



Aviation Investigation Preliminary Report

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|--------------------------------|-----------------------------------|-------------------------|------------|
| Location: | Portland, OR | Accident Number: | DCA24MA063 |
| Date & Time: | January 5, 2024, 17:14 Local | Registration: | N704AL |
| Aircraft: | Boeing 737-9 | Injuries: | 177 None |
| Flight Conducted Under: | Part 121: Air carrier - Scheduled | | |

On January 5, 2024, about 1714 Pacific standard time, Alaska Airlines flight 1282, a Boeing 737-9, N704AL, returned to Portland International Airport (PDX), Portland, Oregon, after the left mid exit door (MED) plug departed the airplane leading to a rapid decompression. The airplane landed on runway 28L at PDX without further incident, and all occupants (2 flight crewmembers, 4 cabin crewmembers, and 171 passengers) deplaned at the gate. Seven passengers and one flight attendant received minor injuries. The flight was operated under Title 14 *Code of Federal Regulations*(CFR) Part 121 as a scheduled domestic passenger flight from PDX to Ontario, California (ONT).

Figure 1 below shows the location of the missing MED plug from inside and outside the airplane. The separation of the MED plug from the airplane adversely affected the pressurization performance of the airplane and the damage to the MED plug adversely affected its structural strength, requiring replacement of the MED plug, resulting in a classification of substantial damage in accordance with Title 49 *CFR* Part 830.



Figure 1. Photos of the location of the missing MED plug. (Source: left photo provided by a passenger. Right photo provided by media.)

In response to the accident, the NTSB traveled to Portland. As part of the investigative process, the NTSB invited qualified parties to participate in the investigation. These included Alaska Airlines, Air Line Pilots Association (ALPA), Association of Flight Attendants – CWA (AFA-CWA), Federal Aviation Administration (FAA), the Boeing Company (Boeing), Spirit AeroSystems, and the International Association of Machinists Union (IAM).

The parties were formed into specialized investigative groups led by NTSB group chairs in the areas of Operations, Structures, Materials/Metallurgy, Systems, Survival Factors/Cabin Safety, Flight Recorders (flight data recorder [FDR]) and cockpit voice recorder [CVR]), and Manufacturing Records/Human Performance. The Chair of the NTSB traveled with the investigative team and acted as the agency spokesperson.

Crew Experience and History of Flight

Both flight crewmembers held airline transport pilot (ATP) certificates. The captain had accumulated about 12,700 hours of flight experience, of which about 6,500 were in the accident airplane make and model. The first officer (FO) had accumulated about 8,300 hours total flight experience, of which about 1,500 were in the accident airplane make and model.

The captain was the pilot flying and the FO was the pilot monitoring. The flight crew stated that the preflight inspection, engine start, taxi, takeoff, and departure climb were unremarkable.

After takeoff, the flight crew checked in with Seattle Air Route Traffic Control Center and was cleared to flight level (FL)230 [23,000 feet]. The captain said that, while climbing through about 16,000 ft, there was a loud bang. The flight crew said their ears popped, and the captain said his head was pushed into the heads-up display (HUD) and his headset was pushed up, nearly falling off his head. The FO said her headset was completely removed due to the rapid outflow of air from the flight deck. Both flight crew said they immediately donned their oxygen masks. They added that the flight deck door was blown open and that it was very noisy and difficult to communicate.

The flight crew immediately contacted air traffic control (ATC), declared an emergency, and requested a lower altitude. The flight was assigned 10,000 ft. The captain said he then requested the rapid decompression checklist, and the FO executed the required checklist from the Quick Reference Handbook (QRH). As the FO completed the checklist, the captain flew the airplane as they coordinated with ATC to return to the PDX airport. The flight landed on runway 28L without further incident and taxied to the gate.

Recorders: Cockpit Voice Recorder and Flight Data Recorder

The CVR and FDR were removed from the airplane and brought to the NTSB's Vehicle Recorder Laboratory in Washington, DC, for download of the data. The accident airplane was required to be equipped with a CVR that retained, at minimum, the last 2 hours of audio information, including flight crew communications and other sounds inside the cockpit. A CVR starts recording when the aircraft is powered on and will continue to record until the aircraft is powered down or the CVR is deactivated, either by a loss of electrical power after a major event or by manually deactivating the CVR's circuit breaker after a less severe event.

The CVR was downloaded successfully; however, it was determined that the audio from the accident flight had been overwritten. The CVR circuit breaker had not been manually deactivated after the airplane landed following the accident in time to preserve the accident flight recording.

The accident airplane was required to be equipped with an FDR that recorded, at a minimum, 91 parameters and 25 hours of data. The accident airplane's FDR was successfully downloaded and had about 1800 parameters and was 68 hours in length. It contained 16.5 flights, and the oldest recorded flight was from December 30, 2023. A summary of the FDR data is as follows:

- o 17:06:47 PST: The airplane departed runway 28L at PDX.
- o 17:12:33 PST: The recorded cabin pressure dropped from 14.09 to 11.64 pounds per square inch (psi) when the airplane was at an altitude of about 14,830 ft and speed of 271 knots (kts). The "Cabin Altitude Greater than (>) 10k ft Warning" activated. Differential pressure was at 5.7 psi and rapidly decreased to 0 psi over the next few seconds.

- o 17:12:34 PST: The Master Caution activated. The cabin pressure dropped to 9.08 psi at approximately 14,850 ft and 271 kts. The airplane magnetic heading was 123°.
- o 17:12:52 PST: The Master Caution deactivated.
- o 17:13:41 PST: The airplane continued to climb and reached a maximum altitude of 16,320 ft and began to descend. The airspeed was 276 kts on a magnetic heading of 120°.
- o 17:13:56 PST: The Selected Altitude changed from 23,000 ft to 10,000 ft.
- o 17:14:35 PST: The Master Caution activated for 3 seconds.
- o 17:16:56 PST: The airplane began a left turn from 121°. The altitude was approximately 10,120 ft.
- o 17:17:00 PST: The airplane descended below 10,000 ft.
- o 17:18:05 PST: The airplane altitude was approximately 9,050 ft and the airspeed was 271 kts. The “Cabin Altitude Greater than (>) 10k ft Warning” deactivated. The cabin pressure was 10.48 psi.
- o 17:26:46 PST: The airplane landed on runway 28L at PDX.

Operator and Airplane Information

Alaska Airlines is a *CFR* Part 121 operator and has a fleet of 231 Boeing 737 airplanes to include 737-9, 737-900ER, 737-900, 737-8, 737-800, 737-800F, 737-700, and 737-700F.

The accident airplane, N704AL, a B737-9 (serial number 67501), was delivered to Alaska Airlines on October 31, 2023. Alaska Airlines put the airplane into service on November 11, 2023. At the time of the accident, the airplane had accumulated 510 total hours and 154 cycles.

Mid Exit Door Plug Description

The airplane was equipped with a MED plug option (see figure 2 and third image in figure 3 below), which Alaska Airlines had selected based on its desired seating configuration. Benefits afforded by the plug option include:

1. More passenger comfort because of the lower density of passengers and thus passengers having more space.
2. Reduced weight (63 lbs vs 150 lbs for the door configuration) and associated cost savings in operating the airplane.
3. A full-sized passenger window.
4. A structural component that does not have the complexity of a door with its associated parts, operations, and maintenance concerns.

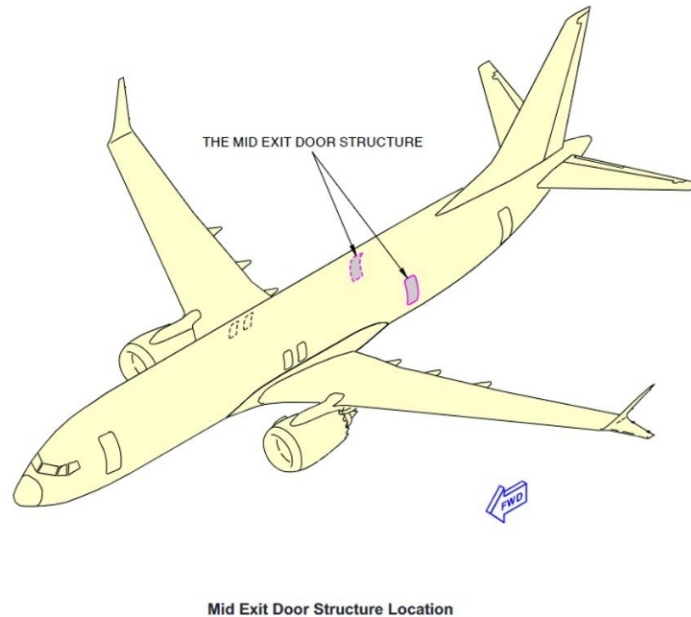


Figure 2. Diagram showing the mid exit door locations. (Source: Boeing. Image Copyright © Boeing. Reproduced with permission.)



Figure 3. Three types of mid exit doors. (Source: Boeing. Image Copyright © Boeing. Reproduced with permission.)

The accident airplane was equipped with 178 passenger seats, of which rows 1 through 4 were first class, rows 6 through 9 were premium seats, and rows 10 through 34 were economy class. The MED plugs, with a standard window each, were located at row 26 on the right and left sides of the airplane. Each door plug was about 29 inches wide and 59 inches high.

The accident MED plug was manufactured by Spirit AeroSystems Malaysia on March 24, 2023, and was received at Spirit AeroSystems Wichita on May 10, 2023. The MED plug was then installed and rigged on the fuselage (Spirit AeroSystems Fuselage Line 8789) before it was shipped to Boeing on August 20, 2023. The fuselage arrived at Boeing's Renton, Washington, facility on August 31, 2023.

The MED plug is primarily constructed of aluminum and is installed in the fuselage by means of two upper guide fittings and two lower hinge fittings (see figures 4 and 5). The two upper guide fittings are located on the upper sides of the plug and engage with two upper guide rollers that are fixed to the upper sides of the fuselage opening (see figure 6). Two lower hinge guide fittings are fixed to the lower section of the plug and engage with the two lower hinge fittings that are attached to the bottom of the fuselage opening at the lower hinge bracket assemblies.

Once the plug is in place, it is secured from moving vertically by a total of four bolts. There is a bolt installed through each upper guide fitting and each lower hinge guide fitting. Once these bolts are installed, they are secured using castle nuts and cotter pins. Outboard motion of the plug is prevented by 12 stop fittings (6 along each forward and aft edge) installed on the fuselage door frame structure.

The door plug is only intended to be opened for maintenance and inspection, which requires removing the vertical movement arrestor bolts and upper guide track bolts. The strap assemblies below the second stop pad from the top restrict the plug from opening further than 15°, suitable for maintenance and inspection purposes (see figure 6).

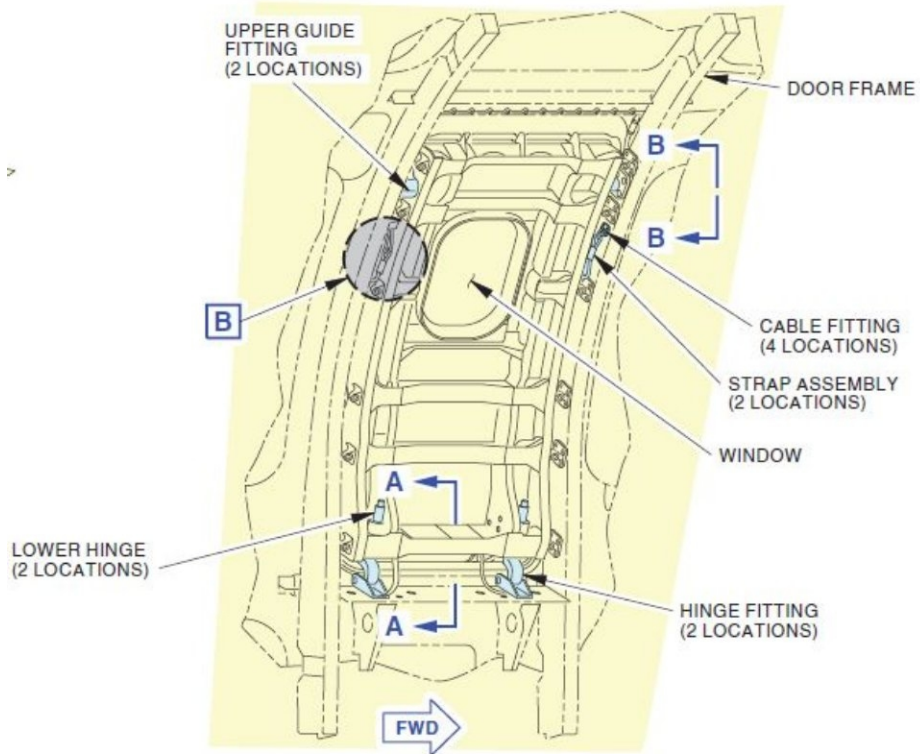


Figure 4. 737-9 Mid Exit Door Plug. (Source: Boeing. Image Copyright © Boeing. Reproduced with permission.)

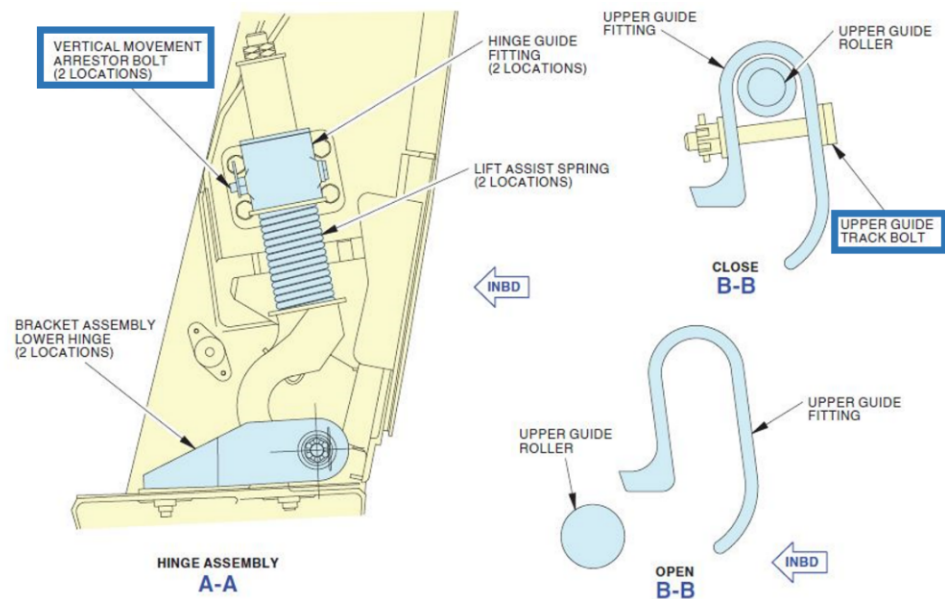


Figure 5. 737-9 Mid Exit Door Plug – Arrestor and Track Bolts. Boxes added for emphasis. (Source: Boeing. Image Copyright © Boeing. Reproduced with permission.)

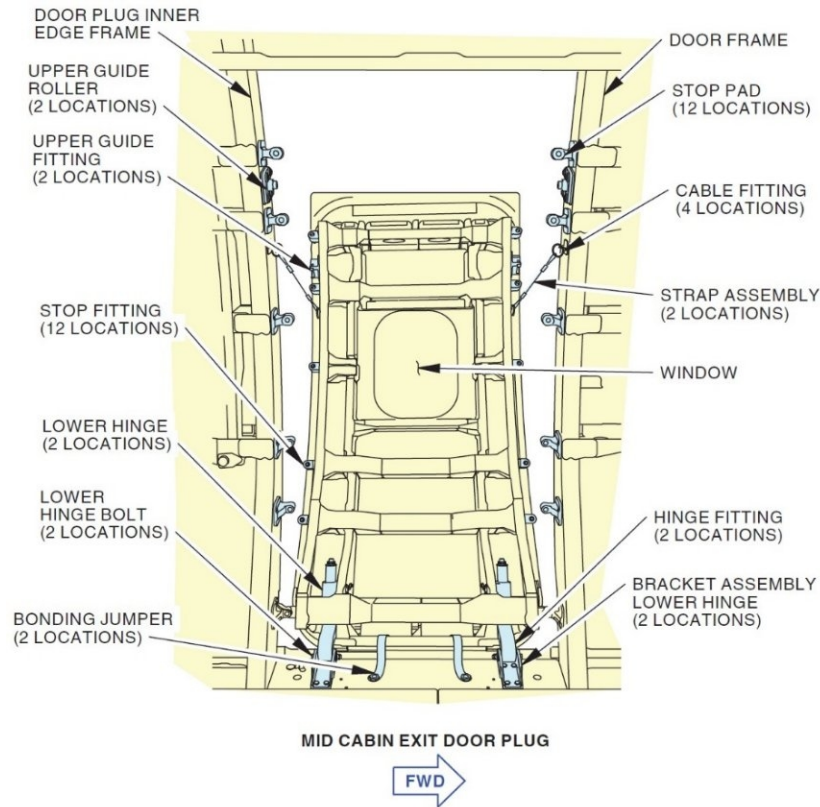


Figure 6. 737-9 Mid Exit Door Plug – Components. (Source: Boeing. Image Copyright © Boeing. Reproduced with permission.)

The NTSB’s investigative team conducted a postaccident examination of the aircraft structure, flight deck, cabin interior, cabin safety systems, and pressurization system.

Cabin Pressurization/Cabin Description

The cabin pressurization system maintains a safe, comfortable cabin pressure altitude and, under normal operations, the maximum cabin pressure altitude is around 8,000 ft. A postaccident review of cabin pressure/cabin altitude data before the decompression event showed that the cabin pressure control system had functioned per design with no cabin altitude or cabin rate exceedances. However, the NTSB’s examination of the airplane’s maintenance logs identified entries indicating that a pressure controller light had illuminated on three previous flights.

Pressurization on the 737-9 is managed by a triple-redundant system with two automated pressure controllers and a manual back-up system. An issue with one controller prompts the system to switch to the alternate controller automatically. If both automated pressure controllers fail, a manual back-up system can be used, which is operated by the pilots. Any one of these three systems is fully capable of maintaining safe cabin pressurization. To ensure a complete study of the pressurization system, the NTSB retained the two cabin pressure controllers and the outflow valve for further study.

When the rapid decompression occurred, all flight attendant and passenger oxygen masks immediately deployed. Examination revealed that the masks' associated chemical generators operated as designed and produced oxygen for the airplane occupants.

In addition, the examination included cabin communications and lighting systems, emergency equipment, passenger safety information, the flight deck door, aircraft exits, and the condition of the cabin interior to include all seats, seat tracks, windows, doors, and interior paneling.

The flight crew reported that the cockpit door had opened during the depressurization event. In a revision to the Flight Crew Operations Manual, issued on January 15, 2024, Boeing confirmed that the door functioned as designed.

Damage to the passenger cabin included: damage in seat rows 25ABC and 26ABC as described below, deformation of the doorframe of the forward lavatory, and buckling and displacement of the sidewall panels and trim throughout the airplane. There were no indications of any other failures or malfunction of the airplane or any of its systems.

As seen in figure 7, Seat 25A was rotated out and aft approximately 10°–20° toward the opening. The seatback of Seat 26A was rotated forward and outboard.



Figure 7. Photo of seat rows 25ABC and 26ABC.

Accident Left MED Plug

The left MED plug was recovered in the backyard of a private residence. The recovered plug and associated hardware were shipped to the NTSB's Materials Laboratory for further examination.

Materials and Structure Examination

The NTSB Structures and Materials specialists, along with representatives from parties to the investigation, examined the MED plug and associated components removed from the accident airplane shown in figure 8 as received in the NTSB Materials Laboratory. The MED plug was mostly intact with some damage from the event and appeared to be manufactured in accordance with the engineering drawings.

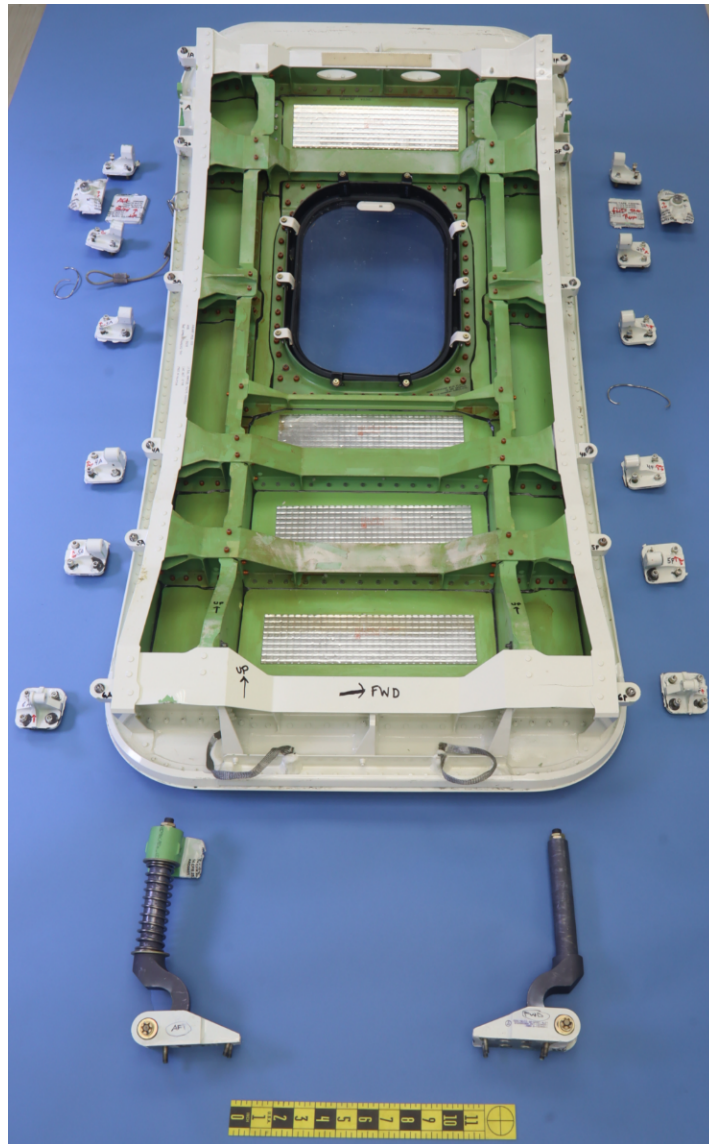


Figure 8. Overall view of the MED plug and associated components removed from the accident airplane as received at the NTSB Materials Laboratory.

The two vertical movement arrestor bolts, two upper guide track bolts, forward lower hinge guide fitting, and forward lift assist spring were missing and have not been recovered. See figure 5 for example of installed locations.

Contact damage was noted on the lower sides of the 12 stop pins and fittings on the MED plug. Corresponding contact damage was noted on the 12 stop pads and fittings attached to the fuselage. Overall, the damage was consistent with the MED plug translating upward, outboard, and aft during the separation. Figure 9 shows damage features at the upper forward stop location and is representative of the other stop locations.

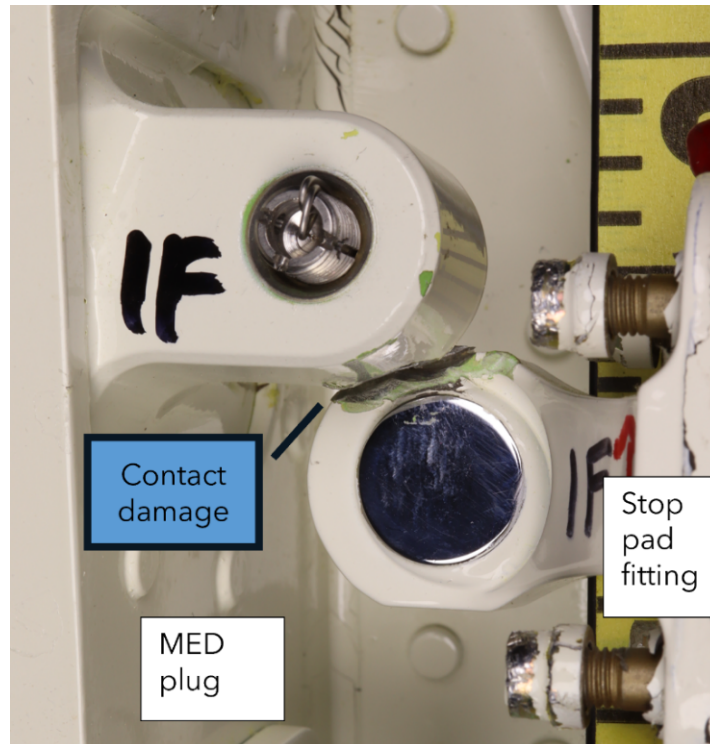


Figure 9. Witness mark matching between upper forward MED plug stop pin fitting and stop pad fitting as received in the NTSB Materials Laboratory.

Both upper guide fittings installed on the forward and aft sides of the MED plug, respectively, were fractured vertically through the inboard wall of the track. Examination revealed features consistent with overstress fracture and no evidence of pre-existing cracks or damage. The outboard upper guide track bolt holes were intact and exhibited no deformation. Figure 10 shows the aft upper guide fitting; the forward upper guide fitting was similar.

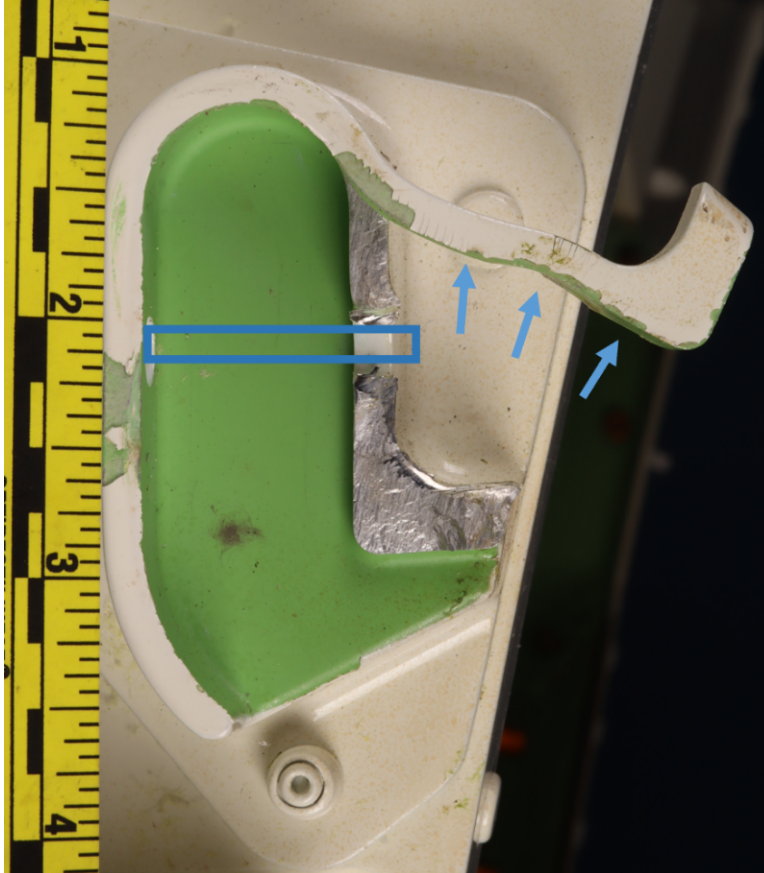


Figure 10. Fractured aft upper guide fitting. Arrows point to the fractured and deformed piece of the guide fitting's inboard wall. The rectangle indicates where the upper guide track bolt would be installed.

The paint in the upper guide track bolt hole bores was intact and showed no evidence of heavy contact damage. Figure 11 shows a representative hole bore. There were some light circular witness marks around the hole bores consistent with the presence of a washer at some time.

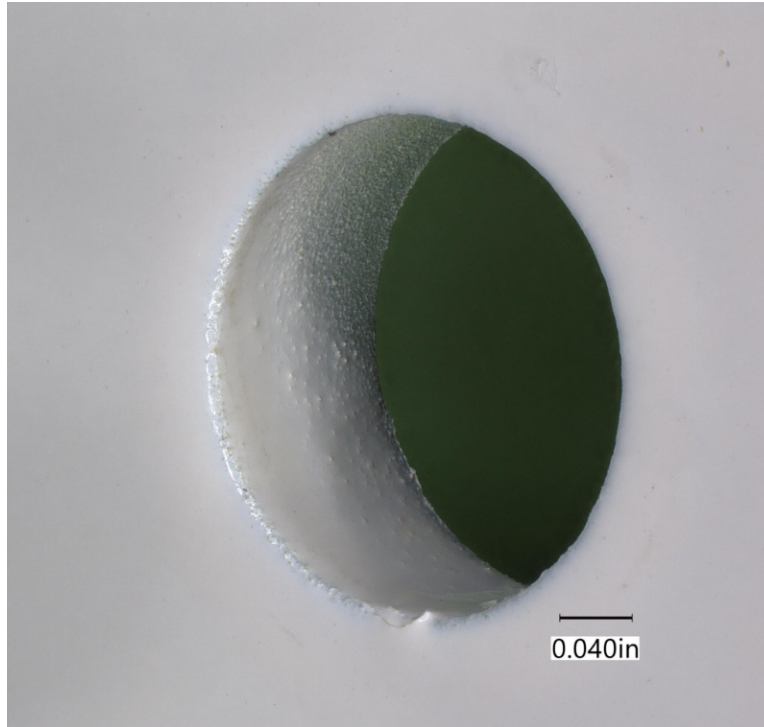


Figure 11. Aft upper guide track fitting showing the outboard track bolt hole bore.

The aft lower hinge guide fitting fractured from the MED plug during the event and remained attached to the aft hinge fitting. The forward lower hinge guide fitting fractured from the MED plug and separated from the forward hinge fitting. The forward hinge fitting shaft was bent inboard about 0.4° with corresponding contact damage noted to the MED plug lower beam. The vertical movement arrestor bolt hole bore in the forward hinge fitting was intact and undamaged.

The aft hinge fitting was bent inboard about 3.7° with corresponding contact damage noted to the MED plug lower beam. Contact damage was noted on the inboard side of the hinge fitting shaft intersecting the vertical movement arrestor bolt hole consistent with contact with the MED plug, but the hole bore was otherwise undamaged. The outboard side of the vertical movement arrestor bolt hole was slightly elongated and exhibited small tensile cracks at the apex of the bend consistent with plastic deformation of the hinge fitting shaft (figure 12). The hole bore was otherwise undamaged.



Figure 12. Aft hinge fitting after disassembly showing the bent shaft.

The attachment flange on the aft lower hinge guide fitting was fractured at the two upper attach hole locations, and the bolts remained installed in the MED plug. The two lower attach bolts were fractured. A similar damage pattern was noted on the MED plug at the forward lower hinge guide fitting attachment location. All features were consistent with ductile overstress fracture. The vertical movement arrestor bolt holes in the aft lower hinge guide fitting were intact and undamaged (figure 13).

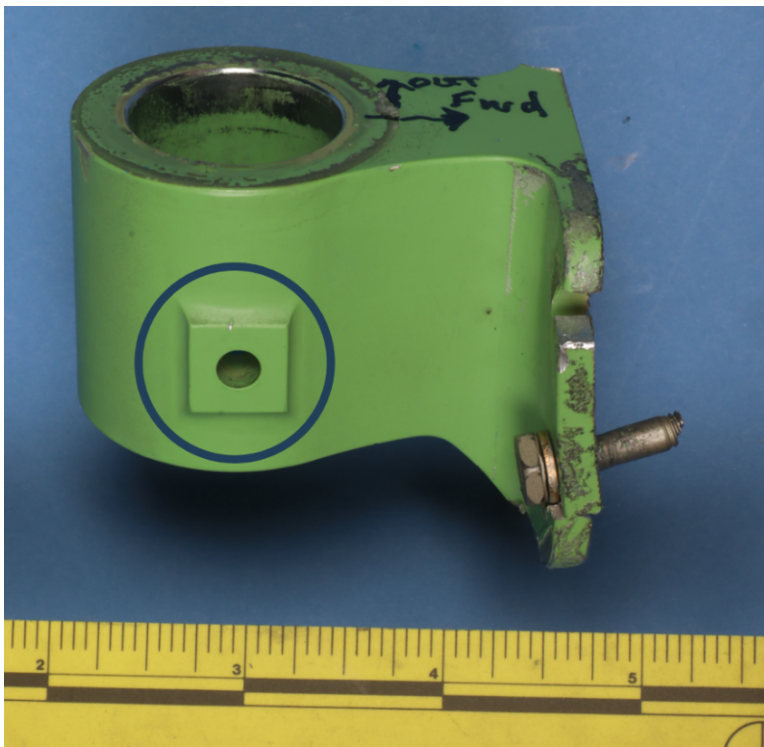


Figure 13. Aft lower hinge guide fitting after disassembly. Circle shows the location of the vertical movement arrestor bolt hole.

Overall, the observed damage patterns and absence of contact damage or deformation around holes associated with the vertical movement arrestor bolts and upper guide track bolts in the upper guide fittings, hinge fittings, and recovered aft lower hinge guide fitting indicate that the

four bolts that prevent upward movement of the MED plug were missing before the MED plug moved upward off the stop pads.

Manufacturing Records/Human Performance

The Manufacturing Records Group traveled to Boeing's Renton, Washington, facility to review manufacturing records for the accident airplane specific to the left MED plug area. According to records, the accident fuselage arrived at Boeing's Renton facility by rail on August 31, 2023. During the manufacturing process, if any defects or discrepancies were found, a Non-Conformance Record (NCR) or a disposition required NCR were generated.

On September 1, 2023, records show that NCR 1450292531 was created noting five damaged rivets on the edge frame forward of the left MED plug. See figure 14 for rivet locations.



Figure 14. Photo on the left shows the five locations of the damaged rivets. Photo on the right is a close-up of a damaged rivet. (Source: Boeing. Image Copyright © Boeing. Reproduced with permission.)

Documents and photos show that to perform the replacement of the damaged rivets, access to the rivets required opening the left MED plug (see figure 15). To open the MED plug, the two vertical movement arrestor bolts and two upper guide track bolts had to be removed.



Figure 15. Photo showing the MED plug opened to work on damaged rivets. (Source: Spirit AeroSystems.)

Records show the rivets were replaced per engineering requirements on Non-Conformance (NC) Order 145-8987-RSHK-1296-002NC completed on September 19, 2023, by Spirit AeroSystems personnel. Photo documentation obtained from Boeing shows evidence of the left-hand MED plug closed with no retention hardware (bolts) in the three visible locations (the aft upper guide track is covered with insulation and cannot be seen in the photo). See figure 16. This image was attached to a text message between Boeing team members on September 19, 2023, around 1839 local. These Boeing personnel were discussing interior restoration after the rivet rework was completed during second shift operations that day.



Figure 16. Photo showing the left MED plug immediately before interior restoration and the circles show the three locations without the retaining bolts, two vertical movement arrestor bolts and the forward upper guide track bolt. The aft upper guide track is covered with insulation and cannot be seen in the photo. (Source: Boeing. Image Copyright © Boeing. Reproduced with permission.)

The investigation continues to determine what manufacturing documents were used to authorize the opening and closing of the left MED plug during the rivet rework.

The Human Performance Investigator joined the group to travel to Spirit AeroSystems, where they reviewed pertinent build work documents and observed a door plug installation. As mentioned earlier, the accident MED plug was manufactured by Spirit AeroSystems Malaysia on March 24, 2023, and received at Spirit AeroSystems Wichita on May 10, 2023. The MED plug was then installed and rigged on the fuselage prior to delivery to Boeing. During the build process, one quality notification (QN NW0002407062) was noted indicating the seal flushness was out of tolerance by 0.01 inches. No manufacturing rework was required, as Spirit AeroSystems Engineering determined the condition was structurally and functionally acceptable and did not adversely affect the form, fit, or function of the installation. There were

no other QNs for the left MED plug before leaving Spirit AeroSystems. Fuselage Line 8789 was shipped to Boeing on August 20, 2023.

The group then traveled to AAR, Oklahoma City, where a wi-fi and PCS antenna was installed on the accident airplane from November 27, 2023, to December 7, 2023. The group reviewed applicable installation retrofit documents and received a presentation on AAR's quality assurance and safety management system (SMS) processes. The group also witnessed a wi-fi retrofit in progress. Facility representatives reported that they have modified approximately 60 Alaska Airlines 737-9 airplanes with the wi-fi and PCS antenna installation and have not had to remove or open any MED plugs for this work, to include the event airplane.

The manufacturing/human performance group has done a complete records review from the time the event airplane left the Boeing factory to the time of the accident and found no evidence that the left MED plug was opened after leaving Boeing's facility.

Interviews of Boeing and Spirit AeroSystems' personnel will be scheduled at a future date. The group will also be looking at Boeing's SMS and Spirit AeroSystems' ongoing development of its voluntary SMS program. The group will also assess the FAA's involvement in the manufacturers' development of their respective SMS programs and the level of oversight applied to each.

Safety Actions

As a precaution, Alaska Airlines grounded its fleet of B737-9 airplanes to inspect the MED plugs soon after the event. Their inspections began Saturday morning, January 6, 2024. In addition, the FAA issued an emergency airworthiness directive on January 6 requiring all operators of 737-9 airplanes to conduct specific inspections before returning the airplanes to service.

On January 21, 2024, the FAA published Safety Alert for Operators (SAFO) 24001 for operators that have the same MED plug as the accident airplane but on a different model of airplane. The SAFO is for Boeing 737-900ER airplanes and recommends that operators inspect, as soon as possible, the four locations where the retaining hardware secures the door to the airframe.

Boeing issued multiple multi-operator messages (MOMs). The most recent, MOM-24-0010-01B(R4) dated January 25, 2024, contains revised instructions for inspecting 737-9 airplanes that have the MED plugs.

The NTSB's investigation is ongoing.

Aircraft and Owner/Operator Information

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|----------------------------------|---------------------|---------------------------------------|--------------------|
| Aircraft Make: | Boeing | Registration: | N704AL |
| Model/Series: | 737-9 | Aircraft Category: | Airplane |
| Amateur Built: | | | |
| Operator: | ALASKA AIRLINES INC | Operating Certificate(s) Held: | Flag carrier (121) |
| Operator Designator Code: | | | |

Meteorological Information and Flight Plan

| | | | |
|---|------------------------|-------------------------------------|-------------------|
| Conditions at Accident Site: | VMC | Condition of Light: | Night |
| Observation Facility, Elevation: | PDX,30 ft msl | Observation Time: | 16:53 Local |
| Distance from Accident Site: | 12 Nautical Miles | Temperature/Dew Point: | 10°C /4°C |
| Lowest Cloud Condition: | Clear | Wind Speed/Gusts, Direction: | 11 knots / , 160° |
| Lowest Ceiling: | Overcast / 6000 ft AGL | Visibility: | 10 miles |
| Altimeter Setting: | 30.23 inches Hg | Type of Flight Plan Filed: | IFR |
| Departure Point: | Portland, OR (PDX) | Destination: | Ontario, CA (ONT) |

Wreckage and Impact Information

| | | | |
|----------------------------|----------|-----------------------------|----------------------|
| Crew Injuries: | 6 None | Aircraft Damage: | Substantial |
| Passenger Injuries: | 171 None | Aircraft Fire: | None |
| Ground Injuries: | | Aircraft Explosion: | None |
| Total Injuries: | 177 None | Latitude, Longitude: | 45.454167,-122.75555 |

Administrative Information

| | |
|--|---|
| Investigator In Charge (IIC): | Lovell, John |
| Additional Participating Persons: | Matt Rigsby ; FAA/ Federal Aviation Administration AVP-100 John Miller; Boeing Marc Henegar; ALPA Max Tidwell; Alaska Airlines Seth Heiple; AFA Heather Meyer ; Spirit AeroSystems Jon Holden ; International Association of Machinists and Aerospace Workers Union (IAM) |
| Investigation Class: | Class 2 |
| Note: | The NTSB traveled to the scene of this accident. |