Aviation Investigation Final Report

Location:	Des Moines, Iowa	**Accident Number:**	CEN20LA261
Date & Time:	July 3, 2020, 19:37 Local	**Registration:**	N282SH
Aircraft:	Enstrom 280	**Aircraft Damage:**	Destroyed
Defining Event:	Miscellaneous/other	**Injuries:**	1 Minor
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot of the personal flight stated that during a final approach for landing, the engine and rotor speeds decreased below the green arcs on their respective instruments, and the low-speed alarm sounded. The rotor speed and engine speed remained in synchronization and decreased at the same rate. The pilot stated he added throttle but neither the rotor speed nor the engine speed increased. He thought that the helicopter lost engine power and performed an autorotation, lowering the collective and initially pushing forward on the cyclic. The pilot stated he did not perform the autorotation perfectly and the outcome would have been better with a better execution of the autorotation. The proper entry into the autorotation utilizes aft cyclic inputs.

Postaccident examination of the helicopter confirmed flight control continuity. A postaccident engine run excluded the turbocharger system and used engine settings that were different than those of the original engine, which was insufficient to validate normal and original engine operation. The turbocharged engine was a supplemental type certificate installation, and those parameters were not provided and are unknown.

Probable Cause and Findings

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

The partial loss of rotor and engine speed during approach for landing, which resulted in an autorotation and impact with terrain. The reason for the partial loss of rotor and engine speed could not be determined based on the available evidence. Contributing to the accident was the pilot's improper execution of the autorotation.

Findings

Aircraft	Prop/rotor parameters - Unknown/Not determined
Aircraft	Powerplant parameters - Unknown/Not determined

Factual Information

History of Flight

Approach-VFR pattern final	Miscellaneous/other (Defining event)
Emergency descent	Attempted remediation/recovery
Emergency descent	Collision with terr/obj (non-CFIT)

On July 3, 2020, at 1920 central daylight time, an Enstrom 280FX, N282SH, was destroyed when it was involved in an accident near Des Moines, Iowa. The private pilot sustained minor injuries. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The pilot stated during final approach for landing, both the rotor speed and engine speed decreased below the green arc, and the "low-speed" alarm sounded. The rotor speed and engine speed remained in synchronization and decreased at the same rate. The pilot stated he added throttle but neither the rotor speed nor the engine speed increased. He thought that the helicopter lost engine power and performed an autorotation. He further stated he lowered the collective and "pushed forward on the collective." The helicopter impacted terrain about one mile south of Des Moines International Airport, Des Moines, Iowa. The helicopter came to rest on its right side in an area of tall grass, which became blighted from fuel spillage. The helicopter was destroyed by impact forces that damaged the fuselage structure, main rotor blades, and tail rotor blades. The pilot included in his statement that he "did not execute the autorotation perfectly," and "the outcome could have been substantially improved with a better execution of the autorotation."

Postaccident examination of the flight controls and drive train to the main rotor blades and tail rotor blades confirmed continuity of both systems.

The helicopter engine was a Lycoming factory rebuild from January 2020 with approximately 23 hours since rebuild. It was equipped with a turbocharger that was installed under Supplemental Type Certificate (STC) SE484GL (for Rajay Model 325E10-2, P/N RJ0332, or Model 3BT5EE10J2, P/N 103574-00 turbochargers). The STC was issued to Enstrom Helicopter Corporation. Enstrom purchased HIO-360-F1AD engines with turbochargers installed by Lycoming, who helped develop the STC. Because the helicopter type design required the installation of the turbocharged engine, there are no STC installation instructions.

According to the Enstrom 280FX Operator's Manual, the indicated engine speed at idle with the clutch disengaged was minimum – 1,450 rpm and 1,500 rpm. According to the Enstrom Helicopter representative, the pilot said that the engine ran rough at idle but smoothed out about 1,100 rpm. The representative stated that magneto-to-engine timing would most likely have been set to 21° - 22° before top center (BTC) for better performance when the engine was installed onto the accident helicopter at the Enstrom Service Center. The engine, with

turbocharger installed, had a normal rated power of 225 horsepower at 3,050 rpm. The rated power of the engine without a turbocharger was 190 horsepower at 3,050 rpm. Engine specifications for a turbocharger-equipped engine (such as power versus engine speed, fuel pump pressure output, or engine timing) were not provided to the National Transportation Safety Board investigator-in-charge (NTSB IIC) and are unknown.

The engine was removed from the airframe and shipped to Lycoming Engines, Williamsport, Pennsylvania, for an engine run. The engine was run without the turbocharger system because it was removed by Lycoming for the engine run without the knowledge of the NTSB IIC. The Lycoming representative stated that they do not test HIO-360-F1AD engines at the factory with the turbocharger system because Enstrom installs it under an STC.

The engine run consisted of four engine start attempts. During the first start attempt, the engine did not start. The magneto grounding socket, which was a pressed fitting into the magneto housing, was also found to be missing. The ground wire was wedged into grounding socket for the second start attempt. The factory seal on the magneto retaining nuts was not present. A check of magneto-to-engine timing revealed that it had an advance of about 5° BTC and once the timing was adjusted to the engine data plate specifications, the engine started during a second start attempt, and there were no further magneto issues that precluded normal operation.

After the second start attempt of the engine, the engine idle speed was 1,250 rpm and was then adjusted to 1,150 rpm for subsequent test runs. After the third start attempt, the engine idled at the 1,150 rpm. The fuel pressure from the fuel pump was 30.1 psi (Lycoming test specifications indicated that the fuel pressure setting from the fuel pump should be 18-28 psi). The fuel pressure was adjusted to 22 psi with the engine operating. The engine attained rated power but not engine speed as specified in the test's specification of 3,050 rpm. The engine met test specifications at engine speeds: 1,500 rpm, 1,800 rpm, 2,200 rpm. It was noted that the injector had a rich mixture, and the injector idle/mixture lever stop was not in place on the injector. The lever stop was found on the test cell floor. When injector was replaced with a slave injector and a propeller speed adjustment made, the engine produced rated power at 3,050 rpm.

The Federal Aviation Administration (FAA) Helicopter Flying Handbook states the following:

Rotor rpm in low inertia rotor systems has been studied in simulator flight evaluations which indicate that the simultaneous application of aft cyclic, down collective, and alignment with the relative wind (trim) at a wide range of airspeeds, including cruise airspeeds, is critical for all operations during the entry of an autorotation.

Pilot Information

Certificate:	Private	**Age:**	61,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	September 9, 2019
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	May 5, 2020
Flight Time:	5000 hours (Total, all aircraft), 50 hours (Total, this make and model), 4980 hours (Pilot In Command, all aircraft), 10 hours (Last 90 days, all aircraft), 3 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Enstrom	**Registration:**	N282SH
Model/Series:	280 FX	**Aircraft Category:**	Helicopter
Year of Manufacture:	2005	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	2105
Landing Gear Type:	Skid	**Seats:**	3
Date/Type of Last Inspection:	April 7, 2020 Annual	**Certified Max Gross Wt.:**	2600 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	662 Hrs at time of accident	**Engine Manufacturer:**	Lycoming
ELT:	C126 installed, not activated	**Engine Model/Series:**	HIO-360-F1AD
Registered Owner:	BUBS Leasing LLC	**Rated Power:**	205 Horsepower
Operator:	Pilot	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	DSM,958 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	18:54 Local	**Direction from Accident Site:**	360°
Lowest Cloud Condition:	Few / 5000 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Broken / 30000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	70°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.02 inches Hg	**Temperature/Dew Point:**	29°C / 18°C
Precipitation and Obscuration:			
Departure Point:	Burlington, IA (BRL)	**Type of Flight Plan Filed:**	None
Destination:	Des Moines, IA (DSM)	**Type of Clearance:**	VFR
Departure Time:	18:00 Local	**Type of Airspace:**	Class B

Airport Information

Airport:	Des Moines International Airpo DSM	**Runway Surface Type:**	
Airport Elevation:	958 ft msl	**Runway Surface Condition:**	Dry
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Full stop;Traffic pattern

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	1 Minor	**Latitude, Longitude:**	41.518333,-93.682502(est)

Administrative Information

Investigator In Charge (IIC):	Gallo, Mitchell
Additional Participating Persons:	Kendall Arkema; Federal Aviation Administration; DSM FSDO; Ankeny, IA William Taylor; Enstrom Helicopter Corporation ; Menominee, MI Ryan Enders; Lycoming Engines; Williamsport, PA
Original Publish Date:	May 6, 2022
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=101537