



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

LDG 2177

*Call Tom Skueter
for acc #*

Date: August 9, 1989

In reply refer to: A-89-79 and -80

Honorable James B. Busey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On January 25, 1987, a Boeing 727, N7015U, registered to and operated by United Airlines, experienced a rapid decompression while at flight level 220 en route from Columbus, Ohio, to Chicago, Illinois. The flight diverted to Fort Wayne, Indiana, where an uneventful landing was made. The airplane sustained minor damage. There were no injuries to the 6 crewmembers or the 63 passengers on board. At the time of the accident, the airplane had a total of 54,572 flight hours and 44,171 pressurization cycles.

Examination of the airplane revealed that the damage was confined to an 8- by 18-inch rupture in the outer skin located between stringers 3 and 4 and stations 1090 and 1108, which is located on the upper aft fuselage just forward and to the left of the "S" duct inlet for the Number 2 engine. Examination of the separated skin material revealed a scratch or score mark 0.0007 inch deep that ran along the upper edge of the number 4 lap joint adhesive bond line. The length of the score mark coincided with the crack in the skin material. The skin material on the B-727 in this area is 0.040 inch thick. The edge of a circular patch covering a 2-inch hole was immediately adjacent to the crack. A Boeing quality assurance or inspectors stamp was located on the skin next to the patch. According to records, the patch was applied to the airplane skin in 1964 by the manufacturer, during correction of a production flaw.

The National Transportation Safety Board's investigation revealed that the crack had initiated at multiple origins along the linear score mark and had grown by fatigue through the thickness of the material. The crack had progressed longitudinally until it turned in the circumferential direction at the tear strap. Striation count analysis indicated that the total number of cycles through the thickness of the material was between 3416 and 4622 cycles.

On December 26, 1988, a Boeing 727, N8148U, registered to and operated by Eastern Air Lines, experienced a rapid decompression while climbing through flight level 310 while en route from Rochester, New York, to Atlanta, Georgia. The flight diverted to Charleston, West Virginia, where an uneventful landing was made. The airplane sustained minor damage. Of the 6 crewmembers and 102 passengers on board, 2 passengers were treated for minor injuries. At the time of the accident the airplane had a total of 68,036 flight hours and 51,195 pressurization cycles.

Damage to the airplane was confined to an elongated "U-shaped" opening in the fuselage skin between body stations 1090 and 1110 intersecting the lower row of rivet holes in the lap joint at stringer number 4 left. This area is located on the aft upper left side of the fuselage, forward of the "S" duct inlet for the number 2 engine. The longitudinal crack ran in a straight line and was through the underlying skin of the lap joint.

Examination of the longitudinal crack established that, although the crack line intersected the rivet holes, it did not pass through the longitudinal centerline of the holes. Rather, the crack plane was at a slight angle to the line of the rivets and to the edges of both the stringer number 4 left lap joint skin panels. Magnified examination revealed a straight scratch or score mark in the outer surface of the lower skin running from the ends of the crack on either side of skin that remained attached to the fuselage. Analysis further determined that the longitudinal crack had initiated at multiple origins along the linear mark and had grown by fatigue through the thickness of the material. Further examination found the scratch to be approximately 0.01 inch deep and about 0.01 inch wide at the surface.

The longitudinal crack was examined for the total number of fatigue cycles striations at several fatigue zones. The examination found that between 3360 and 5040 cycles of fatigue progression were present.

The exact time at which the outer surface was scratched could not be determined. During a heavy maintenance "D" inspection on August 20, 1986, the upper skin panel had been removed, cleaned, primed, and riveted back into position due to evidence of corrosion of underlying components. At the time of this repair, the airplane had a total of 61,913.35 hours and 46,870 pressurization cycles. Eastern Air Lines does not retain repair records prior to one complete "D" check cycle; therefore, no records of previous repairs could be found. Additionally, Boeing did not have any pertinent records concerning the manufacturing or repair of this airplane.

The Safety Board's concern in these two cases is not when the scratch or score mark damage occurred to the airplane, but rather the mechanism by which the surface of the aluminum sheet metal was damaged. It is believed that in both incidents the scratch or score damage to the surface of the fuselage skin was probably caused by maintenance personnel using improper tools in marking the metal while performing a repair to the structure. The serious nature of such practices cannot be overstated because such scratching or scoring of aluminum structure of an aircraft, from whatever source, can lead to premature failure.

The Safety Board realizes that during training aviation mechanics are provided information concerning the proper handling and marking of materials to be used in the construction and repair of airplanes. This instruction includes such information as not using graphite pencils on aluminum surfaces and not scoring the material. The Safety Board is concerned that repair personnel may not be fully cognizant of the fact that even an apparently insignificant flaw or scratch can significantly reduce the service life of the component. These two decompression incidents indicated that pressurized fuselage skin panels are particularly sensitive to surface damage, especially in the longitudinal direction.

The Safety Board is aware that manufacturers, air carrier maintenance shops, and independent maintenance organizations often utilize personnel who do not have FAA repairman certificates to repair airplane structures. These personnel work under the guidance and supervision of a person who has a mechanic or repairman certificate. This practice is approved by 14 CFR Part 43.3 and allows a non-certificated repairman to perform maintenance and alterations that the supervisor is authorized to perform. The Safety Board is concerned that repair personnel may unknowingly damage the surface of the fuselage skin by using improper marking tools. The Safety Board also recognizes that repair personnel may not be trained to detect scratch damage or recognize the potential hazards if such damage is unreported.

The Safety Board believes that a Maintenance Bulletin should be issued to all manufacturers, airlines, and maintenance organizations informing them of the circumstances of these two incidents and reminding them of damage that can be incurred in pressurized fuselage skin panels by what appears to be a minor scratch. The bulletin should also inform repairmen to inspect materials for scratches or other minor damage that was incurred during manufacturing or handling that could cause failure of a pressurized skin panel. The circumstances of these two incidents should be publicized and brought to the attention of airframe and powerplant schools and FAA maintenance inspectors to preclude future such incidents.

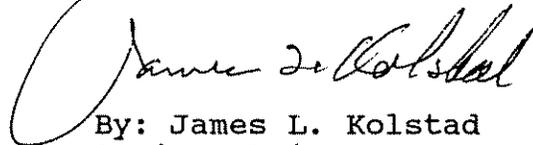
Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue a Maintenance Bulletin to all manufacturers, airlines, air carrier maintenance organizations, and aviation maintenance training schools which:

- Informs them about the circumstances of these two incidents;
 - Requests that they issue appropriate informational material to personnel who perform work on aircraft structure, whether certificated or non-certificated mechanics, about the serious consequences of minor scratches on pressurized fuselage skin panels; and
 - Outlines the proper techniques and tools for marking materials to prevent the possibility of creating fatigue initiation from minor scratches.
- (Class II, Priority Action) (A-89-79)

Direct all Principal Maintenance Inspectors to review the maintenance practices of the operators under their jurisdiction to determine that certificated and non-certificated maintenance personnel are utilizing proper tools and repair techniques when marking structure for repair or painting. (Class II, Priority Action) (A-89-80)

KOLSTAD, Acting Chairman, BURNETT, LAUBER, NALL, and DICKINSON, Members, concurred in these recommendations.



By: James L. Kolstad
Acting Chairman