



AVIATION



HIGHWAY



MARINE



RAILROAD



PIPELINE

# Aviation Investigation Final Report

<b>Location:</b>	Boulder City, Nevada	<b>Accident Number:</b>	WPR17LA133
<b>Date &amp; Time:</b>	June 27, 2017, 14:03 Local	<b>Registration:</b>	N151GC
<b>Aircraft:</b>	Eurocopter EC 130 B4	<b>Aircraft Damage:</b>	Substantial
<b>Defining Event:</b>	Loss of engine power (total)	<b>Injuries:</b>	2 Minor, 5 None
<b>Flight Conducted Under:</b>	Part 135: Air taxi & commuter - Non-scheduled - Sightseeing		

## Analysis

The commercial pilot reported that, during an air tour flight, the engine lost total power. He initiated an autorotation to a nearby helicopter pad, during which the helicopter contacted power lines. He subsequently conducted an emergency landing on up-sloping terrain.

Postaccident on-site engine examination revealed that both the gas generator and power turbine were seized and could not be rotated by hand and that there was a significant amount of heat damage to the turbine blades and thermocouples. The vehicle and engine multifunction display recorded multiple engine temperature exceedances during the accident flight. Metal particles were found on the accessory gearbox magnetic plug. Further, no oil filter was found installed in the airplane.

Subsequent engine examination revealed that there was a hole in the centrifugal compressor. Examination further revealed that the No. 2 oil jet for the axial compressor rear bearing was obstructed, which resulted in oil starvation of the bearing and its subsequent failure. The bearing failure subsequently caused the gas generator rotating assembly to seize and resulted in the centrifugal compressor contacting the cover and creating the hole found in the component. Subsequent oil jet examinations revealed that coke pollution had obstructed the No. 2 oil jet. The lack of an oil filter precipitated the No. 2 oil jet obstruction and resulted in the axial compressor rear bearing deterioration.

The resultant engine inefficiency caused by the bearing failure and obstructed oil jet led to the need for higher fuel flow, which eventually resulted in an overtemperature/high pressure turbine failure and seizure of the gas generator and subsequent flameout; this was confirmed by data downloaded from the digital engine control unit, which recorded exceedances in the gas generator and free turbine speeds and an increase in fuel flow.

The manufacturer conducted the last maintenance, which was planned to be an overhaul of the accessory gearbox, 109.6 hours before the accident. During the maintenance, the oil filter was removed and discarded as part of the normal process for arrival inspection. A maintenance document review revealed

that the overhaul was not due and that the manufacturer then sent the accessory gearbox back to the operator as is. However, the manufacturer did not inform the operator that it had removed the engine oil filter before returning the module, which is why no filter was found installed on the airplane.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

A loss of engine power due to the failure of the manufacturer to reinstall the oil filter after it was removed for inspection, which led to coke pollution that obstructed the oil jet and resulted in the subsequent oil starvation of the axial compressor rear bearing oil and its subsequent failure.

Findings	
Aircraft	Oil system - Not installed/available
Aircraft	(general) - Failure
Personnel issues	Installation - Maintenance personnel
Aircraft	Oil - Fluid level
Environmental issues	Pole - Contributed to outcome

# Factual Information

## History of Flight

<b>Enroute</b>	Miscellaneous/other
<b>Enroute-cruise</b>	Loss of engine power (total) (Defining event)
<b>Autorotation</b>	Collision with terr/obj (non-CFIT)
<b>Landing</b>	Off-field or emergency landing

On June 27, 2017, about 1403 Pacific daylight time, a Eurocopter EC 130 B4 helicopter, N151GC, sustained substantial damage following a loss of engine power and subsequent forced landing near Boulder City, Nevada. The commercial pilot and four passengers were not injured, and two passengers sustained minor injuries. The helicopter was registered to American Helicopters LLC, and operated by Papillon Grand Canyon Helicopters as an air tour flight under the provision of Title 14 *Code of Federal Regulations*, Part 135. Visual meteorological conditions prevailed for the flight, and a company flight plan had been filed. The flight originated from Boulder City Municipal Airport, Boulder City, Nevada at 1348, and was destined for Grand Canyon West Airport, Peach Springs, Arizona.

The pilot reported that, as he executed an "S-turn" about 3,000 ft mean sea level, the helicopter made a subtle yaw to the right, which was accompanied by an audible "gong." The pilot lowered the collective and simultaneously noted a yellow engine parameter failure indication on the instrument display. Moments later, the main rotor rpm warning horn activated and was followed by warning lights on the caution warning display. The helicopter began to descend immediately. The pilot elected to perform an autorotation to a nearby helicopter pad. In the attempt to steer away from power lines, the pilot made a left cyclic input; however, the retreating main rotor blade contacted a power line. The pilot continued to maneuver the helicopter and subsequently made an up-slope emergency landing on rising mountainous terrain. The helicopter was recovered to the operator's hangar for further examination.

The last maintenance performed on the engine was 109.6 hours prior to the accident at the Safran HE USA facility, Grand Prairie, Texas. On June 30, 2016, the facility received the accessory gearbox for an overhaul. The oil filter was removed and discarded as part of the normal process for arrival inspection. During the document review, it was determined that the overhaul was not due, and the operator agreed to have the accessory gearbox sent back as is. The operator received the accessory gearbox with no tags, and an entry on a log card that stated "Equipment returned repairable, not repaired, not airworthy as is". This statement was subsequently voided by Safran HE USA after being questioned by the operator thus reverting the airworthiness back to the previous entry. The manufacturer did not inform the operator that they had performed maintenance on the accessory gearbox and pulled the engine oil filter prior to sending the module back to the operator. The engine was then rebuilt with the existing accessory gearbox and operated for 109.6 hours without an oil filter installed.

On June 28 and 29, 2017, representatives from the Federal Aviation Administration (FAA), Papillon Grand Canyon Helicopters, and Safran HE conducted an engine examination. The engine did not exhibit any visual external damage. All fuel, oil, and air lines were found secured; oil was present in the oil

tank. Both the gas generator and power turbine were seized and could not be rotated by hand. There was no evidence of foreign object debris on the axial compressor. The high pressure turbine was examined with a borescope and revealed a significant amount of heat damage to the turbine blades and thermocouples. The Vehicle and Engine Multifunction Display noted exceedances in engine temperature. Metal particles were found on the accessory gearbox magnetic plug. Sludge was present on the reduction gearbox magnetic plug and electric chip detectors. Upon inspection of the engine oil filter it was revealed that the filter was not installed. The complete onsite examination report is appended to this accident in the public docket.

On July 6 and 7, 2017, at the Safran HE USA facility, the engine was further disassembled by its modules, and the Digital Engine Control Unit (DECU) data was downloaded. All magnetic sensors, strainers, magnetic plugs and the main oil strainer were removed and inspected. All were clean except for the accessory gearbox magnetic plug. The thermocouple harness had sustained thermal damage. The reduction gearbox was freely rotated by hand. The free turbine module was seized at the blade tip/shroud section and its bearings were able to rotate freely by hand. Evidence of thermal and impact damage was present on the leading edge of the free turbine blades. The accessory gearbox was rotated by hand and continuity was established throughout the gear train. The axial compressor could be rotated by hand; however, it was rough and noisy. The gas generator was unable to rotate. After removal of the axial compressor from the gas generator, a hole in the centrifugal compressor was observed. The axial compressor rear bearing was shattered. The oil jet for the rear bearing was obstructed and subsequently sent for further examination to Safran HE factory laboratory in France. The gas generator rear bearing appeared normal and rotated freely. There was no damage to the piston shaft or rear bearing housing. The Safran HE air safety investigator (ASI) stated that this would indicate that the rear of the gas generator stayed in alignment during the failure of the axial compressor bearing.

The DECU download revealed 3 faults recorded during the accident flight. The first recorded fault indicated a P3 drift. Within the same second the next fault was a raw t4 fault which, according to the Safran HE ASI was most likely caused by the thermal damage to the thermocouple harness. The third fault recorded 6 seconds later was a helicopter t4 indication fault, which was most likely also caused by the thermal damage to the thermocouple harness. During those 6 seconds, the gas generator speed and free turbine speed decreased, and the fuel flow increased. Torque indication recorded at the last fault was .52%, which is consistent with the helicopter freewheeling at this point.

On October 9, 2017, the obstructed axial compressor oil jet was examined at the Safran HE factory laboratory, Bordes, France. The double oil jet was found blocked on only one side and was subsequently tested to identify the cause of the obstruction. A borescope examination of the obstruction revealed that it was composed of carbon oxygen and phosphor, which was significant of oil cokefaction. Oil cokefaction appears in the presence of oil in a hot temperature environment. Coke pollution moved through the scavenge circuit to the oil tank, and then through the oil filter to the lubrication circuit of the engine. Due to a lack of the engine oil filter, coke pollution migrated to the oil jet.

The axial compressor bearing and its external housing were analyzed and revealed that all the balls were deformed with flat zones. The two-half internal race had material transfer which led to seizure and jamming. The outside race and the separating cage were stuck together with the outside housing. The complete onsite examination reports, and the engine and oil jet examination reports are appended to this accident in the public docket.

## Pilot Information

<b>Certificate:</b>	Commercial	<b>Age:</b>	33, Male
<b>Airplane Rating(s):</b>	None	<b>Seat Occupied:</b>	Front
<b>Other Aircraft Rating(s):</b>	Helicopter	<b>Restraint Used:</b>	
<b>Instrument Rating(s):</b>	Helicopter	<b>Second Pilot Present:</b>	
<b>Instructor Rating(s):</b>	Helicopter	<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	Class 2 Without waivers/limitations	<b>Last FAA Medical Exam:</b>	March 7, 2017
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	May 10, 2017
<b>Flight Time:</b>	(Estimated) 3827 hours (Total, all aircraft), 1634 hours (Total, this make and model), 3748 hours (Pilot In Command, all aircraft), 118 hours (Last 90 days, all aircraft), 42 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

## Aircraft and Owner/Operator Information

<b>Aircraft Make:</b>	Eurocopter	<b>Registration:</b>	N151GC
<b>Model/Series:</b>	EC 130 B4 B	<b>Aircraft Category:</b>	Helicopter
<b>Year of Manufacture:</b>	2007	<b>Amateur Built:</b>	
<b>Airworthiness Certificate:</b>	Normal	<b>Serial Number:</b>	4402
<b>Landing Gear Type:</b>	Skid	<b>Seats:</b>	8
<b>Date/Type of Last Inspection:</b>	June 22, 2017 100 hour	<b>Certified Max Gross Wt.:</b>	5350 lbs
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	Turbo shaft
<b>Airframe Total Time:</b>	12536.2 Hrs as of last inspection	<b>Engine Manufacturer:</b>	Turbomeca
<b>ELT:</b>	C126 installed	<b>Engine Model/Series:</b>	Arriel 2B1
<b>Registered Owner:</b>	AMERICAN HELICOPTERS LLC	<b>Rated Power:</b>	592 Horsepower
<b>Operator:</b>	Papillon Grand Canyon Helicopters	<b>Operating Certificate(s) Held:</b>	Rotorcraft external load (133), On-demand air taxi (135), Commercial air tour (136)

## Meteorological Information and Flight Plan

<b>Conditions at Accident Site:</b>	Visual (VMC)	<b>Condition of Light:</b>	Day
<b>Observation Facility, Elevation:</b>	KBVU, 2202 ft msl	<b>Distance from Accident Site:</b>	2 Nautical Miles
<b>Observation Time:</b>	13:35 Local	<b>Direction from Accident Site:</b>	129°
<b>Lowest Cloud Condition:</b>		<b>Visibility</b>	10 miles
<b>Lowest Ceiling:</b>		<b>Visibility (RVR):</b>	
<b>Wind Speed/Gusts:</b>	7 knots / 13 knots	<b>Turbulence Type Forecast/Actual:</b>	/ Unknown
<b>Wind Direction:</b>	190°	<b>Turbulence Severity Forecast/Actual:</b>	/ Unknown
<b>Altimeter Setting:</b>	29.81 inches Hg	<b>Temperature/Dew Point:</b>	39°C / -8°C
<b>Precipitation and Obscuration:</b>	No Obscuration; No Precipitation		
<b>Departure Point:</b>	BOULDER CITY, NV (BVU )	<b>Type of Flight Plan Filed:</b>	Company VFR
<b>Destination:</b>	BOULDER CITY, NV (BVU )	<b>Type of Clearance:</b>	None
<b>Departure Time:</b>	13:48 Local	<b>Type of Airspace:</b>	Class G

## Wreckage and Impact Information

<b>Crew Injuries:</b>	1 None	<b>Aircraft Damage:</b>	Substantial
<b>Passenger Injuries:</b>	2 Minor, 4 None	<b>Aircraft Fire:</b>	None
<b>Ground Injuries:</b>	N/A	<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	2 Minor, 5 None	<b>Latitude, Longitude:</b>	35.967498,-114.892219(est)

## Administrative Information

<b>Investigator In Charge (IIC):</b>	Smith, Maja
<b>Additional Participating Persons:</b>	John Becker; Papillon John Waugh; FSDO
<b>Original Publish Date:</b>	February 26, 2019
<b>Last Revision Date:</b>	
<b>Investigation Class:</b>	<a href="#">Class</a>
<b>Note:</b>	The NTSB did not travel to the scene of this accident.
<b>Investigation Docket:</b>	<a href="https://data.ntsb.gov/Docket?ProjectID=95448">https://data.ntsb.gov/Docket?ProjectID=95448</a>

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).