



AVIATION



HIGHWAY



MARINE



RAILROAD



PIPELINE

Aviation Investigation Final Report

Location:	Springerville, Arizona	Accident Number:	WPR23LA306
Date & Time:	August 5, 2023, 15:20 Local	Registration:	N461WY
Aircraft:	Boeing CH-46E	Aircraft Damage:	Destroyed
Defining Event:	Loss of engine power (partial)	Injuries:	3 None
Flight Conducted Under:	Part 91: General aviation - Firefighting		

Analysis

The pilot in command (PIC) reported that the crew had performed firefighting water drop activities for about 2 hours. After they had filled the bucket with water and began to climb, they heard an extremely loud horn in their helmets—loud enough that it was difficult to understand what was being said. The pilot noticed that the No. 2 engine torque indicator was “maxed out” and the No. 1 torque indicator was about 60%.

The pilot released the water in the bucket and initiated a turn to an open field. The pilot then slowly retarded the No. 2 engine control lever out of the FLY position (which took it out of the governing range and into manual mode) to match the torque. He noted that the torque for both engines matched about 90%. Upon turning final for his intended landing field, the pilot noticed that the descent rate increased. The pilot told his copilot to jettison the bucket as he placed the No. 2 engine control lever back into the FLY position. Subsequently, the helicopter landed hard and rolled onto its right side. The engines were shut down and the co-pilot and crew chief assisted the pilot in exiting the helicopter while a postimpact fire ensued.

Postaccident examination of the wreckage showed no evidence of a preimpact engine failure or anomaly that would have precluded normal engine operation. The examination determined that a flex shaft failure did not occur because the cockpit torquemeter displayed Nf values on both engines and each engine’s flex shaft continuity was confirmed. The No. 2 engine signal conditioner, torquemeter relay box, and both torquemeters were destroyed in the post-crash fire and could not be examined.

Helicopter performance calculations for the conditions at the time of the accident show that each engine was only capable of producing a maximum of 85% torque. Neither engine could produce the 100% torque required to trigger the aural overtorque tone, nor was capable of

producing the 107% or higher torque required to activate the overtorque indicators on the torque meter. Accordingly, a maximum beep failure did not occur, because neither engine could produce the torque required to trigger the overtorque alarms.

When the PIC heard the overtorque alarm and saw a split in the torque needles, he diagnosed the problem as a “high side failure,” meaning that the engine was producing uncommanded maximum/topping power. However, neither pilot said that they looked to see if either rotation speed of the power turbine (Nf) needles were at zero; in fact, the PIC saw that both Nf needles were reading accurate power turbine speeds. After the PIC retarded the No. 2 engine, the overtorque tone did not go away once the engines were indicating less than 100% torque. Because the pilot’s torquemeter (which records overtorque events generated by the No 2 engine signal conditioner) indicated 143% overtorque, and all 3 overtorque indicators were red, the No. 2 engine signal conditioner likely malfunctioned and provided false torque readings and overtorque warnings.

Once the PIC took the No. 2 engine out of its governing range, the No. 2 engine was at minimum power, and performance calculations show that the helicopter was not single-engine capable in level flight or hover. The PIC subsequently made a steep landing approach that required more power than was available with one engine. Realizing the need for additional power, the PIC moved the No. 2 engine rapidly to the FLY position; however, that rapid movement likely activated the fail-freeze circuitry, freezing the engine at the minimum power position and switching it to manual mode. Without additional power from the No. 2 engine, the landing approach descent rate could not be arrested and resulted in a hard landing.

Probable Cause and Findings

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

The flight crew’s misidentification of a No. 2 torque sensing system signal conditioner malfunction when both engines were performing normally, which resulted in their attempt to execute a single-engine steep approach and landing without sufficient engine power. Contributing to the accident was the failure of the torque sensing system signal conditioner.

Findings

Personnel issues	Identification/recognition - Flight crew
Personnel issues	Use of equip/system - Pilot
Aircraft	Central warning - Malfunction
Aircraft	Engine out capability - Attain/maintain not possible

Factual Information

History of Flight

Enroute	Loss of engine power (partial) (Defining event)
---------	---

On August 5, 2023, about 1520 mountain standard time, a Boeing CH-46 helicopter, N461WY, was destroyed when it was involved in an accident near Springerville, Arizona. The pilot, co-pilot, and crew chief were not injured. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 133 external load flight in support of firefighting operations. The privately owned helicopter was performing firefighting operations under a contract with the United States Forest Service (USFS) in response to the Corduroy fire.

The pilot reported that they had performed firefighting water drop activities for about 2 hours. After they had filled the bucket with water and began to climb, the crew heard an extremely loud horn in their helmets—loud enough that it was difficult to understand what was being said. The pilot noticed that the No. 2 engine torque indicator was “maxed out” and the No. 1 torque indicator was about 60%.

The pilot released the water from the bucket and initiated a turn to an open field. The pilot then slowly retarded the No. 2 engine control lever out of the FLY position (which took it out of the governing range and into manual mode) to match the torque. He noted that the torque for both engines matched about 90%. Upon turning final for his intended landing field, the pilot noticed that the descent rate increased. The pilot told the co-pilot to jettison the bucket as he placed the No. 2 engine control lever to the FLY position. Subsequently, the helicopter landed hard and rolled onto its right side. The engines were shut down and the co-pilot and crew chief assisted the pilot in exiting the helicopter while a postimpact fire ensued.

The helicopter was destroyed by postimpact fire. The engine bays and rear transmission remained intact. The upper portion of the rear pylon had extreme fire damage but the vertical shaft connecting the rear transmission to the rear rotor head was intact. The forward transmission and rotor head were also intact. Approximately 90% of the helicopter structure between the forward and aft transmissions was consumed by fire, including the cockpit. All six rotor blades were accounted for. The nose gear and left main landing gear tubes were fractured, and the right main landing gear was intact but fire damaged. The cargo hook was found within the main wreckage, embedded within melted aluminum.

The postaccident examination of the engines revealed that both engines sustained significant thermal damage from the postcrash fire, and there was no evidence of an uncontained failure in either engine. The removal of one compressor case half from both engines revealed damage throughout the compressor sections consistent with engine rotation and producing of

power. The No. 1 engine ECA indicated a power setting near the maximum of the fly band. The No. 2 engine condition actuator (ECA) indicated a power setting near the minimum of the fly band (minimum power).

Examination of the torque system magnetic pickups on the engine torque tubes did not reveal any anomalies. The signal conditioner, torquemeter relay box, and both torquemeters were destroyed in the post-crash fire and could not be examined.

Manual mode can also be activated automatically via the Fail Freeze mode. A power interruption to the Engine Condition Control Assembly (ECCA) or Engine Condition Control Box (ECCB), or an improper signal from the ECA, ECCA, or collective control position transducer, will result in the ECCS going into manual mode via Fail Freeze circuitry. Additionally, automatic engagement of the manual mode via the Fail Freeze circuitry will occur if a loss of normal mode power, incorrect ECA feedback, or rapid ECL movement is detected by the ECCB.

The PIC reported that he heard an extremely loud horn in their helmets, which was consistent with the overtorque audible alarm. The PIC observed the split in the torque needles and diagnosed the problem as a "high side failure" (the No. 2 torque indicator was "maxed out"), meaning that the engine was producing maximum/topping power but not commanded to do so. Neither pilot said that they looked to see if either rotation speed of the power turbine (Nf) needles were at zero. However, during the emergency landing when the PIC advanced the ECL to the fly position, the PIC saw that both Nf needles were reading accurate power turbine speeds; the No. 1 Nf was at 100% and the No. 2 Nf was at about the "12 o'clock position" (60%), respectively.

Each engine had a torque sensing system located on the torque tube between the engine and the mix box. All the sensors from both sensing systems were evaluated with a multimeter and found to be operational and within the defined acceptable limits. Flex shaft continuity was established between Nf (the rotation speed of the power turbine) and the Nf flex shaft drive gearbox on both engines.

Two dual torquemeters (Figure 1) were mounted on the instrument panel in the cockpit. Two signal conditioners, two integrated tone generators, and a relay box were mounted in the nose electronics compartment. The signal conditioners and tone generators provided the input signals to the cockpit torque meters. An overtorque tone would be generated if the system sensed torque greater than 100% for both engines or 134% on either engine. The tone was silenced once the torque was reduced below 100%. The overtorque indicators turned red at 107%, 134%, and 143% indicated torque. Both engines must exceed 107% for longer than 5 seconds before either 107% indicator would trip; once tripped, the No.1 engine overtorque would display on the copilot's torquemeter and the No. 2 engine overtorque would display on the pilot's torquemeter. Once tripped, the indicators continued to indicate red until reset by maintenance personnel.

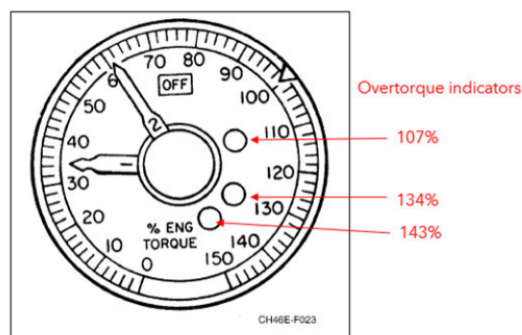


Figure 2-16. Dual Torquemeter

Figure 1-Figure of the cockpit dual torquemeter.

Helicopter performance calculations determined that the flight consumed 991 gallons of fuel during the flight. The weight of the equipped helicopter, three crew members, and bambi bucket with long line at the time of the accident was about 17,128 lbs. The single-engine torque available at military power was calculated at 85%. The single-engine torque required to maintain level flight was calculated at 86% at 60 knots.

According to the flight manual, In-Flight Emergencies - Single Engine Operations, should an in-flight single-engine failure be experienced, it is recommended to land as soon as practical and no further flight is advised until the cause of the engine malfunction is determined. It further reports that failure of an engine during cruise will not change the attitude of the helicopter; therefore, immediate control manipulations are not necessary to avoid a dangerous flight condition.

Pilot Information

Certificate:	Commercial	Age:	62, Male
Airplane Rating(s):	None	Seat Occupied:	Left
Other Aircraft Rating(s):	Helicopter	Restraint Used:	3-point
Instrument Rating(s):	Helicopter	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	
Medical Certification:	Class 2 Without waivers/limitations	Last FAA Medical Exam:	October 11, 2022
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	November 2, 2022
Flight Time:	11885 hours (Total, all aircraft), 305 hours (Total, this make and model), 9620 hours (Pilot In Command, all aircraft), 6 hours (Last 30 days, all aircraft), 6 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Commercial	Age:	28,Male
Airplane Rating(s):	None	Seat Occupied:	Right
Other Aircraft Rating(s):	Helicopter	Restraint Used:	3-point
Instrument Rating(s):	Helicopter	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	
Medical Certification:	Class 2 Without waivers/limitations	Last FAA Medical Exam:	May 10, 2022
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	June 28, 2023
Flight Time:	476 hours (Total, all aircraft), 61 hours (Total, this make and model), 339 hours (Pilot In Command, all aircraft), 56 hours (Last 90 days, all aircraft), 35 hours (Last 30 days, all aircraft), 7 hours (Last 24 hours, all aircraft)		

Other flight crew Information

Certificate:		Age:	
Airplane Rating(s):		Seat Occupied:	Rear
Other Aircraft Rating(s):		Restraint Used:	5-point
Instrument Rating(s):		Second Pilot Present:	Yes
Instructor Rating(s):		Toxicology Performed:	
Medical Certification:		Last FAA Medical Exam:	
Occupational Pilot:	No	Last Flight Review or Equivalent:	
Flight Time:			

Aircraft and Owner/Operator Information

Aircraft Make:	Boeing	Registration:	N461WY
Model/Series:	CH-46E	Aircraft Category:	Helicopter
Year of Manufacture:	1968	Amateur Built:	
Airworthiness Certificate:	Restricted (Special)	Serial Number:	154831
Landing Gear Type:	None; Skid	Seats:	3
Date/Type of Last Inspection:	April 3, 2023 Continuous airworthiness	Certified Max Gross Wt.:	24300 lbs
Time Since Last Inspection:	211 Hrs	Engines:	2 Turbo shaft
Airframe Total Time:	13512 Hrs at time of accident	Engine Manufacturer:	GE
ELT:	C126 installed, not activated	Engine Model/Series:	T58-GE-16A
Registered Owner:	SKY AVIATION CORP	Rated Power:	1770 Horsepower
Operator:	SKY AVIATION CORP	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	KSOW, 6411 ft msl	Distance from Accident Site:	44 Nautical Miles
Observation Time:	15:15 Local	Direction from Accident Site:	317°
Lowest Cloud Condition:	Clear	Visibility	10 miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	14 knots / None	Turbulence Type Forecast/Actual:	None / None
Wind Direction:	230°	Turbulence Severity Forecast/Actual:	N/A / N/A
Altimeter Setting:	30.27 inches Hg	Temperature/Dew Point:	33°C / 4°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Show Low, AZ (KSOW)	Type of Flight Plan Filed:	Company VFR
Destination:	Show Low, AZ (KSOW)	Type of Clearance:	Unknown
Departure Time:	13:00 Local	Type of Airspace:	Class G

Wreckage and Impact Information

Crew Injuries:	3 None	Aircraft Damage:	Destroyed
Passenger Injuries:	N/A	Aircraft Fire:	On-ground
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	3 None	Latitude, Longitude:	33.730624,-109.41119

Administrative Information

Investigator In Charge (IIC):	Swick, Andrew
Additional Participating Persons:	Kevin Whitlock; FAA-FSDO; Scottsdale, AZ Robert Roedts; Columbia Helicopters, Inc.; Aurora, OR Eric Shambora; United States Forest Service; Boise, ID David Gridley; GE Aerospace Alyssa Gaulke; Sky Aviation Corporation; Worland, WY Jeffrey B Hutchinson; The Boeing Company; Philadelphia, PA
Original Publish Date:	July 16, 2025
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=192818

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](#).