757 in service & operations

Most 757s are the -200 model and operate as passenger aircraft. Their operating & fuel burn performance on sample routes is analysed.

Out of the 998 757s in operation, 826 are passenger-configured -200s and 55 are passenger-configured 757-300s. The majority of the remainder are factory-built freighters flying for UPS.

The fleet of 757-200s is dominated by a small number of large fleets operated by US carriers, the largest by American Airlines (141) and Delta (121). The major US airlines operate a total of 501 757-200s, which account for 60% of the passenger fleet. Another 33 are operated by European scheduled carriers and 64 by major Chinese airlines. The operations of airlines in these three continents are similar, with most aircraft being operated on average flight times of 2.0-3.0 flight hours (FH) and at annual utilisation of 2,500-3,000FH per year. Many other 757-200s operated in smaller fleets by other carriers are utilised in a similar way.

The 757 is a reliable workhorse, operated by airlines such as Finnair and Iberia. Finnair uses the 757 for leisure routes and has an average flight time of 6FH for operations from Helsinki to the Mediterranean. The aircraft average 14FH per day and 4,000FH and 950FC per year. The fleet of six PW2000-powered aircraft achieve this with a technical despatch reliability of 99%.

Iberia's operation is for an average route length of 930nm for flights with its fleet of 10 757-200s. These generate an average of 3,800FH per year, and manage this operation with an average turn time between flights of 45 minutes.

Fuel burn performance

To illustrate the fuel burn performance of the different 757-200 variants and the RB211-535E4-B-powered 757-300 on different routes of varying length, three sample city-pairs have been used. These have sector lengths of between 881nm and 3,225nm *(see first table, page 16)*.

Four different 757 variants have been analysed, including three 757-200 models. These three have a maximum take-off weight (MTOW) of 255,000lbs, fuel capacity of 11,276lbs, and are powered by the RB211-535E4, PW2037 and PW2040. The fourth variant analysed is a 757-300, powered by RB211-535E4-B engines.

The fuel burn calculations have been made using a maximum passenger load of 190 and a conservative average weight of 220lbs. The 757-300 has been analysed with a passenger payload of up to 245.

The fuel burns in US Gallons, flight times, distance tracked, equivalent still air distance (ESAD) flown, wind component factor, and number of passengers carried for each aircraft type on each route in both directions are summarised.

The results also show the average fuel burn per passenger carried, illustrating the difference in fuel burn efficiency between the engine types.

The data for the three 757-200s first show that the aircraft is not payload-limited on the longest and most challenging route: Lima to New York. This is because it is able to carry a full passenger load, and the aircraft takes off at its MTOW of 255,000lbs.

The fuel burns of the three -200 variants illustrate the fuel efficiency of the PW2000-powered aircraft over the RB211-535E4-powered aircraft. In most cases the RB211-535E4-powered aircraft burns 5-8% more fuel. The PW2040-powered aircraft is marginally more fuel efficient than PW2037-powered aircraft in most cases, although few operators specified the PW2040. The difference in fuel burn between the RB211-powered and PW2000-powered aircraft is in the region of 0.6-0.8USG per passenger: equal to about additional $1.2 in fuel cost on a 800-1,000nm route.

The 757-300 experiences a payload limitation on the Lima-New York route. This city-pair has an ESAD of about 3,200nm when wing direction and speed are considered. This compares to a range of about 3,050nm with 245 passengers at an average weight of 220lbs. A payload reduction therefore has to be made on this route. Analysis on other routes with shorter ESADs in the region of 2,700nm shows that the 757-300 can operate with a full payload. One example of this is JFK-Birmingham, UK where the reverse trip has an ESAD of 3,300nm, forcing the aircraft to have a payload reduction. Bahrain-Brussels, with an ESAD of 2,814nm, allows the aircraft to operate with a full passenger load. This indicates that the aircraft can operate on routes with an ESAD of up to 2,900nm, and a flight time of about 6 hours and 25 minutes, without payload restrictions.

In terms of fuel burn efficiency, the 757-300 burns 6.2-10% less than PW2000-powered -200s and 13-15% less than RB211-535-powered -200s, mainly because of the aircraft's larger size, carrying 29% more passengers.

Freighter performance

Since a large number of 757-200s are likely to be converted to freighter, an analysis of their fuel burn performance on a few routes has been analysed.

Because of the large number of different -200 variants and the three conversion programmes available, the analysis has been simplified by taking two variants converted under one modification programme. The two variants are the RB211-535E4-B-powered and PW2037-powered -200 aircraft. These are the most numerous of -200 variants and the fuel burn difference between them and the other two variants is only 1-2%.

The conversion programme used here is the Precision Conversions modification, which results in the -200PCF aircraft. For the same engine type, MZFW, aircraft fuel capacity and payload carried; the only other factor that will affect the fuel burn between this and aircraft converted under another programme is the operating empty weight (OEW). The difference in OEW between -200PCF and the same aircraft converted by ASCC is 1,823lbs in favour of the -200PCF. The -200ACF will have a 1.0-1.1% higher fuel burn. The fuel burn data shown *(see second table, page 16)* can thus be increased by about 1% for an aircraft converted by ASCC: the -200ACF.

The three routes used to illustrate the fuel burn performance of the freighter are Cincinnati-New York JFK, Miami-Bogota and Miami-Manaus. These routes have still air distances of about 500nm to 2,140nm and so are representative of how many 757 freighters may be used in the future.

The weight specifications of the -200PCF aircraft are: MTOW of 250,000lbs; MZFW of 188,000lbs; and OEW of 116,041lbs for the RB211-535E4-B-powered aircraft and 115,541lbs for the PW2037-powered aircraft. In all cases, the aircraft carries a gross payload of 53,100lbs; which includes a tare of 7,100lbs, leaving a net payload of 46,000lbs.

There were no take-off weight restrictions, and so no payload limitations on any route. The shortest sector is completed in about 77 minutes. The RB211-535E4-B-powered aircraft burns 1,445USG of fuel *(see second table, page 16)*. This is 82USG and about 6%

FUEL BURN PERFORMANCE OF 757-200 & 757-300

City-pair	Aircraft variant	Engine model	Fuel USG	Flight time	Passenger payload	Fuel USG per passenger	Tracked distance-nm	ESAD nm	Wind speed factor
Chengdu-Beijing	757-200	RB211-535E4	2,313	1:58	190	12.2	881	799	43
	757-200	PW2037	2,171	1:57	190	11.4	881	800	43
	757-200	PW2040	2,208	1:59	190	11.6	881	804	40
	757-300	RB211-535E4-B	2,562	1:56	245	10.5	881	802	42
Beijing-Chengdu	757-200	RB211-535E4	2,795	2:23	190	14.7	884	1,000	-50
	757-200	PW2037	2,643	2:22	190	13.9	884	998	-49
	757-200	PW2040	2,637	2:27	190	13.9	884	1,012	-53
	757-300	RB211-535E4-B	3,072	2:22	245	12.5	884	998	-49
Miami-Lima	757-200	RB211-535E4	6,318	5:06	190	33.3	2,303	2,303	0
	757-200	PW2037	6,003	5:08	190	31.6	2,303	2,303	0
	757-200	PW2040	5,870	5:15	190	30.9	2,303	2,303	-1
	757-300	RB211-535E4-B	7,099	5:09	245	29.0	2,303	2,303	0
Lima-Miami	757-200	RB211-535E4	6,325	5:09	190	33.3	2,320	2,320	0
	757-200	PW2037	5,983	5:12	190	31.5	2,320	2,320	1
	757-200	PW2040	5,929	5:18	190	31.2	2,320	2,314	1
	757-300	RB211-535E4-B	7,097	5:10	245	29.0	2,320	2,320	0
New York-Lima	757-200	RB211-535E4	9,058	7:12	190	47.7	3,288	3,219	1
	757-200	PW2037	8,658	7:13	190	45.6	3,288	3,281	1
	757-200	PW2040	8,467	7:18	190	44.6	3,288	3,281	1
	757-300	RB211-535E4-B	9,830	7:13	220	44.8	3,288	3,181	1
Lima-New York	757-200	RB211-535E4	8,897	7:00	190	46.8	3,225	3,197	4
	757-200	PW2037	8,416	7:04	190	44.3	3,225	3,197	4
	757-200	PW2040	8,171	7:09	190	43.0	3,225	3,196	4
	757-300	RB211-535E4-B	9,633	7:02	229	42.0	3,225	3,197	4

Source: Navtech

FUEL BURN PERFORMANCE OF 757-200PCF

City-pair	Aircraft variant	Engine model	Fuel USG	Flight time	Freight payload lbs	Tracked distance-nm	ESAD nm	Wind speed factor
Cincinnati-New York	757-200	RB211-535E4-B	1,455	1:16	53,100	550	491	49
	757-200	PW2037	1,373	1:17	53,100	550	498	43
New York-Cincinnati	757-200	RB211-535E4-B	1,750	1:33	53,100	528	607	-53
	757-200	PW2037	1,648	1:33	53,100	528	600	-48
Miami-Bogota	757-200	RB211-535E4-B	3,511	3:04	53,100	1,336	1,333	1
	757-200	PW2037	3,349	3:07	53,100	1,336	1,333	1
Bogota-Miami	757-200	RB211-535E4-B	3,560	3:08	53,100	1,349	1,356	-2
	757-200	PW2037	3,416	3:11	53,100	1,349	1,356	-2
Miami-Manaus	757-200	RB211-535E4-B	5,408	4:40	53,100	2,095	2,077	4
	757-200	PW2037	5,114	4:42	53,100	2,095	2,077	4
Miami-Manaus	757-200	RB211-535E4-B	5,575	4:48	53,100	2,117	2,141	-5
	757-200	PW2037	5,287	4:53	53,100	2,117	2,141	-5

Source: Navtech

more than the PW2037-powered aircraft. This is equal to about $120 at current fuel prices, and has to be considered against all other cash operating costs and aircraft financing and lease charges.

The Miami-Bogota route is completed in just over three hours and uses about 3,500USG. Again, the RB211-powered aircraft has a higher fuel burn, in this case 4-5% more than the PW2037-powered aircraft depending on the direction of flight and the effects of en-route winds.

The Miami-Manaus route, with an ESAD of 2,080-2,140nm, depending on the direction travelled, is completed in 280-290 minutes. The RB211-powered aircraft burns 5,400-5,575USG, 5-6% more than the PW2037-powered aircraft. AC