

The 30-80 ton freighter category is one of the largest in the entire market. It has experienced high growth rates, especially in recent years with the surge of e-commerce. Overall fleet requirements over the next 20 years could exceed 1,300 units, providing a challenge for the sector.

The market for 30-80 ton freighters

Medium-sized freighters generally include all aircraft types from the 757 to the DC-10-30. Other types include all variants of the 767, A300, A310, and A330. To date, there are no 787 freighter variants. These aircraft have gross structural payload ranging from 67,000lbs to 178,000lbs, equal to 30-80 tons. Net structural payloads, when configured with containers, are 34-71 tons.

The active fleet of these types has been increasing by 35-62 aircraft per year for the past three years, and was 876 aircraft at the end of 2018. This is an increase of 263 aircraft and a factor of 1.4 over the 10-year period since 2008, equal to an annual growth rate of 5%. The first two or three years of this period had suppressed growth, so the average annual growth rate was limited. This compares to an increase of just 22% for large widebody freighters over the same 10-year period (see *The market for large widebody freighters, Aircraft Commerce, October/November 2018, page 61*). The fleet also increased by a factor of 4.4 over the 20 years since 1998, equal to an average annual growth rate of 7.6% over the term.

In addition to its continued steady growth, the medium freighter bracket accounts for one of the largest sectors of the freighter fleet. The 757 is the smallest type in this category, and has gross payloads of 30-37.5 tons (see *table, page 59*). There were 307 757 freighters in service at the end of 2018, which accounted for 35% of the fleet.

The other main type comprises the 767-200/-200ER and 767-300ER freighters. These have gross structural payloads of 102,000-125,000lbs, equal to 45-56 tons (see *table, page 59*). There were 299 in service at the end of 2018, equating to 34% of the global fleet. These are split between 57 smaller 767-200/-200ERs and 242 larger 767-300ERs.

The A300-600F/RF has a gross payload of 107,000lbs. Fleet numbers have steadily increased to 174.

The A310-300F is similar in payload capacity to the 767-200, but numbers have declined to just 11 aircraft left in service from a peak of 80 in 2008. Similarly, the A300B4-200F has a structural payload of 100,000lbs, or 44.5 tons, but the fleet has now diminished to just nine aircraft. The DC10-10F fleet peaked at 61 aircraft in 2005, but has declined to 21, and is being phased out. There are just 15 DC-10-30Fs in service.

The A330-200F and -300F are the youngest types, and numbers have increased from 2010 to 40 by the end of 2018. Most deliveries to date are factory-built A330-200Fs. Only a small number of aircraft have been converted to date.

This category of freighters will continue to grow, and large numbers of these aircraft have been added to the fleet to serve the e-commerce market. The 757PF is no longer in production, and the number of passenger-configured aircraft that will be converted is likely to decline as the better-quality examples are acquired. No more A310s, A300B4s or A300-600Rs are being converted; and production of factory-built A300-600RFs has stopped.

The 767-300ERF continues to be built, with FedEx having an outstanding order for 54 aircraft, and with deliveries continuing at up to 13 units per year until 2023. UPS has nine outstanding orders for 767-300ERFs, with the latest to be delivered in 2022. Another 63 aircraft will therefore be added to the fleet over the next five years. A growing number of 767-300ERs has been converted in recent years, reaching 23-25 aircraft per year in 2017 and 2018. More than 150 767s have been converted since 2002.

With the probable demand for aircraft to satisfy demand for increased freight traffic volumes and the continued retirement of older types, airlines have to

consider which types will be available to satisfy their requirements in this category over the next 10-20 years. This will be a combination of continued conversions of 757-200s and 767-300ERs, an increased rate of A330-200/-300 conversions, and the addition of new types. Within 20 years this could include conversions of 787s and A330neos, factory-built 787s and A330-200s, and a possible new dedicated freighter variant of the A330.

Main issues

The main factors affecting the market for aircraft in this category are the profile of the current fleet, the likely number of active aircraft that will be retired over the next 20 years, and the likely annual rate of traffic growth and fleet requirements.

One option in this sector that does not require consideration is the reactivation of stored aircraft. There are few or no aircraft in storage. Older A300s, A310s and a few 757-200s have been fully retired.

Traffic growth

There are several market forecasts that predict annual growth rates in all world markets, and also on a global level as a whole. Large volumes of freight are carried as belly freight in passenger aircraft, but a large number of dedicated freighters are nevertheless required.

Traffic growth rates in recent years have been stimulated by the development of e-commerce. The long-term average growth rate of global freight has been 4.2% per year over the past 20 years, based on general and express package freight.

The continued growth in intracontinental and intercontinental markets has seen volumes increase significantly, thereby adding to annual growth rates. Traffic growth increased to above average levels in 2016, and grew

MEDIUM FREIGHTER WEIGHT SPECIFICATION & PAYLOAD CHARACTERISTICS

Aircraft type	757-200 SF/PCF	757-200 PCF	A310-300F	767-200ER BDSF	767-300ER BDSF	A300B4 -200F	A300-600 RF	A330-200F PAYLOAD MODE	A330-300F PAYLOAD MODE	DC-10-10F	DC-10-30F
MTOW - lbs	255,000	255,000	361,620	351,000	412,000	373,760	375,890	500,308	500,308	440,000	572,000
MZFW - lbs	184,000	200,000	251,320	266,000	309,000	277,780	286,600	392,312	392,312	335,000	414,000
OEW - lbs	116,300	116,000	162,920	164,000	183,500	177,780	179,230	240,236	245,746	217,300	236,000
GROSS PAYLOAD - lbs	67,700	84,000	88,400	102,000	125,500	100,000	107,370	152,076	146,566	117,700	178,000
GROSS PAYLOAD - tons	30	38	39	46	56	45	48	68	65	53	79
Payload carriage											
Main deck -											
ULD Vol cu ft	6,600	6,600	10,572	9,456	12,034	10,398	11,016	12,084	14,220	13,508	13,508
Tare Weight ULD - lbs	7,140	7,140	8,992	9,170	11,550	10,810	11,416	12,540	14,788	14,300	14,300
Lower deck											
ULD Vol cu ft	1,790	1,790	2,100	2,728	3,720	3,000	3,300	3,900	4,800	3,900	3,900
Tare containers - lbs	N/A	N/A	2,800	4,466	6,090	4,000	4,400	5,200	6,400	5,200	5,200
Total volume - cu ft	8,390	8,390	12,672	12,184	15,754	13,398	14,316	15,984	19,020	17,408	17,408
Total tare - lbs	7,140	7,140	11,792	13,636	17,640	14,810	15,816	17,740	21,188	19,500	19,500
Net structural payload - lbs											
Net payload - tons	60,560	76,860	76,608	88,364	107,860	85,190	91,554	134,336	125,378	98,200	158,500
Max packing density - lbs/cu ft	27	34	34	39	48	38	41	60	56	44	71
	7.2	9.2	6.0	7.3	6.8	6.4	6.4	8.4	6.6	5.6	9.1

by an unprecedented 10% in 2017.

While the business model for express packages includes quick delivery, for which a premium is paid; e-commerce does not, but requires transport by air in the case of long distances.

The express package carriers have been established for a long time, and traffic has been transported by a variety of airlines. These have now consolidated into the three main carriers of FedEx, UPS and DHL.

The largest e-commerce providers are Amazon in North America, Europe and many other parts of the world; and Alibaba in China. These companies have started to develop freighter fleets of their own, and Amazon is transporting more packages via airlines working for it on a wet lease basis or via its own aircraft. Amazon recently signed a lease with ATSG for 10 767-300ERFs, and there has been speculation for some time that it will order up to 100 767-300ERFs.

Alibaba has transported some shipments by Chinese freight carrier SF Express, which operates a small fleet of 757-200PCFs. E-commerce companies are still several years away from having fleets close to the size of FedEx, UPS and DHL.

Even though the growth of e-commerce suggests that higher than historic global freight traffic growth rates might become the norm in the future, global air freight traffic forecasts still predict average annual growth rates of 4.5% per year over the next 20 years. This has implications for the current fleet of aircraft, and the number required in the future. The 2018 fleet of 30-80 ton

freighters included about 300 757-200s and 570 medium widebodies, varying in size from the A310/767-200 up to the DC-10-30; a total fleet of about 870 aircraft. Fleet projections are that the number of aircraft in the same size category will double to about 1,650 aircraft. The actual number will depend on the availability of aircraft in the 757-200F's payload and volume capacity.

This growth is a net increase in the fleet of about 780 aircraft. However, a larger number of aircraft will have to be delivered to airlines over this period, due to retirements among the 870 aircraft in service.

Current fleet

The fleet of 30-80 ton freighters stood at 876 active aircraft, split between 307 757-200Fs, 299 767-200F/-300Fs, 183 A300B4Fs and A300-600RFs, 11 A310-300Fs, 40 A330-200F/-300Fs, 21 DC-10-10Fs, and 14 DC-10-30Fs. The 757 is therefore the largest sub-fleet, and accounts for 35% of the total. The 767 fleet accounts for another 34.1% of the total fleet. It can be sub-divided between 57 of the smaller 767-200ERF with a gross payload of up to 46 tons, and 242 of the larger 767-300ERF with a gross payload of up to 56 tons.

There are also nine A300BFs in service, having declined from a peak of about 67 aircraft in 2008/09. The 48-ton A300-600RF fleet is the third largest, with 174 in service and 20% of the fleet. It reached this peak number in 2015.

The A310-300F fleet has been in decline for the past 10 years. Of a fleet of

81 aircraft at its peak, only 11 remain in service. The DC-10-10F fleet was exclusively operated by FedEx, and has declined from a peak of 64 in 2008 to 21 aircraft. FedEx is replacing the 53-ton DC-10-10F with the 767-300ERFs it has on order. The 79-ton DC-10-30F is also operated exclusively by FedEx, and numbers have declined from a peak of 58 aircraft in 2005 to 15 by the end of 2018.

The fleet is dominated by the three express package carriers, which account for 63% of the aircraft. The other 37% of the fleet is operated by a large number of airlines that operate small fleets. Many of these operate on a wet lease or fixed-fee basis for the three main express package carriers.

In addition to the longer-term carriers, some airlines are also now providing an increasing portion of their capacity for e-commerce giant Amazon on a wet lease basis. These include some of the aircraft operated by Atlas Air.

Of the 549 aircraft operated by DHL, FedEx and UPS, 500 are 757-200Fs, 767-300ERFs, and A300-600RFs. The other 49 aircraft are small numbers of other types which are all being phased out over the next five years. Most are DC-10s. Estimating what portion of the 500 aircraft will be retired over the next 20 years is a major issue in determining the demand for new aircraft up to 2037.

757-200F fleet

The 757-200F fleet of 307 aircraft includes 40 that are operated by the DHL group and its associated carriers. DHL's European division European Air



Transport (EAT) operated the first batch of 757-200s converted to freighter. These were mainly ex-British Airways aircraft equipped with RB211-535C engines. Most of these have been retired, but 10 are still in service with DHL and European Air Transport (EAT). The other 30 aircraft have all been converted with Precision Conversions' supplemental type certificate (STC), and are a mixture of aircraft equipped with RB211-535E4 and PW2037 engines. Most were built from 1996 to 2002, and average utilisation across the whole fleet is about 1,100 flight hours (FH) per year. DHL retired many of its -535C-powered aircraft at 30-35 years old. This implies that all aircraft that have passed the 35-year mark are retired, so all aircraft in the fleet should have retired by 2037.

FedEx is the single biggest operator of 757-200Fs. It has 111 757-200SF aircraft, converted from passenger configuration using the Boeing modification, by ST Aerospace. These 111 aircraft are equipped with both the RB211-535E4 and PW2037/40 engines. They were built from 1983 to 1998, and were converted from 2008 to 2017. Rates of utilisation are relatively high, with most aircraft operated at more than 2,000FH per year. The oldest aircraft in FedEx's fleet will be 29 years old in 2037, so most will have been retired by then.

UPS operates a fleet of 75 factory-built 757-200PFs, split between 35 PW2040-powered aircraft built from 1987 to 1994, and 40 RB211-535E4-powered aircraft built from 1994 to 1999. Average utilisation is similar to DHL, at about 1,200FH and 770 flight cycles (FC) per year. These low rates of utilisation mean that the youngest 30-

50% of the fleet may still be in operation in 2037, but the remainder will have retired by then. The oldest aircraft in the fleet are now more than 30 years old, but have accumulated highest total times of only 25,000FH and 16,500FC. This suggests aircraft could operate until they are more than 40 years old, as is the case with FedEx's DC-10s.

The remainder of the 757-200F fleet comprises 81 aircraft, all of which were converted using the Precision Conversions modification. These aircraft are operated by a mixture of carriers that include Air China Cargo, Air Transport International (ATI), Blue Dart Aviation, Cargojet Airways, China Postal Airlines, SF Airlines and YTO Airlines. Another 13 aircraft, operated by Morningstar Express and SF Airlines, were converted using the Boeing STC by ST Aerospace, which has control of the licence and manages the conversions.

These 81 aircraft were built from 1984 to 2002. These have annual rates of utilisation ranging from 1,000FH to 3,500FH. Most are likely to have been retired by 2037.

Overall, 220-230 757 freighters are likely to retire over the next 20 years.

767-200F/-300F fleet

The fleet of 767-200Fs totals 59 aircraft, sub-divided between two groups. The first comprises 23 aircraft that were modified from 2004 to 2006 with a non-conventional cargo door. This was a freighter modification for ABX that was provided by Bedek Aviation of Israeli Aircraft Industries (IAI). This loaded cargo containers through the original passenger door, and a large cargo door on

The 757-200 accounts for 305 of the 876 active freighters in the 30-80 ton category. With 757PF production having ceased, probably less than 100 passenger-configured aircraft left as suitable conversion candidates, and high growth rates in the sector, alternative aircraft types will be required.

the main deck was not installed.

The second group is 36 aircraft that were modified by Bedek Aviation using the IAI STC, and were fitted with a conventional large cargo door. These were modified from 2004 to 2008.

This fleet of 59 aircraft was built from 1983 to 1994, and so is 25-36 years old. Some of the aircraft converted with the special modification for ABX Air have already been retired. Annual rates of utilisation are low, however, so aircraft could operate until they are 40 years old if they remain economically viable. All aircraft are likely to have been retired by 2037.

The 767-300ERF fleet totals 242 aircraft, with 133 operated by the express package carriers and 109 by other airlines.

DHL operates a small fleet of 2009-built 767-300PFs. FedEx has the largest fleet of all airlines with 67 factory-built aircraft that have been delivered since 2012. It has another 54 aircraft on firm order, with deliveries due until 2023.

UPS operates a fleet of 62 -300PFs that were delivered from 1994 to 2013. Average annual utilisation is 3,300FH and 900FC. UPS has another nine aircraft on order, and aircraft are due for delivery from 2019 to 2022. The oldest aircraft in this fleet are therefore likely to have been retired by 2037, but a large portion will still be in service.

The other 109 767-300Fs in service are operated by a mix of airlines. About 30 were converted using the Boeing modification, and so are -300BCFs.

Another 63 aircraft are modified with the Bedek Aviation conversion programme, and so are -300BDSFs, while 20 are factory-built freighters.

The converted aircraft were built from 1988 to 1999, and so are 20-31 years old. Many are operated at medium rates of utilisation, but some accumulate fewer than 1,500FH per year. The 20 factory-built 767-300PFs are six to 18 years old. Most of these can therefore be expected to retire over the next 20 years, but a minority may still be operational.

A300-600RF fleet

Of the 179 A300-600RFs in service at the end of 2018, 141, or 81%, were operated by the big three express package operators. These are split between 51

converted aircraft operated by EAT and FedEx, and 92 factory-built aircraft operated by FedEx and UPS. In total there are 76 converted aircraft, all of which were modified from passenger aircraft to freighter using the EFW STC and modification, and 103 factory-built aircraft.

The DHL group operates 22 converted aircraft that were modified from 2011 to 2013, and are 17-28 years old. They operate at average annual utilisations of 2,000FH and 1,600FC.

FedEx operates the largest fleet of 71 aircraft, including 29 that were converted from 2002 to 2009, and are 26-34 years old. FedEx also operates 42 factory-built freighters, most of which were produced from 1993 to 1999. All aircraft are operated at low annual rates of utilisation of 1,300FH and 730FC, but despite this their age means that these aircraft are all likely to be retired by 2037.

UPS operates 52 factory-built aircraft that are 13-19 years old and operate at averages of 1,200FH and 700FC per year. Their age means that some will have retired by 2037.

The remaining 33 aircraft in the fleet include 25 converted and eight factory-built aircraft. MNG Cargo and Uni-Top Airlines account for most of the remaining converted aircraft. Air Hong Kong operates eight factory-produced A300-600RFs.

DC-10-10F/-30F

The DC-10-10F and -30F fleet is small at just 35 aircraft and declining. All but one aircraft are operated by FedEx, which is phasing out its fleet. These are being replaced by 767-300ERFs. All of FedEx's aircraft were converted from DC-10s to MD-10s using Aeronavali's programme in the late 1990s. The aircraft still in service were built from 1971 to 1980 in the case of the DC-10-10F, and from 1973 to 1988 in the case of the DC-10-30F.

In addition to the DC-10Fs, the 11 A310-300Fs and nine A300B4Fs are part of a larger fleet that has been retired. These remaining aircraft are expected to be in service for another five to 10 years.

A330-200F/-300F

The A330-200F and -300F are the most recent types to enter this category. The A330-200F was originally developed as a factory-built freighter by Airbus after the A330-200 platform was developed into an in-flight refuelling aircraft for the military. In addition there is a passenger-to-freighter modification for the A330-200 and -300 series, the -200P2F and -300P2F. The STC is held by EFW.

The factory-built freighter is designated the A330-200F. To date, Airbus has received 43 orders for the

aircraft, of which 39 have been delivered. Deliveries started in 2011, and have continued at an average of four to six aircraft per year. The main customers for the A330-200F are Avianca Cargo, EAT, Hong Kong Air Cargo, Malaysia Airlines, QATAR Airways and Turkish Airlines.

There are outstanding orders for four A330-200Fs, which are due for MNG Airlines and Avianca cargo.

The first A330-200s and -300s were converted to freighter by EFW in 2017 and 2018. One A330-200P2F has been modified and a second is in conversion, and will be operated by Egyptair. Two A330-300s have been converted, and are operated by Air Hong Kong. There is also one -200P2F in conversion, to be operated by Egyptair; and three -300P2Fs in conversion to be operated by DHL Air.

The converted aircraft were built from 1995 to 2005, so some are likely to have retired from this small fleet by 2037.

Total aircraft market

Examining the fleet and age profile for each type, the number of aircraft retired from the current fleet of 876 aircraft over the next 20 years can be estimated at 580 units. This will leave about 300 of the current fleet in service in 2037.

In addition to the 580 retirements, the growth in freight traffic and the fleet means that another 780 aircraft will be

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required. This would take the total to 1,350 aircraft over the next 20 years. Airlines will therefore need to add an average of 65 new aircraft per year.

These will clearly come from a mixture of converted and factory-built aircraft. The main issue this raises is which types are available, and likely to be converted, and which types will be acquired as all-new factory built aircraft.

FedEx and UPS account for most factory-built aircraft, while airlines in the DHL group have acquired a more even mix of converted and new-built freighters. Other airlines have acquired most of their fleets through freighter modifications, although a difference has been seen with the A330-200F, where large numbers have been acquired as new-built freighters by non-express package carriers.

One main issue is that because large numbers of aircraft are converted and many types are no longer in production, several new aircraft types will have to be acquired, either as converted or as new-built freighters. The new types will not be direct replacements for older types, which complicates fleet planning and aircraft selection. The 30-80 ton category of aircraft clearly has a wide range of gross payload characteristics; but also a wide range of containers or palletised cargo volumes, which vary from 6,600 cu ft to 19,000 cu ft. The gross structural payload, total containerised cargo volume, net structural payloads, and maximum packing densities of the aircraft types are summarised (see table, page 59).

An example of the complexity involved in choosing replacements is the A330-300F/P2F, whose structural

payload is 32,000lbs lower than the DC-10-30F's. However, the A330-300F/P2F's total volume is 2,600 cu ft higher, so it could potentially reach its payload limit before all available volume is utilised.

Another issue is aircraft in the 757-200's, A310-300's and 767-200's payload capacity, which have a gross structural payload of 38-46 tons, net structural payloads of 35-39 tons, and cubic capacities of 10,180-12,184 cu ft. There is no direct replacement for any of these aircraft.

A321 P2F

The A321-200 passenger-to-freighter conversion is offered by several providers that include EFW and Precision Conversions. The initial Precision Conversions offering has a net structural payload of about 22.7 tons and a freight volume capacity of 7,430 cu ft. This comes from a combination of 6,160 cu ft on the main deck from 14 main container positions, and 10 AKH ULDs on the lower deck that provide another 1,270 cu ft.

EFW is further advanced with its conversion programme, and has a different configuration to Precision Conversions. Aircraft converted by EFW have a lower net structural payload of up to 22.6 tons and a volume of 7,600 cu ft when loaded with containers on both decks.

The A321-200PCF's total volumetric capacity is up to 960 cu ft smaller, and its net payload is up to 10 tons lower, than the 757-200PC's total volume; the A321-200PCF is converted by Precision Conversions.

The A321-200PCF's volumetric

The 767-300ERF is the second most numerous type in the 30-80 ton freighter fleet. Factory-freighter production continues with orders from FedEx, and demand in the sector has been high, and a large number of 767-300ERs have been converted to freighter over the past 10 years.

capacity is, however, 830 cubic feet more than the 757's main deck containerised volume. The appropriate comparison between the two may not include the 757's lower deck volume when the aircraft are being used to carry express packages. The A321-200PCF actually provides higher containerised volume and so is an appropriate replacement for some 757-200Fs for some current operators.

"Most freight has changed from a weight-dominated business to a volume business because of the fall in average packing densities to the 6lbs per cu ft level," says Brian McCarthy, vice president of sales at Precision Conversions. "When all the costs of acquisition, conversion and preparation for service are considered, the A321-200PCF is an economic option, particularly given the growth in postal services and e-commerce in many countries."

A basic analysis of the A321-200 passenger fleet reveals that there are 641 CFM56-5B- and 990 V2500-A5-powered aircraft in service. The oldest aircraft were built in 1997, so there is a large pool of potential feedstock for freight airlines and lessors to choose from.

757-200

The number of aircraft required over the next 20 years raises the issue of further 757-200s being converted. The 757-200 has proved a popular type for the past 10 years, with the number being converted peaking at 25 in 2011, and reaching 19 aircraft in 2018. All 757-200s have been converted for FedEx, and ST Aerospace is unlikely to convert any more aircraft. It did not convert any aircraft in 2017, and converted only three in 2018. Meanwhile, Precision Conversions converted nine aircraft in 2015, but this rose to 16 in 2016, 17 in 2017, and 16 in 2018. Moreover, there are 12 aircraft due for conversion in 2019 by Precision Conversions. An issue for further 757-200 conversions is that the last passenger aircraft were built in 2005.

Analysis of the remaining 757-200 fleet shows that there are about 310 passenger-configured aircraft still in operation. These are split between 145 PW2000-powered and 167 RB211-powered aircraft.

It seems that ST Aerospace, with a 14-position conversion, will not modify any more aircraft. This leaves Precision

Conversions as the only remaining programme. “To date we have had orders for 107 conversions,” says McCarthy. “Of the remaining passenger fleet, we think we could convert about another 45 or even possibly 60 aircraft. We have a few outstanding conversions to complete for DHL and Swiftair.

“Demand for conversions temporarily slowed down due to a shortage of good quality engines, and life limited parts (LLPs), but it has now picked up again,” continues McCarthy. “The problem is that while the PW2000 may be the favoured engine, few aircraft are available in the right maintenance condition. We do not expect any Delta Airlines aircraft to be converted, because of its policy of using up all maintenance life before retirement. Some good quality RB211-powered aircraft remain in the fleet.”

The main fleets of remaining passenger aircraft are 111 PW2037-powered aircraft operated by Delta, and 15 PW2000 aircraft operated by United. Of the RB211-powered aircraft, there are four big fleets operated by American Airlines (34), Icelandair (24), TUI UK (13), and United Airlines (41). “The better quality aircraft have to be picked out. Investors do not like aircraft that have accumulated more than 30,000FC,” says McCarthy.

Up to 60 possible future conversions could come from about half the remaining American fleet, most of Icelandair’s aircraft following finalisation of its merger with Wow, most of TUI UK’s remaining aircraft, and the United fleet.

767-300ER

In addition to a lack of smaller widebodies, A300-600RF production has stopped and most A300B2/B4Fs have been retired. The lack of aircraft types to choose from has clearly stimulated demand for the 767-300ER in recent years. The A300B4E, A300-600RF and 767-300ERF are all close in payload characteristics. They have net structural payloads of 41-48 tons and total containerised volumes of 13,400-15,700 cu ft (see table, page 59).

The 767-300ER is now in a class of its own. It has the largest containerised volume and net payload over the two A300 models. These factors explain the large orders for factory-built 767-300ERFs, as well as the high number of aircraft being converted. This had fallen to just two aircraft in 2013, but rose to 25 in 2018. Bedek Aviation has had the majority share of the conversion market in recent years. It converted 12 aircraft in 2016, 16 in 2017, and 15 in 2018. There are nine aircraft due for conversion, with Bedek Aviation modifying some of them.

A main consideration here is how many more 767-300ERs could be converted, as well as how many more factory-built aircraft could be sold by Boeing. As discussed, there are more than 60 outstanding orders that take production up to 2023, and rumours of a large order being placed by Amazon.

Continued conversion of passenger aircraft to freighter is likely, and with large numbers. Although production of passenger-configured 767-300ERs has halted, the last aircraft was built in 2014. There are 360 good-quality passenger-

configured aircraft with high-specification weights in the passenger fleet. These are split between 220 CF6-80C2-powered and 135 PW4000-94-powered aircraft. A few are also equipped with RB211-524 engines. There are large fleets operated by American (24), Air Canada (29), All Nippon Airways (24), Delta Airlines (53), Japan Airlines (28) and LATAM Group airlines (32). A large portion of these could satisfy demand by freight carriers for several years. Fewer than 40 aircraft are less than 10 years old, however.



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A330-200F

The A330-200 is the only aircraft currently available that is young and still in production. The A330-200 has proved to be less successful as a new-built freighter than the 767-300ERF. The A330-200 has a similar containerised volume to the 767-300ERF, but the A330-200F/P2F has a 12-ton higher payload and a 88,000lbs higher maximum take-off weight (see table, page 59). The main difference is that it allows the A330-200F to operate with a higher packing density. The A330-200F is therefore at a disadvantage to the 767-300ERF in some respects. The A330-200's higher packing density and higher specification weights are not required by express package carriers and integrators.

What may be required is a type larger than the A330-200F to provide more volume. The A330-300F/P2F provides the largest amount of containerised ULD volume at 19,000 cu ft, the highest of all modern types (see table, page 59). The A330-300F's net structural payload allows for a maximum packing density of 6.6lbs per cu ft, which is close to that of express packages. The -300F also has the same specification weights as the -200F, but the -300F has about 2,000 cu ft more volume.

There are a large number of passenger-configured A330-200s and -300s available in the global fleet as possible conversion candidates. The fleets can be divided by engine type. There are 150 CF6-80E1-, 86 PW4000-110-, and 288 Trent 700-powered A330-200s in service in passenger configuration. Main fleets are operated by Aer Lingus, Air Europa, Air France, Alitalia, Iberia, KLM, Qantas Turkish Airlines, Brussels

Airlines, China Southern, Delta Airlines, Korean Air and Malaysian.

There are also 122 CF6-80E1-, 69 PW4000-110-, and 253 Trent 700-powered A330-300s in passenger configuration still in operation. These 968 aircraft are all potential freighter conversion candidates.

The A330 conversion market has been slow in recent years. This may be explained by a plentiful supply of 767-300ERs for conversion and the continued production of the factory freighter.

"It is not clear how much longer production will continue, but once it stops and the better passenger aircraft have been converted then we expect the rate of A330 conversions to increase," says Wolfgang Schmid, vice president sales & marketing for Airbus Conversions, at EFW. "There are no other conversion candidates in this size bracket, and we expect a good market over the next 10 years at least. Demand will be higher for the A330-300 because of its volume, which will appeal to express carriers. DHL has already got some, and I others will follow.

"The problem with the A330 is that the majority of feedstock is still expensive, and the only aircraft available are five- to 10 year-old aircraft that have come off lease. These are clearly too young," continues Schmid. "The oldest A330-300s are now 24 years old, so there should be more on the market. Airlines, such as American, are keeping the aircraft in service for longer than expected, and these particular aircraft will probably be too old to convert when they do come available. The optimum age is probably 15-20 years. Some aircraft that need a lot of structural work may be available for conversion at a younger age."

With a probable exhaustion of good quality 767-300ER conversion candidates, alternative types with similar freight volumes are required. The A330-300 is a prime candidate, and there are more than 440 passenger-configured aircraft available.

There is no shortage of potential conversion candidates, and EFW has plans to increase its A330 conversions to 18 aircraft per year by 2020/21 between its Dresden and Singapore facilities.

Overall aircraft feedstock

There are therefore large numbers of A321-200s, 757-200s, 767-300ERs and A330-200s/-300s that could be converted to satisfy part of the requirement for 1,350 new freighters in this sector over the next 20 years. The total number converted from these three main fleets is likely to reach about 600, and could even reach as many as 800 or 900. Other types will still be required to fill remaining demand. This raises the issue of other possible aircraft types. Only a small number of 757-300s and 767-400ERs were built, so passenger-to-freighter conversion programmes are unlikely to materialise for them.

The next aircraft type of the right size and payload capacity is the 787. The oldest aircraft is seven years old, so it will be more than 12 years before a conversion programme is developed and the first aircraft undergoes modification. The 787 has been developed for ultra-long-range missions, however, so it will be heavier than the 767-300ER, while the 787-8 will have similar volumetric capacity. This high weight may diminish the 787's appeal to freight airlines. The 787-9 may be more attractive because of its longer fuselage and therefore higher containerised volume.

Even with almost 800 787s in operation, a portion of the fleet being converted will still not satisfy all demand over the next 20 years. This is even when numbers provided by the 757-200, 767-300ER and A330 are considered.

This raises the issue of what other possible types could be included. The factory-built A330-200F will provide some aircraft, but other new-built freighters may have to come into production.

Airbus is rumoured to be considering a dedicated factory-built freighter variant of the A330. This will be about the same size as the -300 series, but will be optimised in terms of weights, and weight and balance. [AC](#)

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