The Service Bulletin detailing a modification to replace the window belt skins on 737-300s & -500s provides airlines with an option to avoid costly repetitive inspections and repairs. The modification is expensive, and if made mandatory could have serious implications for asset life.

737 Classic window belt skin replacement modification

The release of Revision 7 of Boeing Service Bulletin (SB) 53A1177 in June 2013, has ended years of uncertainty for operators and owners of high flight cycle (FC) 737-300s and -500s affected by structural problems with the fuselage window belt skins. SB 53A1177 is covered by Airworthiness Directive (AD) 2002-07-08, and now provides details of how to replace the window belt skins.

The SB was initially issued in 1994. The first six revisions detail an increasing number of inspections and interim repairs (permanent repairs with repeat inspections) to cracks found in the fuselage lap joint, lower fastener row at the tear strap locations, or between the tear straps (metal strips installed for additional safety on the internal side of the skin attachment of the frame work). An alternative to these six revisions was to use the 737 Structural Repair Manual (SRM) with Boeing support to change the skin belts.

The 7th Revision of SB 53A1177 supersedes the first six revisions, and also provides an alternative to the SRM repair. It also provides an option of either even deeper inspections and more repairs, or the complete replacement of the passenger-cabin window belt skins, using instructions in the SB. The only option for the 737-400, however, is for deeper inspections and more temporary repairs.

The existing window belt skins are prone to cracking and need extensive weighty repairs. This is why there have been six previous revisions of SB 53A1177, which have grown in scope.

This 7th revision of the SB is long-awaited, since some airlines have been anticipating for a few years that they would have to make large investments in their classic fleets. This modification would delay their fleet retirements, but the downside is that if a superseding AD makes replacing window belt skins mandatory, it may accelerate retirement from service for airframes approaching 50,000FC and over. This is because of the high cost of replacing the window belt skins. Some may prefer to 'mothball' or retire the classics from their operation and move on to aircraft with lower accumulated FC, or change aircraft type.

Background

The SB, and the encompassing AD 2002-07-08, involve inspecting and repairing cracks in lower airframe skins at lap joints (skin joins) and window corners, to prevent undetected cracks resulting in widespread fatigue damage that could cause the aircraft to suffer sudden cabin decompression.

All seven revisions of SB 53A1177, resulting from AD 2002-07-08, require inspections using non-destructive testing (NDT) on aircraft that have accumulated more than 45,000FC. The SB 53A1177 breaks down the FC inspection criteria further by the use of tables.

SB 53A1177, describes these cracks as either 'Primary', located in the lap joint lower fastener row in the lower skin at tear strap locations, or 'Secondary' found between the tear straps. These cracks can be hidden between the upper skin and the tear strap, and need NDT to find them.

Due to operator reports of cracks found in the lap splices (where fuselage skin sections overlap to be riveted together) and in window corners of aircraft that have mainly accumulated 44,000-82,000FC, the lap joint repair is now recommended for aircraft approaching or exceeding 50,000FC. The SB states that the Federal Aviation Administration (FAA) may make this SB mandatory by releasing an AD with compliance times for the replacement of window belt skins.

This would affect all four fuselage window belts on passenger aircraft (there is one belt on either side of the emergency exits on each side of the aircraft), and three belts on the QC (Quick Change) variant or pure cargo aircraft which have a freight door installed.

Converted freighters, or QC aircraft, will not be exempt from this SB. The original window belt skins unaffected structurally, or modified by the freighter conversion, will need attention. The design holder of the type of cargo door installed needs to issue instructions or alternative actions in response to the SB for any work required to the window belts around the freight door.

Inspection findings and reports made to Boeing by airlines performing revisions 1-6, reveal cracks located outside of areas covered by the SB. Because of this, more inspections have to be carried out until a preventative modification or lap joint repair has been completed.

The main affected area of the aircraft in this SB is Stringer 10 L/R to Stringer 14L/R, Body Station (BS) 360 to BS 540, and BS 727 to BS908. The area also to be noted for repair/modification at this time is Stringer 4 L/R BS 360 to 908. Stringers run from front to back on the airframe and provide structural integrity and fixing points to rivet the skin panels too.

Stringers 10 and 14 are crucial to the referencing of the belt changes, since this is where the aircraft skin that holds the passenger windows is located.

There is an extensive list of aircraft

UK airline Jet2.com is one 737-300 operator that has taken the option to replace window belt skins on its fleet. This will prolong its useful life to 60,000-80,000FC.

groupings in the SB, depending on aircraft type, line number and, importantly, modification and inspection status in accordance with previous SB releases. As the SB was originally issued in 1994, existing airframes have had numerous different bulletin releases detailing inspection procedures and several attempts at preventative modification. Revision 7 of the SB for 737-300s and -500s means that replacing the window belt skins is now an option.

It is worth noting that the language used for the window belt lap joint modification and lap joint repair in previous Revisions of the SB 53A1177 has caused some confusion. Indeed, Boeing has referred to it in the SB. This is because the word 'repair' was used on both preventative cut-out and reinforcing work, along with repairs needed due to cracks. The lap joint terminating modification, which is the replacement of window belt skins, is now referred to as the 'lap-joint modification (repair)' in the text of the SB.

The key point of this SB Revision 7 release with window belt skin replacement option is that operators now have an alternative to frequent and time-consuming inspections (unless the action is made mandatory). The choice is therefore to continue making an unknown quantity of repairs, or to take control of forecasting the aircraft's maintenance and life expectancy by replacing the belt skins. If the aircraft are operator-owned and the plan is to operate them well into 60,000-80,000FC, then this could be a worthy financial outlay for long-term viability.

The SB still has repeat intervals for post skin-replacement NDT inspections, however. The new skins will nevertheless decrease the intensive inspection programme for the affected skin areas.

Operators have previously chosen to replace window belt skins based on SRM data and with Boeing's further technical assistance, so this is not a completely new phenomenon or the latest phase to hit the 737 Classics. There will be high FC aircraft flying with relatively new window belts installed.

The ease of the SB's instructions and condensing the task into a detailed common-use document will assist the work immensely.

Fleet data

No new manufacturer's serial numbers (MSNs) have been added or removed from this SB's effectivity, because the SB groups the aircraft by type. This is because the number of additional and repeat inspections needed during the belt replacement varies according to the work previously carried out in the window belt area, and the configuration and use of the aircraft. The SB must be studied in detail to determine how each aircraft is affected by it.

Grouping the aircraft is similar to listing by MSN for each aircraft's needs. A key note, though, is that for this Revision 7 release the aircraft groupings have been revised and greatly increased to define the work required for each batch of aircraft. It is important to note that the SB affects all aircraft with bonded skin.

The known global fleet data for 737-300/-500 aircraft that have accumulated less than 35,000FC, and have compliance times detailed in the SB for inspections, is 574 active and parked airframes. Boeing data analysis of the reported cracks found, shows that 240 parked and active 737-300/-500s approaching 35,000-45,000FC, potentially need extensive repairs.

The number of 737-300/-500s approaching 45,000-50,000FC are about 71 active and parked 737-300s, and 10 active and parked 737-500s.

There are also 113 aircraft that have already accumulated more than the threshold of 50,000FC. It is worth noting that some operators of these high-time aircraft may have already invested in belt changes, or the extensive repair modifications listed in the previous release of the SB.

Labour inputs

Boeing's guide to labour needed to replace the window belts is 795 man-hours (MH), based on skilled labour, experienced on the job to hand, with no time allocated to find tools, procure materials and inspect the work.

A more realistic prediction to carry out the work as a standalone item for budgetary purposes is 450MH for jacking, support, ground handling and extensive pre-modification pressure runs, plus 5,000-5,500MH for the window belt skin replacements. This includes time to gain access for the modification by removing items like seats, carpets, sidewall panels, insulation blankets, overhead lockers and the personal service units contained within them. It also includes the labour for re-installing these items on modification completion and painting the new window belt skins.

The above MH also include inspections prior to the skin belt replacement.

The MH quoted also include the completion of SB 53-1179, SB 53-1210, and SB 53-1262. These three SBs are referenced in SB 53-A1177.

SB 53-1179 (AD 2003-14-06), for example, requires internal inspections for cracks, delamination and corrosion on bonded skins.

Sections of SB 53-1210 (AD 2004-18-06 now superseded by 2013-18-08) are inspections at the horizontal and vertical bonded doubler chemical-mill steps. SB 53-1262 (AD 2010-05-13) is for scribe line inspections, preferably with paint removed.

Besides the MH used, the window belt skins cost $360,000 for a shipset. Depending on labour rate, the whole

When all access, reinstallation, and aircraft jacking and rigging are considered, the window belt skin replacement, together with other appropriately combined heavy modifications, uses a total of about 5,500 man-hours. Together with the cost of new window belt skins, the whole modification costs about $800,000 per aircraft.

process could cost a total of $800,000.

Depending on the shift layout, manning and repairs, this could result in four to six weeks of work. The amount of work required will vary slightly with aircraft grouping by the SB. When performed together with a major check, such as a D check, incorporating heavy scheduled maintenance items and an extensive AD/SB inspection and/or modification clearance, the check could have a total downtime of up to two months. In turn, however, it will give the aircraft a new lease of life.

Two months for the aircraft to be out of action may sound extreme, but it is important to remember that only one belt can be changed in the same section of the aircraft at one time to maintain the aircraft's structural alignment. The forward skin on one side of the aircraft, for example, can be changed at the same time as the alternate aft skin. Once those two belts have been riveted into position the opposite pair can be started.

If the upper fuselage Stringer 4 preventative modification, which runs from front to back of the aircraft just above the window belt skins, is carried out at the same time, then it can only be done independently to the adjacent window belt skin replacement on the same check. This relates to the repair of fuselage Stringer 4.

Stringer 4 failed on a Southwest Airlines 737-300 in early 2011. An emergency release AD 2011-08-51, which mandated SB 53A1319, requires the Stringer 4 area to be modified by 45,000FC.

What affects the MH used during the course of replacing the window belt skins is that all existing repairs around the affected window belt areas will need to be replaced. Boeing will need to be contacted for this.

Also prior to the new skin panel installations, adjacent skin panels will need to be checked for disbonding, cracks and corrosion. It is possible that during the de-riveting and removal of the old panels the disturbance to the structure of the panels left behind may cause some unforeseen additional work.

Budgeting for additional MH for repairs to skins disturbed during the modification is advised. Delamination, for example, may be found in every second aircraft, as a result of removing the belt skins, resulting in an additional skin repair. This will be of key concern when contracting in this kind of additional work for maintenance repair organisations (MROs).

Extensive cabin leakage checks will need to be carried out at aircraft arrival. By using the auxiliary power unit (APU) to pressurise the aircraft's cabin, engineers can assess the fuselage for any pre-existing aircraft skin air leaks prior to beginning the modification. Known fuselage leaks can be addressed during the modifications, and can be separated from those that may need rectification due to skin panel disturbance for different billing purposes. Mapping the known areas of discrepancies like this, will assist post-check cabin pressurisation runs if leaks are found again.

Maintenance downtime

The window belt modification is an ideal time to carry out other major SBs that take advantage of the access gained and/or available downtime to hand.

One example of efficient use of the access gained is also to carry out AD 2008-23-09 (SB 25-1572), which is for the AN26 insulation blanket replacement on aircraft built prior to 1988. This is due to be carried out by mid-2017 because the blankets' film cover inflammability degrades over time.

Since most of the upper lobe insulation blankets will be removed for the belt modification, and the lower cargo-liner blankets removed to clean up rivet tail and metal debris from drilling, any AN26 blanket removed could conveniently be replaced on the re-build of the interior with the new approved blanket. This could save 800-1,200MH of duplicated access if the affected blankets were replaced on a smaller airframe check in the affected area.

Another time-consuming task on the higher FC aircraft is to include the replacement of the BS 178 forward pressure bulkhead. This uses about 800MH and requires extensive strip-out of the flightdeck. The forward pressure bulkhead replacement before reaching 50,000FC is recommended by AD 2000-05-29, and related specific vertical beams by AD 2007-03-03. Although this bulkhead is not adjacent to the window belts, it would be useful to carry out this modification at the same check as the window belt change. This is because the flightdeck work can be quite disruptive during C checks due to the disabling of cockpit instruments and control panels needed to function aircraft systems.

Summary

Further key advantages of the belt change include aerodynamic fuel burn savings due to skin smoothness, versus the sometimes complicated and extensive repairs around the corners of the window and skin lap joints. Using the SB Revision 7 release to change the window belts, operators are fully investing in extending the life of their high FC fleet, in order to turn ageing 737-300/-500s into long-term investments. The maintenance action and costing will be researched with those operators that choose to carry out this modification, and a more in-depth analysis will appear in later issues of *Aircraft Commerce*.