Log 2272

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: February 19, 1991

In reply refer to: A-91-19 and -20

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

On November 26, 1990, an Avions de Transport Regional (ATR) 42-300 airplane, N971NA, experienced a collapse of the left main landing gear while taxiing after landing at Saint Thomas, U.S. Virgin Islands. The airplane, which received minor damage, was operating as a scheduled, domestic flight from San Juan, Puerto Rico, to Saint Thomas and was carrying 41 passengers and a crew of 3, none of whom were injured.

Postincident investigation revealed that the side brace assembly lower arm, P/N D56779, from the left main landing gear had separated and allowed the gear to collapse. At the time of the incident, the separated lower arm had accumulated a total of 7,728 hours of service and 10,753 flight cycles. The fractured component and the side brace assembly lower arm from the right main landing gear were sent to the National Transportation Safety Board's Materials Laboratory for examination.

The metallurgical examination of the separated lower arm revealed that the bottom end of the arm was fractured at its 85-millimeter (3.3-inch) diameter bore that retains a spherical monoball bearing. The circumferential location of the separation was about 120 degrees from the lubrication hole at the end of the arm. The separation was the result of fatigue cracking that initiated from multiple points within an origin area on the bore surface of the arm end, the surface that contacts the outer diameter of the spherical bearing outer race. Much of the bore surface was darkly discolored and contained corrosion pitting. The corrosion and discoloration were more severe in areas, such as the fatigue origin area, that were further from the lubrication fitting in the bottom end of the lower arm. Chlorine deposits were found in the corrosion areas and on the fracture surface directly adjacent to the fatigue initiation area. A metallographic section through the origin area of the fatigue crack revealed the presence of secondary cracks and local corrosion pits with depths as great as 0.010 inch below the surrounding corroded area.

The metallurgical examination also revealed no evidence of the required cadmium plating on the bore surface. Messier Bugatti[1] has indicated that there may be a substantial number of lower arms that do not contain this required corrosion protection in the bore area, and that they are contemplating a design change to reduce or eliminate the corrosion problem. While the Safety Board is concerned that this lack of the required corrosion protection may lead to early corrosion problems, the Board believes that the current inspection program, if modified as suggested in this letter, is sufficient to detect corrosion on arms with unplated bore surfaces before cracking can initiate and progress to a critical size.

After installation of the spherical bearing into the 85-millimeter diameter hole of the lower arm, both sides of the outer race are roll-staked (mechanically deformed around the circumference of the bearing) to prevent motion of the outer race against the bore surface. Sealant is then applied to the staked area. Lubrication for the spherical bearing is provided through a lubrication fitting in the very bottom of the arm. The grease passes through the arm end and travels along a circumferential channel in the outer diameter surface of the bearing outer race. The channel has four equally spaced holes that allow the grease to pass through the outer race and thereby lubricate the bearing ball.

The side brace assembly lower arm from the right main landing gear was also examined for evidence of corrosion damage on the bore surface on the arm end. Portions of this surface contained corrosion damage similar to that found on the lower arm from the left gear. Most of the corrosion was located opposite from the lubrication hole, and it appeared to be more severe than the corrosion damage on the separated lower arm. Fresh, clean grease was found in portions of the outer race channel closer to the lubrication hole in the lower arm. Dried, hardened, and discolored grease was found in portions of the outer race channel opposite from the lubrication hole. The Safety Board believes that the sealant and lubrication may be insufficient to protect the side brace assembly lower arms from corrosion (and subsequent cracking), especially when a corrosion protection layer (cadmium plate) has not been applied and the airplane is operated in a salt air environment.

As a result of this incident, the Direction Generale De L'Aviation Civile (DGAC) of France issued a telegraphic Airworthiness Directive (T90-232-035(B)), effective December 18, 1990, which is applicable to all ATR 42 airplanes equipped with side brace assembly lower arms that have accumulated more than 10,000 flight cycles. The Airworthiness Directive (AD) requires a one-time visual inspection of the sealant around the roll-staked area on the spherical bearing on the bottom end of the side brace assembly lower arm. If

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[1] Messier Bugatti is the firm responsible for the design of the ATR 42 landing gear but not for the manufacture of the side brace assembly lower arm.

the visual inspection of a lower arm on designated airplanes operating in warm coastal environments reveals cracked or damaged sealant around the bearing, the lower arm is to be immediately removed from service and sent to ATR for examination. For the remaining airplanes, if the visual inspection reveals cracked sealant, the bottom end of the lower arm is to be ultrasonically inspected according to ATR Service Bulletin (SB) No. ATR42-32-0036 and Messier Bugatti SB No. 631-32-070. The ultrasonic inspection is designed to detect corrosion or cracking on the bore surface of the bottom end of the lower arm.

Pieces of the separated side brace assembly lower arm from the left main landing gear on the incident airplane, along with the side brace assembly lower arm from the right main landing gear, were subjected to the ultrasonic inspection detailed in the service bulletins. The largest ultrasonic indication found on either of these arms was 60 percent full scale height, despite the presence of severe corrosion on both components. The service bulletins require that all lower arms with ultrasonic indications of 85 percent or greater be immediately removed from service. Lower arms with indications of less than 85 percent may continue in service. The service bulletins suggest (but the DGAC Airworthiness Directive does not require) that lower arms that pass the ultrasonic inspection be reinspected at intervals of less than 300 cycles.

The Safety Board has several concerns regarding the French AD and SB inspections:

1. The cycle limit at which the current inspection requirements are initiated (10,000 cycles) is about the same as the number of cycles on the separated lower arm from the incident airplane (10,753 cycles). Thus, the AD does not provide a safety margin to assure that a lower arm will not separate before reaching the inspection threshold.

2. Periodic visual inspections of the sealant around the outer race of the spherical bearing are not, but should be, required at intervals sufficient to ensure that a proper seal is maintained and that moisture does not enter the crevice between the bearing and the lower arm.

3. The AD does not explicitly require that lower arms that pass an initial ultrasonic inspection receive additional periodic ultrasonic inspections to detect corrosion or cracks. Because the ultrasonic inspection is capable of detecting relatively small cracks but may not detect corrosion even when the corrosion is severe, the reinspection interval for the ultrasonic inspection should remain near the current level specified in the service bulletins, 300 cycles, unless it can be demonstrated that cracking would take substantially longer than this to grow from a size just below the level of detectability to a critical size.

4. Lower arms with ultrasonic indications just below the 85 percent rejection limit are allowed to remain in service but are likely to have

severe corrosion and may have small cracks. The rejection limit should be substantially reduced to remove these corroded arms from service.

5. Because the French AD is not enforceable in the United States, there are no requirements that ATR 42 operators in this country perform any type of inspection of the side brace assembly lower arms from the main landing gear. Although a representative of Messier Bugatti has indicated that all North American operators are in voluntary compliance with the French AD and SB's, the Safety Board believes that an AD issued by the Federal Aviation Administration and incorporating the concerns expressed in this letter would ensure a high level of confidence in the airworthiness of the side brace assembly lower arms.

6. Although the corrosion in the bottom end of the lower arm is probably caused by cracked sealant that allows moisture to enter the crevice between the bore surface of the lower arm and the outer race of the spherical bearing, it has not been demonstrated that lower arms with intact sealant are free of corrosion. For this reason, an inspection program is needed to determine the condition of lower arms with intact sealant, and if these lower arms need to be included in additional repetitive inspections for corrosion and cracking.

The Safety Board believes that a separation of a side brace assembly lower arm could cause a serious or catastrophic accident if the separation occurred at a critical point during takeoff or landing. Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an Airworthiness Directive applicable to ATR 42 airplanes to require initial and periodic visual inspections of the sealant around the spherical bearings at the bottom end of the landing gear side brace assembly lower arms (P/N D56779) for cracking or damage. The threshold for the initial inspection and the periodic intervals should be substantially less than 10,000 cycles. Lower arms that contain cracks or damage in the sealant should be immediately inspected by ultrasonic methods as described in ATR Service Bulletin No. ATR42-32-0036 and Messier Bugatti Service Bulletin No. 631-32-070. However, the rejection limit for the ultrasonic inspection should be substantially reduced from that specified in the service bulletins. The Airworthiness Directive should also establish an appropriate periodic ultrasonic inspection interval for those lower arms that pass the initial ultrasonic inspection. (Class I, Urgent Action)(A-91-19)

In cooperation with the French Direction Generale De L'Aviation Civile, Avions de Transport Regional, and Messier Bugatti, develop an ATR 42 airplane inspection program that can determine if main landing gear side brace assembly lower arms (P/N D56779) with intact sealant around the spherical bearing at the bottom end of the arm are subject to corrosion on the bore surface, the surface that contacts the bearing's outer race. Based on the results of this inspection program, determine if the scope of the Airworthiness Directive

described in Safety Recommendation A-91-19 should be expanded to require ultrasonic inspections of the lower arms on which the sealant is not cracked or damaged. (Class II, Priority Action)(A-91-20)

Chairman KOLSTAD, Vice Chairman COUGHLIN, and Members LAUBER, BURNETT, and HART, concurred in these recommendations.

By: James L. Kolstad
Chairman