



AVIATION



HIGHWAY



MARINE



RAILROAD



PIPELINE

Aviation Investigation Final Report

Location:	Hayden, Idaho	Accident Number:	WPR20LA191
Date & Time:	June 23, 2020, 17:01 Local	Registration:	N280MM
Aircraft:	Enstrom 280	Aircraft Damage:	Destroyed
Defining Event:	Unknown or undetermined	Injuries:	1 Fatal, 1 Serious
Flight Conducted Under:	Part 91: General aviation - Instructional		

Analysis

Shortly after takeoff on an instructional flight, a helicopter was maneuvering at a low altitude when the engine rpm “skyrocketed,” and the engine lost total power; the flight instructor (who was at the controls) reported hearing “backfiring” at the time, although the engine was still running. The flight instructor then had to maneuver the helicopter to avoid nearby power lines, but the helicopter impacted terrain. The main rotor blades struck the tailboom, and the helicopter subsequently spun around about 180° before coming to rest. A postcrash fire then ensued, which consumed most of the helicopter. Additionally, the student pilot stated to a witness after the accident that the helicopter was losing power.

An engine examination revealed that detonation had occurred in two of the four engine cylinders. (Detonation in a piston engine occurs when the fuel-air mixture in a cylinder detonates or explodes prematurely instead of being ignited by spark plugs and burning evenly and smoothly, as occurs with normal combustion.) Furthermore, damaged spark plugs were observed in one of the detonated cylinders as well as another cylinder. The combined effects of the detonation and damaged spark plugs likely caused the loss of engine power. Because the loss of power occurred at a low altitude, the flight instructor likely did not have enough altitude to adequately establish a steady-state autorotation to avoid the helicopter’s impact with terrain.

Probable Cause and Findings

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

The total loss of power while maneuvering at low altitude due to the detonation of two engine cylinders and damaged spark plugs.

Findings

Aircraft	Recip eng cyl section - Damaged/degraded
Aircraft	Spark plugs/igniters - Damaged/degraded

Factual Information

History of Flight

Maneuvering-low-alt flying	Unknown or undetermined (Defining event)
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On June 23, 2020, about 1701 Pacific daylight time, an Enstrom 280 FX helicopter, N280MM, was destroyed when it was involved in an accident near Hayden, Idaho. The student pilot was fatally injured, and the flight instructor was seriously injured. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 91 instructional flight.

The flight instructor stated that, shortly after takeoff from Coeur d’Alene Airport, Coeur d’Alene, Idaho, he temporarily leveled off the helicopter at an altitude of about 100 ft above ground level and accelerated to more than 100 mph to ensure that all the helicopter systems and indications were properly functioning. Shortly thereafter, the engine’s rpm “skyrocketed,” and the engine lost total power; the flight instructor could hear “backfiring.” The helicopter then lost altitude, and the flight instructor maneuvered the helicopter to avoid nearby power lines. Subsequently, the low rotor rpm horn sounded; at that time, the engine was still running. As terrain approached, the flight instructor pulled the collective and increased the throttle, but the helicopter had no rpm. Shortly afterward, the helicopter impacted terrain, the main rotor blades contacted the tailboom, and the helicopter spun about 180° before coming to rest. A postcrash fire ensued, which consumed most of the helicopter.

According to witnesses, the helicopter was maneuvering at a low altitude before it crashed in an open field. Two witnesses stated that the helicopter was flying at or below the power line level. One witness stated that the tail of the helicopter was moving up and down and that the helicopter did not seem to be flying smoothly. The witness further stated that the helicopter’s tail swung around quickly before ground impact. One witness who provided assistance after the accident reported the student pilot stating that the helicopter was losing power and that the helicopter did not strike anything before ground impact.

Student pilot Information

Certificate:	Student	Age:	78,Male
Airplane Rating(s):	None	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	None	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 3 Without waivers/limitations	Last FAA Medical Exam:	April 2, 2019
Occupational Pilot:	Last Flight Review or Equivalent:		
Flight Time:	(Estimated) 157 hours (Total, all aircraft)		

Flight instructor Information

Certificate:	Commercial; Flight instructor	Age:	42,Male
Airplane Rating(s):	None	Seat Occupied:	Right
Other Aircraft Rating(s):	Helicopter	Restraint Used:	
Instrument Rating(s):	Helicopter	Second Pilot Present:	Yes
Instructor Rating(s):	Helicopter	Toxicology Performed:	No
Medical Certification:	Class 2 With waivers/limitations	Last FAA Medical Exam:	August 17, 2018
Occupational Pilot:	Last Flight Review or Equivalent:		
Flight Time:	(Estimated) 365 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Enstrom	Registration:	N280MM
Model/Series:	280 FX	Aircraft Category:	Helicopter
Year of Manufacture:	2003	Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	2099
Landing Gear Type:	N/A; Skid	Seats:	
Date/Type of Last Inspection:	July 15, 2019 Annual	Certified Max Gross Wt.:	2600 lbs
Time Since Last Inspection:		Engines:	1 Reciprocating
Airframe Total Time:	1793.4 Hrs as of last inspection	Engine Manufacturer:	Lycoming
ELT:		Engine Model/Series:	HI0-360 SER
Registered Owner:	On file	Rated Power:	205 Horsepower
Operator:	On file	Operating Certificate(s) Held:	None

The engine maintenance logbook revealed that the engine time since overhaul was 407.4 hours. The logbook showed that, during the annual inspection on July 15, 2019 (almost 1 year before the accident), the mechanic performing the inspection “cleaned [the spark] plugs.”

The Enstrom height and velocity diagram revealed that the helicopter’s altitude and airspeed before the accident were not within the shaded regions, which represented areas, altitudes, and airspeeds to avoid during operation.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	KCOE, 2307 ft msl	Distance from Accident Site:	3 Nautical Miles
Observation Time:	16:56 Local	Direction from Accident Site:	99°
Lowest Cloud Condition:	Clear	Visibility	10 miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	8 knots /	Turbulence Type Forecast/Actual:	/
Wind Direction:	280°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29.96 inches Hg	Temperature/Dew Point:	30°C / 13°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Coeur D' Alene, ID (COE)	Type of Flight Plan Filed:	None
Destination:	Coeur D' Alene, ID (COE)	Type of Clearance:	None
Departure Time:	16:59 Local	Type of Airspace:	Class G

Wreckage and Impact Information

Crew Injuries:	1 Fatal, 1 Serious	Aircraft Damage:	Destroyed
Passenger Injuries:		Aircraft Fire:	On-ground
Ground Injuries:		Aircraft Explosion:	None
Total Injuries:	1 Fatal, 1 Serious	Latitude, Longitude:	47.775001, -116.89555(est)

The Kootenai County Sheriff's Office responded to the accident site, which was in a field northwest of a road intersection. The Kootenai County Fire Department extinguished the postaccident fire. The wreckage was surrounded by a burnt area on the ground that was about 45 ft in diameter. The front section of the fuselage came to rest on a northeast heading. The tail rotor assembly was located west of the wreckage.

A postaccident examination of the helicopter revealed extensive thermal damage, which prevented a thorough examination of most systems and components. The tailboom was separated from the fuselage, and the horizontal stabilizer was separated from the tailboom. The engine also sustained thermal damage.

An engine examination revealed no evidence of a catastrophic mechanical malfunction or failure and no anomalies with the transmission. When the top and bottom spark plugs were removed, the examination showed that the No. 3 cylinder bottom spark plug was missing part

of its center electrode, and that the No. 4 cylinder bottom spark plug was missing its electrode. Furthermore, when all six cylinders were removed, the No. 2 cylinder piston was found to exhibit a sandblasted appearance consistent with detonation. Additionally, the No. 4 cylinder head and piston exhibited signatures and damage consistent with detonation.

Additional Information

The Federal Aviation Administration's *Airplane Flying Handbook* states the following about detonation:

Detonation, as the name suggests, is an explosion of the fuel-air mixture inside the cylinder. During detonation, the fuel/air charge (or pockets within the charge) explodes rather than burns smoothly. Because of this explosion, the charge exerts a much higher force on the piston and cylinder, leading to increased noise, vibration, and cylinder head temperatures. The violence of detonation also causes a reduction in power. Mild detonation may increase engine wear, though some engines can operate with mild detonation regularly. However, severe detonation can cause engine failure in minutes.

The handbook also stated, "excessive cylinder temperature can lead to detonation, which in turn can cause catastrophic engine failure."

Additionally, the Federal Aviation Administration *Aviation Maintenance Technician Handbook*—General stated that "detonation causes explosive burning of the fuel which creates an increased cylinder pressure, excessive cylinder head temperatures, and decreased engine performance." According to the engine manufacturer, "severe or prolonged detonation can cause damage to the cylinder head and pistons. In some extreme cases, the connecting rod can be bent or broken, the cylinder head may crack or fail, or the piston ring lands may break."

Administrative Information

Investigator In Charge (IIC):	Nixon, Albert
Additional Participating Persons:	David Hartson; Federal Aviation Administration; Spokane, WA Mark Platt; Lycoming Engines; Williamsport, PA William Taylor; Enstrom Helicopter Corporation; MI
Original Publish Date:	August 16, 2022
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=101480

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](#).