

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ANC24LA064

MATERIALS LABORATORY

Factual Report 25-049

July 22, 2025

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A. ACCIDENT INFORMATION

Location: Petersville, Alaska
Date: July 12, 2024
Vehicle: Dehavilland DHC-2T (N535KT)
Investigator: Mark Ward (AS-ANC)

B. COMPONENTS EXAMINED

Pieces of a beta switch assembly from a Pratt and Whitney Canada (P&WC) PT6A-34 Engine, including:¹

- Propeller slip ring
- Carbon block and yoke
- Sliding clamp block and cam rod
- Potentiometer and microswitch bracket

C. EXAMINATION PARTICIPANTS

Specialist Brian Fuchs
 National Transportation Safety Board, RE-30
 Washington, D.C.

D. DETAILS OF THE EXAMINATION

Components from a beta switch assembly from a P&WC PT6A-34 turboprop engine were submitted to the Materials Laboratory for examination. Figure 1 shows the as-received components and Figure 2 shows an assembly schematic for these components. Figure 3 is a picture taken of the assembly during a post-accident examination, showing that the assembly was consistent with the schematic drawing. As discovered during the examination, the cam rod and the guide rail on the potentiometer bracket were bent; per the investigator-in-charge, these parts were straightened by the operator and intended for return to the field prior to entering custody of the NTSB (Figure 4). As a result, the components did not exhibit the same degree of bending deformation at the time of the examination.

In operation, this assembly is part of the variable-pitch-propeller system that controls the pitch of the propeller blades. The slip ring is a spinning component that moves aft and forward as part of the pitch control system. The cam rod is connected to a carbon block that rests inside the c-channel around the outside of the slip ring. As the ring moves forward, the cam rod engages a mechanical microswitch housed in the potentiometer bracket. The cam rod feeds through a t-bushing in the bracket which restricts lateral movement of the rod. As discovered during examination of the

¹ Part names adapted from "Turbo Beaver, Model DHC-2 MK 111, Maintenance Manual," revised 1 June 1970.

accident aircraft, the slip ring was in a far-forward position and the cam rod was outside of the bushing. The end of the rod rested against the forward face of the bushing.

The components were examined visually. The circumferential c-channel of the slip ring was 0.505 inches wide and showed black residue on all inner faces. The number "24533" was engraved into one of the three legs on the forward face of the ring. The outside edge of the forward flange was worn. Figure 5 shows the damage at the edge of the flange. The damaged area appeared smeared and pitted, consistent with hard contact. This smearing extended around most of the circumference of the ring, with a width of approximately 0.02 inch. The width of the smeared area was mostly constant, except for an approximately 1-inch long segment where the width reduced to 0 inch.

Figure 6 shows the carbon block and yoke. The carbon block had a thickness of 0.497 inch. The upper and lower surfaces of the block showed scratches and wear consistent with expected normal use. The Y-shaped metal yoke showed damage in two locations; a groove was visible in each leg of the 'Y'. Both grooves had smeared, shiny surfaces, consistent with hard contact. At their widest point, the grooves were approximately 0.04 inch wide. The directionality of the smearing and position of the grooves were consistent with the legs contacting the edge of the slip ring as the ring was spinning.

The sliding clamp block and cam rod were submitted as a single assembly. The cam rod was threaded through a nut and the clamping block. The end of the cam rod was chamfered; per the manufacturer, the rod was normally manufactured with a flat end. The chamfer was approximately 45° off-axis of the rod, and the flat face had a smeared appearance consistent with hard contact. The rod was approximately 4.6 inches long from the lower end of the chamfer to the end of the threaded section, and approximately 3.8 inches from chamfer to the nut. The total length of the rod including the chamfered end was approximately 4.8 inches. The rod was mostly black or brown in appearance, with shiny, silver-colored sections consistent with surface wear (Figure 7). The worn areas corresponded to sections that were expected to be in contact with other components during normal use. A wear strip along the cam was consistent with the location of a microswitch housed in the bracket. The rod was silver in color at the chamfered end; this extended 1.2 inches towards the cam. This was consistent with the section of the rod that fed into the t-bushing during normal use.

The potentiometer and microswitch bracket is shown in Figure 8. Silver-colored surface wear was visible along the guide for the clamp block. Shallow gouges were visible on the surface of the t-bushing inside the bracket (Figure 9). These gouges were located towards the outside of the bracket, approximately where the chamfered end of the rod was resting in the field images taken post-accident. The

potentiometer was missing the slide rod insert (Figure 10); the slide rod was not recovered.

Submitted by:

Brian Fuchs
Materials Engineer

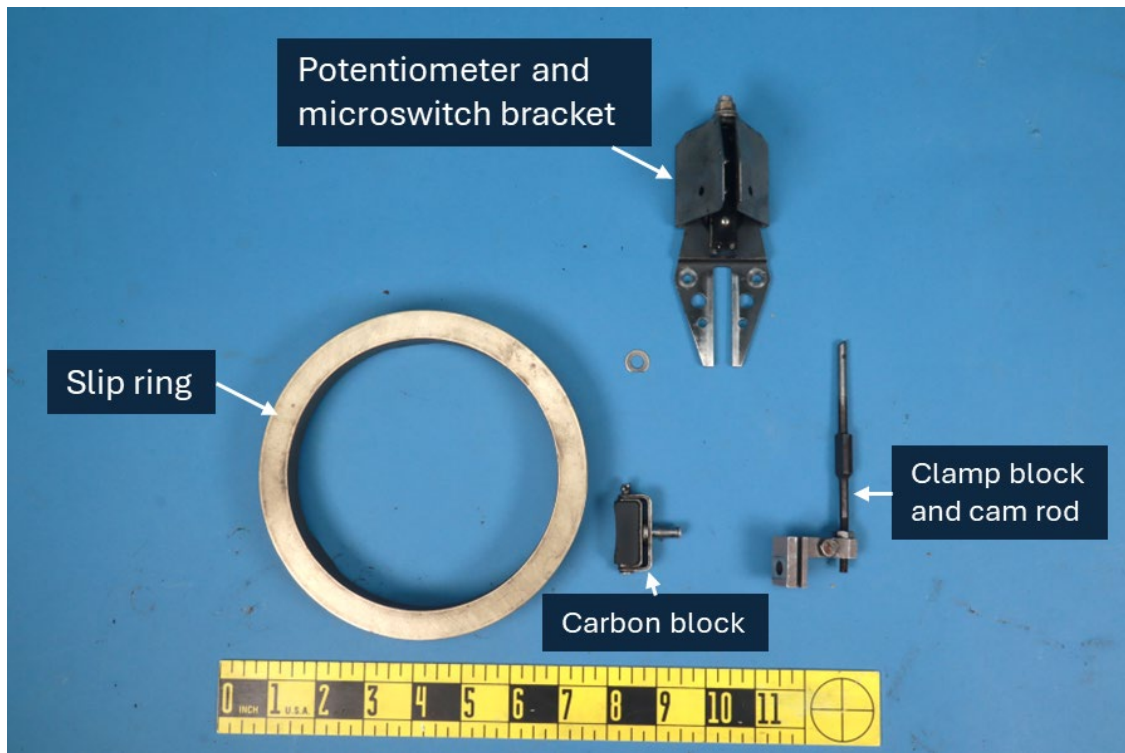


Figure 1. Components submitted for examination.

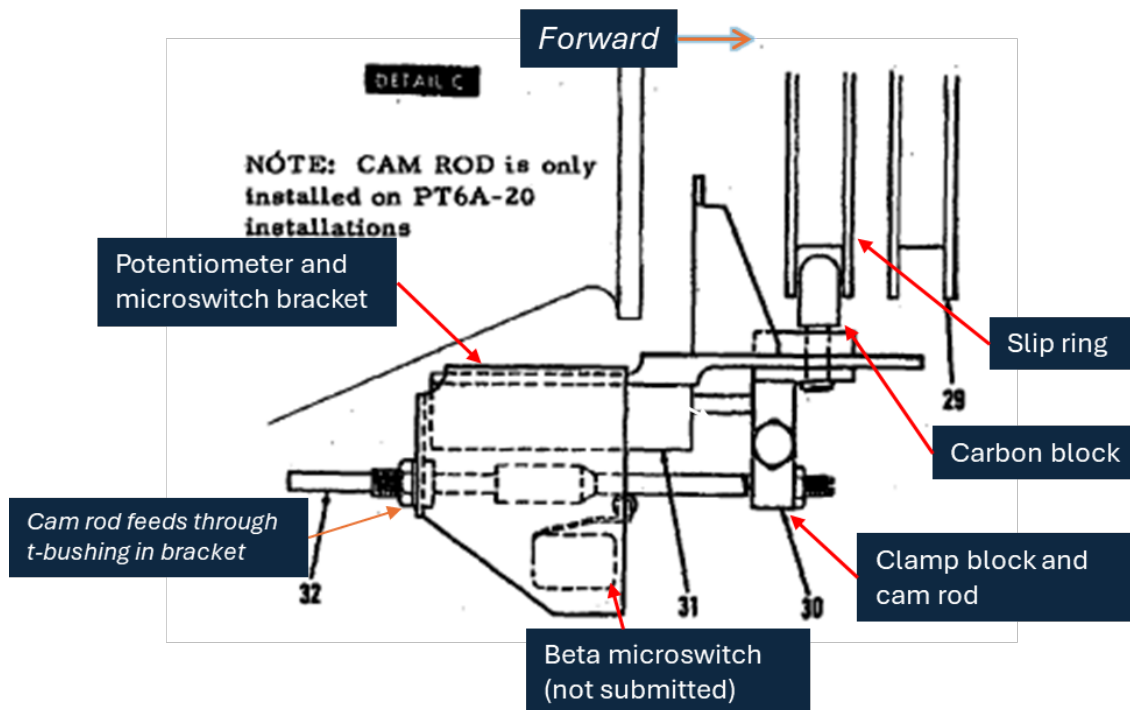


Figure 2. Schematic of the beta switch assembly²

² Image adapted from "Turbo Beaver, Model DHC-2 MK 111, Maintenance Manual," revised 1 June 1970.

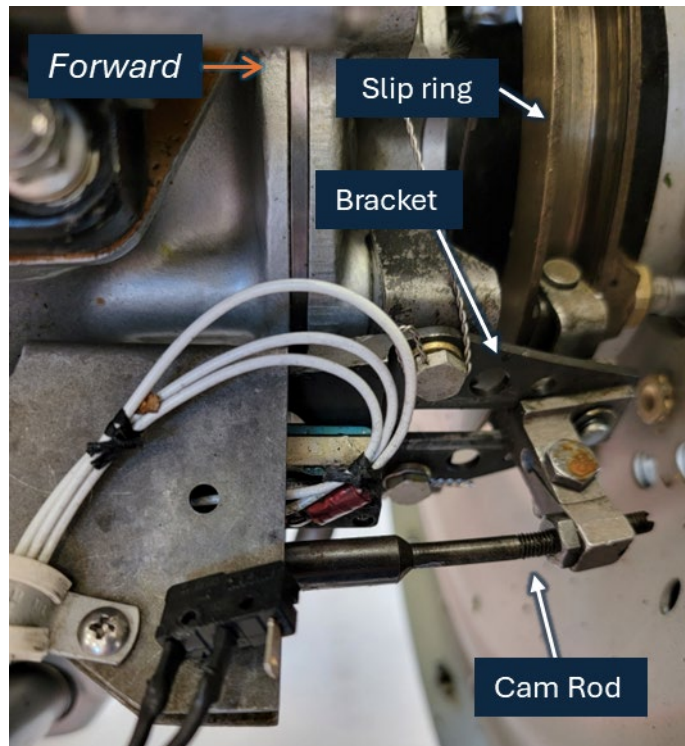


Figure 3. Beta switch assembly as found during engine examination. The bracket and cam rod were bent (NTSB photo).

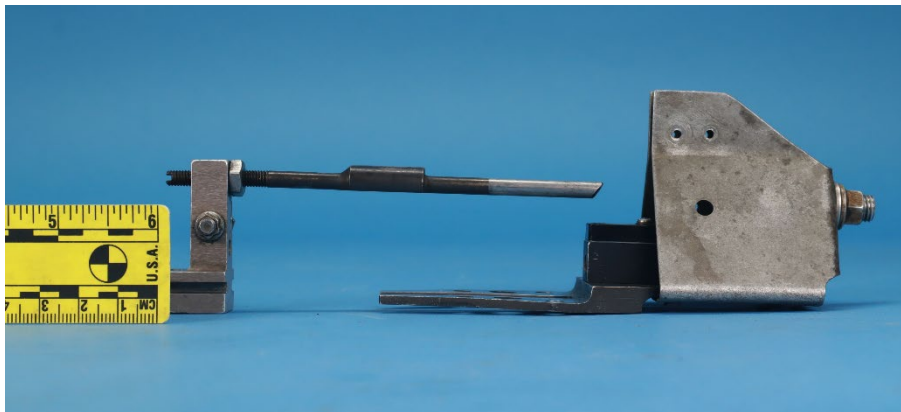


Figure 4. Cam rod and potentiometer bracket as submitted to the laboratory. The pieces had been re-straightened after the engine examination.

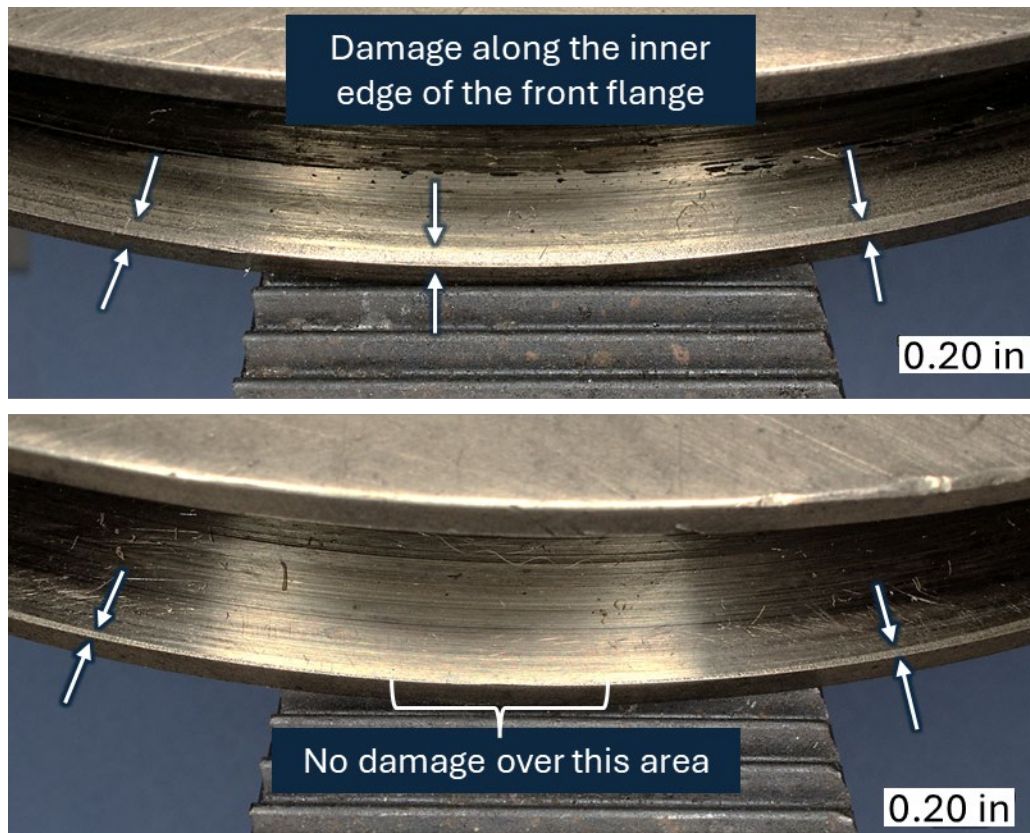


Figure 5. (Top) Smearing and pitting damage along the edge of the c-channel of the slip ring, indicated by white arrows. (Bottom) Section where no damage was seen.



Figure 6. The carbon block and yoke. White arrows indicate grooves found on the yoke.

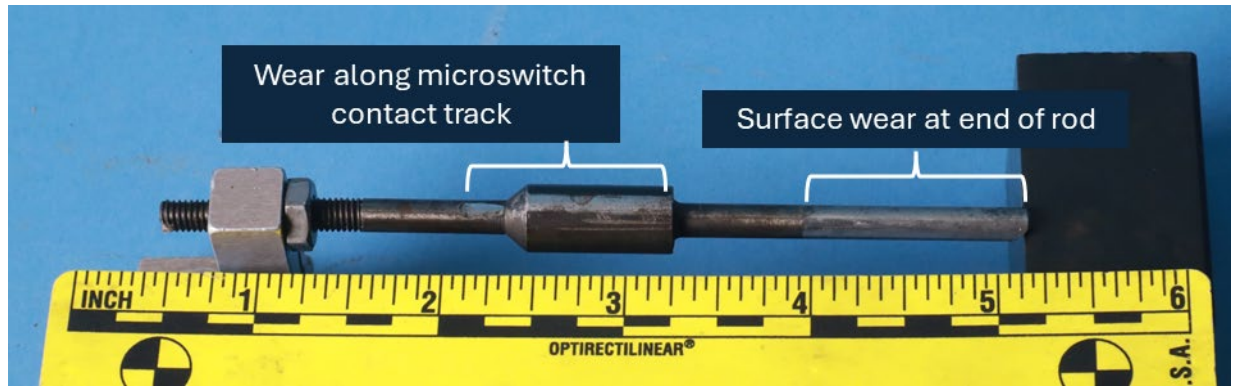


Figure 7. Surface wear along the cam rod.

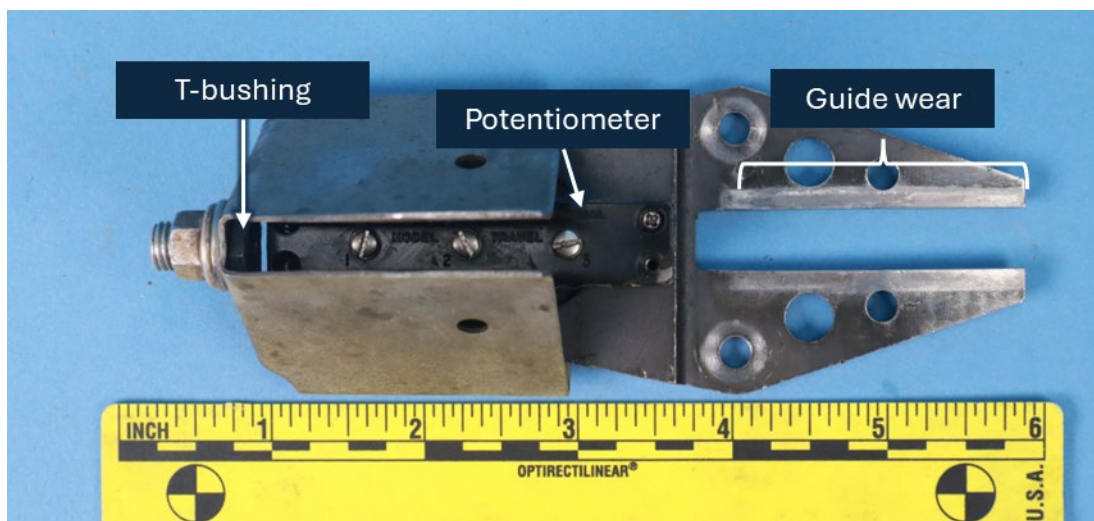


Figure 8. Microswitch and potentiometer bracket.

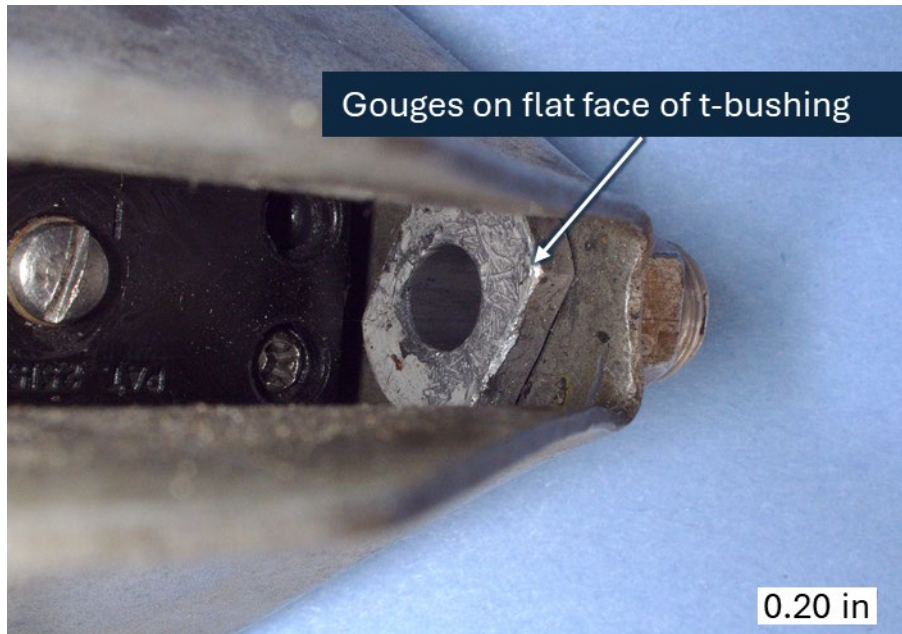


Figure 9. Gouges on the surface of the t-bushing, in the area where the end of the cam rod was in contact with the bushing.



Figure 10. The potentiometer slide rod was not recovered.