



NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

April 22, 2021

HELICOPTER SPECIALIST'S FACTUAL REPORT

NTSB No: ERA20LA054

A. ACCIDENT

Operator: Alamo Helicopter Tours San Antonio LLC
Aircraft: Robinson Helicopters R-44
Location: San Antonio, TX
Date: December 14, 2019
Time: 1656 CST

B. GROUP

No group was formed.

LIST OF ACRONYMS

CW	clockwise
CCW	counterclockwise
FAA	Federal Aviation Administration
FCU	Fuel Control Unit
FOD	Foreign object damage
N1	Gas generator turbine speed (% rpm)
N2	Power turbine speed (% rpm)
PN	Part number
RHC	Robinson Helicopter Company
SN	Serial number

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C. SUMMARY

On December 14, 2019, about 1656 central standard time, a Robinson R44 Raven II, N440AH, experienced a loss of engine power during cruise flight and was substantially damaged during a subsequent autorotation in San Antonio, Texas. The commercial pilot and two passengers sustained minor injuries. The helicopter was operated by Alamo Helicopter Tours San Antonio, LLC. The flight was operating under the provisions of Title 14 Code of Federal Regulations Part 91 as a revenue sightseeing flight. Visual meteorological conditions prevailed, and no flight plan was filed for the intended 30-minute local flight, which departed from Stinson Municipal Airport (SSF), San Antonio, Texas, about 1650.

The fiberglass fan scroll portion that has the brackets that hold the lower bearing was sent to RHC for examination. Additionally, the v-belts, and clutch assembly also accompanied the fan scroll sections.

D. DETAILS OF THE INVESTIGATION

1.0 FAN SCROLL & BRACKETS

The portion of the fan scroll to be examined had been cut out from the main scroll assembly by on-scene investigators. The cut-out portions of the upper scroll and lower scroll, along with the A185 brackets were included in the shipment.

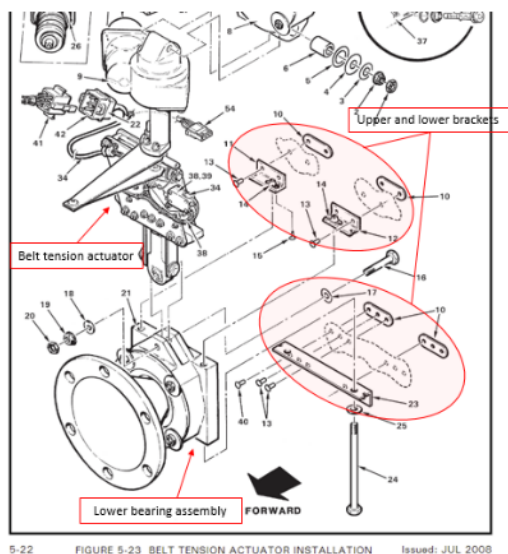


Figure 1 – Illustration of the belt tension actuator, lower bearing, and brackets.

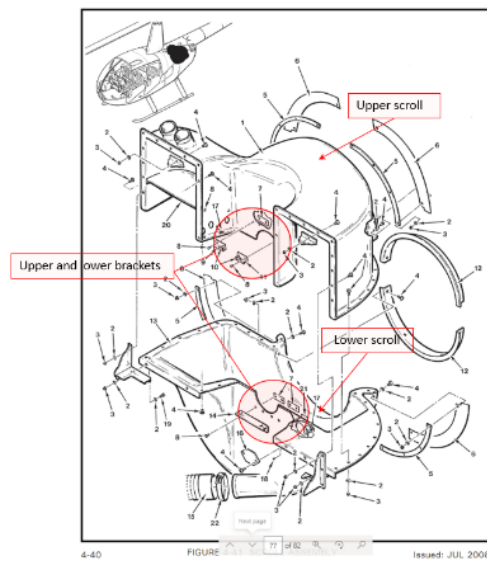


Figure 2 - Illustration of upper and lower fan scroll.

The upper brackets (A185) were separated from the scroll (photo 1). Both rivets in each bracket appeared to be sheared flush with the contact face of the bracket. Both bracket contact surfaces and sheared rivets had a shiny bright surface. Three of the four rivet heads appeared not to be installed using approved standards (rivet heads smeared). All 4 holes were elongated on the mating surface of the upper scroll (photo 1 & 2), and the surface was worn under each bracket and the inside back plate. The two upper scroll back plates were not recovered on-scene. Brown

colored material was observed on the surface of the fiberglass scroll around the outline of the back plates. The brown material appeared to be squeezed out from between the scroll and the back plate (photo 2).



Photo 1 - Upper scroll section and brackets.

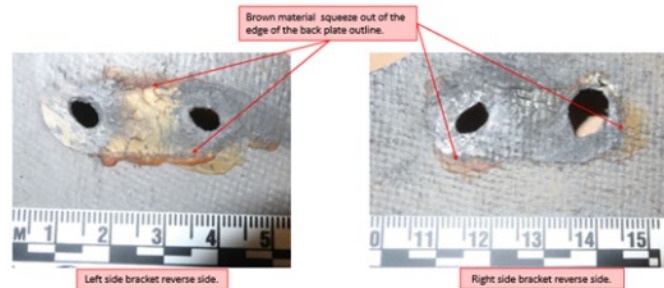


Photo 2 - Upper scroll (reverse side) closeup.

The lower bracket remained attached to the lower scroll (photos 3 & 4). Fiberglass damage was evident on the left side of the bracket (photo 3). Non factory back plates were used on the back side (photo 4). The scroll area around the lower bracket appeared to have been repaired (fiberglass repair). The paint surface on the upper portion of the bracket (bracket to bearing housing surface) had worn through on the inboard edge. Maintenance logbook entry dated November 24, 2017, noted Service Bulletin 94 (SB94) had been complied with in accordance with Service Letter 61 (SL61); however, SB94 and SL61 required a third rivet to be installed on the upper brackets which was not performed.

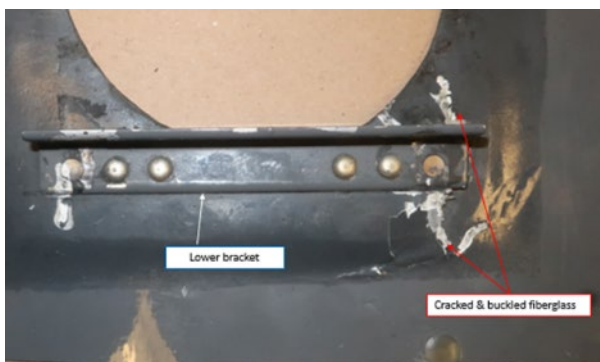


Photo 3 - Lower bracket on lower scroll section.

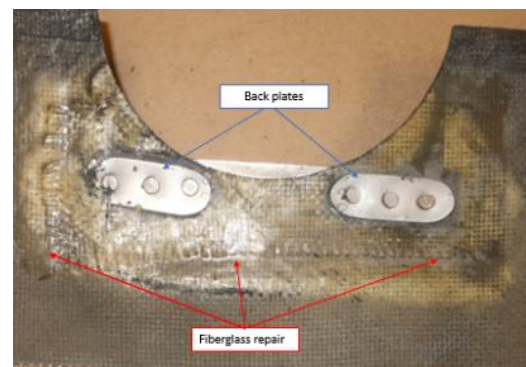


Photo 4 - Reverse side of lower scroll.

1.1 BELT TENSION ACTUATOR

On-scene documentation of the belt tension actuator showed the actuator connected to the lower bearing and drive shaft assembly. The actuator screw tube was bent, and the actuator over-travel safety shutoff switch was engaged (photo 5).

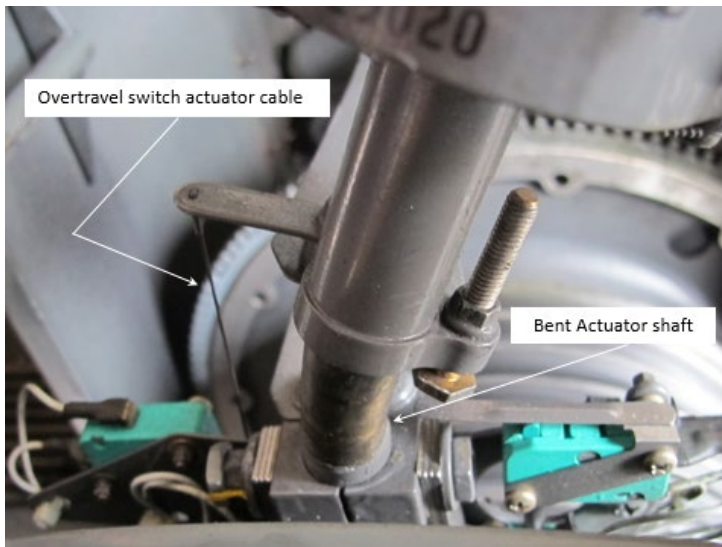


Photo 5 - Belt tension actuator

2.0 V-BELTS AND SHEAVE

The upper sheave rotated on the shaft when moved in a CW direction (looking forward, from the pilot's point of view), with a very rough movement and a grinding sound during the rotation. The sheave grooves exhibited significant rubber residue/transfer (greater than normal¹); small rubber-like spheres were present within the grooves. The forward surfaces of the sheave had a film of black dust (rubber soot) associated with normal wear. Scuff marks were identified around the aft face of the upper sheave, approximately 270° of continuous scoring on the face. The palnut² on the centering strut adjacent to the aft face of the upper sheave was bent and contact damage was observed. A single impact mark was also observed on the aft face. The forward face had black (rubber) residue around the outer circumference of the face. Per the maintenance records, Service Bulletin 79, which requires the early-revision sprag clutch lubricant be inspected for metallic debris, was not applicable because the sheave part number (rev H) was excluded from the inspection.

3.0 CLUTCH ASSEMBLY

Sprag	PN: C188-3 Rev H	SN: 10395
Shaft	PN: C166-4 Rev P (Traceability Stamp not observed)	SN: 9614
Bearing	PN: C184-2R Lot FC, RO 123722.2	SN: N/A

¹ Per the RHC technical expert present at the examination.

² A locking device for nuts usually constructed of sheet metal.

3.1 CLUTCH OIL FILTRATION

The clutch drain plug was removed. Brownish oil drained from the clutch and was passed through a 190-micron paper filter and collected (photos 6 & 7). One flake (aprox 0.10 in. in length) was observed to react to a magnet. One long black piece of debris (approx. 0.30 in long, similar to 0.5 pencil lead) also captured, and was not reactive to magnet. Multiple dark “specs” captured by filter that reacted to magnet. Oil was filtered a second time through a 190-micron filter, and numerous specs were identified visually, none of which reacted to a magnet.



Photo 6- Particles collected from the forward support bearing.



Photo 7 - Particles collected from the rear support bearing.

3.2 CLUTCH DISASSEMBLY

Sprag elements within the clutch were all present, and the inner contact surfaces were rough to the touch. Galling observed on the drive shaft area where sprags contact the surface. The sprag bearing was removed. The outer portion of the bearing/sprags elements were slightly rough to the touch. No cage damage was observed. All sprag elements remained within the cage. The sprag clutch/bearing was flushed with solvent (photos 6 & 7) and metallic flakes were captured in a 190 micron filter. The outer race of sprag bearing exhibited visual sprag element contact marks.

A detailed clutch assembly examination was conducted by the NTSB Materials Laboratory³.

3.3 CLUTCH FLUID ANALYSIS

The collected clutch fluid was sent to a commercial laboratory for analysis. The results of the analysis indicated that the viscosity and base values were consistent with ATF (automatic transmission fluid)⁴ as specified by the RHC maintenance manual. The metallic particles that were identified were associated with typical wear.

³ 20-061 Materials Lab Factual Report (ERA20LA054) located in the official docket of this investigation.

⁴ RHC MM 1.470 Lubricants. A257-4 (Dextron II, or Dextron II/Mercon, or Dextron III/Mercon, or ATF)

4.0 TIME DELAY SWITCH

The time delay switch was removed from the airframe by personnel at Air Salvage of Dallas for testing. Testing was performed at RHC with oversight by an NTSB investigator.

PN	D602-1 Lot 76 Rev D
SN	N/A

Testing Results

Test	Specification	Test Results
Resistance test	1,000 Ω	983 Ω
Time delay	0.22 - 0.39 seconds	0.297 sec

5.0 MAINTENANCE DOCUMENTATION

The Hobbs time recorded from the helicopter after the accident was 3439.76 hrs.

5.1 HELICOPTER MAINTENANCE LOGBOOK

A review of the helicopter maintenance records found the following:

Date	Record Summary	Hobbs Time (hrs)
May 5, 2016	Complete helicopter overhaul per RHC guidance. Engine replaced and fan balanced.	2200.0
June 2, 2017	Annual inspection included selected items from the 500-hour inspection. Did not include an entry for flushing of the clutch assembly.	2692.93
October 23, 2017	100-hour inspection. Work Order 6735 included replacement of sprag clutch fluid.	2793.08
November 24, 2017	SB-94 was complied with by inspection and repair of lower fan shroud IAW R44 SL-61.	2813.78
February 13, 2019	Annual inspection included selected items from the 500-hour inspection. Did not include an entry for flushing of the clutch assembly.	3180.07
September 21, 2019	100-hr inspection. Last entry in the airframe maintenance logbook.	3380.27

Table 1 - Selected entries from the maintenance log books.

The A&P mechanic who performed all the maintenance after the overhaul in May 2016 could not provide additional information or work orders to confirm that the 500-hour clutch assembly lubricant inspection and servicing (RHC MM §7.210) was performed at the required time (3200 hrs).

5.2 RHC MAINTENANCE GUIDANCE

SB-94, dated 8 June, 2017 is addressed to R44 series owners, Operators, and Maintenance Personnel. The bulletin directs the inspection of the A185 brackets for evidence of fretting or looseness. Loose brackets can allow lower bearing to misalign resulting in belt-tension actuator damage.

SL-61A, dated 21 July, 2017 is addressed to R44 series owners, Operators, and Maintenance Personnel. The service letter directs actions to be performed whenever looseness of an A185 bracket is detected and whenever the upper or lower scroll is removed. To comply with SL-61A a third middle rivet is to be placed on each upper bracket.

RHC MM §2.410, 100-hour inspection requires inspection of the lower actuator bearing including inspection of the fiberglass scroll area at the bearing attachment brackets for signs of cracking, and the lower bearing brackets for looseness and wear.

RHC MM Maintenance schedule requires the performance of clutch assembly lubricant inspection and servicing per §7.210 every 500 hours. The lubricant inspection involves the straining of the lubricant thru a 180-200 micron filter/strainer and inspecting for metal debris trapped by the filter. If metal debris is captured by the filter, the clutch assembly is to be replaced or overhauled.

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