

NATIONAL TRANSPORTATION SAFETY BOARD

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



November 20, 2017

MATERIALS LABORATORY FACTUAL REPORT

Report No. 17-084

A. ACCIDENT INFORMATION

Place : Myrtle Beach, South Carolina
Date : July 24, 2017
Vehicle : Robinson R44, N828RD
NTSB No. : ERA17LA257
Investigator : Timothy W. Monville, AS-ERA

B. COMPONENTS EXAMINED

Valve train components from the number 4 and number 5 cylinders of an O-540-F1B5 engine.

C. DETAILS OF THE EXAMINATION

An overall view of the submitted valve train components from the numbers 4 and 5 cylinders are shown in figure 1. Components from both cylinders included the intake and exhaust tappet bodies, plunger assemblies, and sockets and the exhaust valves, rotator caps, keys, and spring seats from both cylinders. The rocker arm, pushrod, and pushrod housing were also included from the number 5 cylinder, and the valve springs, intake valve, and intake key were included from the number 4 cylinder.

The head of the number 5 exhaust valve was covered with tan-colored deposits up to the position corresponding to the end of the valve guide as can be seen at the left side of the image in figure 2. The valve seat contact area was free of deposits and had a uniform contact pattern with no evidence of excessive impact. The area next to the tan-colored deposits on the valve stem was tinted black and brown. Around the circumference, the number 5 exhaust valve stem had black streaks generally oriented in the longitudinal direction near the upper end of the tinted region as indicated with a bracket in figure 2. No evidence of galling was observed on the stem, and no change in surface roughness was detected by rubbing a fingernail across the black streaks. Curved impact marks were observed on the face of the valve tip as indicated with arrows in figure 3. The shapes of the impact marks were consistent with multiple impacts with the edge of the displaced rotator cap.

The valve contact pad on the number 5 exhaust rocker arm is shown in figure 4. An area of pitting consistent with fretting contact damage was observed at the edge of the shiny contact area on the pad as indicated in figure 4.

The number 5 exhaust pushrod was bent and fractured as shown in figure 1. Fracture features on the pushrod pieces were obliterated by post-fracture contact between the mating fractures. The rocker arm and socket ends of the pushrod are shown in figure 5. Gouges consistent with contact damage with the edge of the rocker arm seat and with the edge of the cylinder flange were observed on the side of the pushrod at the rocker arm end as indicated in figure 5. The contact damage closest to the end of the pushrod was located in line with the inner radius of the bend. The wear pattern at the socket end of the pushrod was angled relative to the longitudinal axis of the pushrod. The wear pattern was consistent with the pushrod axis angled relative to the socket axis, and the orientation of the angle was consistent with the orientation of the bend in the pushrod.

The pushrod housing was fractured near the middle of its length as shown in figure 1. Rough fracture features with adjacent deformation of the housing wall was consistent with fracture due to overstress loads. Rub marks consistent with contact with the pushrod were observed on the interior of the pushrod housing. The inboard end of the pushrod housing where it was inserted in the crankcase is shown in figure 6. Arrows in figure 6 indicate areas of impact damage with missing material at the end of the pushrod housing. The position and geometry of the damage was consistent with contact with the edge of the tappet socket, also shown in figure 6. Corresponding contact marks and material transfer were observed on the edge of the socket.

The head of the exhaust valve from the number 4 cylinder was covered in tan deposits on the head area and black deposits on the stem portion up to the valve guide position. The deposits appeared relatively thicker than the deposits on the number 5 cylinder. The valve seats contact faces were uniform with no deposits or evidence of abnormal contact. The middle portion of the stem was tinted black and brown and was smooth with no evidence of galling or surface deposits.

The intake valve head was covered with dark gray and black deposits up to the location corresponding to the end of the valve guide. The valve seat contact area was uniform and free of deposits or abnormal contact patterns. The underside of the valve tip corresponding to the key contact area was free of impact damage, and no deformation lip was observed.

The springs, spring seats, tappet sockets, and tappet bodies were examined, and no abnormal signatures were observed. The tappet plunger assemblies were disassembled, wiped clean of oil, and then reassembled. In each case, the plunger was inserted into the cylinder, compressed, and released. In each case, the plunger sprung back to the extended position.

Matthew R. Fox, Ph.D.
Senior Materials Engineer

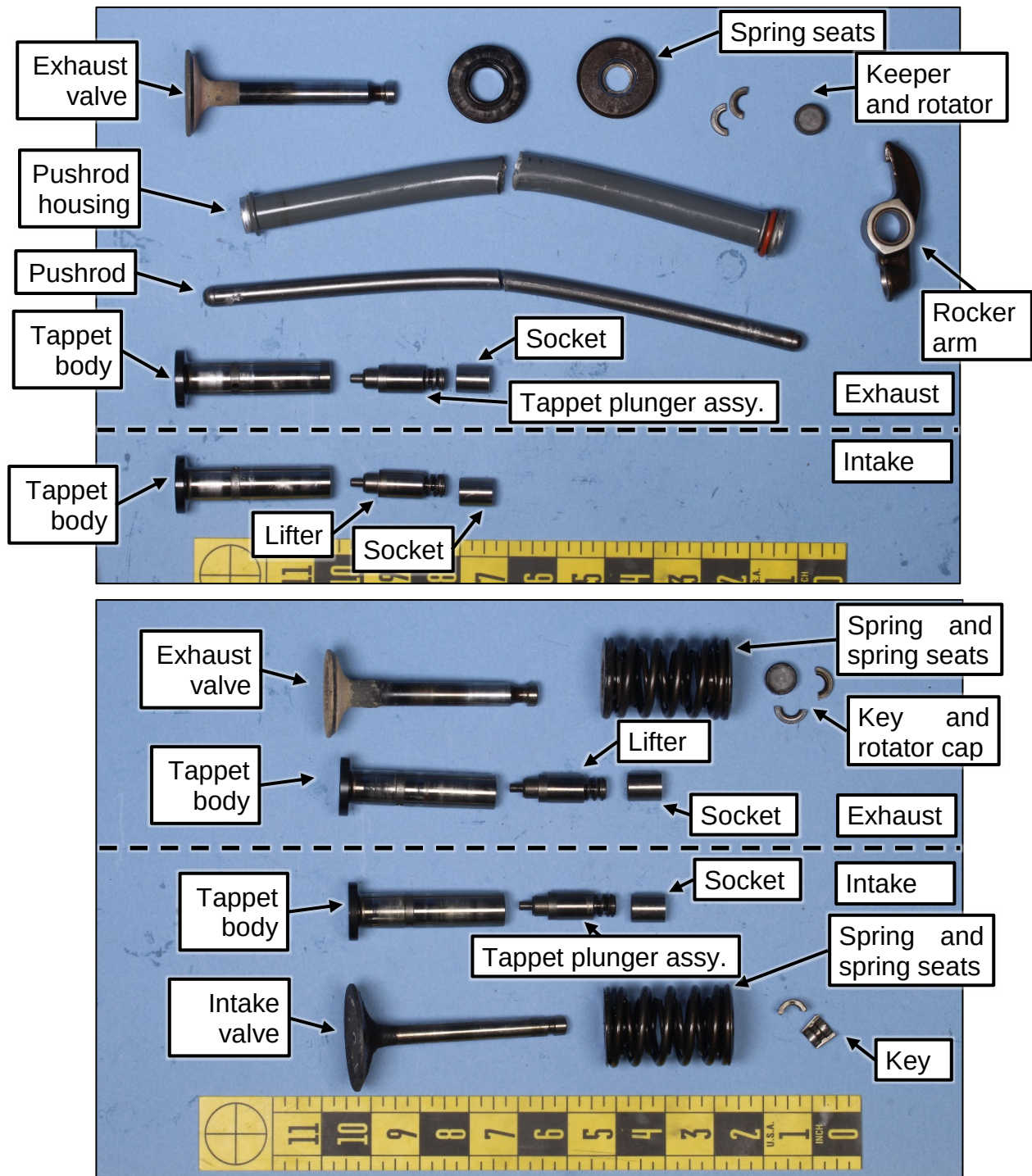


Figure 1. Overall view of the submitted valve train components from the number 5 cylinder (upper image) and the number 4 cylinder (lower image).

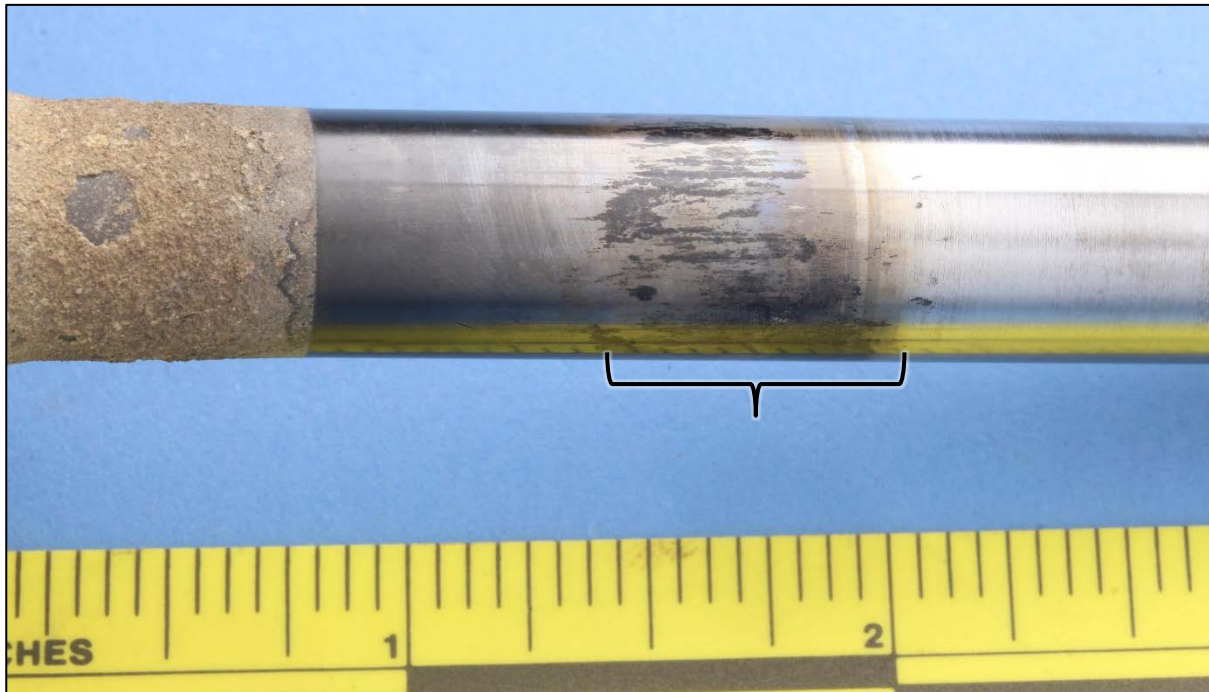


Figure 2. Number 5 exhaust valve stem. A bracket indicates an area with glazed black streaks on the surface.

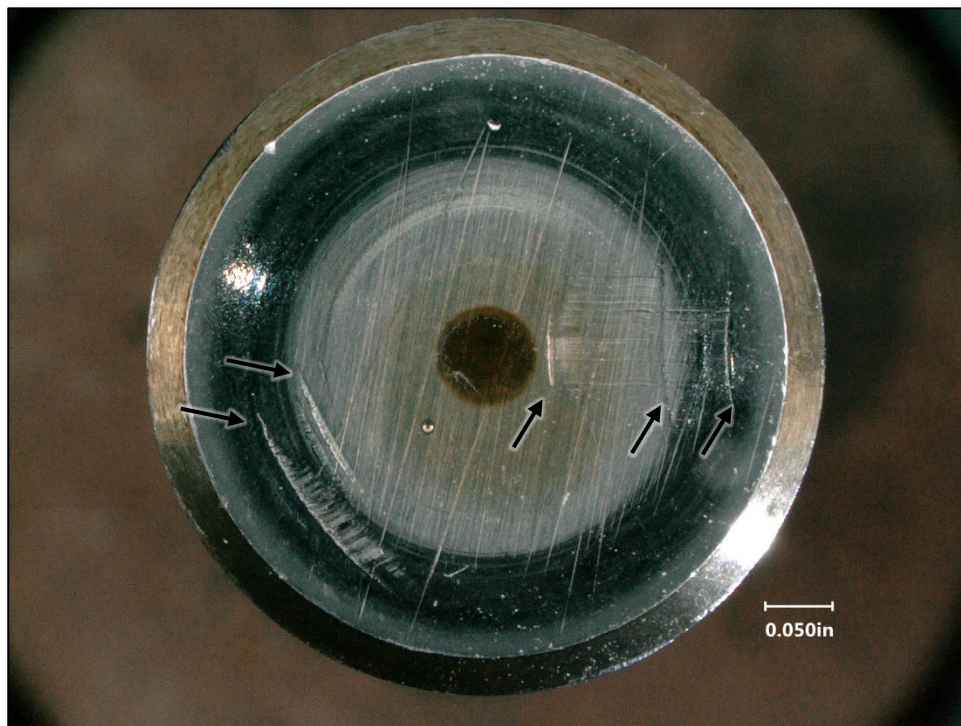


Figure 3. Number 5 exhaust valve tip. Arrows indicate arc-shaped impacts consistent with contact with the rotator cap edge.

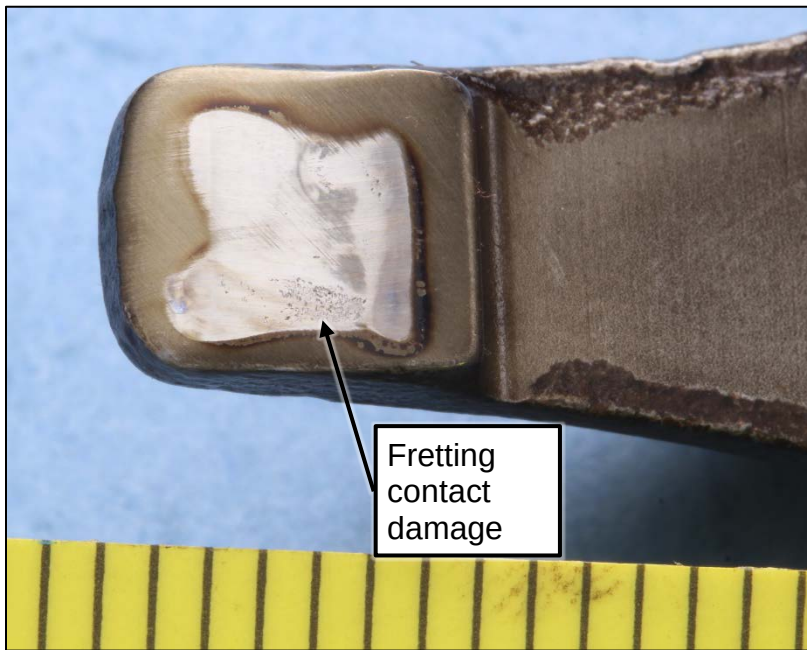


Figure 4. Number 5 exhaust rocker arm pad.

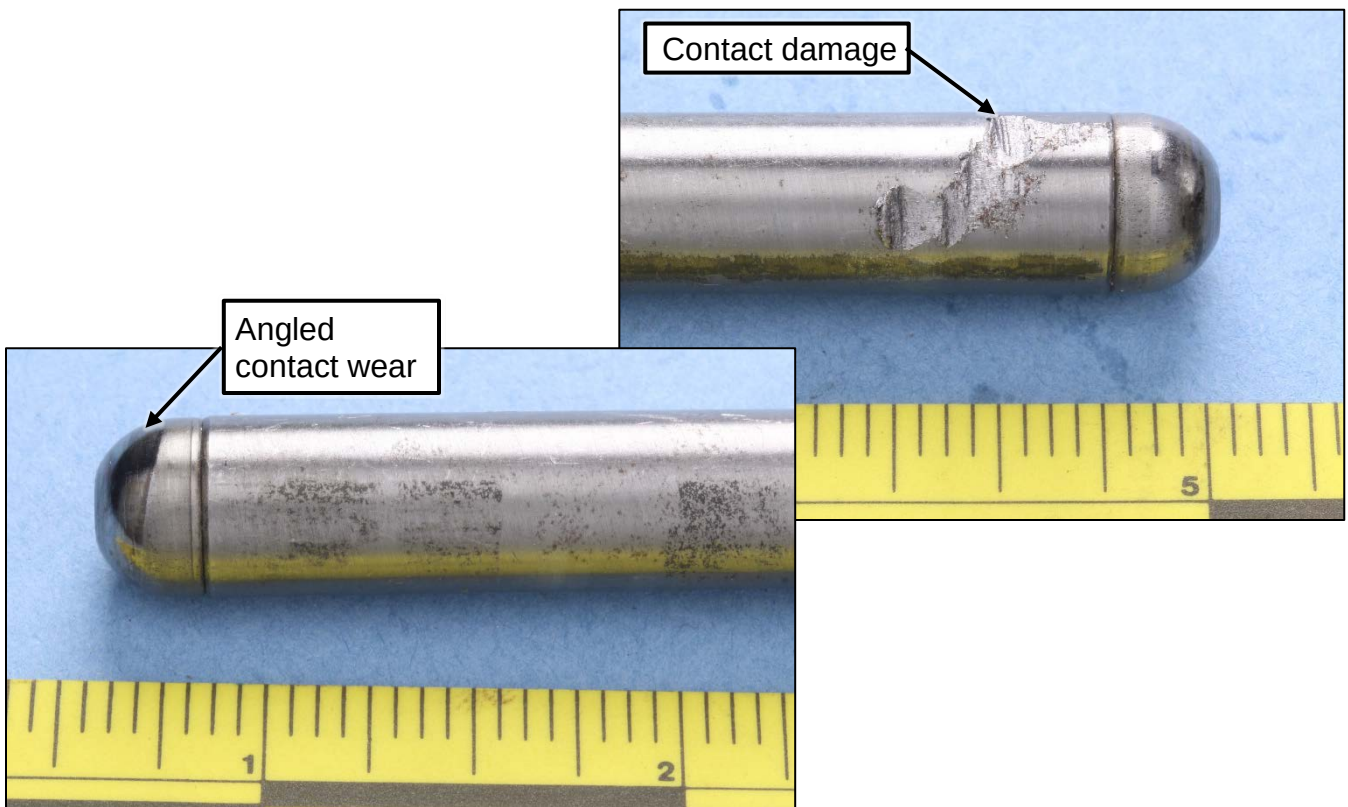


Figure 5. Rocker end (upper image) and tappet end (lower image) of the number 5 exhaust push rod. Contact damage and angled contact wear patterns are indicated.

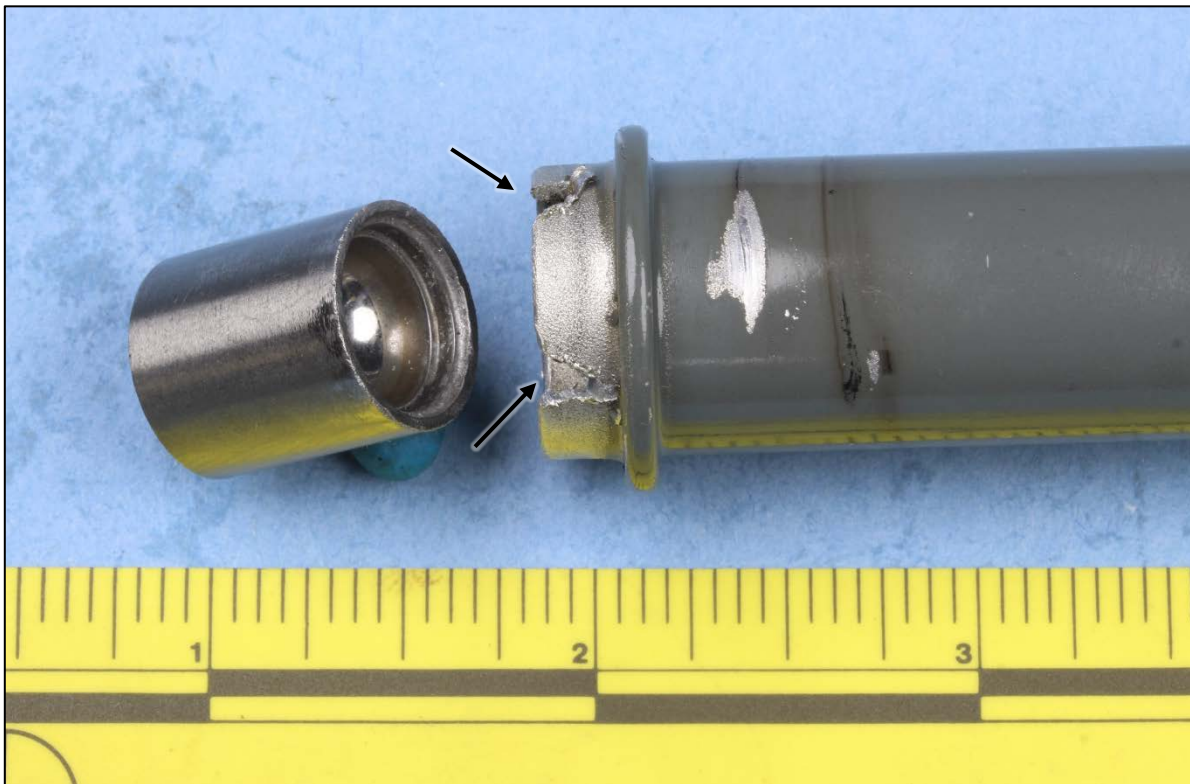


Figure 6. Number 5 exhaust tappet socket and crankcase end of the pushrod housing. Arrows point to contact damage to the pushrod housing corresponding to contact with edges of the tappet socket.