

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



DCA23FA417

STRUCTURES

Group Chairman's Factual Report

March 1, 2024

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A. ACCIDENT

Location: Santa Ana, California
Date: August 20, 2023
Time: 2315 PDT
0615 UTC
Airplane: Boeing 737-890 / N516AS

B. STRUCTURES GROUP

Group Chair	Van S. McKenny IV National Transportation Safety Board Washington, DC
Group Member	Manual Hernandez Federal Aviation Administration Riverside, CA
Group Member	Troy Levanen Alaska Airlines Santa Ana, CA
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C. SUMMARY

On August 20, 2023, about 2315 Pacific daylight time (PDT), Alaska Airlines flight 1288, a Boeing 737-890, sustained damage when the left main landing gear collapsed after landing on runway 20R at John Wayne-Orange County Airport (SNA), Santa Ana, California. The 112 passengers and crew evacuated the airplane via stairs onto taxiway E with no injuries. The flight was operating under the provisions of 14 *Code of Federal Regulations* Part 121 as a scheduled domestic passenger flight from Seattle, Washington, to SNA.

According to the captain, upon landing, the touchdown had a “firm jolt feeling” to it, and the aircraft was pulling reasonably hard to the left. The captain was able to overcome this with rudder pedal input and keep the plane on the center line. The captain slowed the aircraft to taxi speed and exited the runway onto taxiway E. After the aircraft made the turn onto the taxiway, the crew noticed that the aircraft was listing to the left.

The captain stopped the airplane on the taxiway and set the parking brake. He opened his window, looked outside, and noticed that the aircraft was resting on the left engine (No. 1) nacelle (figure 1), and the engine appeared to be still running normally. He immediately shut down the left engine. The captain also noted that the left main landing gear position indicator light was not illuminated, whereas the nose and right main landing gear position indicator lights were still green. After confirming the APU was running, he shut down the right engine (No. 2).



Figure 1. Left side view of the airplane resting on the left engine nacelle and left main landing gear displaced aft.

D. DETAILS OF THE INVESTIGATION

1.0 Main Landing Gear General Description¹

The two main landing gear (MLG) absorb landing forces and holds most of the airplane weight when the airplane is on the ground. The MLG also transmits the braking forces to the airplane structure. The MLG doors open to permit gear operation. They close to aerodynamically seal the main landing gear wheel well.

The main gear shock strut is the primary supporting member of the landing gear. The shock strut consists of an integral drag strut, and an outer and inner cylinder (figure 2). When the shock strut retracts or extends it rotates about two trunnion bearings and pins at the top of the outer shock strut. Each pin extends through a trunnion bearing and support in the wing and beam assembly. Trunnion bolts keep the trunnion pins from backing out during landing gear operation.

¹ Boeing 737-600/700/800/900 Aircraft Maintenance Manual
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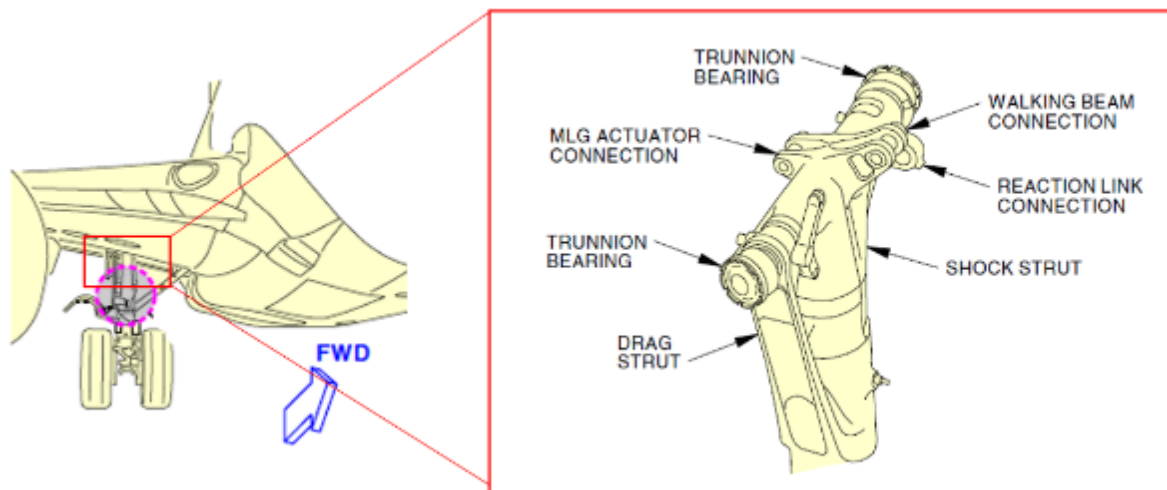


Figure 2. Illustration labeling the main landing gear components. (Source: Boeing. Image Copyright Boeing. Reproduced with permission.)

2.0 On-scene Examination

The airplane was observed resting on the left engine nacelle with the right MLG and nose gear fully extended. The left MLG was displaced aft about 45 degrees and the panels of the upper surface of the wing were fractured and pushed upward by the MLG outer cylinder immediately forward of the wing's rear spar (figure 3). Three upper wing skin panels were pushed and fractured upward by the displaced MLG outer cylinder's upward impact.² There was no visible damage to the left-wing flaps and spoilers.



Figure 3. Aft view of the left wing showing upper wing panels displaced upward.

² Skin panel part numbers (PN): 115A2521-10, 115A2524-1, and 115A2523-1
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Within the left hand MLG wheel well and trunnion area, the forward trunnion/spherical bearing were in place (figure 4). There was no visible damage to the wing spar. The MLG shock strut outer cylinder was in contact with the MLG retract actuator hydraulic lines. There was no evidence of hydraulic line leakage. The aft trunnion pin (PN³: 161A1192-4, 161A1192-13, SN: E5514) had fractured in half vertically across the pin diameter. Half the trunnion pin remained within the spherical bearing of the rear landing gear beam, and the other half remained in the outer cylinder of the MLG trunnion (figure 5). The trunnion pin half that remained in the landing gear beam spherical bearing migrated aft and was found protruding from the aft side of the spherical bearing (figure 5). The trunnion pin half (figures 6 and 7) was easily slid out of the spherical bearing by hand.

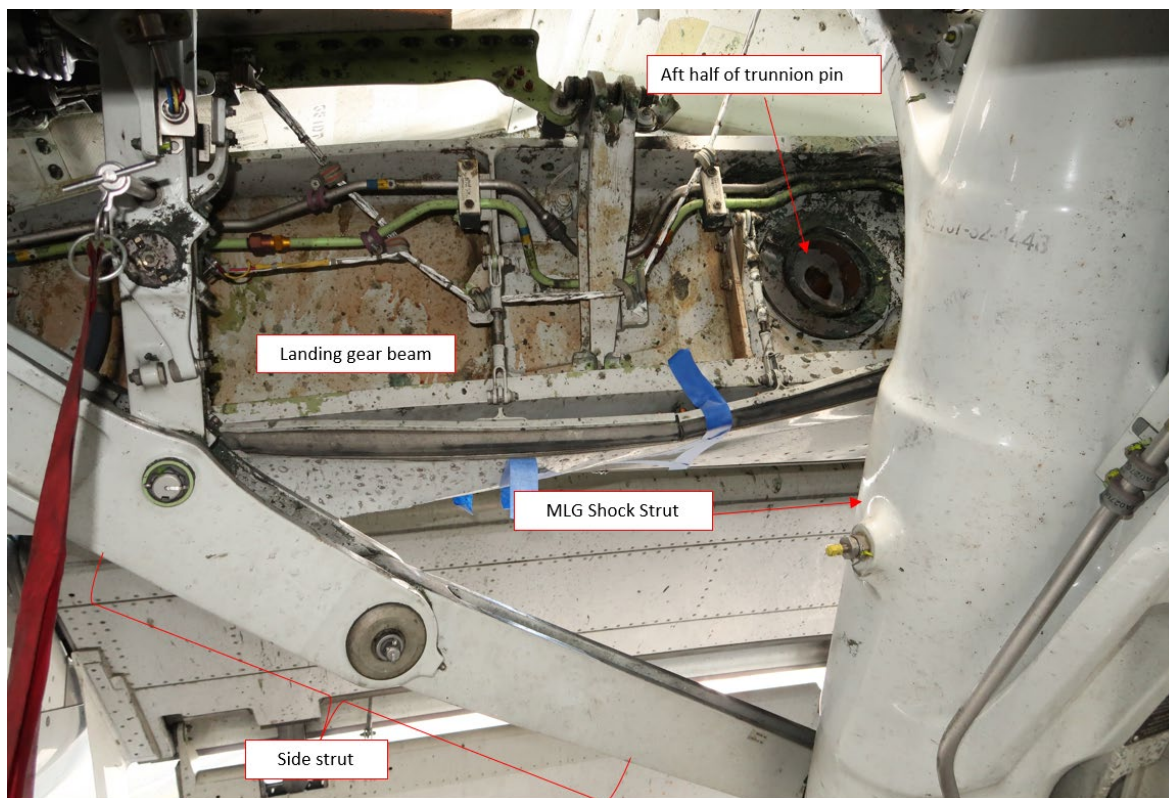


Figure 4. Interior view (looking aft) of the left main landing gear wheel well. The main landing gear shock strut is displaced aft at an angle and a fractured portion of the trunnion pin remained in the landing gear beam spherical bearing.

³ The trunnion pin had two part numbers on it.

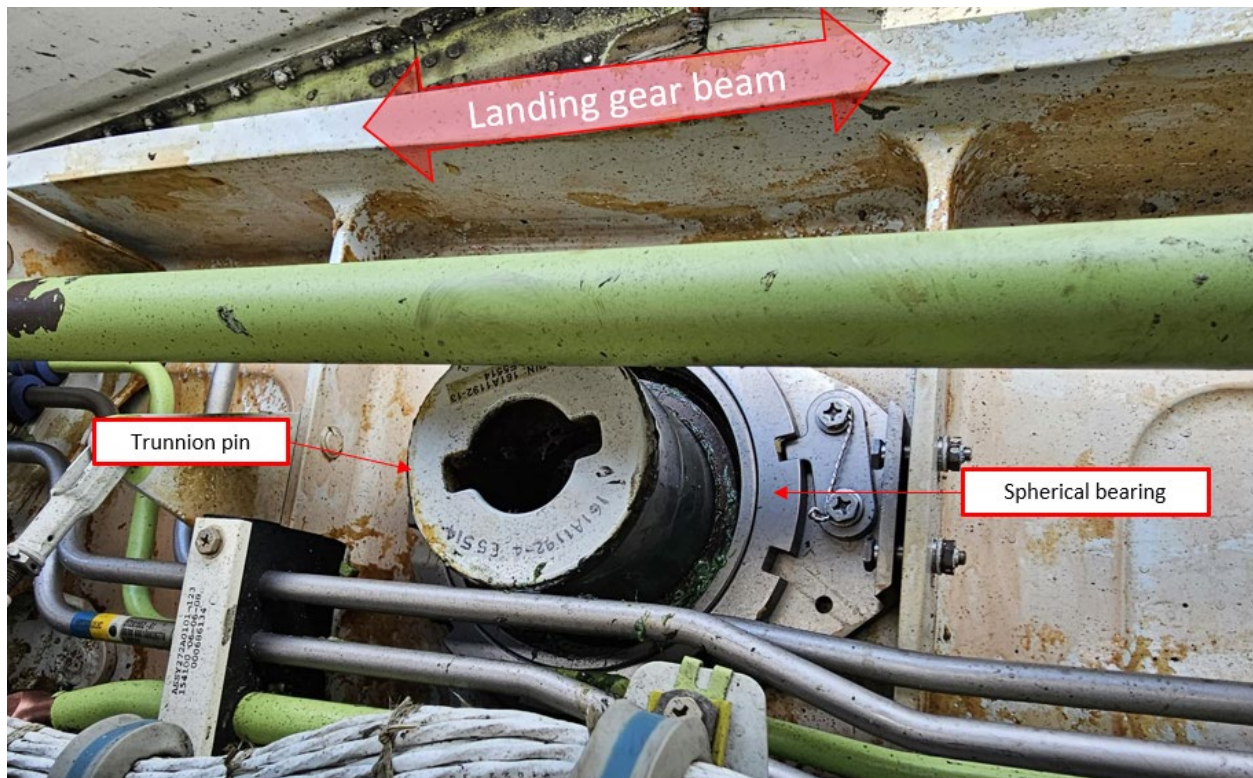


Figure 5. View of the aft side of the landing gear beam. The trunnion pin half had migrated aft out of the spherical bearing. (Source: Alaska Airlines)



Figure 6. Two views of the trunnion pin half that was removed from the landing gear beam. (Source: Alaska Airlines,)



Figure 7. View of the trunnion pin fracture face. (Source: Alaska Airlines)

The trunnion pin half that was removed from the landing gear beam was sent to the Boeing EQA (Equipment Quality Analysis) laboratory, Seattle, Washington, for examination.

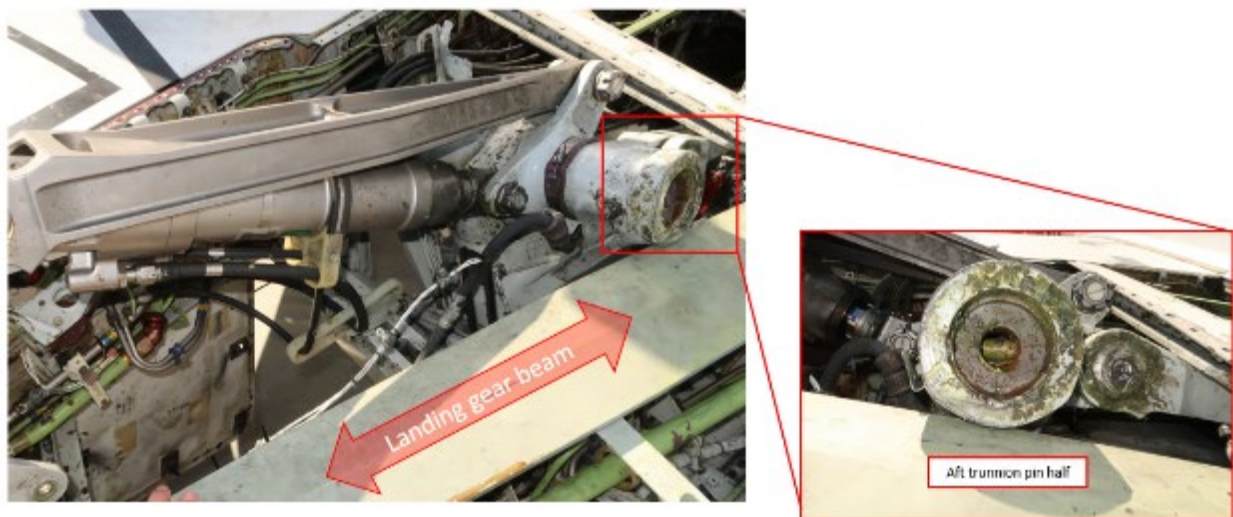


Figure 8. Overhead view of the left main landing gear trunnion after the upper wing panels had been removed. Inset box is a close up view of the half of the trunnion pin than remained in the outer cylinder.

The MLG shock strut outer cylinder had rotated aft and made contact with the underwing and landing gear beam. The upper side brace was bent and was in contact with the lower portion of the landing gear beam. The data plate on the MLG

shock strut contained the following: PN: 161A1100-53, SN: MAL05621Y2721, Sunvair JUL 01, 2018.

One leg of the idler link support fitting assembly (PN: 115A5313-5) remained attached to structure via the installed bolt and nut. The three other idler link bolt and nut fasteners were not in place (figure 9); however, fractured portions of the three fasteners were found lying free within the wing wheel well area (figure 10). Two bolt heads and 3 nuts with bolt fragments threaded in them were recovered. The idler link support assembly had fractured in two locations.

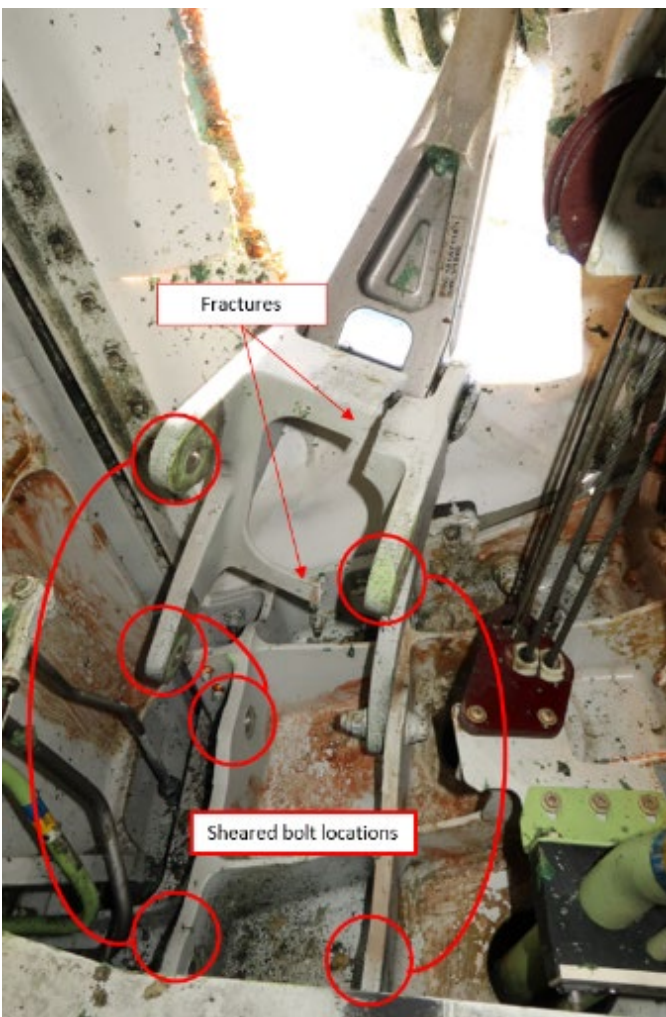


Figure 9. The fractured idler link support assembly.



Figure 10. Sheared bolt fragments located within the wing main landing gear wing and wheel well area.

Within the left MLG wheel well the flap drive transmission unit had been liberated and found on the runway near the initial landing touchdown area (figure 11).

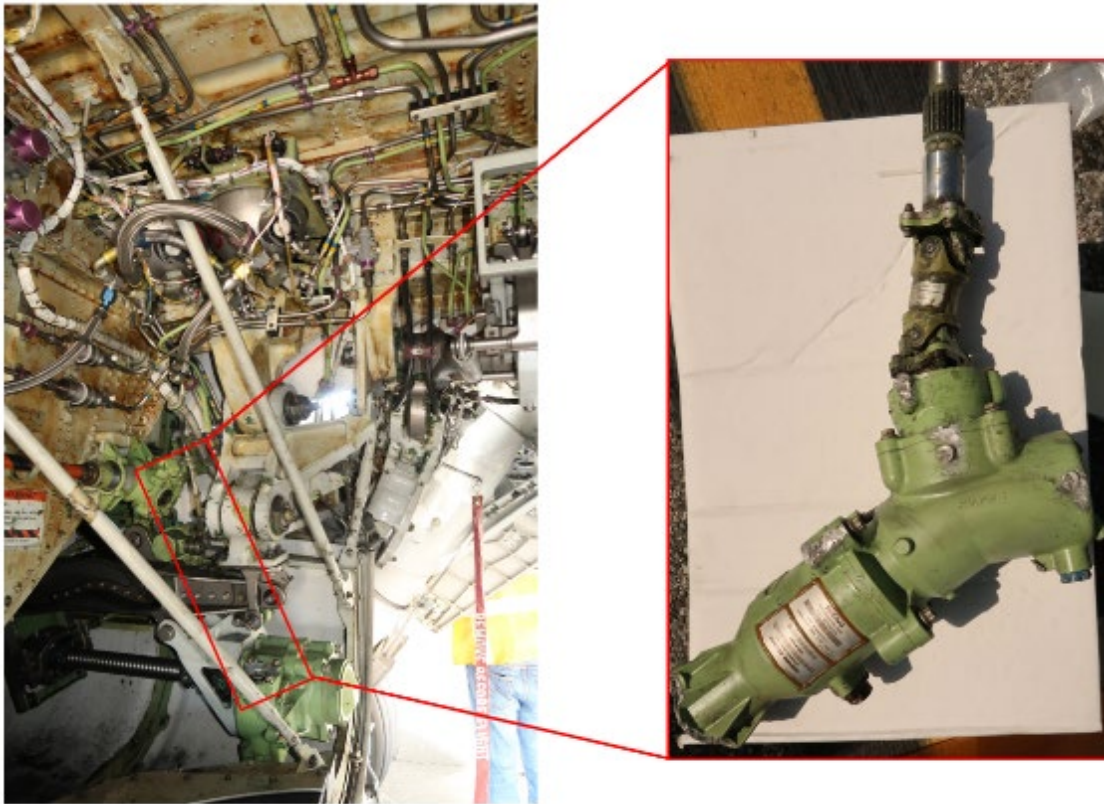


Figure 11. Left main landing gear wheel well depicting the location of the separated left flap drive transmission and the recovered flap drive unit found near the runway touchdown zone.

3.0 Removal of the main landing gear

On November 29, 2023, Alaska Airlines maintenance personnel and Boeing AOG (Aircraft On Ground) personnel removed the MLG strut from the airframe (figure 12).

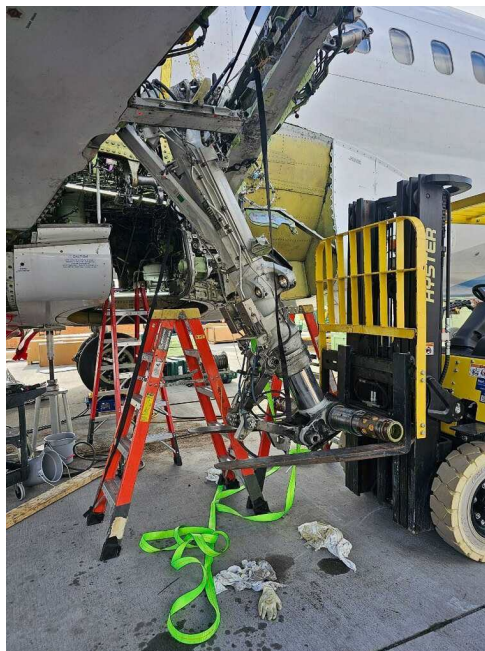


Figure 12. Removal of the left main landing gear from the airplane wing. (Source: Alaska Airlines)

The trunnion pin retaining bolt was removed and the remaining half of the trunnion pin was easily slid out of the outer cylinder. The trunnion pin half (figures 13 and 14) was sent to the NTSB materials laboratory for further examination.



Figure 13. Side view of the trunnion pin half after removal from the outer cylinder. (Source: Troy Levanen, Alaska Airlines)



Figure 14. View of the fracture face of the trunnion pin half. (Source: Troy Levanen, Alaska Airlines)

Submitted by:

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