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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C

METALLURGIST'S FACTUAL REPORT
Report No. 97-68

Front Spar Lower Chord Fracture Area

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

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METALLURGIST'S FACTUAL REPORT — Report No. 97-68

A. ACCIDENT

Place : East Moriches, New York
Date : July 17, 1996
Vehicle : Boeing 747-100
NTSB No. : DCA96-M-A070
Investigator : Al Dickinson, AS-10

B. COMPONENTS EXAMINED

Front spar lower chord fracture area cut from piece CW504

C. DETAILS OF THE EXAMINATION

Figure 1 shows a view looking forward at a portion of the front spar lower chord fracture on the lower inboard corner of piece CW504. The horizontal leg of the chord in this area was separated adjacent to the fillet radius between the chord's two legs. A portion of the chord fracture in this area was smoother and flatter than other portions of the fracture, indicative of fatigue cracking. The fatigue cracking initiated from multiple locations in the fillet radius, based on ratchet marks within the fatigue region. The fatigue crack was located in the chord at LBL 80.5, just outboard of the drag splice fitting between the fuselage and the wing center section lower skin. The Structures Group Notes contains additional information on fatigue cracking in the airplane, including a smaller fatigue crack in the front spar lower chord at RBL 80.5. The fatigue crack region was cut from the remainder of the chord and brought to the Safety Board's Materials Laboratory for more detailed examinations.

Figure 2 shows a view of the fatigue crack region on the cut-out piece. The photograph in this figure was taken after repeated replication and extensive ultrasonic cleaning in acetone. The width of the fatigue crack was 1.45 inches, and its maximum depth was 0.125 inch (about 40% of the way through the chord thickness). The boundary between the fatigue crack and the overstress portion of the chord fracture is indicated by the dashed line in figure 2. Mechanical damage along the corner between the fracture and the upper surface of the horizontal leg of the chord had obliterated the fracture features at the origin area over slightly less than one half of the width of the fatigue region (in the area indicated by the bracket in figure 2). The mechanical

damage corresponded to the lower edge of a bathtub fitting that was attached to the mating half of the fracture, as if this forward fractured off portion of the front spar chord had moved up and against the bottom surface of the bathtub fitting. Ratchet marks indicated the presence of individual fatigue initiation sites approximately at the positions indicated by the unlabeled arrows in figure 2. Some ratchet marks extended below the mechanically damaged area, indicating that the mechanical damaged area also contained multiple initiation sites.

Following cleaning of the cut-out piece, the fatigue region was examined with a scanning electron microscope (SEM). This examination showed that the multiple initiation sites along the fillet radius were linear in nature, as shown in figure 3. Lower magnification SEM examinations showed that the fatigue region had a banded appearance. Examination at higher magnifications showed that the finer details of the fracture were still hidden by tightly adhering corrosion deposits. However, some of the bands were relatively corrosion free and individual fatigue striations were discernible, as shown in figures 4, 5, and 6. The origin area appeared free of preexisting corrosion pits or other defects that may have contributed to initiation of the fatigue cracking.

for James F. Wildey II
National Resource Specialist - Metallurgy