

New turboprop P-to-F conversion programmes and a newbuild freighter have been launched over the past few years. The main turboprop freighter options are summarised here. Payload-range specifications and potential feedstock levels are considered.

# The market for turboprop freighters and conversions

There have been a number of developments in the turboprop freighter market over the past few years. These include changes and additions to the available passenger-to-freighter (P-to-F) conversion programmes, and the launch of a newbuild freighter. The main turboprop freighter options are analysed here including all types with active P-to-F or newbuild programmes.

## Turboprop freighters

Turboprop freighters are often used for carrying mail or express packages on short regional sectors, but might also be used for general freight. Some large integrators use turboprop freighters to link smaller regional communities into their international networks. These turboprops are usually operated by a third party on behalf of the integrator.

This analysis will focus on turboprop freighters with payloads in excess of three tonnes (t), since smaller types tend to serve niche requirements.

Most turboprop freighters with payloads in excess of 3t are converted passenger aircraft. Many of these have been converted to bulk freighter status. A bulk freighter conversion will see the passenger interior replaced by a Class E cargo cabin. It will normally include the addition of some form of interior wall lining, window plugs, a cargo net and maybe some strengthening of the cabin floor. It does not, however, involve the installation of a large cargo door (LCD).

Turboprops that have been modified in this fashion have to be bulk-loaded with packages or small items through the pre-existing passenger entry or cargo doors.

LCD conversions are also available for some turboprops. An LCD freighter is more flexible in terms of its potential loading configurations, and more capable of accommodating containers or pallets.

The following analysis will provide a guide to the basic specifications of the main turboprop freighter candidates and potential conversion list prices where available. Operators should, however, make independent enquiries to determine exact specifications and costs.

The payload and range figures used here are based on specific maximum take-off weight (MTOW) and maximum zero fuel weight (MZFW) assumptions. In some cases, other certified weight options may be available, which could result in different payload and range-performance. Some conversion programmes may offer a basic conversion price with additional options incurring additional fees. The list prices quoted here may not relate precisely to the quoted payload figures.

Current market values (CMVs) have been identified for some turboprops at typical feedstock vintages. Most P-to-F conversions tend to take place when aircraft are 15-20 years old. This is generally the age at which CMVs and remaining utilisation levels combine to make conversions economically viable.

## 3-4 tonne freighters

There are 129 active turboprop freighters in the 3-4t category, which is an increase of 63% since 2001. The most popular in-service variants are the Saab 340A (41), Shorts 360 (39), EMB-120 (31) and Shorts 330 (14).

There are currently no newbuild aircraft available in the 3-4t turboprop freighter market. In the near-term the main 3-4t freighter candidates will be converted Saab 340s and EMB-120s. There are no LCD conversions available for either type, so this segment will be dominated by bulk freighters.

Some aircraft in this category may be operated under FAR Part 135 regulations if they are based in the United States (US). This could result in those aircraft being limited to a cargo payload of 7,500lbs.

## EMB-120

There are two main variants of the Brasilia: the standard version EMB-120RT with an MTOW of 25,529lbs, and the extended range version EMB-120ER with an MTOW of 26,609lbs.

Embraer designed a Service Bulletin (SB) for the Brasilia that allows passenger aircraft to be converted to full-cargo configurations. Aircraft modified under Embraer SB 120-25-0245 are designated EMB-120FCs. Only EMB-120ER variants can be converted to -120FC status. It is however possible to modify any EMB-120RT into -120ER status and then convert it into the freighter configuration.

Any approved Part 145 maintenance facility can modify EMB-120ERs to EMB-120FC status using the Embraer SB.

The EMB-120FC modification involves removing the passenger interior and installing a Class E cargo compartment. This includes a smoke detection system, smoke barrier, vertical cargo nets, horizontal cargo nets, floor finishing, cargo lighting and liners.

A converted EMB-120FC offers a maximum structural payload of 8,150lbs and a cargo volume of 1,190 cubic feet (cu ft) (see table, page 78). It would have a range of up to 305 nautical miles (nm) when operating with a maximum payload, but could operate sectors of up to 836nm with a reduced cargo payload of about 6,600lbs.

Embraer also offers the option of a 'quick change' (QC) modification for the EMB-120ER. This allows aircraft to be converted between passenger and freighter configurations.

Worldwide Aircraft Services (WASI), a regional aircraft maintenance specialist based in the US, also offers full freight conversions for EMB-120s. WASI has considerable experience in performing P-to-F conversions for turboprop airliners, including the Fairchild Metro series, Saab



340, Brasilia and ATR 42 and ATR 72. It developed its own independent supplementary type certificate (STC) for the P-to-F conversion of the Brasilia.

Like the OEM SB, the WASI STC involves replacing the passenger interior of the Brasilia with a Class E cargo cabin and does not include the installation of an LCD. An EMB-120 converted by WASI would offer a cargo volume of 1,185 cu ft. An EMB-120ER converted by WASI would typically offer a maximum structural payload of about 8,500-9,013lbs. WASI also offers conversions for the EMB-120RT variant.

WASI has performed 53 P-to-F conversions of EMB-120s under its STC. The cost for WASI's EMB-120 cargo conversion is \$168,000 plus options.

There are 151 active and stored EMB-120s remaining in passenger service. This includes 51 active and 49 stored EMB-120ERs, and 27 active and 23 stored EMB-120RTs. The age profile of the passenger-configured EMB-120RTs is 23-29 years. This compares to an age profile of 16-29 years for the EMB-120ER fleet, including 32 aircraft that are within the typical conversion age range. The EMB-120ER is the most likely variant to be converted in the future.

According to Oriel, the current market value for a typical 20-year-old EMB-120ER in half-life condition with half-life engines is \$800,000 (see table, page 83). The total cost of acquiring and converting an EMB-120ER using the WASI STC would therefore be about \$968,000, excluding additional conversion options.

### Saab 340

There are two main variants of the Saab 340: the Saab 340A and Saab 340B. There is also a sub-variant, the Saab 340 BPlus. In comparison to the Saab 340A, the Saab 340B has superior payload-range performance due to increased design weights, increased baggage load due to an extended horizontal stabiliser, and reduced cabin noise levels. The Saab 340B also features upgraded CT7 9 engines, which provide it with improved hot and high performance and reduced flight times. In addition to the improvements associated with the standard Saab 340B, the Bplus features an active noise system to further reduce cabin noise, a third generation interior with larger overhead bins, and the provision for wing-tip extensions to improve short, and hot and high airfield performance.

The first Saab 340 freighter conversion took place in 2002. All of the aircraft converted so far have been Saab 340As. Saab designed an OEM SB for the P-to-F conversion of Saab 340As to Class E bulk freighters. "The SB includes all of the parts necessary to perform the modification," explains Jan Andsäter, senior director of product management, modifications & technical support, regional aircraft at Saab. "Any Part 145 organisation with sufficient knowledge and experience of the platform could carry out the modification. Saab could also offer the modification in its own facility in Linköping, Sweden. So far 35 Saab 340As have been converted to

Saab 340 freighters have gross structural payloads of 8,500lbs and 9,100lbs; 3,000-3,500lbs less than an ATR 42-300 freighter.

freighters via the OEM SB," continues Andsäter.

A Saab 340A modified to freighter status using the OEM SB would provide a gross structural payload of 8,500lbs and a cargo volume of 1,270 cu ft (see table, page 78). This is similar to an EMB-120ER freighter. The Saab 340A would have a range of up to 482nm with a maximum payload.

One MRO with Saab 340 conversion experience is WASI, which has modified 20 Saab 340As using the OEM SB. In April 2016 Saab and WASI launched a collaboration to develop a P-to-F conversion for the Saab 340B.

"In conjunction with Saab Aerospace WASI is developing an STC to convert Saab 340B aircraft into an all-cargo configuration," explains Jim McLean, president at WASI. "Currently WASI will be the only holder of the STC for Saab 340B P-to-F conversion that can be sold in a Saab factory kit for global installation by Saab 340B operators."

"The initial Saab 340B conversion will be brought to market via an STC designed by WASI and based on the Saab 340A SB," says Andsäter. "There will be the option to offer Saab 340B conversions via an OEM SB at a later date."

Saab estimates that a Saab 340B freighter will offer a gross structural payload of about 9,100lbs, which is 600lbs more than a converted Saab 340A (see table, page 78). The Saab 340B will offer the same cargo volume as the earlier model, and a range of 500nm when operating with a maximum payload. A converted Saab 340B Plus would offer the same volume and payload as the standard Saab 340B.

The cost of a Saab 340 conversion will vary according to an operator's specific requirements. "The price for modification depends on the package put forward," explains Andsäter. "Options such as a heavy duty floor and roller system may be included or excluded, and this will affect the price."

"The price for a Saab 340A conversion varies according to the options selected by the operator but it starts from \$265,000," says McClean at WASI. This price is for the most basic conversion without any optional extras. No price has yet been set for the Saab 340B conversion, but McClean believes that it will be similar to that for the Saab

## TURBOPROP BULK FREIGHTER SPECIFICATIONS

3-4t Aircraft	EMB-120FC (Embraer SB)	Saab 340A	Saab 340B
MTOW (lbs)	26,433	28,500	29,000
MZFW (lbs)	24,030	25,700	26,500
Max structural payload (lbs)	8,150	8,500	9,100
Cargo Volume (cu ft)	1,190	1,270	1,270
Range with max payload (nm)	305	482	500
5-7t Aircraft	ATR 42-300/320 (IPR STC)	ATR 42-500 (IPR STC)	Fokker50Express
MTOW (lbs)	37,257	41,005	43,980-45,900*
MZFW (lbs)	34,259	37,478	41,000-41,665*
Max structural payload (lbs)	11,969	13,098	15,653
Cargo Volume (cu ft)	1,978	1,978	2,119
Range with max payload (nm)	456/459	716	590
8t Aircraft	ATR 72-200/210 (IPR STC)	ATR 72-500 (IPR STC)	Q400PF
MTOW (lbs)	47,400	48,501	65,200
MZFW (lbs)	44,092	45,855	58,000
Max structural payload (lbs)	17,714	18,482	19,800
Cargo Volume (cu ft)	2,666	2,666	2,730
Range with max payload (nm)	872/805	785	725

## Notes:

- 1). Payload figures are estimates and will vary by individual aircraft according to OEW. Other MTOWs/MZFWs may be available. These could affect payload and range.
- 2). EMB-120FC based on Embraer SB. Worldwide Aircraft Services also offers conversions for EMB-120s.
- 3). ATR 42 and 72 bulk conversions also offered by Aeroconseil and Elbit systems of America. These specifications are for aircraft converted under the IPR STC.
- 4). Fokker 50 specifications based on Aircraft Conversions mod. The precise MTOW/MZFW for these specs was not available. Fokker Services also offers conversions.

340A.

There are 191 passenger-configured Saab 340s still in service, with a further 60 aircraft in storage. This includes 27 active and 15 stored Saab 340As, and 164 active and 45 stored Saab 340Bs. The age profile of the Saab 340A fleet ranges from 27 to 32 years. This compares to an age range of 17 to 27 years for the Saab 340B fleet, which includes 77 aircraft within the typical conversion age range. The Saab 340B therefore represents the largest source of feedstock for future P-to-F conversions in the 3-4t market.

The youngest available Saab 340A feedstock was manufacture in 1989. An aircraft of this vintage in half-life condition with half-life engines has a CMV of \$1.00 million (see table, page 83). The total cost of acquiring and converting a Saab 340A to the most basic specification would therefore be \$1.27 million. Without a conversion list price the total cannot be estimated for the Saab 340B.

## 5-7 tonne freighters

There are 114 active turboprop freighters in the 5-7t segment, representing a decline of 39% since 2001. The most popular in-service variants are the ATR 42-300/-320 (44), Convair 580 (21), Fokker 50 (13) and HS748 (13).

The 5-7t category previously contained some of the most popular candidates for turboprop P-to-F conversions, including the F.27, HS748 and Convair 580. In more recent years

there has been a trend for operators to replace ageing 5-7t freighters with larger types, including 8t aircraft.

The main candidates for future P-to-F conversions in the 5-7t market are the ATR 42, Fokker 50 and Q300. There are LCD and bulk conversions available or in development for all three types.

## ATR 42

Several different series of the ATR 42 have been produced. The earliest variants were the -300/-320 series. These were superseded by the -500 series, which was first delivered in 1995. The most recent version is the ATR 42-600, which was first delivered in 2012. The only viable ATR 42 conversion candidates in the near term will be the -300/-320 and -500 series aircraft, due to their older age profiles and lower CMVs.

The ATR 42-300, -320 and -500 series all have the same fuselage dimensions. The -300 and -320 series have the same certified weights, but the -320 series has more powerful PW121 engines compared to PW120-equipped ATR 42-300s.

The ATR 42-500 has higher certified weights than the -300/-320 series aircraft. It also has higher-rated PW127E or M engines and six bladed propellers. The ATR 42-500 can therefore carry higher payloads than earlier -300/-320 series aircraft.

There are several organisations offering bulk freighter conversions for ATR 42s, but only one has an STC for LCD conversions. IPR Conversions,

Aeroconseil and Elbit Systems of America can all provide bulk freighter conversions for ATR 42s. IPR Conversions is the only organisation with STCs for LCD conversions of ATR aircraft.

In September 2015 IPR Conversions acquired the OEM STCs for the P-to-F conversion of ATR 42s and ATR 72s from Alenia Aermacchi (now Leonardo). These covered the conversion of ATR 42-300/-320 series and ATR 72-200/-210 series aircraft into bulk or LCD freighters. Since it took ownership of the STCs, IPR has also gained approval for the bulk conversion of the ATR 42 and ATR 72-500 series. It expects to gain approval for the LCD conversion of -500 series aircraft in September 2016.

IPR Conversions is part of the Swiss-based IPR Invest group, which also includes IPR Leasing. IPR Conversions owns the STCs for ATR conversions, while the physical modifications are performed at its approved conversion centre (ACC), ASI-Maintenance in Toulouse. Additional ACCs are planned in other regions including North America. The IPR ATR conversions are available to third-party operators.

## ATR 42 Bulk freighter options

The bulk freighter modification designed for ATR aircraft by Alenia Aermacchi, and acquired by IPR, involves the removal of the passenger interior and installation of a Class E cargo cabin, window plugs and a reinforced floor. The resulting cargo cabin is sometimes referred to as the 'structural tube'. IPR



Conversions claims that its OEM freighter conversions offer the largest floor width available for ATR freighters.

An ATR 42 converted into bulk freighter status using IPR's STC would offer a cargo volume of up to 1,978 cu ft (see table, page 78). An ATR 42-300 would offer a range of 456nm when operating with a maximum payload of 11,969lbs, while an ATR 42-320 would have a range of 459nm.

In comparison, an ATR 42-500 converted to bulk freighter status by IPR would offer a gross structural payload of up to 13,098lbs. Its range with this payload would be up to 716nm. The ATR 42-500 would therefore be able to fly 250nm further than an ATR 42-300/-320 with 1,000lbs of additional payload.

Since it took on the STCs, IPR has booked three conversions for ATR 42 bulk freighters. The list price for IPR's ATR 42 bulk freighter or 'structural tube' conversion is \$450,000.

French aeronautical services company Aeroconseil developed its own independent STC for the conversion of ATR aircraft into Class E bulk freighters. Aeroconseil has subsequently become a subsidiary of the Akka Technologies Group, and the ATR bulk freighter modification is now managed by the Air Transport Services division of the group. Aeroconseil provides the STC and the parts that are required for the conversion, which is then performed by an MRO partner.

The Aeroconseil STC is certified for ATR 42-300/-320 and ATR 72-200/210 series aircraft. It can also be applied to ATR 42 and ATR 72-500s. Any -500 series aircraft converted using the Aeroconseil STC would, however, be limited to the maximum payloads

approved for the earlier models.

Aeroconseil is carrying out internal studies to explore the potential for additional capabilities including new certification for -500 series aircraft to make maximum use of the higher payloads they offer.

An ATR 42 converted to bulk freighter status using the Aeroconseil STC would provide a cargo volume of about 1,872 cu ft. Aeroconseil's modification would provide ATR 42-300/-320 and -500 series aircraft with a gross structural payload of up to 12,566lbs.

So far, 23 ATR 42-300/-320 series aircraft have been converted into bulk freighters using the Aeroconseil STC. The list price for the conversion is roughly \$400,000 including engineering and MRO work. The lead time for the modification kit is four weeks.

M7 Aerospace also developed a bulk freighter conversion for ATR 42s and ATR 72s. M7 Aerospace has since been acquired by Elbit Systems of America, which continues to offer the ATR conversions.

Elbit Systems of America performs conversions at its own facility in San Antonio Texas. Conversions involve the installation of a Class E cargo cabin and reinforced floors. They also include the installation of longitudinal horizontal poles, to which a continuous net system can be attached. The aft cargo door with air stairs is replaced with an upper-hinged door to provide better access and limit damage to cargo.

Elbit Systems of America offers bulk conversion for ATR 42-300/-320 series and ATR 42-500 series aircraft. The gross structural payload would be 12,500-14,500lbs, depending upon the variant, while the available cargo volume would

The Q300 has a gross structural payload of 12,500lbs when configured as a bulk loading freighter. This is similar to the capacity of the various ATR 42 variants.

be 1,600 cu ft. To date, 30 ATR 42-300/-320s have been converted to bulk freighters using the M7/Elbit Systems of America STC.

### ATR 42 LCD options

IPR Conversions offers the only LCD conversion option for ATR 42s. This modification involves the installation of a 116-inch X 71-inch LCD on the left-hand side of the fuselage forward of the wing.

Some potential container and pallet loading configurations for an ATR 42 LCD freighter have been listed (see table, page 81). The ABZ unit load device (ULD) is optimised for the ATR family.

The cargo volume of an ATR 42 LCD freighter ranges from 1,265 cu ft when loaded with LD-3s, to 1,607 cu ft when loaded with ABZ ULDs. An ATR 42 LCD freighter would provide a cargo volume of 1,693 cu ft in a typical palletised configuration.

There is an option to install an Ancra cargo loading system (CLS) during an ATR 42 LCD conversion. The LCD weighs 580lbs and this would be subtracted from the basic structural payload. The following net structural payload and volumetric payload summary assumes the ATR 42 has an LCD installed.

The net structural (revenue) payload of an ATR 42 LCD freighter with a CLS will vary from 9,710 to 11,583lbs when loaded with containers. It would range from 10,150 to 11,279lbs for an aircraft loaded with pallets.

At a typical express packing density of 7.0lbs per cu ft (lbs/cu ft), an ATR 42 LCD freighter would offer volumetric payloads from 8,855 to 10,839lbs when loaded with containers and from 10,150 to 11,279lbs when loaded with pallets. At a packing density of 9.0lbs/per cu ft, which is more typical of general freight operations, an ATR 42 LCD freighter would offer volumetric payloads of 9,710-11,385lbs when loaded with containers, and 10,150-11,279lbs when loaded with pallets.

The net structural payload and volumetric payload performance of the ATR 42 LCD freighters vary according to the particular aircraft series and the container or pallet loading configuration. The superior certified weights of the -500 series aircraft mean that they will provide higher volumetric payloads than older -300/-320 series models in many

scenarios.

The list price for IPR's ATR 42 LCD conversion is \$1.54 million. Only one ATR 42 has ever received the LCD conversion, and that was before IPR took ownership of the STCs. IPR does not yet have any LCD conversions booked for ATR 42s.

### ATR 42 feedstock

There are 195 active and 51 stored ATR 42s in passenger configuration. This includes 76 active and 29 stored ATR 42-300/-320s, and a further 99 active and 15 stored ATR 42-500s.

The age profile of the ATR 42-300/-320 fleet varies from 19 to 31 years, with only four aircraft in the typical conversion age range. The age profile of the ATR 42-500 fleet varies from four to 21 years, with 67 aircraft within the typical conversion age range. This suggests that -500 series aircraft will account for an increasing percentage of the ATR 42 freighter feedstock.

The current market value for a 20-year-old ATR 42-300/-320 in half-life condition with half-life engines is \$1.80-2.00 million (see table, page 83). The CMV for a 20-year-old ATR 42-500 is \$5.45 million. This increases to \$6.70 million for a 15-year-old example. The total cost of acquiring and converting typical ATR 42 feedstock to bulk freighter status using the IPR conversion could therefore be \$2.25-7.15 million.

The cost of acquiring and converting typical ATR 42 feedstock to LCD freighter status could be \$3.34-8.24 million.

### Fokker 50

Fokker Services has previously performed several Class E bulk freighter conversions on Fokker 50s. Netherlands-based Aircraft Conversions B.V. has also developed STCs for the conversion of Fokker 50s into bulk or LCD freighters. At the time of going to press, Aircraft Conversions is the subject of an acquisition by an unnamed party.

Fokker Services still offers a Class E bulk cargo conversion for Fokker 50s. Converted aircraft would offer a payload of about 7t (15,432lbs) and a cargo volume of about 1,900 cu ft. The converted freighter would have a range of about 900nm with a full payload.

An aircraft modified into bulk freighter configuration using the Aircraft Conversions STC is designated as a Fokker50Xpress. The conversion includes the installation of a Class E cargo cabin.

A typical Fokker50Xpress would offer a gross structural payload of about 15,650lbs and a cargo volume of 2,119 cu ft. It would be capable of operating on sectors of up to 590nm with a maximum

## IPR ATR 42 & ATR 72 LCD FREIGHTER PAYLOAD SPECIFICATIONS

Configuration	ATR42-300/320 LCD F	ATR42-500 LCD F	ATR72-200/210 LCD F	ATR72-500 LCD F
Containers	5 LD3	5 LD3	7 LD3	7 LD3
Gross Payload (lbs)	11,389	12,518	17,064	17,832
Total volume (cu ft)	1,265	1,265	1,583	1,583
Total tare weight (lbs)	935	935	1,309	1,309
Net structural payload (lbs)	10,454	11,583	15,755	16,523
Max packing density (lbs/cu ft)	8.26	9.16	9.95	10.44
Volumetric payload @ 7.0lbs/cu ft	8,855	8,855	11,081	11,081
Volumetric payload @ 9.0lbs/cu ft	10,454	11,385	14,247	14,247

  

Configuration	ATR42-300/320 LCD F	ATR42-500 LCD F	ATR72-200/210 LCD F	ATR72-500 LCD F
Containers	3 (88" x 108") + 1 (53" x 88")	3 (88" x 108") + 1 (53" x 88")	5 (88" x 108")	5 (88" x 108")
Gross Payload (lbs)	11,389	12,518	17,064	17,832
Total volume (cu ft)	1,525	1,525	1,975	1,975
Total tare weight (lbs)	1,661	1,661	2,295	2,295
Net structural payload (lbs)	9,728	10,857	14,769	15,537
Max packing density (lbs/cu ft)	6.38	7.12	7.48	7.87
Volumetric payload @ 7.0lbs/cu ft	9,728	10,675	13,825	13,825
Volumetric payload @ 9.0lbs/cu ft	9,728	10,857	14,769	15,537

  

Configuration	ATR42-300/320 LCD F	ATR42-500 LCD F	ATR72-200/210 LCD F	ATR72-500 LCD F
Containers	3 ABZ + 1 (53" x 88")	3 ABZ + 1 (53" x 88")	5 ABZ	5 ABZ
Gross Payload (lbs)	11,389	12,518	17,064	17,832
Total volume (cu ft)	1,607	1,607	2,112	2,112
Total tare weight (lbs)	1,679	1,679	2,325	2,325
Net structural payload (lbs)	9,710	10,839	14,739	15,507
Max packing density (lbs/cu ft)	6.04	6.74	6.98	7.34
Volumetric payload @ 7.0lbs/cu ft	9,710	10,839	14,739	14,784
Volumetric payload @ 9.0lbs/cu ft	9,710	10,839	14,739	15,507

  

Configuration	ATR42-300/320 LCD F	ATR42-500 LCD F	ATR72-200/210 LCD F	ATR72-500 LCD F
Pallets	3 (88" x 108") + 1 (53" x 88")	3 (88" x 108") + 1 (53" x 88")	5 (88" x 108")	5 (88" x 108")
Gross Payload (lbs)	11,389	12,518	17,064	17,832
Total volume (cu ft)	1,693	1,693	2,230	2,230
Total tare weight (lbs)	1,239	1,239	1,775	1,775
Net structural payload (lbs)	10,150	11,279	15,289	16,057
Max packing density (lbs/cu ft)	6.00	6.66	6.86	7.20
Volumetric payload @ 7.0lbs/cu ft	10,150	11,279	15,289	15,610
Volumetric payload @ 9.0lbs/cu ft	10,150	11,279	15,289	16,057

#### Notes:

- 1). Gross payload assumes Anca cargo loading system is installed. Total volume includes bulk volume.
- 2). Payload figures are estimates and will vary by individual aircraft according to OEW. There may be other MTOWs/MZFWs available and differences related to conversion options.
- 3). Container & pallet volume and tare weights will vary by manufacturer.

payload (see table, page 78).

A Fokker 50 converted into an LCD freighter using the Aircraft Conversions STC is referred to as a Fokker50Freighter. This conversion involves the installation of a Class E cargo cabin and a 92.1-inch x 69.7-inch LCD on the left side of the fuselage forward of the wing.

Marketing material for the Fokker50Freighter indicates that it will offer a similar gross structural payload and range to the Fokker50Express. It is unclear if this takes account of additional options, such as a CLS.

One potential loading configuration for a Fokker50Freighter would see it accommodate up to six LD-3s, providing a containerised cargo volume of about

954 cu ft. It is not possible to provide a total cargo volume for this configuration, since it is unclear what additional bulk volume would be available.

There are 61 passenger-configured Fokker 50s in service and a further 63 in storage.

The age profile of the Fokker 50 fleet varies from 19 to 29 years. There are only seven aircraft remaining in the typical conversion age range. No conversion prices were available.

### Q300

Air Inuit has been operating two Q300s in a bulk cargo configuration since 2009. The STC for this particular



conversion is not commercially available.

In March 2016 Bombardier announced that it was working with Air Inuit to design a P-to-F conversion for the Q300 featuring the option of an LCD.

“The STC for the conversion will be developed by B/E Aerospace,” explains Todd Young, vice president & general manager, customer services, at Bombardier Commercial Aircraft. “The STC will allow for the installation of an LCD, but this is optional. Operators will be able to choose between two cabin configurations. The first will provide a Class E cabin for bulk-loading freight. The second will see the aircraft configured as a Class E palletised freighter featuring a cargo handling system.”

In a palletised configuration the Q300 freighter will accommodate up to nine 46-inch x 66-inch ‘cookie sheet’ pallets. These can be loaded through the standard OEM baggage door, and so do not require the installation of an LCD. Even with an LCD installed, the Q300’s fuselage dimensions will not support the loading of standard size ULD containers. The option of an LCD may, however, appeal to general freight bulk cargo operators with oversized loads.

A Q300 freighter modified under the B/E Aerospace STC will provide a gross structural payload of about 12,500lbs when configured for bulk loading. It will offer a cargo volume of about 1,750 cu ft in the bulk-loading configuration and a volume of about 750 cu ft in the palletised configuration.

“The STC will be available for sale as retrofit as early as the first quarter (Q1) of 2017,” continues Young. “It is expected to gain full approval by Q4 2017. Air Inuit will have three aircraft

converted using the new STC.”

No list prices were available for the proposed Q300 conversion options.

There are 176 passenger-configured Q300s in service, and 33 in storage.

The age profile of the Q300 fleet varies from seven to 27 years, and there are 53 aircraft within the typical conversion age range.

## 8 tonne freighters

There are 96 active 8t turboprop freighters. This segment has seen a 700% increase in active aircraft since 2001, as operators have turned to 8t aircraft to replace ageing 5-7t types.

The most popular in service 8t freighters are the ATR 72 (60), BAE ATP (29) and the Q400 (5). There are only seven ATPs remaining in a passenger configuration, and with an age profile of 23-26 years it is unlikely that any further examples will be converted. This leaves the ATR 72 and Q400 as the main candidates for future conversions.

There are no new build all-cargo turboprops in the 8t segment. There are bulk and LCD conversions available for the ATR 72, and a bulk conversion option for the Q400.

### ATR 72

The first ATR 72 was delivered in 1989. Early models were ATR 72-200/-210 series aircraft. These were superseded by the ATR 72-500 series, which entered service in 1997. The most recent -600 series entered service in 2011. Only ATR 72 -200/-210 and -500 series aircraft will be considered for freighter conversions in the near to medium term.

All ATR 72 variants feature the same

*IPR is the only organisation that holds an STC for a large cargo door passenger-to-freighter modification. List price for the conversion is \$1.54 million.*

fuselage dimensions. The ATR 72-200 and -210 have the same certified weight options. The main difference is that the -210 is equipped with PW127 engines, while the -200 series features lower-rated PW124Bs. The ATR 72-500 also features PW127 series engines, but has six bladed propellers. There are also higher weight options available for the -500 series.

### ATR 72 bulk conversions

IPR Conversions, Aeroconseil and Elbit Systems of America all offer bulk freighter conversions for ATR 72s.

An ATR 72 converted to bulk freighter status using IPR’s STC would offer a cargo volume of up to 2,666 cu ft (see table, page 78). An ATR 72-200/-210 would have a maximum payload of 17,714lbs. The -200 series would have a range of up to 872nm with this payload, while an ATR 72-210 would have a range of up to 805nm. In comparison, an ATR 72-500 converted to bulk freighter status by IPR would offer a gross structural payload of up to 18,482lbs. Its range with this payload would be up to 785nm. When operating with a maximum payload, the ATR 72-500 would therefore be able to carry 750lbs of additional payload compared to the -200/-210 series, but would have 20nm shorter range than an ATR 72-210, and about 90nm less than a -200 series aircraft.

Only three ATR 72s were converted into bulk freighters using the OEM STC before it was acquired by IPR. In the 12 months since it took on the STC, IPR has already booked slots for five ATR 72 bulk conversions and completed two. The list price for IPR’s ATR 72 bulk freighter or ‘structural tube’ conversion is \$498,000.

An ATR 72 converted to bulk freighter status using the Aeroconseil STC would offer a cargo volume of 2,649 cu ft. Any ATR 72-200/-210 or -500 modified using the Aeroconseil STC would have a gross structural payload of up to 18,959lbs.

Aeroconseil says that 23 ATR 72-200/-210s and six ATR 72-500s have been modified into bulk freighters using its STC. The list price for the Aeroconseil conversion is roughly \$400,000, including engineering and maintenance, repair & overhaul (MRO) work, with a lead time of four weeks for the modification kit.

Elbit Systems of America offers bulk conversions for the ATR 72-200/-210 series, and ATR 72-500 series. ATR 72s converted by Elbit Systems would offer a cargo volume of 2,250 cu ft. The gross structural payload would be 18,750-19,500lbs, depending on the variant.

To date, 22 ATR 72-200/-210s have been converted to bulk freighters using the M7/Elbit Systems of America STC. The basic conversion has optional extras that can be installed, including: permanently plugged emergency exits; an aft canopy door; a continuous rail cargo restraint system; an improved floor structure that results in higher floor capacity; a hazmat (hazardous materials) zone; aluminium window plugs; improved forward door operation; and a smoke detection system that exceeds Federal Aviation Administration (FAA) requirements, allowing for dispatch with any one smoke detector inoperative. Elbit Systems of America claims that these optional extras can contribute to lower operating costs.

### ATR 72 LCD conversion

IPR Conversions offers the only LCD conversion option for ATR 72s. Like the ATR 42 LCD conversion the ATR 72 modification involves the installation of a 116-inch X 71-inch LCD on the left-hand side of the fuselage forward of the wing.

All ATR 72s converted into LCD freighters will also have the Class E structural tube cargo cabin installed.

Some potential container- and pallet-loading configurations for an ATR 72 LCD freighter have been identified (*see table, page 81*). The total cargo volume of an ATR 72 LCD freighter ranges from 1,583 cu ft when loaded with LD-3s, to 2,112 cu ft when loaded with ABZ ULDs. In a typical palletised configuration an ATR 72 LCD freighter would provide a cargo volume of 2,230 cu ft.

IPR offers the option of an Ancra CLS for all ATR 72s converted into LCD freighters. IPR says that most ATR 72 LCD freighter customers also select the CLS. The following net structural payload and volumetric payload summary therefore assumes that the aircraft have a 650lbs CLS installed. Aircraft without a CLS would have an additional 650lbs of revenue payload available.

The net structural payload of an ATR 72 LCD freighter with the CLS installed will vary from 14,739 to 16,523lbs when loaded with containers. It would range from 15,289 to 16,057lbs for an aircraft loaded with pallets.

At a typical express packing density of 7.0lbs per cu ft (lbs/cu ft), an ATR 72 LCD would offer volumetric payloads from 11,081 to 14,784lbs when loaded with containers, and from 15,289lbs to

### ESTIMATED ACQUISITION COSTS FOR TURBOPROP AIRCRAFT

Aircraft Type	Engines	Year of manufacture	2016 CMV (\$-millions)
EMB-120ER	PW118	1996	0.80
Saab 340A	CT7 5	1989	1.00
ATR 42-300	PW120	1996	1.80
ATR 42-320	PW121	1996	2.00
ATR 42-500	PW127	1996	5.45
ATR 42-500	PW127	2001	6.70
ATR 72-200	PW124	1996	3.00
ATR 72-210	PW127	1996	4.00
ATR 72-500	PW127	1996	5.80
ATR 72-500	PW127	2001	7.05

Source: Oriel

Assumes half-life maintenance condition with half life engines

15,610lbs when loaded with pallets. At a general freight packing density of 9.0lbs/per cu ft, an ATR 72 LCD freighter would offer volumetric payloads from 14,247lbs to 15,537lbs when loaded with containers, and from 15,289lbs to 16,057lbs when loaded with pallets.

The net structural payload and volumetric payload performance of the ATR 72 LCD freighters varies according to the particular aircraft series, and the container- or pallet-loading configuration.

The list price for IPR's ATR 72 LCD conversion is \$1.59 million. Only 10 ATR 72s were converted to LCD freighter prior to IPR's acquisition of the OEM STCs. IPR has already booked conversion slots for 13 LCD conversions in 12 months. Two are destined for IPR leasing. IPR Invest has just acquired an ATR 72-210 (MSN 467), which will undergo an LCD freighter conversion before being offered for dry-lease.

### ATR 72 feedstock

There are currently 644 passenger-configured ATR 72s in service and 64 in storage. This includes 47 active and 26 parked ATR 72-200/-210s, and 311 active and 11 parked ATR 72-500s.

The ATR 72-200/-210 fleet is 18-27 years old. It includes 22 aircraft that are within the typical feedstock age range. The age profile of the ATR 72-500 fleet varies from three to 20 years, with 69 aircraft within the typical feedstock age thresholds. It is likely that the -500 series will account for an increasing number of ATR 72 P-to-F conversions.

The CMV for a 20-year-old ATR 72-200/-210 in half-life condition with half-life engines is \$3.00-4.00 million (*see table, this page*). The CMV for a 20-year-old ATR 72-500 is \$5.80 million, and increases to \$7.05 million for a 15-year-old example.

The total cost of acquiring and converting a typical ATR 72 feedstock to bulk freighter status using the IPR

conversion could therefore be \$3.50-7.55 million. The cost of acquiring and converting an ATR 72 LCD freighter status could be \$4.59-8.64 million.

### Q400

Bombardier has launched a Q400 Cargo-Combi variant which can accommodate 50 seats and 9,000lbs of cargo. There is only one all-cargo conversion option available for the Q400. This is the Q400 Package Freighter (PF) modification provided by Cascade Aerospace in Canada.

The Q400PF modification converts passenger-configured Q400s into all-cargo bulk freighters. Cascade Aerospace provides the STC and kits required to replace the passenger interior with a Class E cargo cabin. The conversion can be completed by any approved MRO.

A typical Q400PF will provide a cargo volume of 2,730 cu ft and a gross structural payload of up to 19,800lbs (*see table, page 78*).

The passenger-configured Q400 fleet includes 467 active and 25 parked aircraft. The age profile of this fleet varies from new aircraft to 18-year-old examples. There are 29 Q400s in the typical conversion age thresholds.

### Large turboprop freighters

The large freighter segment accounts for turboprops with cargo payloads of 15t or more. The number of active aircraft in this category has declined from 57 in 2001 to 24 in 2016.

For a number of years the only active large turboprop freighters to be converted have been Lockheed Electras and Lockheed L-100s, which were manufactured from the mid-1960s to the early 1990s. The fleet consists of 22 L-100s and two Electras. There are no active conversion programmes in this segment, but a newbuild freighter has been launched.



### LM-100J

In 2014 Lockheed Martin launched the LM-100J Super Hercules, a civilian development of its successful C-130J Super Hercules military design.

The LM-100J will have a maximum structural payload of 48,000lbs. It will be capable of transporting a heavy weight payload of 43,200lbs on sectors of up to 2,340nm. The LM-100J will accommodate eight 463L master pallets. It could also be configured with eight 88-inch X 108-inch ULDs, five 88-inch X 125-inch ULDs or five 96-inch X 125-inch ULDs.

“We have orders and letters of intent for 25 LM-100Js,” says Tom Wetherall, director of business development for the LM100J programme at Lockheed Martin. “The first flight is due during the first half of 2017, with the initial delivery scheduled for the first quarter of 2018.”

The list price for a newbuild LM-100J is expected to be \$65.00-70.00 million. Lockheed Martin believes demand for the LM-100J will come from a mix of existing L-100 operators and other growth opportunities. “One of the main drivers of the LM-L-100J programme was demand from existing L-100 operators who require a replacement for their ageing aircraft,” explains Wetherall.

According to FlightGlobal’s Fleets Analyzer there are 22 active L-100s, with a further nine in storage. These aircraft range from 18 to 48 years of age. Only two aircraft are less than 25 years old.

The LM-100J will feature several design improvements in comparison to the L-100. “The most visible difference is the new Rolls-Royce AE2100D3 engine and six-blade propellers,” says Wetherall. “The AE2100D3 will provide more thrust than the L-100’s T56 engines, but

at the same torque level. The AE2100DE has superior hot and high performance which will allow the LM-100J to operate from even more remote or restricted airstrips than the L-100 can currently serve. We also expect the LM-100J to demonstrate fuel savings of 15%.”

Many L-100s are currently deployed on operations for the United Nations (UN) in Africa. LM-100Js are likely to be used for similar missions, although Lockheed Martin believes they could also be used to complement commercial jet freighter fleets.

“The world’s population is growing faster than the world’s infrastructure,” says Wetherall. “Whereas the majority of commercial freighters carry cargo between hubs, the LM-100J is capable of operating to airports or airfields with very little infrastructure. The LM-100J’s ability to accommodate standard containers and pallets will allow it to interline at hubs with other commercial freighters. Operators, including large integrators, could use LM-100Js to expand in emerging markets by operating them from hubs to locations that might not have the infrastructure to support normal commercial freighters.”

### RJ competition

There are a number of regional jet (RJ) freighter options that could provide competition for turboprops.

### CRJ100/200

Aeronautical Engineers Inc (AEI) launched a P-to-F conversion for CRJ100 and CRJ200 series aircraft in 2013 (see *The CRJ100/200 SF freighter conversion programme*, *Aircraft Commerce*,

*The ATR 42 LCD freighter has a containerised volume of 1,265-1,693 cubic feet, while the ATR 72 LCD has a volume of 1,583-2,230 cubic feet.*

*February/March 2016, page 73).* The conversion includes the installation of a LCD. Converted aircraft will be designated CRJ100 or CRJ200 SFs.

A CRJ100 SF and CRJ 200 SF will offer a maximum structural payload of 14,870lbs and 14,840lbs. This is similar to a Fokker50Freighter and positions the CRJs between an ATR 42 and ATR 72 freighter. Turboprops are likely to be more popular than RJ freighters on shorter sectors, where the latter’s speed advantage has little operational benefit. On sectors longer than 500nm, the CRJ’s speed advantage could make it the more appealing option for certain niche requirements.

AEI expects to receive the STC for its CRJ100 and CRJ200 SF conversion in September 2016. It has 43 conversions booked.

A bulk conversion option is also offered for the CRJ100 and CRJ200. This was developed by Cascade Aerospace, and modified aircraft are designated as CRJ100 or CRJ200 Package Freighters (PF). Cascade Aerospace provides the STC and kits for the PF modification. Aircraft modified to PF status offer a bulk cargo volume of 1,765lbs and a gross structural payload of about 15,000lbs.

### BAE 146/Avro RJ

The only other RJ freighters in service are BAE 146QTs, but their numbers have been declining. The BAE 146-200QT and -300QT offer gross structural payloads of 25,000lbs and 27,400lbs.

In August 2016 BAE Systems Regional Aircraft announced that it is investigating the potential for a P-to-F programme for its younger Avro RJ airliners. The Avro RJ100 would be the main conversion candidate and would offer a payload of about 14 tonnes, which would position it between the 8t turboprops and small narrowbody freighters like the 737. The conversion would include the installation of an LCD.

BAE Systems claims that an RJ100 could be acquired for \$1.0-1.5 million, and converted for \$2.2-2.8 million. It adds that the conversion could be available from the end of 2017. [AC](#)

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