

Winglets: making their presence felt

Though sales have been limited by the downturn, those customers that have elected to install winglets are reporting significant benefits. *Aircraft Technology* investigates the latest developments in an emerging market.



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“Our most prominent benefit is actually the fuel reduction in cruise. That’s what we target in the design of our winglets.” So says Jay Inman, VP programs at Aviation Partners Boeing (APB), of the winglet his company manufactures for B737NG, B737-300 and BBJ aircraft. This winglet, it is claimed, can deliver a reduction in drag of up to seven per cent, depending on mission profile; and this reduction in drag brings with it various operational benefits. As a general rule, the longer the range, the higher the cruising altitude and Mach number, the greater the fuel savings.

Small lifting surfaces which are attached to the outboard end of an aircraft wing — usually at a vertical angle from the wing structure — winglets serve to relocate the tip vortex of the wing further outboard and above the unmodified location. And it is by relocating the tip vortex that winglets reduce drag — the retarding forces that act on an aircraft as it moves through the air — and hence decrease the rate of fuel burn.

Furthermore, winglets have the aerodynamic impact of increasing the aspect ratio without necessitating structural reinforcements through increases in the span or wing bending moment. They also increase the wing

buffet margin, which allows the aircraft to fly at higher altitudes, where fuel mileage is increased.

Another potential benefit of using winglets is a reduced noise footprint during takeoff. Because a winglet improves the wing’s angle-of-attack characteristics, climb performance is improved for a given takeoff thrust, allowing operators either to use less engine thrust during the takeoff phase, or to use the full takeoff thrust to obtain a greater climb-out performances. This latter option may be preferred where noise is a constraining factor.

Service experience

So, how are APB’s winglets actually performing in service? “We have been very happy with the winglets so far,” says Jim King, VP planning at Aloha Airlines, which has winglets installed on four of its B737-700s and plans to install them on the remainder of its fleet during maintenance visits in spring 2004. “Winglet-equipped aircraft are realising fuel savings of between 4.9 and 5.1 per cent. This is a little better than advertised, probably because we fly very long stage lengths — averaging 1,800 miles. We have also realised takeoff performance improvements from some of the shorter



ATA Airlines is among the airlines operating B737-800s equipped with APB winglets.

airports we use. Installation went smoothly, during a regular C check downtime, and took about 1,300 man-hours per aircraft. The pilots have had no trouble adapting to them — they can switch back and forth between winglet and non-winglet aircraft with no difficulty.”

Also registering a favourable reaction is Brazilian carrier Varig, which has winglets installed on both its B737-800 aircraft. “We’ve had a better performance with winglets, especially to improve our payload and put more weight on the aircraft,” says Norberto Raniero, general manager of operations and engineering at Varig. “And as we have better fuel consumption, we can increase our range of operation.”

Australian carrier Qantas Airways has winglets installed on its B737-800 aircraft. “Due to Australia’s remoteness, payload-range capability has always been a consideration with any aircraft evaluation — domestic or international,” says David Cox, Qantas’ executive general manager, engineering, technical operations and maintenance services (ETOMS). “Our evaluation of the B737-800 initially considered an east-coast network and the use of blended winglets was found to be beneficial both to range and fuel burn. Our network now includes cross-country flights — that is, east coast to west coast — where this benefit is further increased. During our evaluation, we also considered reduced costs and derate benefits. “

He continues: “According to Boeing data there is a saving of between approximately one per cent for a 250nm sector and up to four per cent for a 2,000nm sector. Our current network would see approximately three per cent block fuel saving by using blended winglets. Fuel burn for our aircraft has been essentially as predicted. Additionally, the improved climb-out capability offered by the winglets gives improved takeoff performance on obstacle-limited runways. On airports with close-in obstacles we are seeing takeoff weight improvements up to 3,100kg over non-winglet aircraft, which translates into improved commercial load on range-limited sectors. We also see a

decrease in costs due to noise charges and savings made by derate benefits.”

As a consequence of its positive past experience with winglets, Qantas has launched a study to evaluate the benefits of installing winglets on its B767-300ER aircraft, on which Aviation Partners Boeing claims a saving of up to five to six per cent in fuel burn for long-range missions. However, as yet, no operator has yet installed winglets on the B767-300.

The Australian market is something of a stronghold for APB, with Virgin Blue also among its major customers. “Prior to going to winglets, we ran a study which looked at potential fuel savings for a single aircraft on a Melbourne-Perth-Melbourne double rotation,” says Stephen Knudsen, Virgin Blue’s flight ops technical manager. “Compared to a non-winglet -800, the winglet aircraft saved around 1.4 to 1.6 tonnes of fuel per day, which gave us the justification to move forward with the programme. An additional plus was the increased second-segment climb performance, which translated into either additional payload under WAT-limited conditions [WAT = weight, altitude, temperature] or reduced engine wear.” And in practice, have the expected improvements in fuel burn and takeoff performance been realised? “Yes.”

Future prospects at APB

So, favourable feedback has been forthcoming. Indeed, Dick Friel — APB’s SVP marketing — claims that, “were it not for the economic downturn and some of the fallouts from 9/11, the domestic airlines would have seized upon this. Our success has really been, to a large extent, in Canada and Mexico and elsewhere, with offshore airlines. Those would include Air Berlin, Hapag-Lloyd, Aloha, Aeromexico, etc. We really feel the downturn is the only thing holding us back at the moment.”

It is anticipated that, as far as domestic sales are concerned, the recruitment of Southwest Airlines as a customer could be a watershed for APB. In June 2003, the Dallas, TX-based carrier announced its intention to affix blended winglets

to its entire B737-700 fleet, creating a great deal of new business for APB, with 169 installations of winglets to be carried out over a period of two years. Southwest also has options to acquire an additional 373 winglets through 2012. "The fact that Southwest Airlines — which is literally the most successful airline in the world today, in the sense that it's never failed to make a profit — has selected our winglets gives us a stamp of approval," says Friel. "They're the toughest of all airlines to win over — they won't adopt something unless it really works." On the subject of Southwest Airlines' in-service experience with the winglets, McCallum offers this: "In casual conversations, Southwest Airlines' initial indications are a four to five per cent block fuel saving."

Plans exist to expand the range of aircraft types for which APB provides

winglet systems to include the B757-200, B767-300 and B777. "You can easily make a blanket statement that there's not a Boeing aircraft flying that couldn't benefit measurably from the adoption of APB's winglets," asserts Friel. "With our new programmes, it's just a case of securing a launch customer — an airline which will: a) lend us an aircraft for flight tests; and b) act as launch customer which will give us an order for x winglets if in fact we get the numbers we are proposing. So, we're actively and aggressively pursuing launch customers for the B757, B767 and B777."

Meanwhile, the growth of the corporate aviation sector is likely to benefit APB's founding company Aviation Partners Inc. (API), which already offers certified blended winglets for Gulfstream II aircraft and is in the process of gaining certification on the Hawker 800.



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Aloha Airlines has winglets installed on four B737-700s and plans to install them on the remainder of its fleet during maintenance visits in spring 2004.

"Virgin Blue did performance checks flying from Seattle [WA] to Hawaii and from Hawaii to New Zealand, and saw a six per cent fuel saving."

—Craig McCallum, sales director, APB

Inman points to another factor which suggests a bright future for APB: "What Aviation Partners Boeing brings to the table, apart from performance benefits, is the backing of the Boeing Company. Once we retrofit an aircraft with winglets, Boeing stands behind that retrofit and stands behind the warranty on that aircraft."

B727 winglets

Though APB dominates the market for winglet systems, there is one other significant player in the shape of Quiet Wing, a Bellevue, WA-based manufacturer of B727 winglet systems. "We've elected to develop a security door programme because we've found that the market for our winglets has slowly declined as the aircraft get older and go out of service," says Quiet Wing's director of engineering Phil Kirk. "Our sales at this point tend to be here and there — mostly overseas airplanes going to third world countries. Most of those sales are tied in with noise regulations, since we provide our winglets as part of a hushkit system. We've continued to win sales in South America, where operators fly in and out of performance-limited airfields much more, but there's very little B727 business inside the US now."

Amerijet International is, however, a customer for Quiet Wing's B727 winglets, and director of quality control Carlo Postell estimates the benefits as follows: "We believe we are getting a fuel saving of, comfortably, four per cent or more, and our pilots can climb a lot faster and get to cruise altitudes quicker." He adds the low level of initial investment involved made the implementation of winglets "a very economical decision".

Quiet Wing is likely to see its business expand with the introduction of a B737 performance and hushkit system — though this will not involve winglets per se. "We completed our company flight-testing in December 2003," explains Kirk. "It involves a variety of changes to the wing, some of which are similar to what we did on the B727. But we're not attempting to put B727 winglets

onto that aircraft, principally because, in our view, it cannot be justified economically. The simple fact of the matter is that the B737 classic is a short- to medium-range airplane, and any benefits you get from fuel savings are pretty much incidental to the total operating cost of the aircraft. There's no way you can show any payback from that — the only benefits of putting winglets on would be aesthetic. So, because of the mechanical complexity of putting winglets on an aircraft of B737-200 or -300 vintage, we ruled out that idea early in the game, but we are doing some things at the wingtip that will produce some benefits, though we're not prepared to disclose what those are at this point in time." Quiet Wing's B737 system is expected to be launched in the fourth quarter of 2004; launch customers are already in place.

"I think, by virtue of Aviation Partners' joint venture relationship with Boeing, they clearly dominate the winglet market for both new and old airplanes," concedes Kirk. "That has affected our decisions on some of the things we might have done. We would obviously be at a very major disadvantage trying to put winglets on newer Boeing airplanes, for example, since APB basically have the inside track there. So, since we can't compete at the new-airplane end, we compete on the old airplanes, and that necessarily means that anything we do absolutely has to be cost-effective. A couple of years ago we did a study for United Airlines, when we were talking to them about some retrofit ideas, and when you go through the economics of its, there's no question that as the marginal benefits fall away a lot as the cost of implementation increases."

He concludes: "The real focus of our business is, as I say, in the low-end market — mostly overseas airlines, start-ups, cargo carriers, third-world operators — people trying to do the best they can with old airplanes. There's a lot of things you can do to old airplanes to make them more effective, and that's where I see our continued business." ●