Aviation Investigation Final Report

Location:	KAUPO, Hawaii	**Accident Number:**	LAX95LA019
Date & Time:	October 24, 1994, 08:30 Local	**Registration:**	N5771L
Aircraft:	EUROCOPTER AS-350D	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	4 Minor
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled - Sightseeing		

Analysis

AN EUROCOPTER AS-350D COLLIDED WITH TREES AFTER A LOSS OF POWER WHILE OPERATING IN A MARINE ENVIRONMENT. THE PILOT REPORTED HE HEARD AN EXPLOSION FOLLOWED BY THE ENGINE OUT HORN. THE ENGINE TEMPERATURE (T4) GAUGE WAS NOTED AT 900 DEGREES CELSIUS AND THE ENGINE CHIP DETECTOR LIGHT ILLUMINATED. EXAMINATION REVEALED THAT THE ENGINE HAD SUSTAINED DAMAGE TO THE AXIAL COMPRESSOR, COMPRESSOR STATOR VANES, AND THE IMPELLER. PORTIONS OF THE IMPELLER BLADES WERE EXAMINED MICROSCOPICALLY REVEALING EVIDENCE OF METAL FATIGUE, WITH PITTING EVIDENT THROUGHOUT THE BLADES. ENERGY DISPERSIVE X RAY SHOWED THE PRESENCE OF SULFUR AND CHLORINE IN CORROSION DEPOSITS IN THE PITS. THE ENGINE WAS INSPECTED TWICE IN THE MONTH PRECEDING THE ACCIDENT. THE INSPECTION CRITERIA OUTLINED IN THE ENGINE MAINTENANCE MANUAL DETAILS A VISUAL INSPECTION PROCEDURE OF THE COMPRESSOR SECTION FOR CRACKS. THE MAINTENANCE MANUAL ALSO PRESCRIBES A DAILY COMPRESSOR WATER RINSE TO REMOVE SALT DEPOSITS, FOLLOWED BY INSPECTING THE COMPRESSOR FOR CLEANLINESS.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: a total loss of engine power by the corrosion fatigue failure of the compressor impeller due to the failure of company maintenance personnel to perform the prescribed daily compressor wash procedures and the inadequate maintenance inspections, which failed to detect the corrosion and subsequent pitting, that led to the fatigue initiation.

Findings

Occurrence #1: LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/MALF
Phase of Operation: CRUISE - NORMAL

Findings
1. COMPRESSOR ASSEMBLY,IMPELLER - CORRODED
2. (C) PROCEDURES/DIRECTIVES - NOT FOLLOWED - COMPANY MAINTENANCE PERSONNEL
3. (C) MAINTENANCE,SERVICE OF AIRCRAFT/EQUIPMENT - INADEQUATE - COMPANY MAINTENANCE PERSONNEL
4. (C) MAINTENANCE,INSPECTION - INADEQUATE - COMPANY MAINTENANCE PERSONNEL
5. (C) COMPRESSOR ASSEMBLY,BLADE - FATIGUE
6. COMPRESSOR ASSEMBLY - FAILURE

Occurrence #2: FORCED LANDING
Phase of Operation: EMERGENCY DESCENT/LANDING

Findings
7. TERRAIN CONDITION - MOUNTAINOUS/HILLY
8. AUTOROTATION - PERFORMED - PILOT IN COMMAND

Occurrence #3: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: DESCENT - EMERGENCY

Findings
9. OBJECT - TREE(S)

Factual Information

On October 24, 1994, at 0830 hours Hawaii standard time, an Eurocopter AS-350D, N5771L, collided with trees after a loss of power near Kaupo, Hawaii, on the island of Maui. The helicopter was being operated as a sightseeing flight under 14 CFR Part 135 by Papillon Helicopter, Ltd., Honolulu, Hawaii. The helicopter was substantially damaged. The certificated commercial pilot and three passengers received minor injuries. The flight originated in Kahului, Maui, about 0800 hours. Visual meteorological conditions prevailed and a company visual flight rules flight plan was filed.

The pilot reported he heard an explosion followed by the engine out horn while flying at 2,500 feet above mean sea level while over mountainous terrain. The engine temperature (T4) gauge was noted by the pilot at 900 degrees Celsius and the engine chip detector light illuminated. The pilot accomplished an autorotative landing in trees.

The engine, a Lycoming LTS 101-600A3, was examined and partially disassembled on October 25, 1994, under the supervision of the Federal Aviation Administration. Preliminary information from the examination indicated the engine had sustained damage to the axial compressor, compressor stator vanes, and the impeller. The engine was shipped to the National Transportation Safety Board Southwest Regional Office for further examination.

The engine was examined on January 10th and 11th, 1995, by the Safety Board, the Federal Aviation Administration, and the engine manufacturer at a metallurgical laboratory, Fowler, Inc., in Gardena, California. According to the examining metallurgists, portions of the impeller blades were examined microscopically revealing evidence of metal fatigue. The precise origin of the fatigue could not be determined due to smearing of the fracture surface. Pitting was evident throughout the impeller blades. Energy dispersive x ray showed the presence of sulfur and chlorine in corrosion deposits in the pits.

Review of the engine logbook revealed the engine was removed from another airframe (serial No. 1186) on June 12, 1994, and installed in the accident helicopter on September 13, 1994. During the period the engine was not installed in an airframe, a 1,200-hour inspection was performed and several components were replaced. According to the records, the impeller, axial compressor, and compressor stator were not replaced.

The engine logbook records subsequent inspections of the engine on October 6th and 11th, 1994. On October 6, 1994, a 100-hour inspection was performed, and on October 11, 1994, a 100/300-hour inspection was performed. The maintenance manual for the Lycoming LTS 101 engine lists a visual inspection of the compressor section every 100 hours. The inspection details removal of the upper inlet scroll which houses the compressor and inspecting for foreign object damage and cracks.

The maintenance manual also prescribes a daily compressor water rinse to remove salt deposits, followed by inspecting the compressor for cleanliness.

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	38,Male
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	October 15, 1993
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	3216 hours (Total, all aircraft), 2100 hours (Total, this make and model), 3150 hours (Pilot In Command, all aircraft), 236 hours (Last 90 days, all aircraft), 96 hours (Last 30 days, all aircraft), 6 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	EUROCOPTER	**Registration:**	N5771L
Model/Series:	AS-350D AS-350D	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	1343
Landing Gear Type:	Skid	**Seats:**	7
Date/Type of Last Inspection:	October 12, 1994 Annual	**Certified Max Gross Wt.:**	4300 lbs
Time Since Last Inspection:	53 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	9146 Hrs	**Engine Manufacturer:**	LYCOMING
ELT:	Installed, activated, did not aid in locating accident	**Engine Model/Series:**	LTS-101-600A3
Registered Owner:	PAPILLON HELICOPTER, LTD	**Rated Power:**	531 Horsepower
Operator:		**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:		**Operator Designator Code:**	ILNA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	OGG ,54 ft msl	**Distance from Accident Site:**	28 Nautical Miles
Observation Time:	07:54 Local	**Direction from Accident Site:**	300°
Lowest Cloud Condition:	Clear	**Visibility**	15 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	40°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29 inches Hg	**Temperature/Dew Point:**	24°C / 17°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	KAHULUI , HI (OGG)	**Type of Flight Plan Filed:**	Company VFR
Destination:		**Type of Clearance:**	None
Departure Time:	08:00 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:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:	3 Minor	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 Minor	**Latitude, Longitude:**	20.769802,-155.990142(est)

Administrative Information

Investigator In Charge (IIC):	Wilcox, Thomas
Additional Participating Persons:	RICHARD NELSON; HONOLULU MICHAEL J GAMBONE; STRATFORD , CT
Original Publish Date:	August 23, 1995
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=28970