A300-600 & A310 fuel burn performance

The operating and fuel performance of the A300-600 & A310-300 in a variety of roles is analysed.

The fuel burn and operating performance of the A300-600R, A310-200, and A310-300 families are analysed.

Each of these families has passenger and freighter variants. Of the passenger variants, the A300-600R and A310-300 have been analysed. In the case of freighter variants, the A300F4-600 factory freighter and the converted freighters of the A310-200 and -300 are analysed.

Performance is also dependent on engine selection. For the A300-600R passenger and freighter versions, the two most powerful engines from General Electric (GE) and Pratt & Whitney (P&W) are used: the CF6-80C2A5F (60,100lbs thrust); and PW4158 (58,000lbs thrust).

For the A310 family a wider range of engine types is represented in the analysis. For the A310-200P2F the previous generation CF6-80A3 (48,970lbs thrust) and JT9D-7R4E1 (50,000lbs thrust) have been used. For the A310-300P2F the CF6-80C2A2 (52,460lbs thrust), CF6-80C2A8 (57,860lbs thrust), PW4152 (52,000lbs thrust), and PW4156A (56,000lbs thrust) have been used.

In the case of the A310-300 passenger aircraft, the CF6-80C2A8 (57,860lbs thrust), JT9D-7R4E1 (50,000lbs thrust), PW4152 (52,000lbs thrust), and PW4156A (56,000lbs thrust) have been used.

Passenger aircraft analysis

One city-pair is used to analyse the A300B4-600R aircraft. This is Munich (MUC) - London Heathrow (LHR), which has a tracked distance of 534nm. For the A310-300, two city pairs are used: Lisbon (LIS) - Paris Charles de Gaulle (CDG), which represents a typical short-range route with a tracked distance of 833nm); and LIS - Toronto (YYZ), which has a tracked distance of 3,253nm, and represents a typical long-range route.

In all cases, aircraft performance has been analysed in both directions on each route to illustrate the effects of wind speed and direction on the actual distance flown. Wind speed and direction result in an equivalent still-air distance (ESAD).

In the flight plans performed by Airbus, 85% reliability winds have been used. The aircraft have been assumed to have full passenger payloads plus baggage, cruising at long-range cruise speed (LRC) of Mach 0.79 and to be carrying no additional belly freight. Two-class passenger loads have been assumed: 266 for the A300-600; and 220 for the A310.

The standard weight for each passenger plus baggage is 220lbs. The payloads for the A300-600 and A310s are therefore 58,643lbs and 48,502lbs respectively.

The flight profile used in each case is based on international Federal Aviation Regulations (FAR) flight rules. It includes standard assumptions on standard diversion plus holding fuel reserves, contingency fuel (based on a percentage of total trip time), optimum long-range cruise (LRC) speed for each aircraft, and using taxi times of nine minutes' taxi out and five minutes' taxi in.

A300-600R performance

Birmingham (BHX) in the UK is selected as an alternate airport for MUC-LHR. The two versions of the A300-600R, which all have a maximum take-off weight (MTOW) of 378,533lbs, encounter a 48-knot headwind component during cruise. This effectively increases the tracked distance of 534nm by 57nm to give a resultant ESAD of 592nm *(see table, page 14)*.

In the reverse direction to MUC, the alternate airport is Nuremburg (NUE). The headwind component is reduced to 8 knots on this sector, which results in a reduced ESAD of 543nm.

Comparing the performance of the PW4000 with that of the GE CF6-80C2A5-powered aircraft, it can be seen that while the operating empty weight (OEW) of the GE-powered aircraft is 176lbs heavier than the PW-powered aircraft, the GE-powered aircraft actually has a lower block fuel burn in both directions *(see table, page 14)*.

A310-300 short mission

For the A310-300 variants analysed on the LIS-CDG route, Lille is selected as the alternate airport when operating to CDG. The aircraft encounter a 6-knot headwind component during cruise. This adds to the tracked distance of 833nm by 10nm to give a resultant ESAD of 843nm *(see table, page 14)*.

In the reverse direction when operating to LIS, Faro (FAO) is the alternate airport. The headwind

The A310-300 is powered by several engine types and variants. Aircraft powered by the PW4000 have the lowest fuel burn per seat-mile.

FUEL BURN PERFORMANCE OF PASSENGER-CONFIGURED A300-600 & A310-300

City-pair	Aircraft variant	Engine type	Seats	Payload lbs	MTOW lbs	Actual TOW lbs	Fuel burn USG	Block time mins	ESAD nm	USG per pax-nm
MUC-LHR	A300-605R	CF6-80C2A5	266	58,643	378,533	286,274	2,517	100	591	0.018
MUC-LHR	A300-622R	PW4158	266	58,643	378,533	286,806	2,571	101	592	0.018
LHR-MUC	A300-605R	CF6-80C2A5	266	58,643	378,533	287,392	2,384	93	543	0.017
LHR-MUC	A300-622R	PW4158	266	58,643	378,533	285,642	2,434	94	543	0.017
LIS-CDG	A310-308	CF6-80C2A8	220	48,502	361,558	257,985	2,943	132	843	0.016
LIS-CDG	A310-322	JT9D-7R4E1	220	48,502	337,307	259,704	3,027	134	843	0.017
LIS-CDG	A310-324	PW4152	220	48,502	346,125	257,158	2,909	134	843	0.016
LIS-CDG	A310-325	PW4156A	220	48,502	361,558	257,980	2,916	134	843	0.016
CDG-LIS	A310-308	CF6-80C2A8	220	48,502	361,558	260,158	3,176	142	917	0.017
CDG-LIS	A310-322	JT9D-7R4E1	220	48,502	337,307	262,010	3,283	143	918	0.018
CDG-LIS	A310-324	PW4152	220	48,502	346,125	259,305	3,147	143	917	0.017
CDG-LIS	A310-325	PW4156A	220	48,502	361,558	260,154	3,157	143	917	0.017
LIS-YYZ	A310-308	CF6-80C2A8	220	48,502	361,558	328,469	12,652	490	3,660	0.018
LIS-YYZ	A310-322	JT9D-7R4E1	220	48,502	337,307	333,067	13,159	490	3,658	0.018
LIS-YYZ	A310-324	PW4152	220	48,502	346,125	325,896	12,398	489	3,658	0.017
LIS-YYZ	A310-325	PW4156A	220	48,502	361,558	326,936	12,435	489	3,658	0.017
YYZ-LIS	A310-308	CF6-80C2A8	220	48,502	361,558	313,261	10,723	428	3,173	0.015
YYZ-LIS	A310-322	JT9D-7R4E1	220	48,502	337,307	317,337	11,146	429	3,173	0.016
YYZ-LIS	A310-324	PW4152	220	48,502	346,125	311,290	10,535	428	3,174	0.015
YYZ-LIS	A310-325	PW4156A	220	48,502	361,558	312,284	10,566	428	3,174	0.015

component increases to 45 knots, resulting in a significantly increased ESAD of 917nm.

Comparing the performance of the different A310 variants, certain hardware variations should be noted. First, different MTOW/OEW versions are used, with different engine types powering them *(see tables, this page and page 15)*. Interestingly, the A310-322 powered by JT9D engines has the lowest MTOW, but a slightly higher OEW due to the installation of heavier engines. In addition, it suffers from higher fuel burn (and consequently requires a greater fuel load for a given mission) than do the other A310-300 airframe/engine variants that are powered by PW4100s or CF6-80C2s.

The PW4152 has slightly lower fuel consumption than the PW4156A and CF6-80C2A8 *(see tables, this page and page 15)*. All four aircraft/engine variants on this route can carry the full nominal payload of 220 passengers without restriction. In the reverse direction, there are also no restrictions, although the 45-knot headwind and ESAD of 917nm (compared with 833nm) result in 300 US gallons (USG) more fuel being burned in each case.

A310-300 long mission

The alternate airport used for the A310-300s on the LIS-YYZ direction is Pittsburgh (PIT), and the aircraft encounter a 53-knot headwind component during cruise. This adds 407nm to the tracked 3,253nm distance to give an ESAD of about 3,660nm *(see table, this page)*.

In the reverse direction, there is an assisting tailwind component of 12 knots, resulting in a reduced ESAD of 3,173nm.

Comparing the performance of the aircraft, which all have identical weight specifications to those analysed in the LIS-CDG city pair, it can be seen that there is a more marked difference in the fuel burn differences between the four aircraft/engine variants. For example, the worst performing aircraft is still the JT9D-powered A310-322, which burns 1,000 USG more fuel than the other variants. As before, the best performing aircraft is the PW4152-powered A310-324. All four aircraft/engine variants on this route can carry the full nominal payload of 220 passengers without restriction. In the reverse direction, there are also no restrictions.

Freighter aircraft analysis

Three types of A300/A310 freighters are analysed. Both the A300F4-600 (factory freighter) and the A310-200P2F (passenger to freighter conversion) are analysed on Memphis (MEM) - Calgary (YYC), which is representative of a typical medium-distance freighter route. This has a tracked distance of 1,487nm, and is typical of the type of route both these aircraft would operate.

The A310-300P2F (passenger to freighter conversion) is analysed on Dubai (DXB) - Istanbul (IST), which has a longer tracked distance of 1,705nm. This represents the longer-range capabilities of the A310-300P2F as a package freighter platform.

A300F4-600R performance

The A300F4-600 is represented here by two engine types (CF6-80C2A5F) and two MTOW variants (370,376lbs and 375,888lbs). The lighter variant is configured in 'payload mode' to allow for higher payload-packing densities. This has a high maximum zero fuel weight (MZFW) of 300,931lbs. This compares to the heavy MTOW variant which has an MZFW of 286,601lbs.

The aircraft with the higher MZFW consequently has a higher maximum structural gross payload of 122,248lbs. This is the same as the available payload demonstrated on the MEM-YYC route, since the aircraft is not MTOW-restricted. On the other hand, the aircraft with the lower MZFW has a maximum structural gross payload of only 107,918lbs. It has the same available payload uplift on the route since it is not MTOW-restricted.

Regarding any engine-related differences, there is a very slight fuel burn

FUEL BURN PERFORMANCE OF FREIGHTER-CONFIGURED A300-600 & A310-300

City-pair	Aircraft variant	Engine type	Payload lbs	MTOW lbs	Actual TOW lbs	Fuel burn USG	Block time mins	ESAD nm	USG per ton-nm
MEM-YYC	A300F4-605R	CF6-80C2A5F	107,918	375,888	344,542	6,938	235	1,664	0.097
MEM-YYC	A300F4-605R	CF6-80C2A5F	122,248	370,376	361,216	7,217	234	1,663	0.089
MEM-YYC	A300-F4-622R	PW4158	107,918	375,888	344,364	6,920	238	1,666	0.097
MEM-YYC	A300F4-622R	PW4158	122,248	370,376	361,086	7,210	238	1,665	0.089
YYC-MEM	A300F4-622R	PW4158	122,248	370,376	354,439	6,323	213	1,463	0.078
YYC-MEM	A300F4-605R	CF6-80C2A5F	107,918	375,888	337,569	6,017	211	1,463	0.084
YYC-MEM	A300F4-622R	PW4158	107,918	375,888	337,556	6,008	214	1,462	0.084
YYC-MEM	A300F4-605R	CF6-80C2A5F	122,248	370,376	354,346	6,314	210	1,463	0.078
MEM-YYC	A310-203P2F	CF6-80A3	85,246	313,056	298,435	6,268	237	1,663	0.111
MEM-YYC	A310-222P2F	JT9D-7R4E1	85,246	313,056	300,516	6,406	231	1,661	0.113
YYC-MEM	A310-203P2F	CF6-80A3	85,246	313,056	293,314	5,498	212	1,463	0.097
YYC-MEM	A310-222P2F	JT9D-7R4E1	85,246	313,056	295,547	5,655	206	1,463	0.100
DXB-IST	A310-304P2F	CF6-80C2A2	87,823	346,125	304,191	6,669	260	1,870	0.100
DXB-IST	A310-308P2F	CF6-80C2A8	87,823	361,558	304,191	6,669	260	1,870	0.100
DXB-IST	A310-324P2F	PW4152	87,823	346,125	304,044	6,590	262	1,870	0.099
DXB-IST	A310-325P2F	PW4156A	87,823	361,558	304,044	6,590	262	1,870	0.099
IST-DXB	A310-304P2F	CF6-80C2A2	87,823	346,125	300,327	6,018	237	1,681	0.090
IST-DXB	A310-308P2F	CF6-80C2A8	87,823	361,558	300,327	6,018	237	1,681	0.090
IST-DXB	A310-324P2F	PW4152	87,823	346,125	300,360	5,976	238	1,681	0.089
IST-DXB	A310-325P2F	PW4156A	87,823	361,558	300,360	5,976	238	1,681	0.089

advantage for the P&W-powered A300F4-622R compared with the GE-powered A300F4-605R. This results in the CF6-powered aircraft having a slightly higher fuel burn and having to carry a higher fuel load *(see table, this page)*. All the aircraft nevertheless operate comfortably within their MTOW limits despite differences in total fuel loads.

It is also worth noting that Edmonton is used as the alternate when operating to YYC. The aircraft encounter a 51-knot headwind, which results in an ESAD of 1,664nm, compared with an actual tracked distance of 1,487nm.

Greenville is the alternate airport on the return route to MEM, and here there is an assisting 8-knot tailwind which reduces the tracked distance to an ESAD of 1,463nm. These different ESADs result in a difference in block fuel burn of about 900 USG for the four variants. An exact aircraft-by-aircraft comparison on both directions is shown *(see table, this page)*.

A310-200P2F performance

The A310-200P2F, being an older aircraft, is powered by two earlier-generation engines: the GE CF6-80A3 and the P&W JT9D-7R4E1. Both A3100-200 variants have the same OEW, MTOW, and structural payload capability *(see table, this page)*. Both variants carry the same actual payload (85,246lbs) in both directions on the MEM-YYC city pair.

The main aircraft-related difference to note therefore, is the lower fuel burn for the CF6-80A-powered A310-203P2F, equating to a difference of 100-200 USG per sector.

The A310-200P2F encounter the same 51-knot headwind component as the A300F4-600R on the MEM-YYC direction, and the 8-knot tailwind component on the YYC-MEM operation. The effect these different ESADs have on aircraft block fuel burn is an approximate difference of 700USG. An exact aircraft-by-aircraft comparison in both directions is summarised *(see table, this page)*.

A310-300P2F performance

The final city-pair of DXB-IST is a longer route with a tracked distance of 1,705nm. This is suitable for the longer-range capability of the A310-300P2F converted freighter.

Here, all four variants are able to carry their maximum structural payload of 87,823lbs in both directions. All variants also have the same OEW of 163,503lbs, whereas the MTOW capabilities are either 346,125lbs or 361,558lbs *(see table, this page)*. Both GE and P&W provide an optimised engine variant for these two MTOW versions: the CF6-80C2A2 (52,460lbs thrust) for the lower MTOW A310-304P2F; CF6-80C2A8 (57,860lbs thrust) for the higher MTOW A310-305P2F; the PW4152 (52,000lbs thrust) for the lower MTOW A310-324P2F; and the PW4156A (56,000lbs thrust) for the higher MTOW A310-325P2F.

The P&W-powered aircraft enjoy a slightly lower fuel burn advantage over the GE-powered aircraft on the route in both directions *(see table, this page)*.

The aircraft encounter a 43-knot headwind when operating to IST, which increases the tracked distance of 1,705nm to an ESAD of 1,870nm. Despite this, the aircraft does not suffer a payload limitation. The variants' actual take-off weights are well within their respective MTOW capabilities. AC