Aviation Investigation Final Report

Location:	Mineral Wells, Texas	**Accident Number:**	CEN19LA133
Date & Time:	May 2, 2019, 17:02 Local	**Registration:**	N8160C
Aircraft:	Cirrus SR20	**Aircraft Damage:**	Substantial
Defining Event:	Part(s) separation from AC	**Injuries:**	2 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot was conducting a personal flight in the airport traffic pattern when he felt the airplane "shudder" shortly before the turn onto the base leg for the runway. The pilot and passenger then saw the right aileron "fluttering," and the pilot immediately turned to intercept the final approach. The right aileron separated from the wing about 0.5 mile from the approach end of the runway. The pilot was able to maintain roll control of the airplane after the right aileron separated, and he completed an uneventful landing on the runway.

Examination of the airplane and the recovered right aileron revealed that the aileron's inboard hinge bolt was not threaded into its nut plate. The safety wire that normally secured the inboard hinge bolt was found fractured. The safety wire had been excessively twisted when the right aileron was installed; the excessive twisting led to the torsional overstress fracture of the safety wire during the accident flight. Additionally, the nut plate had significantly reduced thread-locking abilities that allowed the unsecured inboard hinge bolt to loosen; the right aileron separated from the wing when the inboard hinge bolt disengaged from the nut plate. Although the inboard hinge bolt assembly included a slightly longer bolt than specified and an additional small washer, these component discrepancies did not contribute to the aileron separation.

The airplane had accumulated about 733 flight hours during the more than 10 years since the right aileron was last removed and reinstalled during maintenance. The most recent maintenance performed on the airplane was an annual inspection completed about 15.2 flight hours before the accident. The mechanic who performed the last annual inspection observed safety wire installed on the aileron hinge bolts.

Probable Cause and Findings

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

The in-flight separation of the right aileron when the inboard hinge bolt disengaged from its nut plate due to excessively twisted safety wire, which resulted in a torsional overstress fracture that caused the inboard hinge bolt to become unsecured.

Findings

Aircraft	Aileron control system - Failure
Aircraft	Aileron control system - Incorrect service/maintenance
Personnel issues	Installation - Maintenance personnel

Factual Information

History of Flight

Approach-VFR pattern final	Part(s) separation from AC (Defining event)

On May 2, 2019, about 1702 central daylight time, a Cirrus SR20 airplane, N8160C, was substantially damaged when it was involved in an accident near Mineral Wells, Texas. The pilot and the passenger were not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The pilot stated that, while on the downwind leg for runway 31 at Mineral Wells Airport (MWL), Mineral Wells, Texas, he felt the airplane "shudder" before he turned onto the base leg for the runway. The pilot and the passenger then saw the right aileron “fluttering,” and the pilot immediately turned to intercept and align with the final approach to the runway. The pilot stated that the right aileron separated from the wing about 0.5 mile from the approach end of runway 31. The pilot was able to maintain roll control of the airplane after the right aileron separated, and he completed an uneventful landing on the runway.

Pilot Information

Certificate:	Airline transport	**Age:**	67,Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land; Multi-engine sea	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	April 18, 2019
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	April 19, 2019
Flight Time:	7500 hours (Total, all aircraft), 4 hours (Total, this make and model), 4400 hours (Pilot In Command, all aircraft), 50 hours (Last 90 days, all aircraft), 30 hours (Last 30 days, all aircraft), 0.5 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cirrus	**Registration:**	N8160C
Model/Series:	SR20 No Series	**Aircraft Category:**	Airplane
Year of Manufacture:	2003	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	1381
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	November 1, 2018 Annual	**Certified Max Gross Wt.:**	3000 lbs
Time Since Last Inspection:	15.2 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	2108.8 Hrs at time of accident	**Engine Manufacturer:**	Continental
ELT:	Installed, not activated	**Engine Model/Series:**	IO-360-ES
Registered Owner:		**Rated Power:**	200 Horsepower
Operator:		**Operating Certificate(s) Held:**	None

According to the Cirrus SR20 illustrated parts catalog, the right aileron is attached to the wing by two bolts installed through inboard and outboard hinge supports, which are attached to the wing rear spar. Each hinge bolt passes through a bearing housed in its respective hinge support and is threaded into a nut plate that is riveted to an attachment bracket, which is bolted to the aileron spar (see figure 1). According to the Cirrus SR20 maintenance manual, the inboard and outboard hinge bolt assemblies are torqued between 20 and 25 inch-pounds when fully seated. Each hinge bolt head is safety wired to a tab that is riveted to the aileron.

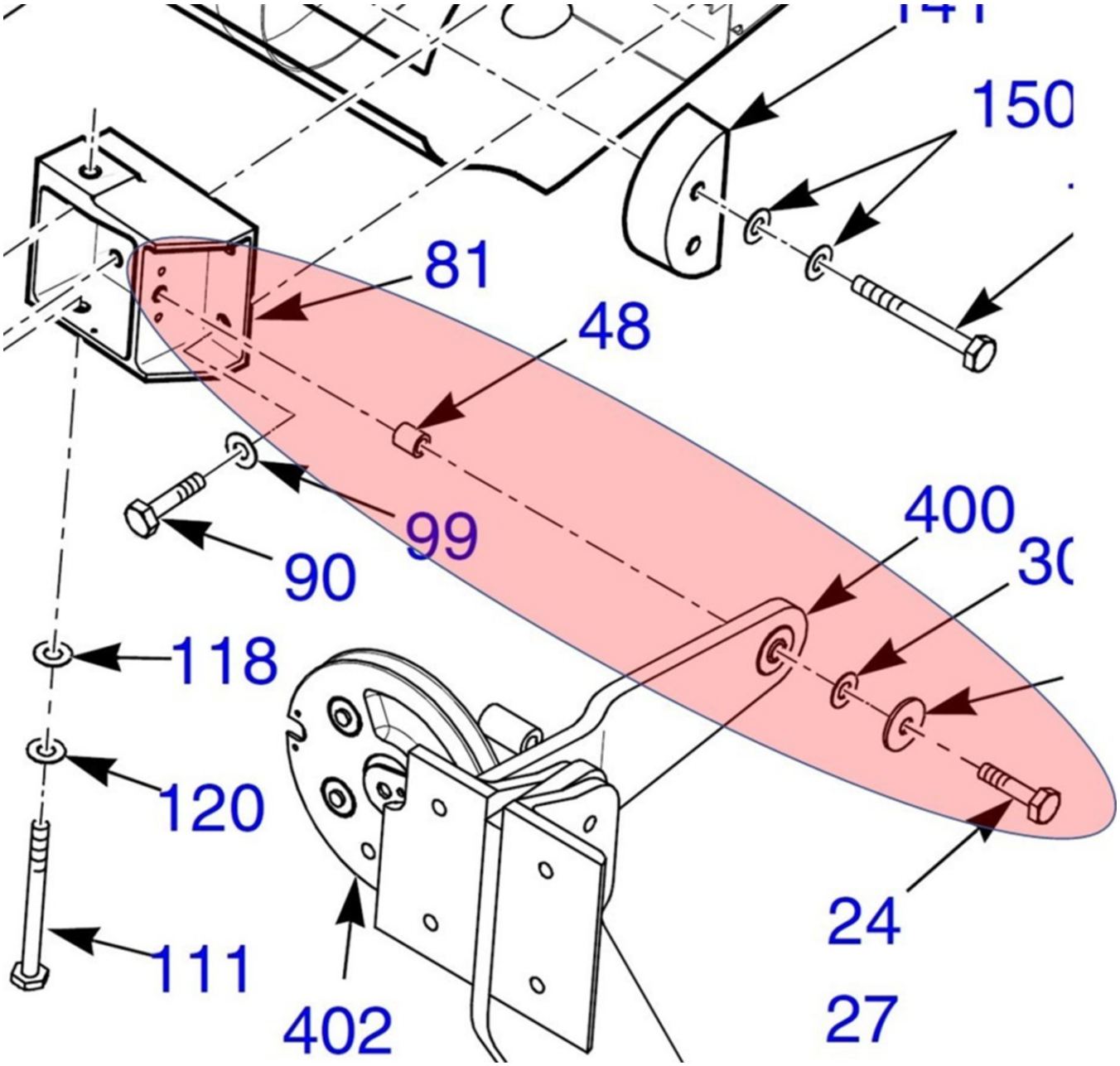

Figure 1. Right aileron inboard hinge assembly.

A review of the maintenance records revealed that the right aileron was installed on the airplane on August 29, 2007, when the airframe had accrued a total of 1,059. The right aileron was last removed for maintenance on January 15, 2009, when the airframe had accrued a total of 1,376 hours, to replace the right aileron bearing block. The aileron bearing block is mounted to an aileron actuation pulley that is part of a larger fixture mounted to the outboard flap hinge assembly. The replacement of the aileron bearing block required the aileron to be removed from the wing.

The last maintenance performed on the airplane was an annual inspection completed on November 1, 2018, when the airframe had accrued a total of 2,094 hours. According to the logbook entry for the

annual inspection, the mechanic "lubricated control surface rod ends & hinges." The aviation mechanic who completed the annual inspection told a Federal Aviation Administration (FAA) maintenance inspector (during a postaccident interview) that he had followed the Cirrus SR20 annual inspection checklist. The mechanic also stated that he did not remove any aileron hinge bolts during the inspection and that the safety wire installed on the aileron hinge bolts was present during the inspection. The Cirrus SR20 annual inspection checklist did not require the removal of an aileron during the inspection. The airplane had accumulated 15.2 hours between the time of the last annual inspection and the in-flight right aileron separation.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	MWL,974 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	16:53 Local	**Direction from Accident Site:**	135°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	12 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	260°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.93 inches Hg	**Temperature/Dew Point:**	20°C / 14°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Fort Worth, TX (FTW)	**Type of Flight Plan Filed:**	None
Destination:	Weatherford, TX (WEA)	**Type of Clearance:**	None
Departure Time:	16:30 Local	**Type of Airspace:**	Class E

Airport Information

Airport:	Mineral Wells Airport MWL	**Runway Surface Type:**	Asphalt
Airport Elevation:	974 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	31	**IFR Approach:**	None
Runway Length/Width:	5996 ft / 100 ft	**VFR Approach/Landing:**	Traffic pattern

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 None	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	32.770832,-98.042778

The right aileron was found in one piece along the final approach path to runway 31 in a wooded area about ½ mile from the approach end of the runway. The outboard attachment point was embedded with grass and mud, and the outboard trailing edge corner was bent. The remaining surfaces of the aileron were relatively straight with minor scratches. Figure 2 shows that the inboard attachment bracket remained bolted to the aileron spar and appeared undamaged, the nut plate remained riveted to the bracket, the inboard safety wire tab remained riveted to the aileron, and twisted safety wire was attached to its tab.

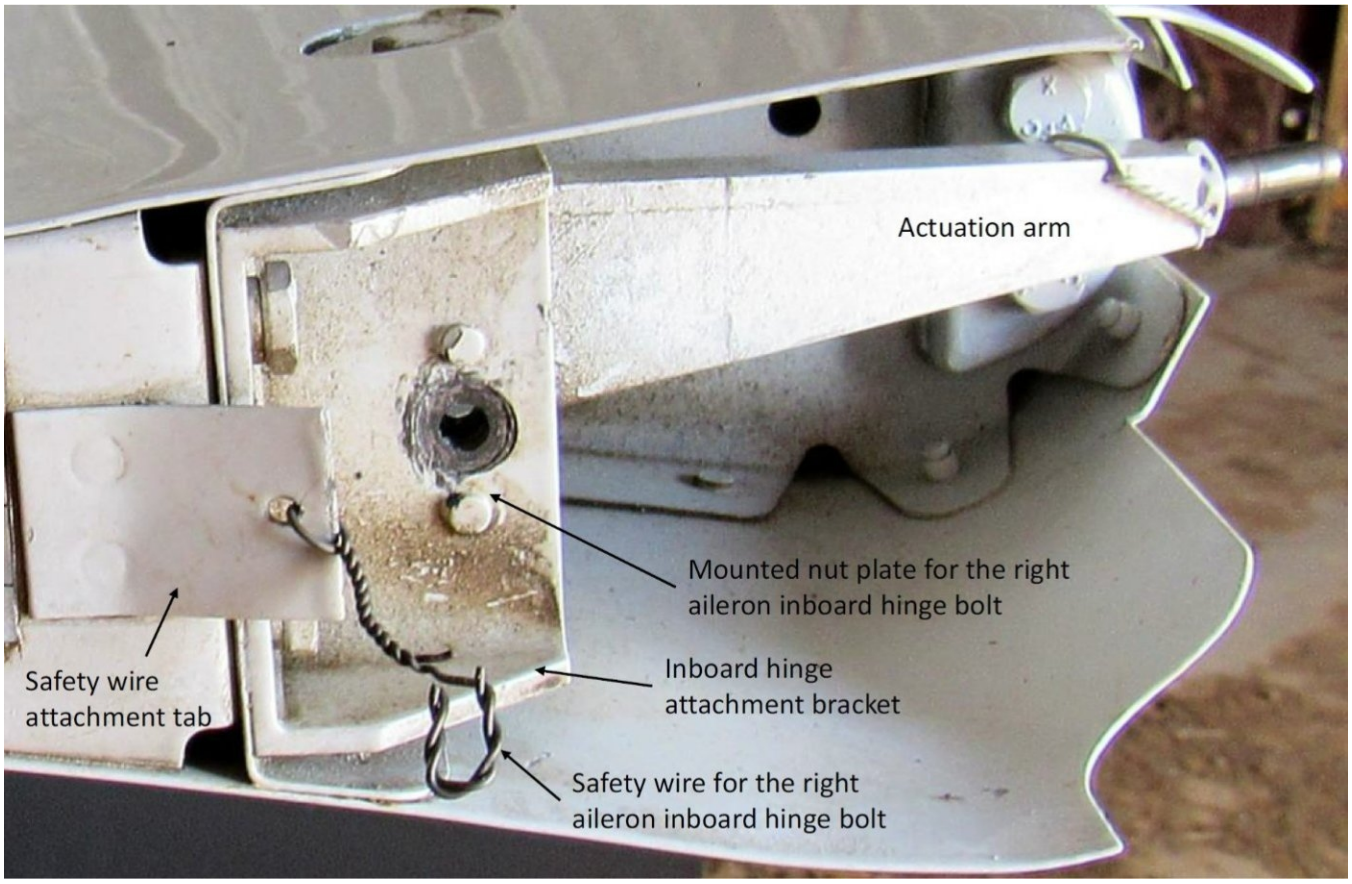

Figure 2. Right aileron inboard attachment bracket and safety wire with riveted tab.

Examination of the airplane revealed that the right aileron inboard hinge bolt remained attached through the inboard hinge support and its bearing, with associated washers and spacer present; however, the

inboard hinge bolt was not threaded into the nut plate riveted to the inboard attachment bracket (the inboard attachment bracket remained bolted to the separated aileron). The inboard hinge bolt head did not have any safety wire present.

The airplane's right aileron inboard hinge assembly consisted of a bolt (NAS6203-11H) with one large washer (MS63040-3), two small washers (NAS1149F0332P), and a spacer (see figure 3). Although the Cirrus SR20 illustrated parts catalog specified an NAS6203-9H or NAS6203-10H hinge bolt for the assembly, there was ample space behind the nut plate to accommodate the longer NAS6203-11H hinge bolt. Additionally, the assembly should have had only one small washer instead of two; (NAS1149F0332P) in addition to the large washer and spacer. The additional small washer had been installed between the bearing and the spacer.

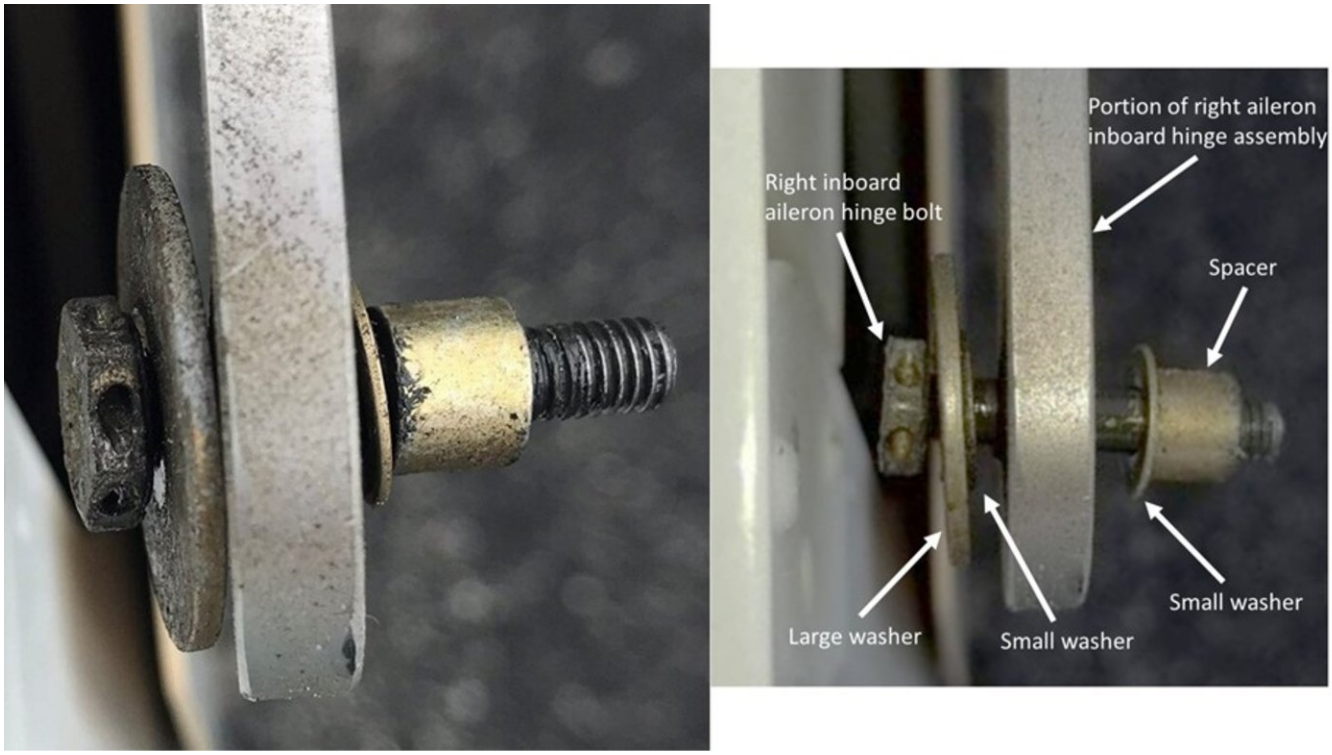

Figure 3. Right aileron inboard hinge bolt with associated washers and spacer.

The right aileron outboard hinge bolt remained attached to its respective hinge bracket and support. The outboard hinge bolt also remained threaded into the associated nut plate, but the outboard hinge bracket had fractured in overstress. Safety wire was installed between the outboard hinge bolt head and its respective safety wire tab. The outboard safety wire tab was twisted, bent, and fractured, consistent with an overload separation.

The right aileron inboard hinge bolt with its associated washers and spacer, the inboard attachment bracket with its riveted nut plate, and the fractured safety wire with its attached tab were examined by the National Transportation Safety Board Materials Laboratory. Measurements of the fractured safety wire were consistent with 0.032-inch safety wire. Adjacent to the attachment tab, the safety wire was twisted about 22 times per inch (see figure 4). The Cirrus SR20 maintenance manual specified that safety wire that was 0.032 inch in diameter was to be installed with 6 to 12 twists per inch. The safety

wire was fractured where it threaded through a drilled hole in the inboard hinge bolt head (see figure 5). Fractographic analysis revealed that the safety wire had fractured due to torsional overstress.

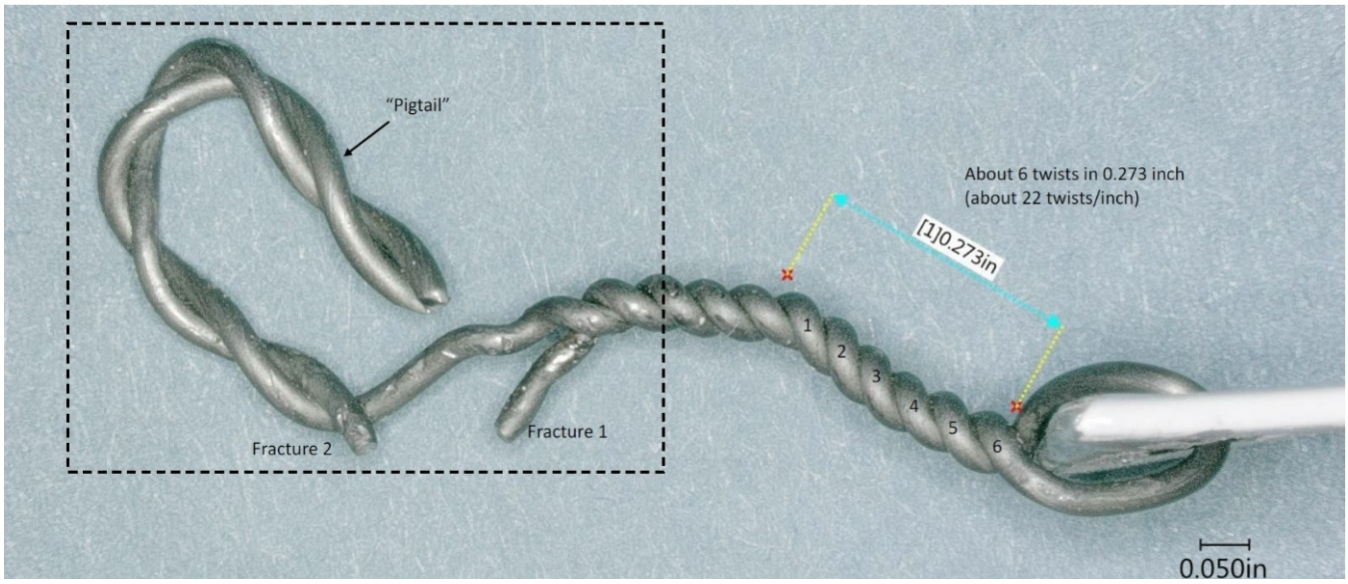

Figure 4. Right aileron inboard hinge attachment bolt safety wire with twist count.

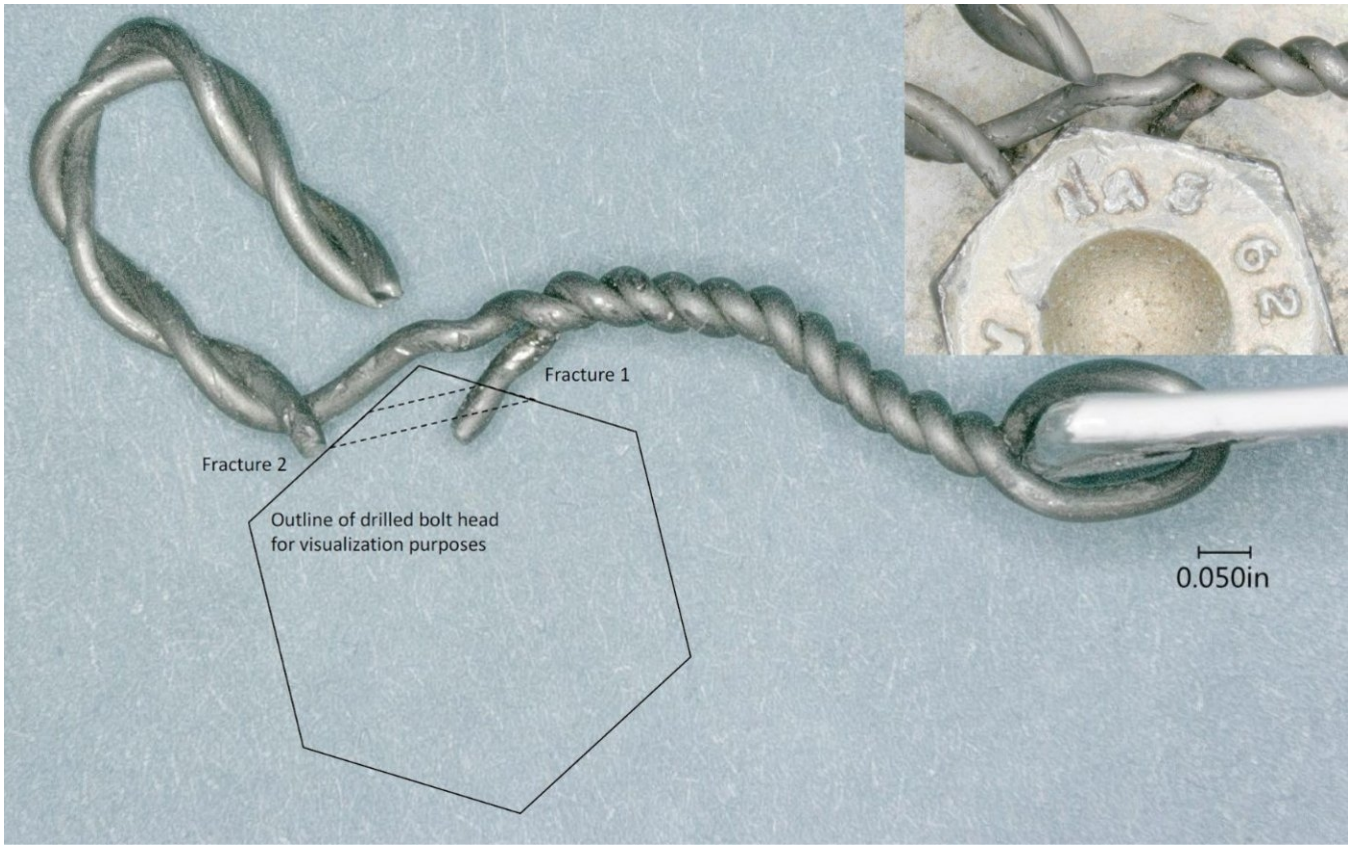

Figure 5. Right aileron inboard hinge attachment bolt safety wire with fracture position on bolt head depicted.

The right aileron inboard hinge bolt exhibited circumferential wear to its grip area, and the threads were intact, fully formed, and in good condition. The associated nut plate had intact, fully formed threads that were also in good condition. The periphery of the threaded portion of the nut plate was relatively round. Typically, when manufactured, the periphery of the threaded portion of a nut plate is intentionally deformed to an oblong or oval shape to provide mechanical resistance (or thread-locking) to the mating bolt threads (see figure 6). The thread roots of the hinge bolt and nut plate were found partially filled with a black grease.

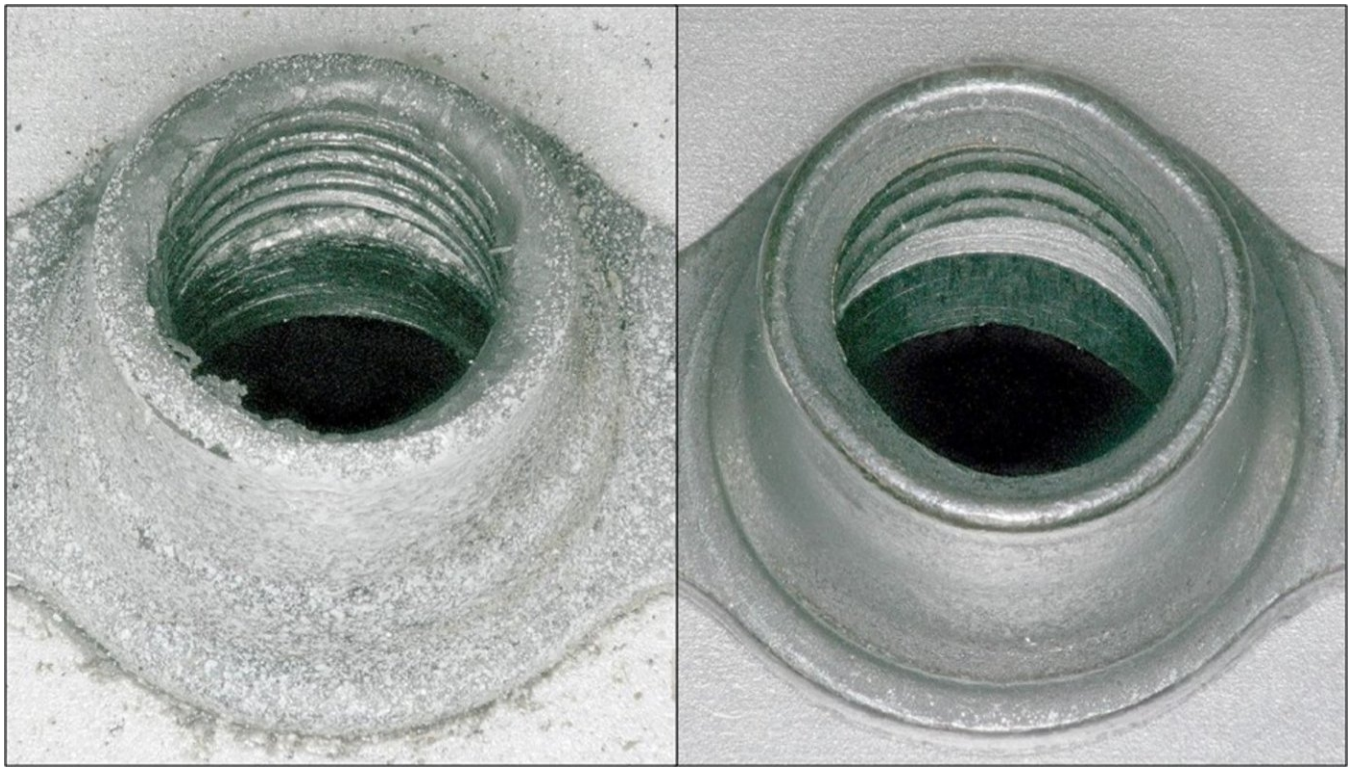

Figure 6. Right aileron inboard hinge nut plate (left) and exemplar nut plate (right).

Laboratory testing of the as-received components revealed that, when the right aileron inboard hinge bolt was threaded into the nut plate, the hinge bolt could be rotated by hand through 540° before any appreciable torque was measured. The prevailing torque measured 3 inch-pounds after the hinge bolt had been rotated 720°. According to FAA Advisory Circular 43.13-1B, "Acceptable Methods, Techniques, and Practices," the minimum prevailing torque for the hinge bolt type was 8 inch-pounds. The as-received components demonstrated the ability to be final-torqued to the airframe manufacturer's maximum specified value of 25 inch-pounds when the bolted assembly was completely seated.

Administrative Information

Investigator In Charge (IIC):	Fox, Andrew		
Additional Participating Persons:	Terry Collins; Federal Aviation Administration, North Texas FSDO; Irving, TX		
Original Publish Date:	March 4, 2022	**Investigation Class:**	3
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=99362		