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