

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594



April 6, 2021

MATERIALS LABORATORY FACTUAL REPORT

Report No. 21-025

1. ACCIDENT INFORMATION

Place : Spanish Fork, Utah
Date : November 12, 2019
Vehicle : Agusta 109SP, N271HC
NTSB No. : WPR20LA029
Investigator : Stephen Stein, AS-WPR

2. COMPONENTS EXAMINED

Tail rotor blades
Tail rotor hub halves
Tail rotor rotating controls, pitch change links and bolts

3. DETAILS OF THE EXAMINATION

On November 12, 2019, about 2008 mountain standard time, an AgustaWestland A109SP helicopter was substantially damaged during cruise flight near Spanish Fork, UT. The airline transport pilot and flight nurse were not injured. According to the pilot, when the helicopter was about 5 minutes from its destination, the flight nurse attempted to step on the press-to-talk button located on the cabin floor, but instead inadvertently stepped on the left anti-torque pedal, which caused a rapid yaw to the left. The pilot immediately countered the movement and re-established straight and level flight.

After completing a subsequent flight, the oncoming pilot discovered damage to the tail boom during a preflight walkaround. The helicopter was taken out of service, repaired, and ferried to the company's maintenance facility. Postaccident photographs provided by the helicopter operator showed damage to the composite tail boom and tail rotor blades. Parts from the tail rotor assembly were sent to the NTSB Materials Laboratory for examination.

Figures 1 through 4 show the tail rotor blades, as received. The blades were approximate 2.7 ft long, with a metal leading edge and a white and red alternating paint scheme, with yellow painted tips. Each blade had a marked inboard and outboard side, as depicted in Figures 1 and 3.

Both blades exhibited identical plate markings stating, "A0126 709-0160-48-101 109-5010-02-101". Each blade had a different serial number, with the blade in Figures 1 and 2 having "Q2036," and the blade in Figures 3 and 4 having "R2108."

Neither tail rotor blade exhibited any indications of deformation, impact gouging, or cracking. The extent of the damage of both blades is illustrated on the blade tips of each in Figures 2 and 4. On the tips of the leading edge were 3-inch long and 0.5-inch-wide areas of a discoloration, exhibiting a dark gray hue with red undertones. These features were consistent with paint transfer to the leading edge of the tail rotor blade tips.

Figure 5 shows the tail rotor gear box, as received. The assembly consisted of a cast housing with an elongated output shaft (horizontal and to the right in the figure) and a shrouded input shaft (facing upward in the figure). The gear box was full of oil, which began to leak out when positioned as shown in Figure 5 (the leak occurred on the side opposite shown). The housing was painted white, and displayed the following markings on the housing:

108 044201 109C
108-0442-01-133
A0126 108-0442-01-131
S/N TUR00387
REV AC

Figure 6 shows the splined input shaft of the tail rotor gear box. The shaft exhibited no indications of deformation or impact damage, and the splines were absent any typical indications of wear such as rounding or gouging. The interior coupling castellations likewise did not exhibit any indications of rounding or damage, and the exposed surfaces appeared smooth and reflective.

Areas of the output shaft are highlighted in Figures 7 and 8. Figure 7 shows the forward face of the balance flange at the end of the input shaft. Two of the bolt holes exhibited some circular marks, consistent with the location of the removed bolts and/or nuts. There was also a larger circular mark on the bottom of the figure, consistent with the location of a washer that had been removed (compare with the in-place washer on the top of the figure). The balance flange did not exhibit any indications of missing material or deformation, such as hole widening or chipping. The circular washer and bolt witness marks were consistent with marks made from bolted connections under typical service of helicopter components. This face was absent any indications of wear, impact, or deformation.

Figure 8 shows the splined portion of the output shaft of the gear box, towards the forward end (near the mounting sleeve). Like the splines in the input shaft, these splines did not exhibit any indications of rounding or wear and were absent deformation or cracking. There was a loose washer on the shaft, located aft of the splined area. This washer did not exhibit any witness marks on the faces and was absent any wear marks or similar damage.

Figures 9 and 10 show the submitted links and bolts, as received. While these links exhibited areas of darker color, these were found to be consistent with accumulated dirt and oils and were inconsistent with any exposure to elevated temperatures. The bolts showed cylindrical contact marks, which were consistent with typical in-service contact between bolted parts. No indications of deformation or wear were found on any of these components. The markings for the links in Figure 9 stated "109-0130-05-1F" on one side, and "A0126 ASSY.109-0130-05-117 REV.P3" on the other. The link serial numbers were "MOR5864" and "MOR6153". The serial numbers for the links in Figure 10 were "MOR6795" and "MOR6807". The link with S/N MOR6807 had marking on the reverse side stating, "A0126 109-0133-04-109 REV.E2"; the other link had no markings on its reverse side.

Figure 11 shows the pitch change slider assembly, as received. This assembly was able to be actuated without excessive force or interruption. No indications of damage were observed along the body, and none of the bolted connections were loose, or absent cotter pins where applied. The markings on the main body of the pitch change slider assembly were, "A0126-109-0130-94-115-REV.G1 S/N MOR0683".

Figure 12 shows the interior splined driven connection on the inboard side of the slider assembly. The exterior surface exhibited markings stating, "A0126-109-0130-90-121 Rev.M – S/N MOR1157". The splines exhibited some rounding on the edge near the inboard face, but no such wear along the interior spline edges. The inboard face of the flange exhibited some scuff marks, but no indications of gouging or deformation.

Figure 13 shows the rubber gasket or bumper from the slider assembly, viewed from both sides. The color of the part was consistent with having been cleaned after the accident but prior to receipt. While the face in Figure 13b was absent any features, the obverse face in 13a exhibited two opposite-facing dark-colored areas of circular rubbing.

Figure 14 and Figure 15 show the tail rotor hub assembly, with the internal trunnion and retention strap bundles still attached inside. The strap bundles had been tied together with plastic ties. Figure 16 shows the internal splined trunnion of the hub from both sides. The inboard face exhibited some discoloration marks (left in the figures). However, there were no indications of wear, rounding, or deformation of the splines.

The markings on both sides of the hub and blade assembly stated, "A0126 109-0162-01-105 ESR V121" on one side and "A0126 109-0162-01-102 ESR V128" on the other.

Erik M Mueller
Materials Research Engineer

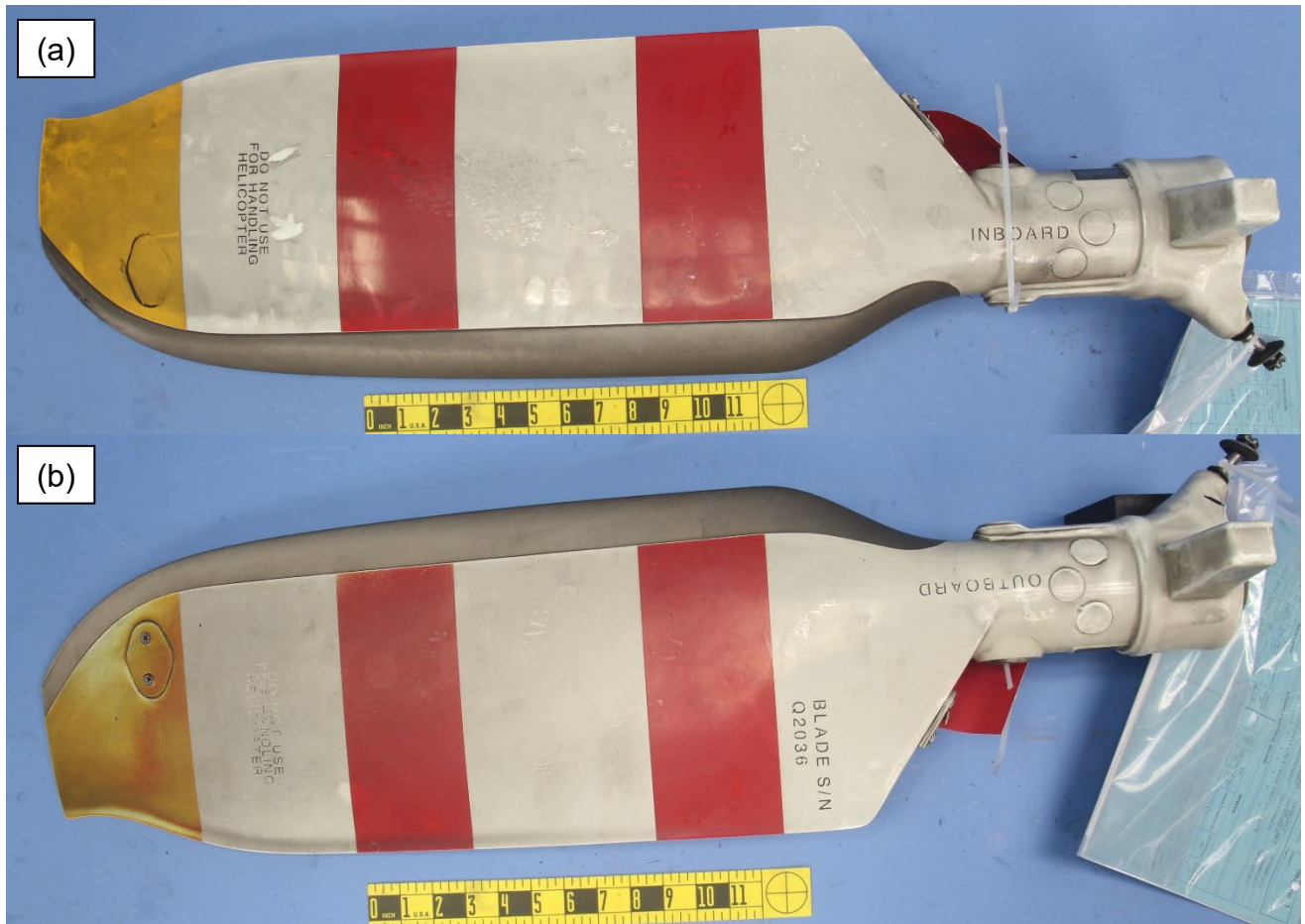


Figure 1 – View of the tail rotor blade Q2036 from the (a) inboard and (b) outboard faces.

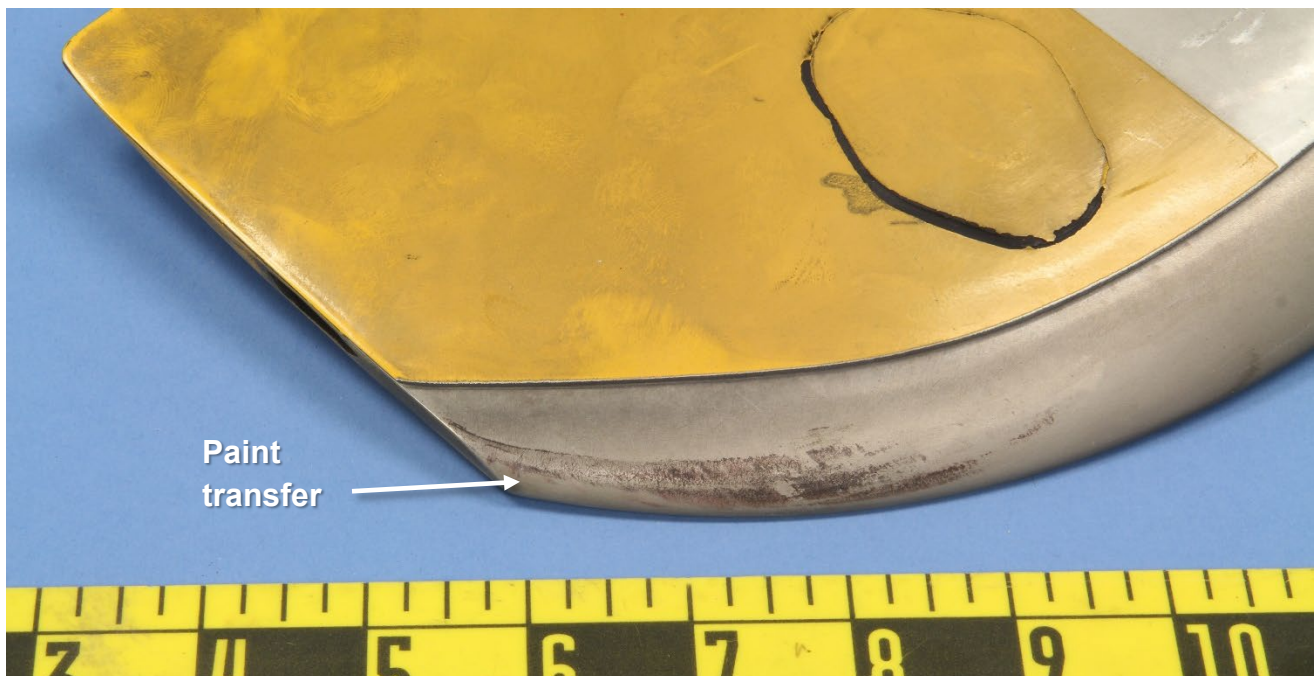


Figure 2 – The inboard face blade tip of Q2036, showing paint transfer marks.

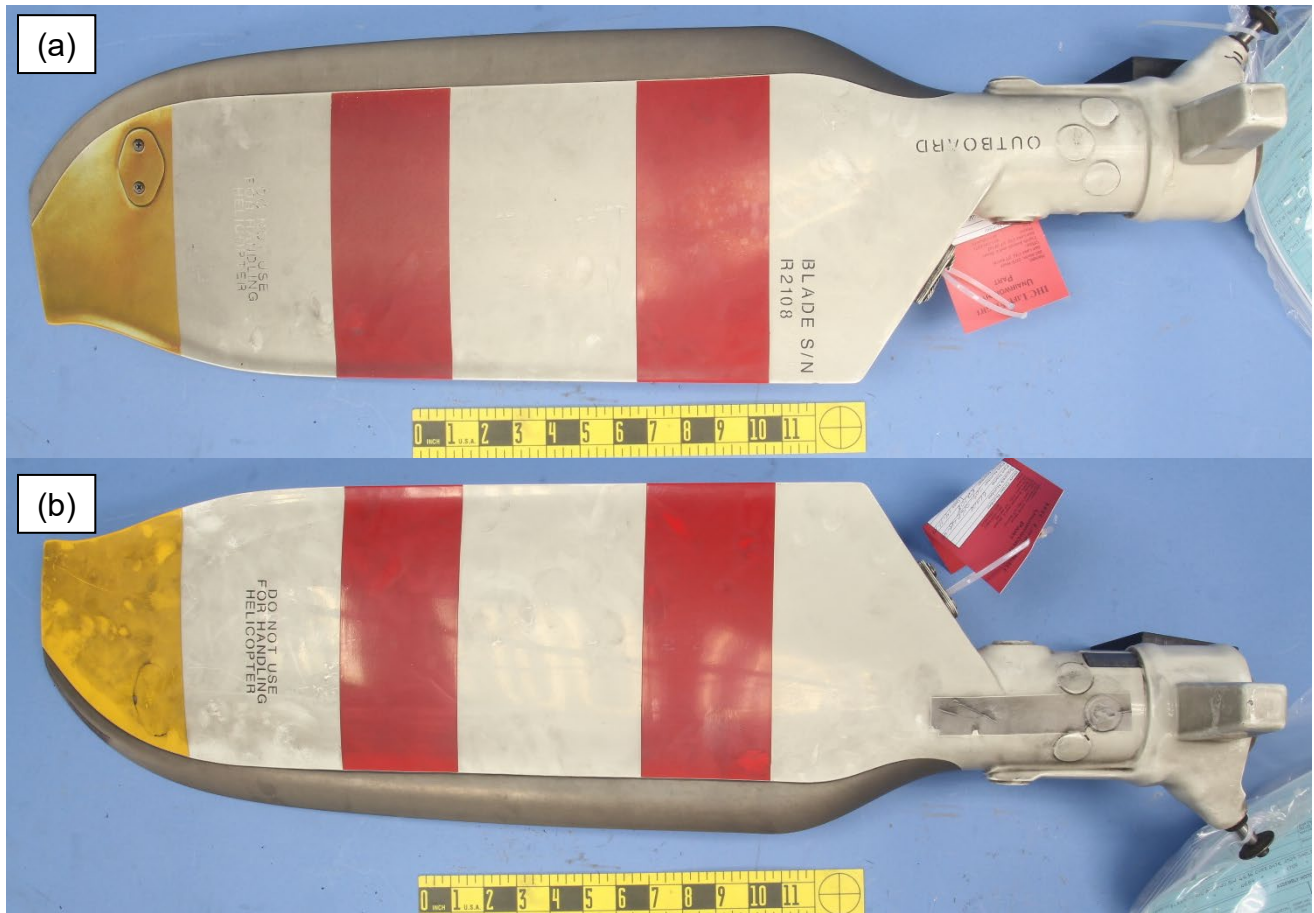


Figure 3 – View of the tail rotor blade R2108 from the (a) inboard and (b) outboard faces.

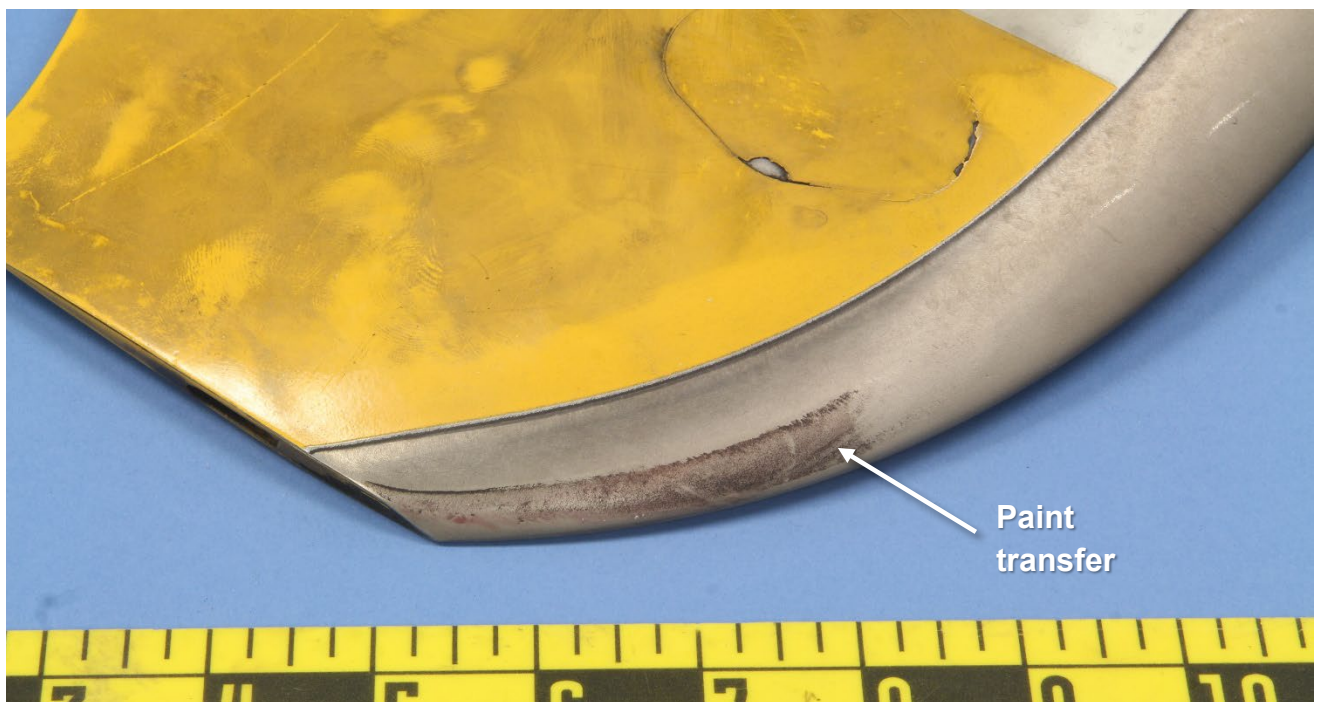


Figure 4 – The inboard face blade tip of R2108, showing paint transfer marks.

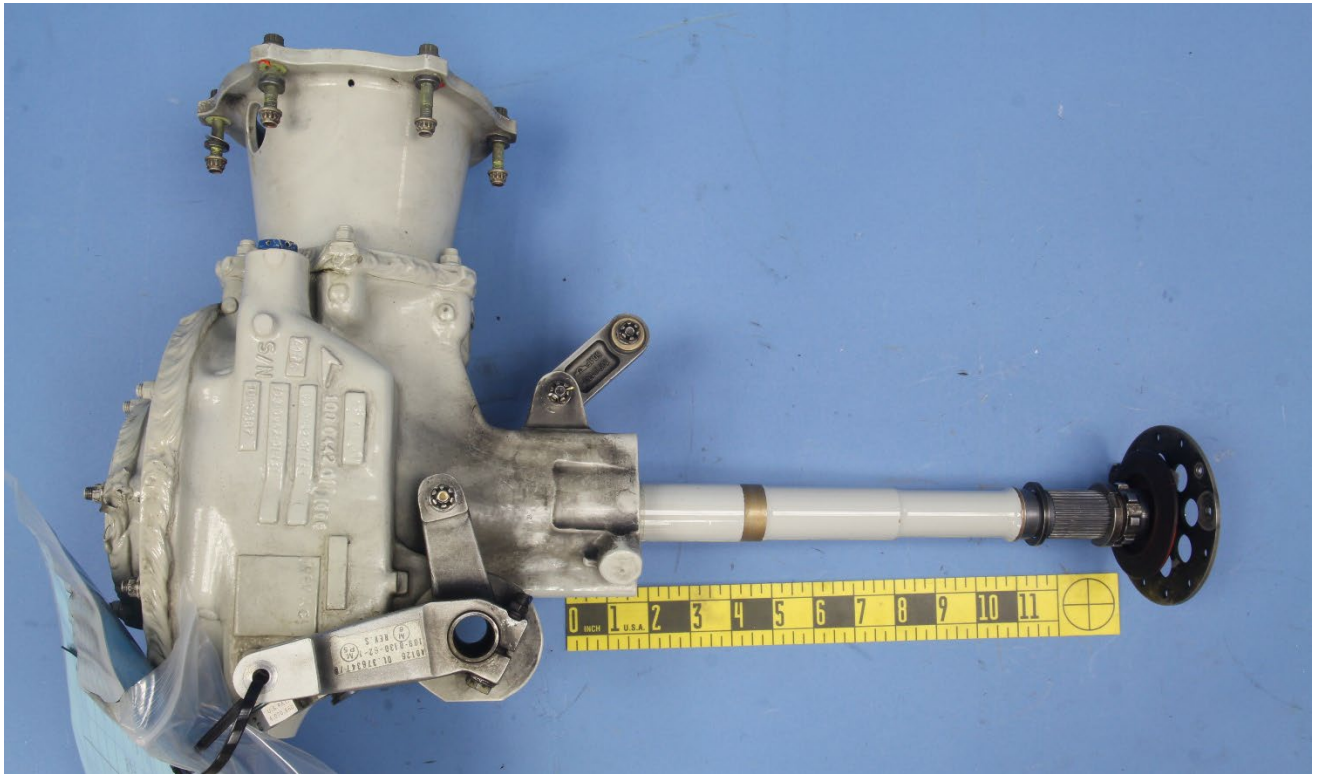


Figure 5 – The tail rotor gear box 90°, as received.

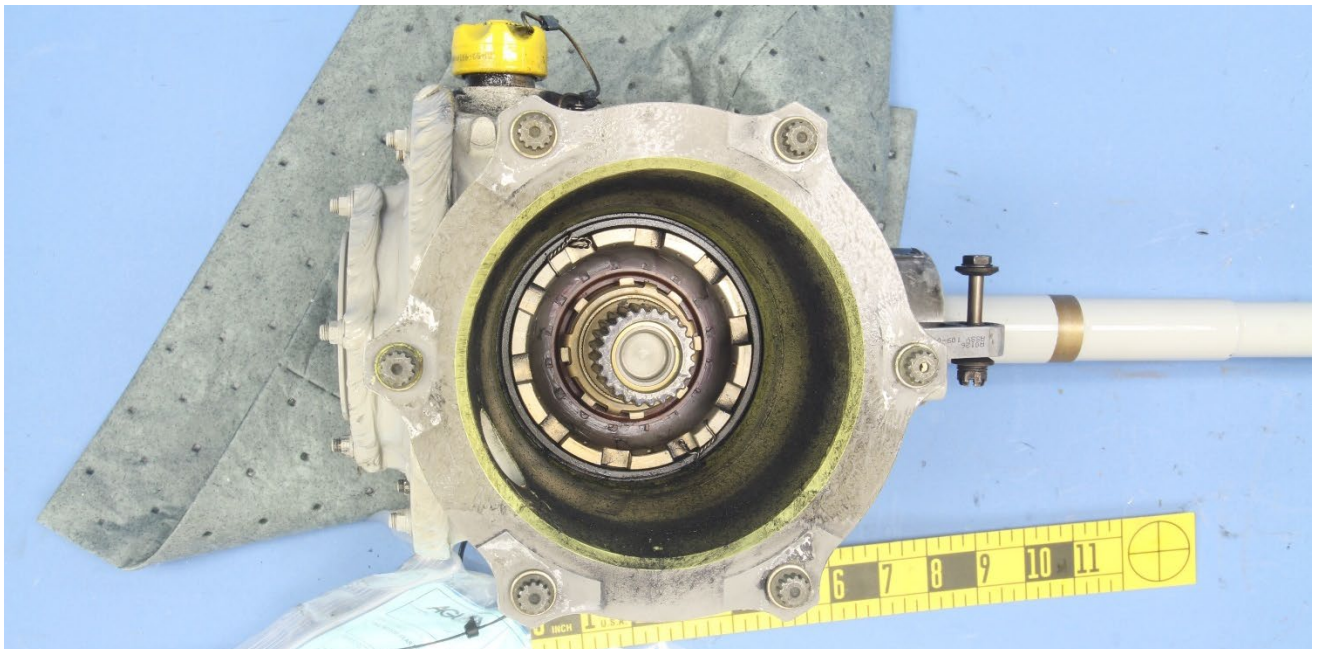


Figure 6 – The splined axial input drive shaft of the transmission from the gear box, as received.

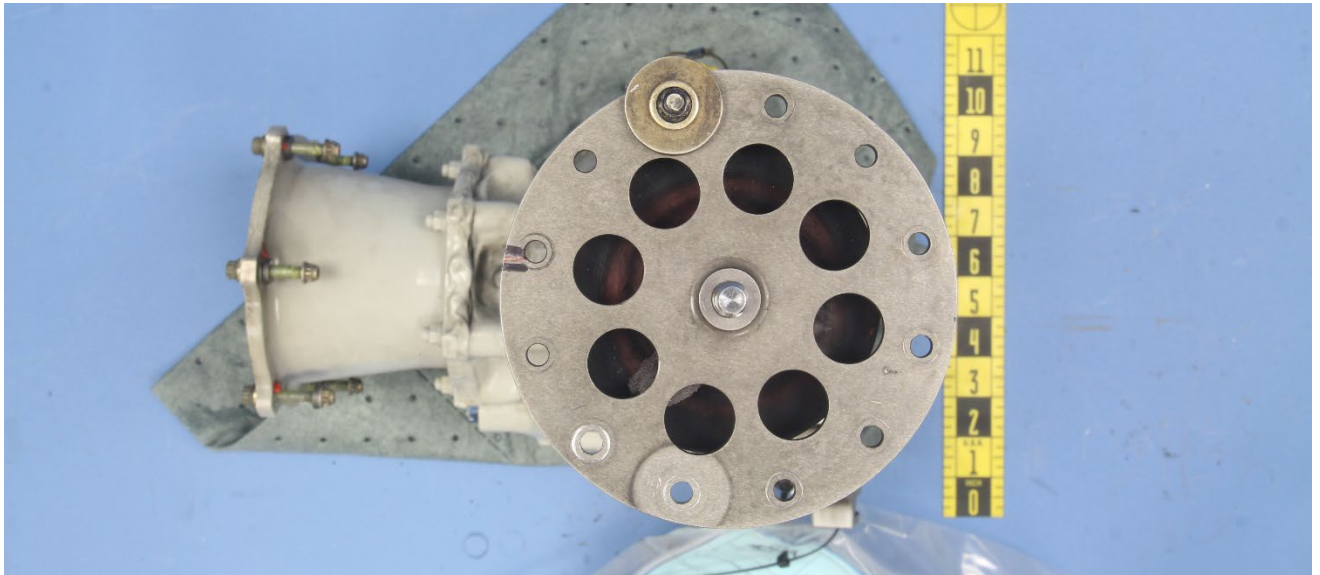


Figure 7 – View of the face of the balance flange on the input shaft arm of the tail rotor gear box output.



Figure 8 – Side view of the arm from Figure 7, showing the splined area of the shaft and the washer (loose on the shaft).



Figure 9 – One set of links and bolts from (a) the obverse and (b) reverse sides.



Figure 10 – The second set of links viewed from (a) the obverse and (b) reverse sides.

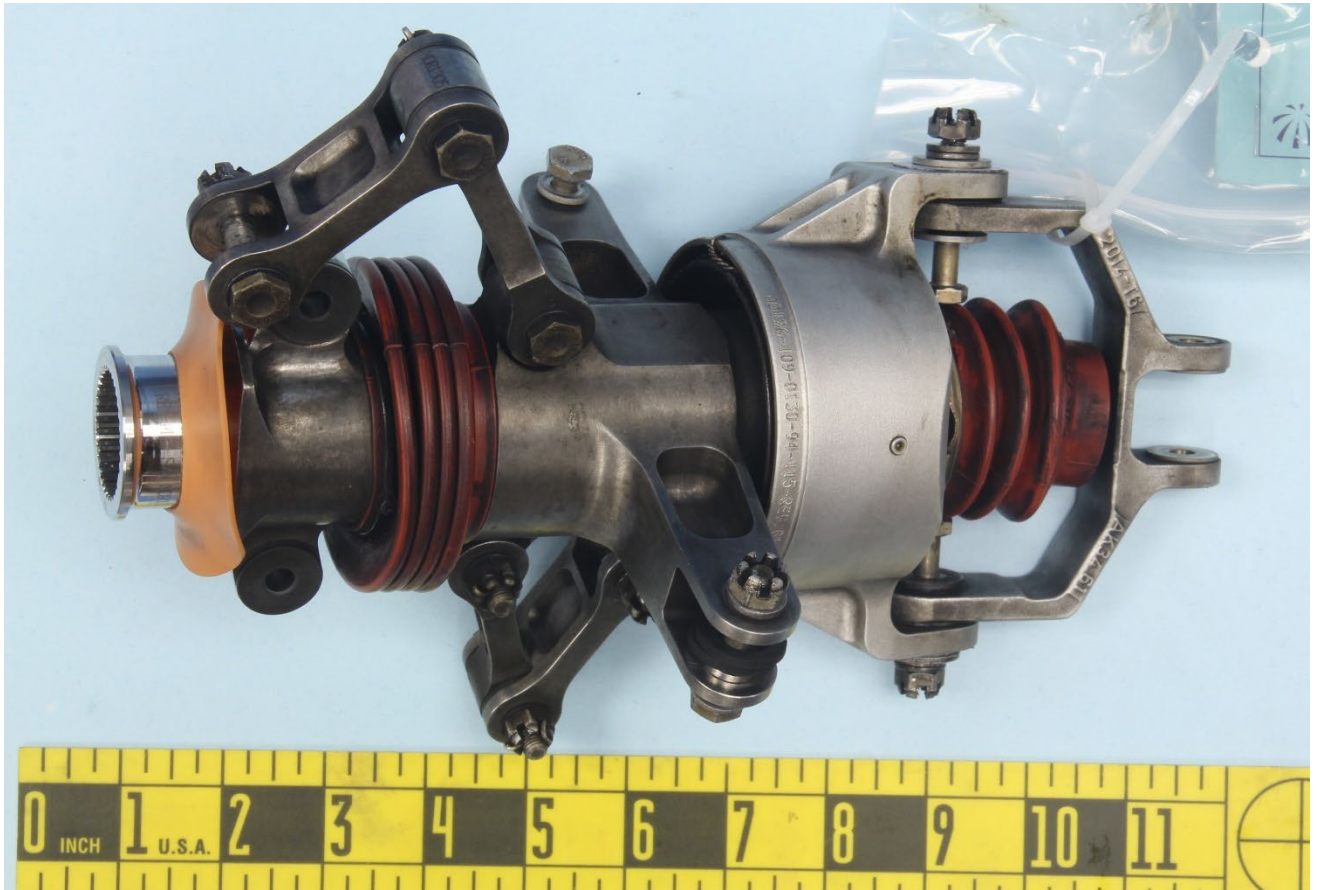


Figure 11 – The pitch change slider assembly, as received.



Figure 12 – View of the splined driven connection of the slider assembly in Figure 11.

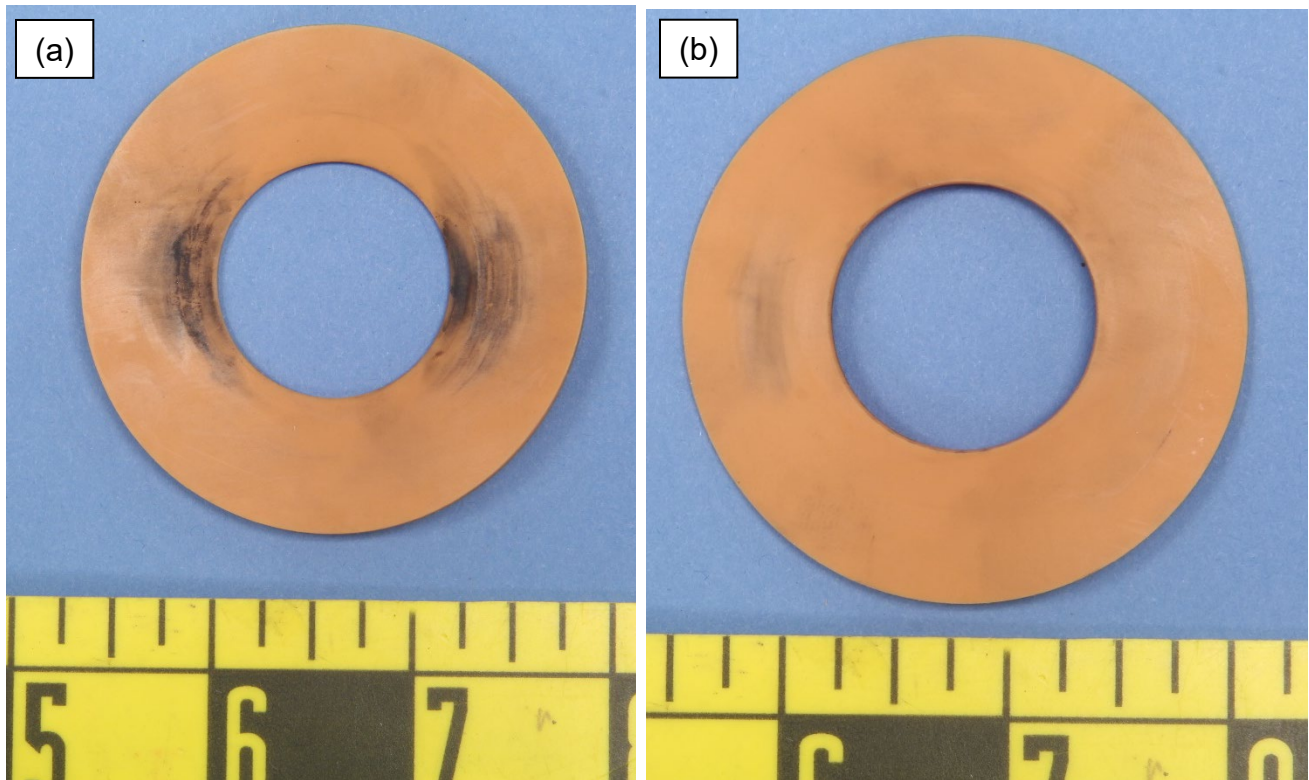


Figure 13 – The rubber bumper from the pitch change slider assembly from (a) the face exhibiting witness marks and (b) the reverse side.



Figure 14 – The tail rotor hub assembly, from the outboard side.



Figure 15 – The tail rotor hub and blade assembly, viewed from the inboard side.

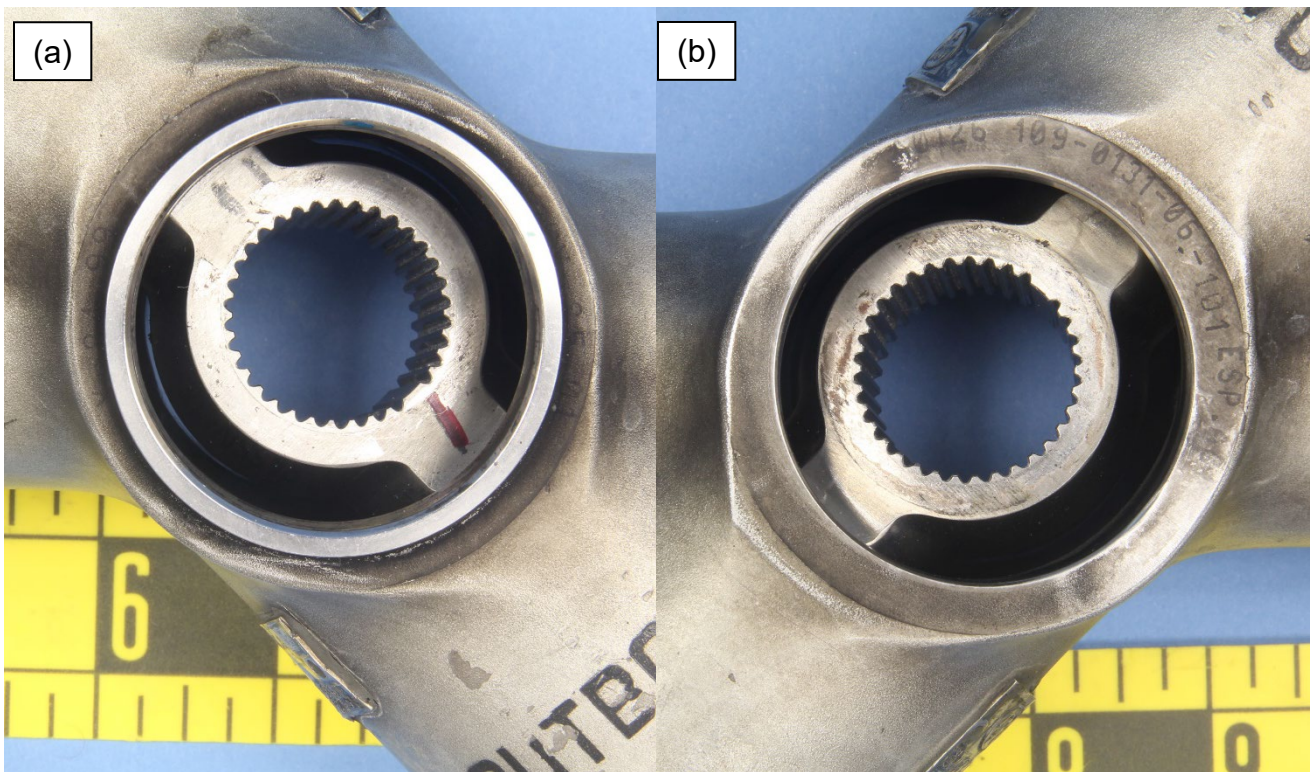


Figure 16 – The internal splined trunnion of the hub, viewed from (a) the outboard side and the (b) inboard side.