



National
Transportation
Safety Board



In-Flight Separation of Left Mid Exit Door Plug Alaska Airlines Flight 1282 Boeing 737-9 Portland, OR January 5, 2024

Investigator-in-Charge

Summary

- January 5, 2024, 5:13 pm Pacific standard time
- Alaska Airlines flight 1282, Boeing 737-9
- In-flight separation of the left mid exit door (MED) plug and rapid depressurization
- Portland International Airport, Portland, Oregon
- There were 6 crew and 171 passengers on board
- One flight attendant and 7 passengers received minor injuries
- Night visual conditions

History of Flight

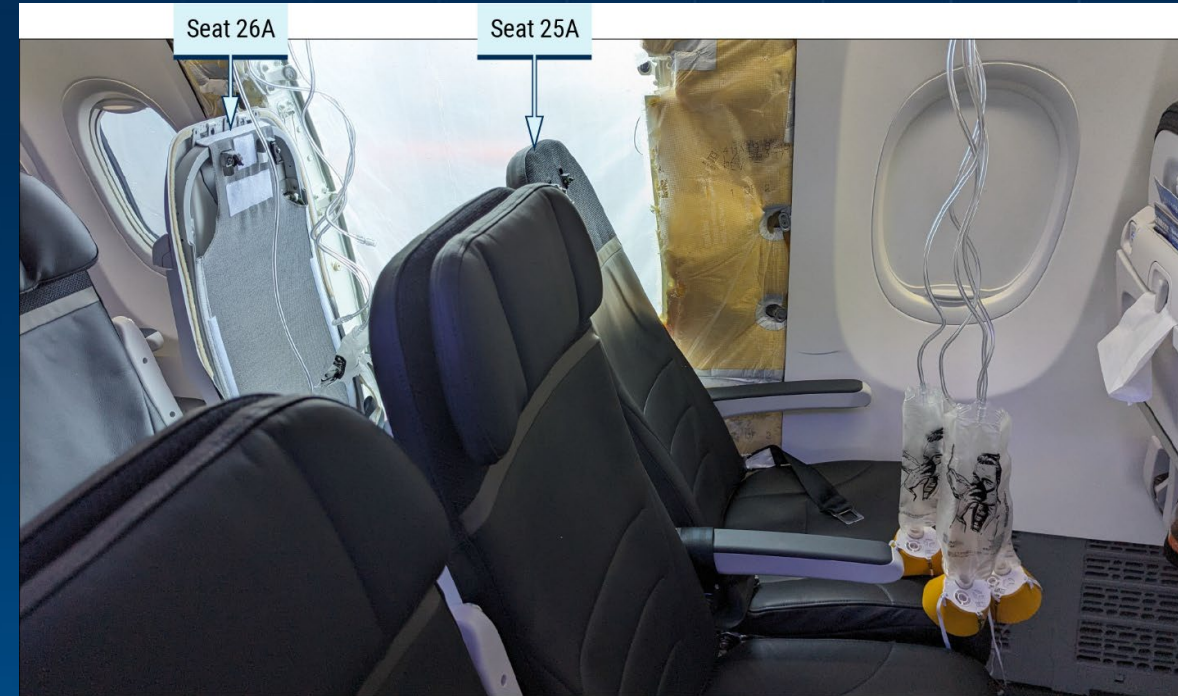
- Climbing through 14,830 feet, there was a loud bang
- Flight deck door was blown open during rapid depressurization
- Both flight crew members donned their oxygen masks
- Flight deck had difficulty communicating due to noise associated with the depressurization
- Declared emergency and descended while executing emergency procedures

History of Flight

- Emergency oxygen masks deployed
- Closed the flight deck door
- Donned oxygen masks
- Attempted to communicate with the flight crew
- Assessed the cabin and assisted passengers
- Prepared cabin for emergency landing

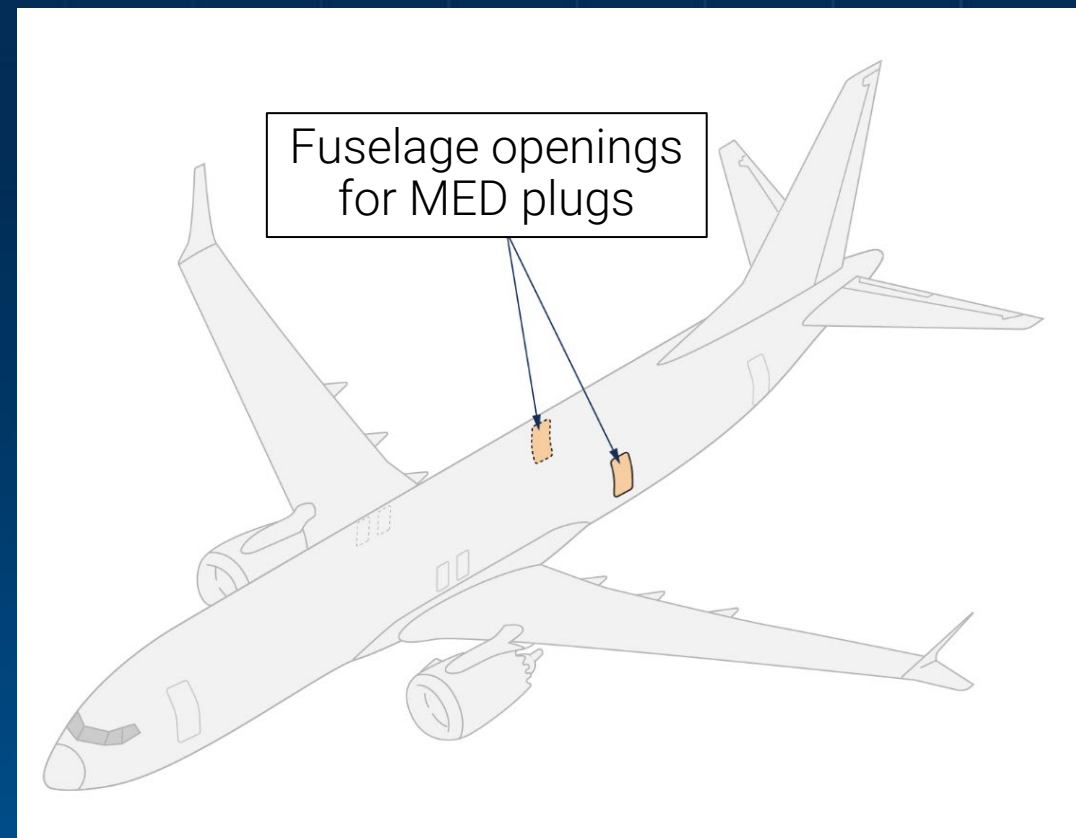
History of Flight

- Returned to Portland
- Near rows 25 and 26
- Airplane had a hole in fuselage where left MED plug had been

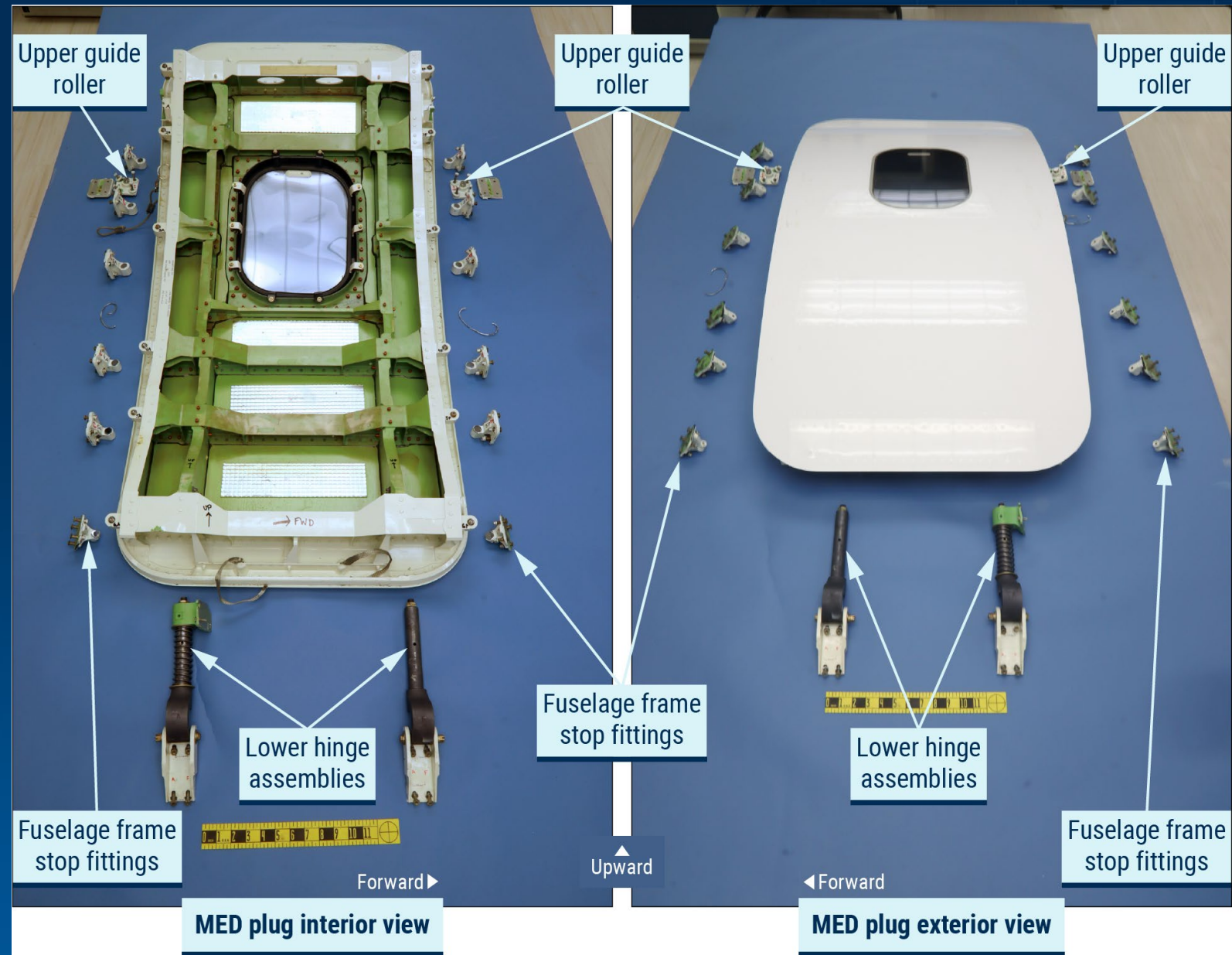


What We Found: MED Plug

- MED plug is a customer option
- Saves weight
- Not intended to be opened during operations
- Not normally opened during production
- Left MED plug was opened during final assembly in Renton
- Left MED plug was missing four retaining bolts



MED Plug



MED Plug



Video Courtesy Spirit AeroSystems

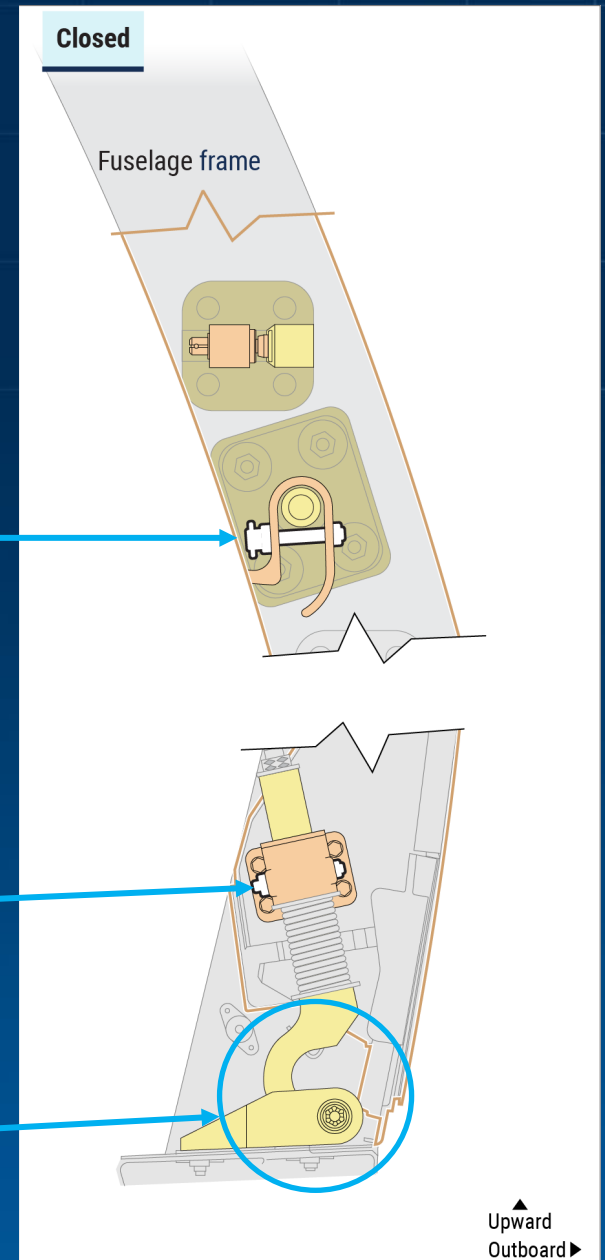
MED Plug Operation

Closed

Upper guide track bolt

Vertical movement arrestor bolt

Lower hinge



MED Plug Operation

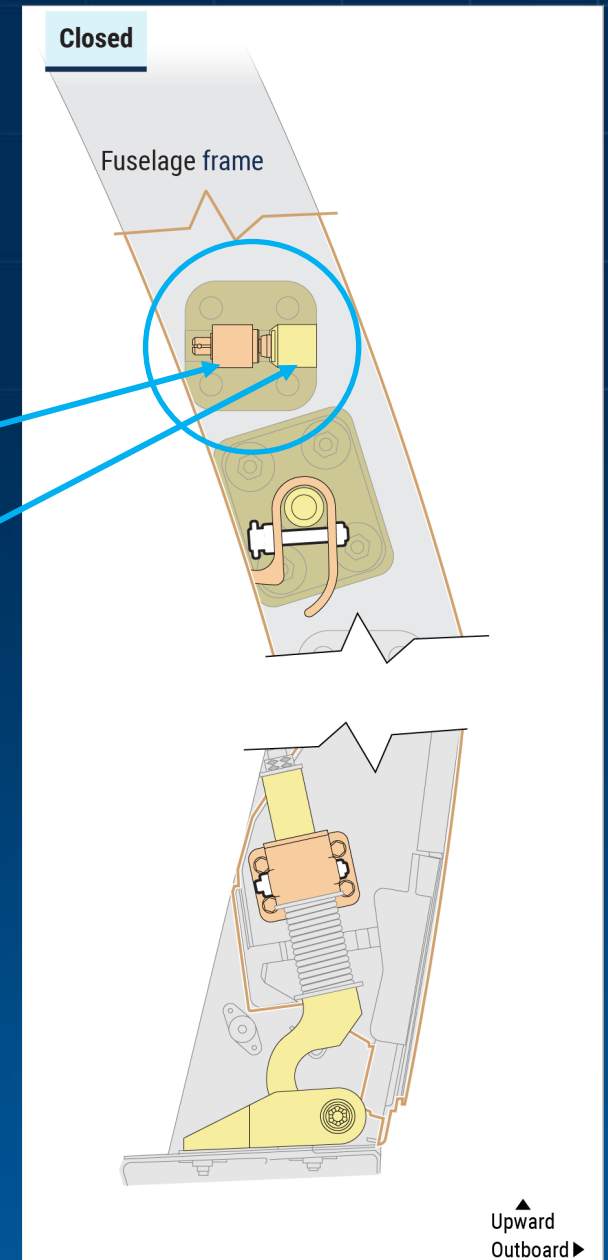
Closed

Stop fitting (1 of 6 shown)

Has two parts:

One on MED plug

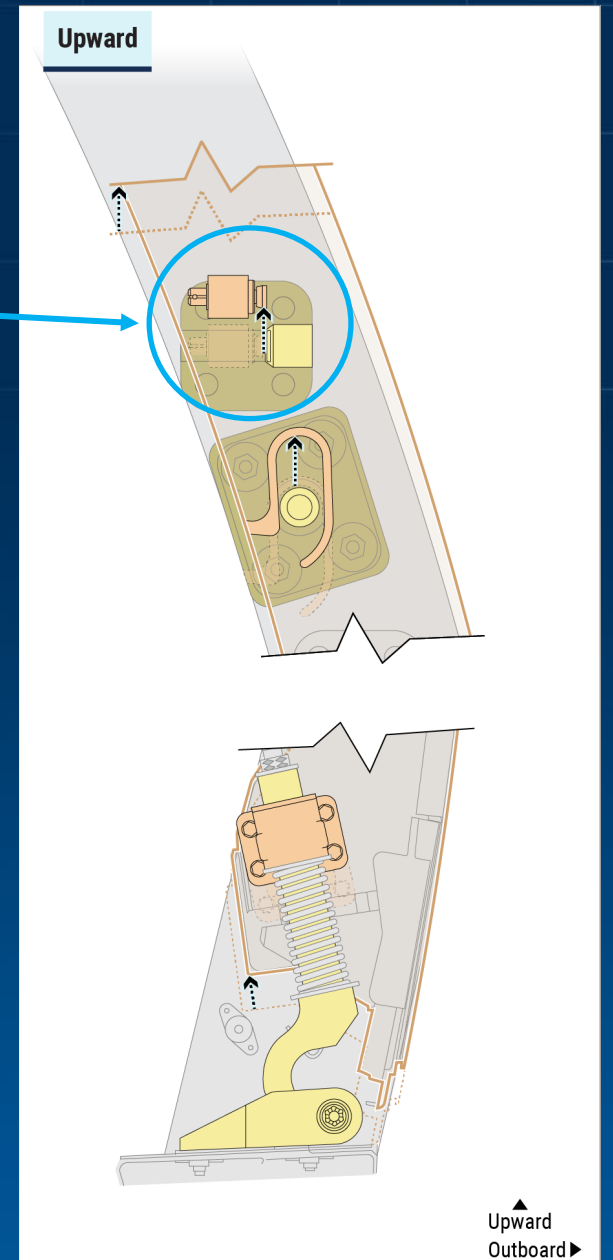
One on fuselage frame



MED Plug Operation

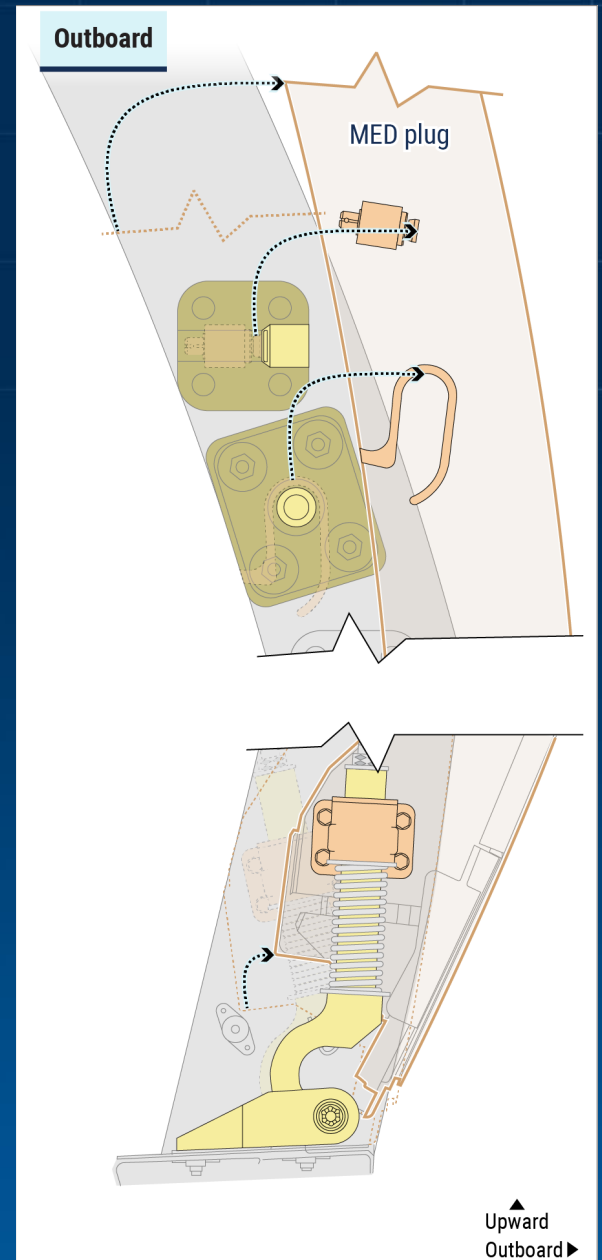
Upward

Stop fittings disengaged

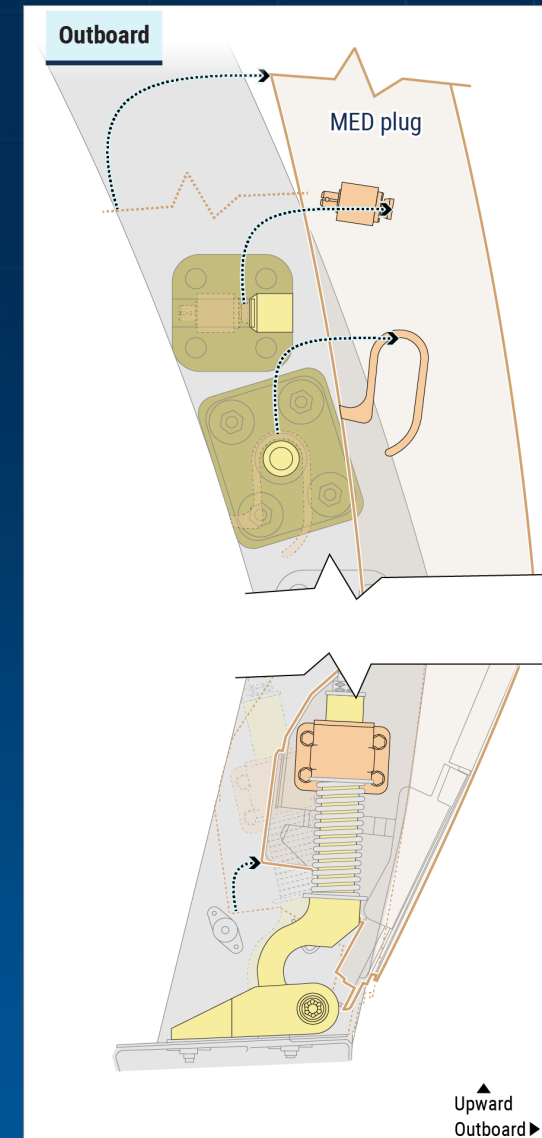
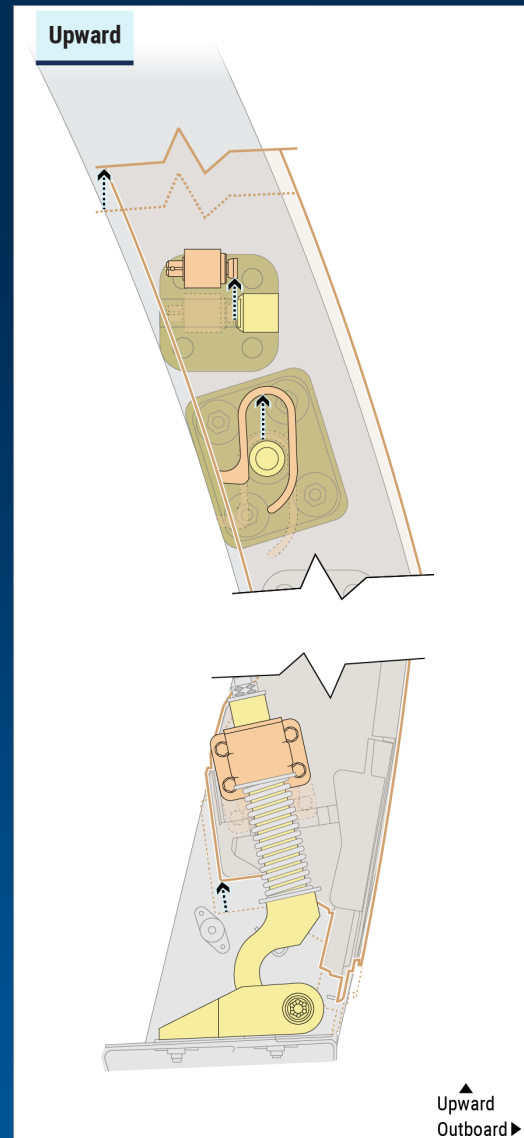
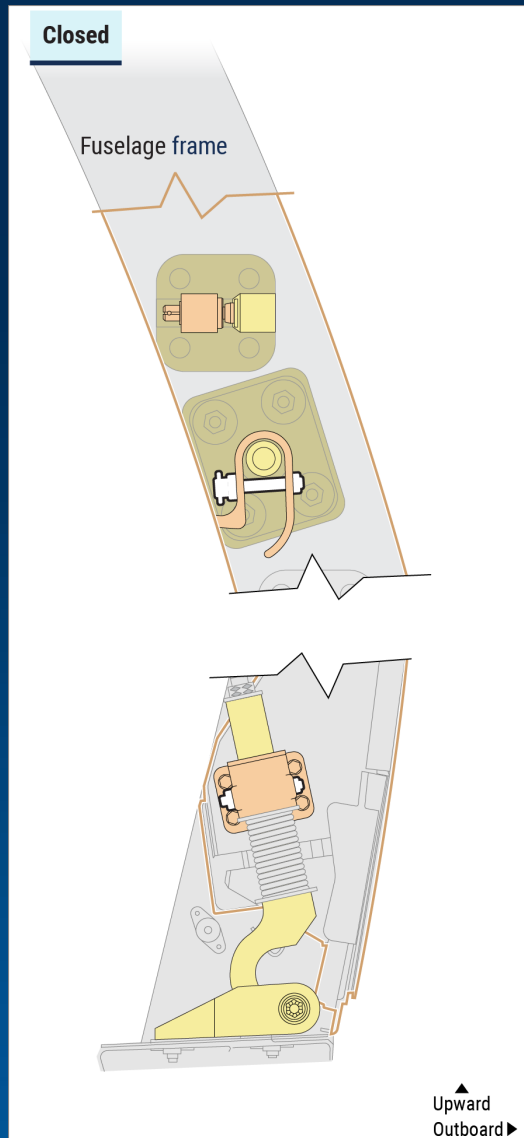


MED Plug Operation

Outboard



MED Plug Operation



Excluded Factors

- Alaska Airlines crew qualifications
- Alaska Airlines airplane maintenance
- Alaska Airlines flight crew walkaround procedures
- Cabin pressurization system and previous cabin pressurization
AUTO FAIL light illumination events

Safety Issues

- Opening of left MED plug during manufacturing without generating a removal document
- Complexity of Business Process Instruction (BPI) for parts removals
- Inadequate training of manufacturing personnel
- Ineffective change management strategies
- Incomplete closure of left MED plug

Safety Issues

- Ineffective corrective actions
- Ineffective oversight
- Inadequate quality escape mitigation
- Portable oxygen bottle design standards review
- Flight deck door operation description
- Insufficient hands-on, aircraft-specific training and procedures for flight crews' use of each oxygen system in an operator's fleet
- Loss of cockpit voice recorder (CVR) audio
- Potential for injury for lap-held children under age 2 during a rapid depressurization

What We Found: MED Plug Movement

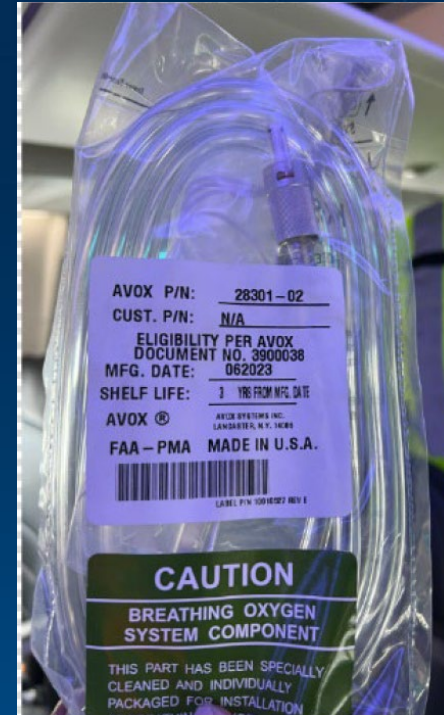
- The MED plug incrementally shifted upward during previous flight cycles
- This upward displacement was subtle as viewed from the ground and would not have been readily detectable during routine preflight walkaround inspections
- The MED plug is not visible from inside the cabin; it is covered by insulation and interior panels

What We Found: Portable Oxygen Bottles

- Difficulty using portable oxygen bottle mask
- Differences between training and actual use
- Differences in equipment (mask type)

What we propose:

- One recommendation to the FAA in this area



What We Found: Child Restraint Systems

- Concern that lap-held children are at risk during rapid depressurization, severe turbulence, or loss of control
- NTSB history – over 30 years we have made recommendations for appropriate child restraint systems

What we propose:

- Two reiterated recommendations to the FAA in this area

What We Found: Cockpit Voice Recorder

- 2-hour CVR; accident flight audio was overwritten
- Procedures were ineffective in preserving CVR data from accident flight
- CVR audio would have been available if airplane had 25-hour CVR

What we propose:

- One new and two reiterated recommendations to the FAA in this area

Parties to the Investigation

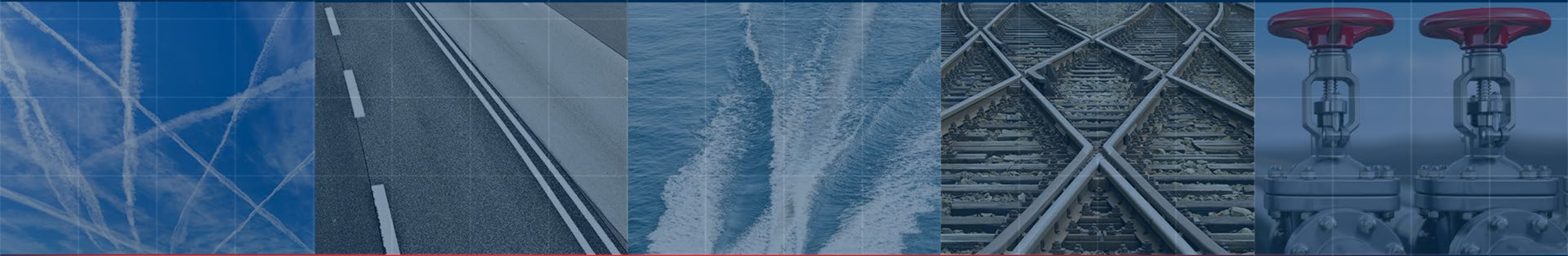
- Air Line Pilots Association
- Alaska Airlines
- Association of Flight Attendants
- Boeing Commercial Airplanes
- Federal Aviation Administration
- International Association of Machinists & Aerospace Workers
- Spirit AeroSystems

Postaccident Safety Actions

- Federal Aviation Administration
- Boeing Commercial Airplanes
- Spirit AeroSystems
- Alaska Airlines

Staff Presentations

- Manufacturing Records
- Human Performance
- Structures
- Operational Factors



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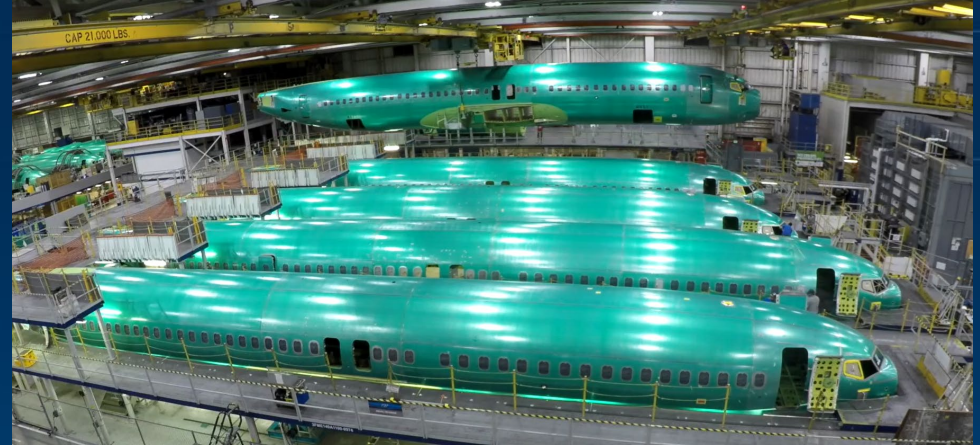
Manufacturing Group

Overview

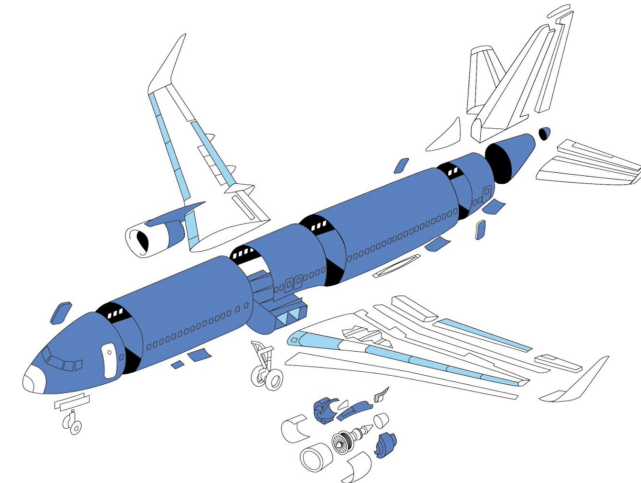
- Boeing 737 Manufacturing Process of Line 8789
- Spirit AeroSystems – Aerostructures Build
- Boeing Renton 737 Manufacturing Process
- Federal Aviation Administration Surveillance

Spirit AeroSystems Manufacturing

- Major supplier of aerostructures for Boeing 737, 777, and 787 fuselages
- Located in Wichita, Kansas
- Boeing 737 components
 - Wing leading edges
 - Pylons
 - Engine nacelles
 - Thrust reversers
 - Flight deck sections
- Fuselage shipped via rail to Boeing

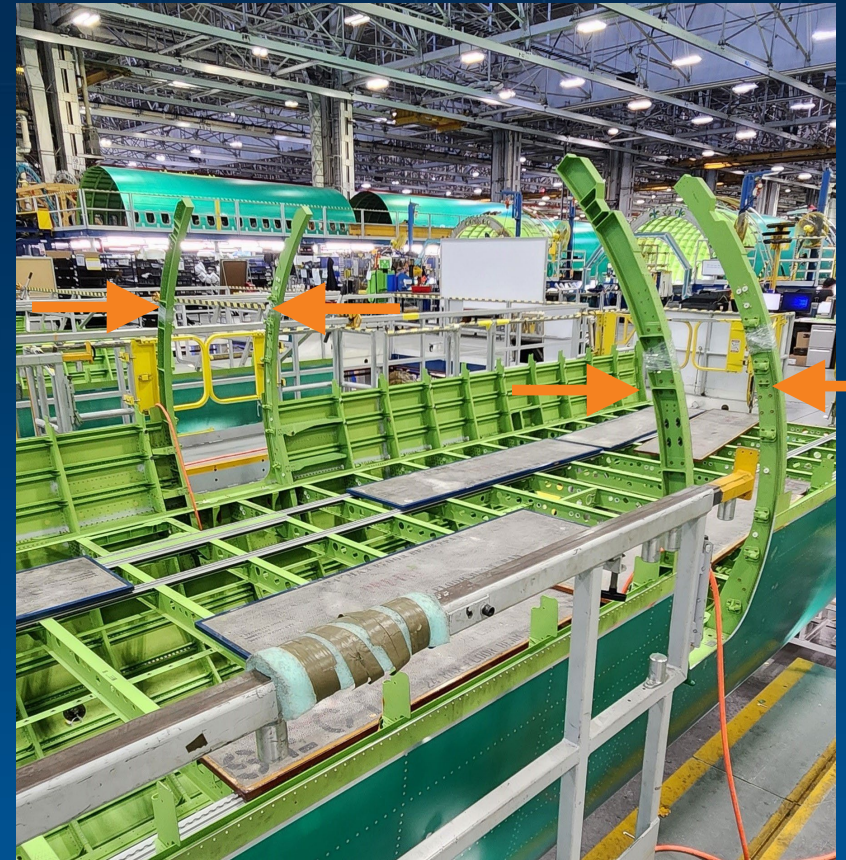


SPIRIT 737 FUSELAGE BUILD



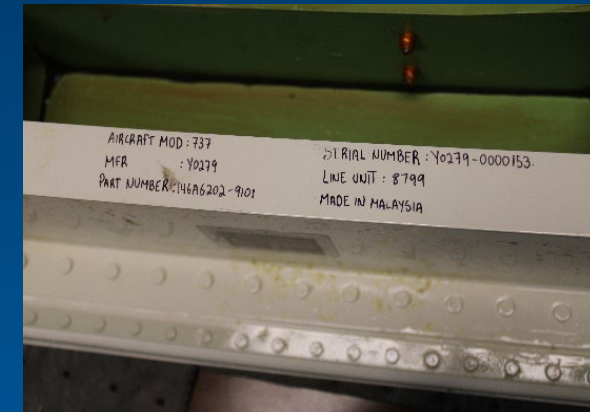
Spirit AeroSystems – MED Plug Edge Frames

- Manufactured by Spirit AeroSystems supplier Quik Tek
- Edge frames installed on Line 8789 on June 16, 2023
- Postaccident actions by Spirit AeroSystems
 - Review of Quik Tek process
 - Inspection of all Quik Tek and in-stock edge frames
 - Inspection of edge frame fuselages in production



Spirit AeroSystems Manufacturing – Left MED Plug

- Design and engineering responsibility
- Manufactured at Spirit AeroSystems Malaysia
- Shipped and received at Spirit AeroSystems Wichita
- Final installation and quality inspection on the event left MED plug on July 28, 2023
- Line 8789 was shipped on August 20, 2023

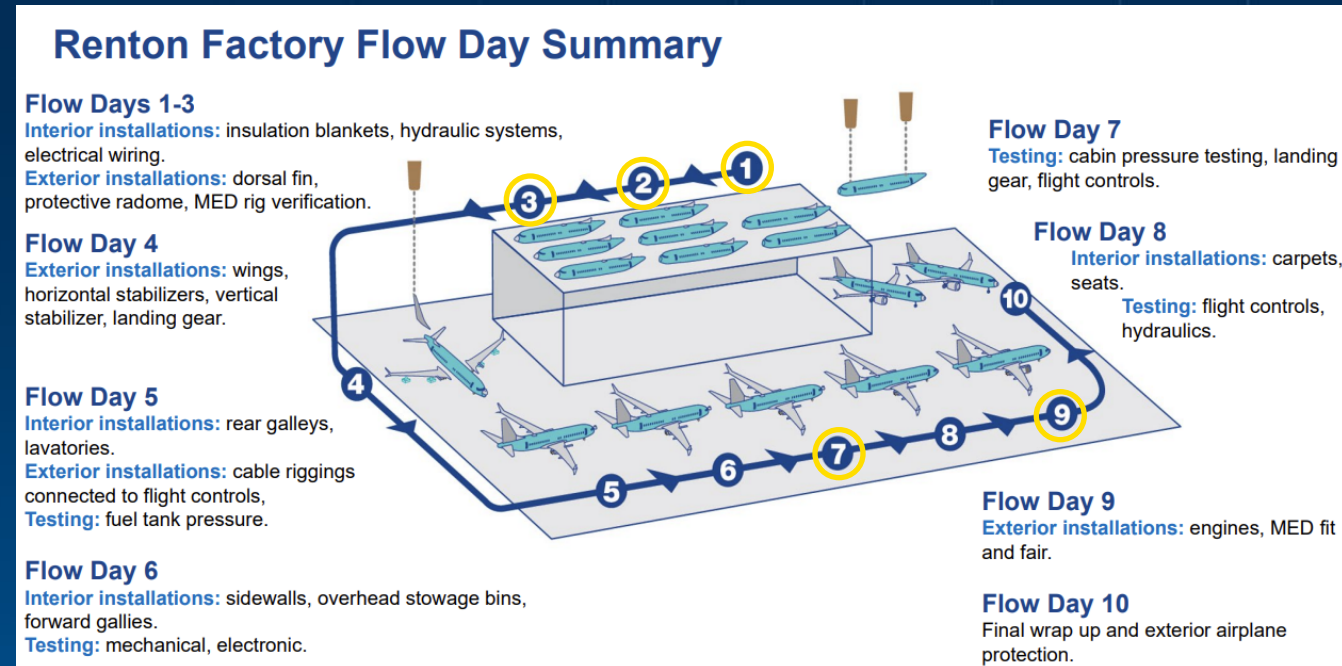


Boeing Renton Manufacturing Process



Boeing Renton Manufacturing Process

- Ten factory positions or flow days
- MED plug work scope accomplished on flow days 1-3, 7, and 9
- Scheduled
 - Installation Plans (IP)
- Unscheduled
 - Nonconformance record (NCR)
 - Nonconformance order (NCO)



Boeing Renton Manufacturing Process

- “Traveled work”
- Definition
 - Build article travels from supplier to Boeing with open work
 - Build article moves from flow day to flow day without scheduled work complete
- Boeing expects an NCR to be completed on the flow day it was generated
- Spirit AeroSystems documentation – no traveled work for line 8789

What We Found: Edge Frame Rivets Discrepancy

- Line 8789 manufacturing
 - Received and entered production line August 31, 2023
 - September 1, 2023, quality inspectors wrote up a discrepancy on five rivets on the forward edge frame common to the left MED plug
- Spirit AeroSystems in Boeing Renton
- Tasked to replace rivets



What We Found: Need to Open Left MED Plug

- Boeing manufacturing personnel provide access to rivets by opening left MED plug
- Boeing quality inspection of Spirit AeroSystems work
- Boeing manufacturing personnel to close the left MED plug
- Nonconformance documentation was signed off September 19, 2023

What We Found: Inconsistent Application of Short Stamp Process

- Review of IPs, NCR, NCO, and process documents near left MED plug
- IPs (OK to Install Blankets), (Install Blankets), and (Sidewall Install)
- NCR for five rivets linked to IP (OK to Install Blankets)
- Short stamp - further work to be accomplished
- Inconsistent application of short stamp process in IPs

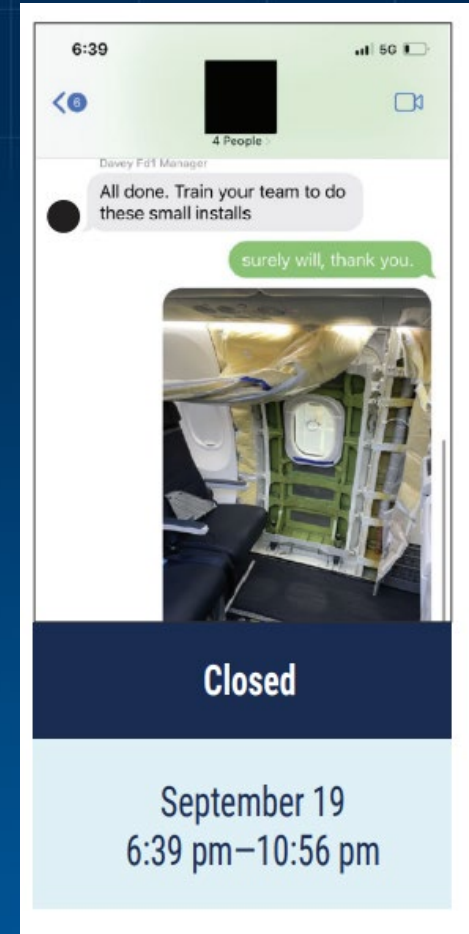
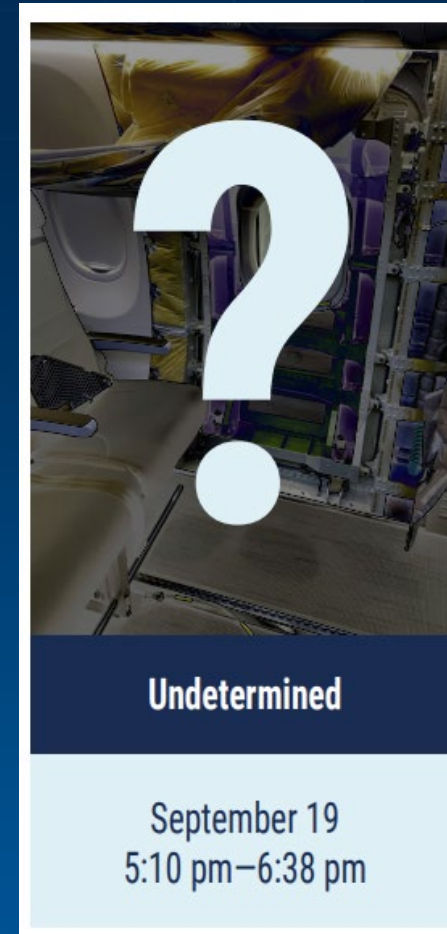
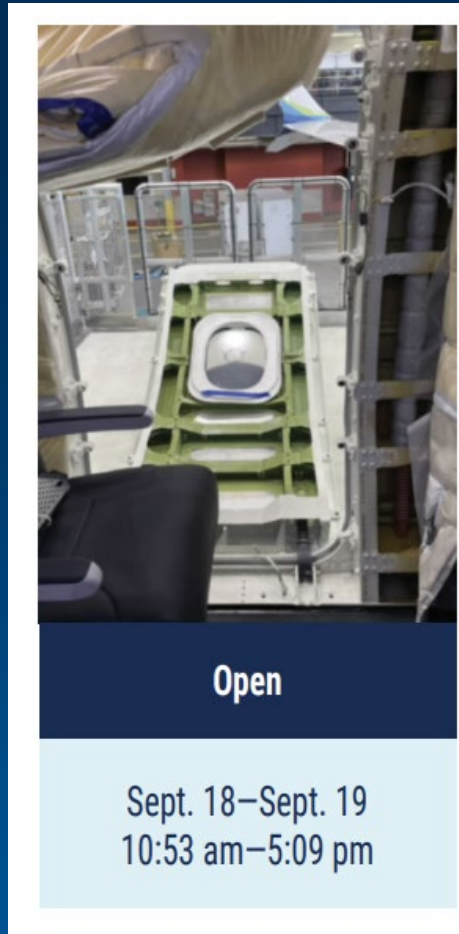
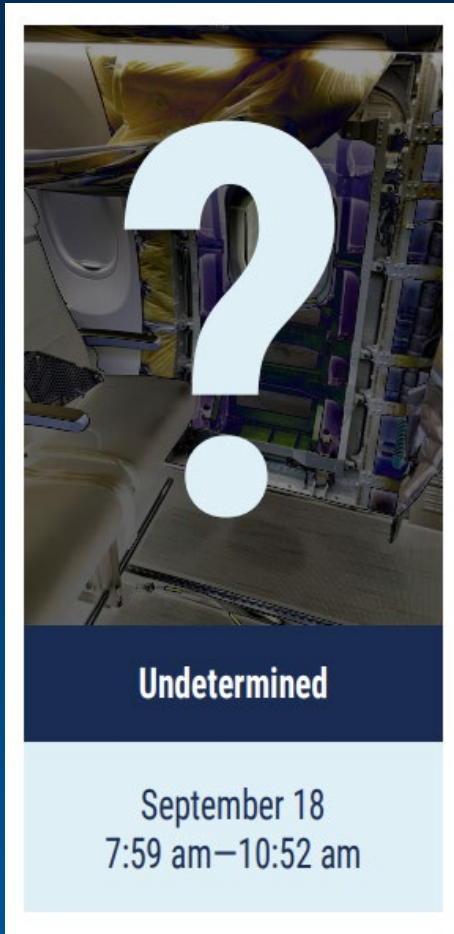
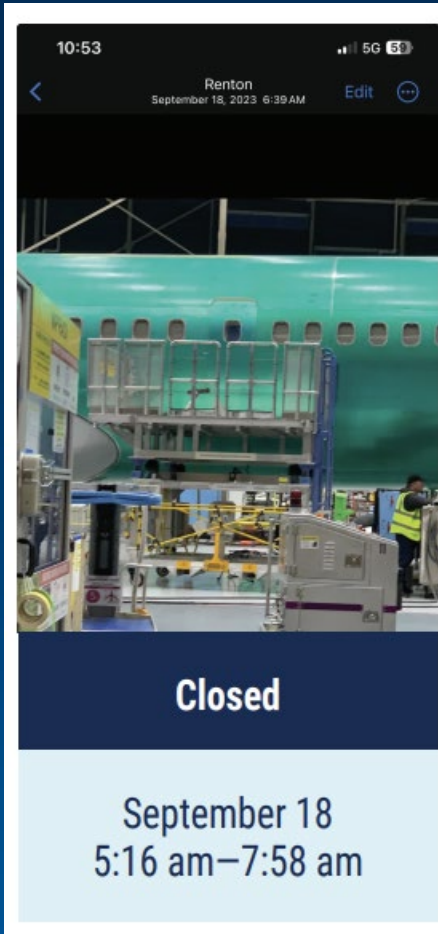
What we propose:

- One recommendation to Boeing in this area

What We Found: No Removal Document for Opening and Closing Left MED Plug

- Removal document – provide pertinent information related to the opening, removing, partially removing, loosening or disassembling previously installed and accepted component, part, or assembly
- Removal document ensures disturbed installations reinspected by Boeing quality assurance
- Led to incomplete left MED plug installation on line 8789
- Timeline development
 - Interviews/written statements
 - Shipside Action Tracker (SAT)
 - Aircraft build records
 - Boeing communication (email/text)
 - Airplane entry and exit records
 - Photographs taken by Spirit/Boeing

What We Found: Most Likely Time Left MED Plug Was Opened and Closed



What We Found: Boeing Renton Manufacturing Process

- Business Process Instruction (BPI) Perform Part or Assembly Removal
 - BPI applicable to all Boeing commercial product lines
- 11 notable revisions to BPI from 2013 - 2023
- Multiple quality alerts sent to production personnel
- 16 regulatory compliance issues cited by Boeing audits and FAA from 2018 - 2023
- Past Boeing safety risk management process was ineffective

What we propose:

- Three recommendations to Boeing in this area

What We Found: Federal Aviation Administration Surveillance

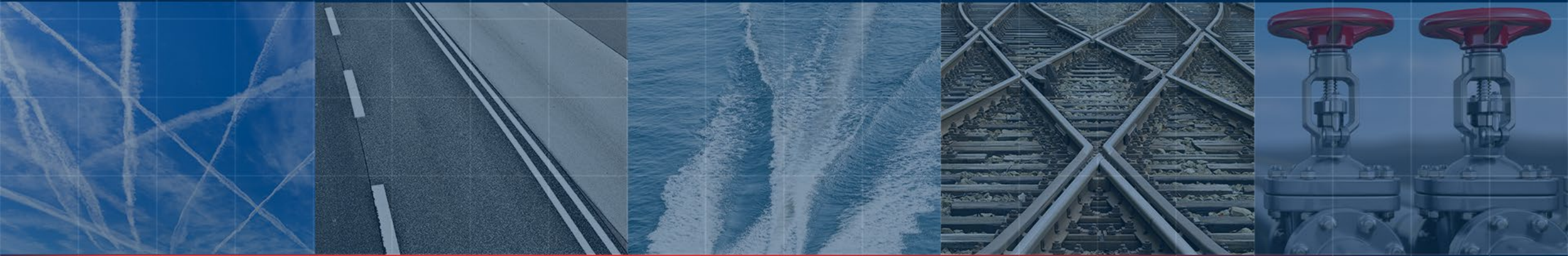
- Certificate management plan for inspectors
- Risk-based resource targeting assessment tool used to assign risk to production holders
- Management develops plan for inspectors through the FAA's Aircraft Certification Audit Information System
- FAA inspectors unaware how risk assessed in certificate management plan

What We Found: Federal Aviation Administration Surveillance

- FAA Order - Compliance and Enforcement Program
- FAA Order - Records Management
- Historic systemic non-compliance not accounted for in yearly certificate management plan
- Compliance and enforcement system, current surveillance system, and procedures and recording systems were not effective

What we propose:

- Six recommendations to the FAA in this area



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Human Performance

Overview

- Manufacturing experience changes at Boeing
- Door manufacturing personnel at Renton
- Door manufacturing personnel training
- Boeing quality management system (QMS)
- Boeing safety management system (SMS)

Manufacturing Experience Changes at Boeing

- Decrease in aircraft production necessitated the reallocation of personnel and the halting of hiring
- Global pandemic saw the loss of even more personnel
- To reobtain pre-2018 production levels, Boeing had to hire to compensate for losses
- Boeing executives and managers reported a decrease in personnel with prior manufacturing experience
- Boeing did not proactively identify the risks associated with having a relatively inexperienced production workforce

Door Manufacturing Personnel at Renton Factory

- Boeing 737 door personnel
 - 1 door manager, 24 door technicians
- Personnel divided into two teams across 10 factory positions
 - All door personnel typically worked first shift, Monday through Friday
 - Door crew team typically covered work for flow days 1, 2, and 3
 - Door masters team typically covered work for flow days 7, 9, 10, and ramp areas
- All door technicians were responsible for functional and operational checks, and troubleshooting for all door systems

Door Manufacturing Personnel Training

- Newly hired production line employees attend initial foundational training and job series specific on-the-job (OJT) training
- Initial foundational training required proficiency checks
- OJT required no task list, grading structure, or documentation
- OJT often relied on the expertise of the more experienced to train the less experienced

Door Manufacturing Personnel Training

- Door manufacturing personnel OJT would have focused on performing routine tasks required for every build
- Non routine tasks, such as the removal of an MED plug, did not offer many opportunities for training
- The four door personnel identified as having worked on the accident fuselage had less than two years of experience working Boeing 737 door systems

What we propose:

- Two recommendations to Boeing

Boeing Quality Management System

- QMS sets standards for a part or component to meet certification and needs of the customer
- QMS was the organizational structure, processes, procedures, records, and resources needed to integrate, document, implement, and maintain the various components of an effective business system
- Boeing's production certificate contains authorization to manufacture type-certificated products

Boeing Quality Management System

- QMS manual defines a quality escape as a product or article that did not conform to its approved design and has been released from the quality system
- QMS addressed how to identify, control, document and disposition a product that does not conform to specifications
- QMS did not address escapes that are result of human error

What we propose

- One recommendation to Boeing

Boeing Safety Management System

- SMS — a systematic, proactive approach to managing safety risks within an organization
- No requirement for regulatory SMS during accident aircraft production
- In December 2015, the FAA required Boeing to create an SMS
- In December 2020, the FAA accepted Boeing's voluntary safety management system (VSMS)
- VSMS was operational in June 2021

Boeing Safety Management System

- According to Boeing's VSMS manual, the program's goal was to identify, assess, and control hazards and mitigate risks based on a thorough understanding of the systems, processes, human factors, and operating environment
- April 2024, FAA published final rule requiring production certificate holders to implement a regulatory SMS
- SMS rule became effective May 2024
- Compliance within 36 months

Boeing Safety Management System

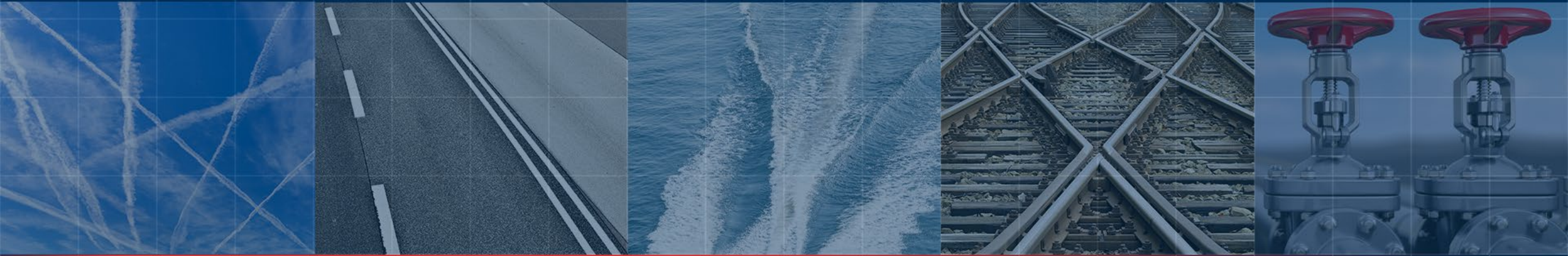
- An SMS is comprised of four pillars
- At the time of the accident, Boeing had not yet fully implemented its VSMS to the Boeing 737 production level
- Boeing was working to integrate SMS principles into its QMS
- Boeing identified the need to conduct safety risk management on technician training and the removal process
- After the accident, developed Product Safety and Quality Plan and identified six key performance indicators

Boeing Safety Management System

- Boeing production personnel did not recognize SMS by name nor could they define safety culture
- Feedback about Boeing's safety culture was varied
- Most technicians knew about reporting programs, but few used them
- Data collected was from individuals identified for the investigation
- The development of a safety culture survey was originally initiated to perform a more robust assessment
- Work stoppage halted assessment plans

What we propose:

- One recommendation to Boeing



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Structures Group

Overview

- Airworthiness Directive issued by FAA
- Postaccident design changes

What We Found: Emergency Airworthiness Directive 2024-02-51

- Issued January 6, 2024
- Prohibited further flight of all Boeing 737-9 airplanes
- Required inspection and correction of discrepancies
- All MED plugs installed correctly
- All upper guide track bolts and vertical movement arrestor bolts installed

What We Found: Emergency Airworthiness Directive 2024-02-51

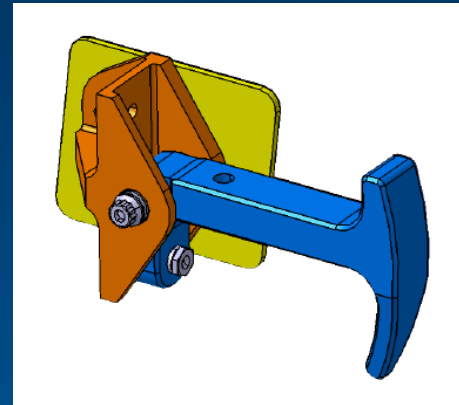
- Production airplane compliance
- March 1, 2024 – Multi-airplane nonconformance record (NCR)
- Inspection procedures per AD
- Logbook entry for AD compliance
- November 4, 2024 – Installation Plans (IP) in factory
- AD compliance part of type design

What We Found: MED Plug Design Enhancement

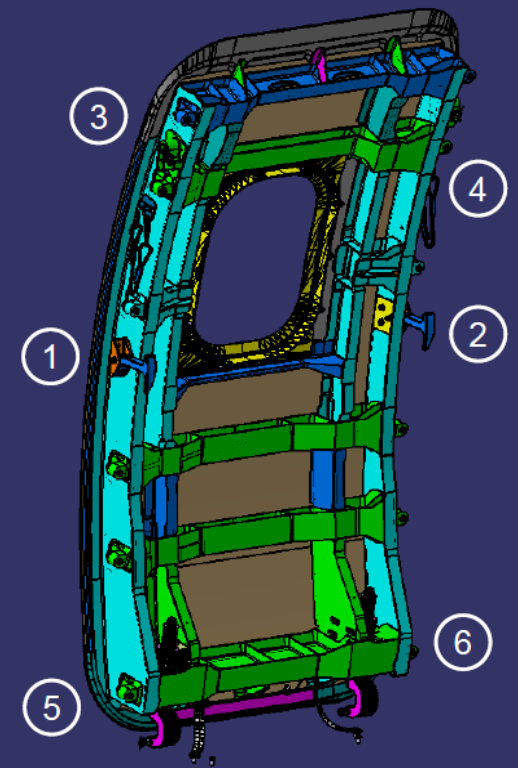
- Adds secondary retention device
- Prevents vertical translation
- Prevents installation of cabin sidewall
- Adds lanyards to bolts
- Planned incorporation in factory
- Service Bulletin retrofit

What we propose:

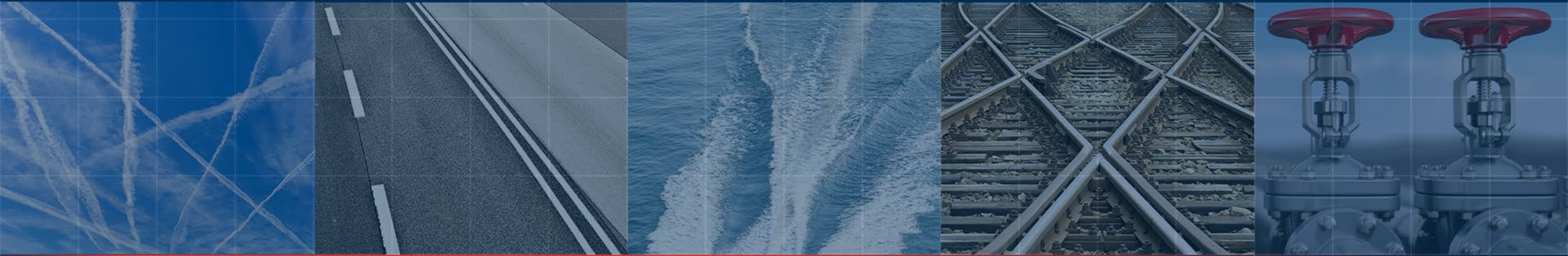
- One recommendation to Boeing
- One recommendation to FAA



737-9/-900ER MED Plug Enhancements
Subject to final certification



Isometric view looking outward



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Operations Group

Overview

- Flight crew performance
- Differences in the audio control panel
- Flight crew training
- Postaccident safety actions

What We Found: Flight Crew Response

- Pressurization was normal
- Explosive experience
- CABIN ALTITUDE OR *Rapid Depressurization* Memory Items
 - Donned oxygen masks
 - Established air traffic control (ATC) communication
- Captain began descent
- First officer completed checklist

Alaska. **EMERGENCY** **E5.1**

**CABIN ALTITUDE WARNING
or
Rapid Depressurization**

CABIN ALTITUDE

Condition: One or more of these occur:

- A cabin altitude exceedance
- In flight, the intermittent Cabin Altitude / Configuration Warning Horn sounds or a CABIN ALTITUDE light illuminates at an aircraft altitude above 10,000 ft MSL.

Note: The warning horn may be silenced by pressing the ALT Horn Cutout switch on the forward overhead panel.

1 Oxygen Masks & Regulators ON, 100%

2 Crew Communications Establish

3 Pressurization Mode Selector MAN

4 Outflow VALVE Switch. Hold in CLOSE until outflow VALVE indicates fully closed

5 **If** cabin altitude is **uncontrollable:**
Seat Belt ON
If the cabin altitude exceeds or is expected to exceed 14,000 ft:
PASS OXYGEN Switch ON

►► **Go to the Emergency Descent checklist on page E5.3**

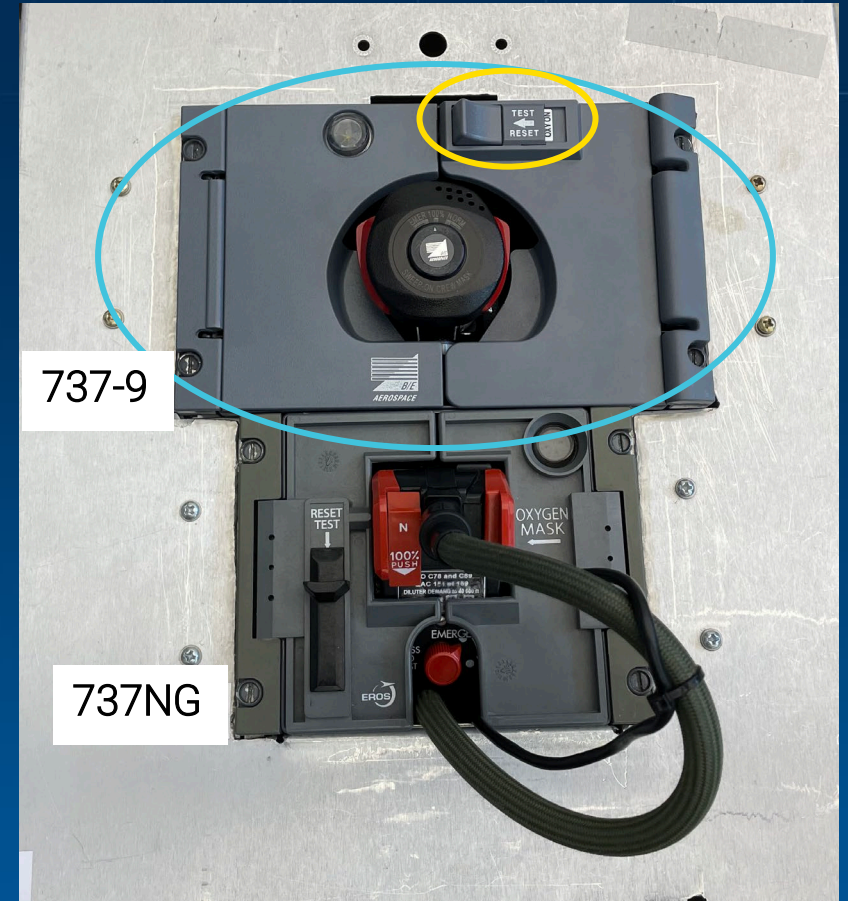
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What We Found: Flight Crew Response

- Attempted communications with the flight attendants
- “Hole” in cabin
- Removed oxygen masks
- Loud squeal in headsets
- Redonned oxygen masks
- Flight crew’s response was timely

What We Found: Oxygen Masks/Stowage Boxes

- Pilots receive hands-on training on a mockup trainer
- Reestablish communications
- Boeing 737-9 oxygen mask microphone automatically enabled when donned
- Close right door and press to TEST/RESET switch



What We Found: Audio Control Panel



737-9



737 NG

What We Found: Training

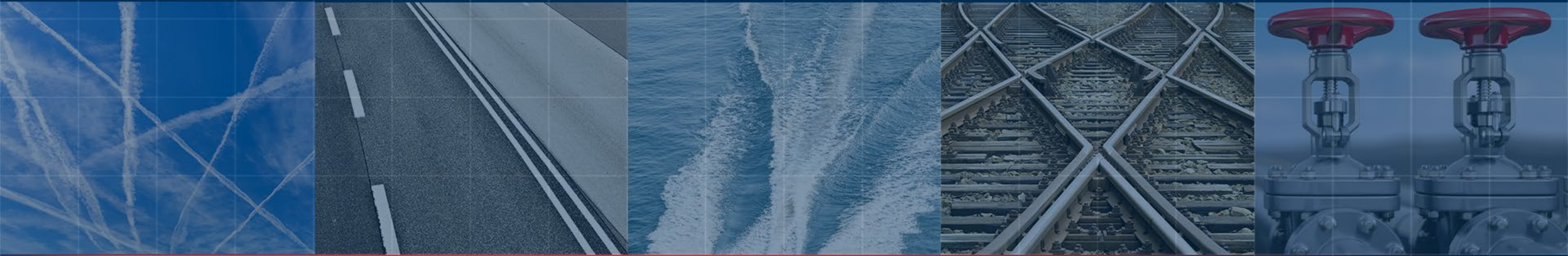
- Rapid depressurization simulator scenario during initial training
- Initial computer-based training familiarization
- Continuing qualification ground training (third quarter every other year)
- Hands-on training during continuing qualification simulator evaluation

What we propose:

- Staff has one recommendation to the FAA

Alaska Airlines Postaccident Safety Actions

- Updated language in manuals
- Updated checklists regarding the CVR and FDR
- Created new computer-based training slides
- Created a new training video
- Bulletin for all instructors
- 2025 continuing qualification simulator evaluation



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