Aviation Investigation Final Report

Location:	KETCHIKAN, Alaska	**Accident Number:**	ANC00LA132
Date & Time:	September 23, 2000, 13:45 Local	**Registration:**	N405AE
Aircraft:	Eurocopter AS-350B-3	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	2 None
Flight Conducted Under:	Part 91: General aviation - Instructional		

Analysis

Two commercial helicopter pilots, both certificated helicopter instructors, were in a turbine-powered helicopter practicing autorotations with a power recovery prior to touchdown. The flying pilot inadvertently activated the flight stop augmented fuel flow switch during a power recovery, and oversped the engine and main rotor. The other pilot joined him on the controls, and increased collective to reduce rotor rpm. The helicopter climbed abruptly to about 60 feet above the ground, where the tail rotor drive shaft separated. The engine subsequently lost power, and an autorotation was accomplished. Investigation disclosed that the engine and main rotor system had been exposed to significant overspeed conditions, resulting in a catastrophic failure of the turbine engine, and the tail rotor drive shaft coupling. The flight stop switch on the collective has no protective guard, and can be readily engaged, allowing the engine to enter the augmented fuel flow regime and, under certain conditions, causing the engine to overspeed. The switch has a history of inadvertent activation, and resultant engine overspeed events.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's inadvertent activation of the collective flight stop/emergency fuel augmentation switch, which resulted in engine and main rotor overspeeds, thereby precipitating failures of the tail rotor drive shaft coupling and power turbine blades. A factor associated with the accident was the manufacturer's inadequate design of the flight stop switch, which has insufficient safeguards to preclude inadvertent activation.

Findings

Occurrence #1: ABRUPT MANEUVER
Phase of Operation: MANEUVERING

Findings
1. AUTOROTATION - INTENTIONAL - PILOT IN COMMAND
2. (C) TURBOSHAFT ENGINE,FREE(POWER) TURBINE - OVERSPEED
3. (C) THROTTLE/POWER CONTROL - EXCESSIVE - PILOT IN COMMAND
4. (F) ACFT/EQUIP,INADEQUATE DESIGN - MANUFACTURER

Occurrence #2: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: MANEUVERING

Findings
5. ROTOR DRIVE SYSTEM,TAIL ROTOR DRIVE SHAFT COUPLING - SEPARATION
6. (C) ROTOR RPM - EXCESSIVE - PILOT IN COMMAND

Occurrence #3: LOSS OF ENGINE POWER
Phase of Operation: MANEUVERING

Findings
7. (C) TURBINE ASSEMBLY,TURBINE BLADE - FRACTURED

Occurrence #4: HARD LANDING
Phase of Operation: DESCENT - EMERGENCY

Findings
8. (F) ROTOR SYSTEM,TAIL ROTOR - NOT CONNECTED

Factual Information

On September 23, 2000, at 1345 Alaska daylight time, a Eurocopter AS-350B-3 helicopter, N405AE, sustained substantial damage during a hard landing three miles south of the Ketchikan International Airport, Ketchikan, Alaska. The commercial pilot-in-command, and the commercial pilot-flight instructor conducting air carrier flight instruction, were not injured. The flight was being conducted under 14 CFR Part 91 to conduct differences training for the pilot. Visual meteorological conditions prevailed at the time of the accident, and a company VFR flight plan was filed.

The instructor, who was seated in the right seat, told the NTSB investigator-in-charge during a telephone interview on September 25, that while practicing a power recovery autorotation to a beach, the pilot inadvertently activated the engine manual overspeed (flight stop) switch on the collective lever. When he began to increase throttle to recover from the maneuver, the engine began to overspeed, and rotor rpm rapidly increased. The instructor stated that he joined the pilot on the flight controls, and increased collective pitch to attempt to maintain rotor rpm. He said the helicopter rapidly climbed to about 60 feet agl, and then the overspeeding engine flamed out. The instructor indicated that he then rapidly reduced collective pitch to maintain rotor rpm for an emergency autorotation landing. He told the NTSB investigator that during the overspeed condition, the tail rotor drive shaft output coupling from the engine M5 module separated, and exited the helicopter. As he increased collective pitch to cushion the final touchdown, the helicopter's nose began to yaw uncontrollably. The helicopter sustained substantial damage to the tail boom.

On November 15, 2000, the helicopter's engine, a turboshaft Turbomeca Arriel 2B, was inspected and partially disassembled. The inspection was accomplished at the Turbomeca-US facility at Grand Prarie, Texas, under the direction of an NTSB investigator from the south central regional office, Arlington, Texas. According to the NTSB investigator's attached report, the engine displayed indications of internal heat distress, and the power turbine wheel's turbine blades had all separated from the wheel at their base.

The helicopter's Vehicular Engine Multi-functional Display (VEMD) was queried to recover archived rotor data from the accident flight. The VEMD only records main rotor rpm to 511. An overspeed is defined by Turbomeca as 47,304 rpm of the power turbine, or 121%, of the standard maximum operating rpm of 39,095. At 511 main rotor rpm, the power turbine was operating at approximately 50,803 rpm. It is possible for the main rotor system to exceed the 511-recorded rpm, and for the power turbine to experience higher revolutions, but it will not be recorded in the VEMD. The accident helicopter's VEMD read-out indicated the maximum, 511-rpm.

Turbomeca personnel indicated that overspeeding of the engine results in excessive internal

temperatures, and weakens the turbine power blades.

During flight, the twist grip throttle on the accident helicopter is normally positioned in the flight detent position, where the Electronic Engine Control Unit (EECU), and Full Authority Digital Engine Control (FADEC), control engine rpm. During a practice autorotation, the power is reduced to simulate a loss of engine power by twisting the throttle out of the detent to the idle position. Returning the throttle to the flight detent position restores power. The EECU and FADEC systems may be overridden, and the engine rpm increased, by moving the flight stop switch on the collective, and continuing to twist the throttle beyond the flight detent. Such action results in augmented fuel flow, and, under certain conditions, can result in engine overspeed.

The NTSB south central regional office investigator noted a history of four previous engine overspeed events with the AS-350-B3 in the two years it had been produced. She examined the twist grip throttle on the collective control, and spoke with pilots who operate the helicopter. She discovered that the manual flight stop switch is unguarded, and can readily be moved from the normal to the emergency augmented fuel flow position, increasing the potential of an inadvertent engine overspeed.

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	44,Male
Airplane Rating(s):	None	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	January 26, 2000
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	3850 hours (Total, all aircraft), 2550 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	Eurocopter	**Registration:**	N405AE
Model/Series:	AS-350B-3 AS-350B-3	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	3286
Landing Gear Type:	Skid	**Seats:**	6
Date/Type of Last Inspection:	September 20, 2000 AAIP	**Certified Max Gross Wt.:**	4961 lbs
Time Since Last Inspection:	17 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	92 Hrs	**Engine Manufacturer:**	Turbomeca
ELT:	Installed, activated, did not aid in locating accident	**Engine Model/Series:**	ARRIEL 2B
Registered Owner:	TEMSCO HELICOPTERS, INC.	**Rated Power:**	847 Horsepower
Operator:		**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:		**Operator Designator Code:**	HXSA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:		**Distance from Accident Site:**	
Observation Time:		**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	10 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	280°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:		**Temperature/Dew Point:**	60°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	, AK (6Z4)	**Type of Flight Plan Filed:**	Company VFR
Destination:		**Type of Clearance:**	None
Departure Time:	13:35 Local	**Type of Airspace:**	Class G

Airport Information

Airport:		**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	
Runway Used:	0	**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	55.609577,-131.579971(est)

Administrative Information

Investigator In Charge (IIC):	Thomas, Matthew
Additional Participating Persons:	GARY DUPARTIS (FAA); JUNEAU , AK NICOLE CHARNON (NTSB); ARLINGTON , TX
Original Publish Date:	February 7, 2002
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=50999

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