

# 747-400 series specifications

The 747-400 series is divided into four main groups of passenger, domestic passenger, combi and freighter aircraft.

The 747-400 was originally proposed as a longer-range, two-flightcrew and advanced version of the 747-300, with 1,000nm more range up to 7,260nm, along with lower fuel burn and operating costs. The 747-400's main features include the same fuselage dimensions as the -300 series, an increased maximum take-off weight (MTOW), a six-foot wingspan extension and a six-foot-high winglet on each wing. The -400 also features a horizontal stabiliser fuel tank, new carbon brakes, a new auxiliary power unit (APU), and various aerodynamic improvements over the earlier models.

Importantly, the -400 introduced a new two-man digital electronic flight instrument system (EFIS) flightdeck, as well as some new materials.

It should also be noted that the Section 41 decompression issue on the earlier 'classics' was resolved on the -400 by strengthening the upper-deck floor structure.

Structural carbon brakes are standard on the 747-400's 16 main landing gear wheels. They provide improved energy absorption characteristics and wear

resistance, as well as an estimated weight saving of 1,800lbs over steel brakes. The 747-400 achieved additional weight savings by using higher strength aluminium alloys with improved fatigue life.

## Powerplant options

There are three engine options for the 747-400: the CF6-80C2B1F rated at 56,700lbs thrust; the PW4056 rated at 56,000lbs thrust; and the RB211-524G/H and -524G/H-T rated at 58,000lbs and 60,600lbs thrust respectively.

The CF6-80C2 and PW4056 had new nacelles and pylons that were common with the 767, while the RB211-524 required a modified pylon and nacelle. The two US engines have full authority digital electronic control (FADEC). The CF6-80C2B5F rated at 62,600lbs thrust is also certified as an option, but only powers the -400ER and the -400ERF variants.

Regarding the RB211 engines, Rolls-Royce also offers a 'hybrid' version of its powerplant, designated the RB211-524G-T or -524H-T. The modified engine is designed to eliminate the performance

and reliability shortfalls that some operators experienced with the standard -524H. The -T upgrade integrates the high-pressure core '04 Module' of the Trent 700 with an otherwise standard -524G or -524H. This delivers a 2.5% reduction in fuel consumption. A number of aircraft have been retrofitted.

According to Ascend, a division of Airclaims, the 747-400 is equipped with a Pratt & Whitney Canada PW901A APU as standard, which is located in the tailcone. This new unit for the Series 400 has 40% lower fuel burn compared to the previous unit.

## Cockpit design

A two-man flightdeck featuring six EFIS screens is standard on the 747-400. In front of each pilot are two duplicated eight-inch-square cathode ray tubes (CRTs). These screens replace all electromechanical gauges of earlier generation 747s. Most importantly, they reduce the number of flightcrew from three to two. This system also has higher reliability.

The flightdeck also features a central maintenance computer (CMC), which is effectively a form of built-in test equipment (BITE) that records any faults with systems and major components for display to mechanics on the ground, or for response from the crew.

The Honeywell/Sperry flight management system (FMS) features autothrottle management, new radio-tuning and a worldwide navigation database.

The aircraft also features two observer seats and two rest bunks, since it will often be used on missions where one or two supernumerary crew are required.

## 747-400

The -400 features the highest specification weights of all 747 variants. The standard MTOW started at 870,000lbs. In late 1993 Boeing introduced a number of improvements, which included an MTOW increase to 875,000lbs. A retrofit kit is also available, Qantas became the first 747-400 operator to move up to the new weight in early 1994. Lower weights are available and British Airways has taken delivery of some 747-400 'Lites' which are certified at 840,000lbs, and do not



*About two-thirds of the 747-400s built are passenger- and combi-configured aircraft. The aircraft is also popular as a freighter.*

feature the crew rest facilities that are standard on other -400s. These aircraft are therefore restricted to a maximum flight time of 11 hours.

The aircraft's maximum landing weight (MLW) options are 574,000lbs, 585,000lb and 630,000lbs. The maximum zero fuel weight (MZFW) options are 535,000lbs, 540,000lbs and 565,000lbs. Typical operating empty weights (OEW) range from 380,000lbs to 407,107lbs.

The total usable fuel capacity, with horizontal stabiliser tank, is up to 57,065 US gallons (USG) compared with 48,070-52,410 USG for the 747-300. The -400 has six wing fuel tanks and a new 3,300 USG fuel tank in the horizontal stabiliser. This tail fuel is required for MTOWs in excess of 850,000lb and provides about 350nm extra range.

The 747-400's standard tri-class seating configuration is 412 passengers, with 34 first class, 62 business class, and 316 economy seats. This configuration will have 10 galleys and 14 vacuum toilets.

A high-density, two-class seating arrangement can accommodate 509 passengers. This is with 30 first and 479 economy class seats. Actual seating configurations and numbers vary between operators.

An optional feature on the aircraft is a rest area for the cabin crew, incorporating four bunks and four seats, which is situated in the upper rear fuselage above the rear passenger door.

The -400's total belly freight capacity is 6,025 cubic feet with 30 LD-1 containers. This reduces to 5,332 cubic feet with five pallets, 14 LD-1 containers and one 'bulk' pallet.

## 747-400 Combi

The 747-400 Combi has a 120-inch by 134-inch main deck cargo door on the port, rear side of the fuselage. The rear zones of the aircraft have a strengthened floor with a cargo handling system.

Typical three-class layouts include: 290 passengers plus six pallets; 266 passengers with seven pallets; or 220 passengers and twelve pallets.

The -400 Combi's maximum range is 7,214nm, while its maximum cargo capacity is 10,422 cubic feet, assuming that seven maindeck pallets, 14 LD-1 belly containers and five lower-hold pallets are used. Fuel capacity is the same as the 747-400.

## 747-400F

The 747-400F freighter is structurally identical to the all-passenger aircraft, and uses the same 120-inch by 134-inch side cargo door and 136-inch by 98-inch nose door as the -200F. The -400 also shares

## 747-400 FAMILY SPECIFICATIONS

Variant	747-400	747-400ER
MTOW lbs	800,000/875,000	910,000
MZFW lbs	535,000/542,500	555,000
OEW lbs (no tare)	394,088	406,900
Gross structural payload lbs	140,912/148,412	148,100
Fuel capacity USG	53,765/57,065	63,240
Seats (3 class)	400	400
Range nm	7,260	7,670
Belly freight cu ft	6,025	5,599
Variant	747-400F	747-400ERF
MTOW lbs	800,000/875,000	910,000
MZFW lbs	610,000/635,000	611,000
OEW lbs (no tare)	349,690	350,390
Gross structural payload lbs (incl tare)	260,130/285,310	260,610
Fuel capacity USG	53,765/57,065	53,765
Maindeck freight Container volume cu ft	21,347	21,347
Belly freight Container volume cu ft	6,120	6,120
Total volume cu ft	27,467	27,467
Volumetric payload lbs @ 7lbs/cu ft	192,269	192,269

the same two-man flightdeck, wing extensions, winglets and increased capacity of the -400.

The -400F's total cargo volume is 27,467 cubic feet. It retains the shorter upper-deck of the earlier 747-200F, and benefits from the -400's MTOW of 875,000lbs and higher MZFW of 610,000lbs. This higher MZFW therefore increases the -400F's payload by up to 44,000lbs, to a maximum structural limit of 248,300lbs over a range of 4,445nm.

The -400F's freight capacity has a maximum usable volume on the maindeck of 21,347 cubic feet, with 30 pallets measuring 96 inches by 125 inches. The usable volume on the lower deck is 5,600 cubic feet using 32 LD-1 containers, while the volume of the additional bulk cargo is 520 cubic feet. The total cargo volume of the -400F is therefore 27,467 cubic feet.

Compared with the 747-200SF, the maindeck floor was revised on the -400F to make room for two additional 10-foot-high pallets on the main deck. This was done by reducing the number of positions available for 8-foot-high pallets. Boeing also created an additional pallet position in the nose area. These changes added 774 cubic feet more cargo space to the -400F's maindeck than on the 747-200F. Moreover, two additional LD-1 or LD-3 containers also fit into the aft lower hold, and, depending on the pallet and container mix, two additional containers can fit into the forward lower hold, thereby adding up to 700 cubic feet of

additional containerised cargo volume in the lower hold.

The 248,300lbs of structural payload revenue capacity published by Boeing is a function of the following specifications: an MZFW of 610,000lbs; an OEW of 349,690lbs with no pallets or containers; and a total pallet and container tare weight of 12,010lbs for both decks. The payload capacity also assumes that a large number of pallets rather than unit load device (ULD) containers are loaded on the maindeck. If 125-inch by 96-inch ULD containers are loaded on the maindeck instead (such as the M1 and M1H ULDs, each of which have a tare weight considerably greater than a 125-inch by 96-inch footprint pallet), then the total structural revenue payload will decrease accordingly.

For example, one 125-inch by 96-inch pallet has a tare weight of 265lbs. This compares to one 125-inch by 96-inch contoured M1H ULD that uses the same floor area, but weighs 816lbs. Furthermore, if an operator loads a 747-400F with the nominal 30 LD-9 pallets on the maindeck, the total corresponding tare weight for the maindeck will be only 7,950lbs. If 23 118-inch high contoured M1H ULDs and seven 96-inch high M1 ULDs (contoured in the nose section) are used, then the total tare weight on the maindeck will be about 24,000lbs. This represents a tare weight difference of about 16,000lbs on the maindeck, with a proportionate reduction in payload capacity.



The generic OEWs quoted in marketing brochures, which incorporate bare minimum tare weights of the lightest pallets, do not represent a likely payload capacity for operators. A more useful starting point is the basic operating weight (BOW). The BOW is the OEW without any pallets or containers. In the case of the 747-400F, the BOW would therefore be 349,690lbs. Moreover, the MZFW minus the BOW is the gross structural payload capacity available to the operator, from which the tare weight of the pallets and containers it uses should be deducted. The operator can then 'mix-and-match' their own pallet and ULD combinations.

Besides the factory-built -400F, there are two passenger-to-freighter modifications for the 747-400. These are offered by Boeing and IAI-Bedek Aviation. Details of the payload specifications of the aircraft are given (See *747-400 modification programmes, page 9*).

### 747-400ER

The 747-400ER is an increased gross weight derivative of the 747-400 that allows it to carry additional fuel for longer ranges. This variant can be equipped with up to two 3,060 USG fuel tanks in the forward lower cargo compartment, and has a higher take-off weight of 910,000lbs, which is an increase of 35,000lbs over existing 747-400s. This gives the aircraft a range of 7,670nm, an increase of 410nm over the -400. The -400ER has the same MZFW as the -400.

It should be taken into consideration that a maximum belly cargo capacity of 5,599 cubic feet is possible with 28 LD-1 containers and bulk freight. According to Boeing's specifications, this capacity falls to 5,332 cubic feet with four pallets, 14 LD-1 containers and bulk freight. These volumes are smaller than for the 747-400, due to the presence of the auxiliary fuel tank in the forward lower cargo hold. The total maximum usable fuel capacity with these two auxiliary fuel tanks is 63,240 USG. With just one auxiliary tank the capacity reduces to 60,495 USG.

The -400ER also features some aerodynamic changes and a strengthened landing gear. Boeing also fitted the -400ER with a 777-style cabin.

### 747-400ERF

The 747-400ERF has many of the -400F's features, and an increased MTOW capability, which allows it to trade range for payload. The -400ERF has a 57,065 USG usable fuel capacity with the tail tank, since it is not fitted with the -400ER's auxiliary fuel tanks.

The 910,000lbs take-off weight allows the -400ERF to fly 525nm more than the -400F, or to carry an additional 22,000lbs payload on long-range flights. As the -400ERF's MZFW is only 1,000lbs greater than the -400F's, the -400ERF's maximum structural payload is 248,600lbs, which is almost the same as the -400F's. This payload is the difference between the MZFW and the OEW. This OEW includes tare container weight of about 12,000lbs, which is based on

A large number of 747-400Fs have been built, but Boeing has taken the last orders for these. Passenger-to-freighter modifications are now available from Boeing and IAI-Bedek.

lighter pallets, rather than heavier ULDs. The -400ERF's BOW is 350,390lbs, making it only 700lbs greater than the 747-400F.

Looking at the original equipment manufacturer's (OEM's) payload-range curve, at one extreme, the -400ERF's range can be increased by 530nm to 4,970nm for the same amount of payload. At the other end, and within the maximum structural payload limitations, an additional 22,000lbs of payload can be carried on longer-range flights of between 4,970nm and 6,300nm when operating at MTOW.

The -400ERF's cargo capacity is the same as the -400F's. The maximum usable volume on the maindeck is 21,347 cubic feet, with 30 pallets. The lower deck usable volume is 5,600 cubic feet using 32 LD-1 containers. The total cargo volume is 27,467 cubic feet.

### 747-400D

The -400D has MTOWs of 600,000lbs and 609,700lbs. According to Ascend, a division of Airclaims, structural provision for an MTOW of 870,000lbs for long ranges is incorporated in all -400Ds. The -400D's other features include strengthening of the aircraft's structure to help cope with its high cycle operations, and the use of de-rated engines. The horizontal tail fuel tank is not activated and usable fuel capacity is reduced to 53,765 USG. The aircraft has a maximum design range of 2,500-3,000nm. The specification high-density configuration is 566 passengers, although JAL has adopted a 568-seat layout. The maximum payload is 246,000lbs, and the total cargo volume is 24,815 cubic feet, which comprises a lower deck volume of 6,095 cu ft, plus a maindeck volume of 18,720 cu ft.

The -400D can be converted to the regular -400 variant for long-range operations, which is a process that takes about four weeks. This includes the activation of the horizontal tail fuel tank, the installation of a wingtip extension and winglets, changes to wheels and tyres, the re-rating of the aircraft's engines and a paper recertification of the aircraft to an MTOW of 870,000lbs. [AC](#)

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