NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

April 16, 2012

MATERIALS LABORATORY FACTUAL REPORT Report No. 12-045

A. ACCIDENT INFORMATION

Place	:	Las Vegas, Nevada
Date	:	December 7, 2011
Vehicle	:	Eurocopter AS350-B2, N37SH
NTSB No.	:	DCA12MA020
Investigator	:	Carol Horgan, AS-40

B. COMPONENTS EXAMINED

Engine parts:
- Axial compressor nose cone
- Section of metal tube
- Freewheel shaft (2 pc)
- Bolt, freewheeling shaft to power shaft
- PTO flange bolts
- Transmission shaft inside linking tube with input pinion to main rotor
- Muff coupling

C. DETAILS OF THE EXAMINATION

The axial compressor nose cone shown at left in figure 1 was deeply scored around its entire outer surface. X-ray fluorescence analysis (XRF) of undamaged areas found the material composition to be similar to that of AA 6061. Addition XRF testing in the damaged regions did not identify any transferred material.

The material of the as-received metal tubing shown at right in figure 1 was identified as an AISI 300 series stainless steel by XRF. Areas of the tube were crushed and exhibited significant rubbing damage. XRF in the rubbed areas identified significant amounts of titanium that were not present in undamaged areas.

The freewheeling shaft, shown in figure 2, was fractured near its forward end as indicated. Microscopic examinations of the fracture revealed fracture and deformation patterns consistent with a bending overstress separation. No indications of torsional deformation were noted in the fracture or surrounding area. A contact mark and deformation area was located approximately 1 inch aft of the fracture. Close examinations found the contact mark to be consistent with stationary (non-rotational) contact with a mating object with the deformation centered at the contact.

The freewheeling shaft to power shaft bolt was fractured through the threads and bent at about mid-grip as shown in figure 3. Microscopic optical viewing of the fracture revealed fracture features and deformation patterns consistent with a bending overstress separation through the threads.

Two of the three PTO flange bolts were received in the flange as shown in figure 4. Both bolts were fractured through the grips adjacent to the bolt heads. Microscopic examinations of both fractures uncovered fracture features and deformation patterns consistent with predominately tensile overstress forces.

The transmission input shaft assembly and surrounding linking tube are shown in figure 5. The forward portion of the freewheeling shaft was attached to aft end of the assembly. The input shaft was fractured inside the linking tube adjacent to both the forward and aft coupling flanges. The fractures were located inside the linkage tube and not directly accessible. The forward fracture appeared typical of compression buckling of the tube and the aft fracture was consistent with bending. No significant rotational markings were visible inside the linkage tube.

The muff coupling is displayed in figure 6. The outer surface had some minor circumferential surface scoring indicative of rotational contact. On the interior, the spline spacers on the forward side were crushed and flattened. The splines on both the forward and aft sides of the coupling were generally undamaged except for rotational contact and smearing on the visible ends of the splines

Joe Epperson
Senior Metallurgist

Figure 1. The nose cone at left showing rotational marking and the crushed and abraded tube at right.

Figure 2. The freewheeling shaft with the fracture at the left end

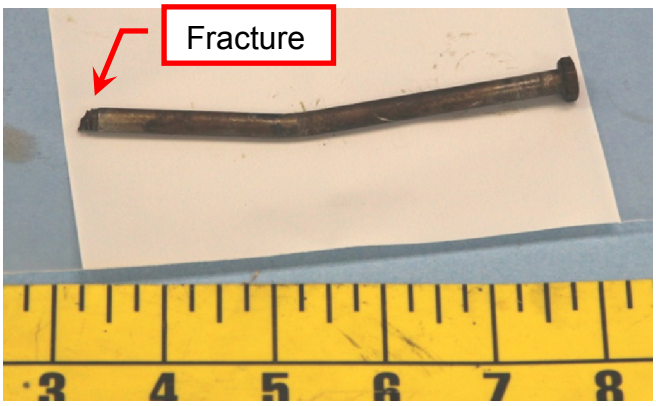

Figure 3. The freewheeling shaft to power shaft bolt with overstress fracture at left end.

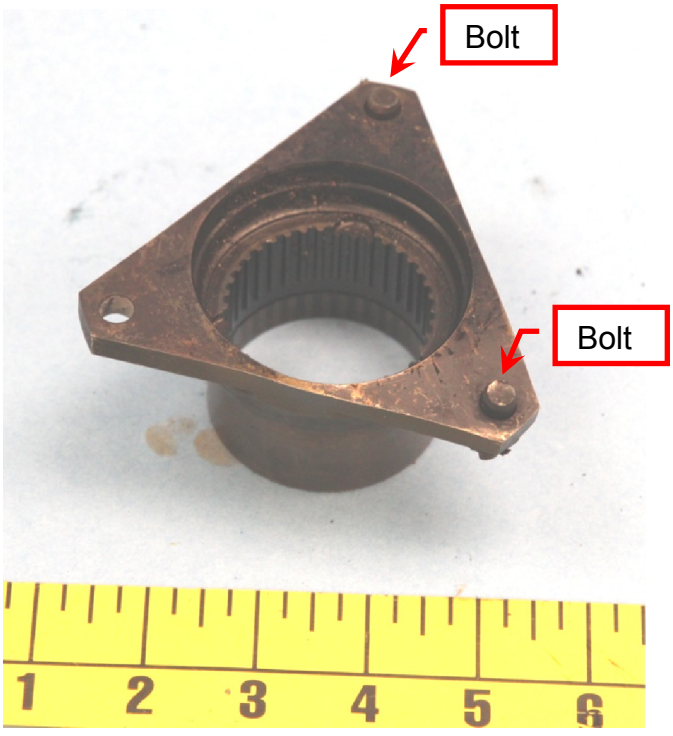

Figure 4. The PTO flange with two broken bolts.

Figure 5. The fractured transmission input shaft inside the linking tube

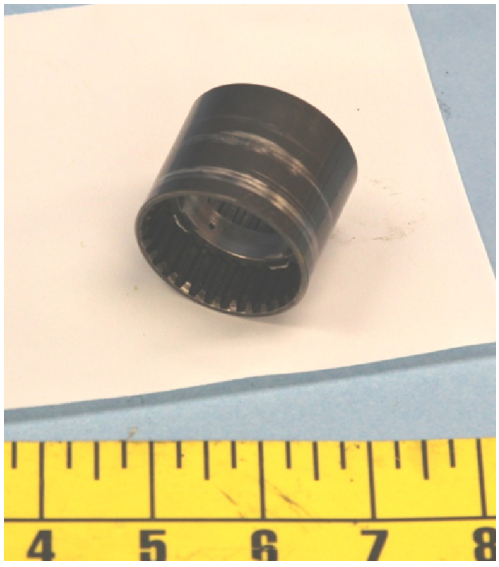

Figure 6. The muff coupling.