



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety

Western Pacific Region

August 25, 2018

AIRFRAME & ENGINE EXAMINATION REPORT

WPR18LA242

This document contains 23 embedded photographs.

Dardanelle, California

August 25, 2018

1600 PDT

Roberts Aircraft Company (Bell) 212 – N512TA

EXAMINATION PARTICIPANTS

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HISTORY OF FLIGHT

On August 25, 2018, about 1600 Pacific daylight time, a Roberts Aircraft Company (Bell) 212 helicopter, N512TA, was substantially damaged when it was involved in an accident near Dardanelle, California. The pilot received serious injuries. The helicopter was operated as a Title 14, *Code of federal Regulations* Part 133 external load flight.

The helicopter came to rest on its left side, on a steep mountain side that had previously burned from a wildfire. All major components were found in a debris area of about 100 ft by 100 ft. The long line holding a water bucket, remained attached to the helicopter cargo hook. The line looped over the top of the fuselage and ran uphill to the water bucket.

Members of the Federal Aviation Administration (FAA) and the US Forest Service (USFS) performed an on-scene examination.

After the field examination, the FAA representative reported this. “The low profile 12-point special bolt heads that connect the gimbal ring to the swashplate support and the inner ring show evidence of battering the collective sleeve for some time in flight, as the swashplate support ears

failed in sequence. Evidence at the scene indicate that the main rotor and mast only rotated 1 or 2 revolutions, (if that), coming to a quick stop after first main rotor contact with the trees, and finally rocks, as one blade is destroyed, and the other blade nearly intact. The mast pole showed no deformation by the hub teeter stops. The many hits on the collective sleeve seem to indicate that the gimbal ring was unsecured for many revolutions of the mast, prior to the sudden stoppage.”

The USFS air safety investigator stated this, “During my inspection of the incident aircraft, H-522, the following was found and corroborated by the FAA representative.

~ The mounts of the swashplate support were broken off of the swashplate support and retained on the gimble assembly.

~ Significant damage and metal transfer/deformation to the area where the swashplate support to gimble assembly mounts were previously located, this type of damage is indicative of pre-impact damage.

~ Significant damage to the collective sleeve from the free movement of the gimble ring around the sleeve after the gimble had become free of the swashplate support. Damage indicative of pre-impact separation of the gimble ring from the swashplate support.

The IIC did not travel to the accident site or the recovery site. A review of photographs and coordination with the agencies that did travel to the sites were used to create this report.

The helicopter was reported to have rolled once and then came to rest on its left side. The fuselage exhibited downward crushing to the upper area above the right-side pilot’s door and the right-side sliding cabin door. The forward fuselage including the windshields and the top of the fuselage extending to the aft part of the overhead windscreens exhibited downward crushing, which shattered both windshields. The two overhead windscreens (greenhouse) were both absent. The nose access panel remained partially attached to the nose. The right-side chin bubble remained attached to the lower fuselage and was missing the upper section.

The right pilot door remained attached to the fuselage, however, the downward crushing of the top of the fuselage also crushed the upper portion of the right-side doorway. The right-side jump-door remained secured and had some downward crushing at the top. The right-side sliding cabin door exhibited downward crushing at the top, with dents and scrapes on the door. Both windows were absent. An area underneath the sliding door exhibited inward crushing. The area of fuselage aft of the sliding cabin door exhibited minor dents and scrapes.

The forward section of the doghouse around the engine and main rotor system was absent. The rear section of the engine nacelle was secure and exhibited minor damage.

The right side of the tail boom exhibited minor damage. The right-side horizontal elevator exhibited a dent at the leading edge, outboard tip. The right side of the vertical stabilizer exhibited minor damage.

The tail rotor assembly had separated from the top of the vertical stabilizer and was found in the wreckage. The tail rotor assembly was complete. Both tail rotor blades remained attached to the hub and exhibited damage at the blade tips inboard to about mid-span. One blade exhibited a 90° bend about ten inches from the tip. The other blade exhibited a separation of the tip about eight to ten inches inboard of the tip. Both pitch change rods remained attached at both ends. One pitch change rod exhibited an outward bend. The other appeared straight. The counterweights remained attached to the pitch change rod. The 90° gearbox remained intact with no evidence of oil leakage. The oil filler cap remained attached to the port. The bellcrank remained attached to the 90° gearbox, and the control rod from the bellcrank appeared to have separated from the control tube at the threads of the control rod.

The left side of the vertical stabilizer exhibited minor damage. The left side of the tail boom exhibited minor damage. The left-side horizontal elevator exhibited minor damage. The top of the tail boom exhibited downward crushing at the tail rotor driveshaft cover, about mid-span. The top of the vertical stabilizer exhibited a fracture at the mounting pad for the 90° gearbox.

The left side of the fuselage forward of the tailboom exhibited minor damage. The left-side sliding cabin door exhibited minor damage. The aft window was absent. The forward window remained attached to the door. There was some evidence of upward crushing above the rear cross tube. The left-side jump door remained attached to the fuselage and was opened. The fuselage area between the left-side jump-door and the left-side pilot's door exhibited inward crushing. The left-side pilot's door was absent.

The landing gear consisted of two skids and two cross tubes. The landing gear remained attached to the underside of the fuselage. The right skid remained attached to both cross tubes and exhibited minor damage. The left skid remained attached to both cross tubes and exhibited minor damage. The forward cross tube remained secured to the fuselage at the right saddle but had separated from the fuselage around the left saddle area. The forward cross tube appeared to have been spread or flattened. The rear cross tube remained attached to the fuselage at both saddles and appeared spread or flattened on the right side. The right side of the two cross tubes exhibited more spreading than the left side.

While neither of the engines were examined, they both remained secured at their respective mounts and did not exhibit any overt external damage. The engine nacelle areas did exhibit downward crushing on the right side only. The oil cooler radiator beneath the exhausts exhibited no damage. Neither of the exhausts exhibited damage.

The transmission partially separated from the fuselage but remained in the helicopter. The lower section of the transmission fractured in multiple locations, which resulted in the separation of all

but 1 mount. The lift-link remained attached at both ends. The drive shaft from the combining gearbox to the transmission remained secured to the combining gear box but separated from the transmission. The driveshaft exhibited multiple rotational scoring signatures consistent with continued rotation after the separation.

The underside of the fuselage and the tail boom exhibited minor dents except for the noted areas near the forward left-side cross tube saddle and the right-side area underneath the sliding door.

The hydraulic servos (lateral, longitudinal, and collective) all remained attached at their respective mounts. The collective push-pull tube remained attached to the collective levers and exhibited a bend aft. Both lateral and longitudinal push-pull tubes fractured and separated from the servos. The push-pull tubes remained attached to the respective arms on the non-rotating swashplate. The one visible hydraulic pump remained secured to the transmission.

The helicopter had a semi-rigid main rotor system that was equipped with two original equipment manufacturer main rotor blades. The main rotor system did not have permanent markings to differentiate one side from the other. For clarity, this report will refer to one half of the main rotor system as A and the other half as B.

Examination of the main rotor control system from the rotating swashplate and above revealed that swashplate drive link A remained attached to the scissors assembly A. Drive link A was fractured at the two tangs used to attach it to the rotating swashplate via a two-piece trunnion bearing. The trunnion bearing outer sleeve remained attached inside the rotating swashplate. There were two distinct areas near the trunnion mount that had paint removed and appeared to have been struck by an object. The drive link A tangs and the inner race of the trunnion bearing separated from the swashplate and were not recovered. Scissors A connected at its opposite end to the scissors control tube, which exhibited no damage and remained attached at both ends. The upper end of the scissors control tube remained attached to the mixer attached to the stabilizer bar. The stabilizer bar remained attached to the stabilizer assembly and appeared to be partially buried in the terrain. From the stabilizer bar the A pitch change rod remained attached to the stabilizer bar and the A blade pitch horn. The A blade pitch horn separated from the A blade grip. The A blade grip secured the blade spar, and the A drag brace secured the A blade aluminum honeycomb after body. The A blade spar separated from the afterbody along the entire span of the blade. Numerous areas of sheet metal that made up the skin of the blade, were bent in a sharp 90° bend. Areas with these bends also had the black paint removed, exposing a tan colored paint. There was an area of darkened aluminum honeycomb near the root end of the blade.

The B swashplate drive link remained attached at the rotating swashplate and the B scissors. The B scissors remained secured to the rotating hub and attached to the B scissors control tube. The B scissors control tube fractured about mid-span. The upper section of the B scissors control tube remained attached to the stabilizer bar. The B stabilizer bar remained attached to the stabilizer bar assembly. The B pitch change rod remained attached to the stabilizer bar and the B blade pitch horn. The B pitch horn separated from the B blade grip. The B blade remained attached to the hub by the blade grip and the drag brace. The B blade exhibited spanwise bending along with

wrinkling along the entire span. There was a hole created near the tip of the blade and a section of the honeycomb after body was fractured near the blade tip.

Examination of the main rotor controls from the non-rotating swashplate and below revealed the swashplate separated from the swashplate support at the four tangs. The four tangs remained attached to the gimble ring. All hardware for the tangs remained attached to the tangs and the gimble ring. The swashplate support remained attached to the top of the transmission. Both the inboard tangs exhibited a smearing of the fractured metal that created a shiny appearance. The collective sleeve exhibited damage consistent with multiple contacts from the gimble ring. One of the two bearings that joined the collective levers to the collective sleeve had separated and released the ball bearings. Both the lateral and longitudinal arms of the non-rotating swashplate exhibited a dent or dents and scratches with shiny metal exposed. The blade tracking mount, attached to the longitudinal arm, was bent over.

The swashplate, inner ring, gimble ring assembly, swashplate support, collective levers, and bearing and liner assemblies were examined by the National Transportation Safety Board's Materials Laboratory. All damage to all submitted components were determined to be a result of overload. Examination of the swashplate drive links and the outer sleeve of trunnion bearing A, by the manufacturer's laboratory revealed that the tangs for drive link A failed in overload. Examination of the outer sleeve of trunnion bearing A revealed brinelling on the interior and an overload fracture on the outer end of the sleeve.

Photo Array



Figure 1. Photo showing the helicopter at rest at the accident site. Photo US Forest Service.



Figure 2. Right-side view of the helicopter at the recovery site.



Figure 3. left-side view of the helicopter at the recovery site.



Figure 4. View of the tailboom while at the accident site. Photo US Forest Service

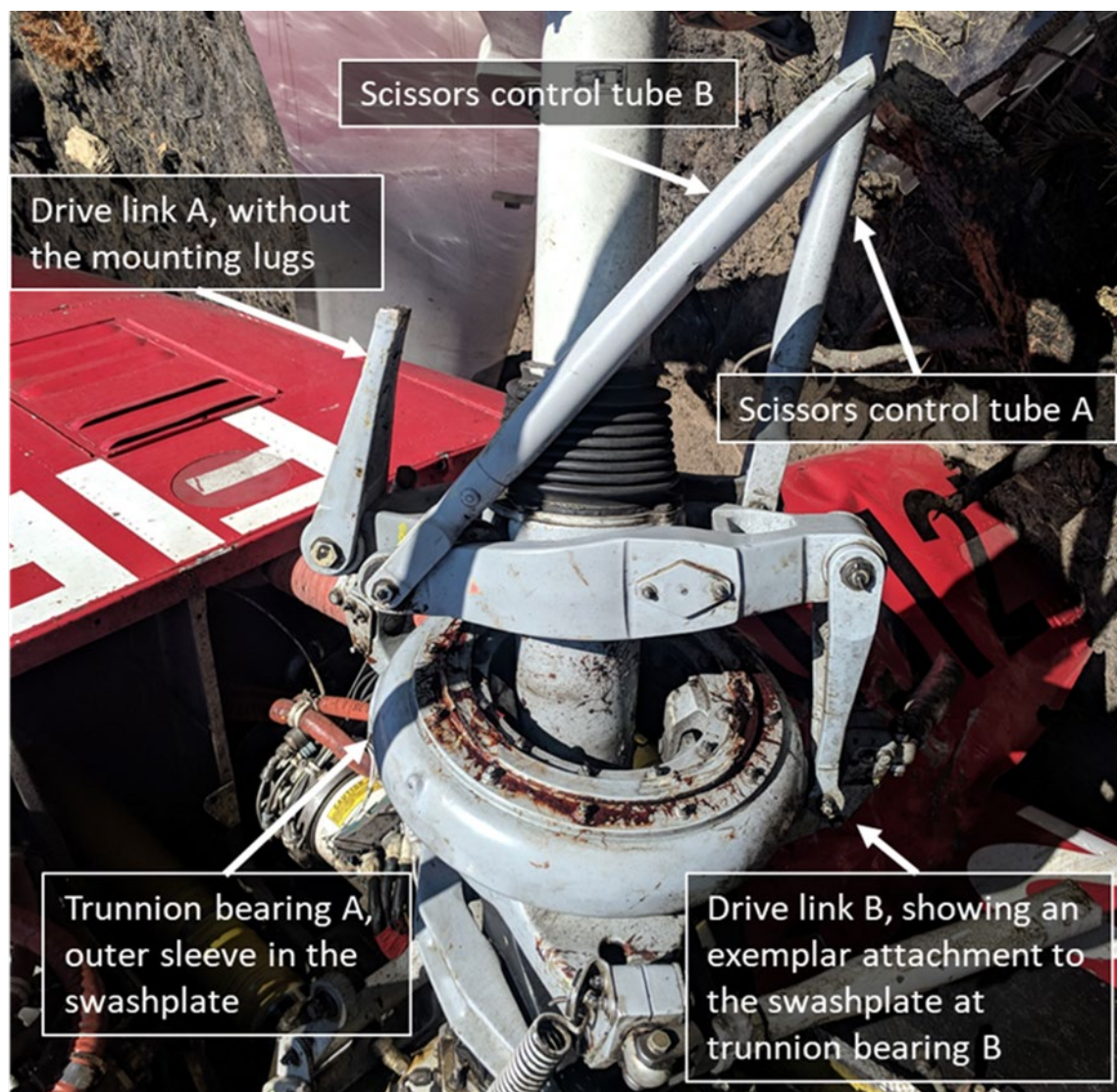


Figure 5. Image showing swashplate drive links, trunnion bearings, and scissors control tubes. Photo US Forest Service.



Figure 6. Image showing swashplate drive link A and the area of the missing tangs. Photo US Forest Service.



Figure 7. Image showing one side of the gimble ring and the attached swashplate support tangs. The contact marks on the collective sleeve are in view. Photo FAA

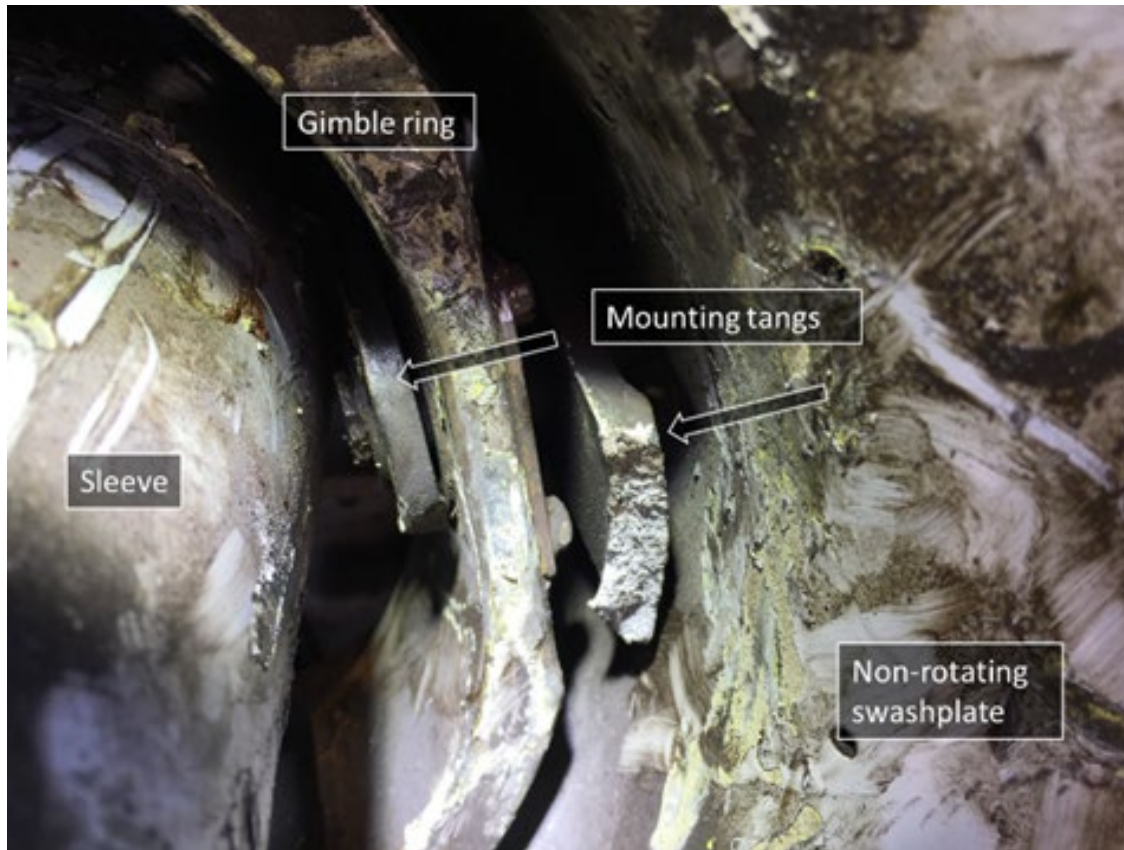


Figure 8. Image showing the other side of the gimble ring and the attached swashplate support tangs. The contact marks on the collective sleeve are in view. Photo FAA



Figure 9. One side of the swashplate support, showing the area of the missing tangs and smearing of the fractured metal. The contact marks to the collective sleeve are in view at the top. Photo FAA.



Figure 10. The other side of the swashplate support showing the area of the missing tangs and smearing of the fractured metal. Photo FAA.

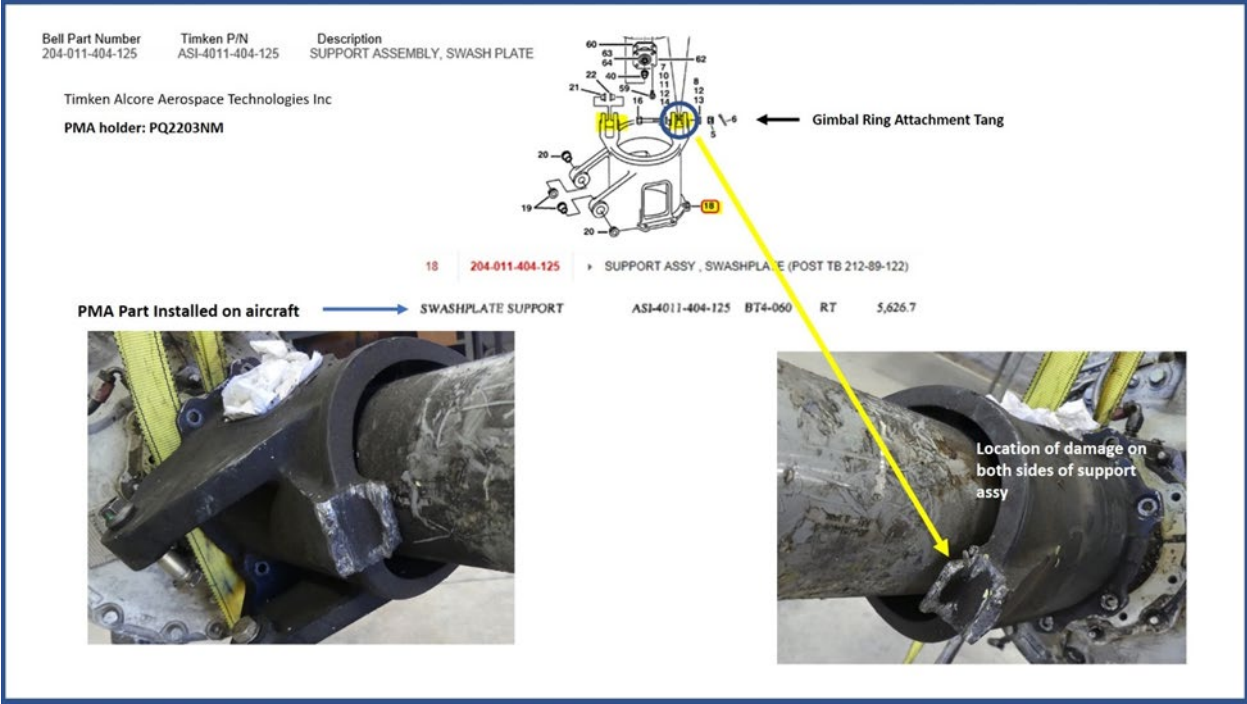


Figure 11. Image showing the location of the swashplate support and highlights showing the tangs. Photo Bell.

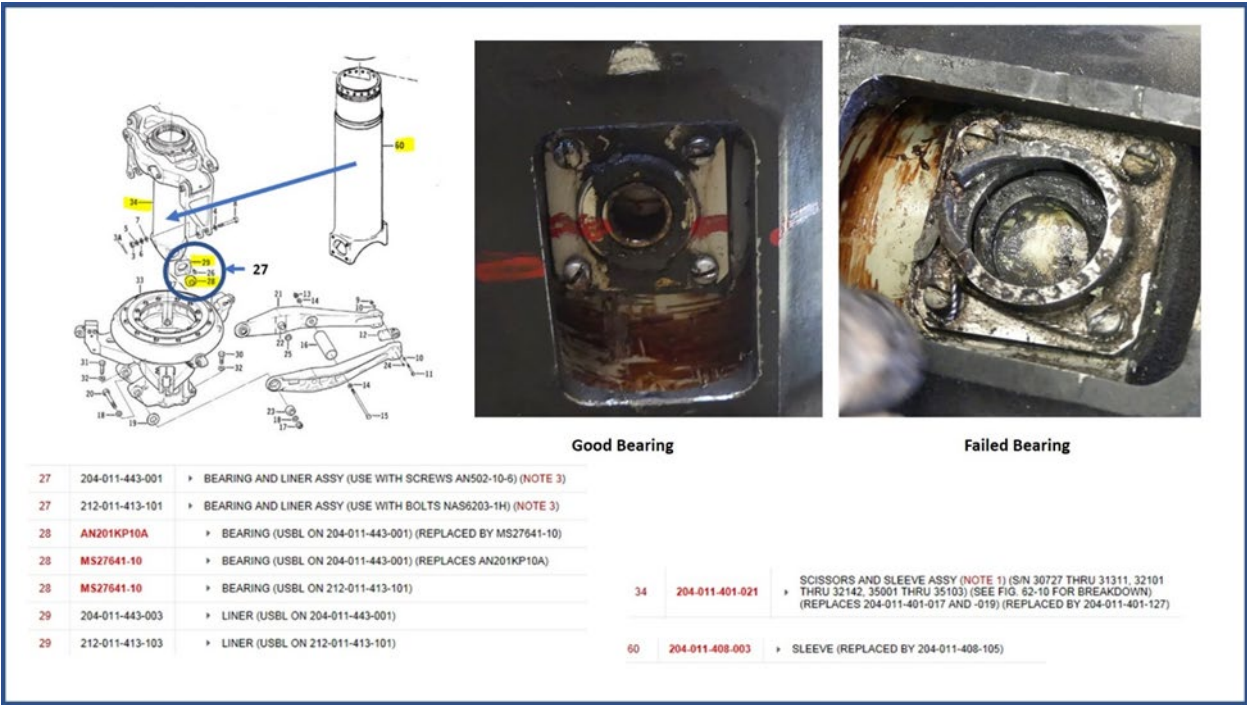


Figure 12. Image showing the location of the bearings. Photo Bell.

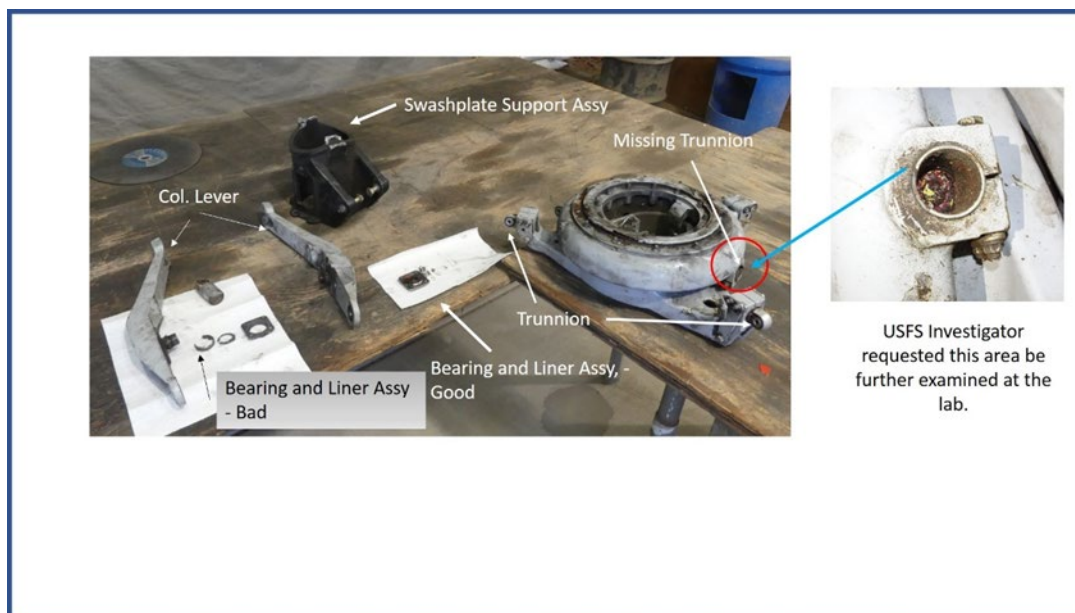


Figure 13. Image showing the components submitted for further examination. Not shown are the two swashplate drive links and the outer sleeve of trunnion bearing A. Photo Bell.



Figure 14. Image showing contact marks made to the non-rotating swashplate arms.



Figure 15. Image showing contact marks made to the rotating swashplate. The trunnion bearing A outer sleeve is visible.

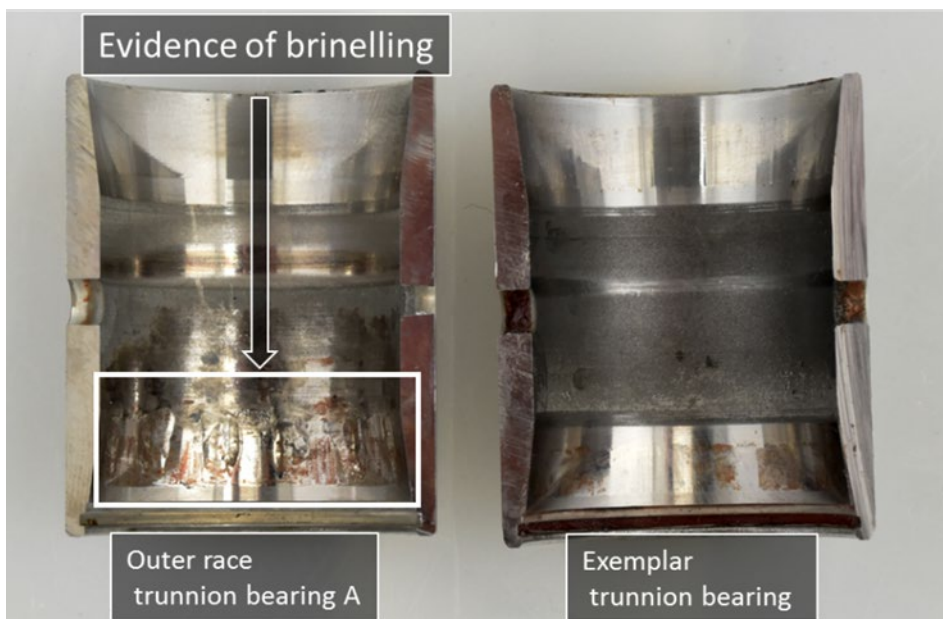


Figure 16. Image showing the outer sleeve of trunnion bearing A on the left that shows brinelling. An exemplar outer sleeve is shown on the right. Photo Bell.



Figure 17. Image showing how Blade A separated into two long halves, a spar half, and a honeycomb after body half. Photo US Forest Service.

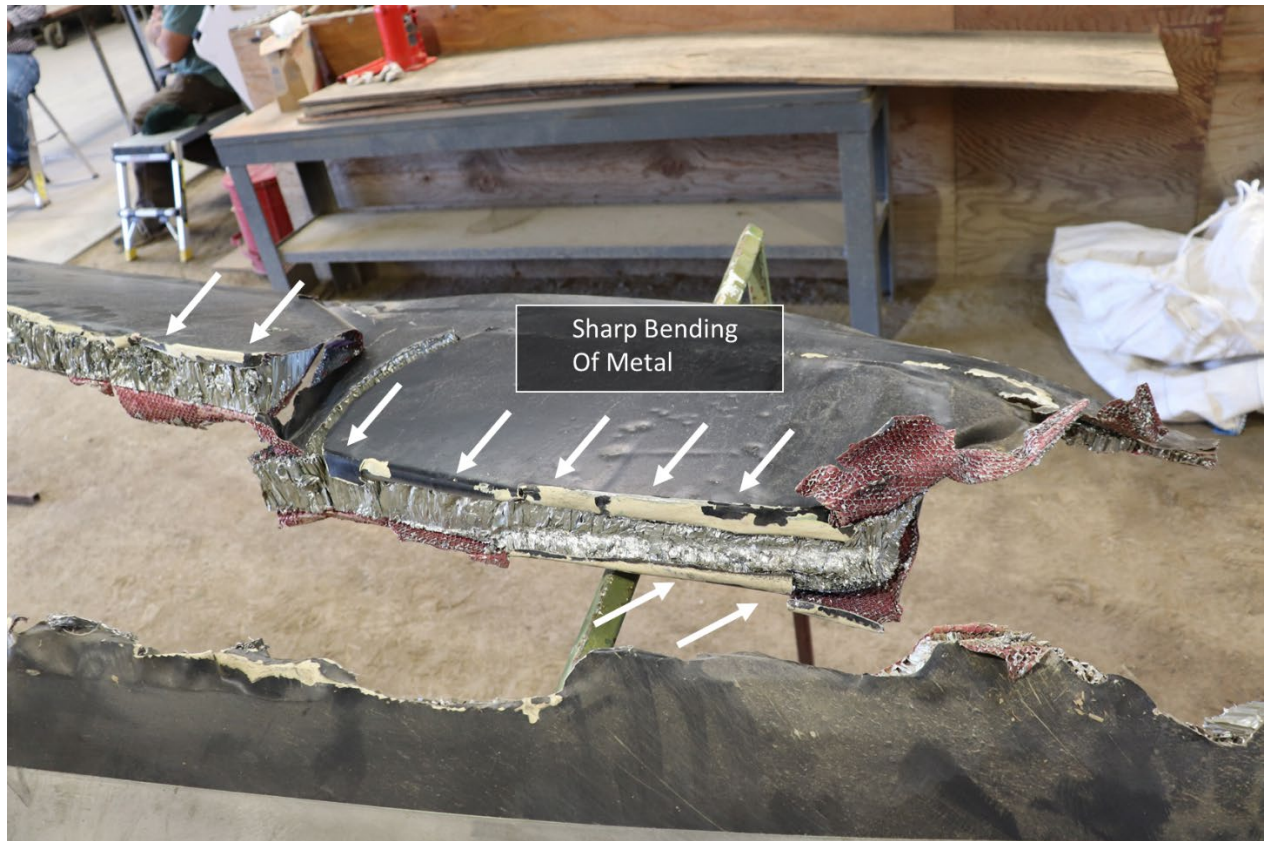


Figure 18. Image of the honeycomb half of blade A, showing the skin bent over 90° and black paint removed.

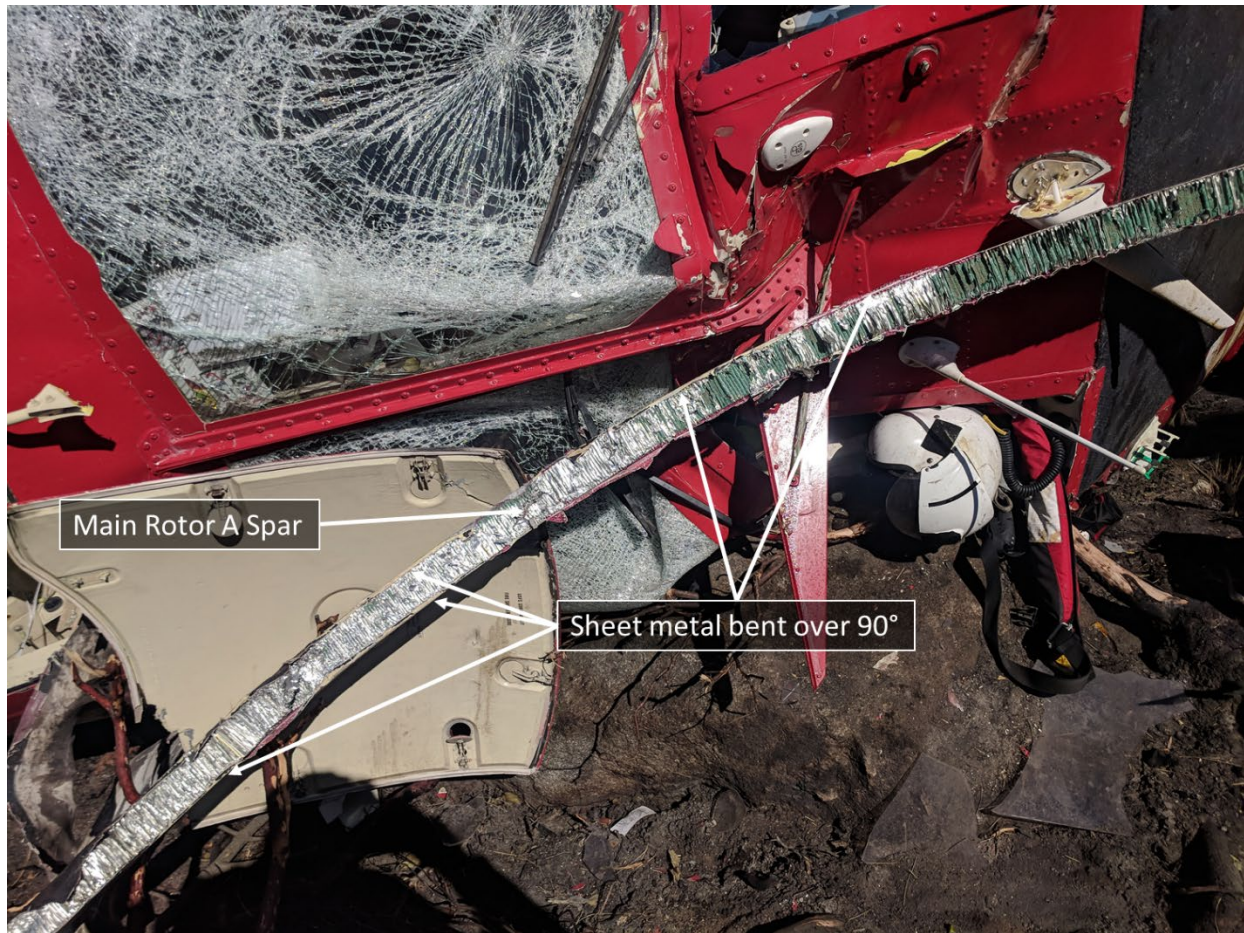


Figure 19. Image showing the spar half of blade A with skin bent over 90°. Photo US Forest Service.



Figure 20. Image showing a darkened area of the aluminum honeycomb from blade A.



Figure 21. Top View. Photo US Forest Service.



Figure 22. Underside view. Photo US Forest Service.



Figure 23. Tail Rotor Assembly and 90°gearbox. Photo US Forest Service.