

The entry into service of the 747-8F gives freight carriers more choice in the very large freighter category. The list price for the 747-8F is up to \$100 million more than the -400F's. What extra capacity and volume does the 747-8F offer over the 747-400F?

747-400F & 747-8F payloads comparison

The introduction of the 747-8F into service increases freight airlines' options for very large freighter types. There are four main variants of the 747-400 freighter: two passenger-to-freighter conversion programmes; the factory-built -400F; and the longer-range factory-built -400ERF. These four main variants have gross structural payloads of 248,000-277,000lbs (*see table, this page*). The 747-8F has a gross structural payload of 295,200lbs: 24,000lbs more than the smaller -400F, and up to 45,000lbs more than a converted 747-400.

Carriers evaluating their needs for very large freighters will consider several criteria, including: aircraft weight and payload characteristics; range capability and operating performance; the cost of aircraft acquisition and financing; and cash operating costs. With the exception of aircraft financing and cash operating costs, these criteria are analysed here.

747-400 freighters

The first main variant of the 747-400 freighters is the factory-built 747-400F, with a standard maximum take-off weight (MTOW) of 870,000lbs and usable fuel capacity of 57,065 US Gallons (USG).

The corresponding maximum zero fuel weight (MZFW) of this standard variant is 635,000lbs. The aircraft has an operating empty weight (OEW) of 364,000lbs, depending on engine type (*see table, this page*). These two weights result in a gross structural payload of 270,500-271,000lbs.

The aircraft's payload-range allows it to carry a full payload up to 4,500nm. Moreover, it can carry a gross payload of 155,000lbs up to 6,000nm.

Boeing also offers lower gross weight sub-variants of the -400F with smaller gross structural payloads of 246,000lbs, and smaller usable fuel volumes.

In 2002 Boeing introduced the -400ERF; a second main variant with an extended-range capability. This aircraft has an MTOW of 910,000lbs, and a usable fuel volume of 53,765USG or 53,985USG, depending on engine type.

The aircraft's design only allows an MZFW of 611,000lbs; close to the lower weight sub-variants of the -400F. The OEW of 362,400lbs means it has a gross structural payload of 248,600lbs (*see table, this page*).

The -400ERF's payload-range profile is affected by its maximum landing weight (MLW), so it is only able to carry a full payload about 2,800nm. Its extended-range capability allows it to carry a payload of 155,000lbs up to 6,600nm.

The third main 747-400 freighter variant is the passenger aircraft converted to freighter using the Boeing modification programme. Following conversion the aircraft is designated the -400BCF, and it retains the passenger aircraft's standard MTOW of 870,000lbs. The MZFW of the passenger aircraft is 542,500lbs, increasing to 610,000lbs during the conversion process. The aircraft actually has a lower OEW of 359,000lbs after conversion than the factory-built variant. This gives the -400BCF a gross structural payload of 250,700lbs (*see table, this page*).

The modified freighter has a usable fuel volume of 53,765USG. The resulting payload-range performance allows the aircraft to carry its maximum payload just over 4,000nm. The aircraft can carry a 155,000lbs payload about 5,700nm.

The fourth main 747-400 freighter variant is passenger aircraft modified under Bedek Aviation's passenger-to-freighter conversion. This aircraft is designated the -400BDSF.

There are several sub-variants of the -400BDSF, which vary according to MTOW and MZFW specification weights. The first sub-variant has a

747-400F/-400ERF/-400BCF/-400BDSF & 747-8F SPECIFICATION WEIGHTS

Aircraft type	747-400BCF	747-400BDSF	747-400BDSF	747-400BDSF
MTOW-lbs	870,000	870,000	870,000	811,000
MZFW-lbs	610,000	610,000	630,000	635,000
OEW-lbs	359,300	358,000	358,000	358,000
Gross structural payload-lbs	250,700	252,000	272,000	277,000
Usable fuel-USG	53,765	53,765	53,765	53,765
Aircraft type	747-400F	747-400ERF	747-8F	
MTOW-lbs	870,000	910,000	975,000	
MZFW-lbs	635,000	611,000	717,000	
OEW-lbs	364,000	362,400	421,800	
Gross structural payload-lbs	271,000	248,600	295,200	
Usable fuel-USG	57,065	53,765	60,211	

ULDS & PALLETS FOR USE ON 747 FREIGHTERS

Main deck devices	M1H ULD	M2 ULD	M1 ULD	PMC Pallet
Base width-inches	96	96	96	96
Base depth-inches	125	238.5	125	125
Profile	Contoured	Square	Square	Contoured
Maximum height-inches	118	96	96	118
Volume-cubic feet	759	1,190	618	745
Tare weight-lbs	672	2,200	606	375
Lower deck devices	LD-1 ULD	LD-29 ULD	LD-7 Pallet	
Profile	Half-width winged	Full-width winged	Full-width winged	
Top width-inches	92	186	160	
Bottom width-inches	61.5	125	125	
Height-inches	64	64	64	
Depth-inches	60.4	88	88	
Volume-cubic feet	175	510	495	
Tare weight-lbs	180	584	375	

standard MTOW of 870,000lbs and standard MZFW of 610,000lbs. The average OEW of 358,000lbs results in this standard sub-variant having a gross structural payload of 252,000lbs (see table, page 56).

The other two sub-variants allow higher gross structural payloads through higher MZFWs. The second sub-variant has an MZFW of 630,000lbs, and so a gross structural payload of 272,000lbs (see table, page 56).

The third sub-variant has an MZFW of 635,000lbs and a gross structural payload of 277,000lbs (see table, page 56).

747-8F

The 747-8 series has several main differences compared to the 747-400. The new, larger wing and higher thrust-rated engines permit a higher MTOW of 975,000lbs. The aircraft's usable fuel capacity is 60,211USG; 3,000USG more than the 747-400F.

The 747-8F has a longer fuselage than the -400F, achieved through two fuselage plug insertions: a 160-inch insertion fore of the wing; and a 60-inch insertion aft of the wing. This longer fuselage provides more payload accommodation, which is aided also by higher specification weights. The 747-8F has an MZFW of 717,000lbs and an OEW of 422,000lbs which provide a gross structural payload of 295,200lbs (see table, page 56).

This is 25,000lbs more than the

payload provided by the standard -400F, and 18,000-45,000lbs more than the different variants of the -400BCF and -400BDSF.

The 747-8F's payload-range profile also gives it superior performance over the 747-400. The 747-8F can carry a full payload about 4,400nm. Its superior range performance is further illustrated by its ability to carry a payload of 155,000lbs about 7,750nm; 1,750nm further than the 747-400F and 1,150nm further than the -400ERF.

Payload accommodation

Payload carriage on the 747-400 and -8 freighters is on the main deck and belly compartment. The main determinants of the capacity of each variant are the dimensions of the two main compartments and the size of the freight doors through which containers or unit load devices (ULDs) and pallets can be loaded.

The 747's main deck has a width that allows two ULDs or pallets with a base width of 96 inches to be loaded side by side. All main deck loading configurations have two rows of pallets or ULDs of this width, or a narrower width of 88 inches, loaded side by side. The ULDs and pallets vary in capacity according to length and height.

The 747-400F has both an upward-opening nose door and side fuselage door through which freight ULDs and pallets can be loaded. The height of the side

door is 120 inches, and its width is 134 inches. The door height allows ULDs and pallets up to 118 inches high to be loaded. The curvature of the fuselage means this height is only possible for ULDs and pallets in the central part of the main deck. Shorter ULDs and pallets are needed on the outer edges facing the fuselage wall.

The forward section of main deck immediately behind the nose door has a maximum height of 98 inches and width of 104 inches. This is up to fuselage station 777. It is aft of this that the higher ceiling allows the loading of ULDs that are up to 118 inches high in the centre.

This difference in door and fuselage section heights has implications for the different types of ULDs and pallets that can be loaded on the main deck. The higher and wider side door should be used to load most freight shipments if the aircraft's main deck capacity is to be fully utilised.

The fuselage curvature means that operators have a choice of loading contoured ULDs and pallets if they are to use the space available on the main deck, or load square-profiled ULDs and pallets while not utilising some of the upper space on the main deck.

The narrower space at the aft of the main deck can accommodate a single contoured ULD with a height of up to 118 inches.

The forward section of the 747-400F's/-400ERF's main deck, just aft of the nose door, allows two curve-profiled ULDs with a width of 96 inches and length of 125 inches to be loaded in tandem. That is, the base length of the device corresponds to the longitudinal axis of the main deck. A third, square-profiled ULD or pallet with the same base dimensions can be loaded behind this. This makes the fuselage wide enough behind these to allow 96-inch wide ULDs to be loaded side by side. The ceiling height of 104 inches in this section means the ULDs have to be square-profiled. The length of fuselage section on the 747-400F/-400ERF allows two rows of these ULDs, with a length of 125 inches, to be loaded. A total of seven ULDs or pallets, with a height of 96 inches, and base dimensions of 96 and 125 inches can be loaded in this front section up to station 777.

The section of the fuselage aft of station 777 can hold a total of 23 ULDs or pallets: 11 pairs with a 96-inch by 125-inch base and height of 118 inches; plus one at the rear of the fuselage.

The 747-400BCF and -400BDSF has a slightly smaller main deck volume. Despite being converted from a passenger aircraft with the same fuselage dimensions, the floor beams of the extended upper passenger deck protrude down to the main deck below, resulting in

747-400F/-400ERF/-400BCF/-400BDSF & 747-8F LOADING CONFIGURATIONS & PAYLOAD CAPACITIES

Aircraft type	747-400BCF/ 747-400BDSF	747-400F/ -400ERF	747-8F
<u>Main deck configurations</u>			
Option 1:			
-M1H ULDs	21	23	27
-M1	7	5	5
-lgloo ULD	2	2	2
Total volume-cu ft	21,412	21,694	24,730
Tare weight-lbs	19,554	19,686	22,375
Option 2:			
-PMC pallets-contoured	21	23	27
-PMC pallets-square	7	5	5
-lgloo pallet	2	2	2
Total volume-cu ft	20,445	20,815	23,795
Tare weight-lbs	11,200	11,200	12,700
<u>Lower deck configurations</u>			
Option 1:			
-LD-1 ULDs	32	32	38
Total volume-cu ft	5,600	5,600	6,650
Total tare weight-lbs	5,760	5,760	6,840
Option 2:			
-LD-29 ULDs	9	9	12
-LD-1 ULDs	4	4	2
Total volume-cu ft	5,290	5,290	6,470
Tare weight-lbs	5,976	5,976	7,368
Option 3:			
-LD-7 pallets	9	9	12
-LD-1 ULDs	4	4	2
Total volume-cu ft	5,155	5,155	6,290
Tare weight-lbs	4,095	4,095	4,860

the low ceiling height in the front section of the main deck extending for a longer length than in the factory-built freighters.

The net result is that nine ULDs and pallets of a height of 96 inches, and base dimensions of 96 by 125 inches, must be loaded in the front section. The section of the main deck that can accommodate the higher ULDs and pallets is therefore shorter. This can only hold 10 pairs and a single device at the rear. The overall difference in available freight capacity between factory-built and passenger-converted 747-400 freighters is therefore the difference between two 96-inch tall square-profiled and two 118-inch tall contoured ULDs or pallets: a few hundred cubic feet.

The factory-built and passenger-converted 747-400 freighters have the same belly space for cargo.

The 747-8's longer fuselage provides more longitudinal space on the main part of its main deck. The front section of the main deck has the same ceiling height of 104 inches and length as the -400F/-400ERF. The 747-8F also accommodates seven square-profiled ULDs or pallets with a height of 96 inches. Its longer fuselage allows 13 pairs of ULDs with a 96-inch wide and 125-inch long base; two more pairs and four more units than the -400F/-400ERF. The 747-8F can also accommodate a single ULD or pallet of the same base size and height at the rear; a total of 27 units.

The difference in main deck freight capacity between the 747-8F and 747-400F/-400ERF is therefore equal to the capacity of two pairs of ULDs or pallets with a base dimension of 96 by 125 inches.

ULDs & pallets

Operators have a variety of ULDs and pallets to choose from, so there is a large number of freight-loading permutations for each aircraft. Most general freight is carried on pallets, while express packages are carried on ULDs. The large items transported by 747 freighters, however, often mean that ULDs can be used, especially for apparel and high-value manufactured items such as electronic goods.

ULDs tend to provide a higher cubic capacity than pallets with the same base and height dimensions. However, ULDs have a higher tare weight, specified in the manufacturers' brochures. There is some variation between different makes of ULD of the same specification. ULDs can also vary in sophistication. The addition of chilling units for food materials or floor slots for loading by fork lift, for example, adds weight.

The revenue-earning payload capacity of the aircraft is related to the net structural payload, cubic capacity, freight packing density, and net rate per lb or kg of freight. The net structural payload is equal to the gross structural payload minus the tare weight of all ULDs and pallets. The use of pallets results in a higher net structural payload, but lower cubic capacity.

The range of commonly used ULDs and pallets can be analysed to see which type gives the highest overall capacity and lowest tare weight for the entire aircraft.

The most commonly used main deck ULD for the 747 freighter is the M1H. This is a contoured ULD, with a height of 118 inches at the wall facing the central part of the 747's main deck. It has a longitudinal length of 125 inches and base width of 96 inches. This is therefore the standard 747 main deck ULD. The M1H's cubic capacity manufactured by Nordisk is 759 cubic feet. It has a tare weight of 672lbs (*see table, page 58*). The M1H is used in the main section of the 747's main deck.

There are also contoured-profile ULDs with a base width of 88 inches. While these have a lower tare weight they also have a smaller volume than the M1H. These narrower ULDs therefore do not provide as much cubic capacity on the main deck as M1Hs.

A pallet that occupies the same space as the M1H is the PMC, which has base dimensions of 96 by 125 inches. This has a tare weight of about 225lbs, but when netting and brackets are added the total tare for each pallet is about 375lbs. The pallet can be stacked to provide a freight volume of about 745 cubic feet.

An alternative to the M1H on the 747's main deck is the M2. This ULD has the same base width, but is twice the length of the M1H, and is square-profiled



with a height of 96 inches. Its height means it can be loaded through the nose door on factory-built freighters.

The M2's longitudinal length is 238.5 inches, and it has a cubic capacity of 1,190 cubic feet and tare weight of 2,200lbs (*see table, page 58*). These are relatively heavy for their cubic capacity, compared to the M1H for example.

A few ULDs and pallets can be used for the front section of the 747's main deck.

The M1 is a square-profiled version of the M1H. The M1 has base dimensions of 96 by 125 inches, and is 96 inches tall. It has a cubic capacity of 618 cubic feet and a tare weight of 606lbs (*see table, page 58*). These are used in the front section of the aircraft's main deck, where the lower ceiling height does not permit taller ULDs. The M1 is sometimes used in the main section of the 747's main deck, but its square profile means total freight volume will be less than when M1H's are deployed.

An M1 pallet will have a slightly lower cubic capacity of 613 cubic feet, and a tare weight of about 350lbs.

The two contoured ULDs that have to be loaded in tandem right at the front of the 747's main deck have a base width of 125 inches, and depth of 96 inches. The height at the apex of the contour profile is 96 inches. These ULDs will have different contour profiles, due to the different dimensions at the front section of the fuselage. The cubic capacity of these two ULDs is 540 and 607 cubic feet, and their combined tare weight is about 1,200lbs.

The belly space on the 747 can hold a variety of ULDs and pallets. The most common type is the wing-profiled LD-1 ULD, which is loaded in pairs. The LD-1 has a height of 64 inches, a top width of

92 inches and a depth of 60.4 inches. Each LD-1 has a cubic capacity of about 175 cubic feet and tare weight of 180lbs.

The LD-29 has the width of two LD-1s, but also has a depth of 88 inches. The LD-29 therefore occupies more space than two LD-1s. The LD-29 has a cubic capacity of about 510 cubic feet and a tare weight of about 584lbs.

Pallets can also be used in the belly of the 747. These can be square-profiled, so they do not use all available space in the belly. Some pallets can be configured to have a winged profile, and so provide a higher volume. Winged pallets, referred to as the LD-7, with a base width of 125 inches and depth or longitudinal length of 88 inches, have a capacity of 495 cubic feet and a typical tare weight of 375 lbs.

Main deck configurations

747-400BCF/-400BDSF

The M1H is the ULD used in the main section of the 747's main deck as previously described, and 21 of these can be loaded in the main section of the 747-400BCF/-400BDSF's main deck. These 21 ULDs are all loaded as 10 pairs and a single unit at the rear of the main deck. The number is determined by the length of the main deck section that allows ULDs or pallets with a height of 118 inches. These 21 units provide a total capacity of 15,939 cubic feet and a tare weight of 14,112lbs.

With these 21 units in the main section, another seven M1 ULDs or pallets are loaded in front of these, and provide a total capacity of 4,326 cubic feet and have a tare weight of 606lbs.

The two contoured ULDs are loaded

The 747-8F has a structural payload 24,000lbs higher than a -400F and up to 45,000lbs more than a converted 747-400. This difference is reduced to 31,000-33,000lbs when packing density and volumetric payload capacity is considered.

at the very front of the main deck, as described. These provide 1,147 cubic feet and have a tare weight of 1,200lbs.

In total, this configuration provides a total of 21,412 cubic feet and has a tare weight of 19,554lbs (*see table, page 60*).

A second configuration uses long M2 ULDs in the main section of the main deck. At 20-feet long and 96 inches high, this means the aircraft's available upper space on the main deck is not used.

Thirteen of these can be loaded on the main deck, as well as another three M1 containers. Given the high tare weight of 31,618lbs and relatively low volume of 18,471 cubic feet, this configuration is less than optimal.

A third configuration is the use of PMC pallets, with a 96- by 125-inch base, stacked in a contoured configuration. Ten pairs and a single unit can be loaded on the main part of the main deck. Another seven PMC pallets, stacked in a square profile, can be loaded in the front section of the main deck, while the two smaller contoured ULDs or pallets can be loaded at the very front. This is basically the same loading configuration as the M1H ULDs. It provides a smaller volume of 20,445 cubic feet, but also a lower tare weight of 11,200lbs (*see table, page 60*).

747-400F/-400ERF

When using the M1H as the ULD in the main section on the main deck of the 747-400F/-400ERF, 12 pairs plus a single ULD at the rear can be loaded through the side door: a total of 25 units.

The shorter section at the front of the main deck will therefore correspondingly take five M1 ULDs and the two smaller contoured ULDs. These seven units, with a shorter height of 96 inches, can be loaded through the nose door.

The total volume provided by this configuration is 21,694 cubic feet; the ULDs have a corresponding tare weight of 19,686lbs (*see table, page 60*).

The 747-400F/-400ERF could carry M2 ULDs in the main section of the main deck in the same configuration as the converted aircraft. The resulting cubic capacity and tare weight are the same as with the converted aircraft.

The third configuration uses PMC

747-400F/-400ERF/-400BCF/-400BDSF & 747-8 FREIGHTER PAYLOAD CAPACITIES

Aircraft type	747-400BCF	747-400BDSF Standard	747-400BDSF High payload	747-400BDSF High payload	747-400F	747-400ERF	747-8F
MZFW-lbs	610,000	610,000	630,000	635,000	635,000	611,000	717,000
OEW-lbs	359,300	358,000	358,000	358,000	364,000	362,400	421,800
Gross structural payload-lbs	250,700	252,000	272,000	277,000	271,000	248,600	295,200
<u>Freight configurations</u>							
<u>Option 1: highest volume</u>							
Main deck with M1H ULDs							
-Total volume-cu ft	21,412	21,412	21,412	21,412	21,694	21,694	24,730
-Tare weight-lbs	19,554	19,554	19,554	19,554	19,686	19,686	22,374
Lower deck with LD-1 ULDs							
-Total volume-cu ft	5,600	5,600	5,600	5,600	5,600	5,600	6,650
-Tare weight-lbs	5,760	5,760	5,760	5,760	5,760	5,760	6,840
Total volume-cu ft	27,012	27,012	27,012	27,012	27,294	27,294	31,380
Total tare weight-lbs	25,314	25,314	25,314	25,314	25,446	25,446	29,214
Net structural payload-lbs	225,386	226,686	246,686	251,686	245,554	223,154	265,986
Maximum packing density -lbs per cu ft	8.3	8.4	9.1	9.3	9.0	8.2	8.5
Volumetric payload @ 7.5lbs per cu ft	202,590	202,590	202,590	202,590	204,705	204,705	235,350
<u>Option 2 highest tare weight-lbs</u>							
Main deck with PMC pallets at 118 inches							
-Total volume-cu ft	20,445	20,445	20,445	20,445	20,815	20,815	23,795
-Tare weight-lbs	11,200	11,200	11,200	11,200	11,200	11,200	12,700
Lower deck with LD-7 pallets							
-Total volume-cu ft	5,155	5,155	5,155	5,155	5,155	5,155	6,290
-Tare weight-lbs	4,095	4,095	4,095	4,095	4,095	4,095	4,860
Total volume-cu ft	25,600	25,600	25,600	25,600	25,970	25,970	30,085
Total tare-lbs	15,295	15,295	15,295	15,295	15,295	15,295	17,560
Net structural payload-lbs	235,405	236,705	256,705	261,705	255,705	233,305	277,640
Maximum packing density -lbs per cu ft	9.2	9.2	10.0	10.2	9.8	9.0	9.2
Volumetric payload @ 8.0lbs per cu ft	204,800	204,800	204,800	204,800	207,760	207,760	240,680

pallets, with 23 at the main section of the deck, and five standard and two smaller pallets at the front, providing a total freight volume of 20,815 cubic feet and a tare weight of 11,200lbs (*see table, page 60*).

For the factory-built and converted aircraft, the use of M1H ULDs provides the largest volume, while using PMC pallets in place of these ULDs has the lowest tare weight. The use of M1H ULDs provides a total of 21,412 cubic feet for the converted aircraft, and 21,694 cubic feet for the factory-built aircraft (*see table, page 60*). The factory-built aircraft thus have 282 cubic feet

more volume than converted aircraft.

The use of PMC pallets as an alternative provides 20,815 cubic feet of space for the factory-built aircraft, and 20,445 cubic feet for the converted aircraft; 900-1,000 cubic feet less than when using equivalent-sized ULDs (*see table, page 60*). The tare weight for both groups of aircraft is 11,200lbs; about 8,000lbs less than when using ULDs.

747-8F

The use of M1H ULDs on the 747-8F's main deck allows 13 pairs and a single unit to be carried in its main

section. As with the factory-built 747-400 freighters, five M1s and the two smaller contoured ULDs are loaded in the front section of the main deck. These can be loaded through the nose door.

This configuration provides a total volume of 24,730 cubic feet; 3,036 cubic feet more than when used on the 747-400F/-400ERF. The tare weight of these ULDs is 22,375lbs.

The use of PMC pallets instead of M1H and M1 ULDs results in 27 of the pallets stacked as contoured units in the main section, and another five stacked in a square profile in the front section, plus the two smaller units in the nose. This



configuration results in a volume of 23,795 cubic feet; about 900 cubic feet less than when using ULDs of the same dimensions. Tare weight of these pallets is lower at 12,700lbs; 9,700lbs less than the ULDs (see table, page 60).

Lower deck configurations

747-400-400 Freighters

The 747-400 can accommodate 32 LD-1s, with 16 pairs being loaded. These provide a volume of 5,600 cubic feet of freight volume and have a combined tare weight of 5,760lbs (see table, page 603).

When using the full-width and deeper LD-29 ULDs, the 747-400 can carry five in the forward hold and four in the aft compartment. The forward and aft compartments also each have room for a pair of LD-1 containers. The nine LD-29s provide 4,590 cubic feet of volume and have a tare weight of 5,256lbs, and the four LD-1s provide a further 700 cubic feet and have a tare weight of 720lbs. Total volume is 5,290 cubic feet, and total tare weight is 5,976lbs (see table, page 60).

The belly space can accommodate the same number of 88-inch by 125-inch LD-7 pallets in a winged configuration as it can LD-29 ULDs. These LD-7s provide 4,455 cubic feet of volume and have a tare weight of 3,375lbs. The additional four LD-1s provide the same capacity and have the same tare weight as previously described. Total volume is therefore 5,155 cubic feet and total tare weight is 4,095lbs (see table, page 60).

The use of LD-1s therefore provides the highest volume, while the use of pallets results in the lowest tare weight.

747-8F

The 747-8F's longer fuselage allows the forward hold of the belly space to hold 10 pairs of LD-1s, and the aft section to carry nine pairs. The total of 38 LD-1s provide a volume of 6,650 cubic feet, and have an associated tare weight of 6,840lbs (see table, page 60).

The aircraft's belly space can hold 12 LD-29 full-width ULDs; seven in the forward section and five in the aft. The aft compartment can also carry a pair of LD-1s. This configuration gives a total volume of 6,470 cubic feet, and the ULDs have a total tare weight of 7,368lbs.

A third configuration using LD-7 winged pallets with an 88-inch by 125-inch base results in 12 of them being carried, plus two LD-1s in the aft section. Total volume for this configuration is 6,290 cubic feet and an associated tare weight of 4,860lbs (see table, page 60).

The use of LD-1s therefore provides the highest volume, while pallets result in the lowest tare weight.

Revenue capacity

The net structural payload on each variant depends on the tare weight of ULDs or pallets carried on the aircraft. The type of ULDs or pallets used depends on the freight being carried. A mix of freight types will be carried on most 747s, so a variety of different-sized ULDs and pallets will be used.

The net structural payload, volumetric payload and maximum packing density that results from the choice of ULD or pallet type has been calculated in order to illustrate the effect of the choice of ULD and pallet type.

The use of contoured-profiled M1H

The last 747-400Fs were built in 2009. Their list prices were more than \$100 million less than the 2011 list price for the 747-8F.

ULDs on all variants results in the highest available volume, but also one of the highest tare weights. The net structural payloads are consequently relatively low: 225,400lbs for the 747-400BCF; 226,700lbs-251,700lbs for the 747-400BDSF; 245,500lbs for the 747-400F; and 223,100lbs for the 747-400ERF. The 747-8F has a net structural payload of 266,000lbs in this configuration; about 20,400lbs more than the 747-400F (see table, page 63).

Actual payload that is likely to be carried is the volumetric payload, since this is a factor of the available volume and packing density of the freight carried. In this configuration, the converted aircraft, with freight packed at 7.5lbs per cubic foot, all have volumetric payloads of 202,590lbs, regardless of specification weights, since all variants have the same available freight volume (see table, page 63).

The 747-400F and -400ERF, with an additional 280 cubic feet of volume, have a volumetric payload of 204,705lbs (see table, page 63). The larger 747-8F has a volumetric payload of 235,350lbs; about 31,000lbs more than the factory-built freighters and 33,000lbs more than the converted 747-400s.

Stacking pallets in a contoured profile results in one of the highest net structural payloads: 235,400lbs for the 747-400BCF; 236,700-261,700lbs for the 747-400BDSF; 255,700lbs for the 747-400F; 233,300lbs for the 747-400ERF; and 277,600lbs for the 747-8F (see table, page 63).

Freight may be packed at a higher density when using pallets. When freight is packed at a density of 8.0lbs per cubic foot, the equal available volumes of the four passenger-converted variants mean they have a volumetric payload of 204,800lbs (see table, page 63). The slightly higher volumes of the 747-400F/-400ERF result in a volumetric payload of 207,800lbs. The larger 747-8F has a volumetric payload of 240,700lbs. The 747-8F has a payload advantage over the 747-400F/-400ERF of 32,900lbs, and an advantage over the converted 747-400s of 35,900lbs (see table, page 63). **AC**

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