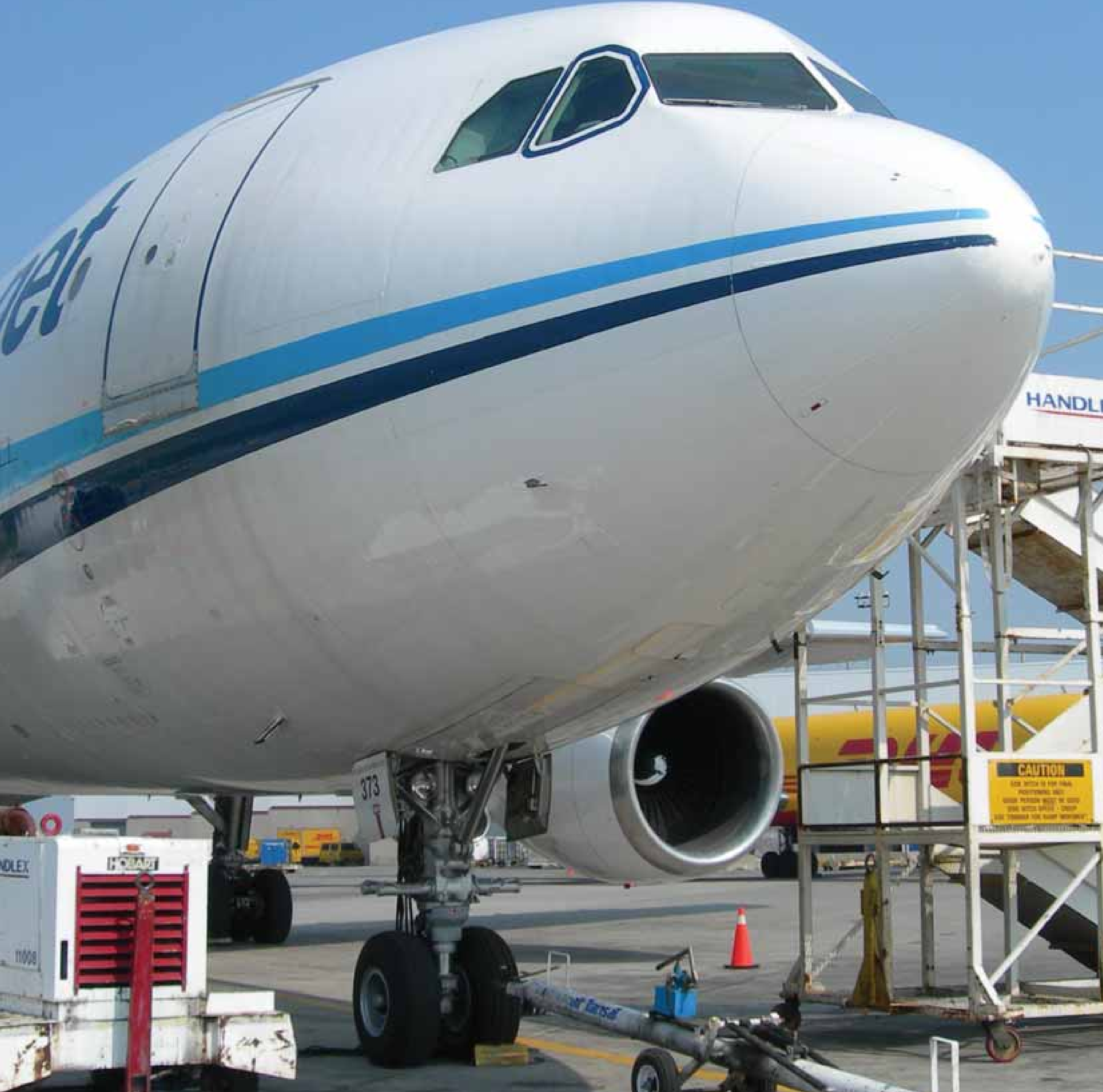
AIRCRAFT OWNER'S & OPERATOR'S GUIDE: A300B2/B4



A300B2/B4 specifications

The A300 is split into variants; the B2 and B4. Each of these is further split into two light and high gross weight sub-variants.

The fuselage size and seat capacity of the A300 changed several times during the aircraft's conception. The A300 was the first Airbus and was built to serve high-density, short- and medium-haul markets. The eventual fuselage design is shared by the two main models: the -B2 and -B4.

The fuselage cross-section became the standard fuselage for all subsequent Airbus widebodies, except for the A380. This standard fuselage allows an eight-abreast seat arrangement in the economy cabin, with 21-inch wide seats in a 2-4-2 arrangement. With all-economy seating in this format and a seat pitch of 32 inches, the aircraft has a maximum seat capacity of 280. Two-class seat capacity is about 270, and tri-class capacity is about 250 seats.

Specifications

The main difference between the A300B2 and A300B4 is fuel volume and gross structural weight. The A300B2 only uses wing tanks for fuel and has a capacity of 11,620 US Gallons (USG) *(see table, page 11)*. This gave the A300B2 a range of up to 1,700nm with a load of 250 passengers *(see table, page 11)*.

Early in the A300's development it became clear that this range did not give the aircraft enough flexibility when its seat size was considered. The use of a centre fuel tank in the A300B4 increased volume to 16,380 USG, giving it a range of up to 2,900nm *(see table, page 11)*.

The use of higher fuel capacity in the A300B4 is accompanied by higher structural weights that are required by the aircraft to increase its payload-range capability.

There are several sub-variants of the A300B2 and A300B4. The A300B2 has the B2-100 and B2-200, while the A300B4 has the B4-100 and B4-200. These differ in specification weights.

The A300B2 and A300B4 are powered by the Pratt & Whitney JT9D-59A/B and CF6-50C/-50C2. Only four customers, however, selected the JT9D, for a total of 25 aircraft. The remaining 223 A300B2s/B4s built were powered by the CF6-50C/50C2.

Nomenclature of -B2-100, -B2-200, -B4-100 and -B4-200 variants indicates which engine types power the aircraft. All aircraft with a -101, -101A/B and -201 suffix are powered by CF6-50C engines rated at 51,000lbs thrust. Aircraft with a -103 and -203 suffix are powered by CF6-50C2 engines rated at 52,500lbs thrust.

Aircraft with a -120 and -220 suffix are powered by JT9D-59A engines, while aircraft with a -221 suffix are powered by JT9D-59B engines, both of which are rated at 53,000lbs thrust.

Airbus used a 'forward facing crew cockpit' (FFCC) two-man flightdeck late in the A300's development, which automated many of the flight engineer's functions and so dispensed with this role. The FFCC flightdeck retains the A300B2's/B4's analogue flightdeck, however. The FFCC was first used on the A300 in 1981 for B4-200 series aircraft built for Garuda. At the time, this made the A300B2/B4 the largest aircraft to utilise a two-man flightdeck. A total of 15 A300B2/B4s were built with the FFCC. The FFCC was further developed for use in the A310 and A300-600.

A300B2

The A300B2-100 has a maximum take-off weight (MTOW) of 302,030lbs, giving it a range of 1,450nm with 250 passengers *(see table, page 11)*. The aircraft also has a maximum zero fuel weight (MZFW) of 281,090lbs. A typical operating empty weight (OEW) of 189,459lbs gives the aircraft a structural payload of 67,381lbs.

This is utilised to carry the passenger payload plus additional belly freight. The A300B2 and -B4 can accommodate 20 LD-3 containers in the underfloor compartment, which provide 2,920 cubic feet of volume. Once about 55,000lbs has been deducted for the weight of 250 passengers and baggage, the A300B2-100 can accommodate a further 12,000lbs of freight.

A total of 30 A300B2-100s were built, all of which are powered by CF6-50C/-50C2 engines. This included aircraft with manufacturer serial numbers (MSN) from 003, built in 1973, to MSN 132, built in 1981. Major A300B2-100 customers included Iran Air, Air France, Air Inter, Lufthansa and Indian Airlines.

The A300B2-200 has a higher MTOW of 313,050lbs *(see table, page 11)*, and a range of about 1,700nm. The aircraft also has an MZFW of 265,700lbs and OEW of 196,400lbs, allowing a gross structural payload of 69,300lbs. This allows up to 14,000lbs of belly freight to be carried over a full passenger payload.

A total of nine A300B2-200s were built between 1977 and 1982, all equipped with CF6-50C2 engines, eight of which were ordered by Iran Air.

A group of late production B2-200s utilised the FFCC. Three A300B2-203FFs were built for VASP of Brazil.

In addition to the basic A300B2-100 and -200 models, Airbus also developed a special high performance variant with Kruger flaps that improved the aircraft's field performance for operations from hot and high airfields. The Kruger flaps gave the aircraft the -B2K designation in its nomenclature.

The B2K-100 has the same weight specifications as the -B2-100, while the -B2K-200 has the same weight specifications as the -B2-200.

Eight -B2K-100s were built for TOA Domestic Airlines of Japan, and five -B2K-200s for South African Airways and TOA Domestic. All 13 aircraft were powered by CF6-50C2R engines and delivered between 1976 and 1983.

A300B4

As described, the A300B4 utilises a centre wing fuel tank, giving it a total fuel volume of 16,380 USG and extending its range over the A300B2.

The lower gross weight A300B4-100 has an MTOW of 347,220lbs and range of 2,550nm *(see table, page 11)*. There are three sub-types of the A300B4-100: the -101 powered by the CF6-50C; the -B4-103 powered by the CF6-50C2; and the -B4-120 powered by the JT9D-59A.

The -B4-100 has an MZFW of 273,400lbs and OEW of 199,900lbs, giving it a maximum structural payload of 73,500lbs. This allows the aircraft to carry up to 18,000lbs freight in addition to a full complement of passengers.

A total of 51 A300B4-100s were delivered, from 1975 to 1982. Production of the longer range B4-100/-200 series aircraft started just two years after the first B2-100s were delivered.

The first main group of B4-100s comprised 41 aircraft powered by CF6-50C2 engines. Major customers were Korean Air, Eastern Airlines, Thai and Olympic Airways.

The second group of A300B4-100s consisted of 10 aircraft equipped with JT9D-59A engines built for SAS and

Iberia.

The -B4-200 is a higher gross weight aircraft, with an MTOW of 363,760lbs and range of 2,900nm *(see table, this page)*. This range was almost twice that of the original A300B2-100, and the A300B4-200's capability made it the most popular A300B2/B4 model.

A total of 137 A300B4-200s were built between 1974 and 1984. There were four main sub-types.

Two sub-types were powered by CF6-50C2 engines. The first of these comprised 119 A300B4-200s, including one A300C4 with a deactivated door. Main customers were Air France, Olympic Airways, Lufthansa, Malaysian Airlines System, Pakistan International Airlines, Alitalia, Singapore Airlines, Thai, Eastern Airlines, Air India, Egyptair, Pan Am and Air Afrique.

The second group was three A300B4-200FFs built for Finnair and Tunis Air.

The two remaining sub-types were powered by JT9D-59A engines. The first group was six A300B4-220s built for China Airlines between 1982 and 1983, and the second was nine A300B4-220FFs built for Garuda.

The A300B4-200 has an MZFW of 277,800lbs and OEW of 200,700lbs, which give the aircraft a structural payload of 77,100lbs *(see table, this page)*. After accounting for a full passenger payload, the aircraft can accommodate a payload of about 22,000lbs belly freight.

A300C4/F4

Only six aircraft were built with a side freight door. These were manufactured to A300B4-200 standards. All six aircraft are equipped with CF6-50C2 engines. Three A300C4-200s were built for Hapag-Lloyd, South African Airways and TOA Domestic Airlines. The last aircraft later had its freight door de-activated and became an A300B4-203. A fourth A300B4-203 was built for Thai and later converted to an A300C4-203. Another two aircraft were originally built as A300C4s, but these were later converted to A300F4-203s for Korean Air.

The A300C4-200 was a convertible aircraft, and could therefore be operated in either passenger or freighter modes. Switching from passenger to freighter mode would require removal of most of the interior furnishings associated with passenger facilities.

In freighter mode, the A300C4/F4-200 has a maximum payload of 88,184lbs and several freight configuration options available for freight carriage.

One option is for nine 96-inch X 125-inch containers plus five 88-inch X 125-inch containers in a single row. This provides 8,666 cubic feet of containerised volume. When added to the 2,920 cubic feet provided by the 20 LD-3 belly containers, the total volume available is 11,586 cubic feet.

A second option is for 20 88-inch X 108-inch containers in two rows, and a third is for 18 88-inch X 125-inch containers in two rows *(see table, this page)*, which provide 8,372 cubic feet and 8,360 cubic feet of freight volume. Belly volume takes the total for these two configurations to 11,292 and 11,280 cubic feet. AC

A300B2-100 SERIES GROSS WEIGHT & ENGINE CONFIGURATIONS

Variant	A300B2-101	A300B2-103	A300B2K-103
MTOW lbs	302,030	302,030	302,030
Structural payload lbs	67,381	67,381	67,381
Fuel volume USG	11,620	11,620	11,620
Tri-class seats	250	250	250
Range nm	1,450	1,450	1,450
Belly freight capacity	20 LD-3	20 LD-3	20 LD-3
Engine options	CF6-50C	CF6-50C2	CF6-50C2R
Engine thrust	51,000	52,500	52,500
Number built	10	20	8

A300B2-200 SERIES GROSS WEIGHT & ENGINE CONFIGURATIONS

Variant	A300B2-203	A300B2-203FF	A300B2K-203
MTOW lbs	313,050	313,050	313,050
Structural payload	69,300	69,300	69,300
Fuel volume USG	11,620	11,620	11,620
Tri-class seats	250	250	250
Range nm	1,700	1,700	1,700
Belly freight capacity	20 LD-3	20 LD-3	20 LD-3
Engine options	CF6-50C2	CF6-50C2	CF6-50C2R
Engine thrust	52,500	52,500	52,500
Number built	9	3	5

A300B4-100/-200 SERIES GROSS WEIGHT & ENGINE CONFIGURATIONS

Variant	A300B4-103	A300B4-120	A300B4-203/ -203FF	A300B4-220/ -220FF
MTOW lbs	347,220	347,220	363,760	363,760
Structural payload	73,500	73,500	77,100	77,100
Fuel volume USG	16,380	16,380	16,380	16,380
Tri-class seats	250	250	250	250
Range nm	2,550	2,550	2,900	2,900
Belly freight capacity	20 LD-3	20 LD-3	20 LD-3	20 LD-3
Engine options	CF6-50C2	JT9D-59A	CF6-50C2	JT9D-59A
Engine thrust	52,500	53,000	52,500	53,000
Number built	41	10	119/ 3	6/ 9

A300C4/F4-200 SERIES GROSS WEIGHT & ENGINE CONFIGURATIONS

Variant	A300C4-203 Passenger mode	A300C4-203 Freighter mode	A300F4-203
MTOW lbs	363,760	363,760	363,760
Structural payload	78,264	88,184	93,120
Fuel volume USG	16,380	16,380	16,380
Tri-class seats	250	N/A	N/A
Freight volume	2,920	11,280/11,292/ 11,586	11,280/11,292/ 11,586
Number built		3	2

A300 fleet analysis

There are less than 100 A300B2/B4s in operation. Two-thirds of these are freighter-configured -200 series aircraft. Most of these are owned, and this will keep supply tight.

Of the 248 A300B2/B4s delivered between 1973 and 1985, only 98 aircraft are currently active and 21 are stored. A summary of the aircraft delivered, still active and in storage is given *(see table, this page)*. While the 21 stored aircraft are officially available, the maintenance status of most is at a level where they are unlikely to operate again.

Since original delivery, 73 aircraft have been converted from passenger configuration to freighter. These aircraft were converted using either the BAE Aviation Services (39 aircraft) or DASA (34 aircraft) passenger-to-freighter modification in the mid- and late-1990s. All aircraft were A300B4-103/-203s powered by CF6-50C2 engines, of which 63 were -203s and only 10 were -103s. There are also two A300C4s and two A300F4s in active service.

Of the current fleet of 98 aircraft, 66 operate in freighter mode and only 32 in passenger configuration.

There are several major structural inspections which have high associated costs. These inspections have initial and repeat inspection intervals based on flight hours (FH) and flight cycles (FC).

One of the most important of these is the Frame 47 inspection, which relates to fatigue in the wing root area. The initial inspection has a threshold of 16,700FC and then repeat intervals of 9,400FC. Most aircraft have been operated at average cycle times in the range of 75-120 minutes. Many aircraft have operated at annual utilisations of 2,000-2,500FH.

The Frame 47 inspection requires a non-destructive test and it is estimated that repairs can result in a downtime of 30-35 days and incur a cost of about $0.5 million.

A second major inspection is the Rib 5 inspection for cracks in the fifth rib of both wings. This concerns cracking on the forward landing gear attachment. Modifications on discovery of cracks can result in high costs for rectification *(see A300B2/B4 modification & upgrade programmes, page 14)*.

Another major ageing inspection relates to the replacement of bolts on the wing bottom skin. This is due at 25,000FC and costs about $150,000 to complete *(see A300B2/B4 modification & upgrade programmes, page 14)*.

The findings and potential costs of these structural modifications have forced the retirement of many A300B2/B4s, and determine whether aircraft that are still in service will continue to be operated.

A300B2 series

There are still 13 A300B2 series aircraft in service, including six A300B2K-103s in operation with Fly Air of Turkey and Japan Airlines (JAL) Domestic. These were all originally delivered to TOA Domestic Airlines, with three aircraft being retained by JAL Domestic.

Eight A300B2-203s were delivered to Iran Air, of which four are the only examples of the type remaining in operation.

Only two of five A300B2K-203s delivered remain in service. These are with Turkish charter carriers Onur Air and SAGA Airlines. Besides Turkish carriers, there is little demand for A300B2s.

A300B4 series

Of 41 A300B4-103s built, 11 remain in service and three are in storage. Of the 11 in operation four remain in passenger configuration. These are ex-Thai and ex-Eastern aircraft operated by Mahan Air in Iran and Onur Air in Turkey. These aircraft were built between 1977 and 1979 and have accumulated 46,000-66,000 FH and 26,000-27,000 FC.

There are seven converted A300B4-100Fs in operation. Three of these are BAe Aviation Services-converted aircraft operated by Astar Cargo and TNT Express. The other four are DASA-converted aircraft operated by Channel Express and Air Contractors. These were built between 1979 and 1982 and have accumulated 34,000-46,000FH and 20,000-30,000FC.

A further two converted ex-Eastern DASA-converted A300B4-103Fs are in storage, and one more A300B4-103F is retired.

Of all remaining A300B2/B4s, only three aircraft powered by JT9D-59A engines are potentially available. These are three ex-SAS A300B4-120s now owned by Turkish carrier Bosphorus, but they are in storage and are unlikely to be operated again.

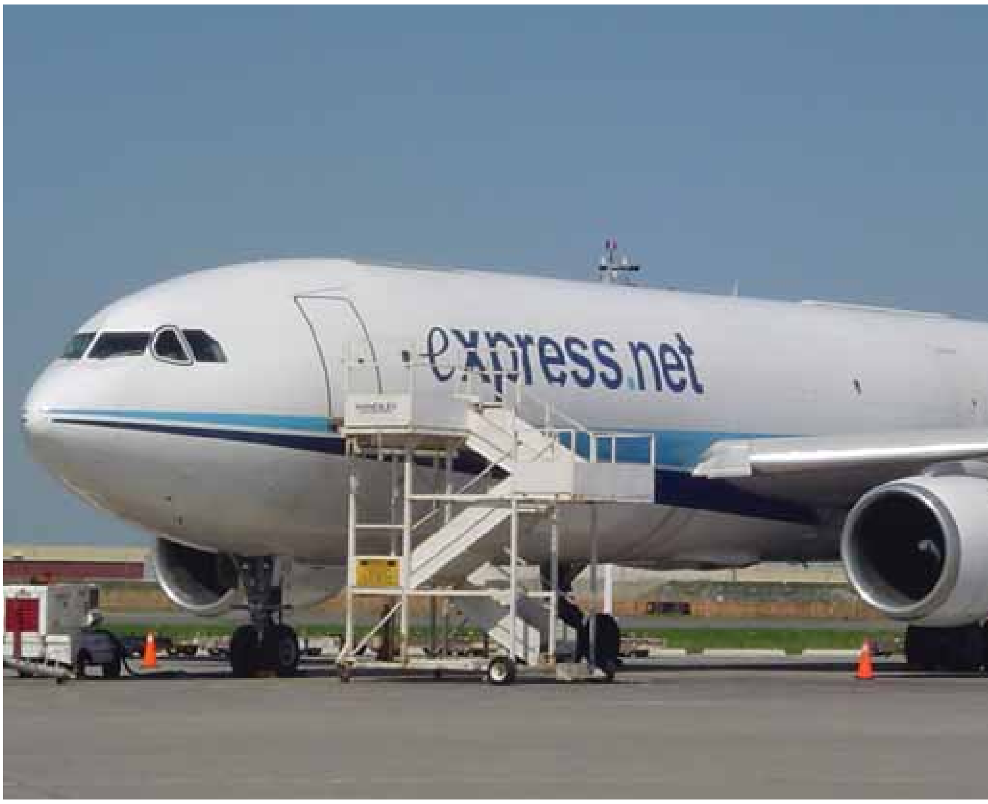
A300B4-200 series

Of all remaining A300B2s/B4s in service and in storage, the A300B4-200 series forms the largest and most important group. The A300B4-200 has the high gross weight and longest range

SUMMARY OF A300B2/B4 PRODUCTION & IN-SERVICE AIRCRAFT

Aircraft variant	Number built	Number in service: Pax	Number in service: Freighter	Number stored
A300B2-101/103	30	1		
A300B2K-103	8	6		
A300B2-203	9	4		
A300B2-203FF	3			
A300B2K-203	5	2		
A300B4-103	41	4	7	3
A300B4-120	10			3
A300B4-203	119	13	55	15
A300B4-203FF	3	2		
A300B4-220	6			
A300B4-220FF	9			
A300C4-203	3		2	
A300F4-203	2		2	
Total	**248**	**32**	**66**	**21**

The majority of A300B2/B4s in operation are A300B4-203Fs. These are mainly owned aircraft and are used on low utilisation, short-cycle overnight operations. These aircraft fill a niche on account of the combination of their low capital cost and high freight capacity. Their operators are therefore unlikely to replace them in the short-term. This will keep supply tight.



capability, and is also the youngest group of aircraft in the remaining fleet.

Of the 73 aircraft converted to freighter, 63 were A300B4-203s. A fleet of 13 passenger-configured A300B4-203s remains in operation. These are aircraft built between 1980 and 1983 that have accumulated 36,000-52,000FH and 19,000-40,000FC. These are operated by several carriers, including Turkish carriers Fly Air, Onur Air and MNG Airlines. Other operators include JAL Domestic, Mahan Air and Ariana.

A further nine passenger-configured A300B4-203s are in storage, formerly operated by Pakistan International Airlines (PIA) and Indian Airlines.

The 63 A300B4-203s that were converted to freighter were mainly sourced from Air France, Lufthansa, Alitalia, Egyptair, Thai, Malaysian Airline System, Eastern Airlines and Pan Am. Two of these aircraft are out of service, and another six ex-Alitalia and ex-Air France aircraft are stored. These are C-S Aviation aircraft and have accumulated 24,000-52,000FH and 20,000-22,000FC.

The largest group of A300B4-203Fs totals 55 units which are active. This is split between 25 DASA-converted aircraft and 30 BAe Aviation Services-converted aircraft.

These were built between 1975 and 1983 and most have accumulated 25,000-50,000FH and 15,000-32,000FC. These are operated by freight carriers around the world.

Operators of DASA-converted aircraft include Channel Express, DHL subsidiary European Air Transport, Express.Net, Dragonair and Egyptair.

Operators of BAe Aviation Services-converted aircraft include Astar Cargo, TNT Airways, MNG Airlines, Aerounion, Tradewinds, and Air Macau.

Two ex-Finnair A300B4-203FFs operate with MNG Airlines, two A300C4-203s are in service with MNG Airlines and ACT Airlines of Turkey, and the two original A300F4-203s are also in service with MNG Airlines.

The largest freighter-configured fleets are operated by DHL subsidiary European Air Transport. This has a fleet of 12. These are are all freighter-converted A300B4-203Fs, and is the largest A300B4-203F fleet in operation.

Express.Net has the second largest fleet, with eight aircraft. MNG Airlines and Tradewinds both operate seven. All other A300B4-100F/-200F fleets are small. Channel Express operates three, TNT Express has a fleet of six, Astar Air cargo flies five for DHL in the US, Air Contractors has a fleet of three, and Aerounion also operates three. Egyptair also flies two of its own converted aircraft.

Turkish carriers

The A300B2/B4 has proved popular with airlines in Turkey. A fleet of 29 aircraft is operated by six different carriers. These include MNG Airlines, Kuzu, Onur Air, Fly Air, Saga Airlines and freight operator ACT. This fleet is also due to expand. Three A300B4-120s were also operated by Bosphorus, but are now in storage and are unlikely to fly again.

MNG Airlines has the largest fleet, with 10 aircraft. This comprises four A300B4-2043Fs, converted freighters that were previously operated by Air France, Alitalia and Singapore Airlines (SIA). It also operates one of two A300C4-203s built, previously operated by South African Airways. This aircraft is also used as a freighter.

MNG Airlines also operates both aircraft built as A300F4-203s, originally operated by Korean Air. These two also operate as freighters. This takes MNG's fleet of freighter aircraft to seven.

MNG Airlines also operates three aircraft in the passenger role. One is an A300B4-203, originally operated by SIA. The other two are A300B4-203FFs, originally operated by Finnair.

MNG is also due to add two more aircraft to its fleet. These are a passenger-configured aircraft, that was previously operated by Pakistan International Airlines, and a DASA-converted freighter. MNG has also bought another two aircraft for parts salvage.

Onur Air and Fly Air have the next largest fleets, with 13 aircraft between them. Fly Air's fleet includes three passenger-configured A300B2K-103s and three passenger-configured A300B4-203s. Onur has one A300B2 and four A300B4s. Saga Airlines is a new carrier, and operates a single A300B2K.

Kuzu Airlines and ACT are Turkey's other major freight carriers.

Other additions to Turkey's freighter fleet include one more aircraft for Fly Air and two for a new carrier. When these, and MNG's additions have been accounted for, the combined Turkish fleet will total 34 aircraft. This will account for a full third of the active A300B2/B4s. AC

A300B2/B4 modification & upgrade programmes

Despite low capital costs and lease rates, the A300B2/B4 are handicapped by high engine maintenance costs and a series of expensive mandatory modifications over the past three to four years.

There are several categories of modification and upgrade programmes for the A300B2/B4. These include: modifications relating to avionics; ageing aircraft and structural modifications; passenger-to-freighter conversion; and noise reduction programmes.

Avionics

Avionics modifications can broadly be divided into those that are mandatory and those that are not. A large number of avionics modifications and upgrades have had to be carried out on A300B2/B4s to keep them operational.

MNG Airlines in Turkey is the second largest A300B4 operator, with a fleet of 10, soon to be joined by two additional aircraft. It has had to perform many modifications on its fleet at high cost to keep it operational.

"Going through modifications by air transport association (ATA) Chapter," explains Ugur Kalkan, engineering manager at MNG Airlines, "the avionics modifications we have performed have been expensive. The first of these relates to ATA Chapter 23, communications, and is 8.33 KHz VHF radio spacing (channel spacing is decreased to increase channel numbers in Europe's congested airspace). This had to be completed by the end of 2003, at a cost of about $40,000. In hand with this was FM immunity of radio receivers (communication and navigation radios prevent interference from FM radio waves), due to the 8.33 KHZ VHF spacing, which cost about $15,000 to complete.

"ATA Chapter 25 has a modification to the emergency locator transmitter (ELT) to widen the range of transmission frequencies (from one to two) in the event of a crash. This was mandatory at the end of 2003," continues Kalkan "and required the installation of a box from Thales priced at about 3,000 Euros, usually during a C check. There are other vendors available. Installation of an antenna may also have been required on some aircraft, at a cost of up to $15,000 per aircraft.

"The same ATA Chapter also required strengthening of the flightdeck door, but only required for passenger-configured aircraft. This modification was provided by Airbus at a cost of about $80,000, and was mandatory by 2004," says Kalkan.

"ATA Chapter 29 contained the modification of a new ram air turbine for all twin-engined aircraft to power hydraulic systems in the event of a double engine failure. The modification was mandatory by 31st December 2002," explains Kalkan. "The ram air turbine has to be modified every 20 years. The last A300B4 was built in 1985, and so all aircraft will have been modified by now. Sundstrand and Dowty are the manufacturers. The modification cost about $100,000 per aircraft."

There have also been modifications to the flight data recorder (FDR) (ATA Chapter 31), which required additional parameters to be recorded. "This did not actually affect most of the aircraft registered by joint airworthiness authority (JAA) countries, since the originally produced FDR already complied with these requirements. The FAA mandated additional parameters on most old generation US aircraft," explains Kalkan. "There has also been a mandatory requirement for installation of the flight data monitoring system. This will record aircraft system data on a removable disk, which can then be downloaded in a similar way to engine health monitoring. Such data monitoring provides better data for the management of aircraft systems. This modification has been mandatory since 1st January 2005 and costs about $10,000 per aircraft, including its read-out software."

Another major avionics modification is the installation of an enhanced ground proximity warning system (EGPWS), or terrain awareness and warning system (TAWS). "This was mandatory on 1st January 2005, and so will have been completed on all aircraft by now," says Kalkan. "In hand with this, we also added other items to the flightdeck. A dual flight management system (FMS) and global positioning system (GPS) were installed to comply with future navigation performance P-RNAV. The TAWS is displayed on the horizontal situation indicator (HSI), and so is replaced with a digital enhanced HSI (EHSI). There were two options for installation of TAWS. Installation of stand-alone TAWS cost about $80,000. Where the installation of an FMS/GPS and EHSI was also required, the total cost reached about $300,000. The advantage of the FMS and EHSI is a more accurate flightpath navigation en route, which results in fewer tracked miles for a given route and therefore lower fuel burn and shorter flight times. Another potential benefit is lower noise penalties, as a consequence of the aircraft flying more accurately on departure and so avoiding noise sensitive areas.

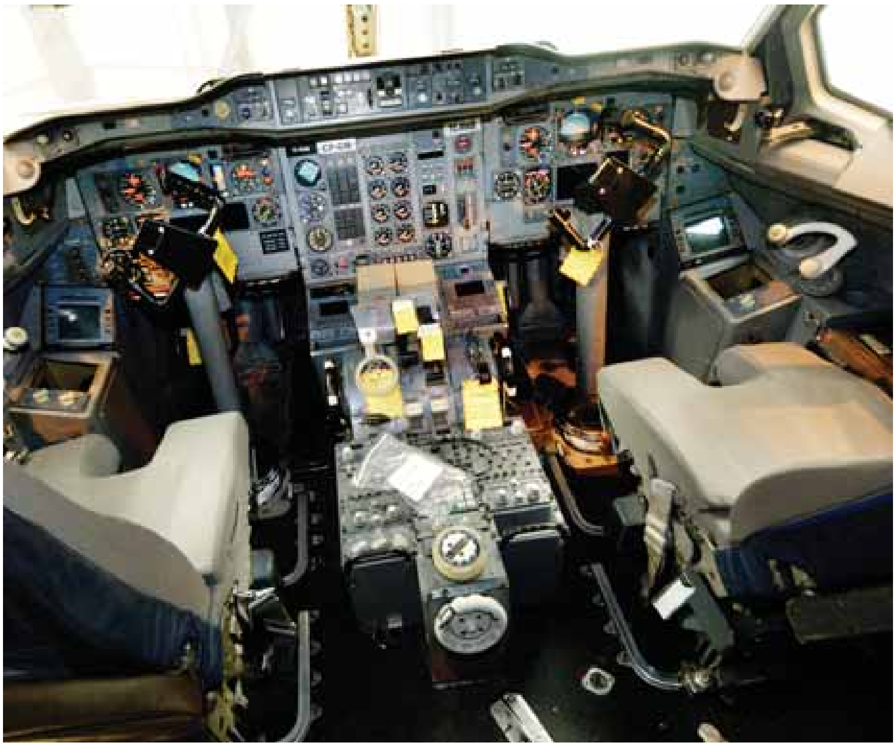
"Two other major avionics modifications are reduced vertical separation minima (RVSM) and a traffic collision avoidance system (TCAS)," continues Kalkan. "RVSM is currently mandatory in Europe and the Atlantic Ocean area, and the A300B4 is already compliant from the factory. TCAS has been mandatory for a few years." TCAS also requires the installation of a mode S transponder, and the cost of both was about $250,000.

The total cost for installing these avionics modifications is $500,000-780,000, depending on whether installation of FMS/GPS and EHSI is required in addition to TAWS. The cost for a passenger aircraft would be $80,000 higher for the additional requirement of a strengthened flightdeck door. This cost of keeping the aircraft operational is high in relation to the aircraft's value.

Future avionics

There are several avionics modifications that are not yet mandatory, but will have to be performed to keep the aircraft operational.

"ATA Chapter 24 has a modification on the transformer rectified unit (TRU), which is mandatory by April 2006. This is for the conversion of AC electrical power to DC power for charging batteries on the aircraft," explains Kalkan. "Cost of the modification is 15,000-20,000 Euros ($18,000-24,000).



The A300B2/B4 has required a plethora of avionic modifications to keep it operational. These have included installing 8.33KHz radio spacing, modifications to emergency locator transmitters and flight data recorders, and installation of EGPWS and RVSM. The cost of these modifications has totalled $500,000-750,00.

Also, modification of ATC transponders for elementary surveillance will be mandatory in 2007. The events of 9/11 prompted this modification to improve flight identification and hijacking reporting. The cost is about $35,000 for aircraft equipped with Honeywell Mode S transponders, and greater for Rockwell Collins transponders.

Thrust reversers

There is the possibility of a requirement for a modification on the A300B2/B4's thrust reversers. This has been triggered by the in-flight thrust reverser deployment on a Lauda Air 767 in 1991. A possible modification would require the installation of a separate locking system and a change of gearboxes. It would also involve a complete re-wiring of the aircraft all the way between the thrust reverser, the centre pedestal in the flightdeck, and the the thrust and thrust reverser levers. It is expected that if the modification were mandated the cost per aircraft could reach in the region of $1 million. Operators have yet to hear if this modification will be issued.

Other modifications

A small modification that was carried out on some aircraft that were converted to freighters was the conversion from steel to carbon brakes. "This was done to save on brake maintenance costs and for the aircraft to take higher structural weights following conversion. The modification can cost about $300,000," says Kalkan.

"There are several major structural inspections and modifications whose high cost influences airlines' decisions to buy the aircraft,"continues Kalkan. "The first of these is known as the frame 47 inspection. This relates to fatigue, structural cracking and corrosion in the fuselage-wing root area. This has an initial inspection threshold interval of 16,700 flight cycles (FC), and then a repeat inspection interval every 9,400FC. If cracks longer than 50mm are found, the repair can cost up to $800,000 (including labour and material) and the aircraft has to be grounded for up to six weeks. The cost of performing this repair looks uneconomic compared to the aircraft's market value and remaining operational life.

"A second major structural inspection is of the landing gear attachment at the wing spar. Modification on the discovery of problems can cost about $40,000, while a major repair can cost more than $1.0 million."

A third modification is the replacement of bolts on the wing bottom skin. This becomes due at 25,000FC and is estimated to cost about $150,000 to complete. High time aircraft will have had the inspection completed.

Many of these modifications and inspections arrived between 2002 and 2004, incurring high costs for many operators, and forcing them to phase out the aircraft. Of the 74 aircraft converted to freighter, eight are stored and four are retired.

Freighter conversion

Two passenger-to-freighter conversion programmes were developed for the A300B4. These were developed by BAe Aviation Services and Daimler Benz Aerospace (DASA). A total of 74 aircraft were converted, with 11 being A300B4-103s and 63 being A300B4-203s. DASA converted 34 aircraft *(see A300B4 Fleet analysis, page 12)*, and BAe Aviation Services 40. DASA offered a conversion for the A300B2, but none were converted.

These conversion programmes are no longer available. The list price for conversion at the time was $5.5-6.0 million, which included the installation of a freight handling system, supplied by Telair and AAR. The A300B4F can be configured to carry a single row or double row of containers on its maindeck.

It was also possible to increase the aircraft's structural weights during conversion. The main difference between the A300B4-100 and -200 is higher maximum take-off weight (MTOW) and maximum zero fuel weight (MZFW). The fuel volumes of both are 16,380 US Gallons, and so no upgrade is required for the -100 variant. Increasing the -100's MTOW and MZFW involved strengthening the aircraft's structure. This was possible with a modification kit, and it is estimated that this upgrade incurred a cost of about $1.8 million. The main benefit of this structural strengthening and increase in MTOW and MZFW was improvement in operational range and structural payload.

Many aircraft were also bridged to a low utilisation maintenance programme during conversion *(see A300B2/B4 maintenance analysis, page 18)*. The maintenance planning document (MPD) programme used for passenger aircraft has an A check every 350-500 flight

A300B4-100F & A300B4-200F PAYLOAD CHARACTERISTICS

Aircraft variant	A300B4-100F	A300B4-100F	A300B4-200F	A300B4-200F
Conversion programmme	DASA	BAe Services	DASA	BAe Services
MTOW lbs	347,230	347,230	363,760	363,760
MZFW lbs	273,370	273,370	277,780	277,780
OEW lbs	178,570	177,780	179,890	177,780
Gross structural payload lbs	94,800	95,590	97,890	95,590
14 maindeck containers				
Container tare weight lbs	10,974	10,974	10,974	10,974
Container volume cu ft	11,500	11,500	11,500	11,500
Net structural payload lbs	83,826	84,616	86,916	84,616
Maximum packing density (lbs/cu ft)	7.30	7.36	7.56	7.36
20 maindeck containers				
Container tare weight lbs	12,080	12,080	12,080	12,080
Container volume cu ft	11,180	11,180	11,180	11,180
Net structural payload lbs	82,720	83,510	85,810	83,510
Maximum packing density (lbs/cu ft)	7.40	7.47	7.67	7.47

hours (FH) and base maintenance programme of a cycle of eight C checks. The basic interval between C checks is 15 months and 3,500FH. The fourth C check in the cycle, at 60 months, is usually combined with the intermediate structural check, the IL check, that has the same interval. The eighth C check, due at 120 months, is usually combined with the larger structural check, which has an interval of 108 months, and so is referred to as the D check. The intermediate and larger structural checks mainly comprise the corrosion prevention control programme (CPCP) and the supplemental structural inspection programme (SSID).

The low utilisation maintenance programme was developed by Airbus for aircraft that operate with utilisations of less than 2,000FH per year. This system has put the majority of A and C check, and CPCP and SSID tasks into three-month multiples. The basic 3-month check is generically referred to as the 'A' check. There are then 6-, 9-, 12-, 15- and 24-month multiples of these checks. The basic base check interval is a 24-month check, and there are four multiples of this. The 24-month check has effectively replaced the C check, while the 48-month check has replaced the IL check, and the 96-month check has replaced the D check.

As described, the aircraft to be converted were 10 A300B4-103s and 63 A300B4-203s. DASA and BAe Aviation Services converted both of these variants.

A300B4-100F

The A300B4-100F has a standard MTOW of 347,230lbs. Although an upgrade to increase MTOW was available during conversion, none of the aircraft modified had weights increased.

The gross structural payload of the aircraft is determined by the difference in MZFW and operating empty weight (OEW). MZFW of the aircraft was the same for both conversions, and is 273,370lbs *(see table, this page)*. The OEW differed slightly for the two conversions. DASA-converted aircraft have an OEW of 178,570lbs and BAe Aviation Services-converted aircraft have an OEW of 177,780lbs.

This gives a gross structural payload for DASA-converted A300B4-100F of 94,800lbs, and for BAe Aviation Services-converted aircraft of 95,590lbs *(see table, this page)*.

A300B4-200F

The A300B4-200F has an MTOW of 363,760lbs and MZFW of 277,780lbs *(see table, this page)*. The DASA-converted aircraft has an OEW of 179,890lbs, and the BAe Aviation Services-converted aircraft has an OEW of 177,780lbs *(see table, this page)*. This gives the DASA-converted aircraft a gross structural payload of 97,890lbs and the BAE Aviation Services-converted aircraft a gross structural payload of 95,590lbs *(see table, this page)*.

Payload capacity

There are several configurations for accommodating freight on the A300B4-100F/-200F. Both aircraft have the same fuselage and so can carry an identical number of containers.

The underfloor belly space can carry 20 LD-3 containers. Each of these has an internal volume of 141 cubic feet, totalling 2,820 cubic feet. Each container has a tare weight of 163lbs, and so total tare weight was 3,260lbs for the LD-3s.

There are two main configurations for the maindeck. The first is a single row of 14 125-inch wide and 88-inch tall containers. These each have an internal volume of 620 cubic feet and so provide a total volume of 8,680 cubic feet. The combined tare weight of these containers is 7,714lbs. The total containerised volume in this configuration is 11,500 cubic feet, and total tare weight is 10,974lbs.

The alternative is for 10 rows of two side-by-side 88-inch wide by 125-inch long pallets. These provide 8,360 cubic feet of freight volume and have a total tare weight of 8,820lbs. Total containerised volume of this configuration is 11,180 cubic feet, and total tare weight is 12,080lbs.

These two different payload configurations give the four different variants net structural payloads and packing densities as shown *(see table, this page)*.

Chapter 4 compliance

Trials have been completed with the A300B4 that have established that the aircraft can be operated in and out of airports which enforce Chapter 4 noise limits. Chapter 4 noise limits are that the cumulative noise measurements for the three readings, are 10 EPNdB lower than the permitted Chapter 3 cumulative noise reading allowance. Two of the Chapter 3 noise limits for each of the three readings are related to MTOW and a third is related to maximum landing weight (MLW).

The A300B4-100 and -200 have Chapter 3 noise compliance margins of 3.0-6.2 EPNdB. Aerodyamic modifications and operational changes introduced during the trials have been reduced the aircraft's noise to between six and eight EPNdB less than Chapter 3 regulations, bringing it close to Chapter 4 compliance.

Another option for noise reduction is to reduce the aircraft's MTOW from 165.0 tons to 157.5 tons. This does not affect the aircraft's ability to carry a maximum payload on flights shorter than three hours, which is equal to about 1,250nm. The MTOW reduction reduces range to about 2,000nm. AC

A300B2/B4 in service & operations

More than two-thirds of A300B2/B4 in operation are freighters, operating at low rates of utilisation. They are also used extensively in the Turkish market.

The majority of A300B2/B4s in service operate as freighters. Many of these aircraft are used for small package freighter operations where low utilisation and short average flight cycle (FC) times are normal. This can have an adverse effect on operating costs, especially with respect to engine reserves and the number of line checks required relative to the number of flight hours (FH).

The A300B4F, however, is in a class of its own. The aircraft has a gross structural payload of 95,000-98,000lbs, net payload of 83,000-86,000lbs and containerised volume of 11,200-11,500 cubic feet *(see A300B2/B4 modification & upgrade programmes, page 14)*. The only other types with similar payload characteristics are the 767-200SF, lower gross weight variants of the 767-300SF and the A300-600RF. All three of these have lease rates or acquisition costs at least twice as high as the A300B4-100F/-200F. The low utilisation of many of the A300B4F's operations means the 767-200/-300 and A300-600 cannot compete economically.

A large number of A300B4Fs are used by European freight operators, including Channel Express, TNT, Air Contractors and European Air Transport. These four airlines operate a total of 20 aircraft, about a third of the global freighter fleet, on express package operations. A further 14 aircraft are used by Astar Air Cargo and Express.Net in a similar way to the European freighters.

The majority of small or express package operations is based on night flying for five or six days per week. In addition, most are hub-and-spoke style operations, with aircraft flying into hubs and then back to outstations on return flights. In this case, most aircraft achieve just two sectors per night. In some cases, airlines roster their aircraft on stopping flights to and from a hub.

Air Contractors in Ireland operates three A300B4-100Fs leased from Europe Airpost. Two of these are flown on a wet-lease basis for the French Post Office and the third on a wet lease for FedEx. One aircraft flies between Lyons and Paris and the second from Ajaccio in Corsica to Marseille and then on to Paris. It then makes the return journey via the same cities. The third aircraft operates a return flight between Dublin and Paris, via London Stansted. These aircraft operate these routes for just four or five nights per week.

"On this basis we accumulate a total of 2,500FC per year for all three aircraft, making an average of 770FC per aircraft," says John Rawls, ground operations manager at Air Contractors. "The average utilisation is also 900 block hours (BH) per year per aircraft, meaning the average cycle time is just over 1BH. With this level of operation, the aircraft are generally very reliable, and have a technical dispatch reliability rate of more than 98.5%."

European Air Transport, a subsidiary of DHL, operates a fleet of 12 A300B4-200Fs, the largest fleet of A300B4Fs. The airline operates from its hub at Brussels to several cities in Europe. Average cycle time is 1.2BH, and average flight time just 55 minutes. This generates an annual utilisation of just 1,000FH per year.

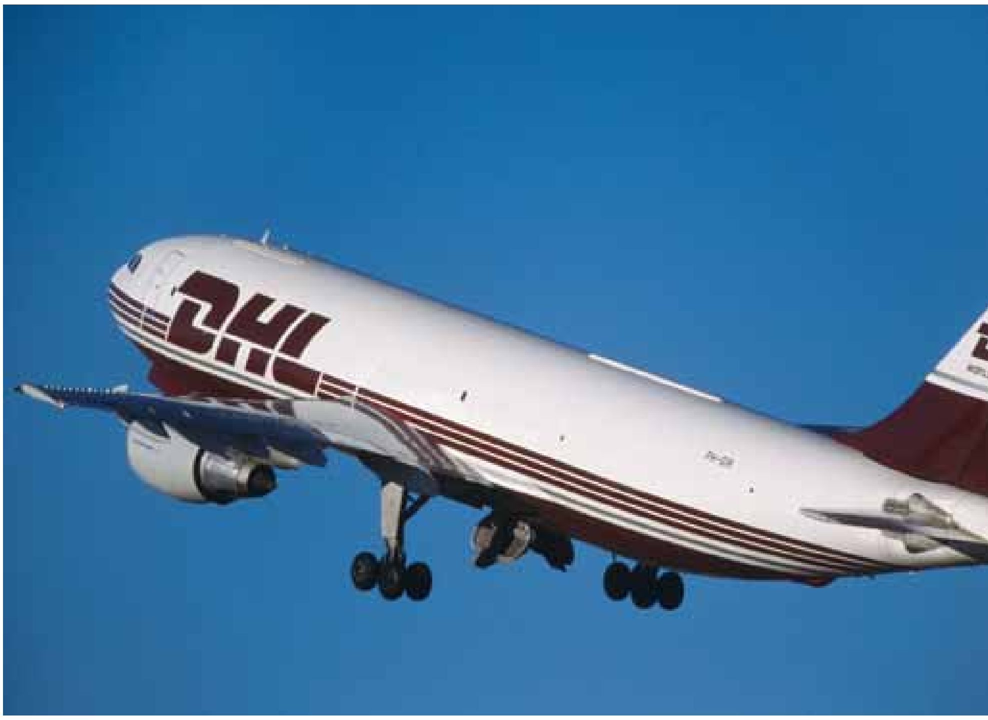
Turn times, including time to load or off-load freight, are about 90 minutes at outstations, while turn times at hubs can be three to four hours when freight is both off-loaded and loaded.

Average cycle times are longer and rates of utilisation higher for operators in North America, where cities across a route network are further apart than in Europe.

A large number of A300B2/B4s are operated by Turkish carriers. MNG Airlines has 10 aircraft, including seven freighters, and will shortly add a further two aircraft to its fleet. Besides MNG, Kuzu, Onur Air, Fly Air, Saga Airlines and ACT operate a further 19 aircraft. This takes the fleet in Turkey to 29, of which thirteen are freighters. The fleet will grow by a further five aircraft with the addition of a further two by MNG, one more by Fly Air, and two more by a new carrier.

Turkey provides an ideal operating base for the A300B4F, since it is located where it can operate 2-3 hour flights to most European cities, and also similar route lengths to the Middle East.

MNG Airlines has an average flight time of 3-4 hours, and an average flight cycle of 2.5FH. On this type of operation, MNG achieves an annual utilisation of about 2,000FH per year for its freighter aircraft. This level of utilisation and average FC time allows lower maintenance costs through fewer line and ramp checks relative to annual FH, and significantly reduced engine reserves compared to aircraft generating low rates of utilisation. AC



Most A300B4s operate as freighters, performing overnight express freight services at low rates of utilisation. In many cases the aircraft only accumulates about 1,000FH per year. Operators report high technical despatch reliability.

A300B2/B4 maintenance analysis

The A300B2/B4 has high maintenance costs when operated on short cycles and at low rates of utilisation. The element with the highest cost is engine reserves. Costs need to be managed.

With only 40% of the original aircraft built still in operation, the A300B2/B4 now fills a niche role. One-third of the 98 aircraft still in operation are used in the passenger role. Many of these aircraft are operated by Turkish charter carriers, and only a few are flown by major passenger airlines. Two-thirds of the aircraft still flying are used by a core of freight carriers, who are exploiting the A300B4F's low capital cost on high-density, short-distance routes.

A300B2/B4 in operation

The A300B2/B4 fleet falls into two sub-fleets, the most important of which is the freighter fleet. Most A300B4Fs are utilised for express package operations. The majority of freighters, more than 50 units, are operated by the DHL subsidiary European Air Transport, Astar Air cargo, Air Contractors, Aerounion, Channel Express, Express.net, TNT and Tradewinds for this purpose. Most of these carriers use the aircraft on sectors that average 75-90 minutes' flying time so the aircraft only accumulate 950-1,200 flight hours (FH) and 750-900 flight cycles (FC) per year.

This low rate of utilisation has the effect of raising maintenance costs per FH. Virtually all elements of maintenance are affected by short average FC times and low utilisation, but reserve rates for engines are particularly high. Heavy components with FC-related removals, line checks and rotables all have high costs per FH as a result of short cycle times and low rates of utilisation. The aircraft requires careful management, especially with respect to engines, in such operations.

The few freight carriers that have longer average FC times and higher rates of utilisation will benefit from reduced maintenance costs per FH.

The 32 passenger aircraft in operation are predominantly owned by Turkish charter carriers, including Fly Air, MNG Airlines, Onur Air and Saga Airlines.

Most passenger aircraft accumulate in the region of 2,000-2,500FH per year. Most aircraft operate average FC times of 75-120 minutes, and so accumulate 1,000-1,600FC per year. Some aircraft operating with charter carriers, however, fly longer FC times of 2-3FH.

These higher rates of utilisation result in lower maintenance costs per FH than the freighter aircraft.

Maintenance programme

There are two maintenance programmes for the A300B2/B4. The first of these is the standard maintenance programme that was originally used for aircraft prior to conversion to freighter. This is similar to maintenance programmes used for all other Airbus aircraft types.

The second maintenance programme for the A300B2/B4 is a system for aircraft operating with low annual utilisations. This was developed by Airbus for aircraft operating as freighters and achieving utilisations of 2,000FH or less each year.

"The standard maintenance programme, or maintenance planning document (MPD) programme, for the A300B2/B4 is based on 1C tasks with an interval of 18 months and multiple 2C, 4C and 8C tasks with respective multiple intervals that result in a system of block checks," says Eric Price, executive vice president and chief operating officer at Aeroframe Services. "This results in a cycle of C1, C2, C3, C4/IL, C5, C6, C7 and C8/D checks. Similar systems are used by all other Airbus aircraft. The basic 18-month interval results in a 72-month interval for the C4/IL check, and a 144-month interval for the C8/D check. In addition to the C checks, there are also some corrosion prevention and control programme (CPCP) items and supplemental structural inspection document (SSID) items, which are incorporated into the C checks. The C4 and C8 checks are the biggest checks."

While the basic 18-month interval gave the full base check cycle up to the C8/D check an interval of 144 months, most operators were completing this in about 8-9 years. This implies that the oldest aircraft on this maintenance programme will have completed three base check maintenance cycles, and will be in their fourth cycle. The youngest aircraft, built in 1983 and 1984, on this maintenance programme will have completed two base check maintenance cycles and be in their third. All aircraft are thus mature.

The standard maintenance programme also has an A check every 450FH.

"The low utilisation maintenance programme has re-arranged most A and C check tasks from the standard programme into 3-month phases. That is, 1A check items have to be re-arranged into a group of tasks with a 3-month interval that forms a 3-month check," explains Ray Mosses, marketing manager at BASCO.

This 3-month check is referred to as a line A check. There are other tasks with multiples of this 3-month interval: the base A check at 6 months; the line A check again at 9 months; and the base A check repeated at 12 months.

"A 24-month group of tasks and check has replaced the C check," continues Mosses. "The FH-related tasks of the C check were changed to multiples of 24 months. The basic 24-month group of tasks and check would thus be performed every eighth A check. There are then multiples of 24-month tasks with 48-, 72- and 96-month checks. The 96-month check is the fourth and heaviest check, and is generically referred to as the 'D' check. These four checks have replaced the eight C checks in the MPD maintenance programme.

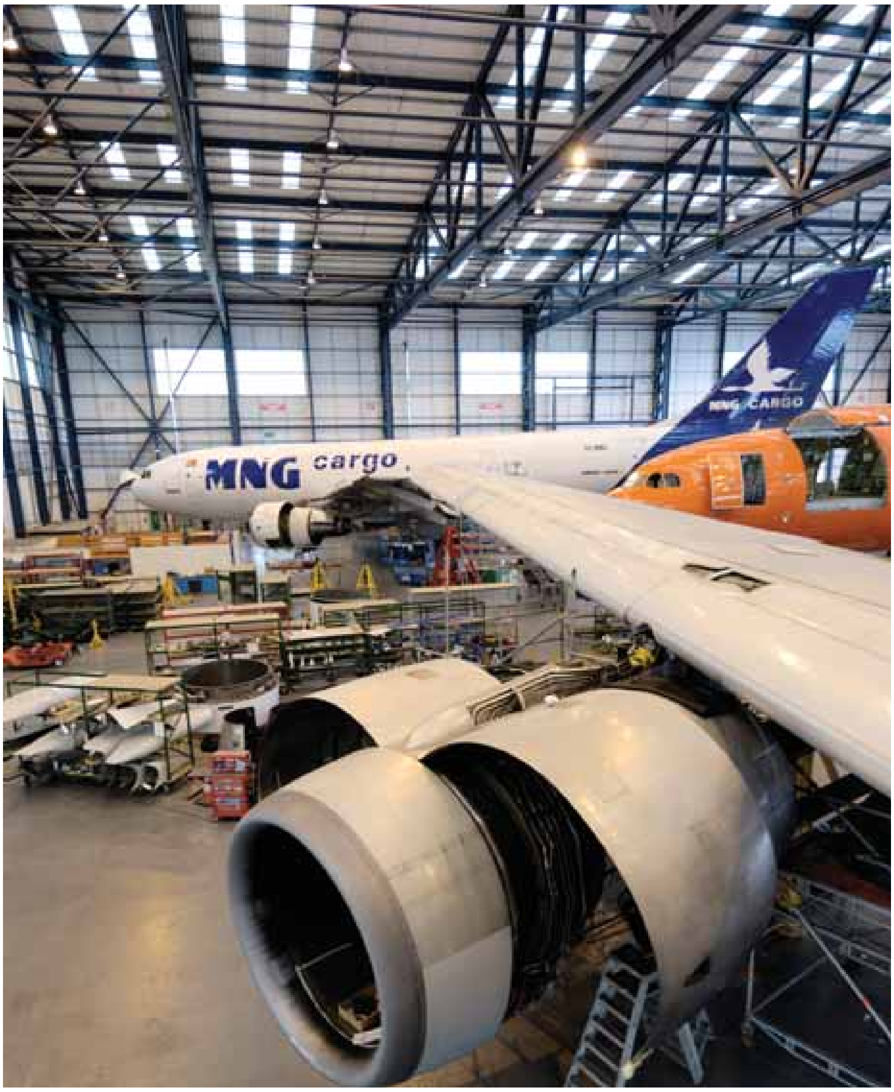
"There are also the CPCP tasks with an interval of 60 months to consider," continues Mosses. "These can be treated as a separate group of tasks, and so require a check different to the 48-month and 72-month C checks. This will increase overall downtime for maintenance and so these 60-month checks are therefore brought forward to the 48-month check by most operators. There is also a group of corrosion tasks with an interval of 108 months. To avoid separate maintenance inputs and out-of-phase maintenance checks, these are also brought forward to the 96-month check."

There is a third group of tasks to consider. "These are the SSID items which have FC-related intervals," says Ugur Kalkan, engineering manager at MNG Airlines. "These look for structural cracks, and include an inspection every five years of the aircraft belly, and other structural areas on the wings and tail, and engine pylons at different intervals."

Finally, there are a few out-of-phase maintenance tasks that Airbus was unable to change to multiples of 3-month calendar intervals. These items therefore have to be dealt with separately.

The majority of A300B4s that were converted to freighter were modified

Airbus devised a low utilisation programme for aircraft that were expected to operate less than 2,000FH per year. Many aircraft were bridged to this programme when they were converted to freighter. The programme exchanged C checks for 24-month checks. The base check cycle is completed at the 96-month check.



between 1995 and 1998. "Most aircraft had their base maintenance check cycles zeroed at conversion and the aircraft were bridged to the low utilisation maintenance programme," explains Mosses. "This means that the first aircraft that were modified will have been through their first 96-month check, while most will have yet to undergo it."

Line maintenance

The line and ramp maintenance programme for the A300B2/B4 consists of pre-flight and transit checks prior to each flight. A daily check has to be performed if the aircraft is grounded for more than four hours. The time between two consecutive daily checks cannot exceed 48 hours. A weekly check is also required, and the largest check in the series is a 150FC check. These are then followed by the 3-month checks.

The majority of aircraft are operated on a low utilisation programme, accumulating only about 800-900FC per year. An example is Irish carrier Air Contractors which flies three aircraft for the French post office and FedEx. Aircraft are only flown five days per week at an average of about three flights per night, depending on schedules. The average block time of 90 minutes means aircraft accumulate four to five block hours (BH) per night, and 20-25 (BH) per week). Pre-flight and transit checks are small enough to be performed by the flight engineer.

Transit checks only require about 1 MH for completion. Kalkan says the daily check usually requires about five MH from four mechanics, consuming a total of about 20MH. The consumption of consumables and materials is negligible for these two checks.

The weekly check, performed every 20-25BH, uses six MH from four mechanics, coming to a total of 24MH and a negligible quantity of consumables and materials.

The 150FC check occurs about once every 10 weeks of operation, coming close to the 3-month check interval. Brendan Smyth, technical services engineer at Aircontractors, says the checks are occasionally performed together if they coincide, but the 150FC check is otherwise performed as a ramp check. The 3-month check is a larger check. The 150FC check consumes an average of 25MH and only a few hundred dollars of consumables.

On this basis, an aircraft will require about 550 transit checks, 250 daily checks, 50 weekly checks and five or six 150FC checks each year. This will consume a total of about 800MH in line and ramp labour.

A total of about 7,000MH would therefore be required to complete these line and ramp checks. At a labour rate of $70 per MH, total cost would be about $490,000. This would have to be amortised over the corresponding 1,000FH for an aircraft operated on a low utilisation operation. The cost per FH would therefore be about $500 per FH, and an additional allowance of $50 per FH would be required for materials and consumables. This would take total cost to $550 per FH *(see table, page 22)*.

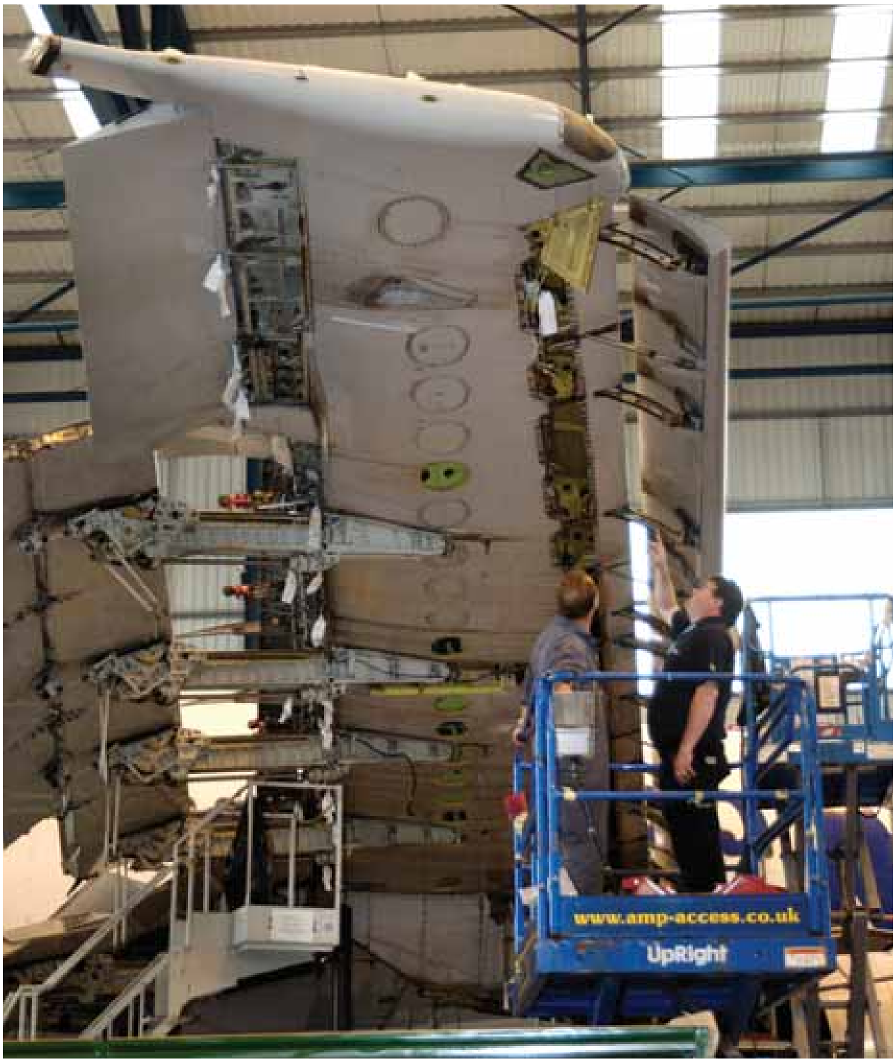
This cost per FH would be reduced for aircraft achieving higher rates of annual utilisation. Longer average cycle times mean fewer transit checks would be required each year, and the final cost for all checks would be amortised over a larger number of FH.

Mosses says MH consumption for 3-month checks is 700-1,100MH, depending on which check in the cycle is being performed and the inclusion of out-of-phase tasks. Average labour use is 1,000MH, and a typical labour rate of $50 per MH will result in a cost of $50,000. The cost of materials and consumables used is about $10,000, taking the total for the check to $60,000. Four checks are completed each year, and when amortised over the annual utilisation, the resulting cost per FH is about $240 *(see table, page 22)*.

Base maintenance

Most operators that have bridged their aircraft to the low utilisation maintenance programme have elected to bring the 60-month and 108-month CPCP tasks forward to the 48-month and 96-month checks respectively.

As described, all aircraft are now mature. The aircraft that were converted to freighter were all A300B4-103s and -203s built between 1975 and 1985, across the full period of A300B2/B4 production. This means aircraft will have completed one or two full base check cycles at the time of conversion and another low utilisation maintenance cycle since, and have thus reached maturity. This will affect the number of MH used



While some rotable components are in plentiful supply due to the large number of A300B2/B4s that have been dismantled for parts, other major components are becoming harder to find on the used market. This is forcing airlines to source new components from Airbus, and will increase costs.

in the four base checks.

"With a fully integrated maintenance programme that incorporates the SSID and CPCP tasks into the base checks, downtimes for other maintenance are avoided over the two-year interval between the checks," says Kalkan. "The integration of base check items and 3-month check items means the number of task cards for checks performed every 24 months varies between 300 and 700."

The first and third checks in the cycle are relatively small in terms of number of tasks and MH consumed. The second check is larger, and the fourth or 96-month check is the heaviest in the cycle.

"The 24-month check on a freighter consumes a total of 7,000-8,000MH," estimates Mosses. "This includes routine inspections and defects arising as a result, as well as MH used for interior work, modifications and SBs, and heavy component changes. About $30,000 is budgeted for materials and consumables consumption, whose use will be relatively low for an aircraft of its size because many items of interior work are not required on a freighter. This check will have a downtime of about 30 days.

"The third or 72-month check is similar in content and size, and also uses about 8,000MH and $30,000 for materials and consumables," says Mosses. "The 48-month check will use about 14,000MH in total and about $70,000 in materials and consumables. The 96-month check is expected to require an average of 20,000MH for most aircraft, and about $100,000 for materials and consumables. This check has a downtime of 45-50 days."

Can Sasmaz, technical manager at MNG Technic explains that 8,000MH of the 20,000MH used in the total for the 96-month check are for defects arising from routine inspections. "The second check will use 12,000-14,000MH," says Sasmaz, "and about 3,000-4,000MH are required for the clearing of defects. More than 40,000MH will be used for the four checks in the cycle."

The MH estimates provided by Mosses indicate that the total MH consumption for the cycle will be in the region of 50,000. At a labour rate of $50 per MH, this will be equal to an expenditure of $2.5 million. Total cost of materials and consumables for these four checks will be $230,000-250,000. The total cost for the four base checks will thus be about $2.8 million.

This cost has to be considered against the number of FH accumulated during the eight-year maintenance interval. The cycle is more likely to be completed in a seven-year period, considering typical utilisation rates of maintenance intervals. At most, this will be equal to about 14,000FH. In this case, the reserve for base checks will need to be in the region of $200 per FH. Many freighter aircraft are, however, operated at rates of utilisation equal to about 1,200-1,500FH per year. Aircraft would thus accumulate 7,000-8,400FH over the seven-year interval. In this case, the reserve for base maintenance would be higher at $330-400 per FH *(see table, page 22)*.

Heavy components

There are four groups of heavy components: wheels and brakes; landing gear; thrust reverser; and auxiliary power unit (APU).

The general high supply of used components on the aftermarket means operators can source some time-continued components at rates that are cheaper than putting them through shop visit overhauls. This analysis assumes all components are put through shop visits at typical removal intervals.

The A300B2/B4 has eight wheels and two nose wheels. Operators also have the choice of using steel and carbon brakes.

The average interval between wheel removals for tyre remoulds and wheel inspections is 200FC. Tyres can be remoulded as many as six times, and so last seven removals and 1,400FC before replacement.

Remoulding of tyres costs about $500, similar for many other widebody types, and replacement costs about $1,000-1,200. The full cost of remould and replacement over the cycle of seven removals is thus about $4,000 per tyre. This equals $40,000 for all 10 tyres. When amortised over the 1,400FC interval, it is equivalent to about $29 per FC *(see table, page 22)*, and equal to $23 per FH for an aircraft operating at an average FC time of 1.25FH.

Wheel inspections are made at the same time as tyre remoulds, and so every 200FC. Each wheel inspection has an average cost of $800, and so equal to $8,000 for the full shipset of all wheels. This equates to a cost of $40 per FC, and $32 per FH for aircraft on an average FC time of 1.25FH *(see table, page 22)*.

Steel brakes have inspection and repair intervals only about one quarter

DIRECT MAINTENANCE COSTS FOR A300B4 FREIGHTER

Maintenance Item	Annual/Cycle cost $	Cycle interval	Cost per FC-$	Cost per FH-$
Ramp checks	$490,000	1 year		550
3-month checks	$240,000	1 year		240
24-month checks	2,800,000	7 years/7,000FH		400
Heavy components:				
Landing gear	$500,000	6,000FC	84	67
Tyre remould & replacement	$40,000	1,400FC	29	23
Wheel inspections	$8,000	200FC	40	32
Brake inspections	$56,000	400FC	140	112
Thrust reverser overhauls	$440,000	6,000FC	75	60
APU	$200,000	12,000FH		20
Total heavy components				314
LRU component support				300-350
Total airframe & component maintenance				**$1,804-1,854/FH**
Engine maintenance: 2 X CF6-50C2				$1,540/FH
Total direct maintenance costs:				**$3,344-3,400/FH**

Annual utilisation:
1,000FH
800FC
FH:FC ratio of 1.25:1.0

the length of carbon brakes. While this may contribute to lower costs per FC for carbon brakes, they can also have very high shop visit costs. This is especially if the heat stack has to be replaced.

Steel brakes have an average removal and repair interval of 400FC, and repair cost of $7,000. The full shipset of eight main brake units will therefore incur a cost in the region of $56,000. This is equal to $140 per FC, and $112 per FH for an aircraft operating an average FC time of 1.25 *(see table, this page)*.

The landing gear has an interval of eight years and 12,000FC, whichever is reached first. The low rates of utilisation of about 800FC per year for express package carriers mean that the eight-year limit is reached before the 12,000FC limit. This is after 6,000FC and about 7,500FH. Even aircraft operated in passenger mode at about 2,500FH per year, do not accumulate more than about 8,500FC between gear overhauls.

Landing gears are usually put through exchange programmes, where operators pay an exchange fee for a gear shipset and a separate charge for the overhaul. The total for this is up to $500,000. For aircraft on low rates of utilisation, this is equal to a reserve of about $67 per FH *(see table, this page)*.

Aircraft operated at higher rates of utilisation of 2,500FH per year will need a lower reserve of about $29 per FH.

Thrust reversers are an on-condition item, as for many other aircraft types. Delamination is a big issue that can force removals. Average removal intervals are in the region of 6,000FC, and a typical shop visit cost is about $110,000 per reverser half, and so $220,000 per shipset. Reserves of $37 per FC should be used for each reverser, and $75 per FC for both. This is equal to $60 per FH *(see table, this page)*.

The A300B2/B4's APU is a Honeywell model, the TSCP 700, which is reliable compared to other APU models, with an average removal interval every 5,000 APU hours. How this relates to aircraft FH depends on several factors in an aircraft's operation. APU is generally used for engine start, but also taxiing in after landing. The APU time per FC can be as low as 30 minutes, meaning the average time between shop visits will be equal to about 10,000FC. In the case of aircraft used in express package operations this will be equal to about 12,000FH. The average shop visit cost will be in the region of $200,000, and so a reserve of $16-20 per FH would result.

Heavier use of the APU during passenger operations would be equal to about 45 minutes per FC, and so a removal about every 6,500FC might be expected. This would be equal to about 9,700-14,000FH. The amortised shop visit cost over this interval would be equal to $14-20 per FH.

Rotables

Besides the heavy components described, operators have to consider the cost of rotables. Analysis of the failure rates, necessity and cost of repair or purchase of each rotable component can give an operator or spares-support provider an indication of which components can be treated as on-condition items, which require soft removal intervals and which should have repairs or overhauls aligned with airframe checks.

In addition, the failure rates and cost of repair and overhaul or purchase allow the rotables to be divided into four categories: those that need to be held in an inventory at an airline's base of operation; those that can be borrowed or exchanged at short notice; those that can be acquired from a third-party supplier several days after a failure; and those that will be acquired only when emergency situations arise.

With many aircraft types, there are several specialist rotables suppliers that will analyse an airline's fleet and operation, determine the quantity of stock it requires at its home base, and then contract to supply the remainder to the airline as required. The provider will guarantee and manage the supply and repair of components for the airline when required, charging a fixed rate per FH for this service, as well as a monthly lease rate for the homebase stock. The supplier takes the risk of dealing with peaks of component failures, and also deciding whether to borrow, exchange, buy or lease each part number in the inventory.

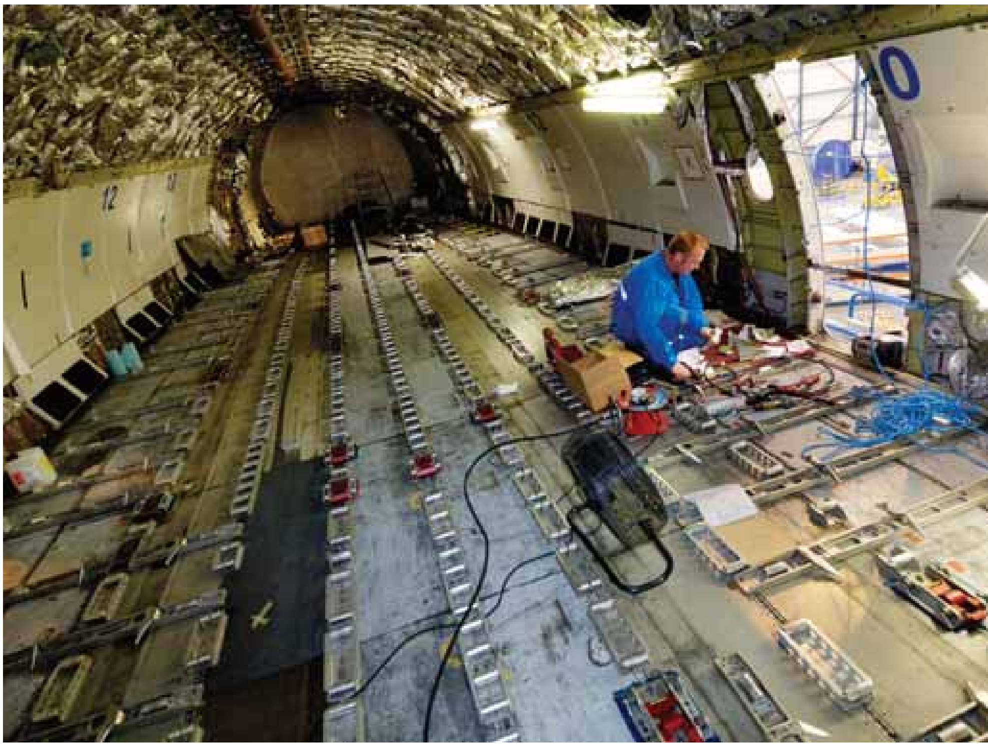
The large number of A300B2/B4s that have been retired and broken for parts has resulted in a high supply of rotables on the aftermarket, making it economic to acquire an increasing number of them through purchase or exchange programmes on the aftermarket.

Some rotable items, such as the drive trains in flap units, are becoming increasingly harder to find, however. Shortages force operators to buy units from Airbus, which is more expensive than buying them on the used market.

The overall effect is that the cost of supplying rotables is becoming more variable and so less predictable for airlines. MNG Airlines, for example, has bought two stored aircraft for breakdown into parts.

The overall effect is that the resulting cost per FH of all rotables will be highly variable. Airlines operating average FC times of 2.0-2.5FH and achieving annual

It is estimated that a total of 50,000MH will be consumed in the four checks of the base check cycle for aircraft operating at low rates of utilisation. Amortised over a likely interval of just 7,000FH for many aircraft results in a base check reserve of up to $400 per FH.



utilisations of 2,000FH per year can expect the cost per FH for rotables to be in the region of $200-250. Aircraft on lower rates of utilisation and flying on shorter average FC times should have $300-350 per FH budgeted for rotables *(see table, page 22)*.

Engine maintenance

All A300B2/B4s still in operation are powered by CF6-50C/C2 engines. Engine maintenance costs for the A300B2/B4 are its Achilles' heel. Removals for this engine are generally related to FCs. Most planned intervals are in the 1,800-2,200FC range. The engine is sensitive, however, to operating environment, rate of de-rate and average FC time.

Express package operators generally have short cycle times, which might be expected to have a negative impact on removal intervals. These airlines can, however, offset the impact of this with relatively high rates of de-rate, plus the advantage of a cool operating environment when flying at night.

Express package operations take place at night, when ambient temperatures are cool. This prolongs on-wing life. There are large differences in removal intervals between aircraft that operate in cool environments and those that fly where ambient temperatures are high. High ambient temperatures can reduce on-wing times to as low as 1,500-1,800 engine flight cycles (EFC).

Express package operations also often provide the opportunity for relatively high levels of engine de-rate. De-rate ultimately is mainly governed by aircraft take-off weight. Express package operations have short average FC times, and so a relatively low fuel load requirement. Load factors and the low packing density of express packages means full payload capacity is rarely reached. Take-off weights are consequently low in relation to maximum take-off weight (MTOW), and engine de-rates are consequently high.

Typical engine removal intervals can be up to 2,000-2,500EFC for low utilisation and short cycle operations. At an average cycle time of 1.25FH, this is equal to 2,400-3,000 engine flight hours (EFH).

The CF6-50 is usually managed in a pattern of alternating light and heavy shop visits. Life limited parts (LLPs) have lives varying from as low as 12,000EFC to as high as 30,000EFC. Most, however, have lives of 20,000-30,000EFC. Shop visit intervals mean that most parts are replaced at least once every eight to 12 shop visits with such removal intervals, so the cost of replacing LLPs is not a consideration for most shop visits.

A light shop visit requires 3,500-4,000MH, about $600,000 in materials and $500,000 for sub-contract repairs, taking the total cost to about $1.4 million. A heavy shop visit can consume 4,500-5,000MH, $800,000 in materials and another $800,000 in sub-contract repairs, with a total cost of $2 million.

Two shop visits amortised over a total interval of about 5,000EFH will thus result in a maintenance engine reserve rate of about $680 per EFH.

LLP amortisation has to be added to this. A full set of LLPs for the CF6-50C2 has a list price of about $2 million. LLPs' lives vary between 20,000EFC and 30,000EFC. Replacement will be after an average of 12 removals, equal to about 26,000EFC. This results in a reserve of $77 per EFC, or $62 per EFH, taking the total cost to about $760 per EFH. Both engines therefore require a total reserve of about $1,500EFH *(see table, page 22)*, which is by far the highest element of total maintenance costs for the aircraft.

Engines can be built for longer intervals of 3,500-4,000EFC. Average shop visit cost is in the region of $2 million, resulting in a lower maintenance reserve of about $475 per EFH.

In the case of aircraft operating longer average FC times of 2.0-2.5FH, average removal intervals are about 2,200EFC and equal to 4,400-5,500EFH. Shop visit input costs of about $1.5 million will result in a lower engine reserve rate of about $270 per EFH.

Summary

The combined effects of low rates of utilisation, a short average FC time and high engine costs result in a total aircraft maintenance cost in the region of $3,300-3,400 per FH *(see table, page 22)*. This cost would be considerably less for an aircraft operated at higher rates of utilisation and longer average FC times.

As described, the A300B2/B4's engines are its weak point. The short removal intervals that result from the short cycle time result in engine reserves that total over $700 per EFH when LLPs are included. Engine costs therefore account for almost half of this amount, while all other costs are escalated by the short average cycle time. These maintenance costs have to be considered against the aircraft's lease rates and other direct operating costs by operators when they are considering the viability of the aircraft.

Line and ramp maintenance, 24-month checks, heavy components, rotables, and engine reserves would all have lower costs per FH if longer average cycle times were operated. In the case of some of these elements, rates per hour would be half, or even one-third, of what they are for an aircraft operating short cycles at low rates of utilisation. On this basis, total costs could be in the region of $1,700-2,200 per FH for a passenger aircraft generating 2,000-2,500FH per year. This makes the A300B2/B4 highly economical when considered in combination with its lease rate. AC

A300B2/B4 values & aftermarket activity

Values and lease rates of A300B2/B4s are low. The aircraft fills a niche role, however, and supply will remain tight.

The A300B2/B4 fleet is divided into passenger-configured aircraft and freighter variants. The A300B2/B4 is dwindling in popularity as a passenger aircraft, except in the case of a few Turkish charter carriers, such as MNG Airlines, Fly Air, Onur Air and Saga Airlines. MNG Airlines, for example, is in the process of acquiring a passenger-configured unit to add to its fleet of three.

The remaining major passenger-configured fleets are those operated by Japan Airlines Domestic, Iran Air, Mahan Air and Ariana. The fleet operated by Pakistan International Airlines has been dispersed, and besides a few aircraft acquired in small numbers by Turkish charter carriers, the popularity of passenger-configured aircraft is low.

Monthly lease rates for passenger-configured aircraft are in the region of $45,000-75,000 per month. At utilisations of 2,000-2,500 flight hours (FH) per year, this makes the aircraft the most economic in its size class.

The A300B4F has become established as a niche freighter. It has a payload of about 45 tons, and has no competitors that are available at similar lease rates. The aircraft is owned by several freight carriers and, with no direct alternative available, they are likely to hold on to it.

The A300B4's Achilles' heel is its engine maintenance costs. On low utilisation and short average flight cycle operations, the CF6-50C2 has maintenance reserves exceeding $700 per engine flight hour (EFH). The engine has maintenance reserves lower than $300 per EFH if average cycle time is 2.5-3.0 flight hours (FH).

The maintenance costs and values of CF6-50C2s affect the A300B4's market values. These engines have been in temporarily high supply in recent years, following the retirement and teardown of large numbers of DC-10-30s and A300B2/B4s. This resulted in CF6-50C2 values dropping to levels less than $1 million. The consequence of this was that many operators were buying time-continued engines in the aftermarket as an alternative to putting engines through shop visits at a higher cost of $1.5-1.8 million.

This practice has led to a shortage of CF6-50C2s on the market, with the consequence that values have increased again and it is now cheaper for operators to put engines through shop visits. Values of freshly overhauled CF6-50C2s are in the region of $2 million, although the market is sensitive to fluctuations in supply and demand.

Aircraft with half-life engines are estimated to have a market value of $5.0-5.5 million, with the two engines accounting for most of the value.

Maintenance reserves for engines operated on short cycle operations are in the region of $700 per EFH, and the cost of the two engines can exceed $1,500 and also account for about half of the aircraft's maintenance costs *(see A300B2/B4 maintenance analysis, page 18)*.

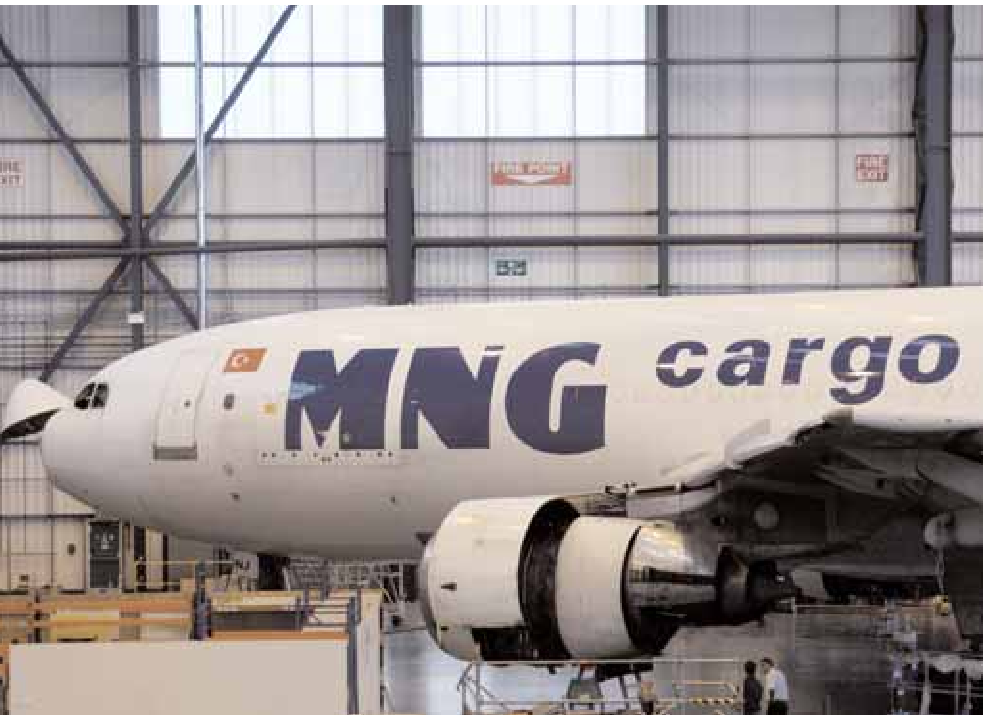
These maintenance costs form a large portion of operating costs, and have to be considered in relation to low rates of utilisation and overall economics. Monthly lease rates for freighters are $110,000-125,000.

Another main difficulty with the A300B2/B4 has been the plethora of different modifications it has required. Avionics modifications required on most aircraft have cost up to $750,000 per aircraft, costs that have been incurred over a concentrated period in recent years. There are also three major structural inspections that can incur high costs. It has therefore been a challenge for many operators to keep the aircraft in service.

During conversion to freighter, most aircraft were bridged to a low utilisation maintenance programme. This is based on a cycle of four C checks with a 24-month interval, so lasting eight years. Converted aircraft would have had their maintenance cycles zeroed at conversion. Conversions were performed on aircraft that were 12-20 years old.

The consequence of this is that most of the 74 converted aircraft that remain in service will have completed their first full base maintenance cycle. Aircraft will be 20-30 years old.

The cost of the fourth heavy check at the end of each base maintenance cycle will influence fleet plans. The cost of the fourth check at the end of the second cycle is likely to force most aircraft into retirement, since it will be too high for aircraft that have then reached an age of 28-38 years. By this time the supply of alternative freighters should have come onto the market at lease rates that make them economic alternatives to the A300B4F. AC



A large portion of A300B4Fs are owned and will be retained by their owners, keeping supply tight. The only major trading market for A300B2/B4s is in Turkey, where about one third of the active fleet now operates. MNG Airlines has acquired two more for operations, and a further two to dismantle for parts.