Aviation Investigation Final Report

Location:	Victorville, California	**Accident Number:**	DCA20LA107
Date & Time:	May 19, 2020, 15:16 Local	**Registration:**	N820TJ
Aircraft:	Boeing 737	**Aircraft Damage:**	Substantial
Defining Event:	Part(s) separation from AC	**Injuries:**	95 None
Flight Conducted Under:	Part 121: Air carrier - Scheduled		

Analysis

After departure, the air carrier airplane was climbing through an altitude of about 8,000 ft, at which time the flight crew heard a loud bang. Because the flight instruments and gauges showed nothing abnormal, the flight crew elected to continue the flight to the destination airport. The airplane landed uneventfully. Postflight inspection of the airplane found that the dorsal fin and three panels on the lower left side of the vertical stabilizer were missing, and that the left horizontal stabilizer was substantially damaged.

Most of the dorsal fin, the vertical stabilizer panels, and 7 of the 14 bolts attaching the dorsal fin to the fuselage were not recovered. Of the seven bolts that were recovered, four remined installed, and three were found loose. Three of the four installed bolts remained attached to pieces of the dorsal fin structure. Examination of the photographs showed that the bolts installed in three positions on the left side of the dorsal fin were the correct part number. The bolt installed in a position on the right side of the dorsal fin was not the correct part number, and the bolt was longer than required. The photographs also showed remnants of old sealant at each of the bolt locations but no evidence that sealant was applied during maintenance of the dorsal fin in February 2019 (less than 3 months before the accident).

The seven missing bolts for the dorsal fin structure became loose, had fractured, or were not properly installed.

Probable Cause and Findings

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

Improper installation of dorsal fin attach bolts which caused the dorsal fin to separate during flight, substantially damaging the left horizontal stabilizer.

Findings

Aircraft	Horizontal stabilizer - Damaged/degraded
Aircraft	(general) - Incorrect service/maintenance
Personnel issues	Installation - Maintenance personnel
Personnel issues	Post maintenance inspection - Maintenance personnel

Factual Information

History of Flight

Initial climb	Part(s) separation from AC (Defining event)

On May 19, 2020, about 1516 Pacific daylight time, Swift Air flight 3518, a Boeing 737-800, N820TJ, sustained substantial damage while climbing after departure from Victorville Airport (VCV), Victorville, California. None of the 95 airplane occupants were injured. The flight was operated as a Title 14 *Code of Federal Regulations* Part 121 scheduled passenger flight from VCV to San Diego International Airport (SAN), San Diego, California.

While the airplane was climbing through an altitude of about 8,000 ft, the flight crew heard a loud bang. Because the flight instruments and gauges showed that the airplane was operating normally, the flight crew elected to continue to SAN. The airplane landed uneventfully. Postflight inspection of the airplane found that the dorsal fin and three panels on the lower left side of the vertical stabilizer were missing (see figure 1). This accident occurred during the Covid-19 pandemic, and National Transportation Safety Board staff did not travel to assess the accident airplane. The operator provided photographs of the damage to the airplane and the recovered components.

Figure 1. Location of missing dorsal fin and vertical stabilizer panels (Source: FAA).

Pilot Information

Certificate:	Airline transport; Commercial	**Age:**	57
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Unknown	**Last FAA Medical Exam:**	February 28, 2020
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	May 5, 2020
Flight Time:	9500 hours (Total, all aircraft), 4000 hours (Total, this make and model), 6500 hours (Pilot In Command, all aircraft), 24 hours (Last 90 days, all aircraft), 24 hours (Last 30 days, all aircraft), 6.5 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Airline transport; Commercial	**Age:**	36
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1	**Last FAA Medical Exam:**	May 30, 2020
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	3690 hours (Total, all aircraft), 110 hours (Total, this make and model), 1967 hours (Pilot In Command, all aircraft), 36 hours (Last 90 days, all aircraft), 14 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Boeing	**Registration:**	N820TJ
Model/Series:	737 8Q8	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal; Transport	**Serial Number:**	28218
Landing Gear Type:	Retractable - Tricycle	**Seats:**	
Date/Type of Last Inspection:		**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	
Airframe Total Time:		**Engine Manufacturer:**	
ELT:		**Engine Model/Series:**	
Registered Owner:	UMB Bank NA Trustee	**Rated Power:**	
Operator:	Swift Air LLC	**Operating Certificate(s) Held:**	Flag carrier (121)

The dorsal fin is attached to the upper fuselage at 14 locations. Figure 2 shows the attach points on the accident airplane with the holes numbered sequentially in red and the required fastener (bolt) part numbers in black.

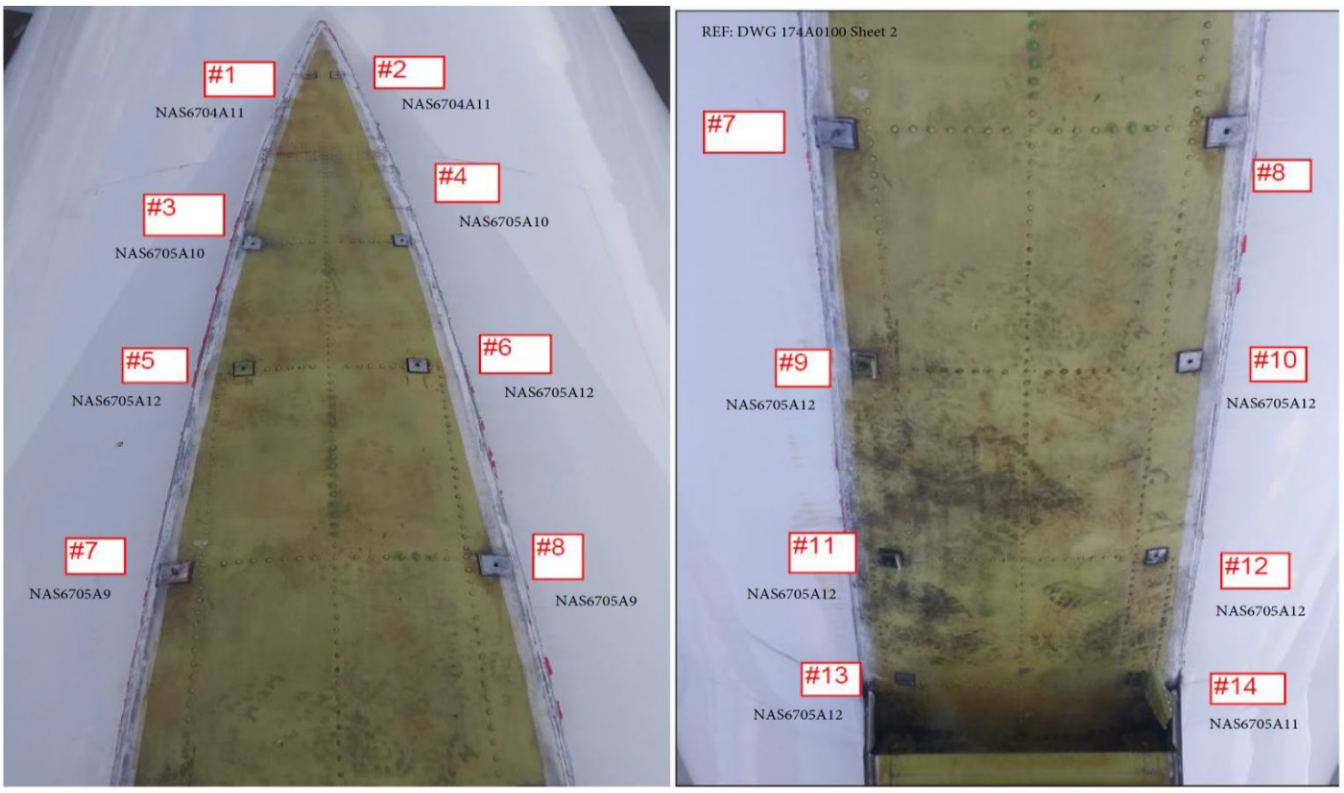


Figure 2. Dorsal fin attach points and bolt part numbers (Source: Swift Air and Boeing Company).

On February 26, 2019 (less than 3 months before the accident), the fuselage skin under the dorsal fin was inspected at iAero Repair Station, Miami, Florida. This inspection was done every 24,000 flight cycles to identify and remove corrosion. The maintenance instructions for the dorsal fin indicated that the mechanic should note the type and location of the bolts removed to ensure that each bolt would be returned to the same location from where it was removed. (The dorsal fin had different bolts with varying grip lengths.) Once the bolts were reinstalled, sealant was applied to the bolt heads.

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:	Clear	**Visibility**	10 miles
Lowest Ceiling:		**Visibility (RVR):**	
Wind Speed/Gusts:	10 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	240°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.95 inches Hg	**Temperature/Dew Point:**	
Precipitation and Obscuration:			
Departure Point:	Victorville, CA (VCV)	**Type of Flight Plan Filed:**	IFR
Destination:	San Diego, CA (SAN)	**Type of Clearance:**	IFR
Departure Time:	22:14 UTC	**Type of Airspace:**	Class C

Wreckage and Impact Information

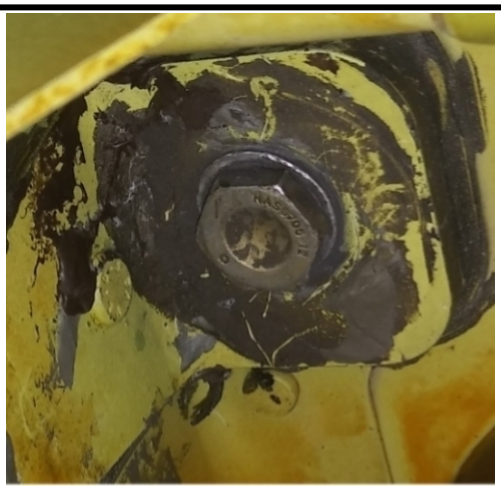
Crew Injuries:	7 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	88 None	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	95 None	**Latitude, Longitude:**	34.570869,-117.32908(est)

The dorsal fin and the missing vertical stabilizer panels were not recovered. The fuselage crown skin, left horizontal stabilizer, and vertical stabilizer sustained substantial damage. The upper fuselage crown skin was dented, punctured, and gouged. The left horizontal stabilizer leading edge, lower skin, and upper skin had multiple dents, gouges, and punctures. The left horizontal stabilizer front spar upper chord was fractured, the lower chord was deformed, and the web was gouged in two locations. The panel attach structure on the lower left side of the vertical stabilizer was fractured and deformed in several places.

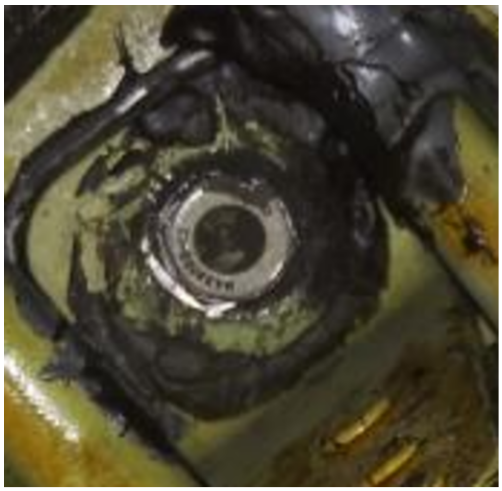
No bolts were found in holes 1-6, 8, 10, 12, and 13. Bolts remained in holes 7, 9, 11, and 14. Pieces of the dorsal fin rib structures remained attached to the bolts in holes 9, 11, and 14. Three loose bolts were recovered on the interior ceiling panels beneath the dorsal fin location.

The airplane operator provided photographs of the four installed bolts (7, 9, 11, and 14; see figure 3). The bolt installed in hole 7 was marked NAS6705-9, and the bolts in holes 9, 11, and 14 were each marked NAS6705-12. One of the three loose bolts was marked NAS6705-9, one was marked NAS6705-12, and the marking on the other loose bolt could not be fully discerned but contained an 8, a 3, a 0, the number and letter 1M, and an S (see figure 4).

Hole 7



Hole 9



Hole 11	Hole 14

Figure 3. Bolts that remained in place (Source: Swift Air).

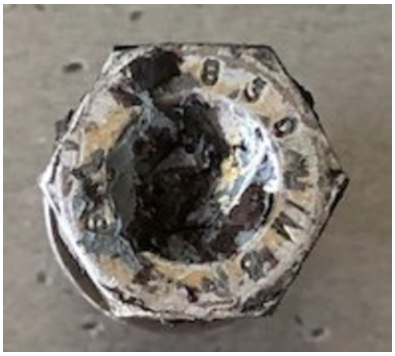


Figure 4. One of the three bolts found on the interior ceiling panels (Source: Swift Air).

Additional Information

Swift Air revised its aircraft maintenance manual on October 15, 2020, to clarify the removal and installation procedures for the dorsal fin. Swift Air also sent a letter to iAero Repair Station, requesting that it review procedures and oversight by quality control inspectors. iAero implemented changes on July 22, 2020. According to iAero Repair Station, it provided additional training on the maintenance procedures for removing and installing the dorsal fin, focusing on the installation procedure. The training emphasized that quality control inspectors should ensure that the associated tasks "are comprehensively examined" and inspected.

Further, on February 15, 2022, Boeing updated the dorsal fin removal and installation instructions in its *737-600/700/800/900 Aircraft Maintenance Manual*. The note in the manual to install the bolts in the same location from where they were removed was changed to a caution to emphasis the importance of matching the correct bolt and grip length. The caution states the following:

MAKE SURE THAT YOU MONITOR WHERE YOU REMOVE EACH FASTENER AT EACH LOCATION. THERE ARE DIFFERENT SIZES FOR THE FASTENERS. IF YOU INSTALL THE FASTENERS AT THE INCORRECT LOCATIONS, DAMAGE TO THE AIRPLANE CAN OCCUR.

Similarly, the following caution was added to the information about reinstalling the bolts that secure the dorsal fin:

MAKE SURE THAT YOU INSTALL EACH FASTENER AT THE CORRECT LOCATION. THERE ARE DIFFERENT DIMENSIONS FOR THE FASTENERS. IF YOU DO NOT INSTALL THE FASTENERS AT THE CORRECT LOCATIONS, DAMAGE TO THE AIRPLANE CAN OCCUR.

In addition, the part number in illustrated parts catalog 55-32-11-01, figure 1, item 15, was corrected for the proper grip length.

Preventing Similar Accidents

Mechanics Manage Risk and Follow Procedures (SA-022)

The Problem

Mistakes made while performing aircraft maintenance and inspection procedures have led to in-flight emergencies and fatal accidents. System or component failures are among the most common defining events for fatal general aviation accidents.

What can you do?

- Remember that well-meaning, motivated, experienced technicians can make mistakes. Learning about and adhering to sound risk management practices can help prevent common errors that can lead to tragic consequences.
- Understand the safety hazards associated with human fatigue and strive to eliminate fatigue contributors in your life. Fatigue has been linked to forgetfulness, poor decision making, reduced vigilance, and other factors that can interfere with your ability to do your job safely.
- Pay particular attention to the safety and security of the items that undergo maintenance and any surrounding components that may have been disconnected or loosened (possibly to ease access) during that maintenance.
- Carefully follow manufacturers' instructions to ensure that the work is completed as specified. Always refer to up-to-date instructions and manuals when performing a task, and ask questions of another qualified person if something is unfamiliar to you.
- Have a qualified person, other than the person who performed the maintenance, inspect the safety and security of critical items that have received maintenance.

- Be thorough when performing routine inspections. Ensure that items needing immediate attention are addressed rather than deferred.

See https://www.ntsb.gov/Advocacy/safety-alerts/Documents/SA-022.pdf for additional resources.

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):	Ward, Effie Lorenda
Additional Participating Persons:	Patrick Lusch; FAA AVP100 Joe Restifo; Swift Air Jim Taley; Boeing
Original Publish Date:	July 7, 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=101318