767-300ERs are potential replacements for ageing medium-widebody freighters, including A300s and A310s. There are a number of important criteria to consider when selecting the most suitable 767-300ERs for conversion. These include the aircraft's accumulated FCs, engine type, maintenance condition, weight specification and winglet status.

Cherry picking 767s for conversion to freighter

Boeing has delivered more than 1,000 767s since the early 1980s. The 767 is a good candidate to replace ageing medium-widebody freighters, including the A300 and A310.

The delay in the 787 programme led to airlines operating 767s for longer than originally anticipated. With an increasing number of 787s now entering service and the imminent introduction of the A350, the available feedstock for 767 conversions can be expected to increase as operators withdraw the aircraft from passenger service.

As more aircraft are retired from passenger fleets, the market value of 767s is likely to fall, making it a more affordable conversion candidate.

The most suitable 767 conversion candidates are identified here based on an analysis of the current passenger-configured fleet.

Important selection criteria include an aircraft's accumulated flight cycles (FC); its weight specifications; the engine type; the presence or absence of winglets; and fleet commonality or aircraft groups that are sisterships.

P-to-F conversion options

Boeing developed multiple variants of the 767: the 767-200, 767-200 extended range (ER), 767-300, 767-300ER, 767-400ER, and 767-300 production freighter (F).

The 767-200 is the smallest member of the family, while the -300 series is a 21 foot stretch version of the -200. The -400ER represents a stretch of another 21 feet over the -300 series fuselage.

The 767-300F is based on the -300ER variant. More than 100 production freighters have been ordered and the aircraft is still in production.

767-200s, -200ERs and -300ERs have all undergone passenger to freighter (P-to-F) modifications, and there is an option to convert non-ER -300s. There are no conversion options for the 767-400ER.

"The first 767s to be converted in the late 1990s were a group of 24 -200s belonging to Airborne Express (now ABX Air)," explains Jacob Netz, analyst and senior consultant at the Air Cargo Management Group, expressing his own opinion.

"These were converted to a unique configuration without large main deck cargo doors, and referred to as the 767-200 package carrier (PC)," continues Netz. "Freight was loaded via the forward left passenger boarding door with C-type containers. Most of these aircraft were converted to PC configuration by IAI Bedek. A decade later, 23 of these 767-200PCs, operated by ABX Air on behalf of DHL, were converted to standard freighters by IAI Bedek; having a standard main deck freight door fitted.

The two choices for passenger-to-freighter conversion programmes for the 767-300ER are Boeing and IAI Bedek. The Boeing modification has a list price of about $18 million; approximately $4-5 million more than the IAI Bedek modification.

TYPICAL SPECIFICATIONS FOR CONVERTED 767-300ERS

Aircraft Type	767-300BDSF Without winglets	767-300BCF Without winglets	767-300BCF With winglets
Conversion provider	**IAI Bedek**	**Boeing**	**Boeing**
Engines	**GE/PW**	**GE/PW**	**GE/PW**
CLS	**Manual**	**Manual**	**Manual**
MTOW (lbs)	412,000	412,000	412,000
MZFW (lbs)	309,000/303,000	309,000	309,000
OEW (lbs)	183,500/183,500	180,800/181,400	183,800/184,400
Gross structural payload (lbs)	125,500/119,500	128,200/127,600	125,200/124,600
Fuel capacity (USG)	23,980	23,980	23,980

Notes
1). Approximate OEWs are estimates only and do not include tare weight. Actual OEW will vary by individual aircraft.
2). OEWs for aircraft with powered CLS could be about 2,000lbs higher. Only Boeing offers a CLS for the 767-300ER at this time.
3). IAI Bedek is developing an upgrade that will increase MZFW of PW-powered 767-300BDSFs to 309,000lbs.

"Following its experience with the 767-200PCs, IAI Bedek independently engineered and certified its own conversion programme for 767-200s," adds Netz.

Modified aircraft are given the designation -200BDSF. The conversion includes the installation of a large cargo door. In addition to the 23 modified 767-200PCs, IAI Bedek has converted a further 39 aircraft to -200BDSF status. Some of these were 767-200ERs.

IAI Bedek's P-to-F conversion programme for 767-200s and -200ERs is still available.

Boeing and IAI Bedek both offer full P-to-F conversions of 767-300ERs, including the installation of large cargo doors. Aircraft converted by Boeing are given the designation 767-300BCF. Those modified by IAI Bedek are referred to as 767-300BDSFs. IAI Bedek's independently developed conversion is licensed by Boeing.

IAI Bedek also offers the option to convert non-ER 767-300s. A converted non-ER -300 would have a 9G cargo net, rather than a 9G rigid barrier, and one fewer loading position in the forward area of the main deck compared to the -300ER.

"The cost of converting a 767-300 is over $1 million less than modifying a -300ER," claims Jack Gaber, senior vice president of marketing and business development at IAI Bedek. "We believe the -300 is a good option for regional operations, such as those within Europe or the United States. The -300's lower acquisition and conversion costs make it an effective solution for low-density cargo on regional operations, where it offers more volume than 767-200/-200ER freighters."

No 767-300s have been converted so far, however.

Netz does not see a large conversion market for 767-300s. "It is most unlikely that these old aircraft will be converted into freighters," reasons Netz. "In comparison, the -300ER has higher weights and an additional wing centre-section fuel tank, giving it greater payload and range performance."

767-300ER

The consensus of opinion is that the -300ER is the most suitable and likely variant of the 767 family for future P-to-F conversions.

"The -300ER is the main candidate for future 767 conversions," says Stephen Fortune, principal of Fortune Aviation Services. "It has superior payload characteristics in comparison to the -200 and -300."

This analysis will therefore focus on identifying which members of the current 767-300ER passenger fleet will make the most suitable candidates for P-to-F conversion.

"The 767-300ER is still a good passenger aircraft, but the number being returned from lease or retired from airline fleets exceeds current passenger market demand," claims Bill Tarpley, president at Creative Conversion Management.

"Values of aircraft with less than 20,000FC are therefore reducing, and even approaching scrap," adds Tarpley. "As passenger-configured 767-300ERs become available at lower prices, the economics of converting them to freighters to replace ageing aircraft such as the 767-200, DC-10 and MD-11 become more favourable."

There were 527 767-300ERs in a passenger configuration at the end of July 2014. Only 41 of these aircraft were parked, with the remaining 486 in active service.

Boeing and IAI Bedek offer conversion programmes for 767-300ERs.

Aircraft considered suitable feedstock for medium widebody P-to-F conversion were typically in the 15-20-year-old age range. Gaber suggests that the upper age for suitable 767-300R conversion candidates is increasing. "Converting a 23 year-old 767-300ER aircraft is still a sound investment option," he claims.

Boeing

Netz says that the first 767-300BCF was delivered to All Nippon Airways (ANA) in 2008.

Conversion work is carried out by ST Aerospace in Singapore.

The structural maximum take-off weight (MTOW) for a 767-300BCF is 412,000lbs *(see table, this page)*. Some aircraft were manufactured with this MTOW. Others with lower weights have their MTOW upgraded to 412,000lbs during conversion.

Boeing also upgrades the maximum landing weight (MLW) of 767-300ERs to 326,000lbs, and the maximum zero fuel weight (MZFW) to 309,000lbs during the conversion process.

Boeing offers 767-300BCFs with either a manual or powered cargo loading system (CLS).

The approximate gross structural payload of 767-300BCFs with a manual CLS and without winglets is about 128,200lbs for aircraft with General Electric (GE) engines and 127,600lbs for those with Pratt and Whitney engines *(see table, this page)*.

The aircraft's net structural payload will depend on whether it is carrying freight on the main deck in unit load

POTENTIAL 767-300ER BCF/BDSF ULD/PALLET LOADING CONFIGURATIONS

Configuration	Main deck ULDS/Pallets
1	22 side-by-side (88" x 125" x 96") + 2 (88" x 125")
2	24 side-by-side (88" x 108" x 96") + 2 (88" x 108")
3	11 longitudinal (96" x 125" x 96") + 2 (88" x 125")
4	15 transverse (88" x 125" x 96") + 2 (88" x 125")
5	14 transverse (96" x 125" x 96") + 2 (88" x 125")

Configuration	Lower deck/cargo hold
1	30 x LD2
2	4 x (96" x 125") + 14 x LD2

Notes:
1). The forward-most and rear-most main deck loading positions are height restricted.
2). There is a bulk hold in the lower deck which provides a cargo volume of 430 cu ft.

devices (ULDs), or on lighter pallets.

Boeing has converted 10 767-300BCFs so far, and has been contracted for three more aircraft.

The list price for a 767-300BCF conversion is $18.36 million, regardless of whether the aircraft does or does not have winglets. This pricing can be deeply discounted, depending on the number of conversions and optional features required by the customer.

Operators need to budget for the additional cost of installing a CLS, and any weight upgrades associated with the conversion.

IAI Bedek

"The first 767-300ER converted by IAI Bedek was delivered to euroAtlantic Airways in Portugal in 2010," says Netz.

The highest available MTOW for a 767-300ER converted by IAI Bedek is 412,000lbs *(see table, page 56)*. As with the BCF modification, aircraft with lower weights can have their MTOW upgraded during the conversion process.

The IAI Bedek conversion offers MZFW and MLW upgrades of up to 309,000lbs and 326,000lbs respectively for 767-300ERs with GE engines. For those with P&W engines, MZFW and MLW upgrades are currently limited to 303,000lbs and 320,000lbs. IAI Bedek is developing upgrades for these aircraft that will allow the MZFW to be taken up to 309,000lbs, and the MLW up to 326,000lbs.

IAI Bedek offers a manual CLS for converted 767-300ERs.

The approximate gross structural payload of converted 767-300ER BDSFs without winglets and with a manual CLS is about 125,500lbs for aircraft with GE engines *(see table, page 56)*. The current payload of a converted aircraft with P&W engines is about 119,500lbs, although this will increase when the new MZFW and MLW upgrades are introduced.

As with the Boeing-converted aircraft, the 767-300ER BDSF's net structural payload will be depend on whether ULDs or pallets are used to carry the payload on the main deck.

IAI Bedek has converted 12 767-300ERs to -BDSF status, and has more aircraft in work and on order. The list price for a 767-300ER BDSF conversion was not available, but is believed to be $13-14 million. Additional costs would be incurred for the provision of a manual CLS and weight upgrades performed during the conversion.

The standard BDSF conversion of a 767-300ER includes a 9G rigid barrier. IAI Bedek also offers a unique conversion option with a 9G net which is more than $1 million cheaper than the rigid barrier configuration.

Freight configurations

The Boeing and IAI Bedek conversion programmes produce 767-300ER freighters with similar freight volume characteristics. In terms of ULD and pallet base dimensions, they offer similar potential volume configurations.

Some of the potential ULD loading configurations for converted 767-300ERs are listed *(see table, this page)*.

The configuration offering the highest containerised volume would include 22 88-inch x 125-inch x 96-inch ULDs arranged side-by-side on the main deck, plus a further two reduced height ULDs in the forward-most and rear-most positions.

The use of pallets on the main deck will have a lighter tare weight, and so provide the aircraft with a higher net payload. The use of ULDs and pallets provides similar payload volumes. An aircraft using pallets will therefore allow a higher freight packing density.

In addition to the main deck, 30 LD-2 containers can be accommodated in the lower deck, split between the forward and aft compartments.

If the bulk freight compartment is also included, a converted 767-300ER in this configuration would provide a total freight volume of about 16,000 cu ft.

Airframe selection

There are a number of factors that could influence the suitability of specific passenger-configured 767-300ERs for P-to-F conversion: the aircraft's accumulated FCs; weight specifications; whether it has a large forward lower deck cargo door; engine type; the presence or absence of winglets; fleet commonality; and maintenance considerations.

Aircraft FCs

The 767's maintenance planning document (MPD) includes several groups of ageing aircraft maintenance tasks with intervals determined by FCs.

There is a group of 77 tasks with an initial inspection interval of 25,000FC. Depending on the age of the aircraft when it reaches this interval, the larger number of man-hours (MH) required for access and performing the actual inspections could represent a retirement watershed *(see Assessing the 767's ageing maintenance, Aircraft Commerce, April/May 2012, page 38)*.

"Some of these tasks have different repeat intervals," explains Peter Cooper, planning manager at Civil Aviation Services Ltd. "Most operators probably want to avoid converting an aircraft that is approaching the 25,000FC threshold."

The typical utilisation of a converted 767-300ER freighter will vary by operator, but is unlikely to exceed 700FCs per year.

This analysis assumes that operators or investors will require a minimum of 10 years of service, and prefer a good probability of securing 15 years, from a freighter following conversion.

Based on these assumptions, aircraft that have accumulated fewer than 14,500FCs would make the best conversion candidates.

These aircraft could be operated for a minimum of 15 years before reaching the 25,000FC threshold.

Weight specifications

Boeing claims that all 767-300ERs can be converted to freighters with an MTOW of 412,000lbs and MZFW of 309,000lbs, with the exception of the first

One important criteria for selecting the best 767-300ERs to convert to freighter is to avoid the 14 aircraft that were built with a smaller forward lower deck cargo door.

seven aircraft produced.

The seven aircraft that cannot be upgraded are Boeing block numbers VL001-VL006 and VL011. The respective line numbers (L/Ns) for these aircraft are 158, 244, 260, 264, 267, 270 and 165. Two of these aircraft, L/Ns 165 and 264, have already been retired, leaving five in service. Boeing does not offer P-to-F conversions for these airframes.

"These aircraft have structural differences and lighter structural weight capability," explains Elizabeth Holleman, communication spokesperson at Boeing Commercial Aviation Services.

Moshe Haimovich, director, marketing & business development at IAI Bedek, cautions that some 767-300ERs may require modifications to their landing gear in order to accommodate weight upgrades carried out during the conversion process. A converted freighter with maximum weight upgrades will need a high gross weight landing gear.

From the weight specification perspective, the only 767-300ERs considered unsuitable for conversion are the five remaining aircraft with lighter structural weights.

Forward lower deck cargo door

767-300ERs have forward and aft, lower deck cargo doors.

"All passenger-configured 767-300ERs were delivered with a 'standard' (70-inch wide) door in the aft cargo compartment," explains Holleman. "All but 14 aircraft were delivered with large (134-inch wide) cargo doors for the forward cargo compartment."

These 14 aircraft were delivered with a smaller, standard-size forward lower deck cargo door. "This limits the size of containers and ULDs that can be loaded in the forward cargo hold to LD-2 or LD-8 containers or half-pallets," explains Holleman. "The large door permits the use of LD1 containers or full pallets."

There are 11 767-300ERs with standard-size, forward lower deck cargo doors in service. Their Boeing block numbers are VN681-VN691. The respective L/Ns are 377, 381, 382, 455, 466, 470, 471, 518, 537, 553 and 562.

These aircraft are not part of Boeing's current 767-300ER baseline conversion. Boeing adds that they could be converted subject to additional pricing to cover the necessary additional analysis and design.

IAI Bedek can offer conversions for aircraft with standard-size forward lower deck cargo doors.

Aircraft with large forward lower-deck cargo doors are the best candidates for conversion due to the additional loading configurations they allow.

Engines

The active and parked fleet of passenger-configured 767-300ERs is split between those with CF6-80C2 series (329), PW4000-94 series (169) and RB211-524 series (29) engines.

Aircraft with RB211-524 series engines are not part of Boeing's current baseline conversion for 767-300ERs. They could be converted subject to additional pricing.

Like Boeing, IAI Bedek does not currently convert aircraft with Rolls-Royce (RR) engines. This is due to the low feedstock numbers for RR-powered 767-300ERs, as well as their high hull weights. Aircraft with GE and P&W engines are the best candidates for conversion.

The CF6-80C2-powered fleet is sub-divided as follows:

- 4 aircraft with CF6-80C2s
- 15 aircraft with CF6-80C2B4s
- 2 aircraft with CF6-80C2B4Fs
- 88 aircraft with CF6-80C2B6s
- 110 aircraft with CF6-80C2B6Fs
- 1 aircraft with CF6-80C2B7s
- 109 aircraft with CF6-80C2B7Fs.

The PW4000-94-powered fleet is sub-divided as follows:

- 9 aircraft with PW4052s
- 10 aircraft with PW4056s
- 123 aircraft with PW4060s
- 23 aircraft with PW4062s
- 4 aircraft with PW4062As

"There are no particular advantages to having aircraft with GE or P&W engines," claims Haimovich. "Currently more GE-powered aircraft have been converted. We expect the final ratio to match that of the passenger fleet."

PW4000-94-powered aircraft have an OEW that is 500-600lbs higher than CF6-80C-powered counterparts. Haimovich suggests the weight difference is too insignificant to influence aircraft selection.

Some 767 freighter operators may prefer aircraft that have engines with full authority digital engine control (FADEC). It has been suggested that FADEC can provide fuel burn savings of up to 3%.

Winglets

Nearly half of the active and parked fleet of passenger-configured 767-300ERs has been retrofitted with winglets using the Aviation Partners Boeing (APB) modification.

The main advantage of winglets is a reduction in fuel burn. The stage of flight in which any fuel burn reduction is greatest is during the cruise.

Aircraft with winglets could therefore be particularly attractive to operators considering the use of converted 767-300ERs on longer-haul missions.

The main drawback of retrofitting winglets to a 767-300ER is the resulting hull weight and consequently payload penalty.

PASSENGER-CONFIGURED 767-300ERS WITH 14,500FC OR LESS

Aircraft L/N Range	CF6-80C2 series engines	PW4000-94 series engines	Total
Without winglets			
Active	74	52	126
Parked	9	6	15
Total	**83**	**58**	**141**
With winglets			
Active	94	48	142
Parked	0	0	0
Total	**94**	**48**	**142**
All Aircraft			
Active total	168	100	268
Parked total	9	6	15
Total	**177**	**106**	**283**

Notes:
1). Excludes five remaining aircraft with lower structural weights - L/Ns 158, 244, 260, 267, 270.
2). Excludes aircraft with 'standard' forward lower deck cargo doors.
3). Excludes aircraft with RB211-524 series engines.
4). Excludes aircraft with no FC information - 34 aircraft in total: 1 Air Astana, 13 ANA, 16 Japan Airlines, 4 Uzbekistan Airlines.

A set of APB winglets will add about 3,000lbs to the operating empty weight (OEW) of a 767-300ER. There is no MZFW upgrade available to offset the associated reduction in gross structural payload.

Only the Boeing conversion programme can convert winglet-equipped 767-300ERs at this time. Boeing can convert aircraft that already have winglets installed or install winglets during the conversion process. The installation of winglets would incur additional costs.

Typical gross structural payloads for a winglet-equipped 767-300BCF with a manual CLS would be about 125,200lbs for aircraft with CF6-80C2 series engine, and 124,600lbs for those with PW4000-94 series engines.

IAI Bedek has not converted any winglet-equipped aircraft. It says that it will achieve the capability to convert winglet-equipped 767-300ERs as and when it receives a customer request to do so.

The influence of the presence or absence of winglets on aircraft selection could depend upon the individual operator's requirements. Airlines operating longer missions may be more inclined to convert winglet-equipped aircraft to benefit from fuel burn improvements.

Those airlines operating shorter routes may prefer to have aircraft without winglets owing to only a small fuel burn improvement, and the slight payload penalty imposed by installing them.

Fleet commonality

The ability to source a group of common 'sisterships' can be a high priority for operators with a requirement to convert multiple aircraft.

'Sisterships' are aircraft that have been in service with the same operator. As a result they are most likely to have the same engines, modifications and parts, and to have been subject to the same standardised maintenance procedures.

Sourcing a fleet of common aircraft for conversion can reduce operating costs. The airline will not need to invest in multiple spares inventories or personnel training for aircraft with numerous specifications.

Maintenance considerations

The aircraft's maintenance condition is an important consideration when selecting airframes for conversion.

The conversion process provides an ideal opportunity to carry out heavy base maintenance checks.

The heaviest check in a base check cycle has traditionally been referred to as a C4 or 'D' check. This check includes a number of structural inspection tasks that require deep airframe access.

The conversion process, including the removal of the passenger interior, floor reinforcement and installation of a large cargo door, requires similar levels of access.

Combining a 'D' or C4 check or other heavy inspection with the conversion process will avoid the duplication of costly airframe access MH.

767 MPD tasks are now given specific interval criteria, rather than being assigned to blocks or groups of letter checks. Despite this, few of the task intervals have changed so they can still easily be assigned to traditional C and D-checks, and base-check cycles.

This analysis assumes that a 15-year-old 767-300ER would be approaching the end of its third base check cycle and its D3 or C12 check *(see Assessing the 767's ageing maintenance, Aircraft Commerce, April/May 2012, page 38)*.

A rough estimate for the cost of this check is $1.72 million. This assumes that the check is carried out in conjunction with the conversion process, and benefits from reduced MH related to aircraft preparation, access MH and interior refurbishment *(see Narrowbody & widebody converted freighter build costs, Aircraft Commerce, June/July 2104, page 58)*.

Operators should also consider whether there are any outstanding airworthiness defects (ADs) or service bulletins (SBs) affecting the 767-300ER at the time of conversion.

"The main AD of note relates to the engine strut or pylon improvement requirement," explains Cooper.

AD 2004-16-12 incorporates SB 54-0080 for PW-powered aircraft and SB 54-0081 for GE-powered aircraft.

It requires the complete removal of both engines and their pylons from the wings. These are then reinstalled following the AD modification.

The AD requires compliance by the

time the aircraft reaches 20 years-of-age.

"Operators seeking conversion candidates would prefer aircraft that have already had the engine strut modification completed," says Cooper. "If the modification has not been completed it makes sense to implement it during the conversion process to minimise downtime."

The P-to-F conversion process also provides an opportunity for flightdeck upgrades to new integrated avionics systems.

A number of OEM and independent avionics suppliers offer system upgrades for 767s.

"US-based Innovative Solutions & Support (IS&S) holds a supplementary type certificate (STC) for flat-panel upgrades of 767 flight and navigation displays," claims Netz. "The new equipment replaces cathode ray-tube electronic flight information systems and reduces line-replaceable unit counts by about 70%."

Avionics upgrades can lead to new functionality. According to IAI Bedek's Haimovich, operators may look to add Category III instrument landing system (ILS) capability; extended range twin-operations (ETOPS) capability; an upgraded traffic collision and avoidance system (TCAS) and a satellite communication (SATCOM) system. Haimovich adds that they may also require controller-pilot data link communication (CPDLC) technology; automatic dependent surveillance broadcast (ADS-B) technology; global positioning system (GPS) technology; and future air navigation system (FANS) 1 and FANS 2-compliant aircraft communication addressing and reporting system (ACARS) technology.

Cost considerations

The estimated purchase value of a 15-year-old 767-300ER in half-life maintenance condition and with half-life CF6-80C2 series or PW4000-94 series engines is $16 million. There will be some variation depending on the specific engine variant.

Estimated conversion costs are $13-18.4 million, and a D check during the conversion process could cost about $1.7 million.

The combined acquisition, maintenance and conversion costs to bring a 767-300ER into service as a converted freighter could therefore be $30.7-36.0 million.

Operators would need to allow for additional costs related to the installation of a CLS or weight upgrades performed during the conversion. Consideration has to be given to condition of the engines.

Suitable airframes

This analysis has identified that the most important criteria to consider when selecting 767-300ERs for conversion are the aircraft's accumulated FCs; weight specifications; engine type; and whether it has the standard or large forward lower-deck cargo door.

Fleet commonality will be more of a priority for operators with a requirement for multiple aircraft.

The extent to which the presence or absence of winglets might influence aircraft selection is more likely to depend on the individual operator and its planned utilisation for the converted freighter.

The five remaining 767-300ERs with lower structural weights, 11 aircraft with standard forward lower-deck cargo doors, and 29 aircraft with RB211-524 series engines, are not considered suitable for conversion. This analysis will no longer include them as potential conversion candidates.

A further 34 passenger-configured 767-300ERs have been excluded from the analysis, because it was not possible to establish the number of FCs they have accumulated. These aircraft are operated by Japan Airlines (16), All Nippon Airways (13), Uzbekistan Airways (4) and Air Astana (1).

American Airlines operates CF6-80C2-powered 767-300ERs with winglets installed. These are some of the prime candidates for conversion to freighter.

Main conversion candidates

The best conversion candidates Among the remaining CF6-80C2- and PW4000-94-powered aircraft are considered to be those with 14,500 accumulated FCs or fewer.

There are currently 283 passenger-configured 767-300ERs that meet this criterion, including 268 active and 15 parked aircraft.

These aircraft are the most suitable 767-300ER conversion candidates.

Seven of the 283 aircraft are beyond the typical 15-23-year-old feedstock age range. The oldest is 25 years old. Provided the general maintenance condition is acceptable, these aircraft may still be considered suitable due to the low number of FC they have accumulated.

About 131 aircraft are currently in the typical feedstock age-range, while another 46 will enter it within the next two years. The remaining 99 aircraft are younger, with some only delivered in the past few years. They are still included in the analysis because of the potential to convert them in the future.

The 283 most suitable conversion candidates can be grouped according to their operators and engine type. They can be further subdivided in to those with and without winglets.

Aircraft without winglets

There are 141 aircraft without winglets among the main 767-300ER conversion candidates *(see table, page 62)*. The majority of these are active (126) but there are also a number of parked aircraft (15).

CF6-80C2 engines power 74 active and nine parked aircraft. The remaining 52 active and six parked aircraft are powered by PW4000-94 series engines.

The largest fleet of 767-300ERs without winglets is operated by Japan Airlines. It has 13 active aircraft powered by CF6-80C2B7F engines. The next largest fleets are those of All Nippon Airways (ANA), which has 12 active aircraft powered by CF6-80C2B6Fs, and United Airlines, which has 10 active aircraft, powered by PW4060s.

None of the 13 Japan Airlines or 12 ANA aircraft have reached the traditional conversion feedstock threshold of 15 years of age. Several aircraft from each fleet will do so in the next three years. In contrast, most of the 10 United aircraft are already within the 15- to 23-year-old feedstock age range.

Transaero Airlines also has a fleet of 10 active aircraft without winglets, but these do not offer the same level of engine commonality. Seven of the Transaero fleet are equipped with CF6-80C2 series engines and three are PW4000-94-powered.

With winglets

There are 142 active aircraft with winglets among the main 767-300ER conversion candidates *(see table, page 62)*.

CF6-80C2 series engines power 94 of these aircraft, while the other 48 have PW4000-94 series engines.

The largest fleets of winglet-equipped 767-300ERs are operated by American Airlines (33), Delta Airlines (31), LAN Airlines (19) and United Airlines (11).

The American Airlines aircraft are all powered by CF6-80C2B6 engines. The LAN aircraft are also CF6-80C2-powered, and the United aircraft are PW4000-94-powered.

The Delta fleet is split between aircraft with CF6-80C2 series engines (14) and those powered by PW4000-94 series engines (17).

Nearly three-quarters of the American Airlines aircraft are already within the typical conversion age range. All of the Delta and United aircraft are either within the typical conversion age-range or will enter it in the next two to three years.

LAN's fleet is younger with only one aircraft in excess of 15 years of age.

Summary

The 767-300ER is the most likely member of the 767 family to be converted in significant numbers in the future.

Aircraft with 14,500FCs or fewer, GE or PW engines, and large forward lower-deck cargo doors are the best candidates for conversion.

There are at least 283 passenger-configured 767-300ERs that meet these criteria. About 65% of these aircraft have already reached the typical feedstock age threshold for P-to-F conversion, or will do so in the next few years. Others have only been delivered new in the past few years.

Half of the 283 candidate aircraft are equipped with winglets.

There is the potential for freight operators to convert standardised sisterships either with or without winglets.

The main sources for aircraft without winglets are Japan Airlines, ANA and United. The main sources for winglet-equipped 767-300ERs are American Airlines, Delta and LAN.

US operators are the largest source for common fleets that are already within the typical conversion age-range. AC