MD-80 modification & upgrade programmes

The MD-80 has no prospects for conversion to freighter, but does have a durable airframe. There are several performance enhancing modifications.

The modification and upgrade programmes for aircraft generally fall into four categories: gross weight and fuel capacity upgrades; avionic modifications and installations; passenger-to-freighter conversions; and noise and fuel burn reduction programmes.

Despite the durability of its airframe there are no passenger-to-freighter modifications for the MD-80, because its fuselage cross-section is narrower than that of all the other narrowbody freighters: the 727, 737 and DC-8. There are, however, other types of modification available for the MD-80.

Gross weight & fuel capacity

There are several variants of the MD-80 series, and several gross weight and fuel capacity specifications for each variant. The three main variants are the MD-81, -82 and -83.

The MD-83 has the highest gross weight of 160,000lbs. There are five different fuel capacity versions for this gross weight, varying between 5,840US Gallons (USG) and 7,780USG *(see MD-80/-90 specifications, page 10)*.

The MD-82 has two gross weight options: 147,000lbs and 149,500lbs. Both have a fuel tank capacity of 5,840USG. The MD-81 has the same fuel tank capacity, and lower gross weight of 140,000lbs.

It is possible to increase gross weight or fuel tank capacity, or both. The MD-81's specification can thus be upgraded to the -82's or -83's. Upgrading to the MD-82 would increase range by up to 600nm, while an upgrade to the -83 would increase range by up to 1,000nm.

Upgrading the MD-81 to the -82 only requires an increase in maximum take-off weight (MTOW). This involves structural strengthening, which is possible with the purchase of a kit from Boeing, which has a list price of $570,000. The upgrade incurs the additional cost of man-hours (MH) used during installation.

Upgrading the MD-81 to the MD-83 involves increasing the MTOW and adding auxiliary fuel tanks that add between 565USG and 1,940USG. Increasing just the MTOW to 160,000lbs would improve the aircraft's range by 700nm, while installation of auxiliary fuel tanks of up to 2,300USG capacity would add a further 350nm of range.

Increasing the MTOW requires strengthening the aircraft structure, and the kit from Boeing has a list price of $900,000, plus MH for installation.

The MD-82 can be upgraded to the MD-83 by an increase in MTOW from 149,500lbs to 160,000lbs and installing auxiliary fuel tanks with 565-1,940 USG.

The MTOW upgrade kit has a list price of $570,000.

Avionic upgrades & installations

Various avionic modifications have become mandatory for all aircraft over the past few years in different operational areas, including: the use and installation of 8.33 KHz VHF channel spacing on VHF radios in Europe; traffic collision avoidance system (TCAS); enhanced ground proximity warning system (EGPWS); reduced vertical separation minima (RVSM) in Europe and the Atlantic Ocean Area; Area Navigation Requirements (BRNAV/PRNAV) in Europe; air traffic control (ATC); mode S transponder additional parameters in Europe and hardened flightdeck doors. There has also been an airworthiness directive (AD) for the installation of insulation blankets in the fuselage walls.

In addition to these, it is possible to retrofit MD-81s, -82s and -83s with electronic flight instrument system (EFIS) that is standard on the MD-88 to gain better situational awareness for navigation. "The Honeywell flightdeck used on the MD-88 is still available," says Mikko Koskentalo, assistant vice president component department at Finnair Technical Services. "We installed these to comply with European Navigation requirements along with a Flight Management System and dual GPS and Scanning DMEs as positional sensors. Overall it complies with the European requirements for RVSM and navigational accuracy until at least 2008.

There are several avionic modifications for the MD-80 and a hardened flightdeck door that are mandatory in Europe and the US, which cost about $350,000. As an alternative to these avionic modifications, airlines can install an EFIS flightdeck at a total cost of about $1 million.

SAS has a fleet of 56 MD-80s, and is considering modifying its aircraft with Jet Engineering's Stage 4 hushkit so that it can operate the aircraft for another 10 years. This will reduce noise, cut fuel burn by about 2% and improve engine on-wing life. SAS may also consider installing winglets.

The cost of installing this type of flightdeck is close to $1 million per aircraft if all the systems are added. It uses more than 1,500MH."

Koskentalo explains the costs of additional avionic upgrades. Each of these are mandatory in various parts of the world, at least in European operational airspace. Installation of RVSM is mainly an accuracy requirement for altitude measurement and flying capability. The typical cost is $30,000 per aircraft and requires about 30MH. The installation of 8.33 KHz radio channel spacing is a VHF Comm radio and control panel modification and minor wiring changes, with a price of $100,000 and about 50MH for installation. The kit for EGPWS/TAWS costs about $80,000 and uses about 100MH. The kit for ATC mode S transponder and TCAS installation costs about $250,000 and requires 800MH for installation. These last two modifications are already mandatory for aircraft operating in US and European airspace, however.

"A hardened flightdeck door has a kit price of $100,000 and uses about 100MH for installation. These are mandatory at least for aircraft operating in European and US airspace," says Koskentalo. "The cost of installing insulation blankets varies with the number of blankets to be replaced. This is covered by AD 2000-11-01, and must be complied with by June 2005. It is mandatory for aircraft operating in all parts of the world."

Noise & fuel burn reduction

The MD-80 is compliant with Stage 3/Chapter 3 noise regulations, and so hushkit and noise reduction modifications have not been needed so far. There is now, however, a Stage 4 noise compliant programme that has already been developed for the MD-80. Although it is not mandatory to make older generation aircraft Stage 4 compliant, it is possible that there will be legislation requiring aircraft to be modified. Jet Engineering and Goodrich Aerostructures are co-operatively marketing a noise reduction kit for the MD-80. This has been developed by Jet Engineering, and the system received its supplemental type certificate (STC) from the Federal Aviation Administration in June 2004. The kit has also completed its European approval and expects to receive the European equivalent of the STC by the end of April 2005.

The kit makes the MD-80 Stage 4 compliant by a margin of up to 13 decibels. Margins vary with the different MD-80 variants.

The system works by remixing the jet exhaust and spreading it over a larger area in the outlet nozzle of the engine by use of a lobed exhaust mixer.

The system reduces noise, but also reduces block fuel burn by 1.5-2.0%. Jack Anderson, president at Jet Engineering explains this is because the exhaust mixer improves the exhaust flow coefficient. The system also reduces exhaust gas temperature (EGT) by about 10 degrees centigrade, which enhances on-wing life and shop visit removal intervals.

Anderson says the system has already been proven in a Pratt & Whitney-approved test cell in San Diego over the course of a year-long study, and Pratt & Whitney has also approved the system for use on the JT8D-200.

The list price of the kit is $750,000, including installation. Installation can be accomplished with a thrust reverser change during an overnight check, with the kit already installed on a modified thrust reverser.

Payback for the system is achieved mainly through fuel burn savings. An MD-80 will typically operate at a utilisation of about 2,000 flight cycles (FC) per year, with an average FC time of about 1.3 flight hours and fuel burn per trip in the region of 1,250USG. A fuel burn reduction of about 2% will save about 50,000USG per year, equal to about $55,000 per year.

Anderson says that studies show that the reduction in EGT of about 10 degrees will save operators $11-16 per EFC. This will be equal to up to $60,000 per year at typical rates of utilisation. The savings from reduced fuel burn and EGT could therefore reach about $120,000 per annum. Anderson points out, however, that European operators would also benefit from reduced fees for noise penalties of as much as $160,000 per year. With these included, the kit will achieve a full payback in just three years.

SAS has confirmed that it is considering modifying its MD-80 fleet with both the Jet Engineering Stage 4 kit, and also with winglets that are being developed by Aviation Partners Boeing. The airline has 56 MD-80s and has said that these modifications will allow it to operate the aircraft for another 10-15 years, adding that it would not receive any economic benefit from replacing them with current generation narrowbodies.

The winglets would provide an additional fuel burn saving of 2.5-3.0%. This would save about 75,000USG and $82,000 per year. The winglets would also achieve a small reduction in aircraft noise. This saving compares to a list price of $600,000 for the winglets, and so allowing a payback over a seven year period. So far SAS is the only airline to show interest, and APB would need a launch customer before progressing with certification.

The modifications to the MD-80 would give it a wide margin over Stage 4 compliance and allow SAS to operate the aircraft until Airbus and Boeing have developed a new generation of narrowbody aircraft types. AC