The Covid-19 pandemic has made more freighter conversion feedstock available at low market values and stimulating market demand for freighters. Almost 200 aircraft have been converted to freighter so far in 2020. The activity in each modification programme is examined here.

# The increased appetite for freighter conversions

hile utilisation of the passenger fleet has had its largest ever slump during the course of the Covid-19 pandemic, the freight sector and freighter fleet have enjoyed their largest ever annual increases in utilisation. The drop in passenger aircraft belly space that followed the cessation of passenger aircraft services, and the increase in online shopping and e-Commerce have all fuelled a rise in freighter utilisation, and an increase in the demand for freighters.

This increase in demand has led to a spike in the conversion of passenger-configured types to freighter since March 2020, with many freight conversion supplemental type certificate (STC) holders and conversion providers winning a record number of orders.

This increased demand for freighters is helped by the large number of aircraft that have been parked and stored since March 2020. While many passenger aircraft have already returned to active service, albeit at low rates of utilisation, large numbers of each aircraft type remain in storage. These include the oldest types, but also some aircraft with a relatively poor maintenance status, and aircraft prematurely returned to lessors.

Overall there is an unusually large number of each aircraft type in storage, and an oversupply that provides many candidates for conversion to freighter. Have these factors have increased the number of aircraft being converted to freighter, and by how much?

# Freighter fleet

The net fleet growth for all narrowbody types was 7.6% in the 10 months from the start of 2020 and the

end of October. More aircraft are due to be added to the fleet during November and December.

#### **Narrowbodies**

The narrowbody freighter fleet had a net increase in active aircraft of 10.9% in the 10 months to October 2020, while the widebody freighter fleet grew by 5.6% (see tables, pages 6 & 13).

The narrowbody fleet comprises a large number of types, starting with the smallest BAE 146/Avro RJ, and up to the 757-200. There are no longer any active 707s or DC-8s.

Of the 775 active narrowbodies at the end of October 2020, the main types include the 737 Classics (320 aircraft), and 757-200 (318). There are also the DC-9 and MD-80 (40), 727-100F/-200F (36) and 737NG (49) (see table, page 6).

The narrowbody freighter fleet has seen a net growth of 76 aircraft in the 10 months to the end of October 2020.

"There has been a clear increase in freighter conversion activity this year," says Bob Convey, senior vice president of sales and marketing at Aeronautical Engineers Inc (AEI). "We had a backlog of six narrowbody conversions in January and February 2020. Now we have 13 aircraft in work, and a contracted backlog for another 35 conversions. We are using five facilities that provide a total of 10 conversion lines, and this is going to be increased to 15.

"There are other factors that clearly show the increase in freighter conversion activity. It is expected that this will continue for at least a few more years," adds Convey. "Ancra is tooling up to manufacture 150 cargo loading systems (CLS), to be installed in freighter aircraft,

during 2021. Other CLS manufacturers AAR and Telair are increasing their production rates as well.

"The factors that have driven this increase are: demand from freight carriers, which have seen growth in freight volumes; several new entrant carriers and lessors with aircraft to convert; and a change in all-passenger airlines that have added freighter operations," adds Convey. "Airlines that have added separate freight divisions include Sun Country; and Mesa Airlines, which operates two 737-400Fs and is also looking at our CRJ-200 freighter conversion."

Indications that there is increased confidence in the P-to-F market is that UK-based Caerdav is looking to perform modification work in the short-term, but is also considering developing its own STCs in the future. "We are interested in providing 737-800 conversions, and are talking to the various STC holders," says Richard Pitts-Robinson, head of commercial at Caerdav. "For the long-term we are looking at various airframe types, including the possibility of smaller types, such as the CRJ-700/-900."

The 737 Classic has had the biggest net increase in active aircraft of 35. There were 22 737-300s and 26 -400s added to the fleet during the year, and a further six 737-200s were placed into active service, after being in storage. The net increase in active -200Fs, -300Fs, and -400Fs takes into consideration aircraft that have been parked or retired. \_

The 737NG and 757-200F have each had a net increase in active aircraft of 16 units during 2020. Conversion of the first 737-700s was in 2017, with the first aircraft modified by Israel Aircraft Industries (IAI). The first -800s were

NARROWBO	DY FREIG	HT FLEET	DEVELOP	MENT JAI	NUARY-O	CTOBER 2	020
	Active	Added		Written	Stored/	Net fleet	Active
Aircraft	fleet	to fleet	Retired	off	parked	growth	fleet
type e	end 2019	2020	2020	2020	2020	2020	Oct 2020
BAE 146/Avro R	<sup>2</sup> J 7	5			1	4	11
DC-9	13	11			3	8	21
MD-8o	17	3			1	2	19
727-100F	2					0	2
727-200F	34	2			2	0	34
/2/-2001	34	2			2	U	34
737-200 Combi	6	3				3	9
737-200F	14	1				1	15
737-200QC	5	2		1	2	-1	4
737-300 Combi	2					0	2
737-300F	110	12	1		5	6	116
737-300QC	6	10	1		1	8	14
737-400 Combi		1				1	7
737-400F	136	25			8	17	153
737-700F	6	1				1	7
737-7001 737-700QC	5	1				0	7 5
/3/°/00QC	)					O	5
737-800F	22	17			2	15	37
737		-/				-9	<i>)</i> ,
A321-200F	0	1				1	1
757-200F - PW	96	3			2	1	97
757200F - RR	207	10			1	9	216
757-200M - PW						0	1
757-200M - RR	4	2			2	0	4
TOTAL	699	109	2	1	30	76	775

converted by Boeing in 2018.

A further 15 757-200s were added to the active fleet from January to October 2020, although five were parked and stored over the same period.

There has also been an increase in the number of DC-9 and MD-80 freighters. While relatively few DC-9 freighters were built or converted, 11 aircraft were added to the active fleet from January to October 2020. The MD-80 is only available as a converted freighter, and the fleet of 17 at the end of 2019 had been joined by three more aircraft by the end of October 2020.

#### Widebodies

The active widebody freighter fleet had a net increase in active aircraft of 61 in the 10 months to October 2020 to 1,157 aircraft. The two dominant types are the 767 family (357) and the 747 (505). There are four other main types, with the A300/A310 (180) and 777-200LRF (189) as the two next largest fleets. There were also 21 DC-10Fs and

105 MD-11Fs at the end of October 2020 (see table, page 13).

The largest increases in active fleets from January to October 2020 were the 767 family (35) and 747 (25). Most of the increase in active 747 freighters was via the reactivation of stored aircraft.

The 777-200LRF fleet also increased by 10 units through deliveries of new aircraft. The active A300/310 fleet grew via the reactivation of four stored aircraft.

The DC-10 and MD-11 fleets all saw a net reduction in active fleets, although some aircraft were also reactivated from storage and put back into active service.

# Fleet development

An examination of the fleet development of each main type provides insight into how many aircraft have been added during the first 10 months of 2020. Further examination of each fleet reveals how many aircraft have been converted by each conversion STC holder.

Passenger-to-freighter (P-to-F)

conversions of several older types are no longer available, although large numbers have been in operation over an extended period. Some have also been in storage. The increase in demand for capacity, and therefore freighter aircraft, has seen the reactivation from storage of several aircraft for each of these fleets. This was therefore a net increase in the number of active aircraft from the end of 2019 to the end of October 2020.

Narrowbodies that can no longer be modified to freighter include the BAE 146 and Avro RJ, the DC-9 and 727-100.

Widebodies that can no longer be converted include the A300/310, DC-10, MD-11 and 747 Classics.

In the case of the older narrowbodies, five BAE 146/Avro RJs were reactivated from storage from March to August 2020. These were put into service with small freight carriers, most of which had not previously operated the type.

The DC-9 freighter fleet experienced a net increase of eight aircraft in the 10 months to October 2020. A total of 11 stored aircraft were reactivated from storage and put back into active service with USA Jet Airlines, and Aeronaves TSM of Mexico. Three aircraft were parked by Aeronaves and Everts Air Alaska, which have both increased their fleets of MD-80Fs.

There were no additions to the 727-100F/-200F fleet.

The 737-200 fleet is split between pure freighters, and Combis and Quick Change (QC) variants. Four aircraft, three Combis and one freighter were reactivated from storage, and went into operation with Canadian airlines Nolinor and Canadian North. Three QC aircraft were also withdrawn from active service.

The aircraft types that have active P-to-F programmes are the MD-80, 727, 737-200, 737-300/-400, 737-700 and -800, A321 and 757-200. AEI still offers conversions for the 727 and 737-200, although Convey says it is unlikely that any more will be modified.

A P-to-F modification is also under development for the A320, and AEI may develop an STC for the 737-900.

# 737-300/-400

The 737-300F and -400F, often referred to as 'Classics', have the largest number of aircraft in active service with 320 at the end of October 2020 (see table, this page). This is a net increase of 35 aircraft from an active fleet of 285 at the end of 2019.

The fleet of 320 Classics is split between 28 active 737-200s, 132 active 737-300s, and 160 active -400Fs.

The 737-300 fleet of 132 is divided between pure freighters, Combis and QCs. Of the 132 active aircraft, 116 are pure freighters.



There is still a lot of appetite in the market for 737-300 and -400 passenger to freighter conversions. There is an adequate supply of 737 Classic feedstock, and their market values are low, making total cost of producing a freighter attractive for lessors and operators. 48 737 Classic freighters entered the fleet in the January-October 2020 period.

In the 10 months to October 2020, 12 aircraft were added to the fleet in Europe and the Asia Pacific, but six aircraft were taken out of it, making a net increase of six active aircraft.

The QC fleet comprised 14 units in October 2020, up from six at the end of 2019, after 10 new aircraft entered the fleet, and two aircraft were retired. The 10 new additions went into service from March to May, so they were already undergoing conversion before the start of Covid-19.

The Combi fleet was unchanged at two aircraft.

The 160 737-400s are dominated by pure freighters, with 153 aircraft; and a fleet of seven Combis.

The 737-400 pure freighter fleet has seen the largest number of new additions of any aircraft type or series in the first 10 months of 2020. There were 25 new aircraft added to the fleet, from conversions of passenger aircraft, during the year. Eight aircraft were placed into storage, making a net increase of 17 during the year.

The 25 new aircraft were added to the fleet in Europe (14), North America (5), the Asia Pacific (4) and Latin America (2).

There were therefore 48 737-300 and -400 freighters, QCs and Combis added to the fleet up to October 2020 (see table, page 6).

There were three main providers of Pto-F conversions for the 737-300 and -400, but this has been reduced to two, after IAI ceased modifications to concentrate on the 737-800. The two remaining providers of conversions are Aeronautical Engineers Inc (AEI) and

Pemco. Both have experienced a surge in 737-300 and -400 conversions during 2020.

Interest in converting 737-300s and -400s declined during 2018 as the first 737 MAXs were delivered to passenger carriers, which resulted in an increased number of 737NGs, in particular -800s, becoming available for conversion and being modified. The oldest 737-300s and -400s were 21 years old at this stage, and most aircraft are more than 25 years old.

The market values of 737-300s and -400s therefore dropped to all-time lows in 2018 (See The second coming of 737 Classic freighter conversions, Aircraft Commerce, February/March 2020, page 57). Despite this, interest in the 737-800 for freighter modification increased. Aircraft converted during 2018 were the first to be modified. Most converted in 2018 and 2019 are owned by GECAS, and were aircraft returned from lease. The -800 has a long fuselage and the ability to carry 11 standard main-deck AAY containers, compared to nine or 10 AAY containers carried by the -400, depending on the conversion programme. The -800 also has the advantage of being

The rate of -300 and -400 conversions therefore started to decline in 2018, while the number of -700s being modified started to increase.

The grounding of the 737 MAX family in early 2019 influenced the values of passenger-configured NGs. Passenger carriers delayed their fleet plans and 737NG retirements, and there was increased competition from passenger airlines for aircraft.

There was an increase in the market

values for 737-700s and -800s. Freight carriers therefore turned back to the -300 and -400 for a source of conversion feedstock during 2019. While more -700s and -800s were converted in 2019 than in 2018 as new conversion programmes got under way, the number of 737 Classics modified during 2019 was similar to 2018, when demand was expected to decline.

"The demand for converting -300s and -400s is still there, and we are still modifying them," says Mike Andrews, director of cargo conversions at Pemco. "The number of orders for 737 Classic conversions was slow at the start of 2020, just before the Covid-19 crisis, and we only had four orders in the pipeline at the time. Demand had actually flattened out by this point, but then freight demand increased and orders for modifications followed.

"We have completed six 737 Classic modifications so far this year on two -300s and four -400s," continues Andrews. "We have modified about 140 737-300s, since we started 737-300 freighter and QC modifications in the 1990s." A total of 170 737-300 freighter, QC and Combi variants has been factory-built or converted to date.

Convey agrees that the 737 Classic conversion market is still active. "We have two -300s in conversion, as well as several aircraft being converted for Vx Capital and Kelowna Flightcraft. Aeronaves TSM of Mexico is also a customer," he says.

"The feedstock of the -300 and -400 fleet is still of the same quality, and a large number of suitable candidates is left," says Andrews. "These are available at very attractive rates and prices because of the Covid-19 situation. Demand for -300 and -400 conversions will probably drop off in a couple of years, mainly because all the better quality conversion candidates will have been used."

Convey adds that are about 50 737-400s of the right maintenance condition and quality left. "There are more suitable candidates coming available. One important consideration is the number of flight cycles (FC) an aircraft has accumulated," says Convey. "I estimate that we could convert about six 737 Classics per year for another two or three

years. Other remaining passenger aircraft will get parted out, especially for engines."

The market value of conversion feedstock is at an all-time low. "737-300s in an 'average' maintenance condition can be acquired for about \$2 million, while -400s have market values of \$2.5-3.0 million," says Convey. "These values are mainly related to the engine, with the airframe being worth only a few hundred thousand dollars. The values have declined from \$4-5 million about a year ago."

Andrews comments that there are still some aircraft going back into service. "This is because of their low lease rates and low rates of utilisation of passenger airlines now," says Andrews. "This is especially the case in Europe and South America. The low values are the main reason for the large number of conversions during 2019 and 2020. It is likely that the 737 Classic conversion market will continue for at least two years. While values can be \$2.0-3.0 million, they will be up to \$4.5-5.0 million for aircraft with both engines that have a lot of green time maintenance life remaining. The target value for an 'average' conversion candidate is about \$3.0 million."

#### MD-8o

The MD-80 P-to-F programme was launched by AEI Inc in 2009. The aircraft has experienced less demand than 737s and 757s on account of the MD-80's smaller and narrower fuselage cross-section, and inability to interline freight containers with the older 727 and DC-8 freighters.

Despite this, the MD-80 has a durable airframe and its JT8D-200 engines have lower maintenance costs than the CFM56-3s and -7Bs powering the 737 Classics and 737NGs.

The number of MD-80s converted each year has varied from just a single aircraft to five in 2018. The aircraft's main customers are Aeronaves TSM in Mexico, Everts Air Alaska and USA Jet in Michigan. Aeronaves TSM, Everts Air and USA Jet also operates the DC-9 freighter.

"The MD-80 has also benefited from the increase in market demand," says Convey. "While we usually convert two to five per year, we have already converted three aircraft this year and have another two in work. We also have more conversion orders to fulfil. The MD-80 conversion takes place at the Commercial Jet Services facility in Dothan Alabama facility. We also have further orders for up to 20 MD-80s in the future.

"Delta Airlines is retiring and selling almost 100 MD-88s, and large numbers

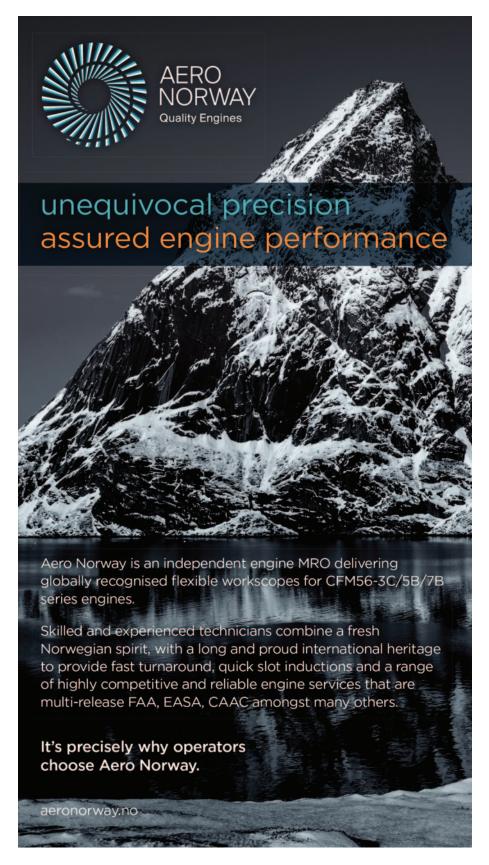
are being acquired. About one-third of these could get converted to freighter. I expect that we will convert about six MD-80s per year for the next two to four years," continues Convey. "There are different groups looking at buying these aircraft, while the rest are likely to get parted out. A complete aircraft can be acquired for less than \$1 million, and JT8D-200 engines with maintenance life can now be acquired for \$200,000-300,000 each."

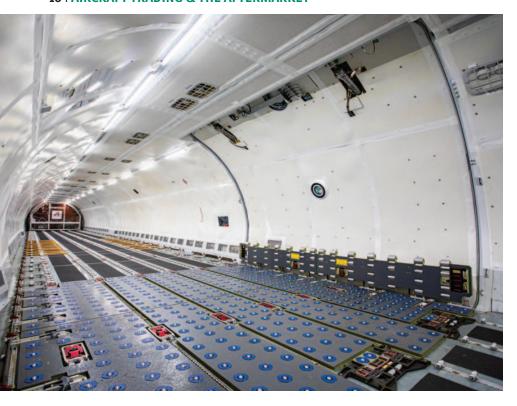
## 737-700/-800

As described, the 737-700 and -800 P-to-F modifications only started in 2017 and 2018.

To date there are seven active -700 freighters, and five QC or Combi aircraft. Four of the QC/Combi aircraft are factory-built, and one was modified by Pemco. There are also two QCs in storage.

There is a total of 42 737-800





The first A321 has been converted to freighter; a A321P2F modified by EFW. There is a large fleet of passenger-configured A321s to consider for modification. The type will provide similar cubic freight capacity to the 757-200.

freighters, of which 37 are in active service, and five are in storage. There has been a surge in 737-800s being modified in 2020, with 17 aircraft up to the end of October, compared to five and 15 aircraft being modified in 2018 and 2019 respectively.

Pemco and IAI are the two main conversion providers for the 737-700. IAI has converted seven 737-700s, designated as -700BDSFs. Pemco provides a conversion for a QC or Combi configuration. "This modification was certified in July, and it provides an aircraft that can switch between a Combi configuration, and a full freighter. We call it a Flex Combi," says Andrews. "As a Combi there is a bulkhead halfway down the passenger cabin. There are two modes. One has 24 seats and six AAYs, and the other 12 seats and seven AAYs. So far we have converted one, which is in operation with Texel Air, while another is in conversion."

The 737-700BDSF has eight main deck positions for AAY unit load devices (ULDs) or pallets plus some smaller containers, the same as the 737-300.

The 737-800 is attracting more interest than the 737-700. The 737-800 can carry 11 main-deck AAY ULDs or pallets, plus a smaller LD-3 ULD. This compares to a capacity for nine or 10 AAYs or pallets on the 737-400. The -800 is therefore expected to attract more interest and to be converted in large numbers over the long-term.

There are three main conversion STC holders for the 737-800: Boeing, IAI and AEI Inc. To date, 37 of the 42 -800s have been modified by Boeing with the -800BCF suffix. IAI converted its first two aircraft in mid-2020, and these have

the -800BDSF suffix. AEI has converted its first four aircraft, which are designated with the -800SF suffix. AEI has 10 conversion lines.

"Of the eight conversion lines operated by IAI, it operates four in China for the 737-800 and will add one in Mexico," says Rafi Matalon, aviation group marketing vice president at IAI. "It takes about three months to convert an aircraft, so one line could complete up to four aircraft per year. This means we will have the capacity to modify 18-20 737-800s per year."

The 737-800s converted so far have mainly been modified by lessor GECAS following returns from passenger airline lessees. This accounts for 31 of the aircraft, of which 29 were modified with the Boeing conversion and two were converted in 2019 with the AEI Inc STC.

The largest number of aircraft converted so far is in operation with Amazon Air, which has 21 in service. There are several small fleets, including ASL Belgium (2), China Postal (3), Ethiopian (2), iAero Airways (2), Spicejet (2), West Atlantic Airways (4) and Allied Air (1).

"The -800 is the only 737NG model we have an STC for, since we believe the market for the -700 will be more specialised," says Convey. "We are looking at the -900/-900ER series as a possible candidate for developing a conversion STC in the future. It is a little too early now, but it takes about three years to develop an STC and convert the prototype.

"We expect the market for 737-800 conversions to be strong for the next 25 years or more," continues Convey. "That means 800-1,000 aircraft could be

converted to replace all the 727s and 737-300/-400s left. This amounts to about 360 aircraft. Then there is the growth in that market segment. It is possible that FedEx and DHL and other smaller integrators will adopt the type.

"The supply of feedstock will not be an issue," continues Convey. "There have been almost 5,000 -800s built so far, and it is possible that up to 1,500 parked -800s will not be returned to passenger service."

Matalon agrees that there is likely to be a big market for 737-800 conversions for the long-term. "The activity is only just getting under way, and most lessors have not yet decided to convert the aircraft," says Matalon. "There is the possibility of a sharp recovery from Covid-19 during 2021, but the lessors are possibly waiting to see what decision to make with respect to their portfolios. Despite the large number of parked aircraft, and actual market values being low, the problem holding a lot of lessors back with respect to converting aircraft is that the book values of aircraft in their portfolios are still high."

This suggests that market values of feedstock will be pushed to, and remain at, lower levels than they were before the Covid-19 pandemic. This will maintain a high supply of green-time engines, which will be the main determinant of used 737-800 values. "Values of the older 737-800s have come down to \$8-12 million in the current market, and need to be at this level to be in the zone of convertibility," says Convey. "Values were \$18-20 million a year ago, if you could find an aircraft, so they have clearly dropped off a cliff."

Convey estimates that the three 737-800 P-to-F STC holders could collectively convert 60-65 aircraft per year going forward.

"Then there is the 737-900, which will accommodate 12 AAY containers on the main deck plus a small device following conversion. This is the same main-deck capacity as the 727-200's, on which the air freight industry was founded," explains Convey. "While there are very few 727Fs left to replace, this is a gap in the market segment that requires an aircraft with the right economics."

The 737-900 will have two fewer main-deck container/pallet positions than the A321F, which has 14; and three fewer than the 757-200PCF, which has 15.



The 757-200 freighter remains popular. While 13 more aircraft entered the freighter fleet between January and October 2020, its is estimated that another 40-50 aircraft of the remaining passenger fleet could be modified.

## A320 & A321

P-to-F conversion STCs are being developed and finalised for the A320 and A321 by EFW of Germany, and for the A321 by Precision Conversions, USA.

The A320 and A321 converted by EFW will be designated the A320P2F and A321P2F, while aircraft modified with the Precisions Conversions STC will be designated the A321PCF.

Following modification to freighter, the A320 accommodates 11 88-inch X 125-inch main-deck positions. These are 10 AAA/AAY ULDs plus one pallet position. At first glance this is the same number as on the 737-400, which can carry 10 AAA/AAY ULDs plus one AEP/AEH half-size position. While the 737-400 has a total freight volume of up to 5,795 cubic feet (cu ft), the A320P2F has a total volume of 5,762 cu ft.

Both the EFW and Precision Conversions A321 modification will carry 14 88-inch X 125-inch ULD or pallet positions; one fewer than the 757-200. The difference between EFW's P2F and Precision's PCF is that Precision's solution can accommodate 13 AAA/AAY ULDs plus one rotated PAG position; whereas EFW's solution can carry 14 AAA/AAY ULDs or pallets.

Unlike Boeing narrowbodies, the A320 and A321 can also carry containerised freight in their belly holds in LD-3-45W (AKH) ULDs. The A321P2F and PCF will both have total containerised volumes of 7,610 cu ft. This compares to 8,360 cu ft on the 757-200PCF, of which 1,790 cu ft is the bulk volume of the lower deck.

There has so far been more interest in

the A321 than in the A320. First, the A321's larger capacity gives it an economic advantage. Second, there is still a large number of 737-400 conversion candidates available at low market rates. There is also the issue that a large number of 737-800s has been converted, with 11 container positions plus one AEP/AEH half-size position; this gives them a slightly larger freight capacity than the A320 on the main deck. Moreover, the three 737-800 P-to-F programmes are now fully certified, while the A320 P-to-F STC is still awaiting its prototype conversion by EFW.

One main factor in the level of interest in the A321 is that the supply of suitable 757-200 conversion feedstock is diminishing, and could be fully used up in three to four years.

To date, there are no A320P2Fs, A321P2Fs or A321PCFs in operation. The first A321PCF had its first flight following modification in October 2020 and the first A321P2F was recently released to service by EFW, and is awaiting its first commercial flight. A third A321 freighter will follow soon after.

So far, EFW has gained firm orders for 20 A321 conversions. This includes orders from Vallair. EFW has a general terms agreement with lessor BBAM for several A321 conversions, and has secured an order for the first two conversions. The first aircraft will be delivered in November 2020.

EFW also has orders from Keystone Holdings and Qantas for A321P2Fs, and these will be delivered from the end of 2021. EFW is also in advanced discussions for other orders. Orders for A321P2Fs have been announced by Titan Airways, SmartLynx of Malta and GlobalX. Miami-based GlobalX has signed a Letter of Intent with lessor Vallair to lease 10 A321Fs, with deliveries to the airline starting in the third quarter of 2021. Vallair has orders for A321 conversions with both EFW and Precision Conversions. Aircraft operated by SmartLynx will comprise several A321P2Fs and one A321PCF.

"The first A321 converted by EFW has already been delivered to Qantas, and the first Precision Conversions' aircraft will go to SmartLynx in the first quarter of 2021," says Gregoire Lebigot, chief executive officer at Vallair. "We have several A321 freighter orders. These are a single trial aircraft for Qantas, two aircraft for SmartLynx, and 10 aircraft for GlobalX."

"The number of A321P2F orders is gaining more momentum," says Thomas Centner, director of sales at EFW.

The A321-100s were the first aircraft to be built from 1993. Production continued until 2001, with fewer than 80 passenger aircraft built. The A321-200 has several higher specification gross weight variants and a larger fuel capacity and therefore longer range than the A321-100. The A321-200 will therefore be the more favourable A321 conversion candidate. To date, almost 1,700 have been built.

"As a result of the current crisis more and more A321-200s are becoming available for conversion," says Centner. "Although we believe that the Covid-19 recovery in the passenger market will favour smaller-capacity aircraft, such as 737-800s, 737 MAXs and A320/21s, to perform regional routes, rather than widebodies, there will still be a satisfactory supply of A321-200 feedstock."

In the meantime, Precision
Conversions is reporting a strong interest in its A321PCF programme. "We already have a queue of companies to discuss possible orders, and have never seen such a level of interest in a new P-to-F conversion programme. Covid-19 has triggered a lot of interest from lessors, as well as freight carriers and combination airlines," says Brian McCarthy, vice president of marketing & sales at Precision Conversions. "We are planning to convert three or four aircraft in 2021 from our first line in the US. We then

expect to open a second production line in Europe or China soon after. We could eventually see four conversion lines, and so an annual production rate of 16-20 aircraft."

With respect to demand, there was an annual rate of growth in air freight of 4% before the onset of Covid-19. The pandemic has stimulated eCommerce, and therefore demand for air freight and cargo aircraft. "There is also the issue of the belly freight being provided by passenger aircraft not being as reliable as dedicated freighter services," adds Centner. "There will also be the grounded 737 MAX returning to service in late 2020 and early 2021.

"We expect to convert up to 23 aircraft per year, but we have to take into account the fact that the market changes from low to high demand and vice-versa in a short period of time," continues Centner. "We estimate that the total narrowbody conversion capacity for all types is 60-70 aircraft per year. We have four sites. These are our own EFW facility in Dresden, at our subcontractor ST Aerospace in Singapore, one in Guangzhou, China, and the fourth in Mobile, Alabama."

#### 757-200

The 757-200 freighter fleet is the second largest narrowbody fleet in operation. There were 313 freighters in active service at the end of October 2020, split between 78 factory-built 757PFs, and 235 converted aircraft. There are also another five Combis in service. Another 14 freighters are parked.

There were three P-to-F programmes for the 757-200, offered by Boeing, Alcoa-SIE and Precision Conversions. The Precision Conversions STC accounts for almost half of the converted 757-200s. There were 126 converted by the end of October 2020, and designated the 757-200PCF. There were several more in work. Precision delivered 10 converted aircraft from January to October 2020.

The 757-200PCF provides an aircraft in a class of its own, by providing 15 main-deck AAA/AAY ULD positions plus 1,790 cu ft of bulk belly capacity. This provides the aircraft with 8,390 cu ft of total freight volume.

This capacity puts it ahead of most narrowbodies, while providing a lighter aircraft than the smallest widebody freighters.

The Boeing 757-200 conversion accounts for the largest portion of converted freighters, with more than 150 modified so far. These are designated the 757-200SF. Most of these have been modified for FedEx and DHL. Boeing delivered four converted aircraft in the first 10 months of 2020. This variant also accommodates 15 full AAA/AAY ULDs

WIDEBODY FREIGHT FLEET DEVELOPMENT JANUARY-OCTOBER 2020

	Active	Added		Written	Stored/	Net fleet	Active
Aircraft	fleet	to fleet	Retired	off	parked	growth	fleet
type	end 2019	2020	2020	2020	2020	2020	Oct 2020
767-200F	53	7			1	6	59
767-300ERF	166	16				16	182
767-300ER SF	103	13				13	116
A300B2/4F	9				1	-1	8
A300-600F	160	11	2		1	8	168
A310-200/-300	oF 7		3			-3	4
DC-10-10F	13	1	1		6	-6	7
DC-10-30F	14	1	1				14
MD-11F	111	4	3		7	-6	105
							.0-
777-200LRF	179	13		1	2	10	189
747-200F	10	2	1		2	-1	0
747-2001	10	2	1		2	-1	9
747-400F	148	13			4	9	157
747-400BCF/E		16			7	16	-57 46
747-400M	3	3	3			0	3
747 400	,	,	,				,
747-8F	90	2			2		90
TOTAL	1,093	102	14	1	26	61	1,157
	, , , , ,		,				, 5,

on its main deck.

The 757-200 continues to be a popular candidate for conversions. "About 126 aircraft have been converted so far under our programme," says McCarthy. "We have several orders outstanding, including two for SF Airlines in China, three ex-Icelandair aircraft, and about 19 ex-American Airlines aircraft out of a batch that AerSale bought earlier this year. There are also another three. We therefore have at least 24 more to convert."

This still leaves up to another 325 757-200s in the active, parked and stored passenger fleet. "I can envisage another 30-40 good quality aircraft being converted to freighter before conversions stop," says McCarthy. "The first batch to examine is Delta's fleet. The airline does not appear to be in the mood to retire these, but it always generally retires its fleets at a late age anyway. I would expect most, or even all, of the remaining Icelandair fleet to get converted, while the ex-Continental aircraft operated by United are young and high-specification examples, which makes them attractive candidates. There are up to 200 aircraft left to consider, and there could be some good candidates. A lot depends on having an adequate supply of engines, which will be needed to support the fleet of freighters."

There is also the possibility that Precision Conversions is considering a P-to-F programme for the 757-300.

McCarthy confirms this would accommodate 18 main-deck AAA/AAY ULDs and have a gross payload in the range of 90,000lbs. While only 57 aircraft were built, McCarthy says that just 15 aircraft could justify developing a conversion programme.

# 767-200 & -300 series

The 767-200 and -300 series have proved to be popular as freighters. The 767 is one of three main types that has an active P-to-F programme. Of the almost 1,200 civil versions of the 767 family built, 233 are -200 series aircraft, and to date 814 -300 series aircraft have been manufactured. There were also 38 -400 series aircraft built, but there is no factory-built freighter variant or a P-to-F conversion for a 767-400 series.

There were 357 767 family freighters in service at the end of October 2020; the largest number provided by a single family type. This included 59 767-200 series aircraft, and 298 -300 series freighters.

To date, 64 767-200s and -200ERs have been converted to freighter. Of these, 59 are in active service, three are either retired or written off, and two have been in storage for under a year. No more 767-200/-200ERs are being converted to freighter. There were, however, seven 767-200BDSFs put back into active service during the year from storage.



Almost 30 767-300ER freighters entered the passenger fleet in the first 10 months of 2020. There is a large number of parked and stored passenger aircraft providing an ample supply of conversion feedstock. There are a large number of conversion lines in operation, and it is possible that another 100-150 aircraft could be converted.

The 298 767-300 series freighters in active service at the end of October 2020 were all the -300ER variant. These were split between 116 converted freighters, and 182 factory-built -300ERF freighters.

In the 10 months to October 2020, 29 767-300ERs entered service as converted freighters: 16 -300ERFs and 13 converted aircraft. There were 15 and 10 767-300ERs converted to freighter, entering service in 2018 and 2019 respectively.

No 767-300ER freighters were retired or put into storage. Only one 767-200F was put into storage, so the 767 freighter fleet increased by 35 aircraft from January to October 2020.

There are two conversion programmes for the 767, provided by Boeing and IAI. The IAI conversion has taken the largest market share, with 77 aircraft modified to date, and 39 modified with the Boeing programme. The 13 aircraft modified in the first 10 months of 2002 were split between three for the -300ERBCF and 10 for the -300ERBDSF.

"We had already filled about 80% of our 767 conversion slots for 2020 before the start of the Covid-19 crisis," says Matalon. "We have eight conversion lines just for the 767, and will increase these to nine in 2021 to meet rising demand.

"Each conversion line can convert about three aircraft annually, so we have the capacity to modify up to 24 aircraft each year in the case of the 767," continues Matalon. "The 767-300ER is very popular as a freighter because of its performance. We expect demand to continue at the same level up to 2023, after which the availability of suitable conversion feedstock will decline."

There are 359 passenger-configured 767-300ERs left in active service and in

storage. Aircraft in operation total 178 units, while there are another 181 in storage. Of those in operation, 145 have been re-entered into active service during 2020. Meanwhile, of the 181 aircraft in storage, 163 entered storage during 2020. Out of these 359 aircraft, 213 are equipped with CF6-80C2 engines, and 139 are powered by the PW4000-94.

The annual rate of all 767-300ER conversions could be 25-30 aircraft per year, although historically rates have not been this high. It is probable that 100-150 of these aircraft could be converted. The modification of 767-300ERs could therefore continue for another 10 years.

# A330-200/-300

The conversion of A330-200s and -300s will be influenced three factors: the retirement of older freighters, such as 767-200s, A300-600s, DC-10s and MD-11s; the continued growth of freight traffic volumes; and a diminishing supply of suitable 767-300ER feedstock.

To date, there are 57 A330-200Fs, and 16 A330-300Fs, most of which are factory-built freighters. The others are aircraft converted to freighter with the EFW P-to-F modification. Converted aircraft have the P2F suffix. There are just three A330-200P2Fs and five A330-300P2Fs in active service.

There is a large A330-200 and -300 passenger-configured fleet from which to source conversion feedstock.

The A330-200P2F and -300P2F are both larger than the 767-300ER. All three types are capable of carrying ULDs on both their main and lower decks. The total containerised volume of the 767-300ERBDSF is 15,574 cubic feet, while the A330-200P2F's total ULD

volume is marginally higher at 15,984 cubic feet. The A330-300P2F's cubic capacity is 19,020 cubic feet.

The A330-200 therefore serves as a direct alternative to the 767-300ER. The A330-200, however, has a gross weight that is 88,000lbs heavier. The A330-300 is limited by the fact that its gross structural payload is relatively low compared to its total ULD volume, so it has a maximum packing density of 6.6lbs per cubic foot. This is likely to favour the A330-300P2F as an express package, integrator and eCommerce freighter.

Another consideration is how the A330-300P2F compares to the factory-built 777-200LRF. The 777-200LRF is a larger aircraft, with a total containerised volume of 22,371 cubic feet, and a gross weight that is nearly 257,000lbs higher than the A330-300P2F's. In addition, the 777-200LRF has ultra-long-range performance.

"We expect the A330 conversion market to follow the 767 modifications," says Centner. "The A330-300P2F will be competitive in operating costs against the 777-200LRF, which will be the only close competitor when the last MD-11Fs have retired. The MD-11F has a total containerised capacity of 20,378 cu ft, just 7.1%. Another main benefit of the A330-300P2F is that there is a large number of passenger A330-300s in service and parked. The age of the fleet ranges from 27 years to brand new. With a large number of aircraft now parked, younger A330-300s are becoming available. These are higher-weight variants with longer-range performance.

"In addition to the usual markets of integrators and general freighter carriers, Covid-19 may lead major passenger airlines to re-establish freight divisions," continues Centner. "It is too early to say what kind of post-Covid-19 passenger traffic recovery the industry will experience, or what levels the traffic will go back to. The values of parked and stored A330s have therefore dropped faster than narrowbodies.

"There will be a large spread between the age, specification, and maintenance condition of parked and stored A330s," adds Centner. "So the best conversion candidates will get cherry-picked."

EFW has the capacity at its two

conversion lines in Dresden and at ST Aerospace in Singapore. "We have already filled the available slots in 2021, and will increase conversion capacity for 2022 as part of our industrial ramp-up plan," adds Centner.

With the continued popularity of 767-300ER freighters, IAI expects the conversion market to dry up by 2024. In anticipation of this, IAI is planning to develop a P-to-F STC for the A330-300. This will be the first freighter conversion STC that IAI has developed for an Airbus aircraft.

# 747 family

The variants of the 747 family comprise the second largest group of widebody freighters in service, with 305 active aircraft in October 2020 (see table, page 13).

There are three main variants in the 747 freighter fleet: the -200, -400 and -8. The -200 fleet comprised only nine aircraft in October 2020, one fewer than at the end of 2019.

The -400 fleet is a mix of 157 factory-built -400Fs, 46 converted freighters, and three Combis. This was nine more than December 2019, with 32 aircraft being reactivated from storage, and four being put into storage.

The fleet of 46 active -400 converted

freighters comprises 24 aircraft converted with the Boeing modifications, designated as -400BCFs, and 22 converted with the IAI STC, designated as -400BDSFs. The last 747-400s were converted by IAI in 2018.

There are three -400Ms, in Combi configuration in active service with KLM, but these will be retired. Other Combis that were built have now been retired.

The active fleet of factory-built 747-8Fs, the largest type in service, comprises 90 aircraft, including two aircraft delivered new during 2020. Two Saudia aircraft have been in storage since January 2020.

In addition to the 90 aircraft in service, there were 14 aircraft on order for UPS and Air Bridge Cargo.

With few 747-8Fs left on order, there are few or no more opportunities to acquire 747 freighters. IAI is now, however, preparing to re-start 747-400 freighter conversions in 2021. "There has been renewed interest in converting both Combi and passenger-configured aircraft," says Matalon. "We believe we will convert at least two aircraft in 2021, and possibly more will follow. A small number of Combis are still in service, and these would be less expensive to convert because they already have the rear cargo door. There is also a large number of 747-400s in active service and recently

put into storage, so there is an adequate supply of feedstock to keep conversions active for a few years if there is demand. It takes about five months to convert a 747 to freighter."

## Summary

More than 210 narrowbody and widebody freighters were added to the active fleet between January and October 2020. A net fleet growth of 137 aircraft was recorded over the same period.

Clearly aircraft entering the fleet have partially replaced older aircraft, but the net rate of additions equals an annual fleet growth of almost 9%.

The Covid-19 pandemic has clearly provided a large number of conversion candidates than what is usually available. It has also stimulated demand for freighter capacity.

There are several other factors that will affect the longer term demand for freight aircraft. These include the rate of recovery from the Covid-19 pandemic, how the purchasing habits of people are changed, and the strength of various economies around the world.

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