The rising price of fuel is putting additional pressure on airlines, but fleet modernisations incur high capital expenditure. Various performance enhancement kits are available for the 727 and several 737 variants that generate savings in fuel burn and enhance revenue performance.

Performance enhancement kits for the 727 & 737

The 737-300/-400/-500 and 737NG families have similar cash operating costs. The 737-300/-400/-500 have higher fuel burn and maintenance charges, while aircraft acquisition and financing costs for all types have generally declined over the past decade. The 737NG has superior seat capacity and revenue generating ability due to better field and range performance. While older 737 variants are still economically viable, various performance enhancement kits are available for several 737 variants from two main suppliers: Aviation Partners Boeing and Quiet Wing Corporation. These kits enhance performance and revenue generating ability, reduce fuel consumption. The rise in fuel prices during the past year has increased the economic benefit of these kits.

Aviation Partners

Aviation Partners Boeing (APB) offers a Blended Winglet system for the 737-700, 737-800 and 737-300. APB originally offered its Blended Winglet on the 737NG business jet, but then offered the system to airline operators. "Other 737NG and Classic models, including the -400/-500/-600 and -900 models, will be certified for Blended Winglets if demand is there," explains Mike Marino, chief executive officer at APB.

The Blended Winglet's principal benefits are reduced drag and fuel burn, improved payload-range performance, faster climb performance and improved take-off performance. These in turn lead to other economic and performance benefits.

Blended Winglet technology reduces fuel burn on the 737NG by up to 5% when operating close to the design range limit of the aircraft. On shorter sectors, Blended Winglet equipped 737NG operators report saving an average 3.2% on block fuel burn. A range of performance benefits includes faster time to climb, higher initial cruise altitude, higher engine-out cruise altitude and a reduced noise footprint on take-off.

Blended Winglet kit

Blended Winglet systems for the 737NG have a list price of $725,000, while the kit for the 737-300 has a list price of $450,000. This has to be considered in relation to the cost of installation and the economic benefits gained during the remainder of the aircraft's operational life, as well as the benefits of enhanced residual value that the blended winglets provide over aircraft without them installed.

Installation can be comfortably performed during the course of a C check at any facility that is authorised to carry out maintenance on 737s.

Installation time varies according to 737 variant and production line number on the 737NG series. "Boeing put in a structural provision for higher wingloads from line number 778 onwards," explains Jay Inman, vice president of programmes at Aviation Partners Boeing. "Downtime for installation for 737-800s up to line number 778, aircraft with an under-provisioned wing, is about seven days and consumes about 1,660 manhours (MH). Installation is faster for 737-800s from line number 778 onwards, that is aircraft with a provisioned wing. Downtime for installation is about three days and uses in the region of 440 MH." At an assumed labour rate of $50 per MH, the additional cost of labour for aircraft with an unprovisioned wing is about $83,000. Additional cost of labour for aircraft with a provisioned wing is about $22,000. This takes total cost per aircraft to the region of $750,000.

"The 737-700 with an unprovisioned wing, which uses the same kit as the -800 with an unprovisioned wing, requires a downtime of about six days and uses 1,100 MH," continues Inman. A labour rate of $50 per MH adds about $55,000 to the cost of the kit.

"Blended Winglet systems have been offered as buyer furnished equipment for aircraft with line number 1545 and higher. Winglets are installed on the production line which incurs no downtime for the operator since they are specified when ordering the aircraft."

Installing the kit on 737-300s has a downtime of about 10 days and consumes about 2,000 MH. The labour portion adds a further $100,000 to the price of the kit and takes total cost to about $550,000.

Fuel burn reduction

The main purpose of the Blended Winglet is to reduce wingtip vortice drag which reduces fuel burn on all phases of flight.

Reduction in fuel burn varies with phase of flight, but the largest reduction is experienced during cruise. The largest fuel savings are thus generated with the longest stage lengths. Fleet studies show average sector lengths for the 737-700 and -800 are 750nm and 980nm respectively. In both cases the average reduction in block fuel is about 3.2%. Fuel burn reduction for longer routes is up to 5%.

An unmodified 737-700 burns in the region of 1,400 US Gallons (USG) on a 750nm trip. A reduction of about 45USG can thus be expected. Annual utilisations for many US and European and other similar operations generate 1,800-2,000 flight cycles (FC) each year. The Blended Winglet system can thus save 80,000-90,000USG for each 737-700 annually.

Aviation Partners Boeing has so far secured orders for 430 737-700s and 266 737-800s. Southwest Airlines is the largest customer for 191 kits. Options are held on a further 807 kits. Fuel burn savings on the 737-700/-800 can generate annual savings of $90,000-160,000.

While fuel costs have historically been 60-70 cents per USG, they have more recently increased to 110-120 cents per USG. The annual benefit from reduced fuel burn alone amounts to $88,000-108,000 per 737-700 per annum at current fuel prices. At a list price for the Blended Winglet, this saving alone will pay back the initial installation cost in seven to eight years.

The 737-300's higher fuel burn of about 1,550USG for a similar 750nm trip length will be reduced by about 50USG. At similar rates of utilisation, total fuel burn saved will be 70,000-100,000USG, equal to $77,000-108,000 per aircraft annually. This will allow operators to realise a payback from installation of the kit in five to six years, based on acquiring the kit at list price.

An unmodified 737-800 burns about 2,100USG on a 1,000nm trip, so fuel consumption can be expected to reduce by about 4%. Typical annual rates of utilisation of 1,800-2,000FC will generate fuel consumption savings of 125,000-135,000USG per year, equal to a saving of $137,000-162,000 per year. Operators can thus realise a payback on the cost of installing the system in five to six years from fuel savings alone, based on the kit being acquired at list price.

The first benefit of reduced fuel burn is greater range performance for a given fuel volume. The lower fuel burn changes the trade between fuel and payload, and the profile of the payload-range curve when the aircraft is operating at the maximum take-off weight (MTOW) and maximum fuel volume portions of its payload-range profile.

This is between still-air ranges of 2,200nm and 4,000nm for the 737-700. Still-air range is increased by 110-130nm over this range of sector lengths. The longer range performance itself is unlikely to generate any significant additional revenue generating ability. Alternatively, 1,100lbs higher payload can be carried between 2,200nm and 3,400nm, and a 4,400lbs higher payload between 3,400nm and 4,000nm. These higher payloads can be directly translated into additional freight carrying capacity.

While most sectors operated by airlines are less than 2,000nm, the 4,400lbs higher capacity can translate into about $2,000 more revenue per trip from additional freight at typical freight yields on longer routes.

The improved payload-range performance for the 737-800 is between still-air ranges of about 2,150nm and 3,900nm. This increases range performance by 80-130nm. Alternatively the aircraft's payload is increased by 910lbs on sectors between 2,150nm and 2,900nm, and by 5,800lbs on longer routes. Again this translates into significant additional freight earning capacity on longer routes.

Operating performance

The lower drag also enhances the aircraft's climb and field performance. Lower drag during take-off reduces field length for take-off. While this may not provide any benefit at sea-level airports or those with long runways, it is likely to do so at airports that limit take-off weight and therefore payload. These will be airports with short runways, high ambient temperatures and high elevations.

The 737-700, which has an MTOW of 154,500lbs, has a take-off run of 6,000 feet at sea level. Blended Winglets reduce this by only 200-300 feet in these conditions, but the difference is greater at a high airport elevation. Take-off field length is reduced by up to 1,700 feet at an airport elevation of 5,000 feet. This enhanced performance can be traded for increased permitted take-off weight. At an ambient temperature of 35 degrees centigrade and airport elevation of 5,000 feet, Blended Winglets will increase the permitted take-off weight by 5,000lbs to about 142,000lbs compared to aircraft without Blended Winglets. This additional 5,000lbs can be translated into higher freight payload, or about 22 additional passengers. Typical freight yields mean the extra payload will be about $2,500 per trip higher, but the additional revenue from 22 passengers is likely to be higher still.

With Blended Winglets installed, the 737-800, which has an MTOW of 174,200lbs, will have its take-off field length reduced by at least 1,000 feet at gross weights of 145,000lbs or more compared to aircraft without Blended Winglets when operating from airfields with an elevation of 5,000 feet. This reduction in field length can be traded for increased permitted take-off weight by the order of 4,500lbs at high ambient temperature, allowing for an equal amount of additional freight payload or about 20 extra passengers, enhancing the aircraft's revenue generating capacity.

Blended Winglets also increase the aircraft's buffet boundary. "This permits the aircraft to climb to higher altitudes at a higher gross weight than to the basic aircraft," explains Mike Stowell, vice president of engineering at Aviation Partners Boeing. "The aircraft can therefore reach its optimum cruising altitude faster, which contributes to the fuel savings."

The higher buffet boundary also allows higher cruise speeds while lowering fuel consumption compared to aircraft without winglets. Increasing cruise speed from Mach 0.78 to 0.805 will reduce block time by about 12 minutes on a 2,500nm sector, with the equivalent fuel consumption as the same aircraft without winglets.

Maintenance costs

Blended Winglets have no moving or complex parts, and so have little impact on the aircraft's structural maintenance costs. "It is estimated the winglets add only about 26MH to planned inspections over six years," says Marino, "and so have very little effect on airframe-related maintenance costs. The winglets are made of the same composite materials used in the 737NG's ailerons. Blended Winglets are also backed by Boeing as part of the aircraft, and so operators can get technical support from Boeing, which also administers warranties.

"The reduced drag at take-off also means airlines can increase engine de-rate at take-off by as much as 4%, as well as reducing thrust during the cruise," continues Marino. "This increases the removal interval between shop visits, thereby reducing cost per flight hour (FH) for engine-related maintenance costs."

Environmental benefits

The benefits of reduced drag and fuel burn translate into the reduction of noise and gaseous emissions. "Take-off noise emissions are reduced by one decibel, which reduces the noise footprint area by about 6.5%," says Marino. "While the reduction in noise at landing is equal to about only 0.1 of a decibel, the lower noise emissions were a major factor in interesting All Nippon Airways."

The lower fuel burn also reduces gaseous emissions, and there is almost a 5% reduction in NOx emissions. This can lead to some financial benefits, especially in parts of the world such as Scandinavia.

Given typical discounts to list prices, the combined benefits of Blended Winglet technology ensure the average operator will experience an economic payback in no more than three to five years, for an asset with an economic life of 30 years.

Further developments

Substantial numbers of 737-700/-800s and -300s have already been modified with the blended winglets. Kits have been ordered for 430 737-700s and 266 737-800s. Major customers include All Nippon Airways (45 kits), American Trans Air, Air Berlin, Continental Airlines, Copa Airlines, Hapag-Lloyd, Qantas, South African Airways, Southwest Airlines (191 kits) and Westjet (49 kits). Options are also held for a further 807 kits: the largest numbers by Alaska Airlines, Continental Airlines, Qantas, Southwest, Virgin Blue and Westjet.

APB is now in the process of developing blended winglets for other Boeing types. "We are developing winglets for the 757-200 and 767-300ER, but have not yet received supplemental type certificates (STCs) for these two aircraft," says Marino. "Continental Airlines is a launch customer for the 757-200 with an order for 11 aircraft, and certification of the system is expected in April 2005. The list price of the kit is $720,000 and installation takes about 2,390MH".

A labour rate of $50 per MH takes total cost of the kit to about $840,000. Fuel burn on a 1,500nm sector is in the region of 4,250USG, and so a 4% fuel burn reduction would save about 170USG per trip. An annual utilisation of 1,000FC would save 170,000USG, equal to about $187,000 annually in lower fuel consumption.

The kit for the 767-300ER has a list price of $1.45 million and requires a similar number of MH for installation. A 3.25% reduction fuel burn would save about 220USG in fuel burn for a 2,000nm trip and about 220,000USG over a year's utilisation. This is equal to savings of about $240,000 at current fuel prices.

APB so far has shelved plans to develop a Blended Winglet for any variant of the 747, but is well into a development study to add very large Blended Winglets to the 777-200ER.

Quiet Wing

Quiet Wing Technologies Inc has developed a new noise reduction and performance kit for the 737-200 and 737-300/-400/-500 series. The new 737 kit consists of three parts: acoustic treatments to the JT8D engines on the 737-200; with wing flap and aileron configuration changes; and an option to install winglets to all aircraft models. Customers have the option of installing just the wing configuration changes alone for added performance (performance kit) or the acoustic treatments and wing configuration changes (noise and performance kit) with the option of adding winglets to either configuration for additional performance and fuel savings. The overall effect is improved operating performance and reduced fuel burn, plus a reduction in aircraft noise, which helps in achieving Stage 4 compliance.

Quiet Wing's design team has had more than 20 years of major modification experience on jetliners. The modifications have included reinforced cockpit doors, operating weight increases, cargo conversions, performance systems, and noise reduction systems (including the Quiet Wing 727 System for the 727, which received its STC in 1996). The system allows the 727 to exceed Stage 3 noise requirements up to an MTOW of 210,000lbs. The 737 noise and performance kits capitalise on the proven design and performance of Quiet Wing's 727-100/-200 noise and performance kits. Similarly to the 727 Quiet Wing System, the 737 system design incorporates performance improvements to the aircraft to facilitate noise reduction, performance gains, and payback with increased revenue.

Total list price for the noise,

AVIATION PARTNERS BOEING 737-300 & 737-700/-800 BLENDED WINGLET KITS

Aircraft type	737-800	737-700	737-300
Kit list price	$725,000	$725,000	$450,000
MH for installation	440/1,660	1,100	2,000
MH labour cost	$22,000/$83,000	$55,000	$100,000
Fuel saving 750nm trip	70USG	45USG	50USG
Annual FC	1,800-2,000	1,800-2,000	1,800-2,000
Annual fuel saving-USG	125,000-135,000	80,000-90,000	70,000-100,000
Annual fuel saving	$137,000-162,000	$88,000-108,000	$77,000-108,000
Performance gains			
Range increase-nm	80-130	110-130	
Increased payload-lbs	910/5,800	1,100/4,400	
Hot & high payload lbs gain @ 5,000 feet & 35 deg C	4,500	5,000	

performance and winglet kit ranges between $295,000 and $645,000, depending on options and the original configuration of the aircraft being modified. An additional cost is that of installation. All three elements can be completed during a C or D check. The performance kit alone requires about 1,200MH, which adds about $60,000 at a labour rate of $50 per MH. Installation of the winglets requires about a further 600MH, adding another $30,000.

Technical details

The Quiet Wing System kits change the wing configuration of the aircraft by drooping the neutral setting of the aft trailing edge flap and ailerons. The effect of this on cruise performance is to reduce the compressibility drag, which contributes to a reduction in fuel burn. The principal effect is the increase in Mach number before the onset of a high rise in drag. That is, the drag divergence Mach number. This is at about Mach 0.76 in an unmodified 737-200, but the aerodynamic improvements offered by the performance kit raise this to about Mach 0.78-0.79, allowing a higher cruise speed without incurring the drag penalty.

In the case of the 727-200 Quiet Wing System, this Mach divergence number is raised from about 0.84 to 0.89, again allowing a higher cruise speed before high drag penalties are incurred. Besides reducing drag and fuel burn for a given cruise Mach number, the Quiet Wing System kits allow higher cruise speed and so reduce flight times by several minutes on short-haul missions. An additional cruise benefit of the wing configuration change is to increase the aircraft's buffet boundary, increasing its flight envelope. This allows the aircraft to operate at higher weights and altitudes.

Lower fuel burn

The reduction in drag provided by the kits directly relates to a reduction in fuel burn through all phases of flight. Savings in fuel burn are about 2-3% for modified aircraft without winglets and 5-6% with winglets installed. These savings have to be considered in relation to fuel burn on unmodified aircraft on typical stage lengths and utilisations.

The 727-200, 737-200 and 737-300/-400/-500 are operated on short-haul operations, and here are analysed in terms of a 750nm stage length. Due to the performance gains achieved with the performance kit, operators are finding that modified aircraft are capable of operating at longer ranges and increasing the gross weight capability without having to upgrade the engines. As the stage length increases and/or aircraft utilisation increases, the operating savings grow proportionately.

In the case of the 727-200, the aircraft burns 3,000-3,200USG on a typical 750nm mission length, depending on the actual variant and engines installed. A 3% saving derived from the performance kit alone (without winglets) reduces fuel consumed by about 90USG. This totals about 135,000USG over a year's utilisation of about 1,500FC for a passenger operation. At current fuel prices of $1.10 per USG this makes an annual saving of $150,000. This has to be considered against $400,000 for the price of the kit and another $60,000 for installation.

The fuel saving alone thus requires a payback period of about three years when based on list price.

With winglets added to the modification, the fuel burn reduction will increase to about 6%, or 180USG. This will be about 270,000USG during a year's operation; equal to a saving of $300,000 at current fuel prices. This has to be considered against the price of the kit, which will be $500,000-600,000, plus the additional MH for installation, which will be about another $90,000.

Installation of Quiet Wing's performance and winglet kit on the 737-200 costs about $600,000, but generates annual fuel savings of about $120,000. Performance from hot and high airfields is enhanced, increasing available payload by up to 5,000lbs in some cases. The additional revenue from this can mean payback from the investment in the kit is made in two or three years.

Based on list price of the kit, the payback for cost of installation is about two years when based on fuel savings alone. The additional cost of installing the winglets has the effect of doubling the fuel burn reduction and reducing the payback period. The 727-200 will generate further savings, or additional revenue, to offset the cost of the kit and labour for installation, by improved operating performance and allowing the aircraft to operate at or close to maximum gross weight. This benefit will be significant for hot and high operations where permitted take-off weights and payloads are limited for unmodified aircraft. This is analysed later.

A typical operator for the performance kit enhanced 727 is Asia Pacific Airlines. It operates three 727-200Fs with both wing flap configuration changes and winglets on cargo routes throughout the Pacific. Mike Quinn, president of Asia Pacific Airlines says the aircraft are achieving average fuel savings of 4.5% over a standard heavyweight -17-powered aircraft. "The re-engined Super 27, which is also equipped with Quiet Wing's 727 winglets and performance kit, has phenomenal fuel savings. We are getting more than 10% fuel burn reduction, which allows us to either carry about 10,000lbs more in payload or save about 2,000lbs of fuel on our longest trips," says Quinn.

The 737-200 has a fuel burn of about 1,850USG on a 600nm mission. A fuel burn reduction of 3% will save about 55USG, or about 82,000USG over a year's operation of 1,500FC, equal to a saving in the region of $90,000 at current fuel prices.

The addition of winglets to the 737-200 will raise the fuel burn saving to about 75USG, which will be a total of about 112,000USG and $123,000 during the course of a year. Based on the kit's list price, the payback for the cost of installing the kit with winglets is about 4-5 years when based on fuel savings alone.

While the same size as the 737-200, the 737-500 has a lower fuel burn of about 1,500USG on the same 750nm mission. Without winglets, the reduction in fuel burn is about 50USG, while the addition of winglets increases this to about 80USG. For an annual utilisation of 1,500FC, these equate to annual savings in fuel consumption of 75,000USG and 120,000USG respectively for aircraft with the performance kit, and with winglets added to the performance kit. These are equal to annual savings of about $82,000 and $130,000.

Payback on the savings from reduced fuel burn alone is thus 3-6 years, depending on which kit is installed.

The 737-300 has a marginally higher fuel burn compared to the -500. On a 750nm mission, the 737-300 burns about 1,550USG. The saving from the performance kit alone is in the region of 50USG. The effect of adding winglets to the modification increases the fuel burn saving to about 80USG.

These are equal to 75,000USG and 120,000USG for a year's utilisation of about 1,500FC, generating savings of about $82,000 and $130,000. Like the 737-500, this will take a payback period of 3-6 years, assuming list price for the modification, and depending on which kit is installed.

The 737-400 has a similar fuel burn to the 737-200 on the same 750nm mission. Reductions in fuel consumption are thus about 55USG for an aircraft with just the performance kit, and about 90USG for an aircraft with the winglets installed. This is equal to annual reductions in fuel burn of 84,000USG and 135,000USG, providing annual savings of $92,000 and $148,000. This is larger than that realised for the 737-300 and -500, thus shortening the payback period to about four years for the 737-400 when based on the kit's list price.

The modification for the 737-300/-400/-500 increases their operational life and enhances their residual value retention. The modified 737-300, for example, will have a fuel burn close to the same size 737-700, and so can defer replacement of the 737-300.

Operating performance

In addition to improved cruise performance and reduced fuel burn, the modification also provides a major improvement in low speed performance. The wing modifications provide an increase in the flap system efficiency, resulting in reduced flap drag. This directly leads to better performance leading to shorter take-off and landing runs. These can be traded for higher permitted take-off weights at airports where aircraft with poorer performance often have limited take-off weight and therefore reduced available payload. "For those cargo operators whose flights are constrained by runway limits, the Quiet Wing Performance kit creates an immediate revenue advantage by improving the MTOW by 8,000-10,000lbs through use of 30-degree flap take-offs," confirms Quinn.

The 727-200 and 737-200 are powered by several variants of the JT8D, starting with the low-powered -7 and going up to the highest powered -17 model. The effect of the Quiet Wing system is the same as changing engines to a higher thrust variant, which would increase the permitted take-off weight and provide the same effect as extending the aircraft's payload-range profile. Higher take-off weights are therefore permitted at challenging airfields, and payload and range are both increased.

The increased payload capability is especially noticeable at hot and high airports. One example is Lloyd Aero Boliviano's (LAB) operation from La Paz, which is 13,000 feet above sea level. LAB's un-modified 727-200 with -17R engines had a permitted take-off weight of 145,000lbs. This was increased to 152,000lbs by the Quiet Wing

QUIET WING 727, 737-200 & 737-300/-400/-500 PERFORMANCE KITS

Aircraft type	727	737-200	737-300/ 737-500	737-400
Performance kit				
Kit list price	$400,000	$400,000	$400,000	$400,000
MH for installation	1,200	1,200	1,200	1,200
MH labour cost	$60,000	$60,000	$60,000	$60,000
Fuel saving-USG	90	55	50	55
Annual FC	1,500	1,500	1,500	1,500
Annual fuel saving-USG	135,000	82,000	75,000	84,000
Annual fuel saving	$150,000	$90,000	$82,000	$92,000
Performance & winglet kit				
Kit list price	$550,000	$550,000	$550,000	$550,000
MH for installation	1,800	1,800	1,800	1,800
MH labour cost	$90,000	$90,000	$90,000	$90,000
Fuel saving-USG	180	75	80	90
Annual FC	1,500	1,500	1,500	1,500
Annual fuel saving-USG	270,000	112,000	120,000	135,000
Annual fuel saving	$300,000	$123,000	$130,000	$148,000
Hot & high payload gain (lbs)	7,000lbs (La Paz)	5,000lbs (Mexico City)	Expected similar to 737-200	Expected similar to 737-200
	8,000lbs (Mexico City)			

modification, and potentially an equal increase in payload of 7,000lbs. This translates into about 30 additional passengers, depending on unit weight and baggage weight or additional freight. A passenger one-way fare of $100 would equal an increase in revenue of up to $3,000 per flight. This would equate to at least $1,000,000 additional revenue per year. The payback period on the installation of the kit would thus be reduced to less than one year. The kit would also defer the need to acquire a replacement aircraft with high capital cost and lease charges.

Operation of the 727-200 as a freighter would increase revenue by up to $3,500 per flight. Even at low rates of utilisation typical of freight operations, this would generate additional revenue equal to several hundred thousand dollars, and so realise a payback in a short period. The system has a similar effect of increasing permitted take-off and payload by more than 8,000lbs for a -9A powered 727-200 operating from Mexico City to Tijuana.

The 737-200 realises similar benefits. The aircraft's permissible take-off weight and payload increases by 5,000lbs when operating from Mexico City. At typical freight yields this generates up to $2,500 additional revenue per flight, translating into several hundred thousand dollars per year. This therefore shortens the payback period to just one or two years, depending on the actual additional payload carried, aircraft utilisation and freight or passenger yields.

It is not yet clear what operating performance and payload enhancements the 737-300/-400/-500 will gain from the kit, although they are expected to be similar to those gained by the 737-200 from hot and high airports. The additional available payload and revenue generated will reduce the payback period for investing in the kit.

Technical support

Installing the kit does not affect aircraft maintenance costs. With the aircraft re-configured and performance affected, Quiet Wing provides documentation support for the flight manual supplement, weight and balance supplement, maintenance manual supplement, illustrated parts catalogue supplement, inspection manual supplement and the minimum equipment list.

Quiet Wing also provides an installation supervisor to oversee and advise the customer's chosen installation facility during the installation process.

Noise reduction

In addition to the savings provided by the kits, installation of the modification reduces noise emissions of the 727-100/-200 and 737-200 to meet Stage 3 and aid in achieving Stage 4 requirements for these aircraft. This permits the continued operation of the older aircraft. With respect to noise reduction on the 727-200 and 737-200, the wing configuration change from the performance kits has the effect of reducing take-off, sideline and landing noise emissions by an aggregate five decibels. The engine treatment kits on the 727 and 737-200 reduce noise emissions by about an aggregate three decibels. This allows the aircraft to operate in and out of noise sensitive airports and will aid in complying with Stage 4 noise requirements.

Life extension

The cost of installation can thus be viewed not only against savings from fuel burn, but also in relation to the life extension the kit allows. The acquisition or financing cost of a replacement aircraft, either a used 737-500 or new 717, 737-600 or A319 is high in relation to the amortisation of the $450,000-600,000 installation cost of the kit. Moreover, the low capital or lease cost of the 737-200 means it is attractive to operators in regions such as Central and South America. The improved operating performance that results from the kit will enhance the aircraft's revenue generating capacity. Another direct benefit of the modification is to increase the aircraft's operational life and enhance its residual value retention. The modified 737-300 will have a fuel burn close to the same size 737-700, and so can defer replacement of the 737-300.

The cost of the kit also has to be considered in relation to the cost of swapping low thrust variants with higher thrust rated JT8D variants. In the case of the 727-200, Quiet Wing gives the example of the sector between Miami and Los Angeles, where payload is increased by about 4,200lbs when swapping -7 engines for -9 variants, while the increase from the performance kit instead is to increase the payload by about 7,900lbs.

Kit availability

Quiet Wing is completing its FAA flight-testing. It expects to receive its STC for the 737 systems in the third quarter of 2004 and plans on having kits available as early as December 2004. AC