National Transportation Safety Board
Aviation Accident Final Report

Location:	Ider, AL	**Accident Number:**	ERA18LA195
Date & Time:	07/18/2018, 1400 CDT	**Registration:**	N8805X
Aircraft:	Eagle DW1	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	1 None
Flight Conducted Under:	Part 137: Agricultural		

Analysis

The commercial pilot was conducting an aerial application flight. He stated that while maneuvering at 1,500 ft, he heard a "deep knock" in the engine; the entire windshield became covered with oil, and the engine lost power. The pilot made a forced landing to a service road, during which the airplane struck a barbed-wire fence with the right wings before coming to rest in a field. Postaccident examination of the engine revealed the No. 2 cylinder had separated from the cylinder mounting deck. Two fractured sections of the left crankcase that included part of the No. 2 cylinder bore were found in the engine cowling. All but one of the No. 2 cylinder base studs and through bolts remained in the cylinder bore and were fractured. The fractured surfaces exhibited signatures consistent with fatigue. The fatigue failure of the No. 2 cylinder studs and through bolts and the fracture of the crankcase led to the loss of engine power.

Probable Cause and Findings

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

Fatigue failure of the No. 2 cylinder studs/through bolts and the fracture of the crankcase, which resulted in a total loss of engine power.

Findings

Aircraft	Recip engine power section - Malfunction (Cause)
Environmental issues	Fence/fence post - Contributed to outcome

Factual Information

On July 18, 2018, about 1400 central daylight time, an Eagle DW-1, N8805X, was substantially damaged when it made a forced landing following a total loss of engine power while maneuvering near Ider, Alabama. The pilot was not injured. The airplane was registered to and operated by the pilot under the provisions of Title 14 *Code of Federal Regulations* as a Part 137 aerial application flight. Visual meteorological conditions prevailed, and no flight plan was filed.

The pilot stated that he was maneuvering at 1,500 ft when the engine stopped producing power after he heard a "deep knock" in the engine followed by the entire windshield getting covered with oil. The pilot made a forced landing to a service road and the airplane struck a barbed-wire fence with the right wings before coming to rest upright on the edge of a soybean field. The airplane sustained substantial damage to the upper and lower right wings, the outboard section of the left wings, and the fuselage. Two of the three propeller blades were displaced aft.

Postaccident examination of the airplane revealed a large hole in the left side of the engine cowling and a large amount of oil over the entire nose and windshield. The No. 2 cylinder had separated from the cylinder mounting deck. Two fractured sections of the left crankcase that included part of the No. 2 cylinder bore were found lying in the engine cowling. All but one of the No. 2 cylinder base studs and thru bolts remained in the cylinder/crankcase bore and were fractured. Photographs of the fractured studs/bolts were reviewed by the National Transportation Safety Board's Materials laboratory. The fractured surfaces exhibited signatures consistent with fatigue

A review of the engine maintenance logbook revealed that all six cylinders were replaced in September 2015 at a total engine time of 1,334.0 hours. At the time of the accident, the engine had accrued 1,582.43 hours and 248.43 hours since the No. 2 cylinder was installed.

In the June 2014 issue of Sport Aviation, the author of the "Savvy Aviator" column noted that, according to a veteran mechanic/expert witness, "who specializes in research on fastener torque and engine assembly practices,...the root cause of spun bearings, thrown rods, and separated cylinders is simply, 'a failure to achieve sufficient preload in the assembled fasteners.'"

The author further noted that, "preload is the technical term for the clamping force created by tightening a fastener (typically a threaded bolt or stud) that holds assembled parts together. Having sufficient preload is the key to a strong and reliable bolted joint that will not loosen, break, or shift under the load. In order for a bolted joint to be stable under cyclic repetitive stress, the preload on the fasteners must be greater than the maximum stress that is trying to pull the joint apart. If this condition is met, the joint will not separate, and the fasteners won't 'feel' the repetitive stress cycles. But if it isn't, the joint will shift under load and the fasteners will ultimately fail from repetitive stress fatigue."

The pilot held a commercial pilot certificate with a rating for airplane single-engine land. His last Federal Aviation Administration second-class medical was issued on December 30, 2017. The pilot reported a total flight time of 2,214.4 hours.

Weather reported at Huntsville International Airport (HSV), Huntsville, Alabama, about 53 miles northwest of the accident site, at 1353, was: wind from 310° at 6 knots, visibility 10 miles, scattered clouds at 3,600 ft, scattered clouds at 25,000 ft, temperature 32° C, dew point 24°, and an altimeter setting of 29.97 inches Hg.

History of Flight

Maneuvering	Loss of engine power (total) (Defining event)
Emergency descent	Off-field or emergency landing
Landing-flare/touchdown	Collision with terr/obj (non-CFIT)

Pilot Information

Certificate:	Commercial	**Age:**	66, Male
Airplane Rating(s):	Single-engine Land	**Seat Occupied:**	Center
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 With Waivers/Limitations	**Last FAA Medical Exam:**	11/17/2017
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	12/20/2017
Flight Time:	2214.4 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Eagle	**Registration:**	N8805X
Model/Series:	DW1 NO SERIES	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Restricted	**Serial Number:**	DW-1-0036-81
Landing Gear Type:	Tailwheel	**Seats:**	1
Date/Type of Last Inspection:	03/23/2018, Annual	**Certified Max Gross Wt.:**	
Time Since Last Inspection:	23 Hours	**Engines:**	1 Reciprocating
Airframe Total Time:	4432.93 Hours at time of accident	**Engine Manufacturer:**	Lycoming
ELT:		**Engine Model/Series:**	IO-540
Registered Owner:	On file	**Rated Power:**	260 hp
Operator:	On file	**Operating Certificate(s) Held:**	Agricultural Aircraft (137)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	HSV, 629 ft msl	**Distance from Accident Site:**	53 Nautical Miles
Observation Time:	1353 CDT	**Direction from Accident Site:**	
Lowest Cloud Condition:	Scattered / 3600 ft agl	**Visibility**	10 Miles
Lowest Ceiling:		**Visibility (RVR):**	
Wind Speed/Gusts:	6 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	310°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.97 inches Hg	**Temperature/Dew Point:**	32°C / 24°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Ider, AL	**Type of Flight Plan Filed:**	None
Destination:	Ider, AL	**Type of Clearance:**	None
Departure Time:	CDT	**Type of Airspace:**	Unknown

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	34.714167, -85.680833 (est)

Preventing Similar Accidents

Proper Torque Application

From 2009 to 2015, over 45 accidents and incidents have occurred that resulted from maintenance personnel applying improper torque to engine fasteners (bolts and nuts) during engine maintenance activities. The application of improper torque led to internal engine damage and subsequent engine failures and accidents or incidents.

Applying too little or too much torque can cause a bolt to fail and/or the nut and bolt threads to become stripped, which allows the fastening hardware to loosen. Applying the proper torque value:

- Allows the structure or assembly the fasteners are holding together to develop its full design strength.
- Prevents the exceedance of the design limitations of the structure or hardware.
- Reduces the possibility of excessive wear of the fasteners and parts being held.
- Ensures that each fastener carries the load for which it was designed and that the load is evenly distributed between the fasteners.

What Can Maintenance Personnel Do?

- Apply torque values provided in the applicable aircraft and engine maintenance manuals. If the engine manufacturer has recommended torque values in its engine specifications, use those specified values.
- Use a calibrated torque wrench to measure the amount of twisting force applied to a nut or bolt. Verify that your wrench is calibrated and check that the wrench is not damaged to ensure continued accuracy.
- Follow manufacturer guidance about whether to use lubricants on the fasteners.
- Use smooth, even pulls when applying torque pressure.
- Conduct a postmaintenance check after applying torque to fasteners to ensure that the correct amount of torque was applied. If possible, have someone else independently check the torque values using a different wrench.
- Also use torque seal to verify that the applied torque has not changed and to visually confirm which fasteners have been torqued.
- Beware of leaving hardware that has been only finger tightened. Once you start the process, make sure you complete it. Set a reminder if you need to step away before completing the torqueing process.

Interested in More Information?

If the engine manufacturer has not provided the specific torque values to be used, reference Federal Aviation Administration Advisory Circular (AC) 43.13-1B, “Acceptable Methods, Techniques, and Practices - Aircraft Inspection and Repair,” chapter 7, section 3, which provides general information about torque application and, in table 7-1, shows the

recommended standard torque values to be used for nuts and bolts. Also, figure 7-2, shows how to calculate the corrected torque values for various torque wrench adapters.

GA Maintenance Alert: Safety and Security of Components provides general tips to maintenance personnel on how they can ensure that airplane components are properly secured and emphasizes the importance of following written procedures and mitigating human factors, such as fatigue and time constraints, when performing maintenance activities. This GA maintenance alert and others can be accessed from the FAA Safety Team website at www.faasafety.gov.

The Aircraft Owners and Pilots Association article, Torque Time, provides detailed information about the basic concepts related to torque, why it is important, and when, where, and how to apply it properly.

The NTSB's Aviation Information Resources web page, www.ntsb.gov/air, provides convenient access to NTSB aviation safety products.

The NTSB presents this information to prevent recurrence of similar accidents. Note that this should not be considered guidance from the regulator, nor does this supersede existing FAA Regulations (FARs).

Administrative Information

Investigator In Charge (IIC):	Leah D Read	**Report Date:**	04/20/2020
Additional Participating Persons:	Kyle Cook; FAA/FSDO; Birmingham, AL		
Publish Date:	04/20/2020		
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=97838		