



AVIATION



HIGHWAY



MARINE



RAILROAD



PIPELINE

Aviation Investigation Final Report

Location:	Scotts Bluff, Nebraska	Accident Number:	CEN20LA041
Date & Time:	December 18, 2019, 09:00 Local	Registration:	CGOJG
Aircraft:	Cessna 525A	Aircraft Damage:	Substantial
Defining Event:	Part(s) separation from AC	Injuries:	5 None
Flight Conducted Under:	Non-U.S., non-commercial		

Analysis

The airplane was in cruise flight at FL250 when it experienced a separation of the right engine cowl, which struck and substantially damaged the right horizontal stabilizer and elevator. The airplane landed at the destination airport without further incident. Postaccident examination of the airplane found that two fasteners located at the forward inboard corner of the right engine lower cowl and a third fastener (which joined the right engine upper and lower cowls) were missing. The cowl and three fasteners were not recovered.

Examination of the remaining fasteners used to secure the separated right engine cowl revealed that two were -4 studs, which were 0.03 inch longer than the other (-3) fasteners. The aircraft manufacturer's drawings and the Illustrated Parts Catalog (IPC) for the engine lower cowl door indicated only -3 studs. Longer studs would allow for increased grip length, which would induce protrusion and misalignment of the engine cowl with adjacent structure. In addition, Skybolt grommets were used in the fastener assembly to secure the right engine lower cowl on the accident airplane; Skybolt grommets have a greater height than those cited in the IPC and the airplane manufacturer's drawing, and, per these sources, Skybolt was not an approved vendor for the fastener assembly. The use of taller grommets would have also caused the cowl to protrude and be out of alignment with adjacent structure.

Postaccident photographs of the left engine lower cowl showed that it exhibited protrusion/mismatch (or misalignment) that exceeded aerodynamic smoothness requirements cited in the airplane structural repair manual. The left engine lower cowl had at least two -3 studs that were recessed below Skybolt grommets, which were located in the same area as that of the right engine lower cowl that had the three missing studs.

Without recovery of the right engine cowl, its aerodynamic smoothness could not be verified; however, using the observed postaccident condition of left engine cowl as an exemplar, available evidence suggests that the use of incorrect mounting hardware on the right engine

cowl would have similarly affected its aerodynamic smoothness. Therefore, the right engine cowl likely separated from the airplane due to the use of incorrect mounting hardware.

Probable Cause and Findings

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

The installation of incorrect mounting hardware to secure the right engine cowl, which resulted in an in-flight separation and impact with the horizontal stabilizer and elevator.

Findings	
Aircraft	Engine cowling system - Failure
Aircraft	Engine cowling system - Design
Personnel issues	Scheduled/routine maintenance - Maintenance personnel
Aircraft	(general) - Incorrect service/maintenance

Factual Information

History of Flight

Prior to flight	Aircraft maintenance event
Enroute-cruise	Part(s) separation from AC (Defining event)
Enroute-cruise	Collision with terr/obj (non-CFIT)

On December 18, 2019, about 0900 mountain standard time, a Cessna 525A airplane, Canada registration CGOJG, was substantially damaged when it was involved in an accident near Scottsbluff, Nebraska. The pilot and four passengers were uninjured. The airplane was operated as a non-U.S./non-commercial corporate/executive flight.

The pilot stated that while the airplane was at cruise altitude of flight level 250 at about 10-15 kts below the never exceed speed (Vne), in smooth air, there was a loud “bang.” The airplane pitched down into negative-G flight, and the overspeed warning sounded. He reduced engine power to idle and began to pull back on the control yoke. He said that he experienced resistance in control yoke movement. To alleviate control yoke forces, he used manual trim since trim changes were more rapid than using electric trim.

The pilot said he performed a gradual pull up, and once the airplane was level, he applied engine power. He said the recovery altitude was about 21,400 ft and the indicated airspeed was about 180 kts. He said there was some control column buffet, so he reduced engine power again to reduce the indicated airspeed to about 161 kts. He said the roll axis control was normal, and the pitch axis control was very stiff. The control column did not have a significant range of motion, and the rudder pedals felt “weird and were in unequal positions.” In checking airplane controllability, he selected flaps 15°, and there was no change in controllability. He retracted flaps and flew to the destination airport where he landed the airplane without further incident using an indicated airspeed of about 145 kts and flaps at 0°.

Postaccident examination of the airplane revealed the right engine lower cowl separated from the airplane, struck the right engine upper cowl, and damaged about a third of the outboard side of the right horizontal stabilizer and elevator, resulting in substantial damage. The cowl fastener assemblies were all quarter-turn fasteners. Two consecutive fasteners located at the forward inboard corner of the right engine lower cowl (labeled receptacles 10 and 11 in figure 1) were missing. A third fastener, which joined the right engine upper and lower cowls through an angle/tab, was missing (see figure 1). The receptacles associated with these fasteners did not display tearing or fractures. All the remaining right engine lower cowl fasteners were in place.

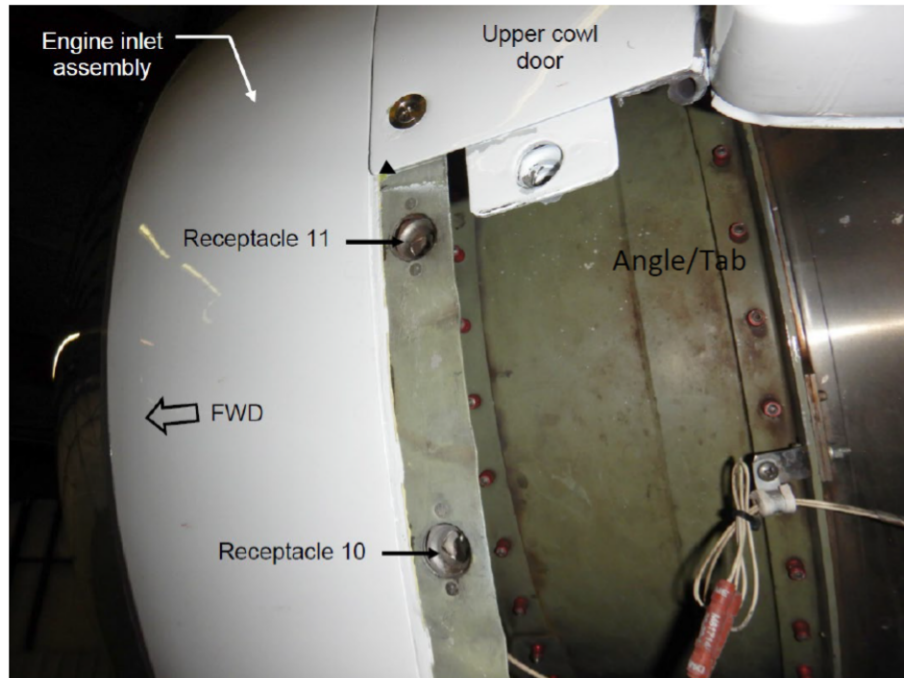


Figure 1: Missing fasteners at receptacles 10 and 11 and at the angle/tab on the right engine lower cowl.

The separated cowlings and missing fasteners were not located. The remaining fastener assemblies were removed by the repair facility that recovered the airplane and sent to the National Transportation Safety Board Materials Laboratory for examination.

The fastener assemblies were examined for part numbers or other identifying marks. None were found on the receptacles. The stud heads were labelled with dash numbers and all studs were “-3” except for the studs at receptacle location 4 on both the forward and aft attachment flanges, which were “-4” studs (see figure 2).

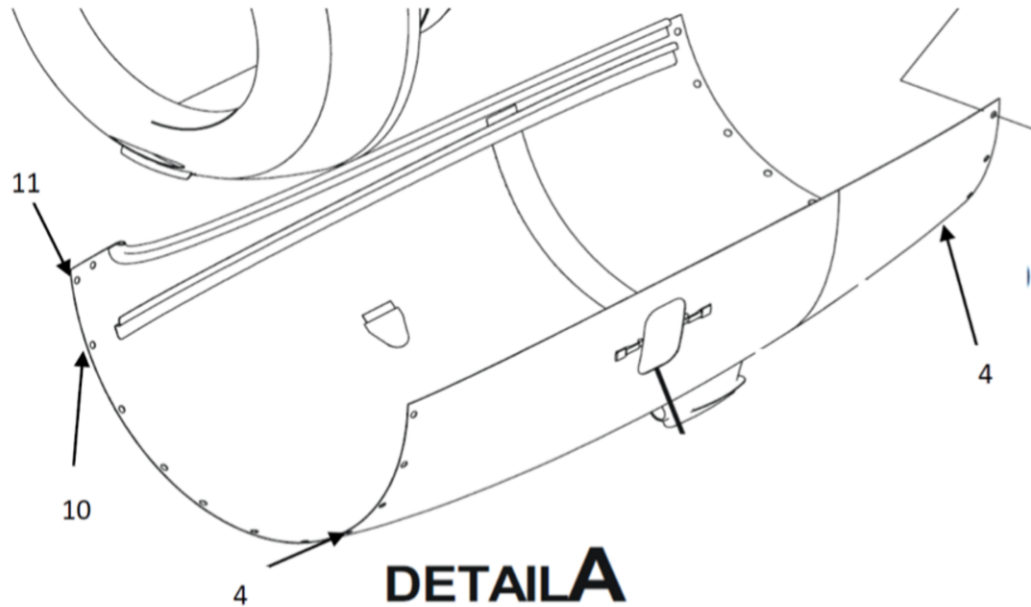


Figure 2: Illustrated Parts Catalog detail of engine lower cowl and locations of number 4, 10, and 11 receptacles.

The Illustrated Parts Catalog (IPC) for the airplane listed the engine lower cowl fastener studs as part number S3412-103, which had a Phillips head and the same stud length as part number S4312-3, which had a straight-slot head. Each subsequent increase in dash number increased fastener length by about 0.03 inch. The IPC did not list any -4 studs for the upper or lower engine cowl. A -4 stud would correspond to part number S3412-104; no S3412-104 fasteners are specified on the Textron Aviation drawing for the lower cowling door.

The fastener assembly grommets that were on the accident airplane right engine lower cowl were all labelled as “SKYBOLT HS.” According to Skybolt product information, HS-type grommets are nominally 0.197 inch in height. Measured with a micrometer, the height of one of the grommets from the accident airplane was 0.204 inch. Figure 3 shows a top-down view of an HS grommet from the accident airplane and a profile view, comparing the height with that of a S2319-63 (from the IPC). Skybolt was not an approved vendor for these assemblies per the Textron Aviation drawing and the IPC.

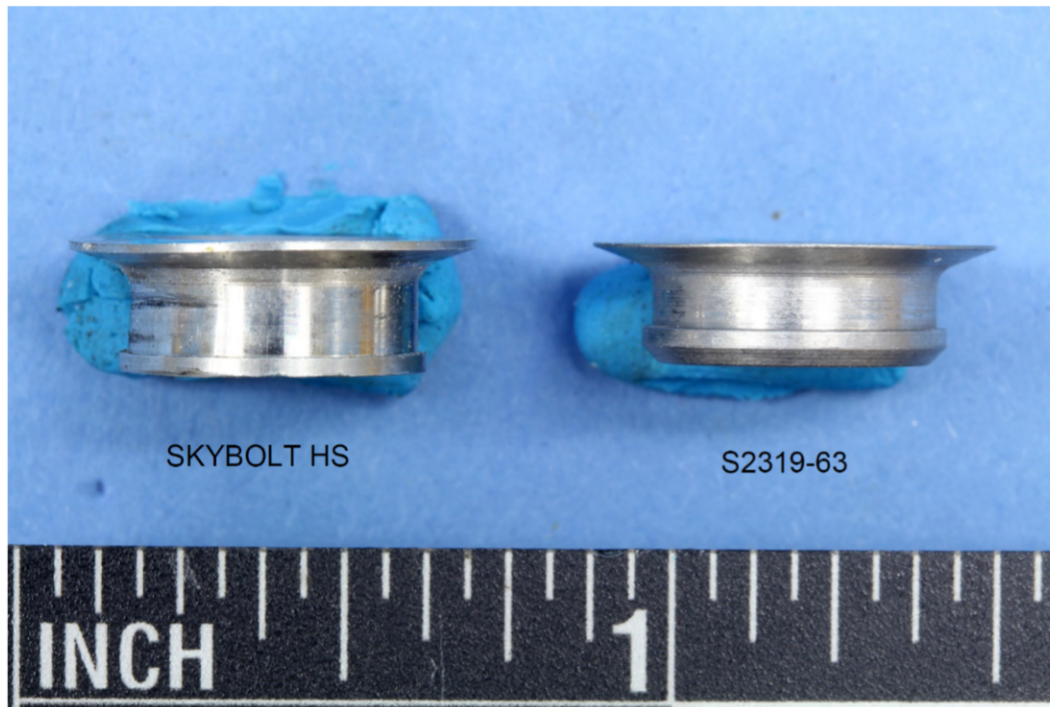


Figure 3: Profile view of the Skybolt HS grommet from the accident airplane and the grommet listed in the IPC (S2319-63) for the airplane.

According to the repair facility that performed postaccident repairs to the airplane, the left engine lower cowl was intact and secure with all its fasteners. Photos provided by the repair facility showed several of the retained fastener heads were recessed and not flush with the cowl surface, as specified in the manufacturer structural repair manual. The repair facility reported that the fasteners that were not recessed were too long. Further, the cowl surface visibly protruded about an 1/8 inch and was not flush with the adjacent structure (see figure 4). The photos of the fasteners shown in figure 4, showed the grommet labelled as “SKYBOLT HS” and “-3” studs. The 1/8-inch protrusion exceeded aerodynamic smoothness requirements cited in the aircraft structural repair manual (SRM). The aircraft maintenance/service manual did not cite aerodynamic smoothness requirements.



Figure 4: Shows the left engine inboard lower cowl mismatch and screw heads recessed beneath their grommets at the same relative receptacle location numbers 10 and 11. The grommets were labeled “HS SKYBOLT” and the studs were labeled “-3.”

The postaccident repair of the airplane included replacement of fasteners with shorter fasteners in the left engine cowl, and through approval by a designated engineering representative, additional fastener(s) were installed in the engine cowlings.

The SRM had the following values for maximum allowable gap and mismatch for zones 1, 2, and 3, which were defined as: ZONE 1 - LEADING EDGES OF WINGS, STABILIZERS AND NACELLES, ZONE 2 - FORWARD FUSELAGE, WINGS AND DORSAL FIN, and ZONE 3 - CABIN, TAILCONE, NACELLES, STABILIZERS, RUDDER AND ELEVATORS.

Zone	Maximum gap	Maximum mismatch perpendicular to airstream	Maximum mismatch parallel to airstream
1	0.060	0.020	0.040
2	0.060	0.030 (NOTE 2)	0.040 (NOTE 3)
3	0.060	0.040 (NOTE 2)	0.040 (NOTE 3)

According to the FAA, a fault hazard analysis (FHA) is a deductive method of analysis, in reference to safety issues, that can be used exclusively as a qualitative analysis or, if desired, expanded to a quantitative one. The FHA requires a detailed investigation of the subsystems to determine component hazard modes, causes of these hazards, and resultant effects to the subsystem and its operation. Cessna Aircraft representative(s) stated that an FHA/safety analysis for departure of an engine cowl for the make and model of airplane was not performed.

The airplane was certified under Part 23, and an FHA was not required by certification regulations during the initial certification of the airplane. Section 23.1193 had similar certification requirements to Section 25.1193, Cowling and Nacelle Skin. Section 25.1193 addresses the design of engine cowlings but does not address the single failure of a latch or hinge, or an improperly fastened latch.

On September 19, 1989, the FAA published Notice of Proposed Rulemaking (NPRM) 89–25 (54 FR 38610) to propose an amendment to 14 CFR Part 25 and invited public comment on the issue of engine cowling retention. The NPRM was prompted by several in-flight incidents of engine cowling separation that resulted in damage to airplanes and property on the ground and highlighted the need to re-evaluate the design and maintenance requirements applicable to engine cowlings. NPRM 89–25 proposed to specify standards for failsafe criteria in the design of engine cowling retention systems, which would enable the systems to withstand the loss of a single latch and easily detect unlocked or improperly closed latches.

The comment period for the NPRM closed March 19, 1990, and it was withdrawn in 2002 to allow the Federal Aviation Administration “to consider harmonization concerns and address the issues more completely in future regulatory actions in consideration of recommendations developed within the [Aviation Rulemaking Committee].”

Pilot Information

Certificate:	Airline transport	Age:	41, Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	3-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:	October 30, 2019
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	August 1, 2019
Flight Time:	3083 hours (Total, all aircraft), 337 hours (Total, this make and model), 2907 hours (Pilot In Command, all aircraft), 63 hours (Last 90 days, all aircraft), 45 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	Registration:	CGOJG
Model/Series:	525A	Aircraft Category:	Airplane
Year of Manufacture:	2002	Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	525A-0087
Landing Gear Type:	Retractable - Tricycle	Seats:	2
Date/Type of Last Inspection:	December 6, 2019 Continuous airworthiness	Certified Max Gross Wt.:	12375 lbs
Time Since Last Inspection:	34 Hrs	Engines:	2 Turbo fan
Airframe Total Time:	4142 Hrs at time of accident	Engine Manufacturer:	Williams
ELT:	Installed, not activated	Engine Model/Series:	FJ44-2C
Registered Owner:	C-GHGR	Rated Power:	2400 Lbs thrust
Operator:	C-GHGR	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:		Distance from Accident Site:	
Observation Time:		Direction from Accident Site:	
Lowest Cloud Condition:	Scattered / 15000 ft AGL	Visibility	
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	10 knots /	Turbulence Type Forecast/Actual:	None / None
Wind Direction:	340°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:		Temperature/Dew Point:	
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Casper, WY (CPR)	Type of Flight Plan Filed:	IFR
Destination:	Scottsbluff, NE (BFF)	Type of Clearance:	IFR
Departure Time:	08:30 Local	Type of Airspace:	Class B;Class E

Wreckage and Impact Information

Crew Injuries:	1 None	Aircraft Damage:	Substantial
Passenger Injuries:	4 None	Aircraft Fire:	None
Ground Injuries:		Aircraft Explosion:	None
Total Injuries:	5 None	Latitude, Longitude:	41.860145,-103.65963(est)

Administrative Information

Investigator In Charge (IIC): Gallo, Mitchell

Additional Participating Persons: Timothy Kray; Federal Aviation Administration, Lincoln FSDO; Lincoln, NE
Beverly Harvey; Transportation Safety Board of Canada; Gatineau
Andrew Hall; Textron Aviation; Wichita, KS

Original Publish Date: April 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.nts.gov/Docket?ProjectID=100722>

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](#).