 9 in)
Max width	4.20 m (13 ft 9 1/2 in)
Underfloor cargo hold volume: forward	75.1 m <sup>3</sup> (2,652 cu ft)
rear	55.0 m <sup>3</sup> (1,942 cu ft)
extreme rear	17.3 m <sup>3</sup> (611 cu ft)

#### AREAS:

Wings, gross	260.00 m <sup>2</sup> (2,798.6 sq ft)
All-speed ailerons (total)	7.06 m <sup>2</sup> (75.99 sq ft)
Trailing-edge flaps (total)	47.30 m <sup>2</sup> (509.13 sq ft)
Leading-edge slats (total)	30.30 m <sup>2</sup> (326.15 sq ft)
Krueger flaps (total)	1.15 m <sup>2</sup> (12.00 sq ft)
Spoilers (total)	5.40 m <sup>2</sup> (58.13 sq ft)
Airbrakes (total)	12.59 m <sup>2</sup> (135.52 sq ft)
Fin	45.20 m <sup>2</sup> (486.53 sq ft)
Rudder	13.57 m <sup>2</sup> (146.07 sq ft)
Tailplane	44.80 m <sup>2</sup> (482.22 sq ft)
Elevators (total)	19.20 m <sup>2</sup> (206.67 sq ft)

**WEIGHTS AND LOADINGS (A: CF6-80C2A1/A5 engines, B: PW4156/4158 engines, both in 266-seat configuration)\*:**

Manufacturer's weight empty:

A (600)	79,210 kg (174,630 lb)
A (600R)	80,070 kg (176,525 lb)
B (600)	79,151 kg (174,500 lb)
B (600R)	79,320 kg (174,870 lb)

Operating weight empty:

A (600)	90,115 kg (198,665 lb)
A (600R)	91,040 kg (200,700 lb)
B (600)	90,065 kg (198,565 lb)
B (600R)	90,965 kg (200,550 lb)
Max payload (structural): A (600)	39,885 kg (87,931 lb)
A (600R)	38,962 kg (85,896 lb)
B (600)	39,151 kg (86,169 lb)
B (600R)	39,037 kg (86,061 lb)

Max usable fuel:

600: standard	49,786 kg (109,760 lb)
600R: standard	54,721 kg (120,640 lb)
with optional cargo hold tank	58,618 kg (129,230 lb)

Max T-O weight (A and B):

600	165,000 kg (363,765 lb)
600R (standard)	170,500 kg (375,885 lb)
600R (option)	171,700 kg (378,535 lb)

Max ramp weight (A and B):

600	165,900 kg (365,745 lb)
600R (standard)	171,400 kg (377,870 lb)
600R (option)	172,600 kg (380,520 lb)

Max landing weight (A and B):

600	138,000 kg (304,240 lb)
600R (standard)	140,000 kg (308,645 lb)

Max zero-fuel weight (A and B):

600, 600R (standard)	130,000 kg (286,600 lb)
Max wing loading: 600	634.6 kg/m <sup>2</sup> (129.98 lb/sq ft)
600R (standard)	655.8 kg/m <sup>2</sup> (134.32 lb/sq ft)

\*Production aircraft from late 1996 onward. See 1989-90 and previous editions for original versions; 1996-97 and six previous editions for intermediate versions

**PERFORMANCE (A and B as for Weights and Loadings):**

Max operating speed (V<sub>MO</sub>) from S/L to 8,140 m (26,700 ft) 335 kt (621 km/h; 386 mph) CAS



Airbus A300-600 twin-turboprop airliner in the insignia of Lufthansa (Paul Jackson/June's)

2001/0103584

Max operating Mach No. (Mmo) above 8,140 m (26,700 ft)	0.82
Max cruising speed at 7,620 m (25,000 ft)	480 kt (890 km/h; 553 mph)
Max cruising speed at 9,140 m (30,000 ft)	M0.82 (484 kt; 897 km/h; 557 mph)
Typical long-range cruising speed at 9,440 m (31,000 ft)	M0.80 (472 kt; 875 km/h; 543 mph)
Approach speed: 600	135 kt (249 km/h; 155 mph)
600R	136 kt (251 km/h; 156 mph)
Max operating altitude	12,200 m (40,000 ft)
Runway ACN for flexible runway, category B:	
standard bogie and tyres: 600	56
600R	59
600R (option)	60
optional bogie and tyres: 600	52
600R	55
600R (option)	56
T-O field length at S/L, ISA + 15°C:	
600: A	2,378 m (7,800 ft)
B	2,270 m (7,450 ft)
600R: A (C2A5 engines)	2,408 m (7,900 ft)
B (PW4158 engines)	2,362 m (7,750 ft)
Landing field length: 600	1,536 m (5,040 ft)
600R	1,555 m (5,100 ft)
Range (1996 and subsequent deliveries) at typical altitude	
OWE with 266 passengers and baggage, reserves for 200 n miles (370 km; 230 miles):	
600, GE/PW engines	3,700 n miles (6,852 km; 4,257 miles)
600R, GE/PW engines, standard fuel	4,050 n miles (7,500 km; 4,660 miles)
600R, GE/PW engines, optional fuel	4,150 n miles (7,685 km; 4,775 miles)
OPERATIONAL NOISE LEVELS (A300-600R, ICAO Annex 16, Chapter 3):	
T-O: A	91.1 EPNdB (96.3 limit)
B	92.2 EPNdB (96.3 limit)
Sideline: A	98.6 EPNdB (99.9 limit)
B	97.7 EPNdB (99.9 limit)
Approach: A	99.8 EPNdB (103.3 limit)
B	101.7 EPNdB (103.3 limit)

## AIRBUS A300-600 CONVERTIBLE and A300-600 FREIGHTER

TYPE: Twin-jet freighter.

PROGRAMME: Specialised versions of A300-600. First flight of A300-600F 2 December 1993; certified April 1994 and entered service with Federal Express in same month; A300-600F powered by GE CF6-80C2A5 with FADEC was first A300-600 version to operate with 180-minute ETOPS in May 1994.

CURRENT VERSIONS: **Convertible:** For all-passenger or all-cargo configuration. Typical options include accommodation (in mainly eight-abreast seating) for maximum 375 passengers (subject to certification) on the main deck; or up to twenty 2.24 x 3.17 m (88 x 125 in) pallets; or five 88 x 125 in plus nine 96 x 125 in pallets.

**Freighter:** For freight only; no passenger systems provided; various systems options give airlines ability to adapt basic aircraft to specific freight requirements; Airbus offers conversion with port-side forward freight door. Freighter conversions, offered by British Aerospace and EFW, are detailed in *Jane's Aircraft Upgrades*.

CUSTOMERS: Federal Express became A300-600 Freighter launch customer July 1991 with order for 25 and commitments for 50 more, of which 11 confirmed as orders in September 1996; 30 delivered by 31 December 1998. UPS placed order on 9 September 1998 for 30 PW4158 powered A300F4-600R Freighters plus options on a further 45 (later confirmed and a further 15 firm orders, to total 90, with 50 more on option). Deliveries began mid-2000; UPS has an option to convert some of the order to A380s if it wishes. First (of two) for CityBird of Belgium delivered 23 July 1999; production set to continue to at least 2009.

STRUCTURE: Generally similar to A300-600. Main differences are large port-side main deck cargo door, reinforced cabin floor, smoke detection system in main cabin; main deck cargo door is on opposite side to door of forward underfloor hold, allowing simultaneous loading or unloading at all positions.

POWER PLANT: Options as for A300-600R; first example was first Airbus aircraft powered by GE CF6-80C2A5 with FADEC.

DIMENSIONS, EXTERNAL: As A300-600R, plus:

Main deck cargo door (fwd, port):	
Height (projected)	2.57 m (8 ft 5 1/2 in)
Width	3.58 m (11 ft 9 in)
Height to sill	4.91 m (16 ft 1 in)

DIMENSIONS, INTERNAL:

Cabin main deck usable for cargo:	
Length	33.45 m (109 ft 9 in)
Min height	2.01 m (6 ft 7 in)
Max height:	
ceiling trim panels in place	2.22 m (7 ft 3 1/2 in)
without ceiling trim panels	2.44 m (8 ft 0 in)
Volume	192.0-203.0 m <sup>3</sup> (6,780-7,169 cu ft)

WEIGHTS AND LOADINGS (basic Convertible, A: with CF6-80C2A5 engines, B: with PW4158 engines):

Manufacturer's weight empty:	
A, passenger mode	82,555 kg (182,000 lb)
B, passenger mode	82,470 kg (181,815 lb)
A, freight mode	80,345 kg (177,130 lb)
B, freight mode	80,260 kg (176,945 lb)

Operating weight empty:	
A, passenger mode	93,550 kg (206,240 lb)
B, passenger mode	93,475 kg (206,075 lb)
A, freight mode	81,600 kg (179,895 lb)
B, freight mode	81,525 kg (179,730 lb)

Max payload (structural):	
A, passenger mode	36,448 kg (80,354 lb)
B, passenger mode	36,523 kg (80,519 lb)
A, freight mode	48,400 kg (106,705 lb)
B, freight mode	48,475 kg (106,870 lb)

Max T-O weight: A, B	170,500 kg (375,900 lb)
Max landing weight: A, B	140,000 kg (308,650 lb)
Max zero-fuel weight: A, B	130,000 kg (286,600 lb)

WEIGHTS AND LOADINGS (basic Freighter variant of -600R):

Manufacturer's weight empty:	
A	78,335 kg (172,700 lb)
B	78,250 kg (172,510 lb)
Operating weight empty: A	79,050 kg (174,275 lb)
B	78,980 kg (174,120 lb)

Max payload (structural):	
A, range mode	50,950 kg (112,325 lb)
B, range mode	51,020 kg (112,480 lb)
A, payload mode	54,750 kg (120,705 lb)
B, payload mode	54,820 kg (120,855 lb)

Max T-O weight: A, B:	
range mode	170,500 kg (375,900 lb)
payload mode	165,100 kg (363,980 lb)
Max landing weight: A, B:	
range mode	140,000 kg (308,650 lb)
payload mode	140,600 kg (309,970 lb)

Max zero-fuel weight: A, B:	
range mode	130,000 kg (286,600 lb)
payload mode	133,800 kg (294,980 lb)

PERFORMANCE:

Range with max (structural) payload, allowances for 30 min hold at 460 m (1,500 ft) and 200 n mile (370 km; 230 mile) diversion: A, B, range mode	2,650 n miles (4,908 km; 3,050 miles)
A, B, payload mode	1,900 n miles (3,519 km; 2,186 miles)

UPDATED

## AIRBUS A310

Canadian Forces designation: CC-150 Polarix

TYPE: Wide-bodied airliner.

PROGRAMME: Launched July 1978; first flight (F-WZLH) 3 April 1982; initial French/German certification 11 March 1983; first deliveries (Lufthansa and Swissair) 29 March 1983, entering service 12 and 21 April respectively; JAA Cat. IIIa certification (France/Germany) September 1983; UK certification January 1984; JAA Cat. IIIb November 1984; FAA type approval early 1985. First flight of extended-range A310-300 8 July 1985 (certified with JT9D-7R4E engines 5 December 1985, delivered to launch customer Swissair 17 December); wingtip fences introduced as standard on A310-200 from early 1986 (first delivery: Thai Airways, 7 May); certification/delivery of A310-300 with CF6-80C2 engines April 1986, with PW4152s June 1987. Russian State Aviation Register certification October 1991 (first Western-built aircraft to achieve this status). A310s powered by PW4000 series and CF6-80C2 approved for 180-minute ETOPS. Enhanced GPWS installed March 1997, following certification.

CURRENT VERSIONS: A310-200: Basic passenger version.

Detailed description mainly applies to A310-200.

A310-200C: Convertible version of A310-200; first delivery (Martinair) 29 November 1984.

A310-200F: Conversion of A310 marketed by Elbe Flugzeugwerke GmbH; max payload 40,600 kg (89,508 lb) and max T-O weight 142,000 kg (313,056 lb). Main cargo deck accommodates sixteen 2.24 x 3.17 m (88 x 125 in) pallets plus further three pallets of this size in underfloor hold, in addition to six LD3s; alternatively 14

LD3s can be carried in underfloor hold. See *Jane's Aircraft Upgrades* for further details.

A310-300: Extended-range passenger version, launched March 1983; second member of Airbus family to introduce delta-shaped wingtip fences as standard. Extra range provided by increased basic maximum T-O weight (150,000 kg; 330,695 lb) and greater fuel capacity (higher maximum T-O weights optional); standard extra fuel capacity is in tailplane, allowing in-flight CG control for improved fuel efficiency. For extra long range, one or two ACTs (additional centre tanks) can be installed in part of cargo hold; modification certified November 1987 (first customer Wardair of Canada).

Belgian Air Force obtained two second-hand A310-200s in 1997; Canadian Forces operate six A310-300s, German Luftwaffe seven and French Air Force two; last-named have ETOPS for 180 minutes; Spanish intention to buy two for VVIP use, following modification by EADS CASA, announced December 2000. Details of projected military versions appear under Airbus Military Company at the end of this entry.

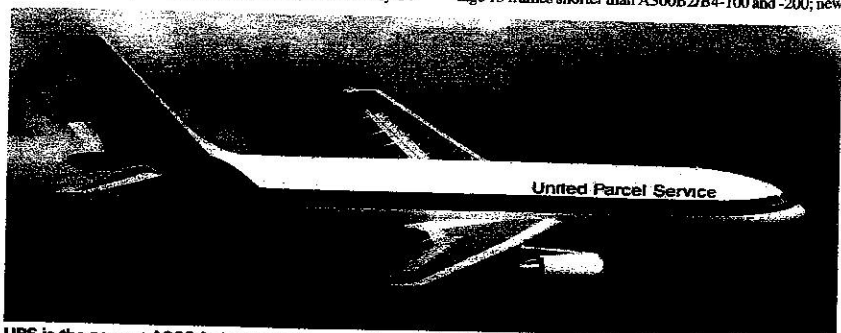
CUSTOMERS: Total of 260 sold, and 255 delivered by 1 December 2000.

## AIRBUS A310 ORDERS (at 1 March 2001)

Customer	Qty
Aeroflot	5
Air Afrique	4
Air Algerie	2
Air France	11
Air India	8
Air Niugini	2
Austrian	4
Balair	4
Biman Bangladesh	2
British Caledonian Airways	2
China Eastern Airlines	5
Condor Flugdienst	5
Cyprus Airways	4
Czech Airlines	2
Delta	9
Ecuadoriana	2
Emirates	8
Hapag Lloyd Flug	7
Interflug	3
ILFC	7
Iraqi Airways	5 (not delivered)
Kenya Airways	2
KLM	10
Kuwait Airways	11
Lufthansa	20
Martinair	2
Nigeria Airways	4
Oasis Group	2
Pakistan International Airlines	6
Pan Am	18
Royal Jordanian	6
Royal Thai Air Force	1
Sabena	3
Singapore Airlines	23
Somali Airlines	1
Swissair	9
TAP-Air Portugal	5
Tarom	2
Thai Airways	2
THY	14
Trans European Airways	1
Uzbekistan Airways	1
Wardair	12
Yemenia	2
Undisclosed	2

Total 260

DESIGN FEATURES: Retains same fuselage cross-section as A300, but with cabin 11 frames shorter and overall fuselage 13 frames shorter than A300B2/B4-100 and -200; new



UPS is the newest A300 freighter customer with order for 30 placed in 1999; artist's impression shows aircraft in house colours

1999/0044859

Airbus

1 by 1



2007/0103585

A310 two-class seating for 20 first and 200 economy passengers

1999/0044876

Airbus A310 medium/extended-range airliner (Dennis Punnett/Jane's)





Airbus A310-300 of Emirates landing at Dubai (Paul Jackson/Jane's)

2001/0103586

generator failure; each has overload rating of 135 kVA for 5 minutes and 180 kVA for 5 seconds; third (identical) AC generator, directly driven at constant speed by APU, can be used during ground operations, and also in flight to compensate for loss of one or both engine-driven generators; current production A310s have APU with improved relight capability, which can be started and operated throughout the flight envelope. Any one generator can provide sufficient power to operate all equipment and systems necessary for indefinite period of safe flight; DC power is generated via three 150 A transformer-rectifiers; three Ni/Cd batteries.

Flight crew oxygen system fed from rechargeable pressure bottle of 2,166 litres (76.5 cu ft) capacity; standard options are second 76.5 cu ft bottle, a 3,256 litre (115 cu ft) bottle, and an external filling connection; emergency oxygen sets for passengers and cabin attendants. Anti-icing of outer wing leading-edge slats and engine air intakes by hot air bled from engines; and of pitot probes, static ports and plates, and sensors, by electric heating.

For current production A310s, an ETOPS modification kit, as for the A300-600, is available.

AVIONICS: As described for A300-600. A310 was first airliner to introduce CRTs with its ECAM system.

#### DIMENSIONS, EXTERNAL:

Wing span	43.90 m (144 ft 0 in)
Wing chord: at root	8.38 m (27 ft 6 in)
at tip	2.18 m (7 ft 1 1/4 in)
Wing aspect ratio	8.8
Length overall	46.66 m (153 ft 1 in)
Fuselage: Length	45.13 m (148 ft 0 1/4 in)
Max diameter	5.64 m (18 ft 6 in)
Height overall	15.80 m (51 ft 10 in)
Tailplane span	16.26 m (53 ft 4 1/4 in)
Wheel track	9.60 m (31 ft 6 in)
Wheelbase (c/l of shock-absorbers)	15.21 m (49 ft 10 1/4 in)

Passenger door (forward, port): Height	1.93 m (6 ft 4 in)
Width	1.07 m (3 ft 6 in)
Height to sill at OWE	4.54 m (14 ft 10 1/4 in)
Passenger door (rear, port): Height	1.93 m (6 ft 4 in)
Width	1.07 m (3 ft 6 in)
Height to sill at OWE	4.85 m (15 ft 11 in)
Servicing doors (forward and rear, subd)	as corresponding passenger doors

Upper deck cargo door (A310C/F)	as A300-600F
Emergency exits (overwing, port and subd, each): Height	1.39 m (4 ft 6 1/4 in)
Width	0.67 m (2 ft 2 1/2 in)

Underfloor cargo door (forward): Height	1.71 m (5 ft 7 1/4 in)
Width	2.69 m (8 ft 10 in)
Height to sill at OWE	2.61 m (8 ft 6 1/4 in)

Underfloor cargo door (rear): Height	1.71 m (5 ft 7 1/4 in)
Width	1.81 m (5 ft 11 1/4 in)
Height to sill at OWE	2.72 m (8 ft 11 in)

Underfloor cargo door (aft bulk hold): Height	0.95 m (3 ft 1 1/2 in)
Width	0.95 m (3 ft 1 1/2 in)
Height to sill at OWE	2.75 m (9 ft 0 1/4 in)

#### DIMENSIONS, INTERNAL:

Cabin, excl flight deck: Length	33.25 m (109 ft 1 in)
Max width	5.28 m (17 ft 4 in)
Max height	2.33 m (7 ft 7 1/4 in)
Volume	210.0 m³ (7,416 cu ft)
Forward cargo hold: Length	7.63 m (25 ft 0 1/2 in)
Max width	4.18 m (13 ft 8 1/4 in)
Height	1.71 m (5 ft 7 1/4 in)
Volume	50.3 m³ (1,776 cu ft)
Rear cargo hold: Length	5.03 m (16 ft 6 1/4 in)
Max width	4.17 m (13 ft 8 1/4 in)
Height	1.67 m (5 ft 5 1/4 in)
Volume	34.5 m³ (1,218 cu ft)
Aft bulk hold: Volume	17.3 m³ (611 cu ft)
Total overall cargo volume	102.1 m³ (3,605 cu ft)

#### AREAS:

Wings, gross	219.00 m² (2,357.3 sq ft)
Alarons (total)	6.86 m² (73.84 sq ft)
Trailing-edge flaps (total)	36.68 m² (394.82 sq ft)

Leading-edge slats (total)	28.54 m² (307.20 sq ft)
Spoilers (total)	7.36 m² (79.22 sq ft)
Airbrakes (total)	6.16 m² (66.31 sq ft)
Vertical and horizontal tail surfaces	as A300-600
WEIGHTS AND LOADINGS (220-seat configuration. C2: CF6-80C2A2 engines, P2: PW4152s, C8: CF6-80C2A8s, P6: PW4156As):	
Manufacturer's weight empty:	
200: C2	71,660 kg (157,975 lb)
P2	71,600 kg (157,850 lb)
300: C2	72,140 kg (159,040 lb)
P2	72,080 kg (158,910 lb)
C8	72,525 kg (159,890 lb)
P6	72,455 kg (159,735 lb)
Operating weight empty:	
200: C2	80,140 kg (176,685 lb)
P2	80,125 kg (176,645 lb)
300: C2	81,205 kg (179,025 lb)
P2	81,165 kg (178,940 lb)
C8	81,610 kg (179,920 lb)
P6	81,545 kg (179,775 lb)
Max payload: 200: C2	32,858 kg (72,439 lb)
P2	32,875 kg (72,476 lb)
300: C8	32,388 kg (71,403 lb)
P6	32,456 kg (71,553 lb)
Max usable fuel: 200*	44,100 kg (97,224 lb)
300	49,039 kg (108,110 lb)
Max T-O weight: 200	142,000 kg (313,050 lb)
300	150,000 kg (330,675 lb)
options (300)	153,000 kg (337,300 lb)
	or 157,000 kg (346,125 lb)
	or 164,000 kg (361,550 lb)
Max landing weight: 200, 300	123,000 kg (271,150 lb)
options (200 and 300)	124,000 kg (273,375 lb)
Max zero-fuel weight: 200, 300	113,000 kg (249,120 lb)
options (200 and 300)	114,000 kg (251,325 lb)

\*optional additional tank in aft cargo hold adds 5,779 kg (12,740 lb) of fuel and increases OWE/reduces max payload by 726 kg (1,600 lb). Two additional tanks add 11,560 kg (25,485 lb) of fuel and increase OWE/reduce max payload by 1,536 kg (3,386 lb)

PERFORMANCE (at basic max T-O weight except where indicated; engines as under Weights and Loadings): Typical long-range cruising speed at 9,450-12,500 m (31,000-41,000 ft): C2, P2, C8, P6

Max operating Mach No. (MMo) M0.80

Approach speed at max landing weight: 135 kt (250 km/h; 155 mph)

T-O field length at S/L, ISA + 15°C:

200: C2 1,960 m (6,430 ft)

P2 1,890 m (6,200 ft)

300: C2 (at 150 tonne MTOW) 2,410 m (7,910 ft)

P2 (at 150 tonne MTOW) 2,180 m (7,155 ft)

C8 (at 164 tonne MTOW) 2,485 m (8,155 ft)

P6 (at 164 tonne MTOW) 2,360 m (7,745 ft)

Landing field length at S/L, at max landing weight (200

and 300): C2 1,479 m (4,850 ft)

P2 1,555 m (5,100 ft)

Runway ACN for flexible runway, category B:

standard tyres: 200 43

300 49

optional tyres: 200

300

41

47

Range (1991 and subsequent deliveries) at typical airline OWE with 220 passengers and baggage, international reserves for 200 n mile (370 km; 230 mile) diversion: 200, GE engines 3,600 n miles (6,667 km; 4,142 miles) 200, PW engines

3,650 n miles (6,759 km; 4,200 miles)

300, GE engines 4,300 n miles (7,963 km; 4,948 miles)

300, PW engines 4,350 n miles (8,056 km; 5,005 miles)

300, option, at T-O weight 157,000 kg (346,125 lb):

GE engines 4,750 n miles (8,797 km; 5,466 miles)

PW engines 4,800 n miles (8,889 km; 5,523 miles)

300, option, at T-O weight 164,000 kg (361,560 lb):

GE engines 5,150 n miles (9,537 km; 5,926 miles)

PW engines 5,200 n miles (9,630 km; 5,984 miles)

OPERATIONAL NOISE LEVELS (ICAO Annex 16, Chapter 3):

T-O: 200: C2 89.6 EPNdB (95.3 limit)

300: C2 91.2 EPNdB (95.6 limit)

Sideline: 200: C2 96.4 EPNdB (99.2 limit)

300: C2 96.3 EPNdB (99.4 limit)

Approach: 200, 300: C2 98.6 EPNdB (102.9 limit)

UPDATED

### AIRBUS A318

Follows entry for the A320, of which it is a derivative.

### AIRBUS A319

Follows entry for the A320, of which it is a derivative.

### AIRBUS A320

TYPE: Twin-jet airliner.

PROGRAMME: Launched 23 March 1984; four-aircraft development programme (first flight 22 February 1987 by F-WWAL); JAA (UK/French/German/Dutch) certification of A320-100 with CFM56-5 engines, for two-crew operation, awarded 26 February 1988; first deliveries (Air France and British Airways) 28 and 31 March 1988 respectively; JAA certification of A320-200 with CFM56-5s received 8 November 1988, followed by FAA type approval for both models 15 December 1988; certification with V2500 engines (first flown 28 July 1988) received 20 April (JAA) and 6 July 1989 (FAA), deliveries with this power plant (to Adria Airways) beginning 18 May 1989; FAA approved common type rating on A320 and A321 without further training in early 1994; 500th A320 delivered, 20 January 1995, to United Airlines; 1000th member of family (an A319) and 1,001st (A320 for United Airlines) were delivered 15 April 1999.

CURRENT VERSIONS: A320-100: Initial version (21 ordered); details in 1987-88 Jane's. Superseded by A320-200.

A320-200: Now called simply A320. Standard version from third quarter 1988; differs from initial A320 in having wingtip fences, wing centre-section fuel tank and higher maximum T-O weights.

Detailed description applies to A320-200

A320 research: An A320 was used for riblet research 1989-91. In mid-1998 Airbus Industrie began testing an experimental laminar-flow fin on an A320; air is sucked through small holes in the leading-edge to reduce drag and save fuel.

A320 Freighter, Convertible and Quick-Convertible: Freight variants under consideration by Airbus and Hindustan Aeronautics; cargo capacities would be 20,000 kg (44,090 lb), 22,000 kg (48,500 lb) and 30,000 kg (66,140 lb), respectively.

A318: Shortened version of A320; described separately.

A319: Shortened version of A320; described separately.

A321-100 and -200: Stretched versions of A320; described separately.

CUSTOMERS: Total 1,452 sold by 1 March 2001, of which 911 then delivered. Airbus announced in June 2000 that production of single-aisle aircraft would increase to 30 per month by 2002.

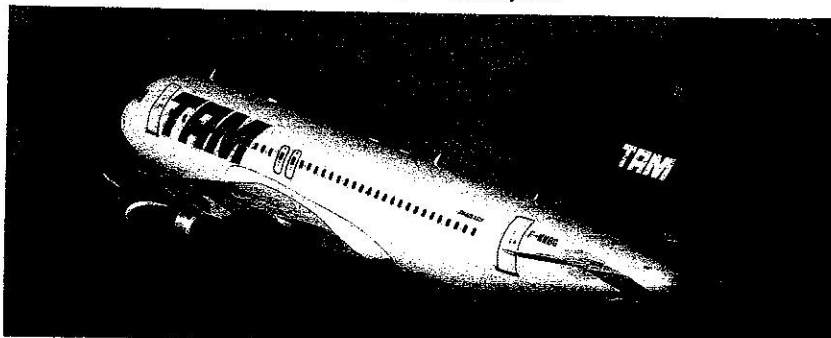
#### CUSTOMERS

ACES
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OREX C
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Qatar A
Royal J
SALE
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Sichuan
Silkair
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Spanair
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Brazil's TAM began receiving Airbus A320s in 2000

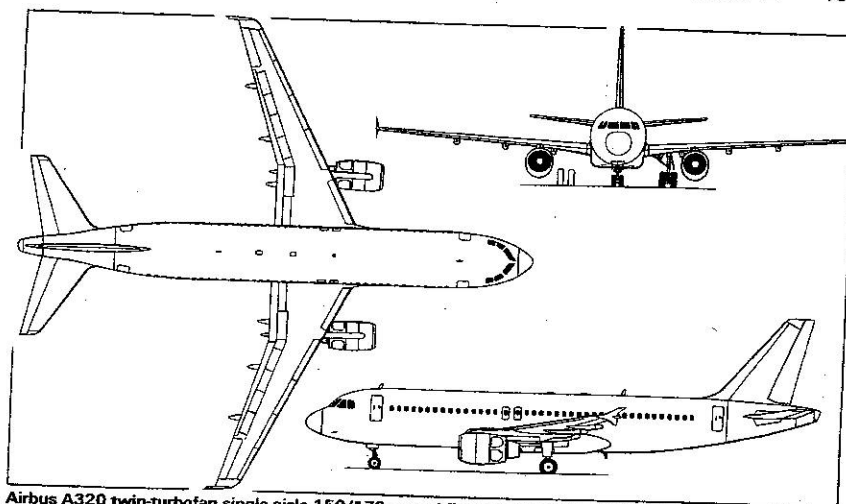
2001/0103540

# AIRBUS A320 ORDERS (at 1 March 2001)

Customer	Qty
ACES	8
Adria Airways	5
Aer Lingus	6
Aero Lloyd	4
Aerostar	12
Air 2000	4
Air Canada	28
Air France	27
Air Inter Europe	22
Air Jamaica	4
Air Malta	2
Alitalia	11
All Nippon Airways	25
America West Airlines	21
Ansett Australia	19
Austrian Airlines	13
Bouillou Aviation Services	13
British Airways	31
British Midland Airways	6
Canadian Airlines International	2
Carlisle Aircraft Ltd	3
China Eastern Airlines	10
China Northwest Airlines	13
China Southern Airlines	20
CIT Group	32
Condor Flugdienst	12
Croatia Airlines	2
Cyprus Airways	8
Debis AirFinance	15
Dragonair	7
Edelweiss Air AG	3
Egyptair	7
Finnair	9
Flightlease	9
GATX/CL AIR	18
GATX/Flightlease	12
GB Airways	12
GECAS	3
GPA	76
Gulf Air	51
Iberia	14
Iberworld	58
Indian Airlines	2
Intl Lease Finance Corp	31
jetBlue Airways	160
Kawasaki Leasing Intl	33
Kuwait Airways	8
Kuwait Finance House	3
LAN Chile	4
Lotus Airline	25
LTU	1
Lufthansa	6
Mexicana	37
Midway Airlines	20
Midwest Airlines	4
Monarch Airlines	2
Northwest Airlines	2
Nouvelair	82
ORIX Corporation	2
Philippine Airlines	24
Premiair	4
Qatar Airways (incl Amiri Flight)	6
Royal Jordanian	7
SALE	3
Sabena	41
Shorouk Air	3
Sichuan Airlines	2
Silkair	2
South African Airways	5
Spanair	7
Sri Lankan Airlines	10
Sudan Airways	2
Swissair	1
Syrian Arab Airlines	17
TACA	6
TAM	32
TAP-Air Portugal	21
TransAsia Airways	6
Tunis Air	5
United Airlines	12
US Airways	116
Zhejiang Airlines	50
	3
<b>Total</b>	<b>1,452</b>

DESIGN FEATURES: First subsonic commercial aircraft to have composites for major primary structures, and centralised maintenance system; advanced-technology wings have 25° sweepback at quarter-chord, 5° 6' 36" dihedral plus experience from A310 and significant commonality with other Airbus Industrie aircraft where cost-effective; 6° tailplane dihedral.

FLYING CONTROLS: A320 is first subsonic commercial aircraft equipped for fly-by-wire (FBW) control throughout entire normal flight regime, and first to have sidestick controller



Airbus A320 twin-turboprop single-aisle 150/179-seat airliner (Dennis Punnett/Jane's)

(one for each pilot) instead of control column and aileron wheel. Thomson-CSF/SFENA digital FBW system features five main computers and operates, via electrical signalling and hydraulic jacks, all primary and secondary flight controls; pilot's pitch and roll commands are applied through sidestick controller via two different types of computer; these have redundant architecture to provide safety levels at least as high as those of mechanical systems they replace; system incorporates flight envelope protection features to a degree that cannot be achieved with conventional mechanical control systems and its computers will not allow aircraft's structural and aerodynamic limitations to be exceeded; even if pilot holds sidestick fully forward, it is impossible to go beyond aircraft's maximum operating speed (VMO) for more than a few seconds; if pilot holds sidestick fully back, aircraft is controlled to an 'alpha floor' angle of attack, a safe airspeed above stall and throttles opened automatically to ensure positive climb. Nor is it possible to exceed g limits while manoeuvring. If a bank angle of more than 30° is commanded with the sidestick, the bank angle is automatically returned to 30° when pressure is released.

Fly-by-wire system controls ailerons, elevators, spoilers, flaps and leading-edge slats; rudder movement and tailplane trim connected to FBW system, but also signalled mechanically when used to provide final back-up pitch and yaw control, which suffices for basic instrument flying. Each wing has five-segment leading-edge slats (one inboard, four outboard of engine pylon), two-segment Fowler trailing-edge flaps, and five-segment spoilers forward of flaps; all 10 spoilers used as lift dumpers, inner six as airbrakes, outer eight and ailerons for roll control and outer four and ailerons for gust alleviation; slat and flap controls by Liebherr and Lucas.

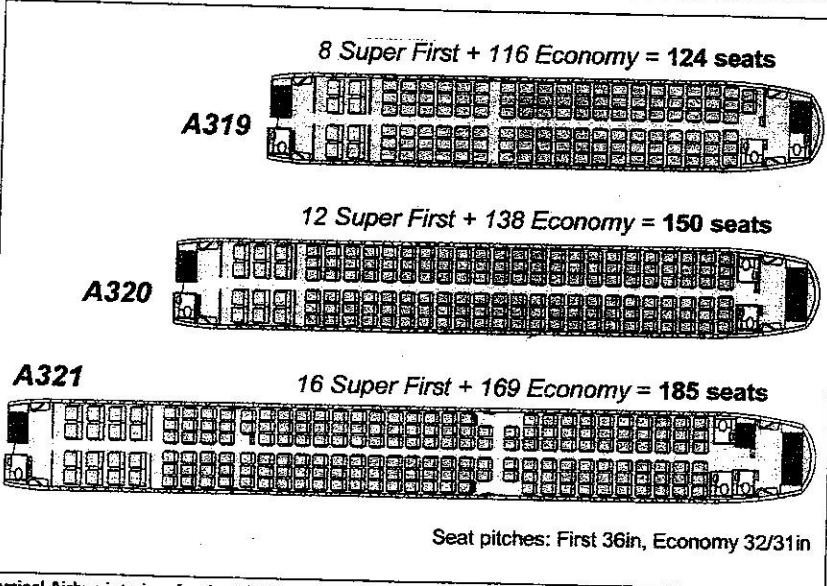
STRUCTURE: Generally similar to A310, but with AFRP for fuselage belly fairing skins; GFRP for fin leading-edge and fin/fuselage fairing; CFRP for wing fixed leading/trailing-edge bottom access panels and deflectors, trailing-edge flaps and flap track fairings, spoilers, ailerons, fin (except leading-edge), rudder, tailplane, elevators, nosewheel/

mainwheel doors, and main gear leg fairing doors. A320 was first airliner to go into production with CFRP tailplane.

Aerospatiale Matra builds entire front fuselage (forward of wing leading-edge), cabin rear doors, nosewheel doors, centre wing box and engine pylons, and is responsible for final assembly; centre and rear fuselage, tailcone, wing flaps, fin, rudder and commercial furnishing undertaken by DaimlerChrysler Aerospace Airbus; BAE Systems builds main wings, including ailerons, spoilers and wingtips, and main landing gear leg fairings; Belgian consortium Belairbus produces leading-edge slats; CASA responsible for tailplane, elevators, mainwheel doors, and sheet metal work for parts of rear fuselage; Mitsubishi builds wing root shroud box under BAE Systems subcontract; AVIC 1 of China provides wing components and signed an MoU in November 2000 to increase its participation, possibly leading to complete wing production by 2007; GKN Aerospace providing cargo door actuators from January 2002. Final assembly undertaken at Toulouse.

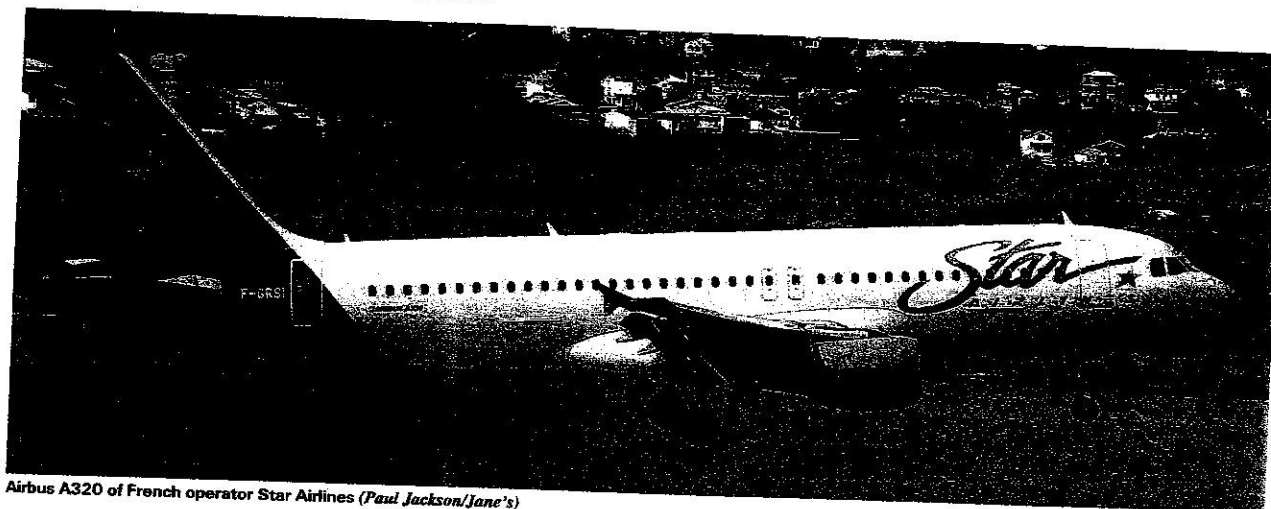
LANDING GEAR: Hydraulically retractable tricycle type, with twin wheels and oleo-pneumatic shock-absorber on each unit (four-wheel main-gear bogies, for low-strength runways, optional); Dowty main units retract inward into wing/body fairing; steerable Messier-Bugatti nose unit retracts forward; nosewheel steering angle ±75° (effective turning angle ±70°). Tyre size 46x16 or 46x17.0R20 (30 ply) on main gear and 30x8.8 or 30x8.8-R15 (16 ply) on nose gear; optional tyres for main gear are 49x17 or 49x17R20 or 49x19R20 or 46x16-20 or 49x19-20. Tyres for main-gear bogie option are 915x300R16 or 36x11 or 46x17.0R20. Carbon brakes standard. Minimum width of pavement for 180° turn 23.1 m (75 ft 9 3/4 in).

POWER PLANT: Two 111.2 to 120.1 kN (25,000 to 27,000 lb st) class CFM International CFM56-5A1 turbofans for first aircraft delivery in 1988, with 113.4 kN (25,500 lb st) IAE V2500-A1 engines available for aircraft delivered from May 1989 and 117.9 kN (26,500 lb st) CFM56-5A3 from November 1990; 120.1 kN (27,000 lb st) CFM56-5B4 and 117.9 kN (26,500 lb st) IAE V2527-A5 available from 1994. New aircraft now (1998 onwards) delivered with



Typical Airbus interiors for the A320 family

1998/0044884



Airbus A320 of French operator Star Airlines (Paul Jackson/Jane's)

2001/0103587

either 120.1 kN (27,000 lb st) CFM56-5B4/P or 117.9 kN (26,500 lb st) IAE V2527E-A5. Nacelles by Rohr Industries; thrust reversers by Hispano-Suiza for CFM56 engines, by IAE for V2500s. Dual-channel FADEC system standard on each engine.

For A320-200, standard fuel capacity in wing and wing centre-section tanks is 23,859 litres (6,303 US gallons; 5,248 Imp gallons); optional additional centreline tank holds 2,900 litres (766 US gallons; 638 Imp gallons); for A320-100, standard fuel capacity without centre-section tank is 15,843 litres (4,185 US gallons; 3,485 Imp gallons). ACCOMMODATION: Standard crew of two on flight deck, with one (optionally two) forward-facing folding seats for additional crew members; seats for four cabin attendants. Single-aisle main cabin has seating for up to 179 (FAR) or 180 (JAR) passengers, depending upon layout, with locations at front and rear of cabin for galley(s) and lavatory(ies); typical two-class layout has 12 seats four-abreast at 91.5 cm (36 in) pitch in 'super first' and 138 six-abreast at 81 cm (32 in) pitch economy class; alternative 152 six-abreast seats (84 business + 68 economy) at 86 and 78 cm (34 and 31 in) pitch respectively; single-class economy layout could offer 164 seats at 81 cm (32 in) pitch, or up to 179 in high-density configuration. Compared with existing single-aisle aircraft, fuselage cross-section is significantly increased, permitting use of wider triple seats to provide higher standards of passenger comfort; five-abreast business class seating provides standard equal to that offered as first class on major competitive aircraft. In addition, wider aisle permits quicker turnarounds. Overhead stowage space superior to that available on existing aircraft of similar capacity, and provides ample carry-on baggage space; best use of underscat space for baggage is provided by improved seat design and optimised positioning of seat rails.

Passenger doors at front and rear of cabin on port side, forward one having optional integral airstairs; service door opposite each of these on starboard side. Two overwing emergency exits each side. Fuselage double-bubble cross-

section provides increased baggage/cargo hold volume and working height, and ability to carry containers derived from standard interline LD3 type. As base is same as that of LD3, all existing wide-body aircraft and ground handling equipment can accept these containers without modification. Forward and rear underfloor baggage/cargo holds, plus overhead lockers; with 164 seats, overhead stowage space per seat is 0.06 m<sup>3</sup> (2.0 cu ft). Mechanised cargo loading system will allow up to seven LD3-based containers to be carried in freight holds (three forward and four aft).

SYSTEMS: Liebherr/ABG-Semra air conditioning, Hamilton Sundstrand/Nord-Micro pressurisation, Hamilton Sundstrand electrical system, and Honeywell 36-300 APU, the last named replaced by Honeywell 131-9(A) from September 1998. Sundstrand APS3200 introduced at same time as alternative APU. Primary electrical system powered by two Sundstrand 90 kVA constant frequency generators, providing 115/200 V three-phase AC at 400 Hz; third generator of same type, directly driven at constant speed by APU, can be used during ground operations and, if required, during flight.

AVIONICS: Flight: Fully equipped ARINC 700 digital avionics including advanced digital automatic flight control and flight management systems; AFCS integrates functions of SFENA autopilot and Honeywell FMS; Honeywell air data and inertial reference system.

Instrumentation: Each pilot has two Thomson-CSF/VDO electronic flight instrumentation system (EFIS) displays (primary flight display and navigation display); PFD was first on an airliner to incorporate speed, altitude and heading. Between these two pairs of displays are two Thomson-CSF/VDO electronic centralised aircraft monitor (ECAM) displays developed from the ECAM systems on A310 and A300-600; upper display incorporates engine performance and warning, lower display carries warning and system synoptic diagrams.

#### DIMENSIONS, EXTERNAL:

Wing span 34.09 m (111 ft 10 1/4 in)

Wing aspect ratio	9.5
Length overall	37.57 m (123 ft 3 in)
Fuselage: Max width	3.96 m (13 ft 0 in)
Max depth	4.14 m (13 ft 7 in)
Height overall	11.76 m (38 ft 7 in)
Tailplane span	12.45 m (40 ft 10 in)
Wheel track (c/l of shock-struts)	7.59 m (24 ft 11 in)
Wheelbase	12.65 m (41 ft 6 in)
Passenger doors (port, forward and rear), each:	
Height	1.85 m (6 ft 1 in)
Width	0.81 m (2 ft 8 in)
Height to sill	3.415 m (11 ft 2 1/2 in)
Service doors (stbd, forward and rear), each	
as corresponding passenger doors	
Overwing emergency exits (two port and two stbd), each:	
Height	1.02 m (3 ft 4 1/4 in)
Width	0.51 m (1 ft 8 in)
Underfloor baggage/cargo hold doors (stbd, forward and rear), each: Height	1.25 m (4 ft 1 1/4 in)
Width	1.82 m (5 ft 11 1/2 in)

#### DIMENSIONS, INTERNAL:

Cabin, excl flight deck: Length	27.50 m (90 ft 2 3/4 in)
Max width	3.70 m (12 ft 1 3/4 in)
Max height	2.22 m (7 ft 4 in)
Baggage/cargo hold volume: front	13.3 m <sup>3</sup> (469 cu ft)
rear	24.15 m <sup>3</sup> (853 cu ft)

#### AREAS:

Wings, gross	122.60 m <sup>2</sup> (1,319.7 sq ft)
Ailerons (total)	2.74 m <sup>2</sup> (29.49 sq ft)
Trailing-edge flaps (total)	21.10 m <sup>2</sup> (227.12 sq ft)
Leading-edge slats (total)	12.64 m <sup>2</sup> (136.06 sq ft)
Spoilers (total)	8.64 m <sup>2</sup> (93.00 sq ft)
Airbrakes (total)	2.35 m <sup>2</sup> (25.30 sq ft)
Vertical tail surfaces (total)	21.50 m <sup>2</sup> (231.4 sq ft)
Horizontal tail surfaces (total)	31.00 m <sup>2</sup> (333.7 sq ft)

#### WEIGHTS AND LOADINGS (Typical 150-passenger configuration)

A: CFM56-5B4/P engines, B: V2527-A5s:

Operating weight empty: A*	42,100 kg (92,815 lb)
B	42,482 kg (93,657 lb)
Max payload: A	18,633 kg (41,079 lb)
B	18,518 kg (40,825 lb)
Max fuel	19,159 kg (42,238 lb)
Max T-O weight: standard	73,500 kg (162,040 lb)
1st option	75,500 kg (166,445 lb)
2nd option	77,000 kg (169,755 lb)
Max ramp weight: standard	73,900 kg (162,920 lb)
1st option	75,900 kg (167,330 lb)
2nd option	77,400 kg (170,635 lb)
Max landing weight: standard	64,500 kg (142,195 lb)
option	66,000 kg (145,505 lb)
Max zero-fuel weight: standard	61,000 kg (134,480 lb)
option	62,500 kg (137,789 lb)

#### Max wing loading:

standard	599.5 kg/m <sup>2</sup> (122.79 lb/sq ft)
1st option	615.8 kg/m <sup>2</sup> (126.13 lb/sq ft)
2nd option	628.1 kg/m <sup>2</sup> (128.64 lb/sq ft)

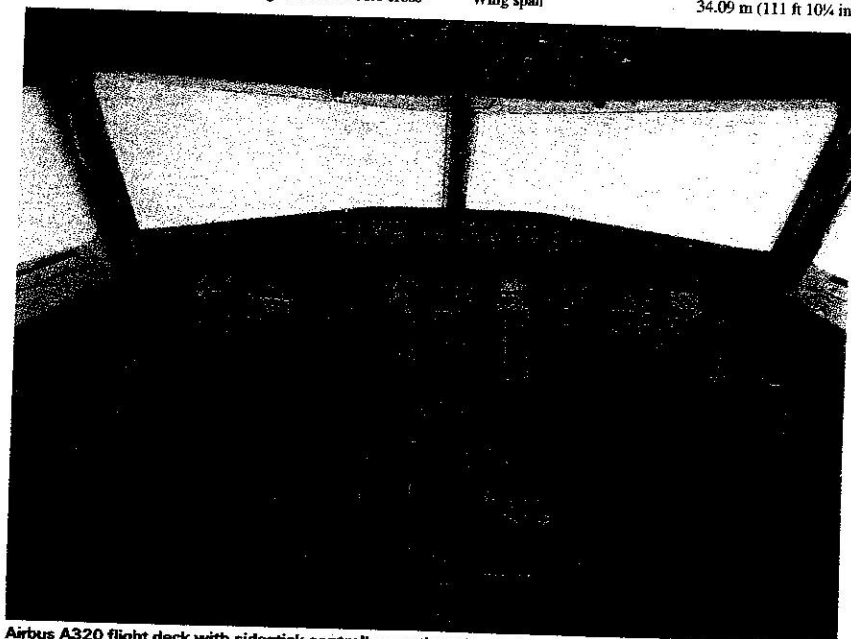
#### Max power loading (V2527 engines):

standard	312 kg/kN (3.06 lb/lb st)
1st option	320 kg/kN (3.14 lb/lb st)
2nd option	327 kg/kN (3.20 lb/lb st)

\*Options raise OWE to a maximum of 43,000 kg (94,799 lb)

PERFORMANCE (engines A and B as for Weights and Loadings, C: CFM56-5A3/5B4, D: 77,000 kg; 169,756 lb max T-O weight):

Max operating Mach No. (Mmo)	0.82
Optimum cruise speed	M0.78
Max rate of climb at S/L	152 m (500 ft)/min
Initial cruise altitude	11,280 m (37,000 ft)
Service ceiling	11,890 m (39,000 ft)
Service ceiling, OEI	5,945 m (19,500 ft)
T-O distance at S/L, ISA + 15°C: A	1,960 m (6,430 ft)
B	1,950 m (6,400 ft)
C	2,180 m (7,155 ft)
D	2,250 m (7,385 ft)



Airbus A320 flight deck with sidestick controllers outboard and six-screen EFIS

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Airbus  
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Landing distance at max landing weight:  
A, B, C, D 1,490 m (4,890 ft)  
Runway ACN (flexible runway, category B):  
twin-wheel, standard 45x16R20 tyres 41  
four-wheel bogie option, 36x11-16 Type VII or  
900x300-R16 22  
Range with 150 passengers and baggage in two-class  
layout, FAR domestic reserves and 200 n mile  
(370 km; 230 mile) diversion:  
A, standard 2,592 n miles (4,800 km; 2,982 miles)  
B, standard 2,596 n miles (4,807 km; 2,987 miles)  
A, optional 2,800 n miles (5,185 km; 3,222 miles)  
B, optional 2,871 n miles (5,317 km; 3,303 miles)  
2nd option:  
A, C 3,045 n miles (5,639 km; 3,504 miles)  
B 3,065 n miles (5,676 km; 3,527 miles)

OPERATIONAL NOISE LEVELS (ICAO Annex 16, Chapter 3; A, B  
and C as for performance):

T-O: A 88.0 EPNdB (91.5 limit)  
B 84.8 EPNdB (91.5 limit)  
C 85.4 EPNdB (91.5 limit)  
Sideline: A 94.4 EPNdB (96.8 limit)  
B 92.8 EPNdB (96.8 limit)  
C 93.8 EPNdB (96.8 limit)  
Approach: A 96.4 EPNdB (100.5 limit)  
B 95.9 EPNdB (100.5 limit)  
C 96.0 EPNdB (100.5 limit)

UPDATED

## AIRBUS A318

TYPE: Twin-jet airliner.

PROGRAMME: Short-bodied version of A319 (itself a truncated A320). Formally announced at Farnborough Air Show, September 1998, although known to be under consideration (as A319M5) since late 1997 when AVIC/ALIA/STPL AE316/AE317 venture became uncertain. Smallest aircraft in Airbus family; programme launched 26 April 1999 with orders, commitments and options for 109 aircraft; launch customer Air France (via ILFC); prototype first flight due first quarter 2002; first deliveries in last quarter 2002. Final assembly at Hamburg, resulting in some A319 production being moved to Toulouse. First metal cut November 2000.

CURRENT VERSIONS: A318-100: Baseline version.

CUSTOMERS: Airbus estimates requirement for 2,124 airliners in 70-100 seat and 7,286 in 125-175 seat categories up to



Computer-generated image of Airbus A318

2000/0085597

2018. First customer, International Lease Finance Corporation (ILFC), signed MoU for up to 30 aircraft on 17 November 1998, subject to launch of project, followed by firm order 30 April 1999. First conditional airline customer, TWA, signed LoI on 9 December 1998 for 50, confirming 25 by firm order 14 December 1999; other early customers include Egyptair (three on 17 July 1999 – first firm airline order, followed by two further examples), GATX-Flightlease (12), America West (15), British Airways (12), Air China (8), Air France (15), CIT Group (four), Frontier Airlines (five) and GECAS (30). Total orders 161 at 1 March 2001, plus 57 options.

COSTS: Programme cost estimated as US\$300 million. Unit price US\$36 million (1998).

DESIGN FEATURES: Has 95 per cent commonality with other A320 family members, including A319 wing, pylon and interface. Laser welding (rather than riveting) used on fuselage to reduce costs and weight; first use of this technology on airliner.

FLYING CONTROLS: As A320.

STRUCTURE: As A320, but fuselage 4 1/2 frames (2.39 m; 7 ft 10 in) shorter than A319; 1 1/2 frames removed forward and 3 aft of wing. Fin has tip extension. AVIC of China will have share of production work to offset AE31X project cancellation.

LANDING GEAR: As A320.

POWER PLANT: Two 97.9 kN (22,000 lb st) Pratt & Whitney PW6122 or two 106.8 kN (24,000 lb st) PW6124 turbofans; A318 is launch aircraft for engine family. Alternative power plant is 97.9 kN (22,000 lb st) or 103.6 kN (23,300 lb st) CFM International CFM56-5B, officially announced 4 August 1999. First CFM-powered A318 will enter service mid-2003. Thrust reversing and deflection as A320; fuel tank capacities and locations as A319.

ACCOMMODATION: Two flight crew plus three cabin crew. Typical passenger capacity eight first class and 99 second class with 96/81 cm (38/32 in) seat pitch, or 117 in single-class seating; high-density seating for 129 passengers. Front and rear passenger doors on port side; service door opposite each on starboard side. Overwing emergency exit each side. A318 will not carry containerised freight due to smaller baggage doors (of which size reduced to maintain same engine nacelle clearance for loading vehicles as A319).

SYSTEMS: As A320.

AVIONICS: As A320.

DIMENSIONS, EXTERNAL: As A320 except:

Length overall	31.45 m (103 ft 2 1/2 in)
Height overall	12.56 m (41 ft 2 1/2 in)
Wheelbase	10.25 m (33 ft 7 1/2 in)
Baggage doors (each): Height	1.24 m (4 ft 0 3/4 in)
Width	1.28 m (4 ft 2 1/2 in)

DIMENSIONS, INTERNAL:

Cabin: Length	21.38 m (70 ft 1 1/4 in)
Baggage hold volume: front	6.51 m³ (230 cu ft)
rear	14.70 m³ (519 cu ft)

WEIGHTS AND LOADINGS:

Operating weight empty	39,035 kg (86,057 lb)
Max payload	13,965 kg (30,788 lb)
Max T-O weight: normal	59,000 kg (130,075 lb)
option 1	61,500 kg (135,585 lb)
option 2	66,000 kg (145,505 lb)
Max ramp weight: normal	59,400 kg (130,955 lb)
option 1	61,900 kg (136,465 lb)
Max landing weight: normal	56,000 kg (123,460 lb)
option 1	57,500 kg (126,765 lb)
Max zero-fuel weight: normal	53,000 kg (116,845 lb)
option 1	54,500 kg (120,150 lb)
Max wing loading: normal	481.2 kg/m² (98.57 lb/sq ft)
option 1	501.6 kg/m² (102.74 lb/sq ft)
option 2	538.3 kg/m² (110.26 lb/sq ft)
Max power loading, PW6122 engines:	
normal	301 kg/kN (2.96 lb/lb st)
option 1	313 kg/kN (3.07 lb/lb st)
option 2	337 kg/kN (3.31 lb/lb st)

PERFORMANCE (estimated):

Runway ACN at 59,000 kg (130,075 lb): flexible Cat B runway 29

T-O run at normal MTOW 500 n mile (925 km;

575 mile) mission, elevation 610 m (2,000 ft), ISA

+15°C: PW6122 1,670 m (5,479 ft)

CFM56 1,630 m (5,348 ft)

Landing run at MLW, S/L, ISA:

PW6122 1,332 m (4,370 ft)

CFM56 1,355 m (4,446 ft)

Range with 107 passengers, FAR domestic reserves,

200 n miles (370 km; 230 miles) diversion, max

payload:

normal MTOW:

PW6122 1,462 n miles (2,707 km; 1,682 miles)

CFM56 1,455 n miles (2,694 km; 1,674 miles)

option 1 MTOW:

PW6122 1,960 n miles (3,630 km; 2,255 miles)

CFM56 1,980 n miles (3,667 km; 2,278 miles)

option 2 MTOW:

PW6122 2,820 n miles (5,222 km; 3,245 miles)

CFM56 2,880 n miles (5,333 km; 3,314 miles)

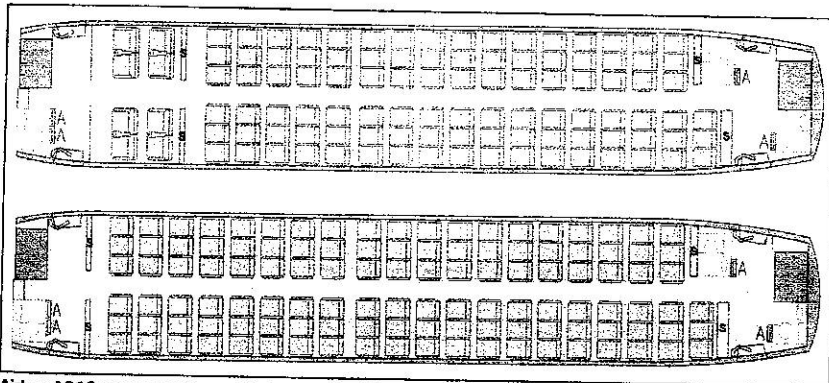
OPERATIONAL NOISE LEVELS (estimated):

T-O with PW6122 at MTOW 79.7 EPNdB

Sideline 90.4 EPNdB

Approach 89.7 EPNdB

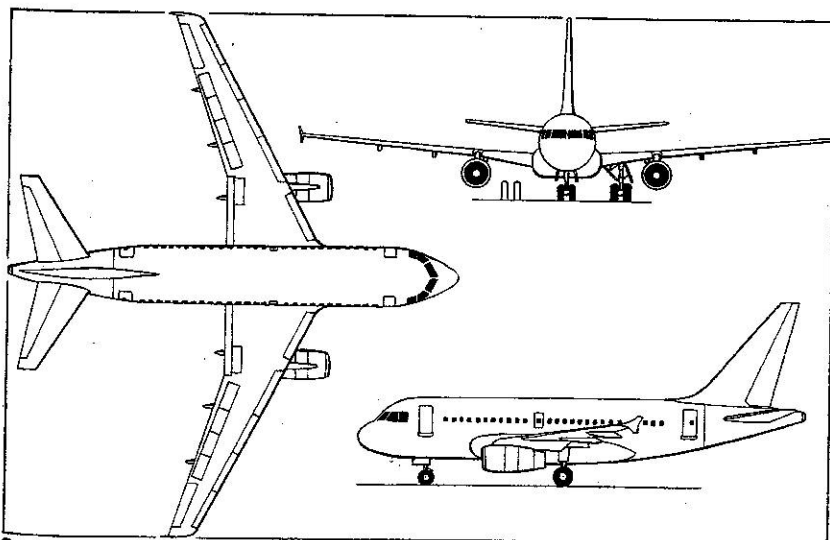
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Airbus A318 representative cabin layouts for 107 seats (top) and 117 seats

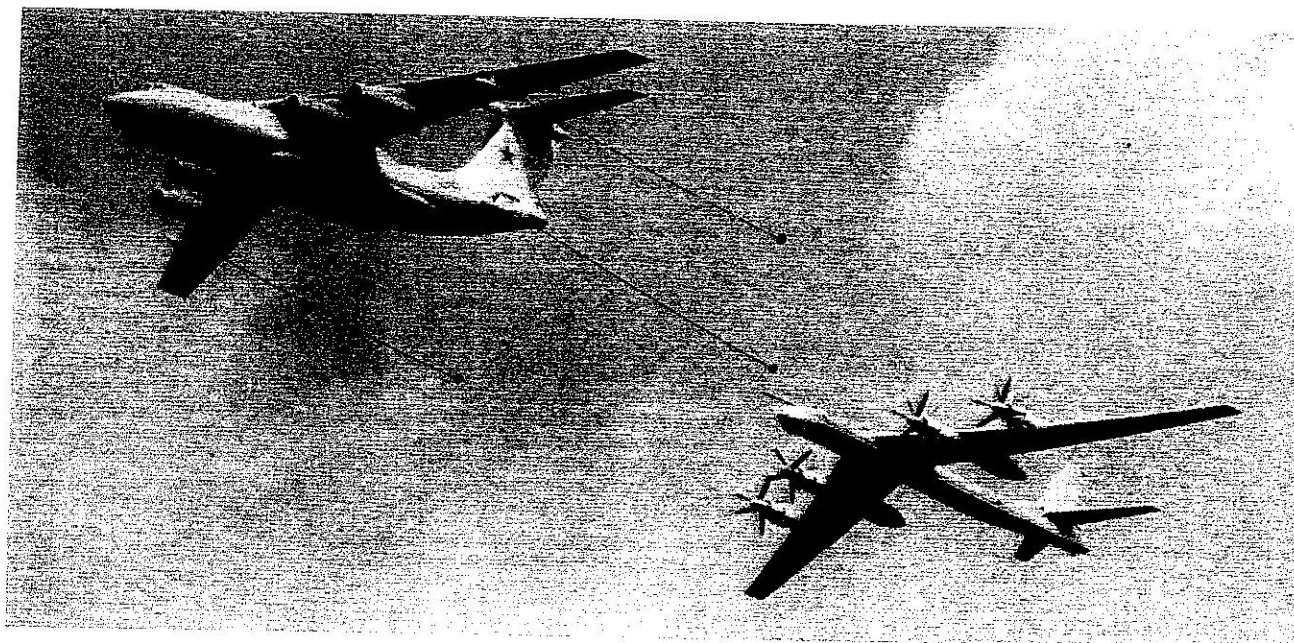
A: attendant's seat, S: screen

1999/0044887



General arrangement of the Airbus A318 (James Goulding/Jane's)

2001/0103546



Il-78M with drogues streamed, in simulated operation with Tupolev Tu-95MS (Peter J. Cooper)

1994

On runway with bearing strength less than 6 kg/cm<sup>2</sup> (85 lb/sq in): 78, 78M 157,000 kg (346,120 lb)  
 Max landing weight: 78 151,500 kg (333,995 lb)

**PERFORMANCE:**  
 Nominal cruising speed: 78 405 kts (750 km/h; 466 mph)  
 Refuelling speed: 78 232-318 kts (430-590 km/h; 267-366 mph)  
 Refuelling height: 78 2,000-9,000 m (6,560-29,525 ft)  
 Max T-O run: 78M 2,080 m (6,825 ft)  
 Refuelling radius:  
 with 60,000-65,000 kg (132,275-143,300 lb) transfer fuel: 78 540 n miles (1,000 km; 620 miles)  
 with 32,000-36,000 kg (70,545-79,365 lb) transfer fuel: 78 1,350 n miles (2,500 km; 1,553 miles)

#### VERIFIED

#### ILYUSHIN II-86

##### NATO reporting name: Camber

TYPE: Four-turboprop medium-range wide-bodied passenger transport.

**PROGRAMME:** Construction of three prototypes (second for static testing only) started 1974; first flight 22 December 1976 from Ilyushin OKB headquarters at old Moscow Central Airport, Khodinka (GAZ 30), from 1,820 m (5,970 ft) runway, to official flight test centre, by prototype SSSR-86000; first production II-86 (SSSR-86003) flew at Voronezh assembly plant (GAZ 40) 24 October 1977; first delivery (SSSR-86004) to Aeroflot 24 September 1979; scheduled services began 26 December 1980; first international service, Moscow-East Berlin, 3 July 1981; four delivered 1993; production terminated; total of 108 built, including four command posts; remainder all commercial. Programme to re-engine with CFM56 turboprops being discussed with five Russian airlines 1995, to increase range by 40 per cent.

**CUSTOMERS:** Aeroflot Russian International (23), Ajt Air International (2), Armenian Airlines (2), Belavia (1), China Airlines (5), Kazakhstan Airlines (7), Krasnoyarsk Airlines (5), Moscow Airways (1), Siberia Airlines (6), St Petersburg Avia (9), Transaero Airlines (1), Ural Airlines (4), Uzbekistan Airways (10), Vnukovo Airlines (20).

**DESIGN FEATURES:** Conventional low/mid swept-wing; two-deck fuselage, intended to be entered via lower-deck doors, into stowage compartments for coats and hand baggage, and up stairways to passenger deck (deletion of lower-deck airstairs and internal stairways optional); additional centreline bogie between main landing gear units; dihedral from roots on wings and tailplane; wing sweepback 35° at quarter-chord; all tail surfaces swept.

**FLYING CONTROLS:** Hydraulic actuation, without manual reversion for primary surfaces; aileron and two-section double-slotted flaps occupy entire trailing-edge of each wing; multisection upper-surface spoilers and airbrakes forward of each flap section; full-span leading-edge slats; variable incidence tailplane; rudder and elevators each two-section.

**STRUCTURE:** All-metal; inner wings three-spar, outer panels two-spar; shallow fence above wing in line with each engine pylon; circular-section semi-monocoque fuselage; floors of both decks of honeycomb and carbonfibre reinforced plastics.

**LANDING GEAR:** Retractable four-unit type. Forward-retracting steerable twin-wheel nose unit; three four-wheel bogie main units. Two of latter retract inward into wingroot

fairings; third is mounted centrally under fuselage, slightly forward of the others, and retracts forward. Mainwheel tyres size 1,300 x 480 mm; nosewheel tyres size 1,120 x 450 mm.

**POWER PLANT:** Four KKBK (Kuznetsov) NK-86 turboprops, each 127.5 kN (28,660 lb st), on pylons forward of wing leading-edges. Combined thrust reversers/noise attenuators. Integral fuel tanks in wings, capacity 114,000 litres (30,116 US gallons; 25,077 Imp gallons).

**ACCOMMODATION:** Two pilots and flight engineer, with provision for navigator. Flight engineer's seat normally faces to starboard, aft of co-pilot, but can pivot to central forward-facing position to enable engineer to operate throttles. Upper deck, on which all seats are located, divided into three separate cabins by wardrobes, a serving area connected by elevator to lower deck galley, and cabin staff accommodation, with eight toilets at front (two) and rear (six) of aircraft. Unusually large windows, indirect lighting in walls and in ceiling panels, and enclosed baggage lockers at top of sidewalls. Preponderance of metal and natural fibre materials rather than plastics throughout cabins to enhance safety in an emergency. Up to 350 passengers in basic nine-abreast seating throughout, with two aisles, each 55 cm (21.6 in) wide. Mixed class layout for 28 passengers six-abreast in front cabin, and 206 passengers eight-abreast in other two cabins. Three airstair doors (made in Kharkov) hinge down from port side of lower deck; one is forward of wing, others aft. Four further doors at upper deck level on each side, for emergency use (using dual inflatable escape slides) and for use at airports where utilisation of high-level boarding steps or bridges preferred. Coats and hand baggage stowed on lower deck before passengers climb one of three fixed stairways to main deck. (Optional deletion of lower deck airstair doors and stairways reduces operating weight empty by 3,000 kg; 6,610 lb and permits installation of 25 more seats on upper deck.) Cargo holds on lower deck accommodate

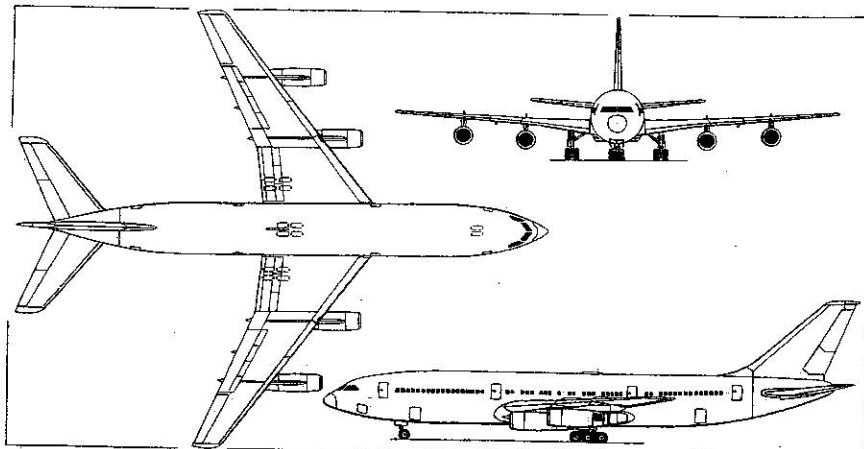
heavy or registered baggage and freight in eight standard LD3 containers, or 16 LD3 containers if some carry-on baggage racks omitted. Access via upward-hinged doors forward of starboard wingroot leading-edge and at side of rear hold. Containers can be loaded and unloaded by self-propelled truck with built-in roller conveyor. Films can be shown in flight, and there is choice of 12 tape recorded audio programmes. A bar-buffet can be provided on lower deck in place of baggage and freight accommodation in forward vestibule.

**SYSTEMS:** Four self-contained hydraulic systems, each operated by one of engines, for actuation of flying control surfaces, tailplane variable incidence, spoilers, airbrakes, slats, flaps, landing gear, nosewheel steering, wheel brakes, anti-skid system, and upper level doors when passenger gangways used. All hot pipelines of air conditioning system, and all fuel supply lines, outside pressure cell. Primary 200/155 V 400 Hz AC electrical system powered by four 40 kVA engine-driven generators. Secondary 36 V three-phase AC and 27 V DC systems. Five accumulators and static transformer. Smoke detection sensors in baggage, freight and equipment stowage areas. Pulse generating de-icing system consuming 500 times less energy than conventional hot air or electrical system. APU in tailcone.

**AVIONICS:** Flight control and nav systems provide for automatic climb to selected height, control of rate of climb and automatic descent, and automatic landing in ICAO Cat. IIIa conditions. Preprogrammable Doppler nav system with readout display screen, on which microfilmed maps can be projected. Position of aircraft indicated by cursor, driven by computer. Nav system updated automatically by inputs from VOR or VOR/DME radio beacons. Collins TCAS II flight tested and available from early 1994.

##### DIMENSIONS, EXTERNAL:

Wing span 48.06 m (157 ft 8 1/4 in)  
 Length overall 59.54 m (195 ft 4 in)



Ilyushin II-86 four-turboprop wide-bodied passenger transport (Jane's/Dennis Punnett)

1993

31



Ilyushin Il-86 wide-bodied transport (four KKBK NK-86 turbofans) (Mark Wagner/Flight International)

1995

Fuselage: Length	56.10 m (184 ft 0 1/4 in)
Max diameter	6.08 m (19 ft 11 1/2 in)
Height overall	15.81 m (51 ft 10 1/4 in)
Tailplane span	20.57 m (67 ft 6 in)
Wheel track (c/l of outer shock-struts)	11.15 m (36 ft 7 in)
Wheelbase	21.34 m (70 ft 0 in)
DIMENSIONS, INTERNAL:	
Main cabins: Height	2.61 m (8 ft 7 in)
Max width	approx 5.70 m (18 ft 8 1/2 in)
AREAS:	
Wings, gross	320.0 m <sup>2</sup> (3,444 sq ft)
WEIGHTS AND LOADINGS:	
Max payload	42,000 kg (92,600 lb)
Max fuel	88,350 kg (194,775 lb)
Max T-O weight (dependent on size and type of runway)	190,000-208,000 kg (418,875-458,560 lb)
Max landing weight	175,000 kg (385,800 lb)
Max wing loading	650.0 kg/m <sup>2</sup> (133.1 lb/sq ft)
Max power loading	407.9 kg/kN (4.0 lb/lb st)
PERFORMANCE (designed):	
Normal cruising speed at 9,000-11,000 m (30,000-36,000 ft)	486-512 kts (900-950 km/h; 559-590 mph)
Approach speed	130-141 kts (240-260 km/h; 149-162 mph)
Field length for T-O and landing	2,300-2,600 m (7,550-8,530 ft)
* Range: with 40,000 kg (88,185 lb) payload	1,944 n miles (3,600 km; 2,235 miles)
* with max fuel	2,480 n miles (4,600 km; 2,858 miles)
* Reports suggest that these design ranges are not being achieved. The former East German airline Interflug quoted a max range of 1,350 n miles (2,500 km; 1,555 miles) in its sales literature	

(including prototypes) flying 1992; certification received 29 December 1992; two built 1993; four in 1994.

CUSTOMERS: Aeroflot Russian International Airlines had five by January 1995, operating Moscow-New York non-stop; it is expected to receive up to 10. Domodedovo Airlines has two.

DESIGN FEATURES: Superficial resemblance to Il-86, but new design, with different engines to overcome performance deficiencies of original Il-86; new structural materials and state-of-the-art technology intended to provide life of 60,000 hours and 12,000 landings; no lower-deck passenger entry; winglets standard; wing and tailplane dihedral from roots; supercritical wings, with 30° sweep at quarter-chord; sweepback at quarter-chord 37° 30' on tailplane, 45° on fin. Current development aiming at range of 6,475 n miles (12,000 km; 7,450 miles) with 300 passengers.

FLYING CONTROLS: Triplex fly-by-wire, with manual reversion; each wing trailing-edge occupied by, from root, double-slotted inboard flap, small inboard aileron, two-section single-slotted flaps, and outboard aileron used only as gust damper and to smooth out buffeting; seven-section full-span leading-edge slats on each wing; three airbrakes forward of each inboard trailing-edge flap; six spoilers forward of outer flaps; inboard pair supplement ailerons, others operate as airbrakes and supplementary ailerons; variable incidence tailplane; two-section rudder and elevators, without tabs.

STRUCTURE: Basically all-metal, including new high-purity aluminium alloy, with composites flaps, main-deck floors and underfloor holds of honeycomb and CFRP; inner wings three-spar, outer panels two-spar; each wing has

seven machined skin panels, three top surface, four bottom, with integral stiffeners; circular-section semi-monocoque fuselage; leading- and trailing-edges of fin and tailplane of composites. Some components manufactured by PZL Mielec, Poland.

LANDING GEAR: Retractable four-unit type. Forward-retracting steerable twin-wheel nose unit; three four-wheel bogie main units. Two of latter retract inward into wingroot/fuselage fairings; third is mounted centrally under fuselage, to rear of others, and retracts forward after the bogie has itself pivoted upward 20°. Oleo-pneumatic shock-absorbers. Nosewheel tubeless tyres size 1,260 x 460 mm; mainwheel tubeless tyres size 1,300 x 480 mm. Tyre pressure (all) 11.65 bars (169 lb/sq in).

POWER PLANT: Four Aviadvigatel PS-90A turbofans, each 156.9 kN (35,275 lb st), on pylons forward of wing leading-edges. Thrust reversal standard. Integral fuel tanks in wings and fuselage centre-section, total capacity 148,260 litres (39,166 US gallons; 32,613 imp gallons).

ACCOMMODATION: Pilot, co-pilot and flight engineer; two seats for supplementary crew or observer. Ten or 12 cabin staff. Basic all-tourist configuration has two cabins for 66 and 234 passengers respectively, nine-abreast at 87 cm (34.25 in) seat pitch, separated by buffet counter, video stowage and two lifts from galley on lower deck. Two aisles, each 55 cm (21.65 in) wide. Two toilets and wardrobe at front, six more toilets, a rack for cabin staff's belongings and seats for cabin staff at rear. Seats recline, and are provided with individual tables, ventilation, earphones and attendant call button. Indirect lighting is standard. 235-seat mixed class version has front cabin for 22 first class passengers, six-abreast in pairs, at 102 cm (40 in) seat pitch

UPDATED

### ILYUSHIN II-86 COMMAND POST

NATO reporting name: Maxdome

TYPE: Airborne command post version of Il-86 transport.

PROGRAMME: First observed at Zhukovsky Flight Research Centre 1992; four seen to be completed at that time (SSSR-86146 to 86149).

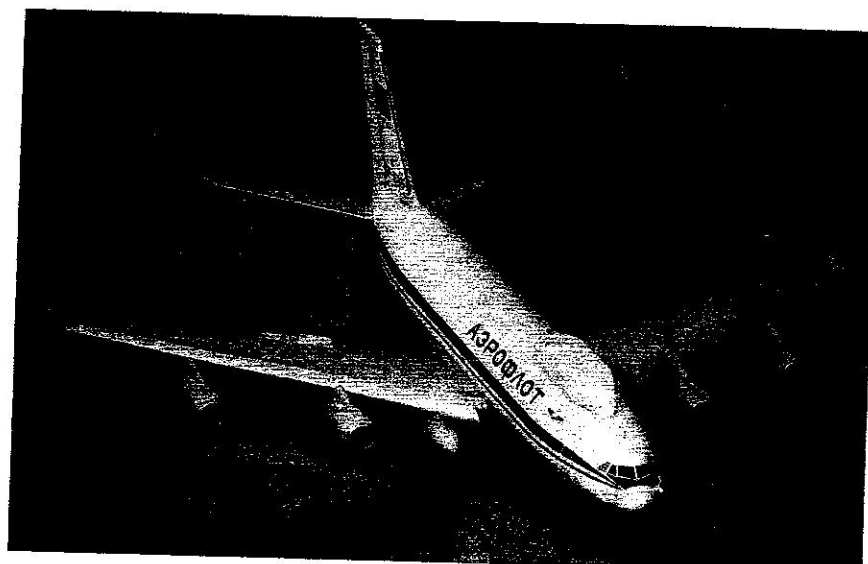
DESIGN FEATURES: Large boat-shaped fairing above fuselage forward of wings; large pod with ram air intake under each inner wing; long and shallow dished fairing forward of fin root; strake antenna under rear fuselage; small fin-like component on port side lower fuselage, carrying what appears to be drogue for VLF trailing wire aerial. SSSR-86146 and -86147 have large blade acrials above centre and rear fuselage and under forward fuselage.

UPDATED

### ILYUSHIN (T-74) II-96-300

TYPE: Four-turboprop wide-bodied passenger transport.

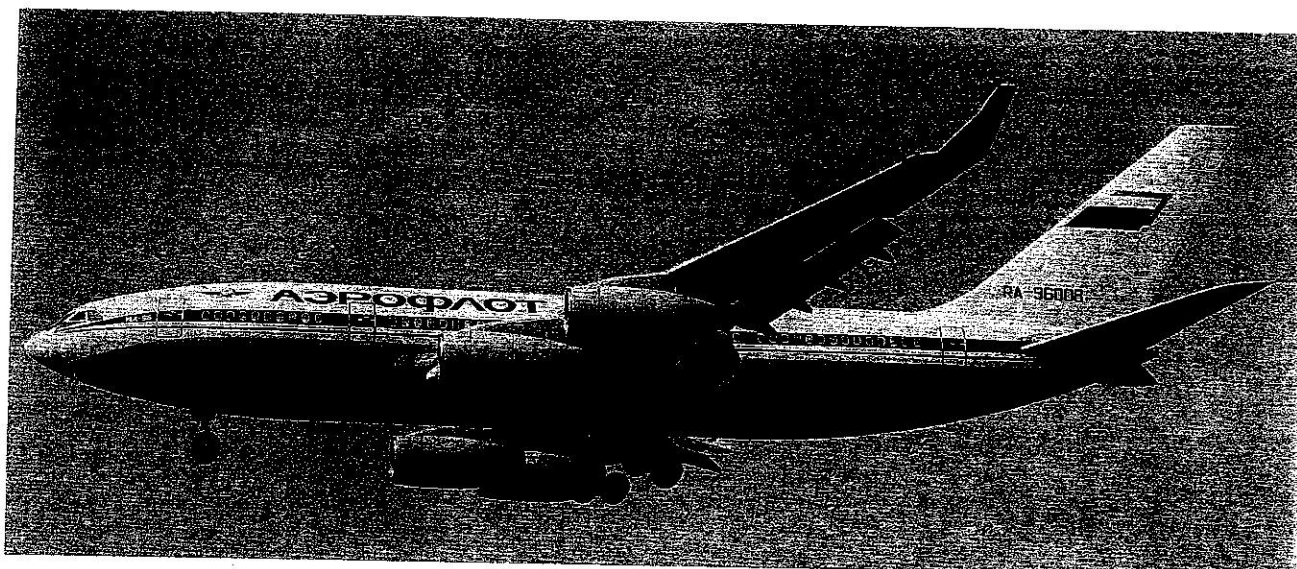
PROGRAMME: First of five T-74 (OKB designation) prototypes (SSSR-96000) flew at Khodinka 28 September 1988, second on 28 November 1989; further two airframes used for static and fatigue testing; all seven built at GAZ 30, Khodinka; areas of commonality with Il-86 permitted planned test programme to be reduced to 750 flights totalling 1,200 hours; route proving trials by SSSR-96005 conducted late 1991; production at GAZ 40, Voronezh; total nine



Ilyushin Il-86 airborne command post (NATO 'Maxdome') (Sebastian Zacharias)

1993





Ilyushin Il-96-300 four-turboprop wide-bodied passenger transport of Aeroflot Russian International Airlines (Mark Wagner/Flight International)

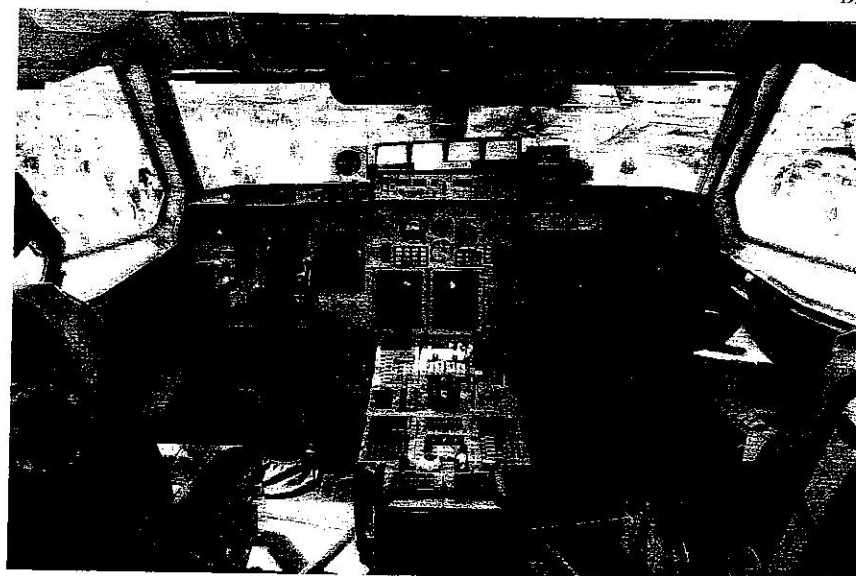
1995

and with aisles 75.5 cm (29.7 in) wide; centre cabin with 40 business class seats, eight-abreast at 90 cm (35.4 in) seat pitch and with aisles 56.5 cm (22.25 in) wide; and rear cabin for 173 tourist class passengers, basically nine-abreast at 87 cm (34.25 in) seat pitch, with aisle width of 55 cm (21.65 in). Unlike Il-86, passenger cabin is entered through three doors on port side of upper deck, at front and rear and forward of the wings. Opposite each door, on starboard side, is emergency exit door. Lower deck houses front cargo compartment for six ABK-1.5 (LD3) containers or igloo pallets, central compartment aft of wing for 10 ABK-1.5 containers or pallets, and tapering compartment for general cargo at rear. Three doors on starboard side provide separate access to each compartment. Galley and lifts are between front cargo compartment and wing, with separate door aft of front cargo compartment door.

**SYSTEMS:** Four independent hydraulic systems, using fireproof and explosion-proof fluid, at pressure of 207 bars (3,000 lb/sq in). APU in tailcone.

**AVIONICS:** Flight: Triplex flight control and flight management systems, together with a head-up display, permit fully automatic en route control and operations in ICAO Cat. IIIa minima. Duplex engine and systems monitoring and failure warning systems feed in-flight information to both the flight engineer's station and monitors on the ground. Autothrottle is based on IAS, without angle of attack protection.

**Instrumentation:** On the flight deck conventional standby instruments are retained, but primary flight information is presented on dual twin-screen colour CRTs, fed by triplex INS, a satellite-based and Omega navigation system and other sensors. Another electronic system provides real-time automatic weight and CG situation data.



Flight deck of Ilyushin Il-96-300 four-turboprop wide-bodied airliner (Photo Link)

1993

#### DIMENSIONS, EXTERNAL:

Wing span: excl winglets	57.66 m (189 ft 2 in)
over winglets	60.11 m (197 ft 2 1/2 in)
Wing aspect ratio	9.5
Length overall	55.35 m (181 ft 7 1/4 in)
Fuselage: Length	51.15 m (167 ft 9 1/4 in)
Max diameter	6.08 m (19 ft 11 1/2 in)
Height overall	17.57 m (57 ft 7 1/4 in)
Tailplane span	20.57 m (67 ft 6 in)
Wheel track	10.40 m (34 ft 1 1/2 in)
Wheelbase	20.07 m (65 ft 10 in)
Passenger doors (three): Height	1.83 m (6 ft 0 in)
Width	1.07 m (3 ft 6 in)
Height to sill: Nos. 1 and 2	4.54 m (14 ft 10 1/4 in)
No. 3	4.80 m (15 ft 9 in)
Emergency exit doors (three): Height	1.825 m (5 ft 11 1/4 in)
Width	1.07 m (3 ft 6 in)
Cargo compartment doors (front and centre): Height	1.825 m (5 ft 11 1/4 in)
Width	1.78 m (5 ft 10 in)
Height to sill: front	2.34 m (7 ft 8 1/4 in)
centre	2.48 m (8 ft 1 3/4 in)
Cargo compartment door (rear): Height	1.38 m (4 ft 6 1/4 in)
Width	0.972 m (3 ft 2 1/4 in)
Height to sill	2.74 m (9 ft 0 in)
Galley door: Height	1.20 m (3 ft 11 1/4 in)
Width	0.80 m (2 ft 7 1/2 in)
<b>DIMENSIONS, INTERNAL:</b>	
Cabins, excl flight deck: Height	2.60 m (8 ft 6 1/4 in)
Max width	approx 5.70 m (18 ft 8 1/2 in)
Volume	350 m³ (12,360 cu ft)
Cargo hold volume: front	37.10 m³ (1,310 cu ft)
centre	63.80 m³ (2,253 cu ft)
rear	15.00 m³ (530 cu ft)

#### AREAS:

Wings, gross	391.6 m² (4,215 sq ft)
Vertical tail surfaces (total)	61.0 m² (656.6 sq ft)
Horizontal tail surfaces (total)	96.5 m² (1,038.75 sq ft)

#### WEIGHTS AND LOADINGS:

Basic operating weight	117,000 kg (257,940 lb)
Max payload	40,000 kg (88,185 lb)
Max fuel	114,902 kg (253,311 lb)
Max T-O weight	216,000 kg (476,200 lb)
Max landing weight	175,000 kg (385,810 lb)
Max zero-fuel weight	157,000 kg (346,120 lb)
Max wing loading	551.6 kg/m² (113.0 lb/sq ft)
Max power loading	344.2 kg/kN (3.37 lb/lb st)

#### PERFORMANCE (estimated):

Normal cruising speed at 10,100-12,100 m (33,135-39,700 ft)	459-486 kts (850-900 km/h; 528-559 mph)
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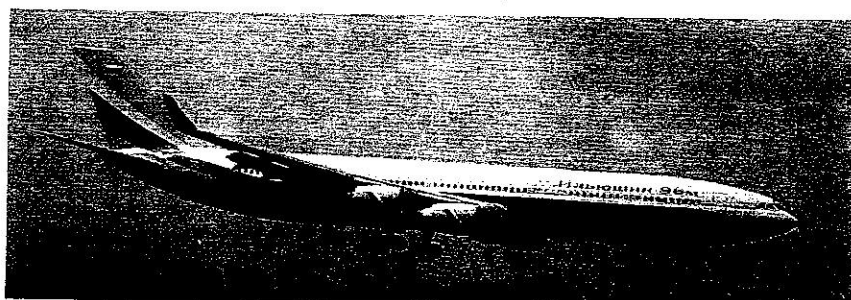
Approach speed	140 kts (260 km/h; 162 mph)
Balanced T-O runway length	2,600 m (8,530 ft)
Balanced landing runway length	1,980 m (6,500 ft)
Range, with USA reserves: with max payload	4,050 n miles (7,500 km; 4,660 miles)
with 30,000 kg (66,140 lb) payload	4,860 n miles (9,000 km; 5,590 miles)
with 15,000 kg (33,070 lb) payload	5,940 n miles (11,000 km; 6,835 miles)

**OPERATIONAL NOISE LEVELS:** Il-96-300 is designed to conform with ICAO Chapter 3 Annex 16 noise requirements.

UPDATED

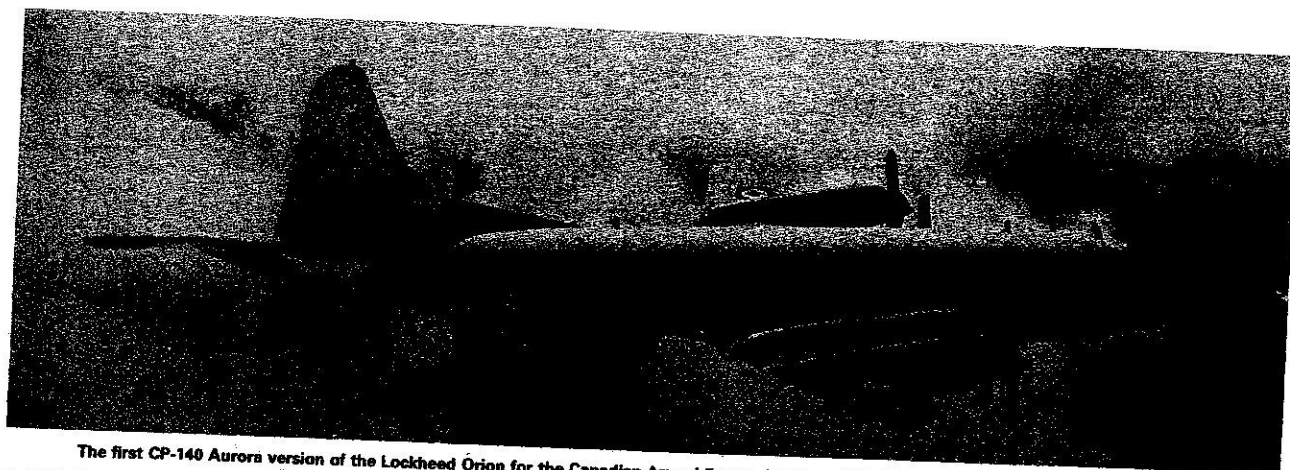
#### ILYUSHIN II-96M and II-96T

TYPE: Four-turboprop wide-bodied passenger or freight transport.



Prototype of increased-capacity Ilyushin Il-96M four-turboprop wide-bodied transport (Paul Jackson)

1995



The first CP-140 Aurora version of the Lockheed Orion for the Canadian Armed Forces, bearing a US civil registration during its early test flying

his MPD. The NAVCOM also has an ASA-82 and ASQ-147, plus HF, VHF (FM) and UHF transceivers; inertial, VLF (Omega) and Doppler navigation sets; LF and UHF ADF, and VHF homer; a high-speed teleprinter and teletype keyboard; provisions for Tactical Satellite Communications (TACSATCOM); data link; control of reconnaissance photography; provisions for control of survey photography; and provisions for secure communications. The NAVCOM's MPD and keyset serve as a backup for the TACNAV in the event of equipment failure.

The two ASOs share a dual console and each has an ASA-82 MPD and ASQ-147 keyset and trackball. They share also an ASA-82 Auxiliary Readout Unit (ARU), a time code generator, and an AN/ASH-27 28-track tape recorder. Their MPDs can display acoustic data or the tactical plot, but the ARU is a dedicated acoustic display. The acoustic functions of receiving, processing, display and recording are controlled by the keysets through the computer.

The two NASOs also have a dual console, each with an ASA-82 MPD and ASQ-147 keyset and trackball, the keysets being used to control radar, electronic support measures (ESM) and FLIR through the computer. Principal controls shared by these two operators, or available to only one of them, include ASQ-501 MAD, OA-5150/ASQ (FACS II) MAD compensator, video tape recorder, SIF and provisions for SLAR.

The heart of the entire control system is a Univac AN/AJK-10 Navigation/Tactical computer. Its two central processors function independently; both have coordinated access to a core memory of 65,536 words. There is growth capacity for an additional 32,000 words, and space has been allocated for a 127,000-word auxiliary memory in the acoustic system processor for the computer.

The search stores and camera bay has stowage for 'A' size sonobuoys, large and small marine markers, Signals Underwater Sound (SUS) and flares. Intercom controls and an ordnance status panel are provided for the ordnance crew member. The computer-controlled electrically-fired cartridge-actuated A-size launchers can all be operated with the aircraft pressurised. They comprise 36 underfloor launchers, loadable only on the ground, and three which can be loaded from the cabin with the aircraft pressurised or unpressurised. A C-size chute, just aft of the three cabin launch tubes, allows free-fall launch (with the aircraft unpressurised) of flares, small marine markers, SUS and mail, and air drops to remote ships or stations.

A KA-107A day/night reconnaissance camera is installed beneath the floor in this area, and is accessible in flight through a floor hatch. The illuminator for night reconnaissance photography is located beneath the floor of the in-flight maintenance station. This position has a bench with 28V DC and 115V 400Hz AC power outlets, and there are provisions for a microfiche reader.

Aircraft operational support equipment for the CP-140 includes the ground-based Data Interpretation and Analysis Center (DIAC), and a Ground Support Computer Complex (GSCC). The former provides operational support for the operating squadrons; the latter provides technical support for the operational software, and maintains software configuration records.

The aircraft's weapon bay, which has a maximum capacity of 2,177 kg (4,800 lb) on eight stations, can accommodate and drop the Canadian SKAD/BR search and rescue kit, as well as a variety of ordnance. There are ten underwing hardpoints, with an individual capacity ranging from 277 kg (611 lb) to 1,111 kg (2,450 lb).

Canadair Ltd is manufacturing forward and aft radomes, rear fuselage sections, centre and outer wing sections, and main electrical load centres, both for the Aurora and for Lockheed-built P-3Cs.

The first CP-140 was rolled out on 25 January 1979, and this aircraft completed a successful five-hour first flight on 22 March 1979. Delivery of the first and last of these 18

Canadian aircraft is scheduled for May 1980 and March 1981 respectively. Because of the growth potential of this aircraft's equipment, it is expected to serve into the next century.

**TYPE:** Four-turboprop long-range ASW and maritime patrol aircraft.

**WINGS:** As P-3C, with all-rouns operated by dual hydraulic boosters, supplied from two independent hydraulic systems.

**FUSELAGE:** As for P-3C.

**TAIL UNIT:** As P-3C, with rudder and elevators each operated by dual hydraulic boosters, supplied from two independent hydraulic systems. Trim tabs in elevators and rudder.

**LANDING GEAR:** Hydraulically-retractable tricycle type with twin wheels on each unit. All units retract forward, main wheels into inner engine nacelles. Oleo-pneumatic shock-absorbers. All units can free-fall to the down and locked position in emergency. Hydraulically-powered steerable nose unit, controlled by handwheel on the pilot's side console. Hydraulically-operated dual segmented-disc brakes. Pneumatic emergency braking system.

**POWER PLANT:** Four 3,661 kW (4,910 ehp) Allison T56-A-14 turboprop engines, each driving a four-blade metal constant-speed fully-feathering and reversible propeller. Fuel in one fuselage and four wing integral tanks, with total usable capacity of 34,826 litres (9,200 US gallons). Single-point pressure refuelling, and four overwing gravity refuelling points, are provided. Fuel dump system. Propeller blade cuffs and spinners de-iced by electrical heating.

**ACCOMMODATION:** Normal eleven-man crew, with seating for five additional passengers. Dual controls standard. Flight deck has wide-vision windows, and circular windows for up to four observers are provided in the main cabin, each bulged to give 180° visibility. Main cabin fitted out as detailed in introductory paragraphs. Door on port side, aft of wing. Overwing emergency exit on each side of cabin; others in side and ceiling of flight deck. De-fogging and anti-icing of windscreens by electrical heating; windscreens have mechanical wipers, a washing system for the removal of salt deposits, and a rain-repellent spray system. Stowage for clothing, life jackets and parachute harness. Four floor tiedown areas have a combined baggage/cargo capacity of 442 kg (975 lb).

**SYSTEMS:** Air-conditioning and pressurisation system supplied by two engine-driven compressors, maintaining cabin temperatures between 15.6°C and 26.7°C (60°F and 80°F), and a cabin altitude of 2,440 m (8,000 ft) to a height of 9,145 m (30,000 ft). Two independent hydraulic systems, each at a pressure of 207 bars (3,000 lb/sq in) are powered by three interchangeable electrically-driven pumps, any two of which can maintain full hydraulic services. Pneumatic system at pressure of 207 bars (3,000 lb/sq in) for emergency braking. Electrical system of 120/208V 400Hz AC supplied by three 60/90kVA engine-driven generators, any one of which can maintain full normal load. DC power supplied by three 200A 24V transformer-rectifiers and one 31Ah storage battery. APU drives a 60/90kVA generator and provides power and bleed air for ground air-conditioning, weapons bay heating and engine starting; it can also provide emergency electrical power in flight. Oxygen system for crew of three on flight deck with 3.5 hour capacity. Individual portable chemical oxygen generators for emergency use by all crew members. Automatic flight control system (AFCS) with dual-channel fail-safe autopilot; includes tactical and airways nav modes and proportional control wheel steering.

**AVIONICS AND EQUIPMENT:** Univac AN/AJK-10 navigation/tactical computer; digital magnetic tape units; teleprinter; display generator units; APS-116 search radar; OR-89/AA (modified) FLIR; video recorder for FLIR

imagery; ARS-2 sonobuoy reference system; OL-82 (modified) acoustics data processor; RD-348, ASQ-147 and ASA-82 displays; LN-33 inertial navigation system; APN-208 Doppler; ARN-115 Omega; Tacan; revised airways/approach nav aids; dual VOR/ILS; communications sets comprising HF, UHF, VHF (AM), VHF guard receiver, VHF (FM); HF SIMOPS filters; RCVR homing; USH 502 crash position indicator/flight data recorder; ASW-31 AFCS; ALR-47 ESM; AN/ASH-27 28-track tape recorder; ASQ-501 MAD; OA-5150/ASQ (FACSII) MAD compensator; SLAR provisions; IFF; data link; Airborne Radiation Thermometer (ART) provisions; and time coding generator. Equipment includes KA-107A day/night reconnaissance camera and night illuminator; provisions for civil sensors canister; galley with refrigerator and sink; white edge lighting for all console-mounted control panels; white cabin lighting; reading lights at all crew positions; white overhead lights; and aisle lights.

**PERFORMANCE** (with mission payload of 2,540 kg; 5,600 lb except where stated otherwise):

Max transit speed at optimum altitude  
395 knots (732 km/h; 455 mph)  
Max level speed below cruise ceiling  
375 knots (695 km/h; 432 mph)  
FAR balanced field length  
2,408 m (7,900 ft)  
T-O to 15 m (50 ft)  
1,829 m (6,000 ft)  
Landing from 15 m (50 ft) at 51,714 kg (114,000 lb)  
landing weight  
975 m (3,200 ft)  
Endurance on station at 1,000 nm (1,853 km; 1,151 miles) radius  
8-2 h  
Ferry range  
4,500 nm (8,339 km; 5,182 miles)

## LOCKHEED S-3A VIKING

### US Navy designation: S-3A

On 4 August 1969 Lockheed announced the receipt of a \$461 million contract from the US Navy to develop an anti-submarine aircraft under the designation S-3A. Development was carried out by Lockheed in partnership with Vought Systems Division of LTV and Univac Federal Systems Division of Sperry Rand. Vought designed and built the wing, engine pods, tail unit and landing gear, and Univac was responsible for the digital computer, the heart of the weapon system, which provides high-speed processing of data essential for the S-3A's ASW role. Lockheed built the fuselage, integrated the avionics, and was responsible for final assembly at Burbank, California, from where the first prototype flew on 21 January 1972.

Production of the 187 S-3As called for under successive US Navy contracts ended in mid-1978. All tooling has been placed in storage at Burbank pending a US Navy decision on further orders. Details of the S-3A Viking can be found in the 1978-79 *Jane's*.

## LOCKHEED L-1011 (MODEL 385) TRISTAR

In January 1966, Lockheed-California began a study of future requirements in the short/medium-haul airliner market. The design which emerged, known as the L-1011 (Lockheed Model 385 TriStar), was influenced by the published requirements of American Airlines, which specified optimum payload/range performance over the Chicago-Los Angeles route, coupled with an ability to take off from comparatively short runways with full payload.

The original design centred around a twin-turboprop configuration. Discussions which followed with American domestic carriers led to the eventual selection of a three-engined configuration, and the Rolls-Royce RB.211 high bypass ratio turboprop was chosen as power plant.

In June 1968 the L-1011 TriStar moved to the production design stage. Construction of the first aircraft began in March 1969, and this was rolled out in September 1970. The first flight was made on 16 November 1970. On 22 December 1971 class II provisional Type Certification was received, permitting delivery of aircraft to customers for route proving and demonstration purposes. In mid-1978

The prototype TriStar was being fitted with a 1.37 m (4 ft 6 in) extension to each wingtip, to flight test a new 'active' aileron control system already evaluated on the standard TriStar wing.

The original version of the TriStar is now known as the L-1011-1. Four other versions were available in early 1977, and Lockheed announced on 15 March 1977 that the company was holding discussions with major airlines throughout the world regarding new versions for service on short/medium-range routes in the 1980s. Details of current production versions, and available information on proposed new versions, follow:

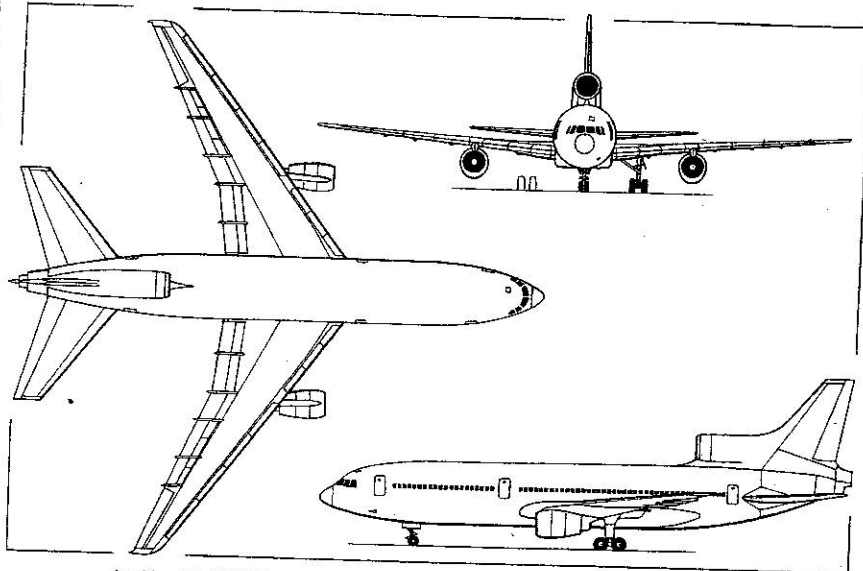
**L-1011-1.** Basic TriStar, as described in detail. Initial delivery of the L-1011-1, to Eastern Air Lines for crew training, made on 6 April 1972, followed by a similar delivery to TWA. FAA certification was granted in the same month and the first passenger service with the TriStar was flown by Eastern on 15 April. Scheduled services began eleven days later.

**L-1011-100.** Longer-range version. Outward configuration identical with that of L-1011-1. Available with RB.211-22B engines (each 187 kN; 42,000 lb st) or RB.211-22F engines (each 193.5 kN; 43,500 lb st). Max T-O weight of 204,120 kg (450,000 lb) can be increased to 211,375 kg (466,000 lb) with additional 8,165 kg (18,000 lb) of fuel in new centre-section tanks. Ordered by Cathay Pacific, Gulf Air and Saudi Arabian Airlines.

**L-1011-200.** Longer-range version, with improved take-off and climb performance, offering particular benefits to operators serving 'hot or high' areas. Outward configuration identical with that of L-1011-1. Powered by RB.211-524 engines (each 213.5 kN; 48,000 lb st). Optional max T-O weights of 204,120 kg (450,000 lb) or 211,375 kg (466,000 lb) according to whether new centre-section tankage is fitted. First flight of TriStar testbed with RB.211-524 (one only) made on 10 April 1976. L-1011-200 certificated by FAA on 26 April 1977. Ordered by British Airways, Gulf Air and Saudi Arabian Airlines.

**L-1011-250.** Long-range version, with further increase in max T-O weight to 224,980 kg (496,000 lb) and max fuel capacity of 96,160 kg (212,000 lb), through added centre-section tankage. Outward configuration identical with that of L-1011-1. Wings, fuselage and fin front spar web reinforced to cater for higher design loads. New nose-wheel unit and strengthened main landing gear axles. Larger tyres with increased ply rating on all units. Braking capacity increased. Powered by RB.211-524B engines (each 213.5 kN; 48,000 lb st). Galley can be below-deck, as on other versions, or dispersed on main deck, which doubles available space in forward cargo hold. Expanded forward hold accommodates 16 LD-3 half-width containers or 5 pallets, each measuring 2.23 m x 3.17 m (88 in x 125 in). For pallet loading, the forward cargo door is replaced by a 1.72 m x 2.64 m (68 in x 104 in) power-operated upward-opening door. Main-deck galleys reduce passenger accommodation from typical 273 to 253 in eight-abreast coach configuration, and from typical 302 to 284 in nine-abreast coach configuration, in each case with 10 per cent first class forward.

**L-1011-400A.** Proposed short/medium-range version, with overall dimensions similar to those of the L-1011-500, except for an increase of wing span to 50.09 m (164 ft 4 in). Introduction of active aileron control system (in which the aircraft's control surfaces are moved automatically to counter manoeuvre or gust loads, without action by the pilot) would permit increased span, to provide drag reduction and consequent fuel savings, without other structural modifications to the wing. Powered by



Lockheed L-1011-500 TriStar extended-range wide-bodied transport (Pilot Press)

three RB. 211-22E turbofan engines, each rated at 187 kN (42,000 lb st); derating would be possible if automatic take-off thrust control (ATTC) system were installed. Accommodation for 251 passengers; range of 4,200 nm (7,783 km; 4,836 miles). Maximum T-O weight 195,045 kg (430,000 lb). Galleys located on the main deck, to permit increased cargo capacity.

**L-1011-400A MP.** Multi-purpose version of the -400A, with identical external dimensions. The -400A MP would have the same power plant, but increased fuel capacity and a max T-O weight of 211,375 kg (466,000 lb), providing international range. Accommodation for 241 passengers, with three main-deck galleys. Cargo capacity as for 400A. Range with full passenger payload 4,600 nm (8,525 km; 5,297 miles).

**L-1011-500.** Extended-range version, with a max T-O weight of 224,980 kg (496,000 lb) and max fuel capacity of 96,160 kg (212,000 lb) through added centre-section tankage. Fuselage is shortened by 4.11 m (13 ft 6 in); all other external dimensions are the same as for L-1011-1. Three RB.211-524B engines (each 222.4 kN; 50,000 lb st). Galley located on main deck. Forward cargo hold accommodates 12 LD-3 containers or four pallets each measuring 2.24 m x 3.17 m (88 in x 125 in). Centre hold takes 7 LD-3 containers. In a mixed class configuration, with 24 first class passengers in six-abreast seating and 222 economy passengers in nine-abreast seating, the aircraft carries 246 passengers. Max accommodation for 300 passengers. Ordered by AeroPeru, Air Canada, British Airways, BWIA, Delta Air Lines, LTV (Germany), PanAm and TAP/Air Portugal. New fuselage/centre engine fairing, installed first on the -500, may be adopted as standard for all TriStar models. Flight testing of this version began in October 1978, and -500s entered service with British Airways on 7 May 1979. Extended wingtips and active aileron system (with 2° low-speed aileron droop for 1% range improvement) will be introduced on Delta, Pan Am,

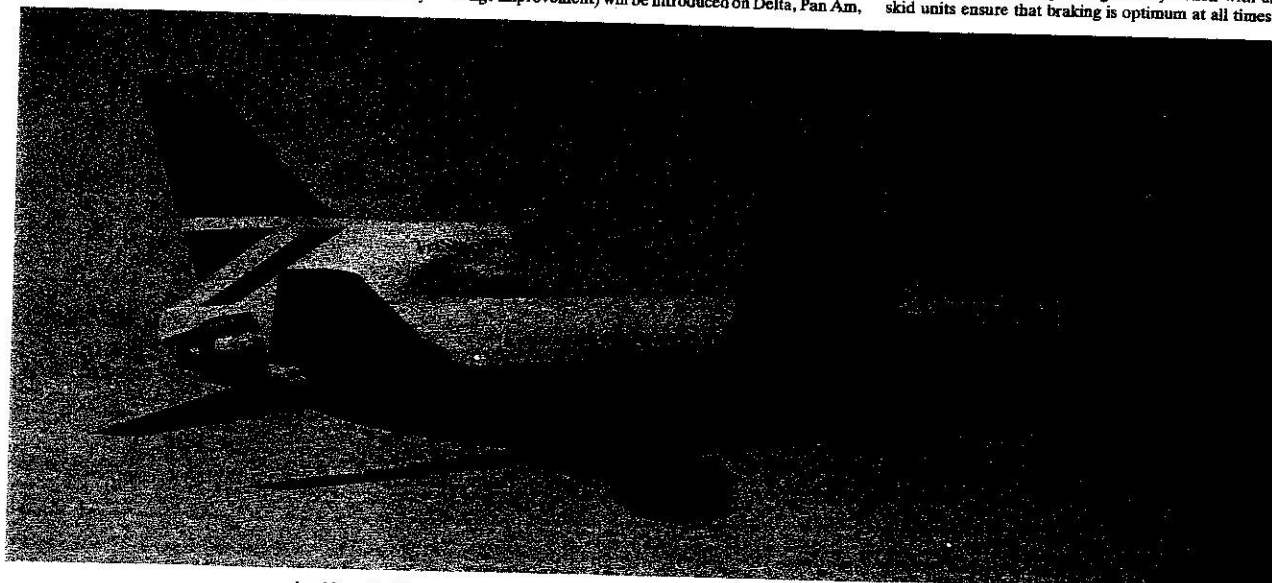
LTV and Air Canada -500s during 1980-81, and will also be standard on the TAP aircraft.

**L-1011-600.** Proposed short/medium-range version with a fuselage 6.48 m (21 ft 3 in) shorter than that of the L-1011-500, new wing centre-section but retaining the outer wing panels of the L-1011-1, a new tail unit which eliminates the mounting for the third engine but retains the tailplane-elevator and fin-rudder assemblies of the L-1011-1, and two RB.211-524B engines the same as those which power the L-1011-500. Max T-O weight would vary between 119,750 kg (264,000 lb) and 134,715 kg (297,000 lb), providing accommodation for 174-200 passengers over ranges of up to 2,700 nm (5,000 km; 3,107 miles).

**L-1011-600A.** Proposed version of the L-1011-600, with a new supercritical wing, advanced high-lift system, and new tail unit, all constructed from high technology materials. Power plant and accommodation as for -600, but max T-O weight 119,750 kg (264,000 lb). Changed external dimensions include: wing span 43.51 m (142 ft 9 in); length overall 42.98 m (141 ft 0 in); height overall 16.15 m (53 ft 0 in); wing area 210.3 m<sup>2</sup> (2,264 sq ft).

**Advanced TriStar.** The original TriStar prototype (N1011) continues in use by Lockheed, under the name Advanced TriStar, to test and develop new ideas and systems that are under consideration for inclusion in future versions of this aircraft. In early 1979, N1011 was powered by three of the latest 222.4 kN (50,000 lb st) Rolls-Royce RB.211-524 turbofan engines. Its equipment included automatic brakes, automatic take-off thrust control, a flight management system, extended wingtips, active aileron control, Autoland, direct lift control, all-moving tailplane, an area navigation system and moving map display. It was intended to install during 1979 a new digital autopilot.

Automatic brakes operating in conjunction with anti-skid units ensure that braking is optimum at all times, in



Lockheed L-1011-500 TriStar extended-range transport in the insignia of British Airways





The original prototype TriStar, now flying as the Advanced TriStar testbed for new-technology equipment and techniques

relation to load, speed and weather conditions. Automatic take-off thrust control allows the pilot to use reduced take-off power settings, and to operate from shorter field lengths than would be normal for such settings. With the throttles set to provide the requisite take-off power, in relation to field length, altitude and aircraft gross weight, failure of an engine during take-off would be offset by automatic advance of the remaining two engines to rated take-off thrust, or to a pre-set emergency power rating limit, thus minimising any time lag that might be experienced due to slow crew response.

Each wing of the Advanced TriStar has been extended at the tip by 1.37 m (4 ft 6 in), resulting in a significant reduction of induced drag, and producing fuel savings in the order of 3 per cent. However, the added span generates an increased wing lift increment which would be unacceptable under certain manoeuvre or gust loads. This required the introduction of an active control system, to provide automatic aileron deflection to offset such loads, thus eliminating the need for wing structural redesign.

By 1 December 1978, Lockheed had delivered 156 L-1011 TriStars to Air Canada, All Nippon Airways, British Airways, Cathay Pacific Airways, Court Line, Delta Air Lines, Eastern Air Lines, Gulf Air, Lufttransport Unternehmen, Pacific Southwest Airlines, Saudi Arabian Airlines and Trans World Airlines. Sales totalled 230, with options on 71 more, by 13 September 1979.

The description which follows applies to the L-1011-1 TriStar in its initial operational form, except where indicated. The basic structural details apply to all current production derivatives:

**TYPE:** Three-turboprop commercial transport.

**WINGS:** Cantilever low-wing monoplane. Special Lockheed aerofoil sections. Dihedral at trailing-edge 7° 31' on inner wings, 5° 30' outboard. Sweepback at quarter-chord 35°. The wing consists of a centre-section, passing through the lower fuselage, and an outer wing panel on each side. It is of conventional fail-safe construction, with aluminium alloy surfaces, ribs and spars, and integral fuel tanks. Hydraulically-powered aluminium alloy ailerons of conventional two-spar box construction, with aluminium alloy honeycomb trailing-edge, in inboard and outboard sections on each wing, operate in conjunction with flight spoilers. The low-speed ailerons extend from approximately 80% of semi-span to within 0.25 m (10 in) of the wingtips, the high-speed ailerons extend from approximately WBL 387 to WBL 480 on each wing. Double-slotted Fowler trailing-edge flaps, constructed of aluminium alloy and aluminium alloy honeycomb. Each flap segment consists of a honeycomb trailing-edge, a front spar, ribs, skin panels, carriages, and tracks mounted on the forward segment to provide for extension and rotation of the aft segment. A sheet metal vane surface, actuated by a linkage system during flap rotation, forms the forward section of the extended flap. Four aluminium alloy leading-edge slats outboard of engine pylon on each wing. Each segment is mounted to two roller-supported tracks and extends in a circular motion down and forward for take-off and landing. Three leading-edge slats inboard of engine pylon on each wing, made of aluminium alloy honeycomb and sheet metal fairings. Six spoilers on the upper surface of each wing, two inboard and four outboard of the inboard aileron, constructed from bonded aluminium alloy tapered honeycomb. No trim tabs. Flight controls fully powered. Each control surface system is controlled by a multiple redundant servo actuator system that is powered by four independent and separate hydraulic sources. Thermal de-icing of outboard wing leading-edge slats by engine bleed air.

**FUSELAGE:** Semi-monocoque structure of aluminium alloy. Constant cross-sectional diameter of 5.97 m (19 ft 7 in) for most of the length. Bonding utilised in skin joints, for attaching skin-doublers at joints and around openings to improve fatigue life. Skins and stringers supported by frames spaced at 0.51 m (20 in) intervals, with fail-safe straps midway between frames. These frames, with the exception of main frames and door-edge members, are 0.076 m (3 in) deep at the sides of the cabin, increasing progressively to a depth of 0.15 m (6 in) at the top of the fuselage and below the floor. Fuselage length reduced on L-1011-500.

**TAIL UNIT:** Conventional cantilever structure, consisting

of variable-incidence horizontal tailplane-elevator assembly and vertical fin and rudder. Primary loads of the fin are carried by a conventional box-beam structure, with ribs spaced at approx 0.51 m (20 in) centres. The rudder comprises forward and aft spars, glassfibre trailing-edges, hinge and actuator backup ribs, sheet metal formers, box surface panels and leading-edge fairings. Elevators are of similar construction. Truss members for the tailplane centre-section are built up from forged and extruded sections. Outboard of the centre-section, construction is similar to that of the fin box-beam, leading- and trailing-edges, except that the surface structure is integrally stiffened. The elevators are linked mechanically to the tailplane actuation gear, to modify its camber and improve its effectiveness. No trim tabs. Controls are fully powered, the hydraulic servo actuators receiving power from four independent hydraulic sources, under control of electronic flight control system. Control feel is provided, with the force gradient scheduled as a function of flight condition. No de-icing equipment.

**LANDING GEAR:** Hydraulically-retractable tricycle type, produced by Menasco Manufacturing. Twin-wheel units in tandem on each main gear; twin wheels on nose gear, which is steerable 65° on each side. Nosewheels retract forward into fuselage. Main wheels retract inward into fuselage wheel-wells. Oleo-pneumatic shock-absorbers on all units. B. F. Goodrich forged aluminium alloy wheels of split construction. Main wheels have tubeless tyres size 50 x 20-20, Type VIII, pressure 10.34-11.38 bars (150-165 lb/sq in) for short- to medium-range operational weights, 12.41 bars (180 lb/sq in) for max-range weight. Nosewheels have tubeless tyres size 36 x 11-16, Type VII, pressure 12.76 bars (185 lb/sq in). Hydraulically-operated brakes, controlled by the rudder pedals. Anti-skid units, with individual wheel skid and modulated control, installed in the normal and alternative braking systems.

**POWER PLANT (L-1011-1):** Three Rolls-Royce RB.211-22B turboprop engines, each rated at 187 kN (42,000 lb st). Two engines mounted in pods on pylons under the wings, the third mounted in the rear fuselage at the base of the fin. Engine bleed air is used to anti-ice the engine inlet lips. Two integral fuel tanks in each wing; inboard tank capacity 30,581 litres (8,079 US gallons), outboard tank capacity 14,489 litres (3,828 US gallons). Total fuel capacity 90,140 litres (23,814 US gallons). Pressure refuelling points in wing leading-edges. Oil capacity approx 34 litres (9 US gallons) per engine. A detachable pylon can be fitted between the starboard engine nacelle and fuselage to permit carriage of a replacement engine for another TriStar. Alternative power plants for -100, -200, -250 and -500 detailed under model listings. These four models each have provision for additional centre-section tankage, raising total fuel capacity to 100,317 litres (26,502 US gallons) in -100 and -200, and 119,774 litres (31,642 US gallons) in -250 and -500.

**ACCOMMODATION:** Crew of 13. First class and coach mixed accommodation for 256 passengers, with a maximum of 400 in all-economy configuration. Alternative intermediate seating capacities are provided by using eight seat-tracks which permit 6, 8, 9 or 10-abreast seating, with two full-length aisles. Underfloor galley. Seven lavatories are provided, two forward and five aft. Three Type A passenger doors of the upward-opening plug type on each side of the fuselage, one pair immediately aft of flight deck, one pair forward of wing, one pair aft of wing. Two Type I emergency exit doors, one each side of fuselage, at rear of cabin, replaced by two Type A doors for 10-abreast seating. Baggage and freight compartments beneath the floor able to accommodate 16 containers, totalling 71.58 m³ (2,528 cu ft), and 19.8 m³ (700 cu ft) bulk cargo (19 containers and 14.2 m³; 500 cu ft in -500).

**SYSTEMS:** Air-conditioning and pressurisation system, using engine bleed air or APU air combined with air-cycle refrigeration. Pressurisation system maintains equivalent of 2,440 m (8,000 ft) conditions to 12,800 m (42,000 ft). Normal cabin pressure differential 0.582 bars (8.44 lb/sq in). Four independent 207 bar (3,000 lb/sq in) hydraulic systems provide power for primary flight control surfaces, normal brake power, landing

gear retraction and nosewheel steering, etc. Electrical system includes four 120/208V 400Hz alternators, one on each engine and one driven by the APU, which is sited in the aft fuselage. APU provides ground and in-flight power, to an altitude of 9,145 m (30,000 ft), producing both shaft and pneumatic power for utilisation by the electrical, environmental control and hydraulic systems. Integral electric heaters to anti-ice windcreens, pitot masts and total temperature probes.

**AVIONICS AND EQUIPMENT:** Standard equipment includes two ARINC 546 VHF communication transceivers, two ARINC 547 VHF navigation systems, two ARINC 568 interrogator units, an ARINC 564 weather radar system, two ARINC 572 air traffic control transponders, partial provision for a dual collision system, three vertical gyros, and full blind-flying instrumentation. Space is provided for installation of two ARINC 533A HF transceivers and a dual SATCOM system.

#### DIMENSIONS, EXTERNAL:

Wing span	47.34 m (155 ft 4 in)
Wing chord at root	10.46 m (34 ft 4 in)
Wing chord at tip	3.12 m (10 ft 3 in)
Wing aspect ratio	6.95
Length overall:	
-1, -100, -200, -250	54.17 m (177 ft 8½ in)
-500	50.05 m (164 ft 2½ in)
Height overall	16.87 m (55 ft 4 in)
Tailplane span	21.82 m (71 ft 7 in)
Wheel track	10.97 m (36 ft 0 in)
Wheelbase:	
-1, -100, -200, -250	21.34 m (70 ft 0 in)
-500	19.71 m (64 ft 8 in)
Passenger doors (each): Height	1.93 m (6 ft 4 in)
Width	1.07 m (3 ft 6 in)
Height to sill	4.60 m (15 ft 1 in)
Emergency passenger doors (each):	
Height	1.52 m (5 ft 0 in)
Width	0.61 m (2 ft 0 in)
Height to sill	4.60 m (15 ft 1 in)
Baggage and freight compartment doors (forward and centre): Height	1.73 m (5 ft 8 in)
Width	1.78 m (5 ft 10 in)
Height to sill	2.72 m (8 ft 11 in)
Baggage and freight compartment doors (aft):	
Height	1.22 m (4 ft 0 in)
Width	1.12 m (3 ft 8 in)
Height to sill	2.92 m (9 ft 7 in)

#### DIMENSIONS, INTERNAL:

Cabin, excl flight deck and underfloor galley:	
Length	41.43 m (135 ft 11 in)
Max width	5.77 m (18 ft 11 in)
Max height	2.41 m (7 ft 11 in)
Floor area:	
-1, -100, -200, -250	215.5 m² (2,320 sq ft)
-500	192.6 m² (2,073 sq ft)
Volume	453 m³ (16,000 cu ft)
Baggage/cargo holds, bulk capacity:	
-1, -100, -200, -250	110.4 m³ (3,900 cu ft)
-500	118.9 m³ (4,200 cu ft)

#### AREAS:

Wings, gross	320.0 m² (3,456 sq ft)
Ailerons (total)	14.86 m² (160 sq ft)
Trailing-edge flaps (total)	49.80 m² (536 sq ft)
Leading-edge slats (total):	
inboard slats	11.52 m² (124 sq ft)
outboard slats	21.93 m² (236 sq ft)
Spoilers (total)	19.88 m² (214 sq ft)
Fin	51.10 m² (550 sq ft)
Rudder	11.89 m² (128 sq ft)
Tailplane	119.10 m² (1,282 sq ft)

#### WEIGHTS:

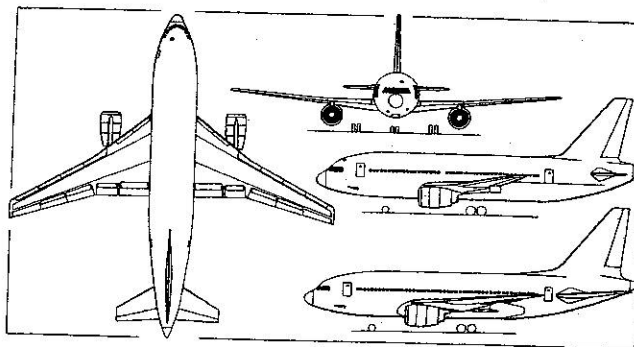
Operating weight empty:	
-1	109,045 kg (240,400 lb)
-100	110,720 kg (244,100 lb)
-200	111,495 kg (245,800 lb)
-250	112,969 kg (249,054 lb)
-500	109,298 kg (240,963 lb)
Max payload: -1	38,373 kg (84,600 lb)
-100	34,427 kg (75,900 lb)
-200	33,020 kg (72,800 lb)
-250	40,345 kg (88,946 lb)
-500	44,015 kg (97,037 lb)
Max T-O weight: -1	195,045 kg (430,000 lb)
-100	211,375 kg (466,000 lb)
-200	216,363 kg (477,000 lb)
-250, -500	224,980 kg (496,000 lb)
Max zero-fuel weight: -1	147,417 kg (325,000 lb)
-100, -200	145,150 kg (320,000 lb)
-250, -500	153,315 kg (338,000 lb)
Max landing weight: -1	162,385 kg (358,000 lb)
-100, -200, -250, -500	166,920 kg (368,000 lb)

**PERFORMANCE (A: L-1011-1 at max T-O weight of 195,045 kg; 430,000 lb; B and C: L-1011-100 and L-1011-200 respectively at max T-O weight of 211,375 kg; 466,000 lb; D and E: L-1011-250 and L-1011-500 respectively at max T-O weight of 224,980 kg; 496,000 lb, except where indicated):**

Never-exceed speed, all versions  
Mach 0.95 (435 knots; 806 km/h; 501 mph) CAS  
Max cruising speed, mid-cruise weight at 9,145 m (30,000 ft): A 520 knots (964 km/h; 599 mph)

B	515 knots (954 km/h; 593 mph)
C	530 knots (982 km/h; 610 mph)
D, E	525 knots (973 km/h; 605 mph)
Econ cruising speed, mid-cruise weight at 10,670 m (35,000 ft): A, B	480 knots (890 km/h; 553 mph)
C, D, E	485 knots (899 km/h; 558 mph)
Stalling speed at max landing weight, flaps and gear up:	
A	148 knots (274 km/h; 170 mph)
B, C, D, E	151 knots (280 km/h; 174 mph)
Stalling speed at max landing weight, flaps and gear down:	
A	108 knots (200 km/h; 124 mph)
B, C, D	109 knots (202 km/h; 126 mph)
E	111 knots (206 km/h; 128 mph)
Max rate of climb at S/L: A	856 m (2,810 ft)/min
B	765 m (2,510 ft)/min
C	847 m (2,780 ft)/min
D, E	777 m (2,550 ft)/min
Service ceiling, all versions	12,800 m (42,000 ft)
FAR T-O field length: A	2,426 m (7,960 ft)
B	3,243 m (10,640 ft)
C	2,460 m (8,070 ft)
D	2,838 m (9,310 ft)
E	2,975 m (9,760 ft)
FAR landing field length, at max landing weight:	
A	1,734 m (5,690 ft)
B, C, D	1,768 m (5,800 ft)
E	1,957 m (6,420 ft)

The projected twin-engine L-1011-600A, with additional side elevation (bottom) of L-1011-600 (Pilot Press)



Range with max passengers and baggage, international reserves: A	2,870 nm (5,319 km; 3,305 miles)
B	3,660 nm (6,783 km; 4,215 miles)
C	3,680 nm (6,820 km; 4,238 miles)
D	4,520 nm (8,376 km; 5,205 miles)
E	5,209 nm (9,653 km; 5,998 miles)
Range with max fuel, international reserves:	
A	4,360 nm (8,080 km; 5,021 miles)

B	4,820 nm (8,932 km; 5,550 miles)
C	4,880 nm (9,044 km; 5,619 miles)
D	5,900 nm (10,934 km; 6,794 miles)
E	6,150 nm (11,397 km; 7,082 miles)
OPERATIONAL NOISE CHARACTERISTICS (FAR Pt 36):	
T-O noise level	97 EPNdB
Approach noise level	103 EPNdB
Sideline noise level	95 EPNdB

### LOCKHEED-GEORGIA COMPANY

86 South Cobb Drive, Marietta, Georgia 30063

Lockheed-Georgia's main building at Marietta is one of the world's largest aircraft production plants under a single roof. Aircraft in current production on its assembly lines are the C-130 Hercules turboprop transport and its commercial counterpart, the L 100.

Lockheed-Georgia had a total of approximately 9,000 employees at the beginning of 1979.

### LOCKHEED MODEL 382 HERCULES

USAF designations: C-130, AC-130, DC-130, HC-130, JC-130, RC-130 and WC-130

US Navy designations: C-130, DC-130, EC-130 and LC-130

US Marine Corps designation: KC-130

US Coast Guard designations: EC-130 and HC-130

Canadian Armed Forces designation: CC-130

RAF designations: Hercules C.Mk 1 and W.Mk 2

The C-130 was designed to a specification issued by the USAF Tactical Air Command in 1951. Lockheed was awarded its first production contract for the C-130A in September 1952, and a total of 461 C-130As and C-130Bs was manufactured. Details of these basic versions and of many variants for special duties can be found in the 1967-68 and 1975-76 *Jane's*. Later military versions of the C-130 are as follows:

**C-130E** (Lockheed Model 382-44). Extended-range development of C-130B, with four 3,020 kW (4,050 ehp) T56-A-7 turboprop engines and two 5,145 litre (1,360 US gallon) underwing fuel tanks. Deliveries began in April 1962, and by February 1975 the planned production of a total of 503 C-130Es had been completed. Details of the basic C-130E can be found in the 1973-74 *Jane's*.

**EC-130E**. Electronic surveillance version for USAF to replace Lockheed EC-121s. Large blade antennae added above dorsal fin and under each outer wing. Smaller antennae include horizontal blade on each side of rear fuselage. Bullet-shape canisters outboard of each underwing antenna and at extreme tail of aircraft house trailing wire antennae which extend several hundred feet behind the EC-130E in flight.

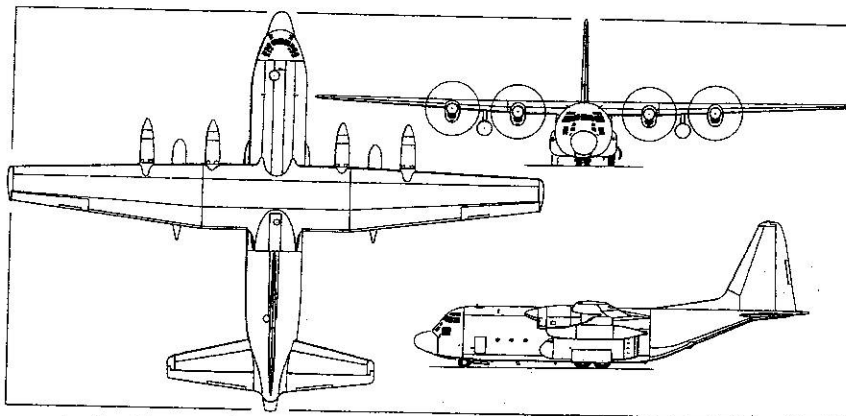
**EC-130G**. Redesignation of four C-130Gs acquired by US Navy. Equipped with VLF radio to relay emergency action messages to Fleet Ballistic Missile submarines anywhere in the world.

**C-130H**. Similar to earlier Hercules models except for more powerful engines: T56-A-15 turboprops rated at 3,661 kW (4,910 ehp) for take-off, but limited to 3,362 kW (4,508 ehp). Deliveries to USAF began in April 1975.

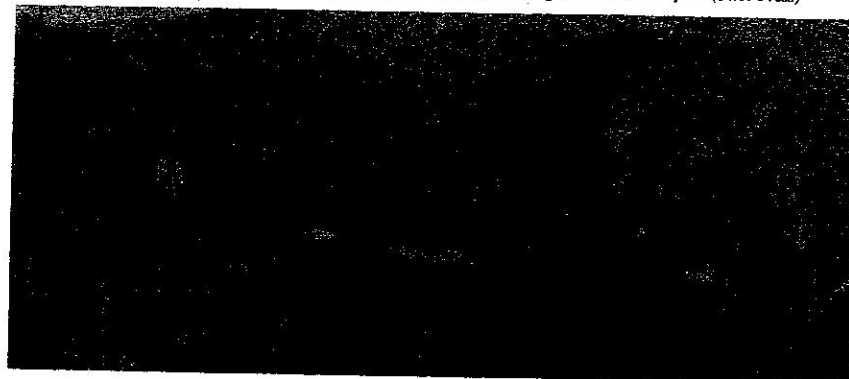
**HC-130H**. Lockheed was awarded two initial contracts in September 1963 for this extended-range air search, rescue and recovery version to be utilised by the Aerospace Rescue and Recovery Service of the USAF for aerial recovery of personnel or equipment and other duties. The US Coast Guard subsequently ordered seven. A folding nose-mounted recovery system makes possible repeated pickups from ground of persons or objects weighing up to 227 kg (500 lb) including the recoverable gear. Four 3,661 kW (4,910 ehp) (limited to 3,356 kW; 4,500 ehp) Allison T56-A-15 turboprop engines, each driving a Hamilton Standard 54H60-91 four-blade constant-speed propeller. Normal fuel tankage as for C-130H. Provision for installing two 6,184 litre (1,800 US gallon) tanks in cargo compartment. Normal crew of 10, consisting of pilot, copilot, navigator, 2 flight mechanics, radio operator, 2 loadmasters and 2 para-rescue technicians, with provision for additional pilot and navigator for long missions. Standard equipment includes four 6-man rafts, two litters,



Lockheed C-130H Hercules of the Egyptian Air Force flying near the Pyramids



Lockheed C-130E Hercules four-turboprop medium/long-range combat transport (Pilot Press)



Large fairings forward of the fin and under each wing, plus antennae canisters, distinguish the new EC-130E

bunks, 16 personnel kits, recovery winches, 10 flare launchers. Total of 66 delivered, of which the first one flew on 8 December 1964. Four modified as JHC-130H with added equipment for aerial recovery of re-entering space capsules. One modified by LAS to DC-130H.

**KC-130H**. A tanker version of the C-130H, very similar to the KC-130R. Exported to Argentina (2), Brazil (2), Israel (2), Saudi Arabia (6) and Spain (3).

**C-130K**. This is basically a C-130H, modified for use by the Royal Air Force. Much of the electronics and

high-speed procedure  
1,109 n miles (2,054 km; 1,276 miles)  
min fuel procedure  
1,216 n miles (2,252 km; 1,399 miles)  
at optional max T-O weight:  
high-speed procedure  
1,535 n miles (2,843 km; 1,766 miles)  
min fuel procedure  
1,665 n miles (3,083 km; 1,916 miles)

#### PERFORMANCE (Fokker 50 Utility):

Range:  
50 passengers 1,818 n miles (3,366 km; 2,092 miles)  
5,000 kg (11,023 lb) cargo  
1,865 n miles (3,454 km; 2,146 miles)  
48 troops 1,348 n miles (2,496 km; 1,551 miles)  
27 stretchers 2,013 n miles (3,728 km; 2,316 miles)

#### PERFORMANCE (Fokker 50 High Performance, PW127B engines): As Fokker 50/PW125B engines except:

Service ceiling OEL, typical mission weight 17,830 kg (39,308 lb), ISA 4,970 m (16,300 ft)  
T-O field length for typical mission T-O weight at S/L, ISA, 15° flap 850 m (2,790 ft)  
Landing field length for typical mission landing weight at S/L, ISA, 35° flap 1,015 m (3,330 ft)

Range with 50 passengers and baggage, reserves for 45 min continued cruise at long-range schedule and 87 n mile (161 km; 100 mile) diversion:  
at standard max T-O weight:  
high-speed procedure  
1,097 n miles (2,031 km; 1,262 miles)  
min fuel procedure  
1,186 n miles (2,196 km; 1,365 miles)

at optional max T-O weight:  
high-speed procedure  
1,521 n miles (2,817 km; 1,750 miles)  
min fuel procedure  
1,628 n miles (3,015 km; 1,873 miles)

#### OPERATIONAL NOISE LEVELS (Fokker 50):

T-O 81.0 EPNdB  
Approach 96.7 EPNdB  
Sideline 85.0 EPNdB

#### OPERATIONAL NOISE LEVELS (Fokker 50 High Performance, PW127B engines):

T-O 81.5 EPNdB  
Approach 96.7 EPNdB  
Sideline 85.0 EPNdB

### FOKKER 60

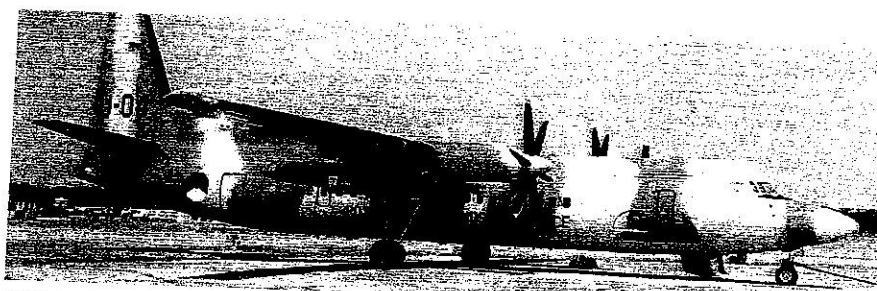
TYPE: Twin-turboprop transport; stretched version of Fokker 50.

PROGRAMME: RNetAF order for four placed February 1994 launched full development; mainly for non-airline customers; first flight (U-01) 2 November 1995; first deliveries (U-02 and U-03) 10 June 1996.

CURRENT VERSIONS: Fokker 60: Baseline aircraft. Details refer mainly to this version, but where indicated to Fokker 60 Utility.

Fokker 60 Utility: A 1.62 m (5 ft 3 3/4 in) stretched version of the Fokker 50 three-door configuration; normally equipped with upward-opening, starboard front large cargo door (height 1.78 m; 5 ft 10 in, width 3.05 m; 10 ft 0 in) and a heavy-duty floor; multipurpose door (height 1.65 m; 5 ft 5 in, width 1.30 m; 4 ft 3 3/4 in) available as an option. Fokker 60 Utility launched February 1994. Applications include:

Staff transport: As a (corporate) shuttle the Fokker 60 can carry up to 68 passengers, depending on cabin layout.



U-04, the last Fokker 60 Utility for the Royal Netherlands Air Force (Paul Jackson)

1997

The aircraft is equipped with passenger seats, overhead bins (including PSUs), carpet, toilet, galley and a rear cabin wall. **Logistics transport:** The Fokker 60 offers 34.4 m² (370 sq ft) floor area and is equipped with the large cargo door. This door allows loading of large outside items, including LD3 containers. Both aircraft can be equipped with a roller track and ballmat system. **Convertible transport:** Both the Fokker 50 Utility and Fokker 60 Utility can be changed from a passenger layout into an all-cargo aircraft. The aircraft is equipped with a removable aft cargo wall, removable overhead bins (including PSUs), passenger seats, galley and toilet. **Tactical transport:** The tactical transport version is normally equipped with the multipurpose door. The aircraft can be used for (para)troop transport, supply dropping and medical evacuation (medevac) operations. For (para)troop transport and supply dropping the aircraft is equipped with seat/litter modules (Fokker 50 Utility, 48 seats; Fokker 60 Utility, 55 seats), para/supply-dropping gear and adaptations (lighting and communication). For medevac operations the aircraft is equipped with stretchers (Fokker 50 Utility, 27 stretchers; Fokker 60 Utility, 30 stretchers).

**Fokker passenger transport:** Passenger version for 60 passengers for official or commercial use being studied. **CUSTOMERS:** RNetAF ordered four Fokker 60 Utility in February 1994 for No. 334 Squadron at Eindhoven. First flight 2 November 1995; initial deliveries (two) 10 June 1996.

**POWER PLANT:** Two 2,050 kW (2,750 shp) Pratt & Whitney Canada PW127B.

**DIMENSIONS, EXTERNAL:** As for Fokker 50 except:

Length overall 26.87 m (88 ft 2 in)  
Height overall 8.34 m (27 ft 4 1/2 in)  
Wheelbase 10.72 m (35 ft 2 in)

**DIMENSIONS, INTERNAL:** As for Fokker 50 except:

Cabin, excl flight deck: Length 16.87 m (55 ft 4 1/4 in)  
Floor area (excl toilet) 34.4 m² (370 sq ft)  
Volume 65.0 m³ (2,295 cu ft)  
Baggage/cargo volume (standard commuter version):  
Main compartment 10.9 m³ (386 cu ft)  
Overhead bins 2.6 m³ (91 cu ft)

**AREAS:** As for Fokker 50

**WEIGHTS AND LOADINGS (Fokker 60):**

Typical operating weight empty 13,328 kg (29,383 lb)  
Max fuel load 4,123 kg (9,090 lb)  
Max payload 7,372 kg (16,252 lb)  
Max ramp weight: standard 21,995 kg (48,490 lb)  
optional 22,995 kg (50,695 lb)  
Max T-O weight: standard 21,950 kg (48,391 lb)  
optional 22,950 kg (50,596 lb)  
Max landing weight 21,750 kg (47,950 lb)  
Max zero-fuel weight 20,700 kg (45,653 lb)

Max wing loading:

standard 313.6 kg/m² (64.31 lb/sq ft)  
optional 327.9 kg/m² (67.24 lb/sq ft)  
Max power loading: standard 5.35 kg/kW (8.80 lb/shp)  
optional 5.60 kg/kW (9.20 lb/shp)

**WEIGHTS AND LOADINGS (Fokker 60 Utility):**

Typical operating weight empty 12,884 kg (28,404 lb)  
Max fuel load: standard 4,123 kg (9,090 lb)  
\*optional 5,980 kg (13,184 lb)  
Max payload 7,816 kg (17,231 lb)  
Max ramp weight 22,955 kg (50,607 lb)  
Max T-O weight 22,950 kg (50,596 lb)  
Max landing weight 21,750 kg (47,950 lb)  
Max zero-fuel weight 20,700 kg (45,653 lb)  
Max wing loading 327.9 kg/m² (67.24 lb/sq ft)  
Max power loading 5.60 kg/kW (9.20 lb/shp)  
\*including optional centre-wing tanks; OWE increased by 165 kg (364 lb)

#### PERFORMANCE:

Max operating Mach No. (Mmo) 0.507  
Typical cruising speed 280 kt (519 km/h; 332 mph)  
Typical climb speed 170 kt (315 km/h; 196 mph)  
Typical descent speed 250 kt (463 km/h; 288 mph)  
Max operating altitude 7,620 m (25,000 ft)  
Service ceiling OEL, typical mission, AOW of 19,554 kg (43,109 lb), ISA 4,080 m (13,380 ft)  
T-O field length for typical mission T-O weight at S/L, ISA, 15° flap 1,054 m (3,460 ft)

Landing field length for typical mission landing weight at S/L, ISA, 35° flap 1,118 m (3,670 ft)

Range (Fokker 60) with 60 passengers and baggage, reserves for 45 min continued cruise at long-range schedule and 87 n mile (161 km; 100 mile) diversion:  
at standard max T-O weight:  
high-speed procedure  
1,108 n miles (2,052 km; 1,275 miles)

min fuel procedure  
1,188 n miles (2,200 km; 1,367 miles)  
at optional MTOW:  
high-speed procedure  
1,488 n miles (2,757 km; 1,712 miles)

min fuel procedure  
1,596 n miles (2,956 km; 1,836 miles)

Range (Fokker 60 Utility):  
60 passengers or 50 troops  
1,600 n miles (2,963 km; 1,841 miles)  
7,000 kg (15,432 lb)  
1,050 n miles (1,944 km; 1,208 miles)  
27 stretchers 1,700 n miles (3,148 km; 1,956 miles)

#### OPERATIONAL NOISE LEVELS:

Comply with ICAO Annex 16, Chapter 3/FAR Pt 36, Stage 3

UPDATED

### FOKKER 100

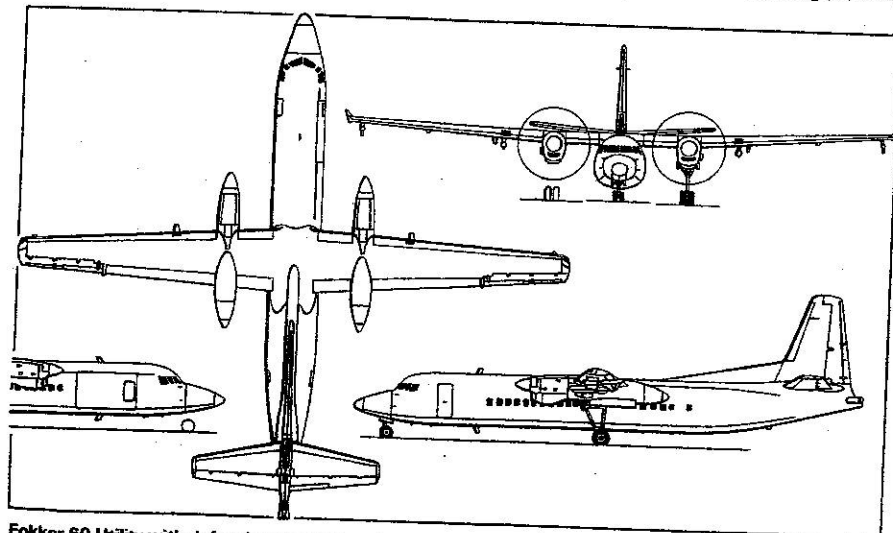
TYPE: Twin-turboprop short/medium-haul airliner.

PROGRAMME: Announced simultaneously with Fokker 50 on 24 November 1983; derived from F28 Mk 4000, which it superseded in production; built in collaboration with Daimler-Benz Aerospace Airbus and Shorts; first flights (PH-MKH) 30 November 1986 and (PH-MKC) 25 February 1987; complies with FAR Pt 36 Stage 3 noise requirements; Dutch RLD certification to JAR 25 on 20 November 1987, followed by Cat. IIIb autoland certificate June 1988.

First aircraft delivered to Swissair 29 February 1988; FAA type approval granted 30 May 1989; certification of version with the higher rated Tay Mk 650 (first flown on PH-MKH on 8 June 1988) received on 1 July 1989; first delivery of Tay Mk 650 version same day to USAir.

CURRENT VERSIONS: Fokker 100: Standard airliner; description applies to this version.

Fokker 100QC: Quick-change version manufactured as standard Fokker 100 and modified to QC specification by a subcontractor; 20 minute changeover by three-person ground crew. Modifications include large (3.40 x 1.93 m; 11 ft 2 in x 6 ft 4 in) cargo door at front on port side; 11 seat pallets (interchangeable with cargo containers). Capacity in all-cargo role for five LD9/LD7 containers plus one half-size container, or up to 11 LD3 containers. Maximum structural payload 11,500 kg (25,353 lb), range with



Fokker 60 Utility with defensive aids under wings and in the tail, plus scrap view of large door on starboard side of forward fuselage (Jane's/Mike Keep)

1995

JET FOKKER (28) 38



typical 10,000 kg (22,046 lb) cargo load estimated at more than 1,600 n miles (2,963 km; 1,841 miles). All-passenger version seats 88 with smaller overhead bins and additional side bins.

**Fokker 70:** Shortened version: described separately.

**Fokker Executive Jet 100:** VIP/Corporate Shuttle version; extended range optional on Executive Jet 100ER with belly tanks; interior custom-built.

**Fokker 130:** Planned stretched version; 30 per cent of design work completed before announcement of company bankruptcy.

Fokker marketed the Fokker 100 and Fokker 70 as the Fokker JetLine.

**CUSTOMERS:** Firm orders totalled 290 Fokker 100s by December 1995, of which 250th was delivered June 1994, although some orders were cancelled in the light of Fokker's difficulties. By March 1997, Fokker had built 283 aircraft.

Deliveries were made to: Air Europe (nine); Air Gabon (one); Air Inter (five); Air Ivoire (one); Air Littoral (four); American Airlines (75); Aviastra (four); Bangkok Airways (one); British Midland (four); China Eastern (10); Formosa Airlines (two); Garuda (five); Inter-Canadian (seven); Iran Air (seven); Ivory Coast government (one); KLM (six); Korean Air (12); Merpati Nusantara (one); Mexicana (10); Midway (eight); Palair Macedonian (three); Pelita (one); Portugalia (four); Royal Swazi National Airways Corporation (one); Sempati (nine); Swissair (10); TABA Brazil (two); TAM Brazil (22); TAT (12); Transwede (six); US Air (38). Fokker retained the two prototypes.

**DESIGN FEATURES:** Compared to F28 Mk 4000, Fokker 100 has stretched fuselage, extended and redesigned wings, Rolls-Royce Tay turbofans, completely new CRT and digital ARINC 700 flight deck, lowest OWE/seat in its class, new cabin interior, and extensively modernised systems, considerable use of composites materials.

Major options include intermediate (44,450 kg; 98,000 lb) and high (45,810 kg; 101,000 lb) maximum T-O weights, higher thrust Tay Mk 650 engines; higher capacity air conditioning system; forward toilet. Moving belt loading system.

Fokker designed transonic wing sections, offering substantially improved aerodynamic efficiency, especially at high speed; thickness/chord ratio up to 12.3 per cent on inner panels, 9.6 per cent at tip; dihedral 2° 30'; sweepback at quarter-chord 17° 27'. Fokker incorporated design changes developed for the Fokker 70 on the Fokker 100; these include modernised JetLine interior and enhanced avionics capability; both aircraft may be operated by flight crews under a common type rating.

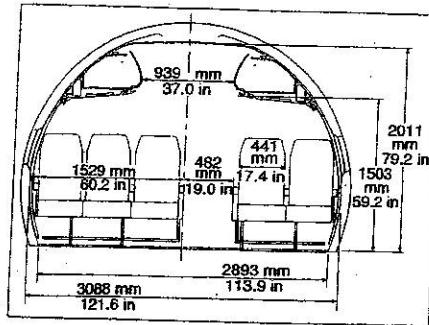
**FLYING CONTROLS:** Hydraulically actuated; fully powered ailerons (in third mode, both ailerons driven manually with assistance of unlockable servo tabs), boosted elevators with manual back-up, and powered rudder with manual third mode; variable incidence tailplane (third mode is electric operation); double-slotted Fowler flaps with electrical alternative extension; five-panel lift dumpers in front of flaps on each wing; sideways-opening airbrakes from rear end of fuselage.

**STRUCTURE:** Light alloy, fail-safe hot-bonded for 45,000-cycle crack-free life and 90,000-cycle economic repair life; except for CFRP ailerons and flaps, AFRP wing/fuselage fairing panels, honeycomb sandwich/multiple spar fin, AFRP dorsal fin, CFRP rudder, and CFRP/GFRP with Nomex core quickly detachable sandwich floor panels. Nacelles manufactured from composites materials. Daimler-Benz Aerospace Airbus built large fuselage sections and tail section, wings by Shorts; engine nacelles and thrust reversers by Northrop Grumman.

**LANDING GEAR:** Hydraulically retractable tricycle type, with twin wheels on each unit. Main units, by Menasco, retract inward into wing/body fairing; nosewheels, by Dowty, retract forward; shock-absorber in each unit; Goodyear tyres, size H40 x 14-19 on main units (pressure 9.38 bars; 136 lb/sq in), size 24 x 7.7-10 (pressure 6.21 bars; 90 lb/sq in) on nose unit; Lorain multiple-disc carbon brakes, with anti-skid and taxi brake select systems; steerable nose unit (effective angle about 76°); minimum pavement width for 180° turn, 22.2 m (72 ft 10 in).

**POWER PLANT:** Two 61.6 kN (13,850 lb st) Rolls-Royce Tay Mk 620 turbofans, fitted with thrust reversers and pylon-mounted on sides of rear fuselage; option of 67.2 kN (15,100 lb st) Tay Mk 650 turbofans. Fuel in 4,820 litre (1,274 US gallon; 1,060 Imp gallon) main tank in each wing as standard. From 1993, at same time as 45,810 kg (101,000 lb) MTOW option, an integral centre-wing tank with capacity of 3,725 litres (984 US gallons; 819 Imp gallons) became standard, and replaced original bag tanks, bringing total capacity to 13,365 litres (3,531 US gallons; 2,940 Imp gallons). Refuelling point under starboard wing, near wing/fuselage belly fairing. Oil capacity (two engines) 41 kg (90 lb).

**ACCOMMODATION:** Crew of two on flight deck; three cabin attendants. Standard accommodation for 107 passengers, in five-abreast seating at 81 cm (32 in) pitch. Optional layouts include 12 first class seats (four-abreast) at 91 cm (36 in) pitch plus 85 economy class (five-abreast) at 81 cm (32 in); 55 business class at 88 cm (34 in) plus 50 economy



Cabin cross-section of standard Fokker 100 and 70 1996

toilets, two wardrobes, two other storages/wardrobe compartments, offering a total of 8.2 m<sup>3</sup> (288 cu ft) of carry-on baggage space, including overhead bins. Oxygen system for crew and passengers. Outward- and forward-opening passenger door at front of cabin on port side. Outward- and forward-opening service/emergency door opposite on starboard side. Optional downward-opening passenger door on port side of aft cabin permits seating capacity to be increased to 122. Two overwing emergency exits (inward-opening plug type) on each side. Two underfloor baggage/cargo holds (one forward of wing, one aft), with three identical, upward-opening cargo doors on starboard side. Option for a moving belt loading system.

**SYSTEMS:** AirResearch air conditioning and pressurisation system (maximum differential 0.52 bar; 7.45 lb/sq in). Two fully independent hydraulic systems for actuation of flight control surfaces, landing gear, brakes and nosewheel steering. AirResearch pneumatic system; Sundstrand integrated drive generator electrical supply system. AirResearch thermal anti-icing system for wings and tail unit. Electric anti-icing of flight deck windows, pitot tubes, static vents, angle of attack vanes and ice detector probe. AlliedSignal GTC36-150RR APU standard, with digital control; can be started and operated up to 10,670 m (35,000 ft).

**AVIONICS:** *Comms:* Standard equipment includes dual VHF com (ARINC 716) with third optional; single ATC transponder (ARINC 718) with second optional; cockpit voice recorder (ARINC 557); digitally controlled audio management system (ARINC 736); PA system (ARINC 715); music reproducer. Dual HF com (ARINC 719) optional; Selcal (ARINC 714) optional; datalink (optional).

*Radar:* ARINC 708 weather radar.

*Flight:* Standard navigation equipment includes dual VOR with marker beacon receiver (ARINC 711); dual ILS (ARINC 710); dual DME (ARINC 709); single ADF (ARINC 712); dual radio altimeters (ARINC 707). Collins

digital aircraft flight control and augmentation system (AFCAS) for Cat. II approaches plus dual-channel full flight regime autothrottle system; Collins flight management system with integrated global positioning system (FMS/GPS) (ARINC 756); dual IRS (ARINC 704) and YRS (ARINC 705); dual digital air data systems (ARINC 706); digital flight acquisition unit (ARINC 717); flight data recorder (ARINC 717); ground proximity warning system (ARINC 723); flight warning computer system (ARINC 726) with full flight envelope protection. Options include aircraft condition monitoring system (ARINC 717); ACARS (ARINC 724); TCAS (ARINC 735); windshear warning system; Cat. IIIa or Cat. IIIb (75 m; 250 ft RVR and no DH) autoland capability; dual FMS/GPS and third IRS.

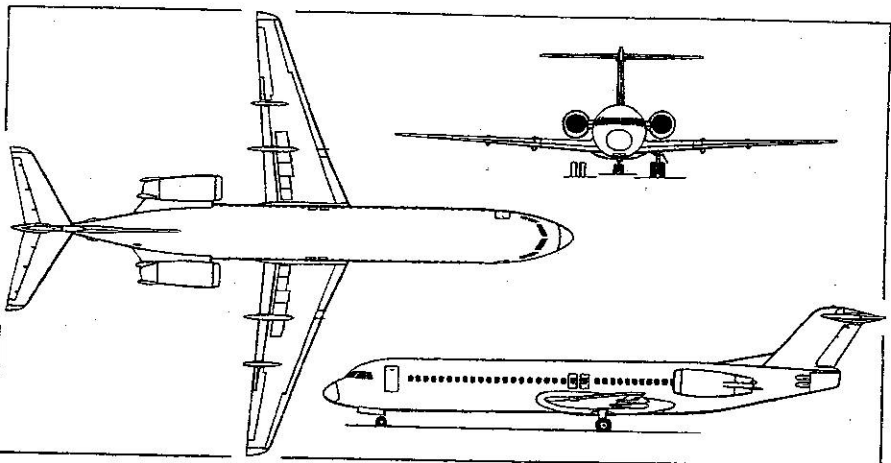
**Instrumentation:** Collins EFIS electronic flight instrument system with primary flight display (PFD) for each pilot, and multifunction display system (MFDS), consisting of two CRTs on centre flight instrument display panel. PFDs and MFDSs identical in size; dark cockpit philosophy emphasised in every system. New centralised fault display unit (CFDU) on port side of flight deck entrance has replaced maintenance test panel.

**DIMENSIONS, EXTERNAL:**

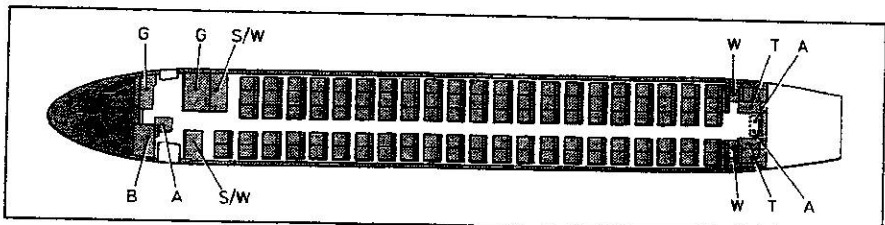
Wing span	28.08 m (92 ft 1 1/4 in)
Wing chord: at root	5.28 m (17 ft 4 in)
at tip	1.26 m (4 ft 1 1/2 in)
Wing aspect ratio	8.4
Length overall	35.53 m (116 ft 6 1/4 in)
Fuselage: Length	32.50 m (106 ft 7 1/2 in)
Max diameter	3.30 m (10 ft 10 in)
Height overall	8.51 m (27 ft 10 1/2 in)
Tailplane span	10.04 m (32 ft 11 1/4 in)
Wheel track (c/l of shock-struts)	5.04 m (16 ft 6 1/2 in)
Wheelbase	14.01 m (45 ft 11 1/2 in)
Passenger door (fwd, port): Height	1.82 m (6 ft 1 in)
Width	0.78 m (2 ft 6 1/2 in)
Service door (fwd, stbd): Height	1.30 m (4 ft 3 in)
Width	0.63 m (2 ft 1 in)
Cargo compartment doors (fwd and rear, stbd): Height (each)	1.43 m (4 ft 8 1/4 in)
Width (each)	1.44 m (4 ft 8 3/4 in)
Height to sill (MTOW): fwd hold, fwd door	1.20 m (3 ft 10 1/4 in)
fwd hold, rear door	1.27 m (4 ft 2 1/4 in)
aft hold door	1.36 m (4 ft 6 in)
Overwing emergency exits (four): Height (each)	0.91 m (3 ft 0 in)
Width (each)	0.51 m (1 ft 8 in)

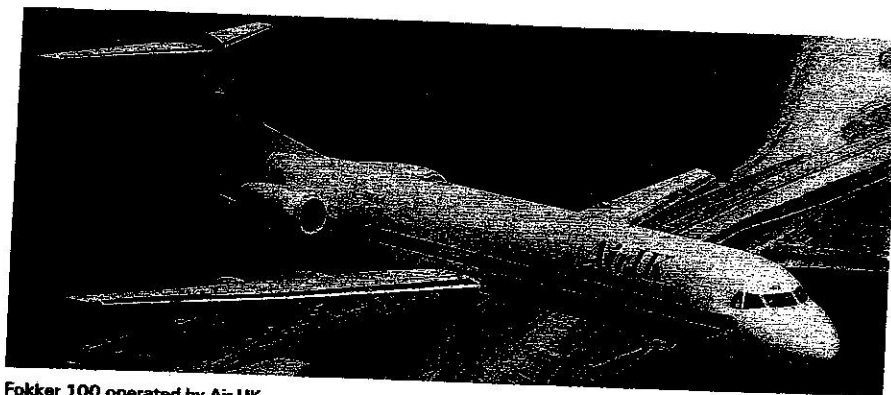
**DIMENSIONS, INTERNAL:**

Cabin, excl flight deck: Length	21.19 m (69 ft 6 1/4 in)
Max length of seating area	18.80 m (61 ft 8 1/4 in)
Max width	3.10 m (10 ft 2 in)
Width at floor	2.89 m (9 ft 5 1/2 in)
Max height	2.01 m (6 ft 7 1/4 in)
Max floor area	58.5 m <sup>2</sup> (630 sq ft)
Max volume	107.6 m <sup>3</sup> (3,799 cu ft)
Overhead storage bins (total)	5.2 m <sup>3</sup> (182 cu ft)
Additional baggage space (total)	3.0 m <sup>3</sup> (106 cu ft)



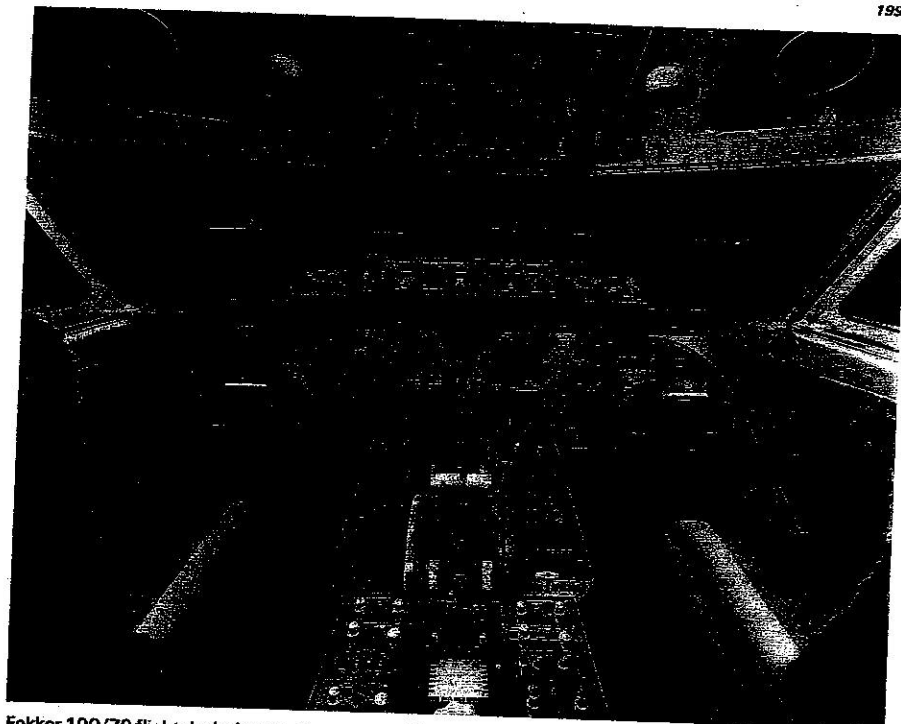
Fokker 100 short/medium-haul transport (two Rolls-Royce Tay turbofans) (Jane's/Dennis Punnett) 1993





Fokker 100 operated by Air UK

1996

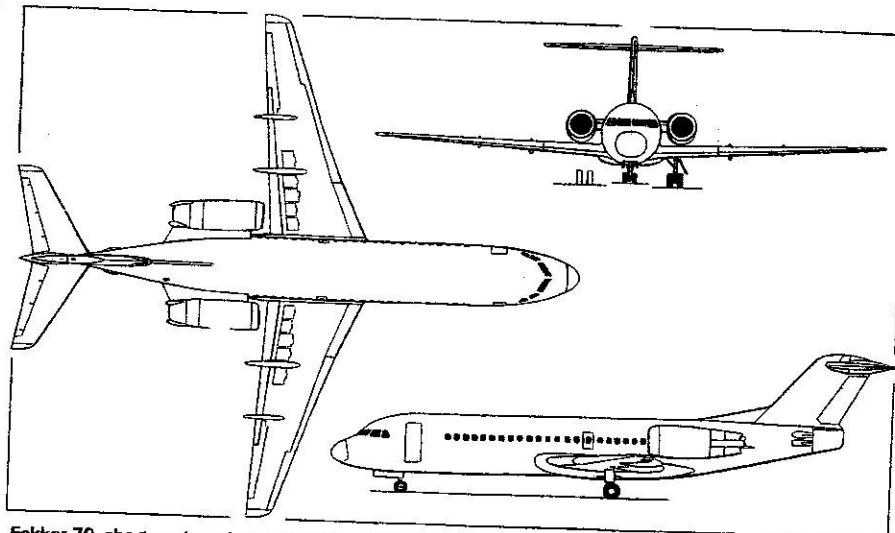


Fokker 100/70 flight deck showing large-screen EFIS, control systems displays and two flight management control and display panels on centre console. Autopilot controls are just beneath the glareshield

1996

Underfloor compartment volume:	
fwd	9.5 m <sup>3</sup> (335 cu ft)
aft	7.2 m <sup>3</sup> (256 cu ft)
AREAS:	
Wings, gross	93.50 m <sup>2</sup> (1,006.4 sq ft)
Ailerons (total)	3.53 m <sup>2</sup> (37.98 sq ft)
Trailing-edge flaps (total)	17.08 m <sup>2</sup> (183.85 sq ft)
Lift dumpers, total	5.30 m <sup>2</sup> (57.05 sq ft)
Fins	10.00 m <sup>2</sup> (107.64 sq ft)
Rudder	2.30 m <sup>2</sup> (24.76 sq ft)
Tailplane	17.76 m <sup>2</sup> (191.20 sq ft)
Elevators (total)	3.96 m <sup>2</sup> (42.63 sq ft)
Airbrakes (total)	3.62 m <sup>2</sup> (38.97 sq ft)
WEIGHTS AND LOADINGS (A: standard weights, Tay 620, B: intermediate gross weight and Tay 650, C: high gross weight and Tay 650):	
Typical operating weight empty:	
A	24,593 kg (54,217 lb)
B	24,727 kg (54,514 lb)
C	24,747 kg (54,558 lb)
Max payload (weight-limited): A	
B	11,108 kg (24,486 lb)
C	12,013 kg (26,486 lb)
B	11,993 kg (26,442 lb)
Max ramp weight: A	
B	43,320 kg (95,500 lb)
C	44,680 kg (98,500 lb)
B	46,040 kg (101,500 lb)
Max T-O weight: A	
B	43,090 kg (95,000 lb)
C	44,450 kg (98,000 lb)
B	45,810 kg (101,000 lb)
Max landing weight: A	
B, C	38,780 kg (85,500 lb)
B, C	39,915 kg (88,000 lb)
Max zero-fuel weight: A	
B, C	35,830 kg (78,990 lb)
B, C	36,740 kg (81,000 lb)
Max wing loading: A	
B	460.8 kg/m <sup>2</sup> (94.39 lb/sq ft)
C	475.4 kg/m <sup>2</sup> (97.37 lb/sq ft)
B	489.9 kg/m <sup>2</sup> (100.35 lb/sq ft)
Max power loading: A	
B	350 kg/kN (3.43 lb/lb st)
C	331 kg/kN (3.25 lb/lb st)
C	341 kg/kN (3.34 lb/lb st)

PERFORMANCE (A, B and C as in Weights and Loadings):	
Max operating Mach No.	0.77
Max operating speed at 7,770 m (25,500 ft), ISA:	
A, B, C	462 kt (856 km/h; 532 mph)
Approach speed at max landing weight:	
A	128 kt (237 km/h; 147 mph)
B, C	130 kt (241 km/h; 150 mph)
Service ceiling	10,670 m (35,000 ft)



Fokker 70, shortened version of the Fokker 100 (Jane's/Dennis Punnett)

1993

A	1,855 m (6,090 ft)
B	1,720 m (5,645 ft)
C	1,825 m (5,990 ft)
FAR landing field length at S/L, ISA, at max landing weight: A	
B, C	1,320 m (4,330 ft)
B, C	1,350 m (4,420 ft)
Range with 107 passengers and baggage:	
A	1,290 n miles (2,389 km; 1,484 miles)
B	1,550 n miles (2,870 km; 1,784 miles)
C	1,680 n miles (3,111 km; 1,933 miles)
OPERATIONAL NOISE LEVELS: Comply with FAR Pt 36 Stage 3, ICAO Annex 16 Chapter 3, Washington National night time limits and Orange County (SNA) Class E exempt (A, B and C as for Weights and Loadings):	
T-O, flyover, actual: A	83.4 EPNdB
B	81.8 EPNdB
C	82.7 EPNdB
T-O, flyover, margin to Pt 36, St 3: A	-5.6 EPNdB
B	-7.2 EPNdB
C	-6.3 EPNdB
T-O, sideline, actual: A	89.3 EPNdB
B	91.7 EPNdB
C	91.6 EPNdB
T-O, sideline, margin to Pt 36, St 3: A	-3.4 EPNdB
B	-3.2 EPNdB
C	-3.4 EPNdB
Approach, actual: A	93.1 EPNdB
B	93.0 EPNdB
C	93.0 EPNdB
Approach, margin to Pt 36, St 3: A	-5.6 EPNdB
B	-5.8 EPNdB
C	-5.9 EPNdB

UPDATED

## FOKKER 70

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

PROGRAMME: Authorisation to proceed given November 1992; programme launched June 1993 with orders for 15 aircraft (see Customers); fuselage structure derived from Fokker 100 by removing two fuselage plugs (one forward and one aft of wing); assembled on same production line as Fokker 100; built in collaboration with Daimler-Benz Aerospace Airbus (fuselage sections) and Shorts (wing); modification of second Fokker 100 prototype into Fokker 70 configuration started 9 October 1992; first flight (PH-MKC) 2 April 1993; final assembly of first production aircraft started February 1994; first flight (PH-MKS) 12 July 1994; RLD and FAA certification granted 14 October 1994; first delivery (N322K ex PH-MKS to Ford Motor Company) 25 October 1994; UK CAA certification April 1995.

CURRENT VERSIONS: Fokker 70: Standard airliner; description applies to this version.

Fokker Executive Jet 70: VIP/corporate shuttle version; extended range available optionally with belly tanks; interior custom built. First delivery 25 October 1994 to Ford Motor Company.

Fokker Executive Jet 70ER: Long-range executive version with increased fuel capacity extending range to 3,237 n miles (6,000 km; 3,728 miles); first (and so far only) delivery 15 December 1995 to Kenyan government. CUSTOMERS: Firm orders totalled 71 by December 1995, some of which were cancelled. By March 1997, 48 Fokker 70s had been produced and delivered to Air Littoral (five); Austrian Air Lines (four); Avianova (six); British Midland (three); Dutch government (one); Ford Motor Co (three);

JET FOKKER 70



Fokker 70 twin-turboprop short/medium-haul airliner of Alitalia regional subsidiary, Avianova

1996

Malev (three); Kenyan Air Force (one); KLM Cityhopper (10, of which two later transferred to Austrian); Mountain West (two); Pelita (one); Sempati (two); Silkair (two); Tyrolean A/W (three); Vietnam Airlines (two).

**DESIGN FEATURES:** Fuselage 4.62 m (15 ft 2 in) shorter than Fokker 100; one pair of overwing emergency exits removed; Rolls-Royce Tay Mk 620 turboprops; downward-opening passenger door with integral stairs; digital ARINC 700 CRT flight deck.

Major options include intermediate (38,100 kg; 84,000 lb) and high (41,730 kg; 92,000 lb) maximum T-O weights, forward-opening passenger door, Cat. IIIa autoland capability, integral centre-wing tank, second rear toilet, forward toilet.

Fokker 70 features Fokker 100's transonic wing, offering substantially improved aerodynamic efficiency, especially at high speed; thickness/chord ratio up to 12.3 per cent on inner panels, 9.6 per cent at tip; dihedral 2° 30'; sweepback at quarter-chord 17° 27'.

**FLYING CONTROLS:** As Fokker 100. Full-time autothrottle; autopilot protection of minimum speed, maximum alpha and maximum speed.

**STRUCTURE:** As Fokker 100. Deutsche Aerospace Airbus built large fuselage sections and tail section, Shorts the wings; Northrop Grumman was subcontractor for engine nacelles and thrust reversers.

**LANDING GEAR:** Dunlop tyres size H40 x 14-19 on main units (pressure 8.07 bars; 117 lb/sq in), size 24 x 7.7-10 on nose unit (pressure 6.14 bars; 89 lb/sq in); Lorol multiple disc carbon brakes, with anti-skid and taxi brake select systems; minimum pavement width for 180° turn: 18.87 m (61 ft 10 in); steering unlocks after nosewheel is deflected more than 76°; tiller used while taxiing and rudder pedals during take-off/landing.

**POWER PLANT:** Two 61.6 kN (13,850 lb st) Rolls-Royce Tay Mk 620 turboprops, fitted with thrust reversers and pylon-mounted on sides of rear fuselage. Fuel in 4,820 litre (1,274 US gallon; 1,060 Imp gallon) main tank in each wing as standard. Optional integral centre-wing tank of 3,725 litres (984 US gallons; 819 Imp gallons) brings total capacity to 13,365 litres (3,531 US gallons; 2,940 Imp gallons). Refuelling point under starboard wing, near wing-fuselage belly fairing. Oil capacity (two engines) 41 kg (90 lb).

**ACCOMMODATION:** Crew of two on flight deck; two cabin attendants. Standard accommodation for 79 passengers in five-abreast seating at 78.5/81 cm (31/32 in) pitch; 80-passenger version also available. Standard layout includes one galley (forward, starboard), one toilet (aft, port), three wardrobes (one forward, starboard, and two aft, port and starboard), and two stowages (one forward, port, and one aft, starboard), offering a total of 8.8 m³ (311 cu ft) of carry-on baggage space (including overhead bins). Outward- and downward-opening passenger door with integral stairs at front of cabin on port side. Outward- and forward-opening service/emergency door opposite on starboard side. Optional passenger door opens outward and forward. One overwing emergency exit (inward-opening plug type) on each side. Two underfloor baggage/cargo holds (one forward of wing, one aft), with two upward-opening doors on starboard side.

**SYSTEMS:** AiResearch air conditioning and pressurisation system (maximum differential 0.52 bar; 7.45 lb/sq in). Two fully independent hydraulic systems for actuation of flying control surfaces, landing gear, brakes and nosewheel steering. AiResearch pneumatic system. Sundstrand integrated drive generator electrical supply system. Oxygen system for flight crew and passengers. AiResearch thermal anti-icing system for wings and tail unit. Electric anti-icing of flight deck windows, pitot tubes, static vents, angle of attack vanes and ice detector probe.

AlliedSignal GTPC36-150RR APU standard, with digital control; can be started and operated up to 10,670 m (36,000 ft).

**AVIONICS:** As for Fokker 100.

**DIMENSIONS, EXTERNAL:** As for Fokker 100 except:

Length overall	30.91 m (101 ft 4 3/4 in)
Fuselage: Length	27.88 m (91 ft 5 1/2 in)
Wheelbase	11.54 m (37 ft 10 1/2 in)
Passenger door (fwd, port): Height	1.91 m (6 ft 3 1/4 in)
Width	0.86 m (2 ft 9 1/4 in)
Cargo compartment door (fwd): Height	1.43 m (4 ft 8 1/4 in)
Width	1.44 m (4 ft 8 3/4 in)
Cargo compartment door (aft): Height	1.22 m (4 ft 0 in)
Width	0.97 m (3 ft 2 1/4 in)

**DIMENSIONS, INTERNAL:**

Cabin, excl flight deck: Length	16.57 m (54 ft 4 1/4 in)
Max length of seating area	13.31 m (43 ft 8 in)
Max width	3.10 m (10 ft 2 in)
Max height	2.01 m (6 ft 7 in)
Max width at floor	2.89 m (9 ft 5 1/2 in)
Max floor area	45.1 m² (485 sq ft)
Max volume	84.0 m³ (2,967 cu ft)
Overhead stowage bins (total)	3.8 m³ (133 cu ft)
Additional baggage space	5.0 m³ (178 cu ft)
Fwd cargo hold	8.2 m³ (288 cu ft)
Aft cargo hold	4.6 m³ (163 cu ft)

**AREAS:** As for Fokker 100

**WEIGHTS AND LOADINGS:** (A: standard weights and fuel capacity; B: intermediate gross weight and optional fuel capacity; C: high gross weight and optional fuel capacity; D: highest gross weight and optional fuel capacity):

Typical operating weight empty	22,784 kg (50,230 lb)
Max payload (weight-limited): A	9,190 kg (20,260 lb)
B	9,870 kg (21,760 lb)
C, D	10,780 kg (23,766 lb)
Max ramp weight: A	36,965 kg (81,500 lb)
B	38,325 kg (84,500 lb)
C	40,140 kg (88,500 lb)
D	41,957 kg (92,500 lb)
Max T-O weight: A	36,740 kg (81,000 lb)
B	38,100 kg (84,000 lb)
C	39,915 kg (88,000 lb)
D	41,730 kg (92,000 lb)
Max landing weight: A (normal)	34,020 kg (75,000 lb)
A (optional), B (normal)	35,830 kg (79,000 lb)
B (optional), C	36,740 kg (81,000 lb)
Max zero-fuel weight: A	31,975 kg (71,500 lb)
B	32,655 kg (72,000 lb)
C	33,365 kg (74,000 lb)

Max wing loading: A	392.9 kg/m² (80.48 lb/sq ft)
B	407.5 kg/m² (83.47 lb/sq ft)
C	426.9 kg/m² (87.44 lb/sq ft)
D	446.3 kg/m² (91.41 lb/sq ft)
Max power loading: A	298 kg/kN (2.92 lb/lb st)
B	309 kg/kN (3.03 lb/lb st)
C	324 kg/kN (3.18 lb/lb st)
D	339 kg/kN (3.32 lb/lb st)

**PERFORMANCE (A, B, C, D as in Weights and Loadings):**

Max operating Mach No.	0.77
Max operating speed at 7,770 m (25,500 ft), ISA:	
A, B, C	462 kt (856 km/h; 532 mph)
Approach speed at max landing weight:	
A	119 kt (220 km/h; 137 mph)
B	122 kt (226 km/h; 140 mph)
C	123 kt (228 km/h; 141 mph)
Service ceiling	10,670 m (35,000 ft)
T-O field length at S/L, ISA, at max landing weight:	
A	1,305 m (4,285 ft)
B	1,395 m (4,580 ft)
C	1,550 m (5,085 ft)
D	1,665 m (5,465 ft)
Landing field length at S/L, ISA, at max landing weight:	
A	1,215 m (3,990 ft)
B	1,255 m (4,120 ft)
C	1,274 m (4,180 ft)

**Range with 79 passengers and baggage:**

A	1,070 n miles (1,981 km; 1,231 miles)
B	1,415 n miles (2,620 km; 1,628 miles)
C	1,855 n miles (3,435 km; 2,134 miles)
D	2,015 n miles (3,731 km; 2,318 miles)

**OPERATIONAL NOISE LEVELS:** Comply with FAR Pt 36 Stage 3, ICAO Annex 16 Chapter 3. (A, B, C, D as in Weights and Loadings):

T-O (flyover, actual): A	76.8 EPNdB
B	77.7 EPNdB
C	78.8 EPNdB
D	80.1 EPNdB
T-O (flyover, margin): A	-12.2 EPNdB
B	-11.3 EPNdB
C	-10.2 EPNdB
D	-8.9 EPNdB
T-O (sideline, actual): A	89.9 EPNdB
B	89.8 EPNdB
C	89.6 EPNdB
D	89.5 EPNdB
T-O (sideline, margin): A	-4.3 EPNdB
B	-4.5 EPNdB
C	-4.9 EPNdB
D	-5.2 EPNdB
Approach, actual: A	87.7 EPNdB
B	88.1 EPNdB
C	88.3 EPNdB
D	88.3 EPNdB
Approach, margin: A	-9.9 EPNdB
B	-10.0 EPNdB
C	-10.1 EPNdB
D	-10.3 EPNdB

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