The increased supply of used narrowbodies has brought more aircraft into the economic zone of conversion. The conversion programmes & their characteristics, costs of preparing aircraft for service, and their economic performance in express package and general freighter roles are examined.

Narrowbody economic freighter performance

With an increased supply of used narrowbody passenger aircraft with reduced values, it is now more economic than ever to replace older generation narrowbody freighters. Older types can be split into two groups: the smaller BAE 146, DC-9, 737-200 and 727-100/-200, which number almost 300, of which the 727 accounts for more than 200; and the larger DC-8 and 707, of which about 35 are still in active service.

Following the decision to shelve the A320/321 freighter conversion programme, the narrowbody candidates for replacing these older types are the 737-300, 737-400, MD-82, MD-83 and 757-200. Many of these have become available in large numbers. Values have declined to the point where the total cost of acquiring, converting and preparing an aircraft for service is low enough to displace a larger number of the older freighter types. Persistently high fuel prices also favour the younger aircraft.

The low utilisation rates of most freight operations mean a low capital cost has always been necessary to convert a used passenger aircraft to freighter. Total costs of acquisition, maintenance and conversion must be financed at a level that makes the aircraft's total operating costs attractive.

Aircraft financing and leasing costs therefore account for a high portion of total operating costs. Direct cash operating costs have always accounted for the smaller portion of total operating costs. Fuel efficiency, low maintenance costs and smaller flightcrew complements of candidate aircraft have historically been less important to operators.

While low prices used to favour older types with low capital costs for freighter conversion, current high fuel prices of $3.20-3.50 per USG favour younger ones.

Fleet planning and aircraft type selection depend on three main issues: aircraft operating performance, with respect to the payload that can be carried on each route in an airline's network; fuselage dimensions and overall freight payload capacity at several packing densities; and economic performance across the operator's network.

Freighter roles

All freighter types are used in both express package and general freight operations. Each type of operation has several characteristics, which affect the aircraft's operating cost performance.

Many express package operations are based on hub-and-spoke or feeder-type services. Aircraft have to operate one return flight via the hub per night, so they only operate five or six nights per week, while the average route length for smaller jets, like the 727F and 737F, tends to be 400-700nm. Resulting block times are only 95-125 minutes. Annual rates of utilisation are therefore 630 flight cycles (FC) and 1,050-1,250 flight hours (FH).

The carriage of small packages means containers, or ULDs, are used where possible. Containers are used on the main decks of aircraft, or in bulk in the underfloor belly compartments of most narrowbody freighter types.

Using ULDs on the main decks of aircraft means the aircraft have to carry a lot of tare weight, which has to be deducted from the gross structural weight, with the difference being the net structural payload *(see table, page 54)*.

The packing density of express packages is relatively low at about 6.5lbs per cubic foot. This density multiplied by the available volume provided by the ULDs and belly space results in the volumetric payload *(see table, page 54)*. The volumetric payload of most aircraft with freight packed at this density is 6,000-18,000lbs less than their net structural payloads.

General freight operations have several contrasting characteristics. Freight is carried more on point-to-point routes. Average route lengths do not differ much from express package operations, but rates of utilisation are higher, and up to 50% more FCs are completed in a year. An aircraft will therefore accumulate about 930FC per year, equal to 1,700FH for a similar average route length.

Large types, like the DC-8 and 757-200, are also generally used on longer routes, which can result in higher rates of utilisation. These may considered against smaller widebody freighters.

The bulky items found in general freight means ULDs are not always needed, and the payload is often carried on pallets. The tare weight is therefore less than for express package operations, so an aircraft's net structural payload tends to be higher than on express package services.

General freight is also packed at a higher density than express packages, typically at 7.0-9.0lbs per cubic foot. This results in higher volumetric payloads. High packing densities of 8.5lbs per cubic foot result in the volumetric payload of some aircraft reaching their net structural payload limits *(see table, page 54)*.

Aircraft that reach their net structural payloads before all available volume is filled at these densities 'gross out'. Others will fill all available volume and still have some structural payload remaining at these packing densities.

The yields of general freight are lower than express packages, so aircraft are only economic when high load factors are experienced.

Freight carriage

The standard contoured ULD used by the 727, 737 family, 707, 757 and DC-8 is the AAA or AAY. This has a base width of 125 inches, which is the widest

737-300/-400 CONVERTED FREIGHTER PAYLOAD CHARACTERISTICS

Aircraft type	737-300	737-300	737-300	737-400	737-400	737-400
Converter	Bedek Aviation	Pemco	AEI	Bedek Aviation	Pemco	AEI
MTOW-lbs	139,500	139,500	139,500	143,500	143,500	143,500
MZFW-lbs	109,600	109,600	109,600	113,000	117,000	117,000
OEW-lbs	66,500	67,100	66,700	69,900	70,200	69,900
Gross structural payload-lbs	43,100	42,500	42,900	43,100	46,800	47,100
Express package operations						
Maindeck payload						
Standard ULD AAA/AAY 125-inch X 88-inch	8	8	8	9	10	10
Containerised volume-cu ft	3,520	3,520	3,520	3,960	4,400	4,400
Tare weight-lbs	3,808	3,808	3,808	4,284	4,760	4,760
Additional ULD	1 AXY demi	1 AXY demi	1 LD-9	1 AXY demi		AYY
Containerised volume-cu ft	260	260	370	260	N/A	150
Tare weight-lbs	300	300	460	300	N/A	220
Total containerised volume-cu ft	3,780	3,780	3,890	4,220	4,400	4,550
Tare weight-lbs	4,108	4,108	4,268	4,584	4,760	5,010
Bulk underfloor volume-cu ft	1,068	1,068	1,068	1,373	1,373	1,373
Total volume-cu ft	4,848	4,848	4,958	5,593	5,773	5,923
Total tare weight-lbs	4,108	4,108	4,268	4,584	4,760	5,010
Net structural payload-lbs	38,992	38,392	38,632	38,516	42,040	42,090
Volumetric payload with freight packed at 6.5lbs per cubic foot-lbs	31,512	31,512	32,227	36,355	37,525	38,500
General freight operations						
Standard 125-inch X 88-inch pallets	8	8	8	9	10	10
Freight volume-cu ft	3,520	3,520	3,520	3,960	4,400	4,400
Tare weight-lbs	1,696	1,696	1,696	1,908	2,120	2,120
Smaller pallets	1 62X88	1 62X88	1 125X88	1 62X60		1 53X64
Freight volume-cu ft	260	260	370	260		150
Tare weight-lbs	80	80	212	80		80
Bulk underfloor volume-cu ft	1,068	1,068	1,068	1,373	1,373	1,373
Total volume-cu ft	4,848	4,848	4,958	5,593	5,773	5,923
Total tare weight-lbs	1,776	1,776	1,908	1,988	2,120	2,200
Net structural payload-lbs	41,324	40,724	40,992	41,112	44,680	44,900
Volumetric payload with freight packed at 8.5lbs per cubic foot-lbs	41,208	40,724	40,992	41,112	44,680	44,900

possible across the floor of these aircraft, and a depth or length of 88 inches. It has a contoured profile, and a height of up to 82 inches at its apex.

There are several manufacturers and specifications of the AAA and AAY, so internal volumes and tare weights vary. This analysis uses an internal volume of 440 cubic feet and tare weight of 476lbs.

The MD-80's main deck is narrower than all the other types mentioned. A contoured ULD is used, and the fuselage width allows an AAK, AAN or AAP ULD, which have a base width of 108 inches, and a depth of 88 inches, and are contoured with a height of 78 inches at the apex. These ULDs are analysed here with an internal volume of 368 cubic feet and a tare weight of 326lbs.

In addition to these two main ULD types, smaller ULDs are used on some Boeing conversions, when additional main deck space allows for a smaller container.

Candidate aircraft

There are four main narrowbodies for consideration for freighter conversion: the 737-300, 737-400, MD-80 and 757-200. The MD-80 is subdivided between the MD-82 and MD-83, while the 757-200 is split between those aircraft with

Rolls-Royce RB211-535E4 engines and those with PW2037/40 engines.

737-300

The most common maximum take-off weight (MTOW) version of the 737-300 is 139,500lbs.

There are four passenger-to-freighter conversion programmes available for the 737-300. The modified aircraft all have a maximum zero fuel weight (MZFW) of 109,600lbs. This is significant, since gross structural payload is MZFW less the operating empty weight (OEW).

In addition to Boeing's passenger-to-freighter modification, three more are available from Bedek Aviation, Aeronautical Engineers Inc (AEI) and Pemco. All conversions for the 737-300, and all other narrowbody aircraft, are licensed by Boeing, so the airline is required to pay Boeing an annual access fee of $50,000 per aircraft, which is capped at $200,000 per year for fleets of four aircraft or more. Paying this fee gives the operator access to Boeing's technical support for the freighter conversion. Boeing is obligated to provide technical support to the airline for any issues on the aircraft that do not relate to the freighter conversion.

The specification weights for the 737-300 modified with the Bedek Aviation, Pemco and AEI conversions are listed *(see table, page 54)*. The gross structural payloads are 42,500-43,100lbs.

The main deck ULD configuration for express package, and pallet configuration for general freight operations are summarised *(see table, page 54)*. All three modifications result in a main deck that can hold eight standard ULDs or pallets of the same base dimensions on the main deck. All three modifications have extra space for a smaller ULD or pallet, which is loaded at the rear of the deck. The AEI conversion has space for a larger ULD/pallet than the other two modifications.

The 737-300 has 1,068 cubic feet of bulk space in the belly, which most operators use to carry freight loaded in bulk or mail bags.

The total available volume and tare weight for the aircraft modified under all three conversion programmes for both express package and general freight operations are summarised *(see table, page 54)*. The net structural payloads and volumetric payloads for freight packaged at the two different packing densities are listed.

The differences in volumetric payloads relate directly to differences in available freight volume. AEI's conversion has the highest volume and volumetric payload in both configurations.

The current list prices for conversion, including the cargo loading system, are $2.45 million for the Pemco modification, $2.8 for the Bedek conversion, and $2.4 million for the AEI programme.

737-400

Boeing, Pemco, Bedek and AEI all offer passenger-to-freighter modification programmes for the 737-400.

The two common MTOWs for the 737-400 are 143,500lbs and 150,000lbs. The specification weights, available payload volumes and tare weights, net structural payloads, and volumetric payloads for both types of freight operation are listed for aircraft modified under the Bedek Aviation, Pemco and AEI conversion programmes *(see table, page 54)*.

Overall, the AEI-converted aircraft has the highest capacity and volumetric payloads *(see table, page 54)*.

The current list prices for conversion, including the cargo loading system, are: $2.75 million for the Pemco modification; $3.0 million for the Bedek conversion; and $2.7 million for the AEI.

MD-82/-83

AEI offers freighter modifications for the MD-82/-83. The MD-80 freighter has had some negative comments because its

MD-82/-83 & 757-200 CONVERTED FREIGHTER PAYLOAD CHARACTERISTICS

Aircraft type	MD-82	MD-83	757-200 RB211-535E4	757-200 RB211-535E4	757-200 PW20376
Converter	AEI	AEI	Pemco	Precision	Precision
MTOW-lbs	149,500	160,000	250,000	250,000	250,000
MZFW-lbs	122,000	122,000	188,000	196,000	194,000
OEW-lbs	74,024	75,320	119,850	116,100	115,900
Gross structural payload-lbs	47,976	46,680	68,150	79,900	78,100
Express package operations					
Maindeck payload					
Standard ULD	12 X 108/88	12 X 108/88	14 X 125/88	15 X 125/88	15 X 125/88
Containerised volume-cu ft	4,416	4,416	6,160	6,600	6,600
Tare weight-lbs	3,912	3,912	6,664	7,140	7,140
Additional ULD	N/A	N/A	1 AXY demi		
Containerised volume-cu ft			260		
Tare weight-lbs			300		
Total containerised volume-cu ft	4,416	4,416	6,420	6,600	6,600
Tare weight-lbs	3,912	3,912	6,964	7,140	7,140
Bulk underfloor volume-cu ft	1,253	1,013	1,790	1,790	1,790
Total volume-cu ft	5,669	5,429	8,210	8,390	8,390
Total tare weight-lbs	3,912	3,912	6,964	7,140	7,140
Net structural payload-lbs	44,064	42,768	61,186	72,760	70,960
Volumetric payload with freight packed at 6.5lbs per cubic foot-lbs	36,849	35,289	53,365	54,535	54,535
General freight operations					
Standard pallets	12 X 108/88	12 X 108/88	14 X 125/88	15 X 125/88	15 X 125/88
Freight volume-cu ft	4,416	4,416	6,160	6,600	6,600
Tare weight-lbs	2,220	2,220	2,968	3,180	3,180
Smaller pallets			1 62/88		
Freight volume-cu ft			260		
Tare weight-lbs			80		
Bulk underfloor volume-cu ft	1,253	1,013	1,790	1,790	1,790
Total volume-cu ft	5,669	5,429	8,210	8,390	8,390
Total tare weight-lbs	2,220	2,220	3,048	3,180	3,180
Net structural payload-lbs	45,756	44,460	65,102	76,720	74,290
Volumetric payload with freight packed at 8.5lbs per cubic foot-lbs	45,756	44,460	65,102	71,315	71,315

fuselage cross-section is narrower than that of the Boeing aircraft and DC-8, and it cannot carry the standard AAA/AAY ULD. Analysis shows, however, that few airlines interline complete ULDs, and most must be emptied and repacked. Commonality of ULDs between aircraft types is therefore rarely needed.

The MD-80 uses a smaller ULD and pallet, and carries 12 on its main deck.

Some aircraft were fitted with one or two supplementary fuel tanks. Standard aircraft have an OEW of 74,024lbs after conversion, and an underfloor belly space of 1,253 cubic feet. Aircraft with a single supplementary fuel tank have an OEW of 75,320lbs and an underfloor volume of 1,013 cubic feet.

The MD-82F/-83F's specification weights, available payload volumes and tare weights, net structural payloads, and volumetric payloads are listed *(see table, this page)*.

Its payload and volume capacities compare closely with the 737-400, and are superior to the 737-300.

Converting the MD-80, including cargo loading system, costs $2.25 million.

757-200

The two conversion programmes for the 757-200 are provided by Pemco and

The 737-300 and 737-400 provide airlines with the option of two aircraft with a high level of commonality and that cover a wide range of payload requirements. Many used passenger aircraft are now at values that makes conversion to freighter economic.

Precision Conversions.

There are significant differences between the 757-200 conversion programmes, starting with payload. Under both modifications, the aircraft has an underfloor space of 1,790 cubic feet.

The Precision-modified aircraft can carry 15 standard ULDs on its main deck, while the Pemco-modified aircraft can carry 14 plus a smaller container.

The type of engine powering the aircraft influences the gross structural payload. The RB211-535E4s are a few hundred pounds heavier than the PW2037/40 engines. OEW is correspondingly heavier and gross structural payload lower for RB211-equipped aircraft *(see table, page 56).*

Structural payload is affected by the aircraft's various MZFW options. There is a standard specification of 184,000lbs. This can be increased for aircraft that are higher than line number 210. A Boeing upgrade takes this to 188,000lbs and 186,000lbs for RB211-535E4- and PW2037/40-equipped aircraft. This also applies to Precision- and Pemco-converted aircraft.

For aircraft above line number 210, Precision provides a further upgrade that takes MZFW up to 196,000lbs and 194,000lbs for the two engine choices *(see table, page 56).* The maximum increase in MZFW is 8,000lbs, and Precision charges $35 per lb; so a maximum of $280,000.

These are the highest MZFW weights possible for the 757-200 Precision-converted freighter, resulting in gross structural payloads of 79,900lbs and 78,100lbs.

The specification weights, available payload volumes and tare weights, net structural payloads, and volumetric payloads are listed *(see table, page 56).* The Precision-converted aircraft have higher volumetric payloads due to their higher available freight volume. They also have higher structural payloads if the second MZFW upgrades are applied.

The cost of conversions including cargo loading system is less than $4.0 million for Pemco's modification, and $4.65 million for Precision's.

Freighter build costs

Total costs of preparation for service are effectively capped by the lease rates that freight airlines are prepared to pay. These need to be at least enough to amortise the total investment, and so equal to a lease rate factor of 1.5-1.7% of total investment per month.

Market lease rates are based on a market rate of what freight carriers are prepared to pay, but also the availability of various aircraft types. Lease rates of 737 freighters have declined in recent years as more used passenger aircraft have become available to convert. Market rates for 737-300Fs and -400Fs are $110,000-120,000 and $140,000-150,000 per month. These rates effectively cap the total amount that should be invested in preparing these two types for service, at $8 million for the 737-300F and $9.5 million for the -400F.

In the case of the MD-80, probable market lease rates are harder to gauge, since none has been converted yet and it has not been accepted by a freight carrier. Lease rates would have to be less than those for the 737-300/-400, but they would be low since values of used passenger-configured MD-80s are at a part-out level. A monthly lease rental of $90,000-100,000 is thought possible, which caps the total investment in a freighter at $6 million.

Monthly lease rates for the 757-200F vary. Aircraft with lower MZFWs and gross structural payloads for use in express package operations command lease rentals of $210,000 per month, which caps total investment at $14 million. Aircraft with upgraded MZFWs, and later build examples, can command higher monthly rentals of $240,000. This caps total investment at $15-17 million.

Actual costs of preparation for service should be considered against these limits. Deducting the cost of conversion and maintenance necessary to get the aircraft into service leaves the maximum purchase value of the used aircraft, which determines the value at which used aircraft are in the zone of convertibility.

The maintenance costs required in addition to conversion to freighter depend on several factors. The two main elements that affect additional expenditure, and have an impact on aircraft values are: airframe check status; and engine and life limited part (LLP) maintenance status.

Heavy checks at the end of a base check cycle are the most likely time for retirement for many aircraft. The conversion process is often also a convenient time to perform a heavy check, although this will reduce aircraft purchase values.

A C4 check on the 737-300/-400 will cost $0.5 million, while a heavier C6 is likely to cost over $1.0 million. Lower C checks will cost $200,000-350,000.

A mid-cycle C4 check on an MD-80 can cost up to $1.0 million, but this is likely to reduce purchase value to less than $1.0 million. Lower C checks will cost $150,000-200,000.

A heavy C4/D check on a 757 will cost more than $1.0 million, and will have some impact on the purchase value, although supply of 757s is limited. Lower C checks will cost about $300,000.

Engine maintenance can have the largest impact on additional expenditure. The supply of CFM56-3s and JT8D-200s is such that it is cheaper to buy time-continued engines than induct existing engines into a shop visit and replace some of their LLPs. A budget of $1.0-1.5 million should be allowed for the 737-

300/-400, and up to $1.0 million for the MD-80. Typical intervals mean that an engine on these aircraft comes due for a shop visit once every 18-30 months when used as passenger aircraft, so there is a good chance that one engine will need maintenance at the time of acquisition.

Engines powering the 757 are in limited supply on the used market. A shop visit can incur more than $3.0 million for the RB211-535E4, and easily reach $2.6 million on the PW2000. An engine shop visit comes due about once every two years on an RB211-535E4-powered 757, but less than once every 18 months on a PW2000-powered aircraft.

Aircraft that need both a heavy airframe check and an engine shop visit will therefore incur significant expenditure, and have a commensurate reduction in purchase value.

The total for a lighter C check and engine maintenance on the 737-300 will therefore be about $1.6 million. A similar requirement for the MD-80 will cost $1.3 million, and up to $3.5 million on the 757.

Some component maintenance will also be required. A budget should be allowed for a new shipset of tyres, wheel rim inspections, and the overhaul of a shipset of wheel brakes. This will cost $50,000-60,000 for the 737 and MD-80, and about $300,000 for the 757, which has carbon brake units.

An additional allowance should be made for maintenance on thrust reversers, the auxiliary power unit and landing gear. Some system rotables will also need to be repaired or exchanged.

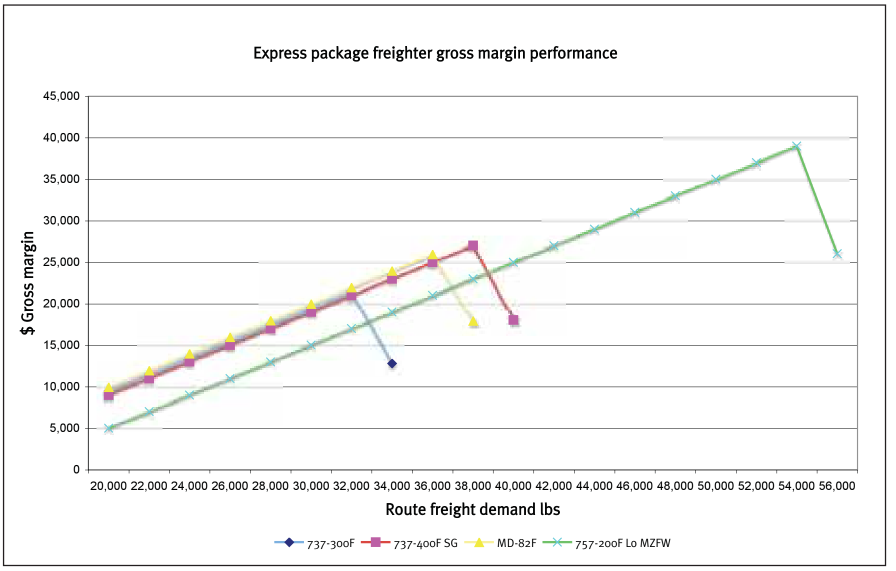
A budget of up to $600,000 should be allowed for the 737 and MD-80 in a mid-life condition, and up to $900,000 for the 757-200 in the same status.

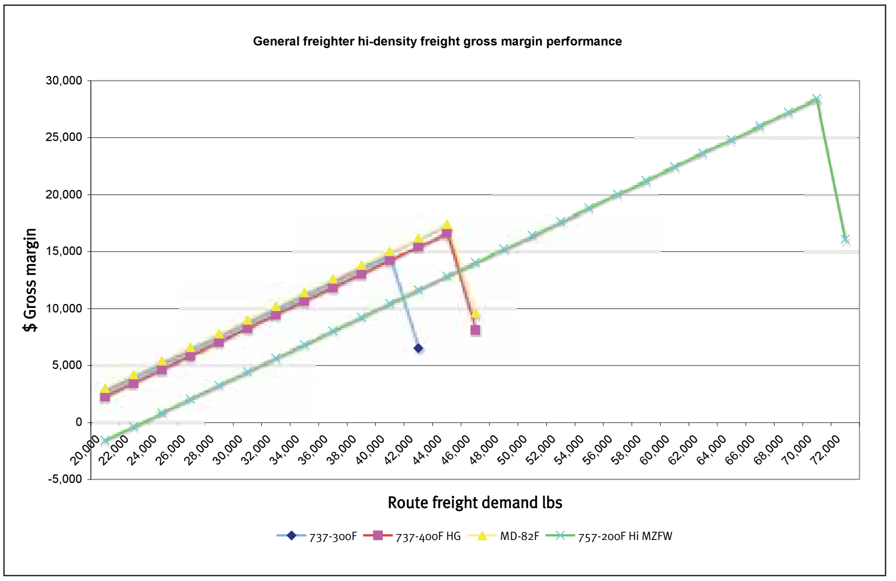
A total maintenance budget of $2.2 million should be allowed for the 737-300/-400, $1.9 million for the MD-80 and $4.2 million for the 757-200; for aircraft purchased in a mid-maintenance life condition *(see table, page 56)*.

The combined cost of maintenance and conversion is therefore about $4.6 million for the 737-300; $4.9 million for the 737-400; $4.1 million for the MD-80; and $8.2-9.0 million for the 757-200, depending on conversion programme.

This leaves the upper limit of purchase values, for aircraft in a mid-maintenance condition, at $3.4 million for the 737-300; $4.6 million for the 737-400; $1.9 million for the MD-80; and $6.0-7.0 million for a 757-200.

Candidate aircraft should preferably have electronic flight system (EFIS) flightdecks, higher rated engines, have no major repairs, have no corrosion or outstanding airworthiness directives or service bulletins, and have a large number of FH or FC to run before lap joint and other major AD thresholds come due.





There is a large supply of 737-300s, and current market values of good quality conversion candidates are $2.5-3.0 million.

Values of good quality 737-400s are a little higher, but the supply of these means they can be acquired for $3-5 million.

Most MD-80s are now at scrap value, with only their engines having any value. Many MD-80s can be acquired for $1.0-1.5 million, while those in the best condition may be closer to $3.0 million.

The supply of 757-200s has remained tight. The oldest, whose structural weights would be adequate for express package operations, may be acquired for only $4-5 million. Aircraft built in the early 1990s, and in a good maintenance condition, may cost $8.0-10.0 million.

Relative economics

The most economic aircraft type for a route or network is the type that carries a particular quantity of freight with the smallest operating cost, and thereby generates the highest gross margin as a contribution to overheads.

The gross margin generated by each aircraft type increases as the amount of freight being carried rises, until the load factor exceeds 100%. For higher freight loads, a second operation is required, which will double the aircraft trip costs. The alternative, more economic option, is the use of a larger type with a marginally higher payload and trip cost.

Freighters tend to be economic only when operating at the highest load factors. The best aircraft on each route in an airline's network is the one whose maximum payload capacity is closest to the average amount of freight being carried.

The four narrowbody freighters analysed for express packages packed at 6.5lbs per cubic foot are the 737-300F, the 737-400F with the standard gross weight option (737-400F SG), the MD-82F, and the 757-200F with an MZFW of 188,000lbs. The lower weight 737-400 and 757-200 models were chosen because a packing density of 6.5lbs results in low volumetric payloads. This avoids the need for higher gross weight variants. The MD-82/-83 variant without the

The 757-200F is in a payload class of its own. With a small MZFW upgrade, the aircraft can be used for express package or low-density general freight operations. A further MZFW upgrade offered by Precision Conversions allows the aircraft to carry freight packed at a density of 8.0-9.0lbs per cubic foot.

supplementary fuel tank has been used, because additional range performance is not needed and the fuel tank's absence increases volume. The lower gross weight variant of the 757-200, converted by Pemco or Precision, has been analysed with a monthly lease rate of $210,000.

These four aircraft have volumetric payloads of 32,000-55,000lbs.

The four aircraft analysed for general freight carried at a high packing density of 8.5lbs per cubic foot are the 737-300F, the 737-400F with the higher gross weight option (737-400F HG), the MD-82F, and the 757-200PCF with a high MZFW of 196,000lbs. These variants have the highest net structural payloads of the four main types. The higher weight 757-200PCF, only available from Precision Conversions, has been analysed with a monthly lease rental of $240,000.

The 737-300, 737-400 and MD-82 all gross out, and reach structural limits, before they use all their available volume. Volumetric payloads are 40,992lbs for the 737-300F, 44,900lbs for the 737-400F HG, and 45,756lbs for the MD-82F. The 757-200PCF has a volumetric payload of 71,315lbs.

The gross margin generated by each aircraft for different quantities of freight can be calculated and plotted *(see charts, page 59)*. A generic yield per lb of freight determines the revenue generated by each aircraft. The yield used for express packages is $1.0 per lb, and $0.60 per lb for general freight.

Trip cost will only increase marginally as freight load increases due to incremental fuel required, so the gross margin for each aircraft type will increase almost proportionately with freight load.

Aircraft trip costs that are deducted from revenues for the generation of gross margins, include fuel, direct maintenance, flightcrew, navigation charges, airport handling fees, and aircraft lease rentals.

A key factor in costs per trip for each aircraft type is the pattern of operation and rate of utilisation.

The express package operation is analysed on FRA-FCO, with an average route length of 630nm, and aircraft completing 630FC per year. Corresponding annual FH utilisations are 915-1,040FH, depending on aircraft type.

The general freight operation is also analysed on FRA-FCO, but with aircraft operating at a 50% higher rate of utilisation than the express package operation. Aircraft are analysed completing 945FC per year. Annual FH utilisations are 1,370-1,560FH.

The operating performance, flight and block times and fuel burn of each aircraft have been analysed in both directions on the route, and fuel burn and flight times averaged. The available gross payload for all aircraft types is not restricted in either direction.

Express package operations

The gross margin performance of the four aircraft types examined is illustrated *(see charts, page 59)*.

The trip costs of the three smaller aircraft (the 737-300, 737-400 and MD-82) are close and only differ by a few hundred dollars. Fuel accounts for 41-50% of all operating costs. Even at low rates of utilisation, fuel costs three to five times more than aircraft lease costs.

The MD-82F has the lowest cost of $10,013. The 737-300F and -400F have trip costs of $10,584 and $10,974. When the similarity of the MD-82F's similar freight capacity to the 737-400F is considered, the MD-82F is clearly an alternative to both the 737-300/-400. The MD-82F has faced resistance due to its narrower fuselage cross-section and older age, however. It has higher fuel burn, but lower lease rentals on account of its age.

The closeness of the 737-300F's and -400F's trip costs also means that many operators may consider just utilising the -400F in a single fleet. If considering operating a single aircraft type, then the 737-400F may present the best option. It has the highest payload, and trip costs are only $400 higher than the -300F.

The 757-200F, with a low MZFW, has a volumetric payload up to 68% higher than the three smaller types. The 757-200F's trip cost, however, is only 37-50% higher than the 737-300F/-400F and MD-82F.

This implies that the 757 can carry freight at the lowest cost per lb. While it is less economic at lower volumes of freight, the 757 has a higher gross margin at levels of demand in excess of 38,000lbs than the smaller types operating at dual frequency *(see chart, page 59)*.

General freight operations

The higher capacity of aircraft with freight packed at the higher density, and the higher rates of utilisation, result in the aircraft having lower trip costs, and unit costs per lb of freight capacity.

Trip costs for the three smaller narrowbodies are brought closer together by the different operating characteristics. The higher packing density and available volume of each aircraft contribute to the MD-82F having the highest volumetric payload. The MD-82F has the lowest trip cost of the three smaller types, so on a purely economic basis it is the best option for lower levels of freight demand.

The 737-400F's trip costs are only about $400 higher than the -300F's, so it makes more sense for an operator to consider using this in a single-type fleet.

Precision's ability to upgrade the MZFW to as much as 196,000lbs allows the 757-200PCF to carry freight at high packing densities of 8.0lbs per cubic foot and higher. This makes it the most economic aircraft for payloads of 45,000lbs to 75,000lbs. AC