

The 727-100F/-200F still have the lowest costs for carrying small packages in their size category. An increasing number of concerns are being raised about the 727F's continued viability. This has come at a time when market values of replacement candidates are making them economic alternatives

Young aircraft sound warning for 727F

While the 727F remains popular, it is nevertheless facing an increasing number of issues about its continued viability as its remaining life shortens. Recent airworthiness directives (ADs) relating to the aircraft's freight door structural integrity are not completely resolved and the possibility of Stage 4 noise rules being defined and adopted, could pose further threats to the 727.

The 727-100F fleet is 27-32 years old. The oldest -200Fs are also 24-32 years old. Both fleets have high and rising maintenance costs. Values of potential replacements, such as the 737-400 and 757-200, are falling. In addition to use of the same freight containers as the 727, lower market values will make the 737-400 and 757 economic replacements and alternatives in the next 5-10 years. This means an assessment of the 727-100F/-200F's continued viability is required.

Replacement issue

Freight operations are more complex than passenger services with respect to how unit costs are determined. While passenger operations depend on average revenue and cost per seat, the economics of freight is complicated by the payload of aircraft being more variable because of packing densities.

The majority of the 500 727-100F/-200Fs in operation are used to carry small packages in the continental US. The packing density of this cargo is 6.5-7.0lbs per cubic foot (cu ft). Any replacement aircraft will carry freight at the same density. Although the 727F is facing an increasing number of difficulties, the problem is finding an aircraft with similar payloads at the relevant density, which has competitive operating costs.

Maximum available payload has to be used, otherwise aircraft with smaller payloads will be more economic. Replacement candidates and competitors

will therefore need to have volumetric payloads close to that of the 727.

The 727-100F has a net structural payload of 42,830lbs, taking into account crew and other factors affecting the aircraft prepared for service (APS) weight. The aircraft can accommodate nine 125 x 88 x 82-inch containers. These each have a tare weight of 250lbs and internal volume of 458 cu ft. The volumetric payload of each container is therefore 2,977lbs. For all nine containers, the aircraft then has a volumetric payload of 26,793lbs (*see table, this page*) when packed at 6.5lbs per cu ft.

The 727-200F has a maximum structural payload of 58,300lbs. The aircraft can accommodate 12 containers and so will carry a volumetric payload of 35,724lbs (*see table, this page*) of small packages.

Because these aircraft are utilised on low utilisation operations, lease and ownership costs have the largest influence on unit costs. A 727-100F market lease

727 & REPLACEMENT CANDIDATE SMALL PACKAGE PAYLOAD SPECIFICATION

	727-100	727-200	737-300	737-400	757-200	A310-300	A300B4	A300-600
Aircraft type	727-100	727-200	737-300	737-400	757-200	A310-300	A300B4	A300-600
APS lbs	89,170	91,640	62,172	65,731	113,020	163,390	178,490	174,290
Maximum structural payload lbs	42,830	58,360	44,328	51,269	86,980	87,934	99,290	112,310
Container size	125/88/82	125/88/82	125/88/82	125/88/82	125/88/82	88/125/97 /LD-3	88/125/97 /LD-3	88/125/97 /LD-3
Number	9	12	8	9	15	16/14	18/20	21/22
Internal volume	458	458	458	458	458			
Tare weight lbs	250	250	250	250	250			
Total volume cu ft	4,122	5,496	3,664	4,122	6,870	10,044	11,920	13,712
Tare weight lbs	2,250	3,000	2,000	2,250	3,750	11,490	13,840	15,860
Packing density lbs/cu ft	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Net structural payload lbs	26,793	35,724	23,816	26,793	44,655	65,286	77,480	89,128

rate is in the region of \$45,000 per month, and about \$60,000 per month for an older and lower-powered 727-200F. This is about \$110,000 a month for a younger and higher-powered -200F.

The build cost for acquiring and preparing a 727-200 for freight operation has fallen to about \$7 million, now that JT8D and 727 airframe values have fallen.

The equivalent cost for 727 replacement candidates will be higher, as will their lease costs, raising a concern over their potential as replacement candidates.

Replacement candidates

Operators could elect to operate larger aircraft if they need additional payload for traffic growth. The 757, for example, has a volumetric payload of 44,655 lbs (*see table, page 43*), about 9,000lbs more than the 727-200F.

Airlines can also substitute one large aircraft for two 727s. This has already been done by FedEx, which operates A310-200s in place of two 727s.

Twice the 727-100F's volumetric payload is 53,000lbs, and twice the -200F's is 72,000lbs. The A310-300 has a volumetric payload in the region of 65,000lbs (*see table, page 43*) and the

A300B4-200 has a volumetric payload of 77,480lbs, making them two-for-one 727-100F and -200F replacement candidates.

The volumetric payload of these aircraft has to be considered in relation to build cost and lease rates. The biggest influence on these will be the market values of the aircraft.

Current market values of the oldest 757s are \$17-19 million. An additional \$3 million would have to be invested for converting and bridging maintenance. Unlike 727s, 757s would not require additional investment for ageing aircraft issues. The total investment of \$20-23 million would result in a monthly lease rate of \$200,000-240,000. Taking twin-engine and two-pilot economics into account, the 757-200 has potential, provided airlines can use the additional payload. Values could also fall if major fleets became available, making the aircraft more attractive.

The 737-300 is unlikely to be considered, since it has a smaller payload than the 727-100. Current market values of the 737-400 are \$19-21 million. Expenditure of a further \$2-3 million would provide 9-11 year old freighters with monthly lease rates in the region of \$210,000-240,000.

The A310-300 has a current market

value of \$18-21 million; close to that of the 757-200 and 737-400. The A310-300 will have higher conversion costs and total for producing a freighter ready for service will be \$26-29 million. Lease rates would then be \$290,000-320,000 a month. Compared to the 737-400 and 757-200, the A310-300 can provide economies of scale. This lease rate is still high relative to the A300B4-200, but the A310-300's lower payload means it carries less risk as far as a 727 replacement is concerned.

The older A300B4-200 is now established in the freight market, and the number of available aircraft is reducing. It has a lease rate in the region of \$200,000.

The younger A300-600 has not begun to be retired and has market values lower than that of the A310-300. Current values of only \$13-16 million and probable build costs would result in a lease rate of about \$220,000-250,000. This would provide an aircraft with similar operating costs to that of the A300-600, and be economic if 727-200 operators could swap two for an A300-600.

The A300-600R has higher values, but its long range is not required by 727 operators. The A300-600R is more suited as a 707/DC-8 replacement candidate.



727-100F/-200F fleet

There are about 500 727-200Fs/-200Fs in operation. The majority are operated by UPS, FedEx, DHL, Emery, Kitty Hawk. Smaller fleets are operated by a variety of other carriers.

Industry predictions are that all -100Fs and the majority of -200Fs will retire. In addition to this, the small narrowbody freighter fleet is expected to grow by about 450 units in the next 20 years. This will generate demand for about 950 new narrowbody freighters in the 727's size category.

As well as aircraft of the same size, the medium widebody fleet of 200 aircraft will grow to 700 in 20 years. Demand for some of this fleet expansion will come from two-for-one 727 replacements.

There are still about 640 passenger configured 727-200s in operation. Not all will be converted, but it is expected that there is a market for about another 300-350 conversions. These are likely to be the first aircraft to replace the 727-100Fs and older 727-200Fs retiring.

The conversion of another 300 727s will still leave a large shortfall for the 950 new narrowbody freighters required to replace and provide additional aircraft to the 727. It is inevitable, then, that other types will have to provide acceptable ton-mile costs compared to the 727's current level.

The prime remaining 727 freighter conversion candidates are fleets operated by American (70), United (75), Northwest (26), Iberia (26), ATA (26), TWA (26) and Delta (112).

Some of these aircraft have already been sold by these operators, but are available as conversion candidates.

727 ageing issues

The 727 has several ageing issues. These affect the economic viability of 727Fs as potential conversion candidates.

These issues can be grouped broadly into:

- 1 Ageing aircraft structural modifications
- 1 ADs 98-26-18/19/20/21 relating to the 727F's freight floor
- 1 AD 98-11-03
- 1 Stage 4 noise compliance

Structural modifications

There are two packages of these modifications. The first is mandatory at 20 years. Almost all aircraft will have had these completed and so the cost no longer affects the fleet.

The second package is mandatory at 60,000 flight cycles (FC). This is expected at 45 years for most aircraft and its cost is expected to present a watershed for retirement. There are several other structural ADs that have been issued against the 727.

Freight door & floor

The 727s converted to freighters so far have been modified using one of four supplemental type certificates (STCs). Hamilton Aviation has recently received its STC, adding to the list. In early 1999 four ADs were issued (ADs 98-26-18/19/20/21), each applying to the four cargo conversion STCs.

Each AD limits the weight of each freight container in the aircraft, on account of concerns that the floor may not be strong enough and that turbulence and gust loads may cause containers to

The 727F is still an economic small package transport, but issues over the airworthiness of its door and Stage 4 noise rules could put pressure on airlines to start replacing a lot of their aircraft.

move and damage the aircraft.

The limitation of payload applies until each STC holder provides a structural modification that is sufficient to restore container weight. Some STC holders have responded by adding side restraints and locks to keep the containers in place.

STC holders could also prove that their modification is strong enough to carry full payload and so no modification is required. STC holders have until June 2001 if they want to do this. Modification will either be required, or original payloads will be restored or limited.

Estimations are that it could cost up to \$700,000 per aircraft for modification. If aircraft cannot be modified and STC holders cannot prove the integrity of their conversions, each pallet position will be limited to 3,000lbs. A tare weight would allow a net payload of 2,750lbs. Small packages packed at 6.5lbs/cu ft provide a volumetric payload of 2,977lbs per container. Weight restriction would therefore only reduce a 727-200F's payload by 227lbs per container and 2,724lbs overall.

Some STC holders have already developed fixes that restore the original payload allowed per container position.

AD 98-11-03

The 727 is also affected by AD 98-11-03; also known as the 'stealth AD'. AD 98-11-03 basically relates to any structural significant item (SSI) being affected in the aircraft by a modification or repair. If an SSI is affected, AD 98-11-03 states that a supplemental structural inspection programme (SSIP) has to be developed to inspect the affect of the modification.

Conversion to freighter thus affects SSIs in the aircraft and a SSIP is required. The problem is that SSIPs require very detailed analysis. In many cases this can only be provided by a finite element model (FEM), which only a few companies have been able to invest in.

The implications of AD 98-11-03 are that four SSIPs will have to be developed for aircraft converted under the four ADs.

AD 98-11-03 goes further because it also affects and concerns any modifications made to restore container payloads following ADs 98-26-18/19/20/21.

Thus, aircraft converted to freighter using one of the four original STCs require SSIPs for their freight conversion, and also for any modifications made to restore original permitted container weights.

Airlines have up to 45 months from their freight modification date to get an SSIP. Many aircraft, however, have exceeded this time limit, since they were converted to freighter many years ago. This leaves a lot of unsolved issues for many aircraft. A lot of 727 operators are reported to be concerned about their aircraft, because the original STC holders have not developed SSIPs. This could theoretically ground a large number of aircraft because their payloads will be restricted at uneconomic levels.

Hamilton Aviation has developed a freight conversion STC and FEM. The freight conversion avoids floor weight restrictions along with an SSIP to cater for AD 98-11-03.

Stage 4

Although it is not clear what levels of noise reductions Stage 4 will impose, the issue is now being debated and the definition is expected by 2002.

For the highest maximum take-off weights (MTOWs), Stage 3 limits set the take-off noise level at 106 EPNdB for 4-engined aircraft, 104 EPNdB for 3-engined and 101 EPNdB for 2-engined aircraft. Sideline and approach noise levels are 103 and 105 EPNdB.

The actual noise level permitted depends on an aircraft's MTOW. The same noise level is allowed for aircraft up to MTOWs of about 50,000lbs. The noise level is then allowed to increase with higher MTOWs, until a MTOW of about 850,000lbs is reached. From this point noise levels have to remain constant with increasing MTOW.

It is expected that Stage 4 noise levels will be 2-5 EPNdB lower than the corresponding Stage 3 level. Total EPNdB readings for take-off, sideline and approach are expected to be five or six EPNdB lower than for Stage 3.

The issue is whether the 727 can make Stage 4 limits. This will depend on what Stage 3 modification the aircraft has already had. About 750 aircraft have been modified with the Feasi hushkit. Another 140 and 47 have been modified with the Raisbeck and Duganair systems. About 30 aircraft have been re-engined with the BF Goodrich Super 27 system.

"Super 27s will be able to meet the Stage 4 limits that are expected to be implemented if they are then modified with our noise reduction system with no trade-offs," says Jim Raisbeck, chief executive officer of Raisbeck Engineering. "The issue is, however, that Stage 4 compliance date is expected to be

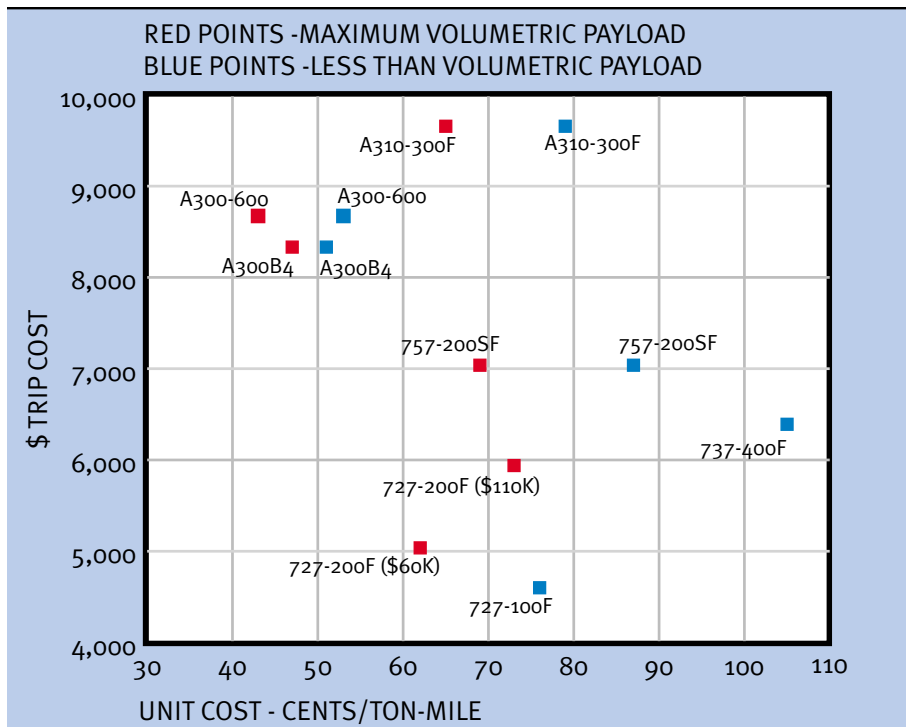
2010-2012. By this time the youngest 727s will be 30 years old and most will have been retired.

Duganair says its Quiet Wing system can be used to make the 727 Stage 4 compliant, by lowering the noise levels by 5 EPNdB. Limiting MTOW at £180,000, would reduce cumulative noise by another 1.9 EPNdB.

Aircraft could be Stage 4 compliant, without being Super 27 modified. This

could only be achieved if the MTOW was reduced, but the operator has to consider the economic viability".

Of the 1,400 727s in service, about 900 aircraft have been Stage 3 modified. Raisbeck estimates that 1,200-1,250 will end up being Stage 3 modified. This leaves a remaining Stage 3 modification market of about 300 aircraft. Of these there are about 200 realistic prospects. These include several fleets retired by



major operators that have been acquired by lessors and may get converted to freighter. All major US fleets that are conversion candidates have been Stage 3 modified.

Economic comparison

As already described, freight aircraft have the lowest costs when their full payload is utilised. Airlines operating the 727 do so because it has low acquisition and lease costs compared to all other types in the same size class. This means that 727s do not necessarily operate with high load factors.

Since there are various alternatives with different payloads, they have to be analysed at several levels. These are with payloads equal to the 727, at their own maximum payload, and in the case of the A310 and A300, payloads twice that of the 727-100F and -200F. The relevant payloads are volumetric payloads with a packing density of 6.5lbs per cu ft.

The 727-100F and -200F have volumetric payloads of 26,793lbs and 35,724lbs (see table, page 43).

The 737-400 has the same payload as the 727-100F. The 757-200 has a higher payload than the 727-200, and so the 757 has to be analysed with the same payload as the 727-200 and maximum payload. The 757 could be used by airlines to accommodate traffic growth.

The A310-300 should be considered with a 53,586lbs payload, twice that of the 727-100F, and a maximum payload of 65,286lbs.

The A300B4 and A300-600 should be considered with a 71,448lbs payload, twice that of the 727-200F, and their maximum payloads.

The major cost categories analysed

are fuel, maintenance, flight crew and lease charges.

Fuel prices are currently high. This will favour younger aircraft, which under a low-utilisation style operation cannot normally benefit from their fuel efficiency. Prices used here are 90 cents per US gallon.

Flight hour (FH) maintenance costs again favour the younger aircraft. These will be high compared to aircraft being operated under high rates of utilisation.

FH rates are \$1,100 for the 727. They are \$800 for the 737-400 and \$975 for the 757, and \$1,525 for the A310, \$1,700 for the A300B4 and \$1,375 for the A300-600.

Flight crew costs are based on annual salaries for a full crew complement of \$248,000 for the 727; \$180,000 for the 737-400; \$210,000 for the 757-200; \$220,000 for the A310 and A300-600, and \$300,000 for the A300B4.

Lease rates for the aircraft have already been described. Trip and ton-mile lease costs are determined by aircraft utilisation. Small package 727 operations typically involve one return flight of 500nm 350 days a year. This will then generate 700FCs annually. Average flight time of 500nm will mean 875FH are flown each year.

The current high fuel prices and a combination of more attractive lease rates and payloads, make many of the younger aircraft competitive against the 727.

The 727-100F has ton-mile costs of 76 cents (see chart, this page). The 737-400 has a ton-mile cost of 105 cents and cannot compete with this at a lease rate of \$225,000 per month. The 737's market value and thus lease rate would have to decrease or annual utilisation would have to increase to have an acceptable cost level. The monthly lease

rate would have to drop to about \$120,000 for unit costs to be close to that of the 727-100F. This implies that 737-400 market values would need to drop to about \$10 million, which will take several years or a surplus of aircraft coming on to the market.

This implies the 727-100F cannot yet be replaced by younger aircraft of a similar size. The 727-200F may then have to replace some older -100Fs. With a payload twice that of the 727-100F, the A310-300 (see chart, this page) has a unit cost of 79 cents per ton-mile, and so presents itself as a two-for-one substitute.

The 727-200 has a unit cost of 62-73 cents per ton-mile, depending on lease rate (see chart, this page). With a payload equal to the 727-200, the 757 has a unit cost of 86 cents. An operator will only use a 757 to carry higher payloads, and would also attempt to get higher rates of utilisation. With a full payload the 757 has a unit cost of 72 cents, which will be more acceptable to 727-200F operators.

The A300B4 and A300-600 can be used as two-for-one 727-200 replacements. With a payload of 71,448lbs, they have unit costs of 51 and 53 cents (see chart, this page), thereby making them more cost-efficient than the 727-200, which has a 10-21 cents higher unit cost.

One example in which the A300B4 has been used to replace 727s is with DHL. The airline has already stated its intention to phase out the 727 in its European operation.

With full payloads the A300B4 and A300-600 have even lower unit costs of 47 and 43 cents per ton-mile. This proves the aircraft are competitive, even in low-utilisation operations.

Summary

Apart from the 737-400, values of alternatives to the 727 are approaching levels where their lease and ton-mile costs will make them economically acceptable.

Since there is no direct replacement for the 727-200 and a small number of 727s remaining to be converted, freight operators will have to accept using larger aircraft. One obvious way will be two-for-one replacement. This will be economic with the A310-300, A300B4 and A300-600.

The 757-200 is also approaching a stage at which its values will allow competitive ton-mile costs. This aircraft can only be used to substitute the 727-200 if higher traffic volumes are available. With the rate in traffic growth it will be feasible to convert many 757s.

The high rate of small package traffic growth should also assist in making the 757, A310, A300B4 and A300-600 viable 727 replacement candidates. 