

# A340-200/-300 modification programmes

The major modification programmes for the A340-200/-300 are weight upgrades and engine build-standard and thrust upgrades.

**U**pgrades and modification programmes for the A340-200 and -300 series fall into the following groups: changes to weight upgrades; engine thrust re-rates; and engine time on-wing and exhaust gas temperature (EGT) hardware upgrades. At this stage there is no passenger-to-cargo conversion planned for the A340 family. The fleet is still relatively young and enjoys a strong demand for long-haul passenger operations, so A340 hull values are too high to make conversion to freighter economic.

## A340-200 weight upgrades

For the A340-200 series, Joint Airworthiness Authority (JAA) certification data lists four possible combinations of maximum take-off weight (MTOW), maximum landing weight (MLWs), and maximum zero fuel weight (MZFW) (see table, page 10).

There are four MTOWs: 558,872lbs (253.5 tonnes), 566,588lbs (257t), 573,202lbs (260t), and 606,271lbs (275t). Only one of these highest MTOW variants was built.

There are two MLW options: 399,037lbs (181t) and 407,855lbs (185t). There are two MZFW options: 372,581lbs (169t) and 381,399lbs (173t).

Accordingly, these are grouped to give four possible JAA-certified combinations of these MTOWs, MLWs, and MZFWs.

The first is the 'basic aircraft' with an MTOW of 558,872lbs, MLW of 407,855lbs, and MZFW of 372,581lbs.

The most capable variant has an MTOW of 606,271lbs, an MLW of 423,287lbs, and an MZFW of 381,399lbs. If any of these combinations are subsequently applied to an A340 model (which was originally delivered with different specifications), this results in a 'configuration change', for which a particular service bulletin (SB) applies.

The A340-200 and -300 are also subdivided into three sub-variants based on engine variant: the A340-211, A340-212, and A340-213. Moreover, operators can choose from the weight options to match particular mission payload, range and take-off performance requirements.

There has been an evolutionary progression of weight capabilities corresponding to successive aircraft variants. The -211 (and -311) tend to have the lowest weights, while the -213 and -313 have the highest ones. Having more engine thrust in the -213/-313 allows operators to take better advantage of higher operational weights. This means the -211 with the 566,588lbs MTOW option can carry its standard load of 263 passengers and baggage over 7,400nm.

The higher weight -212 became available in 1994, using the 573,202lbs MTOW. The enhanced A340-213 model, was previously marketed by Airbus as the A340-8000 from 1997. This aircraft offers the highest MTOW of 606,271lbs. This is combined with CFM56-5C4s and two auxiliary centre tanks (ACTs) in the rear cargo hold, and can carry 239 passengers over 8,000nm, or a full payload over 6,000nm.

## A340-300 weight upgrades

As with the A340-200 series, there is a menu of JAA-certified weights for the A340-300 series (see table, page 10): seven MTOW, four MLW, and five MZFW options. The seven MTOW options are: 558,872lbs (253.5t), 566,588lbs (257t), 573,202lbs (260t), 577,611lbs (262t), 597,453lbs (271t), 606,271lbs (275t), and 609,578lbs (276.5t).

The four MLW options are: 410,060lbs (186t), 414,469lbs (188t), 418,878lbs (190t), and 423,287lbs (192t).

The five MZFW options are: 383,604lbs (174t); 392,423lbs (178t); 396,832lbs (180t); 399,036lbs (181t); and 403,400lbs (183t).

Furthermore, operators may choose from 18 combinations of these. The first is the 'basic aircraft' with an MTOW of 558,872lbs, an MLW of 410,060lbs, and an MZFW of 383,604lbs. At the other end of the scale is the most capable variant, with an MTOW of 609,578lbs, an MLW of 423,287lbs, and an MZFW of 403,446lbs.

It should be noted that in the case of both the A340-200 and A340-300 weight

variants, an aircraft is either delivered new from the factory with the chosen MTOW, MLW and MZFW combination, or an SB relating to the particular 'variant change' can be implemented later on.

A small number of early A340-300s entered service at 'basic' MTOW. The 573,200lbs (260t) MTOW option became the norm from 1994. According to Airbus, most of the earlier aircraft have now been upgraded to this standard, which adds 150nm to the aircraft's range performance with a full passenger load. An option to increase MZFW by 8,880lbs, with an equivalent increase in payload, is also available, and provides a 4,410lbs increase in MLW.

The first high gross weight (597,453-606,270lbs) MTOW A340-300 was delivered to Singapore Airlines in August 1996. This is now flying with Etihad. As well as the increased MTOW, the high gross weight (HGW) A340 features a new strengthened landing gear and 4,400lbs in reinforced structure in various areas including the wing, and an optional ACT fuel tank in the rear cargo hold.

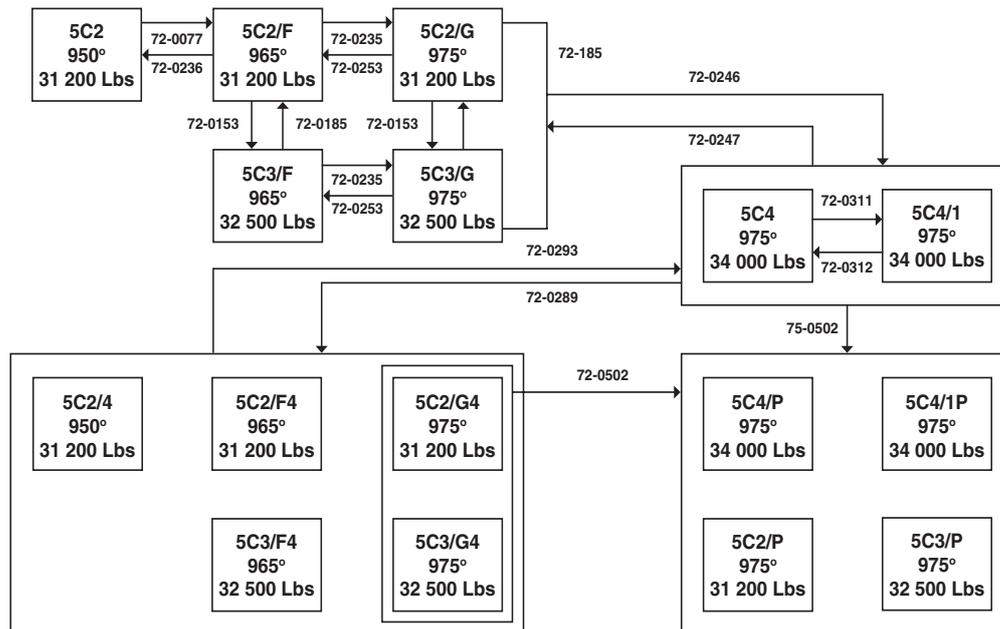
The A340-300E became available from 2004 (msn 544 onwards), and is powered by the improved CFM56-5C4/P as standard. This aircraft also comes with a further increased MTOW capability of 609,570lbs (275t).

## CFM56-5C/P upgrade

The 34,000lbs thrust CFM56-5C4/P is a newer version of the CFM56-5C4, using the high pressure compressor (HPC) and high pressure turbine (HPT) (core) of the CFM56-5B/P on the A320 family, which further improves hot-and-high performance, cuts maintenance costs and increases time on wing.

This engine variant is standard on the A340-300E mentioned above, although the improved hardware can also be retrofitted to earlier -300s. The Aircraft & Fleet Analytical System (ACAS) database lists 15 aircraft equipped with these improved engines which improve hot-and-high performance, reduce costs and increase time on-wing. Swiss took delivery of its first CFM56-5B/P-powered A340-313 in November 2003, and now

## CFM56 - 5C CONVERSION SERVICE BULLETINS



has six in service. South African Airways followed in March 2004 with deliveries of six; three of which are now being operated by Jet Airways in India. In addition, Air Tahiti Nui is operating one, and Air Mauritius operates two.

Another 11 CFM56-5C4/P powered A340-313s are on order. According to ACAS's order-backlog database these comprise 10 for Finnair, to be delivered from 2007 through to 2010, and one listed for an undisclosed customer.

As well as the new-build -5C/Ps, there is also an upgrade kit for operators to modify the CFM56-5C to the /P standard, which is achieved via SB72-0502. This requires revised engine control unit (ECU) software and 'G' hardware.

According to Martin Matthews, engineer at UK-based Total Engine Support, the -5C/P upgrade costs \$600,000 per engine. It involves installing 3D-aero HPT blades, nozzle guide vanes (NGVs), HPC blades and stage-1 LPT NGVs. Matthews says that the upgraded engines average a 15-17°C lower EGT than fleet average (and hence a higher EGT margin), as well as a cruise fuel burn reduction of 0.5-1.0%. The on-wing life also increases by 2,000-3,000 engine flight hours (EFH). CFMI says the upgrade can be installed during normal overhaul, and the modified engines are fully interchangeable and intermixable with unmodified engines, being 'virtually transparent' on the flightdeck. In 2006, Lan Airlines placed a \$48 million order with CFMI for CFM56-5C/P kits to upgrade 18 installed and spare engines on

its fleet of A340-300s.

### Engine re-rates & intermix considerations

Importantly, for some 'intermix' situations, such as where three -5C4 engines of an A340-313 have to be derated for an extended period of time to match, for example, a spare -5C2 fitted onto one of its pylons, the three -5C4s will be temporarily re-designated as -5C2/4s to comply with operational procedures. The /4 suffix shows that these engines have -5C4 hardware, but a -5C2 rating. The A340-313 has to be re-designated as an A340-311 to reflect its new temporary lower operational thrust limitation, and to be operated as such.

This is complicated mainly because of the documentation changes and approvals required. According to Christophe Bertrand, a senior flight test engineer with Airbus, the airline has to update all relevant documents to reflect the model change, and submit them to the airworthiness authorities. These documents include: the flight manual; the flightcrew operating manual (FCOM); take-off and landing charts; the weight and balance manual; and any documents mentioning the aircraft model.

For the actual hardware, full authority digital engine control (FADEC) software needs to be re-programmed to the lower thrust rating, engine rating plugs changed, engine nameplates changed, and the flight warning computers (FWC), SDAC and flight

management guidance envelope computers (FMGECs) all have to be pre-programmed. All of the above, including the documenting changes, can take about two weeks. This makes it unsuitable in aircraft on the ground (AOG) situations.

To cater for AOG situations with engine intermix, Airbus has presented to the airworthiness authorities a policy which allows for temporary engine re-rating without aircraft model change. It is applicable for a short period of time only, whereby any deviation from the aircraft's limitations, procedures and performance must be approved in a Flight Manual Supplement. For example, Airbus mod 45912 has been approved to allow the A340-313 (CFM56-5C4) to undertake temporary operations with engines re-rated to -5C2 thrust levels. This is approved in the A340-313 Flight Manual Supplement chapter 6.03.07 for aircraft having mod 45912. Importantly, by going this route, the A340-313 aircraft model remains unchanged, since operations with this new rating are approved in the Flight Manual Supplement. The applicable sections (for example, regarding rotor speed limitations, procedure and performance items) supersede the basic Flight Manual while the aircraft is in 'intermix' configuration.

All CFM56-5C conversion SBs are summarised (*see chart, this page*). **AC**

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