National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 3, 1986
In reply refer to: A-86-82 through -86

Honorable Donald D. Engen
Administrator
Federal Aviation Administration
Washington, D. C. 20591

On August 2, 1985, at 1805:52 central daylight time, Delta Air Lines (Delta) flight 191, a Lockheed L-1011-385-1, N726DA, crashed while approaching to land on runway 17L at the Dallas/Fort Worth International (DFW) Airport, Texas. While passing through the rain shaft beneath a thunderstorm, flight 191 entered a microburst which the pilot was unable to traverse successfully. The airplane struck the ground about 6,300 feet north of the approach end of runway 17L, hit a car on a highway north of the runway killing the driver, struck two water tanks on the airport, and broke apart. Except for a section of the airplane containing the aft fuselage and empennage, the remainder of the airplane disintegrated during the impact sequence, and a severe fire erupted during the impact sequence. Of the 163 persons aboard, 134 passengers and crewmembers were killed; 26 passengers and 3 cabin attendants survived. 1/

During its investigation, the Safety Board found deficiencies with the restraint systems at the airplane's flight attendant jumpseats. The deficiencies included badly worn shoulder harnesses and seatbelts and improper restraint system installations. The Safety Board believes that these conditions demonstrate a lack of effective quality control practices at the airline and of Federal Aviation Administration (FAA) surveillance of Delta's maintenance practices.

Shoulder Harnesses

The edges of the shoulder harness straps on the R-3, R-4, and L-4 jumpseats were found to be abraded, frayed, pilled, and stretched. This damage was caused by worn strap guides on the R-4 and L-4 seats and by the gears inside the inertia reels on all three seats.

The shoulder harness guides had been designed and installed by the airline. They consisted of a two-piece, Teflon, anti-chafing material between stainless steel backing plates. The Teflon material was so worn that the guides did not prevent the shoulder harness straps from chafing on the underlying steel backing plates.

1/ For more detailed information, read Aircraft Accident Report--"Delta Air Lines, Inc., Lockheed L-1011-385-1, N726DA, Dallas/Fort Worth International Airport, Texas, August 2, 1985" (NTSB/AAR-86/05).

The second source of damage to the shoulder harness straps was the gears on each side of the inertia reel take-up spools. The shoulder harness guides at the R-3, R-4, and L-4 jumpseats did not maintain the harness straps in alignment with the inertia reels, and this permitted the straps to retract onto the take-up spools at an angle. As a result, the straps chafed against the exposed take-up spool locking gears positioned on each end of the spools.

In addition to the damage cited above, the shoulder harness straps were permanently creased--one as much as 47 inches lengthwise--because they folded over as they retracted onto their inertia reels. Although postaccident tensile tests showed that the creases did not reduce the strength of the straps, the double thickness of straps on the inertia reels' take-up spools could have kept the inertia reels from functioning properly under decelerative (inertia) forces. It was also determined that the airline-installed shoulder harness guides at the R-4 and L-4 seats and the factory-installed guide at the R-3 seat were ineffectual in preventing the shoulder harness straps from twisting or doubling over before they retracted onto the inertia reels.

The Safety Board is concerned that the airline's inspection procedures failed to detect the excessive wear of the shoulder harness guides at the R-4 and L-4 jumpseats, which allowed the chafing of the shoulder harness straps. The Safety Board is also concerned that inertia reels may not function properly with doubled-over straps on their take-up spools and that exposed inertia reel gears can readily damage shoulder harness straps.

Installation Errors

The Safety Board's investigation found that the restraint systems at the R-4 and L-4 jumpseats were not installed in conformance with Pacific Scientific installation drawing 1107040. The R-4 restraint system release buckle was installed on the left side of the seatpan instead of on the right side. The L-4 seat had two installation errors: (1) The strap that contained the insert for the release fitting was installed 180° opposite to that specified on the drawing; and (2) A shoulder harness insert was improperly assembled, resulting in a nut cap being positioned next to the seat occupant's sternum and creating a point source for possible injury.

These installation errors did not adversely affect the strength of the restraint systems. However, the fact that the airline's quality assurance practices, or lack thereof, permitted these errors as well as other problems found during this investigation to be uncorrected, is of concern to the Safety Board.

Damaged Seatbelt Straps

The left and right seatbelt straps at the R-4 and L-4 jumpseats were badly abraded, frayed, discolored, and stretched where they had chafed against the jumpseat's seatpan retraction springs. The springs had no protective covers, and routing of the straps from the rear to the front of the seats caused the straps to chafe continuously on the springs and the bolts that attached the springs to the seats. The jumpseats were manufactured in August 1978 by Heath Techna, Precision Structures Division, Part Number MPD 241100, and had Serial Numbers 672 and 674.

During postaccident laboratory tensile strength tests of three of the four damaged seatbelt straps, one strap from the R-4 seat failed at 1,850 pounds of tension and the two L-4 straps each failed at 2,200 pounds. These straps were manufactured to 4,000 pounds minimum breaking strength. The Safety Board believes that the failure of these straps at 2,150 and 1,800 pounds below the manufacturer's specification represents a significant loss of strength. The R-4 and L-4 restraint systems had been manufactured in January and March 1982, respectively; while it is not known when they were installed in the accident airplane, it appears that a significant loss of strength occurred in under 3 years. The Safety Board is concerned that these damaged straps remained undetected for an undetermined length of time.

The flight attendant who occupied the R-4 jumpseat said that she was unable to adjust the seatbelt for a tight fit; she was also unable to reposition the release buckle from over her left hip to the center of the restraint system. This latter condition caused difficulties in releasing the seatbelt after the accident. Postaccident examination of the seatbelt showed that the strap was jammed inside the adjuster fitting and that it could not be easily freed with the jumpseat installed in the airplane cabin. Inspection showed that there were no provisions on the belt or at the adjuster to prevent the strap from twisting and passing into the adjuster. The Safety Board believes that the thin webbing material widely used for seatbelts and shoulder harnesses is susceptible to twisting. The Safety Board also believes that means should be provided to ensure that the webbing remains flat before it passes into any type of fitting or, in the case of shoulder harnesses, before the webbing feeds onto inertia reels.

Laboratory tensile tests of that portion of the R-4 strap that had been jammed inside the adjuster fitting resulted in a failure of the strap at 1,300 pounds--2,700 pounds below the 4,000 pounds specified by the webbing manufacturer, and 950 pounds below the 2,250 pounds specified in National Aircraft Standards (NAS) specification 802 (which is part of Technical Standards Order, TSO-C22f). Visual inspection of the area that had been jammed inside the adjuster revealed no obvious damage and the cause of the failure could not be determined.

The Safety Board believes that the condition that permitted seatbelt straps to chafe on the unprotected seatpan retraction spring assemblies should have been identified during the airplane's routine inspections, and further, that fleetwide modifications should have been incorporated to remedy the condition on similar seats. The Board believes that the FAA should initiate action to correct this condition on all in-service and newly manufactured jumpseats and to make the condition known to all operators who have similar Heath Techna Model MPD 241100 jumpseats onboard airplanes.

The Delta flight 191 accident is not the first time the Safety Board has found badly worn seatbelts in air carrier airplanes. In 1982, the Safety Board investigated an accident involving a deHavilland DHC-6 at Hooper Bay, Alaska. 2/ A passenger was injured seriously in the accident when his badly frayed seatbelt failed. Investigation also found that several other worn and frayed seatbelts were installed in other airplanes operated by the airline. The Safety Board concluded that the condition of these seatbelts had existed for several months, which indicated poor maintenance by the airline and poor or nonexistent FAA surveillance of occupant safety equipment.

2/ Aircraft Accident Report—"Gifford Aviation, Inc., deHavilland DHC-6, N103AQ, Hooper Bay, Alaska, May 16, 1982" (NTSB/AAR-82/16).

The Safety Board has learned that neither the FAA nor the Society of Automotive Engineers has published procedures or guidance to determine when the "on condition" inspection status of restraint system webbing warrants replacement because of wear or damage. Such guidance is long overdue to ensure that dangerously worn and damaged webbing is replaced in a timely manner as well as to preclude unnecessary and uneconomical replacement of straps whose condition may be in question. Such guidance would be beneficial to commercial operators of fixed- and rotary-wing aircraft as well as to operators of general aviation aircraft alike. Further, this kind of standardized criteria would better prepare maintenance inspectors to determine unequivocally the status of restraint system webbing when they inspect restraint systems on commercial and general aviation aircraft.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Issue an Advisory Circular with guidance on the limits of wear and damage to restraint system webbing material that would necessitate the replacement of worn or damaged webbing. (Class II, Priority Action) (A-86-82)
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> Review, and require improvements as necessary in, Delta Air Lines quality control program regarding inspection and replacement of restraint systems. (Class II, Priority Action) (A-86-83)
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> Issue a maintenance alert bulletin that cites the problems of the flight attendant restraint system discovered following the Delta L-1011 accident at Dallas/Fort Worth International Airport, Texas, on August 2, 1985, and require Principal Maintenance Inspectors to emphasize to air carriers the requirements and guidance for periodic inspections of flight attendant restraint systems for worn and damaged webbing, improper installation, and worn shoulder harness guides. (Class II, Priority Action) (A-86-84)
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> Issue an Airworthiness Directive to correct the design deficiency of Heath Techna jumpseats (Part No. MPD 241100) that permit the seatbelt webbing to chafe against the seatpan retraction spring. (Class II, Priority Action) (A-86-85)
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> Perform a Directed Safety Inspection of flight attendant restraint systems on air carrier aircraft to determine design deficiencies that cause damage to webbing materials, and establish a program as needed to replace worn or damaged webbing and correct design deficiencies. (Class II, Priority Action) (A-86-86)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER and NALL, Members, concurred in these recommendations.

By: Jim Burnett
Chairman