

The used 747 market is at an all-time low. A surplus of aircraft and minimal freight conversions has seen values collapse. Buyers still have to budget for many items when acquiring aircraft for freight conversion.

# The merits and pitfalls of buying used 747-200s

Investing in used 747s has become a risky business. The market for the aircraft has always been limited to major flag carriers followed by freight operators. It has never been used on a large scale by secondary airlines. This has always implied that retirement of 747-100s, -200s and -300s would eventually lead to a surplus and collapsed values.

That time has now arrived. Potential buyers, which include lessors and small airlines, can now acquire used 747-100s and -200s at rock-bottom market values. However, buying used 747s and making them operational requires careful assessment. Eventual costs can be high compared to market lease rates, remaining airframe life and the risk of further structural airworthiness directives (ADs).

## Used market prospects

The only real prospect for used 747s is in the freight sector. However, this depends on the number of conversions and retirement rate of large freighters over a protracted period. Although the fleet of large freighters is expected to double, the number of conversion candidates will exceed the number converted.

A small number of 747s will be acquired by smaller and secondary passenger airlines. Cathay Pacific and Air New Zealand, for example, have sold their RB211-powered -200 and -300 fleets to Air Atlanta Icelandic, Iberia,

Virgin and Pakistan International Airways (PIA).

Freight conversion is the best secondary market. The freight fleet is split into four size categories; the largest includes the DC-10, MD-11 and 747. There are currently about 140 747-100/-200 freighters plus a few -400s.

Current forecasts expect the fleet of large freighters to at least double in the next 10 years. "When the number of current 747Fs that will retire is considered, the market for used passenger and combi 747s is substantial," says John Flynn, president of Triton Aviation. "There are a lot of contenders, however. This means that probably 20 of the 30 747-200 combis will get converted but only 75-80 of the best -200 passenger aircraft. The younger and more capable 747-300s will then follow, pushing the least attractive 747-200s to the side."

"The fleet growth and number of MD-11s means that the number of new 747Fs required should average about 15 aircraft per year. At least 10 aircraft will therefore have to be converted per year," says Rick Hatton, president of Cargo Conversions LLC. This forecast closely matches Flynn's expectation of 747-200 combi/passenger conversions.

The number of -200 passenger variants that Flynn expects to get converted means it is too late for operators of lower powered and gross weight aircraft to find a market. "Buyers should only consider aircraft with a maximum take-off weight (MTOW) in excess of 800,000lbs at Stage 3 noise

rules, explains Flynn. "Aircraft with low MTOWs are also older. Only aircraft with JT9D-7J powered or later variants and CF6 engines should be considered for freight conversion."

Flynn expects buyers to avoid RB211-powered aircraft for conversion because they have a 7,000-8,000lbs higher operating empty weight (OEW). At typical freight yields of \$1/lb/trip, their smaller payload makes a large impact on economic performance.

## Major airline fleet plans

The age, high maintenance costs and restricted payload range of 747-100s means they will not get converted.

The youngest and most capable -200s are 13 years old, which means that buyers will now focus on better quality -200s and -300s. Many are due for retirement.

The pressure on the 747-200 fleet to find a secondary market will increase now the 747-400 is also becoming less popular with the major passenger carriers. BA, for example, has recently announced a strategy for using smaller aircraft on short- and long-haul networks. There are suggestions that it could retire its 747-200s earlier than expected and even some -400s. BA has already swapped 747 orders for 777s.

The 30 combi -200 aircraft consist of 10 JT9D-powered aircraft, including a few -7Q models, 17 CF6-powered aircraft and two RB211-powered examples. About 20 are attractive



conversion prospects, but the combi configuration makes them cheaper to convert.

The more desirable JT9D-7J/-7Q/-7R4G2-powered passenger aircraft are operated by Aerolíneas Argentinas, Air India, El Al, Tower Air, Garuda, Iberia, JAL, Northwest, Olympic and SAA. There are 77 of these aircraft.

Air France, Alitalia, KLM, Lufthansa and ANA operate the majority of the 28 CF6-powered aircraft.

There are also 15 -7R4G2 and CF6-powered 747-300 combis and 32 passenger aircraft. All -300s are high gross weight. The majority of the -7R4G2- and CF6-powered -300s are operated by JAL, SAA, Swissair and Varig.

## Market values & acquisition

The 747 secondary and freight conversion market is limited to just a few transactions each year. This is explained by the Asia Pacific economic downturn leading to collapsed freight yields. The trans-Atlantic market has also been transformed by passenger airlines introducing the A340 and 777, which have added considerable belly freight capacity.

“The Asia Pacific market dictates the rate at which 747s get converted,” explains Flynn. “This has been virtually dead, but will shortly pick up again.”

“Current market values of used 747s are down to the value of their engines,

according to their maintenance status, plus about \$1 million each. The 747’s airframe and components no longer have a value,” claims Flynn. “Engines that have just had a heavy shop visit and new life limited parts (LLPs) and have a value of about \$3 million. These would be expected to have an on-wing time of 10,000 flight hours (FH).

“An aircraft with two freshly overhauled engines plus two time-continued powerplants would therefore have a market value in the region of \$10 million,” says Flynn.

Flynn puts the market value of a 1978-build -7J-powered aircraft at \$6–8 million; a -7Q-powered aircraft at \$10 million; a CF6-powered aircraft at \$10–12 million, and a -7R4G2-powered example up to \$15 million. The -7R4G2 equipped aircraft have the highest values because they have the latest technology.

The difficulty with acquisition is that aircraft almost have to be treated individually because of the large number of transactions and their maintenance status. “The remaining airframe major check and engine times are critical to value,” explains Hatton. “So are the completion status of Section 41 and engine pylon modifications. If the aircraft have been well maintained then many of these items will have been done. The Section 41 modification is mandatory at 20,000 flight cycles (FC), and so a few -200s will still need the modification. Freight operators often have low rates of utilisation which could delay the

*The number of 747-200s exceeds the predicted requirement for 747 freighter conversions over the next 10 years. By this stage the 747-300 and -400 will be preferable conversion candidates. The consequences of this and the current slump in 747 freight conversions means that the values of aircraft are rock bottom. A 747-200 can now be acquired for an amount equal to the value of its engine. This varies from \$6 million for low thrust rated versions of the JT9D up to \$15 million for high thrust rated JT9D- and CF6-powered aircraft.*

requirement for Section 41 termination.”

Engine pylon modifications will also be required for some aircraft. Pylon modifications for aircraft with JT9D engines were mandatory by June 1998. Aircraft with other engines still have until June 2000 to comply.

The Section 41 modification will consume 30,000–45,000 manhours (MH) and have a total cost of \$1.0–2.25 million. Engine pylon modifications cost about \$1.5 million.

## Acquisition maintenance

Maintenance work will be required on the aircraft at acquisition, although this will vary between individual aircraft. Buyers should consider airframe checks, removal and repair of heavy components, work to line replaceable units (LRUs) and on-condition components, engine maintenance, all items relating to weight upgrades and conversion to freighter.

“Buyers would not necessarily perform a D check at purchase, even if they were converting the aircraft to freighter,” explains Hatton. “Most airlines do, however, run down an aircraft to when it’s due for a D check before selling it.”

D check cycles are five to six years. A basic D check will include regular inspections, non-routine work as a result of inspections, repair of components, completion of outstanding service bulletins (SBs), corrosion prevention, stripping and painting and refurbishment



of the interior. When converting to freighter, the total labour content would be lower due to the absence of interior work.

This basic package for a mature aircraft will consume about 85,000MH. Consumption can be higher – up to 150,000MH for aircraft with a high degree of deferred maintenance and non-routine items.

The cost of consumable materials and rotatable repairs would have to be added to this. The cost of a basic D check would be in the region of \$5 million when labour is charged at a rate of \$50/MH. Facilities that charge low labour rates can bring down the cost to a level of about \$3 million. Moshe Kovo, business development manager, of Bedek Aviation, says D checks can be performed for \$2–3 million.

The maintenance status and acquisition by a new operator will almost certainly mean LRUs and other rotatable components will have to be repaired and exchanged. Buyers would normally reserve a conservative amount of about \$350,000 to cover all eventualities. Because of the surplus of aircraft and parts, buyers will find it more economical to buy time-continued parts from vendors than to repair unserviceable units on aircraft they have bought.

“A C check at acquisition would consume 2,500–3,000MH and have a total cost of \$500,000–1 million,” says Kovo.

There are three freight conversions from which buyers can select. Boeing has its own supplemental type certificate

(STC), Israel Aircraft Industries has a conversion and Cargo Conversions offers a modification.

Cargo Conversions was recently formed by ex-GATX Airlog president Rick Hatton. Aircraft converted with GATX Airlog’s STC had payload restrictions placed on them. Cargo Conversions now offers a new conversion.

“We pre-build conversion kits and move them into the conversion facility and have the material ready for the conversion when the aircraft arrives. This should reduce downtime,” explains Hatton. “The conversion kits are built by Lucas Aerospace. Rather than have a fixed facility for conversions we are going to take advantage of the spot price maintenance market, since there is usually capacity available on the market and we can often find unused labour.”

Hatton puts the cost of conversion for a combi at about \$9 million and a passenger aircraft at \$14 million. The cost for the same conversions at Israel Aircraft Industries are similar. Boeing’s freight conversion is about 30% more expensive.

Besides the basic conversion costs, buyers should be aware of two other costs: installing a cargo handling system and upgrading the aircraft’s weight capability.

“Passenger and combi aircraft have to have the same cargo handling system installed, since the original system in the combi aircraft was basic and has to be scrapped,” says Flynn. “The cost for a new system is about \$2 million.”

Passenger aircraft also usually have

Besides basic conversion to freighter, buyers should not overlook the additional cost of installing a cargo handling system. This will cost about \$2 million. Other costs will include upgrades to the landing gear, wheels, brakes and tyres.

low gross weight landing gears, wheels, brakes and tyres. These have to be upgraded to high gross weight standards, or new items fitted if the existing components are non-upgradable, so that the operator of the freight aircraft avoids a gross weight penalty.

“First the airframe has to be upgraded for higher maximum take-off, maximum zero fuel and maximum landing weights,” explains Flynn. “This is done using SBs supplied by Boeing at a cost of about \$80,000 and are performed during the D check.”

There are different variants of landing gears and, depending on what’s installed, an upgrade will be required. To avoid a gross weight restriction, freight operators will almost certainly have to upgrade gears.

Besides upgrades, landing gears may also require overhauling at purchase or a few years afterwards. The overhaul interval is 10 years. For stand-alone landing gear repair most airlines do an exchange with a shop. The exchange fee includes elements for ownership and repair. This has a basic cost of about \$380,000, but up to another \$150,000 should be allowed for scrapping parts, taking the cost as high as \$530,000.

Repair and exchange provides a good opportunity for upgrades. The need to upgrade landing gear depends on the aircraft’s serial number. Air France Industries, which has converted combi aircraft to full freighter and also modified passenger aircraft to high gross weight models, says the older the aircraft the more modifications are required. If aircraft are young, Air France Industries explains, only brakes and tyres will have to be upgraded. Older ones, however, will need to have landing gears reinforced.

Along with the landing gears, wheels, brakes and tyres need to be upgraded, again to avoid weight restriction penalties.

Aircraft with high weight wheel, tyres and brakes would probably still require

the units to be repaired at purchase. "Brakes cost about \$5,000 to overhaul and so the cost for all 16 units is about \$80,000," says Matthew Murren, vice president of sales and marketing at the Ages Group. "Wheel inspections cost about \$1,000 each, and so \$18,000 for all 18 wheels. Remoulding each tyre costs about \$200 and so about \$4,000 for the shipset.

"Freighters require high gross weight tyres. New ones cost \$1,000 each and a total cost per aircraft of \$18,000. New brake units cost \$12,000 each and so \$192,000 for the whole aircraft. High gross weight wheels with tyres cost \$7,500 each, taking total cost to \$135,000. Total cost of upgrading wheels, brakes and tyres is about \$350,000."

Other upgrades possible are the standardisation of the flightdeck. Although this is not a legal requirement, most airlines may want a standard flightdeck for their fleets to simplify maintenance, flightcrew training and scheduling. Costs to upgrade from an Allied Signal to a Collins flightdeck, or vice versa, can be small: up to \$200,000. The final major component is the auxiliary power unit (APU). "On-aircraft times are 3,000–5,000FH and shop visit costs will be \$150,000–300,000," says Murren. "Like LRUs and rotables, there

is a surplus of APUs on the market and owners often find they can buy a unit for \$175,000–200,000 rather than have a shop visit for up to \$300,000.

Once the aircraft is in operation operators will need support for LRU inventory and repairs, since it will be too expensive to maintain their own inventory. Vendors, such as AAR, The Ages Group and Aviation Sales, often provide power-by-the-hour packages for small operators of old aircraft types. The FH rate includes two cost elements: one to cover ownership and the other for repairs. Bill Kmiotek, vice president, aircraft sales and trading, at AAR, estimates for a fleet of five 747s operating 10FH per day, an LRU package can be acquired at a rate of \$475 per FH.

## Engine costs

Engine-related costs will vary widely. It is the maintenance status of engines that determine the aircraft's value. As with major airframe checks, operators who are retiring aircraft will attempt to use engine lives to the maximum before retiring them or returning them to lessors.

Values of run-out engines, with little remaining temperature margin, are generally expected to be the difference between the value of overhauled engines and the cost of a heavy shop visit.

Leading industry sources put the 'core' values of JT9D-7Fs at about \$0.5 million. Values of JT9D-7J/-7Q and CF6-50E2s are in the region of \$1.0–1.2 million and -7R4G2s are \$1.5–2.0 million.

The variation in the value of time-continued engines reflects their differing popularity. The -7F is now as low as \$1 million. There are few -7Fs on the market and they often have -7J material put in them during a shop visit. The -7J is much higher at \$1.9 million. The -7Q is similarly higher at \$2.5 million. The CF6-50E2 has a similar value, although some put the CF6-50E2's value as low as \$1.8 million. The -7R4G2, being the most in demand, is valued at \$2.4 million.

The value of overhauled engines starts at about \$2.3 million for a JT9D-7F, \$3.0 million for a -7J, \$3.6 million for a -7Q and \$4.5 million for a -7R4G2.

A CF6-50E2 fresh from a hot section inspection has a market value in the region of \$2.7 million, while a freshly overhauled example is estimated to be worth \$3.4–3.6 million.

## Total acquisition costs

One possible method of reducing net acquisition costs of used aircraft is for the buyer to arrange a sale and leaseback

## SUMMARY OF ACQUISITION AND BUILD COSTS FOR 747-200SF

Aircraft variant	747-200	747-200	747-200	747-200	747-200
Engine model	JT9D-7F	JT9D-7J	JT9D-7Q	JT9D-7R4G2	CF6-50E2
Aircraft					
Purchase \$	6,000,000	8,000,000	10,000,000	15,000,000	12,000,000
Freight					
conversion:					
Combi \$			9,000,000		
Passenger \$			14,000,000		
Cargo system \$					
Weight upgrades \$			2,000,000		
Landing gear upgrade \$			100,000		
Bridging/C check \$		500,000–750,000			
Component repairs \$			350,000		
Landing gear exchange \$			450,000		
Wheels/brakes/tyres \$			350,000		
APU \$			200,000		
Total:					
Combi \$	19,000,000	21,000,000	23,000,000	28,000,000	25,000,000
Passenger \$	24,000,000	26,000,000	28,000,000	33,000,000	30,000,000
Possible additions:					
Section 41: \$1,500,000–2,250,000					
Engine pylons: \$1,500,000					
D check: \$2,000,000–4,500,000					

transaction on the engines. There are several engine traders and lessors that consider such deals. Typical terms would be for a minimum lease of one year and usually three to five years.

Engine traders and lessors would only consider such arrangements if the engines had good residual value prospects and the lessee had a good credit rating.

“The problem with the 747 now is that there is such a glut that the engines will have no residual value in a few years when even more are on the market,” comments Bill Cumberland, executive vice president of The Ages Group. “The other problem is that the engine lessee will have an aircraft without engines when it wants to sell the aircraft. Also, if the lessee goes bankrupt during the lease, it has the problem of selling an aircraft without engines and the lessor is left with the engines with low residual value,” explains Cumberland. This means buyers of JT9D-powered aircraft are unlikely to have the option of engine sale and leasebacks.

The CF6-powered aircraft may present more acceptable opportunities for sale and leaseback transactions on engines, since they have better residual value prospects, are limited in number and are more likely to be bought by

airlines or lessors with high credit ratings. One problem with CF6-powered aircraft is that as the fleet consolidates, engine values fall because of little market activity and questionable residual values.

Estimates of the proceeds an aircraft buyer would get for four CF6s in a range of conditions are about \$6.0 million. Annual lease rate for the engines would be in the region of \$0.9 million per year.

### Acquisition costs summary

The majority of all acquisition costs will be accounted for by freight conversion and associated items and upgrades or repairs to components (*see table, this page*). Besides aircraft purchase, all costs associated with acquisition total about \$13 million for a combi aircraft and about \$18 million for a passenger aircraft.

Possible extra costs are incurred if the aircraft requires a D check, Section 41 termination or engine pylon modifications. Other possible costs include engine shop visits. Light shop visits are \$1.2–2.1 million for different JT9D variants and about \$1.5 million for the CF6. Heavy shop visits will be in the \$2.2–2.4 million range and a full set of

LLPs costs about \$1.7 million. The decision to purchase LLPs will have to be taken carefully, since they have lives of about 15,000FC. Considering that annual freighter utilizations are likely to be no higher than 500FC, buyers will try to avoid purchasing LLPs. The glut of 747s and engines means that many operators could avoid expensive engine shop visits by cannibalising engines, using stub life LLPs and mixing modules.

The age of good-quality, high gross weight and engine-powered 747-200s is 13–22 years. Most aircraft are unlikely to exceed an age of 30 years as a freighter, meaning buyers will have to amortise their investments over eight to 15 years. Older aircraft are only likely to be put through one more D check, after which any time remaining will be used before the aircraft is scrapped. Two or three more D checks will be performed on the 13-20 year old aircraft.

Even the cost for the older -7F-powered aircraft will have to be amortised at a rate of at least \$3 million a year, in addition to reserves for maintenance. The investment in -7R4G2- or CF6-powered aircraft will have to be amortised at the rate of \$2.0–2.25 million a year.

In addition to investment amortisation, equity investors will be expecting a high return on investment. Lessors or buyers will be looking to amortise their investment and either gain a residual value on disposal or continue leasing the aircraft after it has been fully amortised.

Flynn puts monthly lease rates of low gross weight, JT9D-7A/-7F-powered aircraft at about \$350,000 per month, or \$4.2 million per year. The market currently bears a higher rate of \$450,000 per month for -7Q/CF6 aircraft which have greater range capability and as much as \$500,000–550,000 per month for -7R4G2-powered aircraft. “Demand for aircraft was stronger two or three years ago and rates have softened since,” says Flynn.

Lease rates for all -200 variants are still strong enough for lessors and investors to have a good business case, provided they can continue to lease the aircraft for a minimum of eight years. Prospects and lease rates will strengthen as the freight market recovers. Prudent investments will be made where residual values are expected to be low or zero.

Securing long-term 747-200SF leases could eventually see engine and component values begin to rise as they enter a supply and value rollercoaster similar to that experienced by the JT8D.

The market for old and low gross weight -200s remains weak and is unlikely to change. Meanwhile, prospects for investment in good quality -300s, also with low market values, will be good in the long term. 