

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ANC22FA047

MATERIALS LABORATORY

Factual Report 23-038

May 25, 2023

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A. ACCIDENT INFORMATION

Location: Clear, Alaska
Date: June 26, 2022
Vehicle: Bell UH-1B, N9970F
Investigator: Van McKenny, AS-40

B. COMPONENTS EXAMINED

Main transmission pylon structure with isolation mounts and friction dampers and piece of main transmission case.

C. EXAMINATION PARTICIPANTS

Specialist	Matthew R. Fox, Ph.D. NTSB Washington, DC
Specialist	Van S. McKenny IV NTSB Rolling Hills Estates, California
Group Member	David Dunbar Federal Aviation Administration Fairbanks, Alaska
Group Member	Todd W. Murray Federal Aviation Administration Fairbanks, Alaska

D. DETAILS OF THE EXAMINATION

A group examination of the main transmission case, pylon structure, and associated components was conducted on February 8, 2023, at a storage facility in Wasilla, Alaska. Views of the main transmission case and pylon structure are shown in figures 1 through 4. The transmission case was fractured on the right side near the aft support as shown in the lower image in figure 1. The forward pylon support legs were fractured through the rivets attaching the isolation mount pad to the vertical faces of the legs as shown in figure 2. The pylon aft support legs are shown in figures 3 and 4. The aft left support leg was fractured at the lower attachment bracket for the friction damper, and the aft right support leg was fractured at its lower end. The lift link and attached fuselage beam structure pieces had been previously disassembled from the main transmission case and were previously examined (see Materials Laboratory Factual Report 22-093).

To facilitate a more detailed examination of the main transmission case fracture, attachments, and pylon structure, the main transmission case and transmission support were disassembled from the isolation mounts. Most of the bolts that had attached the pylon aft beam to the aft support legs were fractured, but the remaining bolts were unscrewed from the left side of the beam to separate it from the left support leg. The separated pieces including the right aft piece of the main transmission case, the pylon structure pieces, isolation mounts, and friction dampers were then shipped to the NTSB Materials Laboratory in Washington, DC. Views of the components as received are shown in figures 5 through 8.

Views of the fractured main transmission case piece are shown in figure 5. The fracture was located near the right aft attachment lug where the lug portion transitioned to the main body of the case. The fracture surface had relatively uniform rough fracture features consistent with overstress fracture. Radial features were consistent with fracture propagation emanating from an initiation site located at the lower aft corner of the fracture as indicated in figure 5. The initiation site was examined closely using an optical stereomicroscope, and no evidence of any preexisting damage or progressive fracture mechanism was observed. Vertical portions of the fracture surface were rubbed consistent with post-fracture contact as the main body of the case moved upward relative to the aft right attachment lug piece.

The isolation mounts at the four corners of the pylon attachments were marked Bell Helicopter Textron (BHTI) part number 204-031-927-7. The date codes were 04-06 or 06-06. The aft center isolation mount was marked BHTI part number 204-031-927-5 CHG01 with a date code of 04-14. The friction dampers at the aft locations had a Fortner Accessory Service Corp. repair station labels and data plates with part number 204-031-920-003.

Isolation mounts and attached pylon structure at the main transmission case forward left and right attachments are shown in figure 6. The isolation mounts were attached to square pads at the upper ends of the pylon legs, and pieces of the longitudinal channels remained attached to the pads. The channel fractures showed deformation and were on slant angles consistent with ductile overstress fracture. Separation between the square pads and the vertical leg structures occurred mostly by fracture of the rivets, which were deformed consistent with ductile shear fracture. The rivets pieces remaining in the square pads were deformed upward, consistent with the isolation mounts and square pads moving downward relative to the pylon structure.

The inboard sides of the aft right and aft left isolation mounts, friction dampers, and attached pylon pieces are shown in figure 8. The upper portion of the friction dampers were separated from the lower portions consistent with overextension of the dampers. To facilitate closer examination of the damage, the isolation mounts were disassembled from the square pads on the pylon legs.

The lower ends of the pylon's aft legs after disassembly are shown in figure 9. At the aft left leg fracture shown in the upper image in figure 9, the fracture was located near the lower attachment bracket for the friction damper, and the forward end of the bracket remained attached to the pylon leg. The forward attachment flange for the friction damper bracket was deformed downward, consistent with the friction damper moving downward relative to the separated upper portion of the pylon leg. The fracture surface at the aft end of the fracture through the outboard surface of the leg was obliterated by post-fracture contact, but remaining portions of the fracture in the adjacent stiffener were on slant angles consistent with ductile overstress fracture. The remaining lower fractures on the aft left pylon leg also had deformation and slant angles consistent with ductile overstress fracture.

A view of the lower end of the aft right pylon leg after disassembly of the isolation mount from the pylon is shown in the lower image in figure 9. The friction damper lower bracket was deformed consistent with the damper being pushed downward relative to the pylon leg. The leg was separated mostly through sheared rivets and through sheared-out rivet holes at the lower end of the leg.

Overall views of the aft left and aft right isolation mounts and upper ends of the friction dampers after disassembly from the pylon are shown in figure 10. The isolation mounts were further disassembled from the friction dampers and bushings by sliding the isolation mounts off the upper ends of the mounting bolts. Views of the aft left and aft right isolation mounts and associated bushings after disassembly are shown in figure 11. The elastomer on the upper and lower bushings were deformed consistent with heavy contact with the outer cylinder for the isolation mounts. The lower bushings were also fractured and had features consistent with ductile overstress fracture from contact with the lower end of the isolation mount outer cylinder.

The lower ends of the aft left and aft right isolation mounts are shown in figure 12. The elastomer was cracked around approximately $\frac{1}{2}$ the circumference on the inboard side of each isolation mount, and the elastomer was separated from the outer cylinder at the outboard side of each mount, leaving a gap between the cylinder and the elastomer. The outboard sides of the outer cylinders were deformed at the lower end consistent with contact with the fractured edges of the lower bushings, particularly on the aft left isolation mount.

The pylon aft beam was bent slightly upward in the middle relative to the ends. The extent of the bend is illustrated in figure 7, where a straight dashed line touching the lower surface at the outboard ends shows a gap at the middle of the beam. Sliding contact marks were observed on the lower surface in the middle of the beam as shown in figure 13, consistent with contact with the tail rotor drive components extending from the aft side of the main transmission.

The aft center isolation mount was disassembled from the pylon aft beam, and the center bolt was removed to separate the upper bushing and lower washer from the mount. A view of the disassembled isolation mount, upper bushing, and lower washer are shown in the left image in figure 14, and a view of the lower end of the isolation mount is shown in the right image in figure 14. The elastomer in the isolation mount did not show any separations from the outer cylinder. Small cracks were observed in the elastomer near the inner cylinder.

Views of the main transmission support are shown in figure 15. The upper surface was crushed with sliding contact damage to the right of center with corresponding downward deformation at the middle of the support relative to the outboard ends. The left side of the support was deformed upward relative to the right side, and the upper and aft sides of the support were cracked near the left main transmission attachment location. The forward and lower faces also were cracked to the right of center. The crack fractures on the upper and aft sides near the left attachment location had slant angles consistent with ductile overstress fracture. The surfaces adjacent to the crack at the forward and lower faces were deformed consistent with overstress fracture associated with the sliding contact damage. The aft side of the support and the area near the contact damage on the upper surface were darkened consistent with heat damage. Several areas of sliding contact damage were also observed on the forward side of the support between the centerline and the aft right main transmission attachment location.

Curvature associated with sliding contact damage on the upper and forward sides of the support was measured using a Faro EDGE FaroArm coordinate measurement device fitted with a 3-millimeter hard probe acquired using Faro Cam2 Measure 10 software. The damage on the upper surface was fitted to a cylinder, and the measured cylinder had a radius of 3.75 inches. The curvature of the sliding contact damage on the forward face was measured with the aft face on the right side clamped against a flat table, and the data from the sliding contact damage was fit to a circle projected onto the flat plane defined by the table. The damage did not have a precise edge and had some variation in curvature along the entire face. The overall arc had a measured radius between 8.6 inches and 10.2 inches. However, the contact mark extending across the face appeared to be connected with two separate arcs as indicated with dashed lines and unlabeled brackets in figure 16. The upper edge of the forward face was bent downward where it was impacted by the contacting object, and the width of the impact was 0.319 inch. The sliding contact in each of the contact areas of the support indicated in figure 15 was consistent with contact with objects rotating clockwise as viewed looking toward the forward direction.

Submitted by:

Matthew R. Fox, Ph.D.
Chief Technical Advisor - Materials

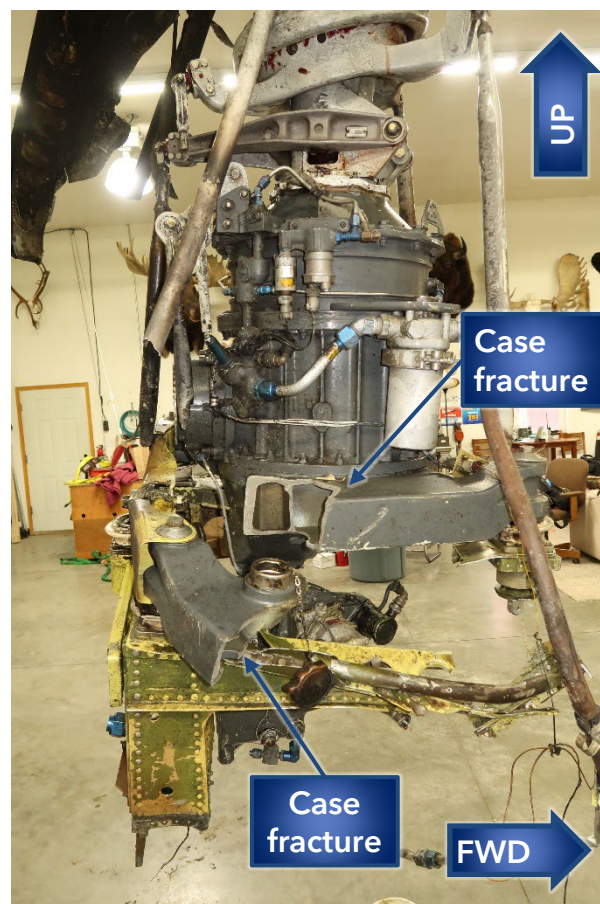
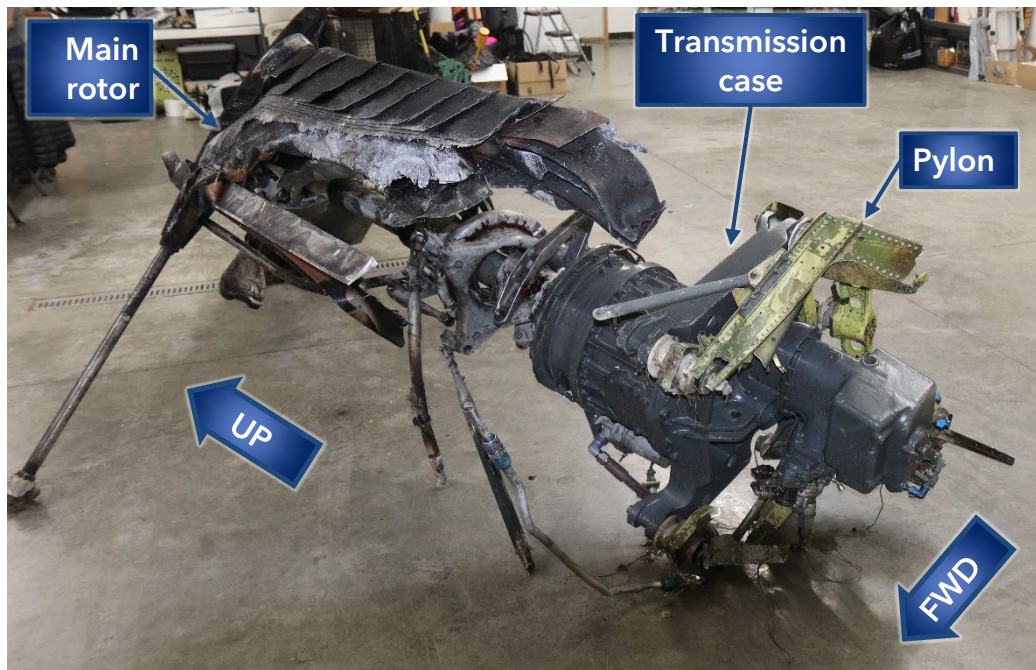


Figure 1. Overall view of the forward left side of the main transmission and pylon assemblies (upper image) and a view of the right side of the assemblies (lower image) showing the location of the case fracture.



Figure 2. Close views of the fractured pylon support legs at the forward left (left image) and forward right (right image) main transmission attachment locations.

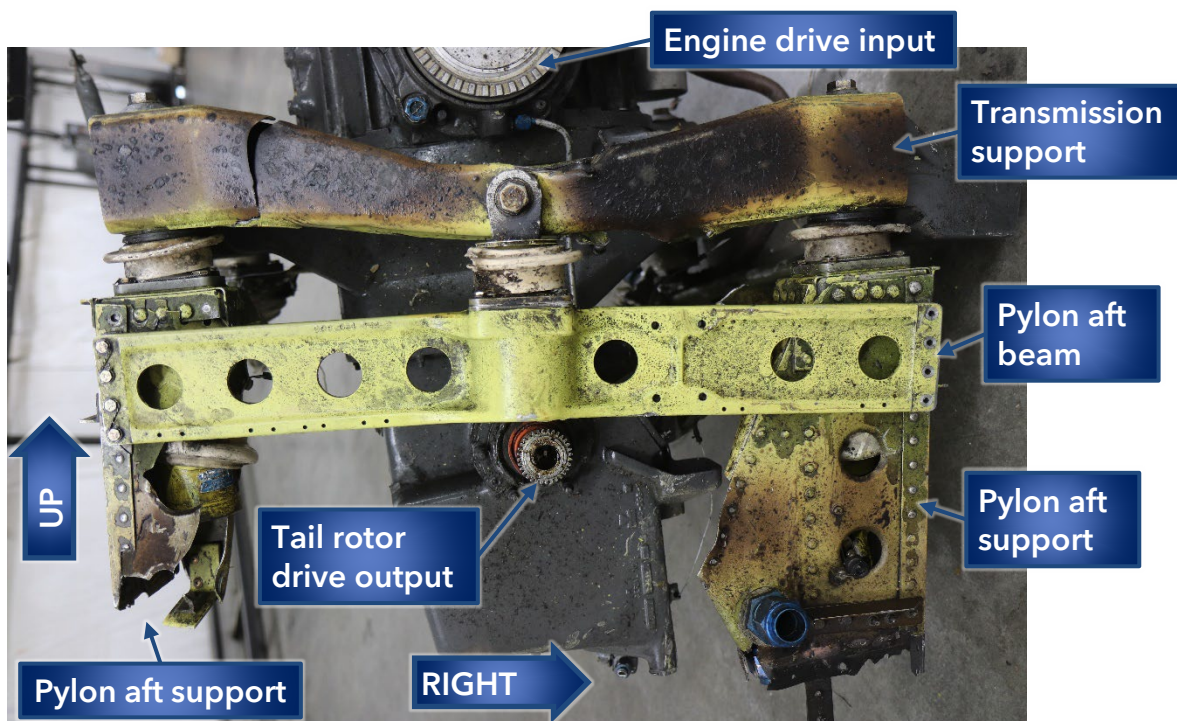


Figure 3. View of the aft side of the pylon assembly.

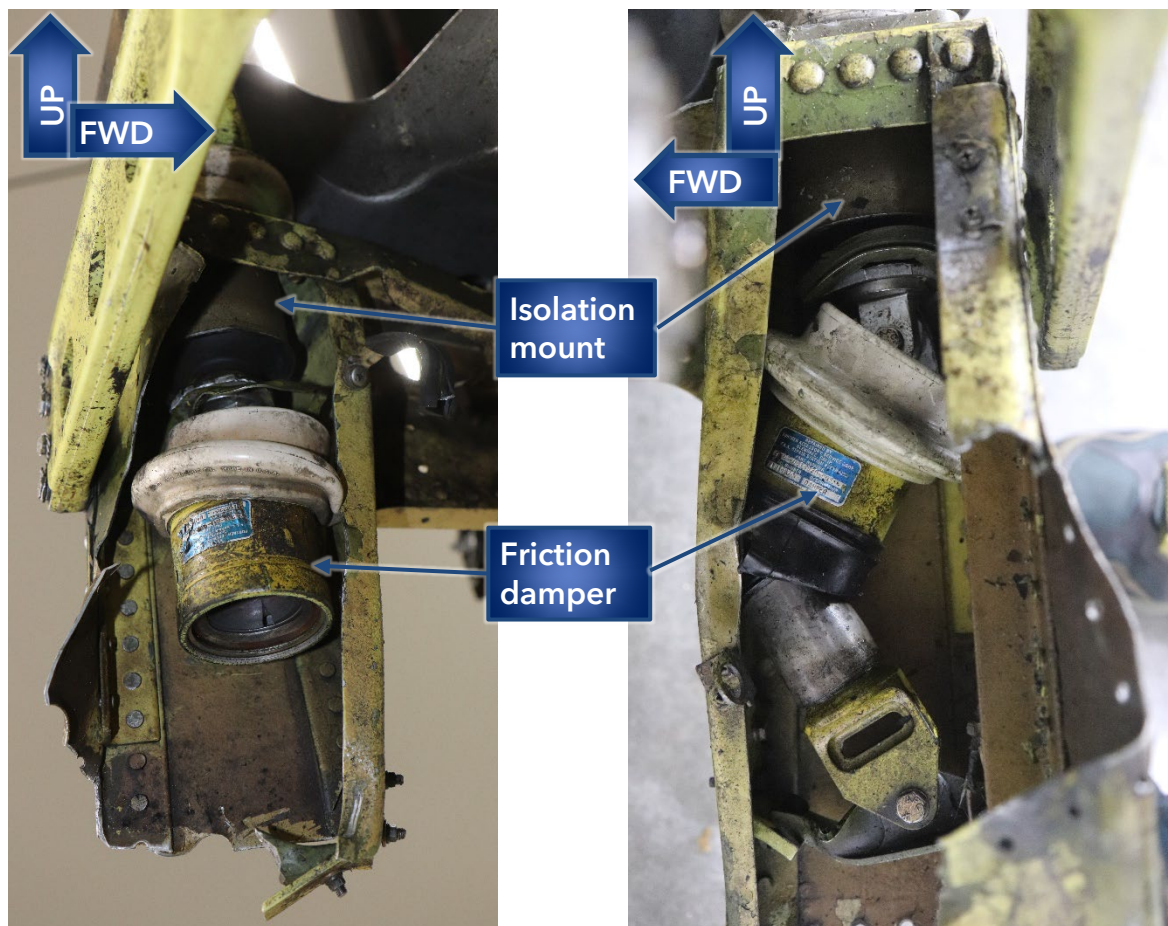


Figure 4. Views of the inboard sides of the left (left image) and right (right image) aft pylon support legs showing friction dampers and isolation mounts.

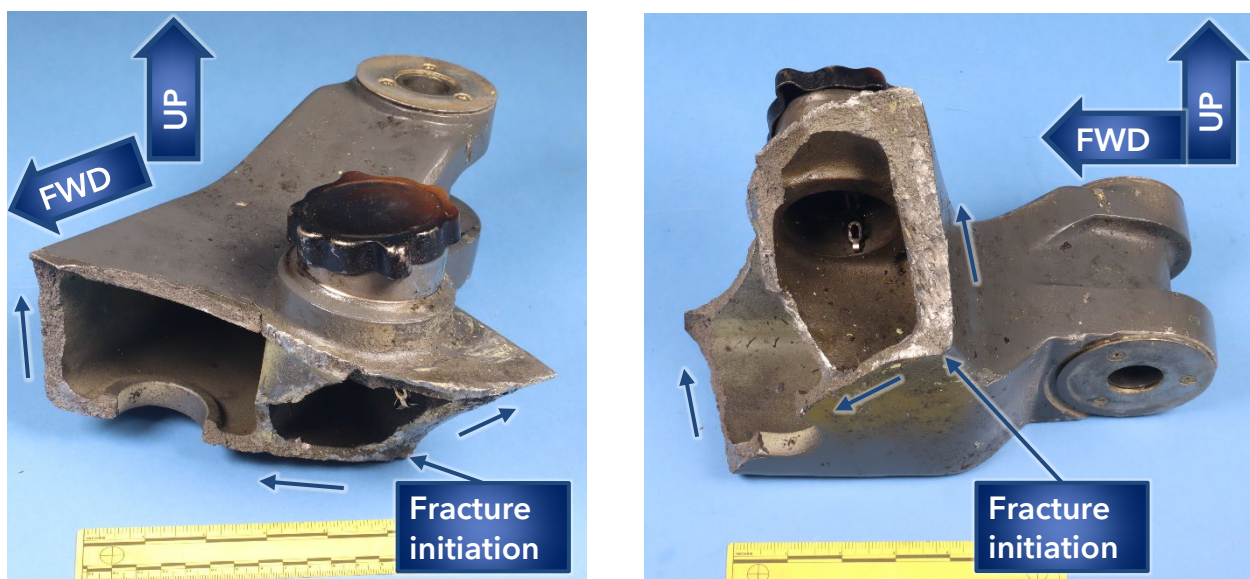


Figure 5. Views of the fracture surface on the main transmission case piece disassembled from the aft right pylon support. Unlabeled arrows indicate overstress fracture propagation directions.

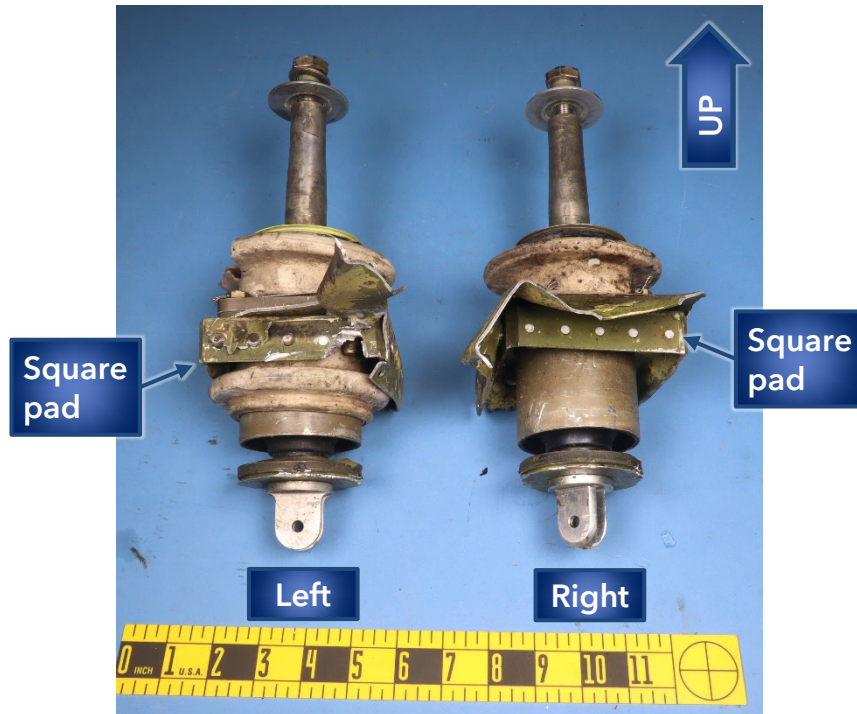


Figure 6. Aft sides of the forward isolation mounts and attached pylon support structure after disassembly from the main transmission case.

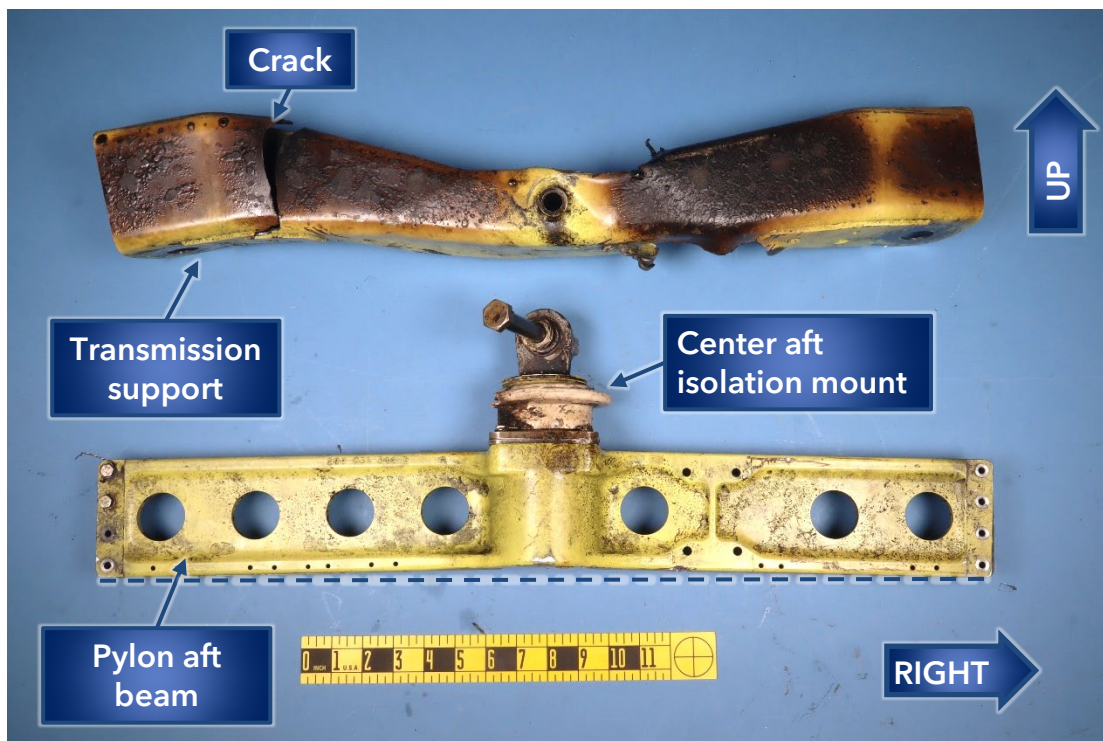


Figure 7. Aft transmission support after disassembly from the isolation mounts and the pylon aft beam with attached center isolation mount after disassembly from the pylon supports.



Figure 8. Aft pylon pieces after disassembling the main transmission case from the aft isolation dampers.



Figure 9. Lower ends of the aft left (upper image) and aft right (lower image) pylon support pieces after disassembling the isolation mounts and upper portions of the friction dampers.

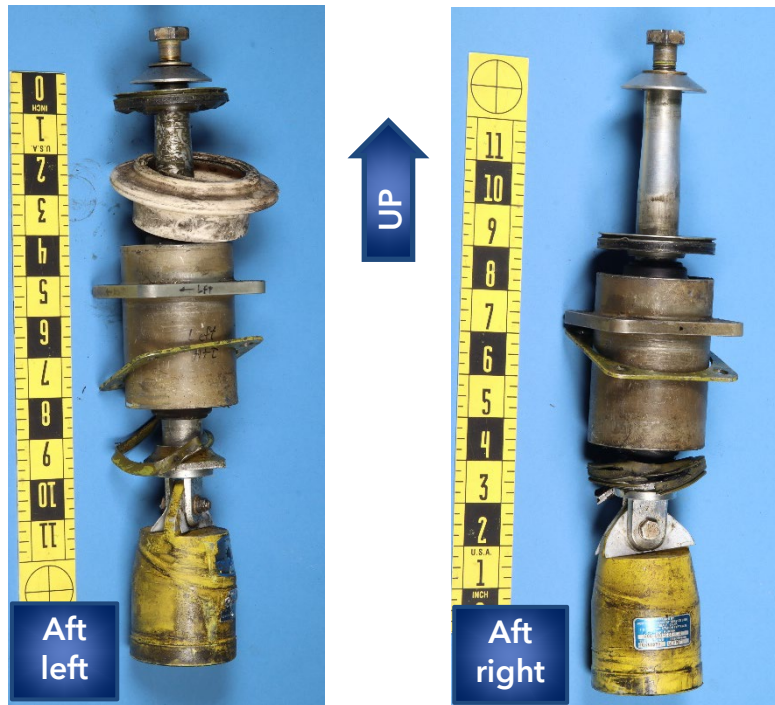


Figure 10. Aft left and aft right isolation mounts and upper portions of the friction dampers after disassembly from the pylon supports.



Figure 11. Aft left and aft right isolation mounts and bushings after disassembly from the isolation mount bolts.

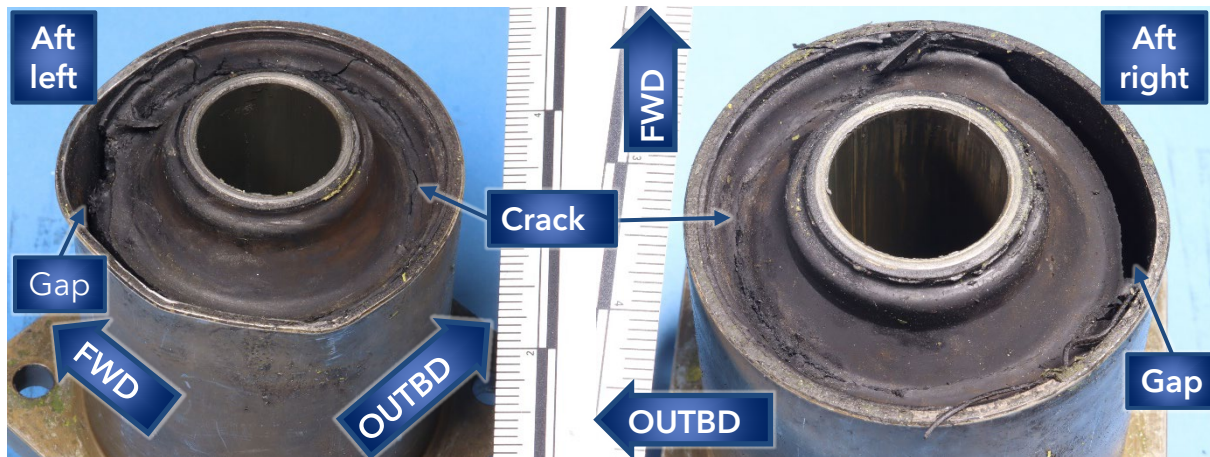


Figure 12. Lower ends of the aft left and aft right isolation mounts.

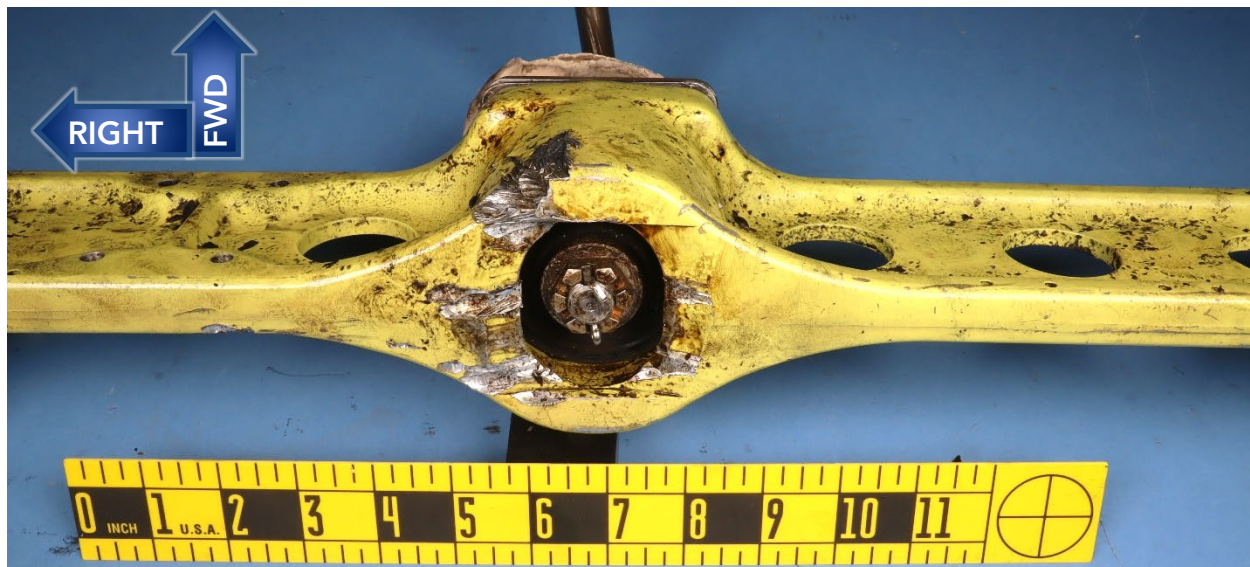


Figure 13. Sliding contact damage on the underside of the pylon aft beam.



Figure 14. Aft side of the aft center isolation mount, bushing, and washer (left image) and lower end (right image) after disassembly from the pylon aft beam.

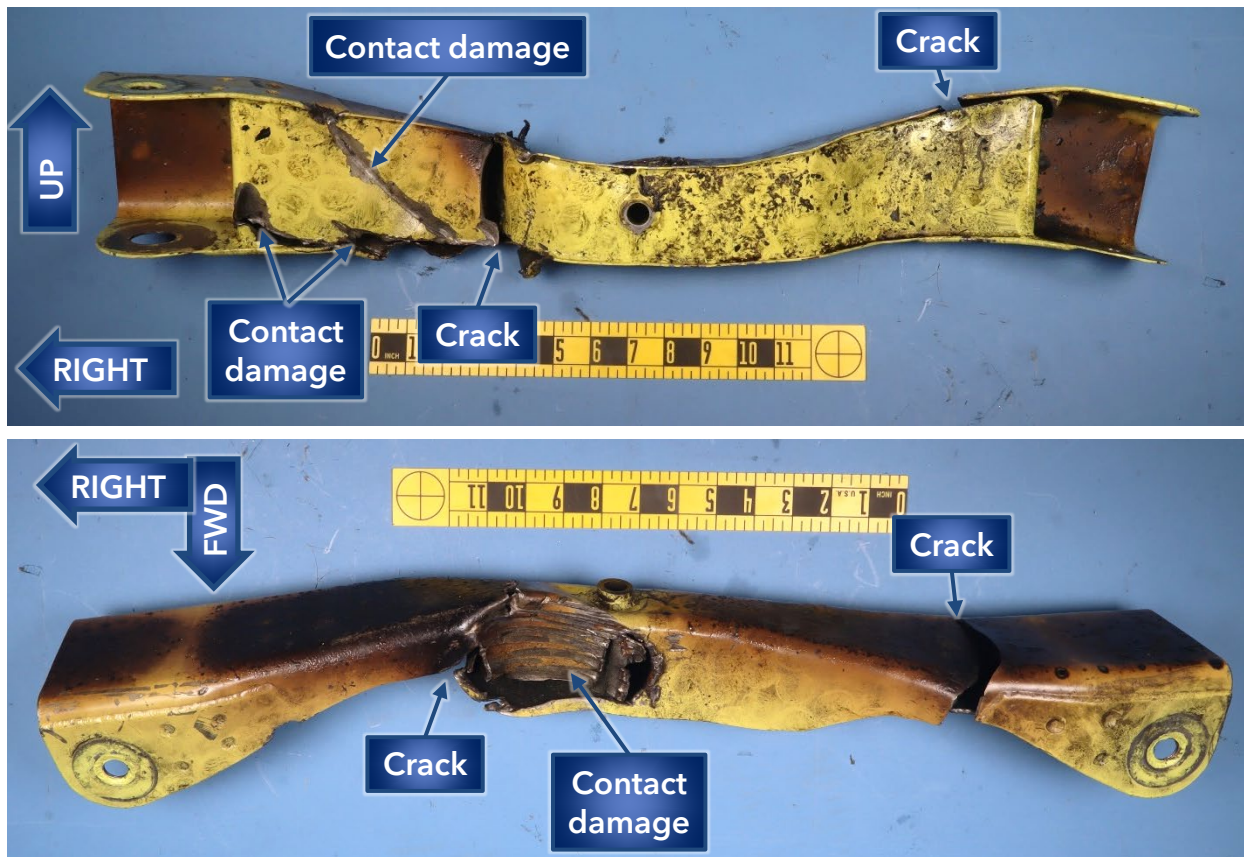


Figure 15. Forward face (upper image) and upper face (lower image) of the main transmission support showing cracks and sliding contact damage.



Figure 16. Closer view of sliding contact damage on the forward face of the transmission support. Dashed lines and unlabeled brackets indicate two separate arc segments on the sliding contact mark that extended across the face.