National Transportation Safety Board
Aviation Accident Final Report

Location:	RYDAL, GA	**Accident Number:**	ATL99FA072
Date & Time:	04/19/1999, 1246 EDT	**Registration:**	N140SW
Aircraft:	Beech T-34A	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General Aviation - Other Work Use		

Analysis

The simulated combat flight made a course change maneuver associated with a climb or a descent. The accident airplane preformed the maneuver with a descending left turn. While descending and turning, the safety pilot instructed the client to turn harder and to bury the nose. While following the safety pilot's instructions the right wing assembly separated from the airframe. The main airplane wreckage collided with the ground along the edge of a wooded area of a subdivision. The right wing assembly was located approximately 1/2 mile north of the main wreckage. Examination of the airplane disclosed fatigue cracking in the spar material in the vicinity of wing spar fracture face. The T-34A design 'G' load limits are +6.0 and -3.0.

This report was modified on November 2, 2005.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: Fracture of the wing spar as a result of fatigue cracking that occurred over an unknown number of flights and flight hours with a wing loading spectrum not anticipated during design of the airplane.

This report was modified on November 2, 2005.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: MANEUVERING

Findings
1. (C) WING,SPAR - FATIGUE
2. (C) DESIGN STRESS LIMITS OF AIRCRAFT - EXCEEDED

Occurrence #2: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Findings
3. TERRAIN CONDITION - GROUND

Factual Information

HISTORY OF FLIGHT

On April 19, 1999, at 1246 eastern daylight time, a Beech T-34A, N140SW, collided with the ground following the in-flight separation of the right wing near Rydal, Georgia. The laser combat simulation flight, "dogfight", was operated by Sky Warriors Aerial Laser Combat under the provisions of Title 14 CFR Part 91 with no flight plan filed. Visual weather conditions prevailed at the time of the accident. The air transport pilot/safety pilot (pilot-in-command) and the pilot/client were fatally injured. The flight departed Fulton County Airport in Atlanta, Georgia, at 1200.

The operator reported that, N140SW and another T-34, N141SW, entered the training area near Rydal to complete the pre-briefed simulation mission as outlined in phase two of the four-phase combat simulation program. Approximately 45 minutes into the mission, both airplanes set up a "beyond visual range engagement". Both airplanes initiated the engagement at a predetermined altitude and direction. After the initial turn toward each other, N140SW started a descending left turn, and an increase roll rate (see attached Operator's Aircraft Accident Report).

The operator reported that the airplane was equipped with an on-board video recorder with three cameras installed to capture the events of the flight. A review of the on-board videotape, the safety pilot provided maneuvering instructions to the client with intercept instructions. Seconds before the accident, as they were in pursuit of the other airplane, the safety pilot of the accident airplane instructed the client to "roll all the way through harder, harder- all the way through. That's it. That's right. Bury your nose, bring it down. That's it, good". The client respond by saying "Okay". As the pursuit continued the safety pilot told the client, "now don't chase him into the ground".

According to the safety pilot of the second T-34, while maneuvering in the left descending turn, the right wing separated from the airplane. The airplane entered a spiral, and impacted the ground on the edge of a nearby tree line, north of a new sub-division.

PERSONNEL INFORMATION

The safety pilot of the accident airplane held an airline transport pilot certificate with single engine land, single engine sea, multi-engine land, and instrument airplane ratings. On November 1998, the safety pilot was issued a first class medical certificate with no limitations. A review the safety pilot's flight experience disclosed that he completed the requirements for the biennial flight review in November 1998; the flight review was taken in a Boeing 767 airplane. The safety pilot had accumulated approximately 15,500 hours of total flight time. The review of the pilot's records showed that he had accumulated a total of 450 hours in the Beech T-34A airplane; within 90 days of the accident, the pilot had flown 20 hours in the Beech T-34A. According to the operator, the safety pilot had worked for approximately 2 years as a safety pilot for Sky Warriors. The operator also reported that the safety pilot on the accident airplane, as well as all of the safety pilot s with Sky Warriors are ex-military fighter pilot.

Additional review of the client information disclosed that he was also a certificated pilot. Reportedly, the client was a 25,000-hour retired airline pilot (see attached Supplement "E").

AIRCRAFT INFORMATION

N140SW was owned and operated by Sky Warriors, Inc. Additional information about the airplane is located in the factual report on page 2, under the "Aircraft Information" data field. The T34A/B airplane is a two-place, single-engine, tandem-seat trainer, manufactured by Beech Aircraft Corporation. The airplane was designed to meet the requirements of a primary trainer, and at the same time prepare the student pilot for the transition to heavier, higher-performance aircraft.

The over-all dimensions of the airplane are wingspan 32.8 feet, length 25.9 feet, height at rest 9.6 feet. The normal gross weight of the airplane is 2,950 pounds. The entire T34A and B production was sold to U.S. military customers, or was exported to foreign military customers.

N140SW was also equipped with three video cameras and a VHS video recorder; the accident VHS tape for the accident flight was recovered. Other unspecified mission equipment was also installed on the airplane.

Maintenance records showed that N140SW was routinely inspected under a wing spar X-ray program since 1996; no significant findings were discovered under this inspection program initiated by the operator. According to the operator, records of cumulative "G" loading for each flight were not maintained. The operator also reported that no simulated combat flight ever exceeded the designed "G" loading limits. The design "G" load limits are +6.0 and -3.0.

METEOROLOGICAL INFORMATION

Visual meteorological conditions prevailed at the time of the accident. Additional information about the weather is located on pages 3 and 4, under the section titled "Weather Information."

WRECKAGE AND IMPACT INFORMATION

The main wreckage was located near the intersection of Lauren Lane and Landers Road, near Rydal, Georgia. No evidence of in-flight or postimpact fire was noted. The right wing forward spar had separated at a point just outboard of the forward wing attach fittings. The rear spar had separated in generally two locations. One area involved separation of the upper and lower spar cap assemblies at a point just outboard of the right main landing gear aft trunnion fitting. The other area involved the area of the aft wing attach fittings. The rear spar upper cap assembly separated at a point just outboard of the aft upper wing attach fitting. The aft lower wing attach fitting separated 3.8 inches outboard of the face of the fitting, which is just outboard of the "bathtub" portion of the fitting.

Examination of the accident site disclosed that the main wreckage, with the left wing attached, rested in a 6 foot deep crater adjacent to the tree line. The right wing assembly, minus the inboard over the wing walk surface and the inboard section of the right rear wing spar, was located approximately one mile north of the main wreckage. The remainder of the right wing structure was located 1/4 mile northeast of the wing assembly. Examination of the main wreckage site also disclosed that the tail section of the airframe extended vertically about five feet above ground level. The left wing sustained perpendicular crushing damage along the entire leading edge; the postimpact chord of the left wing was approximately 8 inches long.

Postaccident examinations of the right wing forward and aft spar structures and the left wing forward and aft spar structures were conducted by the National transportation Safety Board (NTSB) Materials Laboratory. The examination revealed that the upper elements of the forward spar assembly from the right wing were separated perpendicular to the length of the wing. This separation occurred 5.8 inches outboard of the wing joint along the upper surface.

The lower portions of the forward spar assembly were separated 11.5 inches outboard of the wing joint, at the last rivet hole on the outboard end of the wing fitting tang. The aft spar assembly was separated through the wing fitting area 8.2 inches outboard of the wing joint along the top of the spar assembly and 3.8 inches outboard of the wing joint on the bottom of the assembly.

The aft spar structure was also separated farther outboard on the wing, at the outboard end of the landing trunnion fitting. The fractures in the upper spar structure were matte, textured, and oriented along a shear plane. Examination of the fracture surfaces in the lower spar structure revealed 11 flat, shiny fatigue regions. Use of a scanning electron microscope (SEM) revealed striations, ductile dimples, crack arrest markings, and ratchet marks throughout the fatigue regions. Although the left wing remained attached to the airplane until impact, the fractures in the wing fitting areas of the forward and aft spar assemblies were examined in the laboratory for preexisting cracks similar to that found on the right wing. Visual examination of the fracture surfaces revealed flat striated surfaces. All of the fatigue originated at or near a rivet hole except for the cracking found on the aft strap, which originated in multiple locations along the forward edge. All of the fractures were matte, textured, and oriented along a shear plane.

The aileron remained attached to the right wing, and the control cables for the aileron separated inside the wing. The separated ends exhibited signatures consistent with tension overload. The terminal ends of the cables remained attached to the aileron bell crank. The bell crank sustained impact damage to the up aileron arm, but remained intact and securely attached to the wing. The control rod from the bell crank to the aileron was attached at each end. The flap separated chordwise approximately 12 inches from the outboard end. The outboard end remained attached to the wing. The inboard section of flap sustained impact damage, and remained attached to the inboard section of wing. The flap actuator extension measured 2 1/4 inches, which corresponds to a flap position of 3.75 degrees extended. The fuselage was destroyed and the carry through spar structure also sustained damage. The wing attach fittings were removed from the carry through and sent to the NTSB Materials Laboratory in Washington, DC, for examination.

The front and rear cockpit areas were destroyed during ground impact. Both seats and instrument panels were destroyed. Two G-meters were recovered from the wreckage. One of the G-meters indicated +7.5 and -10.0 Gs. The other G-meter had a single pointer and its position was in the white arc between -5 Gs and +10 Gs. The fuel selector handle had separated from the fuel selector and was free to rotate. The fuel selector valve was not found.

The empennage sustained structural deformation. All the empennage components were complete and intact as an assembly, except the right elevator balance weight that separated during the impact sequence. Elevator control cables were found attached to the intact elevator bell crank. The elevator trim tab actuators were intact, and the tab control chains and cables were continuous into the fuselage. Rudder control cables were found attached to the rudder bell crank, and they were found to be free to operate by pulling on the cables in the fuselage. The rudder trim tab actuator, the tab control chains and cables were continuous into the fuselage.

Supplemental Factual Examination

A survey of spare T-34 forward spar assemblies reportedly found one that contained a joggle in

certain members of the lower spar assembly at the approximate location of the right wing separation in the accident airplane. Examination of the accident airplane established the absence of such a joggle in the spar (see attached Supplemental Factual Examination).

MEDICAL AND PATHOLOGICAL INFORMATION

A postmortem examination for the pilot was not performed. The toxicological examinations for the pilot disclosed that 4.1(ug/ml,ug/g) acetaminophen was detected in the blood sample. Unspecified quantities of pseudoephedrine and phenypropanolamine were found in the liver sample.

ADDITIONAL INFORMATION

Wing Spar Examination from N141SW-Damage Discovered May 19, 1996

The forward spar assemblies were reportedly removed from the left and right wings of the aircraft in July 1996, shortly after cracking was discovered in the lower spar structure of the right wing. The spar assemblies were initially examined at the Safety Board's Materials Laboratory and then at the facilities of Raytheon Aircraft Company. The spar assemblies were intact from their inboard end to the cut locations outboard of the wheel well. Visual examination of the left spar assembly revealed no indication of cracking. Visual examination of the right spar assembly revealed a crack in the forward side of the lower center hinge extrusion and a crack in the wing fitting region on the aft J-channel. The center hinge extrusion, outboard of the crack, was displaced. Scanning electron microscopy of the fracture surface revealed numerous linear fatigue origins which spanned the length of the hinge lug radius. Striations were noted both close to and away from the origin; away from the origin, the striations became mixed with bands of ductile dimples. No mechanical damage or deep machining marks were found on the surface of the hinge lug radius where the fatigue originated.

Further examination of the spar assemblies was conducted by Raytheon Aircraft Company using eddy current. No crack indications were found in the left wing forward spar structure. Indications of additional cracking were found in the right wing forward spar structure in the aft J-section, the forward J-section, and the filler strip. Examination of the lower forward hinge angle from the right wing revealed a flat fracture surface with crack arrest markings that originated at the rivet hole on the bottom of the hinge and propagated aft and then up along the hinge angle. Two other cracks were noted in the right wing hinge angle; neither of these cracks was opened for examination. The lower forward hinge angle from the left wing also contained three visible cracks; none of the cracks on the left hinge angle was opened for examination.

Mandatory Service Bulletin 57-3329

Examination of the right wing from N140SW initial separation fractures by NTSB and Raytheon Aircraft Company metallurgists established the presence of fatigue on several of the fracture surfaces. Fatigue cracks have also been found at specific locations in the wing spars of other in-service T-34 airplanes during the process of developing the service bulletin. The YT-34, T-34A, and T-34B airplanes were designed as military trainers. Less than 1,400 were built between 1953 and 1958. At that time, there was no requirement for the establishment of a fatigue life for these three models of military trainer. More important, the accumulated operational service history - the magnitude and number of g-loads - of an individual airplane is unknown. Given the intermingling of spare and salvaged parts installed on airplanes in

military service, it is usually impossible to determine accurately the overall history of the airplane. Fatigue cracks at any location in the forward or aft spar will reduce the wing's ability to carry limit load and may result in an in-flight separation of a wing.

The service bulletin provides inspection procedures for the forward (main) and aft (rear) wing spars of airplanes conforming to Type Certificate No. 5A3 to detect fatigue cracks in specified areas only. The specified areas are those where fatigue cracks have been found during investigation of the referenced accident and during preparation of the service bulletin. While inspecting individual airplanes, inspectors are cautioned to carefully examine other accessible areas and structure. During preparation of the service bulletin, corrosion was found on one wing that was severe enough that the operator elected to replace the wing.

The service bulletin is separated into two parts. Part I provides instructions for the modification and inspection of the forward wing spar structure and aft wing spar structure for fatigue cracks and corrosion at suspected locations. Part II provides a recurring inspection interval at 80-hour intervals.

Videotape Transcription

As previously stated, the airplane was equipped with three video cameras and a video recorder. The videotape from the accident flight was recovered and subsequently transcribed (see attached videotape transcription).

Maneuver

According to Sky Warriors Air Combat Maneuvering Guide, the execution of the accident event incorporates the application of sliceback or pitchback maneuvers. Both maneuvers are set up in the same manner, and uses the horizon and the position of the opponent to determine which maneuver is required. The maneuvering guide has a caution note for each maneuver that states, "When starting a pitchback at high energy levels, an overly aggressive pull could result in an over-G." or "An overly aggressive pull at high energy levels could result in an over-G" (see attached extracts from Sky Warriors Air Combat Maneuvering Guide).

Photogrammetic Evaluation

The photogrammetic evaluation of the video portion of the accident tape determined that there were several factors that prevented the accurate and reliable evaluation. The following factors were considered: 1) The relative high altitude of the airplane at the time of the accident and refraction due to atmospheric effects, 2) The low resolution of the videotape and the ability to select and measure control points on the ground, 3) Recovery of the original wide angle lens for calibration (see attached Photogrammetic evaluation).

The airplane wreckage was released to Mr. Les Cychek , an insurance adjuster with AIG Aviation, Inc. in Atlanta, Georgia.

Pilot Information

Certificate:	Airline Transport	**Age:**	54, Male
Airplane Rating(s):	Multi-engine Land	**Seat Occupied:**	Rear
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 Valid Medical--no waivers/lim.	**Last Medical Exam:**	11/12/1998
Occupational Pilot:		**Last Flight Review or Equivalent:**	
Flight Time:	15500 hours (Total, all aircraft), 450 hours (Total, this make and model), 14000 hours (Pilot In Command, all aircraft), 165 hours (Last 90 days, all aircraft), 65 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	Beech	**Registration:**	N140SW
Model/Series:	T-34A T-34A	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	G-130
Landing Gear Type:	Retractable - Tricycle	**Seats:**	2
Date/Type of Last Inspection:	02/02/1999, Annual	**Certified Max Gross Wt.:**	2950 lbs
Time Since Last Inspection:	140 Hours	**Engines:**	1 Reciprocating
Airframe Total Time:	3200 Hours	**Engine Manufacturer:**	Continental
ELT:	Installed, not activated	**Engine Model/Series:**	IO-550
Registered Owner:	SKY WARRIORS INC.,	**Rated Power:**	300 hp
Operator:	SKY WARRIORS INC.,	**Air Carrier Operating Certificate:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	FTY, 841 ft msl	**Observation Time:**	1153 EDT
Distance from Accident Site:	27 Nautical Miles	**Direction from Accident Site:**	185°
Lowest Cloud Condition:	Clear / 0 ft agl	**Temperature/Dew Point:**	18°C / 1°C
Lowest Ceiling:	None / 0 ft agl	**Visibility**	10 Miles
Wind Speed/Gusts, Direction:	8 knots, 230°	**Visibility (RVR):**	0 ft
Altimeter Setting:	30 inches Hg	**Visibility (RVV):**	0 Miles
Precipitation and Obscuration:			
Departure Point:	(FTY)	**Type of Flight Plan Filed:**	None
Destination:		**Type of Clearance:**	None
Departure Time:	1200 EDT	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	2 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	

Administrative Information

Investigator In Charge (IIC):	PHILLIP POWELL	**Adopted Date:**	08/13/2001
Additional Participating Persons:	BEOTIS WRIGHT; COLLEGE PARK, GA		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at http://dms.ntsb.gov/pubdms/.		

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