Aviation Investigation Final Report

Location:	BANNING, California	**Accident Number:**	LAX99GA005
Date & Time:	October 5, 1998, 12:36 Local	**Registration:**	N416DF
Aircraft:	Grumman TS-2A	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Public aircraft		

Analysis

The air tanker pilot was on a fire suppression mission with fire retardant chemicals aboard, and had made two previous drops on the fire line. Another tanker and spotter pilot witnessed the last drop approach, and reported that the pilot was turning from base leg to the westerly drop heading downwind while in a 60-degree left bank. The aircraft suddenly rolled left to 90 degrees, and at that point the left wing tip struck the terrain. The winds were estimated by the tanker pilots to be 25 to 30 mph with gusts to 40 plus from the east. The pilots also reported turbulence and bad air. Airmet Tango was issued for turbulence and isolated severe conditions mainly below 10,000 in the vicinity of canyons and passes.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot misjudged his maneuvering altitude. Factors to this accident were the mountainous terrain, tailwind conditions, and turbulence in the area.

Findings

Occurrence #1: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: MANEUVERING - AERIAL APPLICATION

Findings
1. TERRAIN CONDITION - MOUNTAINOUS/HILLY
2. (F) WEATHER CONDITION - TAILWIND

3. (F) WEATHER CONDITION - TURBULENCE,TERRAIN INDUCED
4. (C) LOW ALTITUDE FLIGHT/MANEUVER - MISJUDGED - PILOT IN COMMAND

Factual Information

HISTORY OF FLIGHT

On October 5, 1998, at 1236 hours Pacific daylight time, a Grumman TS-2A, N416DF, operated under 14 CFR Part 91 by the California Department of Forestry (CDF) as Tanker 96, was destroyed during a collision with mountainous terrain near Banning, California. The government owned aircraft was maintained and pilot services provided by San Joaquin Helicopters (SJH), a private contractor. The pilot was fatally injured. Visual meteorological conditions prevailed for the flight. The aircraft was on a fire suppression mission at the time of the accident and carrying fire retardant chemicals.

According to the CDF, the tanker pilot made two previous drops on the Mt. Edna fire line. The tanker pilots are directed by spotter aircraft orbiting the fire. The accident pilot was directed by the spotter aircraft to tag onto the previous drop of Tanker 75.

According to the pilot of Tanker 75, he had dropped in the same area, but in the opposite direction due to a gap between the previous drop and the rest of the line they were attempting to build. He stated that the drop was basically into the wind and he encountered severe turbulence but no loss of flight control. However, he had experienced a momentary loss of control on the previous drop while orbiting the fire approximately 1,000 feet agl and 1/4 mile west of the accident site in a left bank (approximately 15 degrees). The aircraft rolled 45-60 degrees. He concluded that there was a severe "rotor" effect coming off the ridges on the east side of the fire.

Another tanker pilot and an U.S. Forest Service (USFS) spotter pilot witnessed the approach to the drop area. They reported that the pilot was turning from base leg to the westerly drop heading while in a 60-degree left bank. The aircraft suddenly rolled further left to 90 degrees, at which point the left wing tip struck the terrain prior to releasing retardant. According to the CDF Aviation Management, the minimum approved descent altitude for a retardant drop is 150 feet above vegetation/terrain.

Pilots and ground personnel estimated the winds to be 25 to 30 mph with gusts of 40 mph from the east. One pilot called the estimate conservative. They also reported turbulence and bad air. Airmet Tango had been issued for turbulence and isolated severe conditions mainly below 10,000 in vicinity of canyons and passes.

The aircraft was based at Fresno, California. The pilot had flown from Fresno to the Mt. Edna fire site with retardant on the morning of the accident. After the initial drop, he landed at Hemet-Ryan Airport, reloaded with retardant, and dispensed the load on the fire line. On the last drop, he reloaded, refueled, and departed at 1229 and crashed at 1236. The combined

totals of flight time for the pilot on the day of the accident was about 2:42 hours.

PERSONNEL INFORMATION

San Joaquin Helicopters employed the airline transport rated pilot as a seasonal employee who had flown three fire seasons with them. The pilot had also flown numerous seasons with other contractors as a tanker pilot. He was type rated in 11 heavy aircraft and 4 additional with VFR limitations. At the start of the 1998 fire season he reported 16,680 total flight hours, with 865 hours in the TS-2A aircraft. He also reported 2,970 hours as a tanker pilot.

On December 16, 1997, the pilot was issued a first-class medical certificate with restrictions that he wear glasses for distant vision and possess glasses for near vision.

At the beginning of the April 30, 1998 season, the pilot was given a pilot proficiency evaluation that consisted of an oral evaluation of aircraft systems, limitations, normal and emergency procedures, and fire-fighting mission questions. Also addressed were ground operation issues for aircraft flight log, preflight, checklist, taxi technique, and takeoff computations. The pilot was evaluated during an actual flight of 40 minutes. The details of the total evaluation are attached to this report.

On September 21, 1998, at the Fresno Air Attack Base the pilot satisfactorily completed a PIC proficiency check and instrument training under the provisions of 14 CFR 61.57. He also demonstrated the skill and knowledge requirements as required by 14 CFR Part 137.19.

The pilot was on a normal day-off schedule the day before the accident. The day of the accident his day started about 0800. Prior to departing Fresno at 0912, he flew a proficiency flight of 12 minutes. At the time of the accident he had been on duty about 4:36 hours. According to contract #7CA51199 part four, section K, 4.7.4 Flight time in state-owned aircraft: Flight time shall not exceed a total of 7 hours per day.

AIRCRAFT INFORMATION

The ex-military aircraft was made available from long term storage to the California Department of Forestry and Fire Protection for Forest and Wildlife Conservation. The Federal Aviation Administration (FAA) issued a Special Airworthiness Certificate in the restricted category on June 20, 1985. The operating limitations specify, in part:

. . . no person may operate this aircraft for other than the purpose for which the special airworthiness certificate was issued (Forest and Wildlife Conservation) and in accordance with operating limitations contained in FAR 91.313 with special operating limitations to operate over densely populated areas, in congested airways, from busy airports where passenger transport operations are being conducted and those contained herein . . . .

Maintenance was provided by the contractor, San Joaquin Helicopters, under 14 CFR 91.409

(F), a continuous airworthiness program. The aircraft flight hours and maintenance data reflected in this report were obtained from the CDF Aviation Management. According to the maintenance contractor inspection schedule, the last annual inspection was performed on April 14, 1998, at 10,676.4 hours. A 100-hour inspection was conducted on July 31, 1998, at 10,776.4 hours.

The annual inspection of the aircraft is routinely performed by SJH during the winter months after the fire season. Prior to the aircraft going back on-line for a fire season, the CDF performs a 27 page S-2 Operations Acceptance Check. A copy of the detailed check is included in this report.

The aircraft was refueled with 357.8 gallons (full fuel) of 100LL aviation fuel after repositioning from Fresno to the Mt. Edna fire, dispensing a load of retardant, and landing at Hemet.

Preliminary Stall Speed vs Angle of Bank calculations were made using the NAVAIR 01-85SAA-1 operations manual and estimating the weight to be 25,876 pounds. A 60-degree bank could generate a stall at 94 knots; a 70-degree bank could generate a stall at 110 knots. The accident site density altitude was estimated about 6,600 feet.

At the time of the accident the aircraft had accumulated 10,848.7 total flight hours. On the day of the accident the pilot flew the aircraft .2 hours for proficiency prior to departing for Hemet. The flight time from Fresno to Hemet was 1:35 hours. The aircraft performed two retardant drops from the Hemet base. The combined flight totals for the day were 2:42 hours.

The aircraft was fitted with an 800-gallon Aero Union Corporation Grumman S-2 retardant tank system. The doors are opened and closed by hydraulic actuators controlled electrically through a relay system. The airplane's 1,500 p.s.i. hydraulic system supplies the energy.

On March 15, 1999, the Safety Board visited the CDF facilities located at Mather, California. A pilot generated test procedure similar to the Aero Union procedure for the retardant tank operational systems was discussed and examined. A brief functional test of a tanker door system was performed.

On March 16, 1999, Tanker's T-100 and T-93 retardant tank operating systems were ground tested in all modes with the engines running. The tests following the written procedures met the required checks. Tanker T-100 experienced a sticking microswitch on the No. 3 door open light limit switch.

The drop/release button is located on the left side of the pilot's control yoke next to the microphone button and is recessed into a circular ring. Improper/interrupted use of the release button was found to cause a door release interruption. The Aero Union operational manual calls for the switch to be held for 1 full second without interruption.

The system has four doors which may be opened individually, or in any combination of

openings either manually or automatically. The drop system control, warning, and condition advisory device panel is located on the lower portion of the center instrument panel.

The switch has two positions "ARM" and "OFF" and is switch guarded in the arm position. The point at which the system is actually "ARMED" for a drop is pilot preference. Some pilots prefer to "ARM" at takeoff to prevent forgetting.

An emergency pneumatic tank dump system is provided utilizing a nitrogen charged accumulator. A red emergency dump button is located on the center of the instrument and must be held "momentarily."

METEOROLOGICAL INFORMATION

There are no official weather observations available that are representative of the accident area. Pilot estimates of wind conditions were 25 to 30 mph with gusts of 40 plus from the east.

At 1246, Beaumont, which is located about 8 miles northwest of the accident site, was reporting: wind 090 degrees at 15 knots with gusts to 26 knots; visibility 25 miles; temperature 70 degrees Fahrenheit; dew point 28 degrees Fahrenheit; and smoke was reported in the vicinity.

At 1153, Riverside Arlington Airport, located about 32 miles west of the accident site, was reporting: clear with visibility 10 miles; temperature 82 degrees Fahrenheit; dew point 32 degrees Fahrenheit; wind direction 030 degrees at 18 knots with gusts of 25 knots; altimeter 30.01 inHg.

Airmet Tango, a weather advisory, was valid for the time period and reported: from 40 southwest of Reno to Needles to Yuma to 40 west of Santa Barbara to Ukiah to 40 southwest of Reno occasional moderate, isolated severe turbulence below 12,000; isolated severe conditions mainly below 10,000 in vicinity of canyons and passes of southern California; and occasional moderate conditions continuing beyond 1900 through 0100.

According to the National Weather Service, Santa Ana winds commonly occur between October and February. Wind speeds are typically north to east at 35 knots through and below passes and canyons with gusts to 50 knots. Stronger Santa Ana winds can have gusts greater than 60 knots over widespread areas and gusts greater than 100 knots in favored areas.

The CDF Aviation Management Procedures Handbook, 8362.2.2 (Wind Limitations) states in part: "Special caution should be taken when operating in wind conditions of 20 knots and above, or when the gust spread exceeds 10 knots. Aerial operations should cease when wind gusts exceed 30 knots over ridgelines."

WRECKAGE AND IMPACT INFORMATION

The accident site is located at latitude 33 degrees 52.40 minutes north and longitude 116 degrees 53.21 minutes west (GPS). The location is in the San Jacinto Mountains on Mt. Edna about 4,300 feet msl.

A linear widening scatter path through natural sagebrush identified the initial point of impact. The path was measured to be a distance about 171 feet. Within that distance were found remnants of a red navigation light, left wing tip cap fairing at 75 feet, and propeller blade sections. Evidence of a widening retardant spill was found commingled with the natural soil in caked mud-like appearance.

At the end of the initial point of impact and scatter path the terrain dropped off and downward about 28 degrees. Over the next 300 feet were found the major airframe components in a fragmented state. Most components were found with postaccident fire damage.

The landing gear was determined to be in the retracted position. The degree of flap extension could not be conclusively determined. There were no annunciator lights recovered for element analysis.

All propeller blades exhibited high torque signatures with leading edge damage, chordwise striations, and tip severing.

MEDICAL AND PATHOLOGICAL INFORMATION

On October 7, 1998, the Riverside County Medical Examiner performed an autopsy on the pilot. During the course of the autopsy, the FAA Civil Aeromedical Institute in Oklahoma City, Oklahoma, obtained samples for toxicological analysis. The results of the analysis were negative for carbon monoxide, cyanide volatiles, and all screened drugs.

TESTS AND RESEARCH INFORMATION

A postaccident recovery, layout, and detailed examination of the airframe, engines, systems, and controls was accomplished. All major parts of the airframe and engines were recovered in the accident area. Control continuity was established where possible. A detailed examination of the wing flap attach and actuation system was conducted.

ADDITIONAL INFORMATION

On October 29, 1998, the engines were transported to an FAA approved overhaul facility (ARS) for a partial teardown examination. All operational signatures were considered to be normal by the ARS.

According to the CDF there are no requirements for a CDF fought fire to have a lead plane precede a tanker into a drop area. A CDF fixed wing spotter aircraft is required to direct all

retardant aircraft, fixed and rotary wing, from above the fire line. Fires under the control of the USFS do require USFS lead planes to precede drop aircraft.

The seasonal pilots employed by San Joaquin Helicopters are paid on a base pay plus flight pay when on a mission.

Parties to this investigation were the California Department of Forestry, San Joaquin Helicopter Helicopters, and The Air Tanker Pilots Association.

On November 4, 1998, the Safety Board released the wreckage to a representative of the California Department of Forestry.

On December 29, 1998, the Safety Board mailed out a request to 23 S-2 pilots for information/assistance regarding retardant tank system operation. The questions were for reliability, predictability, adequacy, and general operation. The Safety Board believed that the pilots were in a better position to give unbiased answers. Of the 23 requests, 16 were returned with responses.

Generally, the pilots agreed that the Aero Union retardant tank system was safe as designed. A near-equal number had experienced door opening system failures while armed. Nearly all admitted to failure "to arm" as an additional cause for the system failure to drop retardant.

The retardant release button hold time of 1 second was not seen as a problem, nor did it become a task overload in turbulent conditions. However, not all tanker pilots were aware of the Aero Union operations manual requirement "push the drop button firmly when ready, holding it in for at least one second."

The tanker pilots routinely plan their drop approaches from left turns utilizing the left bubble side window. Consequently, needs for the annunciator lights to be located in the heads-up left side glare shield area were expressed. A need for a door's released/cycled and retardant remaining light were also expressed.

Other issues pilots commented on were:

1) Suggested review of dispatch procedures for fixed wing aircraft in hostile meteorological conditions. Shutting down air operations in surface winds of 40 knots and above.

2) Training issues were to not correct an overshoot by increasing bank angle and "g" loading, and pilots forgetting to jettison their loads during emergencies.

Pilot Information

Certificate:	Airline transport	**Age:**	62,Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Instrument airplane	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	December 16, 1997
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	16680 hours (Total, all aircraft), 865 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	Grumman	**Registration:**	N416DF
Model/Series:	TS-2A TS-2A	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Restricted (Special)	**Serial Number:**	613/136704
Landing Gear Type:	Retractable - Tricycle	**Seats:**	2
Date/Type of Last Inspection:	July 28, 1998 100 hour	**Certified Max Gross Wt.:**	27000 lbs
Time Since Last Inspection:	4 Hrs	**Engines:**	2 Reciprocating
Airframe Total Time:	10849 Hrs	**Engine Manufacturer:**	Wright
ELT:	Installed, not activated	**Engine Model/Series:**	1820-82B
Registered Owner:	CALIFORNIA DEPT OF FORESTRY	**Rated Power:**	1475 Horsepower
Operator:		**Operating Certificate(s) Held:**	None
Operator Does Business As:		**Operator Designator Code:**	

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	BUO ,2200 ft msl	**Distance from Accident Site:**	8 Nautical Miles
Observation Time:	12:46 Local	**Direction from Accident Site:**	280°
Lowest Cloud Condition:	Clear	**Visibility**	25 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	15 knots / 26 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	90°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:		**Temperature/Dew Point:**	21°C / -2°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	HEMET (HMT)	**Type of Flight Plan Filed:**	Company VFR
Destination:	HEMET-RYAN (HMT)	**Type of Clearance:**	None
Departure Time:	12:29 Local	**Type of Airspace:**	Class G

Airport Information

Airport:		**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	
Runway Used:	0	**IFR Approach:**	
Runway Length/Width:		**VFR Approach/Landing:**	

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	33.939666,-116.969566(est)

Administrative Information

Investigator In Charge (IIC):	Petterson, George
Additional Participating Persons:	SCOTT BURTON; RIVERSIDE , CA JAMES RAMAGE; MATHER , CA ERIK JOSEPHSON; MATHER , CA JOHN M WELLS; SAN DIEGO , CA
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Note:	
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