



National Transportation Safety Board
Washington, D.C. 20594

Safety Recommendation

Date: May 28, 1999

In reply refer to: A-99-47 through -50

Honorable Jane F. Garvey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On April 19, 1999, at about 12:46 p.m. eastern daylight time, a Beech T-34A, N140SW, operated by Sky Warriors, Inc., collided with the ground near Rydall, Georgia, following an in-flight separation of the right wing. Both the air transport pilot and the passenger, who was also a licensed pilot, were fatally injured. No flight plan was filed for the air combat simulation flight, which had departed Fulton County Airport in Atlanta, Georgia, at about 12:00 noon. The flight was conducted under Title 14 *Code of Federal Regulations* (14 CFR) Part 91, and visual weather conditions prevailed at the time of the accident.

The operator reported that N140SW and another T-34 initiated the engagement at a predetermined altitude and direction. After the initial turn toward each other, N140SW started a descending turn. According to the pilot of the second T-34, while N140SW maneuvered in the descending turn, the right wing separated from the airplane. The airplane entered a rapid spin and impacted the ground. The major portion of the right wing assembly, minus the inboard over-the-wing walk surface and the inboard section of the aft spar, was found about 1 mile north of the main wreckage crater. The remainder of the right wing was located about 1/4 mile northeast of the major portion of the wing.

Examination of fractured portions of the right wing was conducted at the Safety Board's materials laboratory. The wing had separated through the wing fitting area, which attaches the wing to the fuselage. The structure of the wing in this area is very complex, being constructed from multiple sections riveted together to form the front and aft spars. The lower cap of the front spar in the area of the separation, for example, consists of a U-shaped center hinge extrusion, a filler plate, the wing fitting tang, and two vertically oriented J-shaped channels, with at least three vertically oriented reinforcement straps riveted to the two J-shaped channels. The lower cap of the aft spar, which carries less load than the forward spar, separated through an area consisting of the T-shaped wing fitting with two L-shaped angles attached.

Metallurgical examination of the lower cap of the right wing aft spar revealed one large fatigue region in the wing fitting, adjacent to the outboard edge of the "bathtub" section of the fitting. The fatigue cracking began on the forward side of the horizontal portion of the fitting, at the bottom edge, where a radius in the fitting allowed for the flush attachment of a plate to the

bottom of the wing fitting. A second fracture area in the lower cap of the right wing aft spar, located farther outboard, was also examined. Fatigue cracking, on both sides of a rivet hole, was also found at this fracture location.

The separation in the lower cap of the right wing forward spar occurred through the last set of rivets on the outboard end of the wing fitting tang. Metallurgical examination of the fracture surfaces in this area revealed eight fatigue regions around the rivet holes in the filler and the forward-most J-channel, stemming (in most cases) from multiple origins. No mechanical damage or corrosion pitting was found at the fatigue origins on either the forward or aft spars.

Because of the extent of cracking found on the right wing, the Safety Board metallurgists also examined the left wing of the accident airplane. The left wing stayed with the main portion of the wreckage and was heavily deformed and fractured in multiple locations on impact. Two of the left wing fractures were roughly equivalent in location to the separated areas of the right wing where the fatigue was located. One of these left wing fracture areas, through the lower cap of the aft spar, did not show signs of fatigue cracking. The other fracture area, through the lower cap of the forward spar, showed multiple fatigue regions, albeit somewhat less extensive than those found on the right wing. The large number of fatigue regions on both the left and right wings and the large number of fatigue origin areas associated with many of the individual fatigue cracks are typically associated with high stresses in the area of initiation. The fact that only the fatigue on the lower cap of the aft spar on the right wing progressed a large distance indicates that most of the cracking originated relatively recently.

The Beech Model 45, designated the T-34 "Mentor," was flight tested in 1949, and three YT-34s were delivered to the U.S. Air Force in 1950 for evaluation. The first of 450 T-34As were delivered to the Air Force in 1953. The T-34B, which has wings that are nearly identical to those on the T-34A, began delivery to the U.S. Navy in 1954. Originally used by the military for training, these airplanes have been surplused by the military and are now used primarily for personal use, aerobatics, and air combat simulation flights.

The accident airplane was probably delivered to the Air Force in the 1954-1955 timeframe. Sky Warriors had owned it since 1990, and had used it for air combat simulation flights. The airplane reportedly accumulated a total of about 8,200 flight hours, roughly 4,000 of these at Sky Warriors. Sky Warriors purchased the airplane from an individual who, although he owned the airplane for over 20 years, reportedly logged fewer than 200 hours on the airplane. The remaining 4,000 hours were probably accumulated during military training operations. Sky Warriors owns two additional T-34A airplanes and has reportedly completed over 8,400 missions between the three airplanes since commencing operation in 1990. According to the operator, each of these missions is about 75 minutes in duration, and the pilots are requested not to exceed 4 Gs in the positive direction. This operator-imposed limit is lower than the 6 positive Gs for which the airplane was originally certified, but the 4-G limit is exceeded at times. Earlier in the accident flight, according to the audio portion of a videotape made during the flight, the pilot informed the passenger that they had performed a 4.5- to 5-G turn. One of the other airplanes owned by this operator reportedly experienced a 12-G loading during one mission.

The Safety Board is aware of two other operators in the United States who use T-34 airplanes for air combat simulation flights. One of these, Texas Air Aces of Spring, Texas, reportedly experienced cracking of a left wing aft spar lower cap in early 1999. The parts were replaced and discarded without being examined by the Safety Board, but the description given of the fracture suggested that it might have cracked from fatigue.

The Safety Board has found no other examples of possible wing structure fatigue cracking in the long history of the T-34 series of airplanes. Although typical wing loading spectra generated by training missions, aerobatics, and air combat simulation flights are not available, the Safety Board believes that air combat simulation flights may induce a larger number of high positive wing loading events per flight hour than other operations. In addition, the multiple initiation sites and large number of fatigue cracks in the wing structure suggest that the fatigue damage is both recent and related to high stress. Considering these factors, it is likely that the fatigue cracking on the accident airplane was the result of the loading conditions experienced during the air combat simulation flights. The Safety Board is concerned that other T-34 series airplanes used in this type of operation could also have fatigue cracks in the wings and that the wings may be in imminent danger of separating. Raytheon Aircraft Company, the current holder of the type certificates for these airplanes, issued a Safety Communiqué on May 19, 1999, stating that all YT-34, T-34A, and T-34B airplanes must not be flown until a final determination of the action required is made by the FAA. Because this Safety Communiqué is not mandatory, the Board believes that the Federal Aviation Administration (FAA) should immediately restrict from further flight all Beech YT-34, T-34A, and T-34B airplanes that have been or are currently being used in air combat simulation flights until an inspection shows the airplanes to be airworthy. The Board further believes that the FAA should immediately restrict all other Beech YT-34, T-34A, and T-34B airplanes from entering future air combat simulation flight service until an inspection shows the airplanes to be airworthy. Raytheon is currently working to develop an appropriate inspection technique.

Beech YT-34, T-34A, and T-34B airplanes operated only for personal and aerobatic use are of somewhat lesser concern than those used for air combat simulation flights. Although these airplanes, especially those regularly performing aerobatics, may experience occasional G loads of the same magnitude as those experienced by air combat simulation airplanes, the number of high G load applications would be expected to be much less for the airplanes in personal and aerobatic use. However, at some time in the future, fatigue cracking could also develop in these other airplanes. Because of this potential, the Safety Board believes that the FAA should require that operators of Beech YT-34, T-34A, and T-34B airplanes perform an inspection of the wings and other critical structures at an appropriate interval sufficient to detect cracking prior to failure (depending on the usage of the airplane), as soon as Raytheon has developed an approved inspection procedure.

As a result of the complexity of the wing in the critical wing fitting region, the Safety Board believes that such an inspection will be difficult to develop. In the meantime, continued application of high stresses to the wings could induce cracking in additional airplanes or cause additional fatigue damage to those airplanes that already contain fatigue cracking. Operators of these airplanes should be informed of the circumstances of the Rydall, Georgia, accident to

encourage pilots and operators to limit high G operations and thereby reduce the possibility of additional failures. Therefore, the Safety Board believes that the FAA should publicize the circumstances of this accident and the potential for wing separation due to wing spar fatigue to all owners of Beech YT-34, T-34A, and T-34B airplanes.

The Safety Board is not aware of any additional analysis or testing performed on the T-34 models prior to their usage in air combat maneuvering, nor was any such analysis or testing required. The only restrictions placed on the operation of the aircraft during air combat simulation are those imposed by the design limits of the aircraft and any guidelines set by the operator. Because of the potential that any airplane used in this type of operation could develop cracking as a result of a large number of high stress events, the Safety Board believes that any type of aircraft being used or considered for air combat simulation flights should be evaluated for its suitability for this type of loading. The Safety Board believes that the FAA should require the development of operational and inspection criteria for the critical flight control surfaces and structural elements, as necessary, for any airplane used in air combat simulation flights.

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

Immediately restrict from further flight all Beech YT-34, T-34A, and T-34B airplanes that have been or are currently being used in air combat simulation flights until an inspection shows the airplanes to be airworthy. Immediately restrict all other Beech YT-34, T-34A, and T-34B airplanes from entering future air combat simulation flight service until an inspection shows the airplanes to be airworthy. (A-99-47, Urgent)

Require that operators of Beech YT-34, T-34A, and T-34B airplanes perform an inspection of the wings and other critical structures at an appropriate interval sufficient to detect cracking prior to failure (depending on the usage of the airplane), as soon as Raytheon Aircraft Company has developed an approved inspection procedure. (A-99-48)

Publicize the circumstances of the accident near Rydall, Georgia, and the potential for wing separation due to wing spar fatigue to all owners of Beech YT-34, T-34A, and T-34B airplanes. (A-99-49, Urgent)

Require the development of operational and inspection criteria for the critical flight control surfaces and structural elements, as necessary, for any airplane used in air combat simulation flights. (A-99-50)
