

NATIONAL TRANSPORTATION SAFETY BOARD

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



November 23, 2020

MATERIALS LABORATORY FACTUAL REPORT

Report No. 20-061

A. ACCIDENT INFORMATION

Place : San Antonio, TX
Date : December 14, 2019
Vehicle : Robinson R44, N440AH
NTSB No. : ERA20LA054
Investigator : Van McKinney (AS-40)

B. COMPONENTS EXAMINED

Clutch assembly bearings (1 sprag clutch bearing and 2 support bearings)

C. DETAILS OF THE EXAMINATION

The clutch assembly was submitted in disassembled condition, with the front and rear support bearings and the sprag clutch bearing removed from the shaft. The components, as well as containers of particulates collected during disassembly, are shown in Figure 1.

The parts were examined visually and with a 5x to 50x digital microscope. The race on the shaft that mated to the sprag clutch had extensive damage, as shown in Figures 2 and 3. Smearing and galled material were observed on the race. Impressions on the race, outlined by yellow dotted lines in Figure 3, matched the profile of the inner surfaces of the mating sprags.

The inner surfaces of the sprags also had heavy smearing damage, as shown in Figure 4. Orange arrows point to material that was pushed to the edges of the sprags in the direction of rotation of the bearing. Damage to the outer surfaces of the sprags was less extensive than compared to the inner surfaces, with light smearing and some gouges, as shown in Figure 5. Numerous metallic particles were observed in the gaps between the cage and the sprags of the sprag clutch bearing (blue arrows).

The front and rear support bearings are shown in Figure 6. The bearings were examined with a 5x to 50x digital microscope prior to disassembly. Small areas of damage were visible on the races of the bearing rings. A few metallic particles were observed inside both bearings, as indicated by the blue arrows in Figure 7.

The front and rear support bearings were cross-sectioned, disassembled, cleaned, and re-examined. The races of inner and outer rings from both bearings had several areas of damage, as shown in Figures 8 and 9. The mating balls had some light scratches.

The damage on the support bearing races was examined using a using a Zeiss Auriga 40 field emission (FE) scanning electron microscope (SEM). Dents and some gouges were observed on the races of the bearing rings. The damage was consistent with particle ingestion. No evidence of rolling contact fatigue was observed on the front or rear support bearing ring races.

Adrienne V. Lamm
Materials Engineer

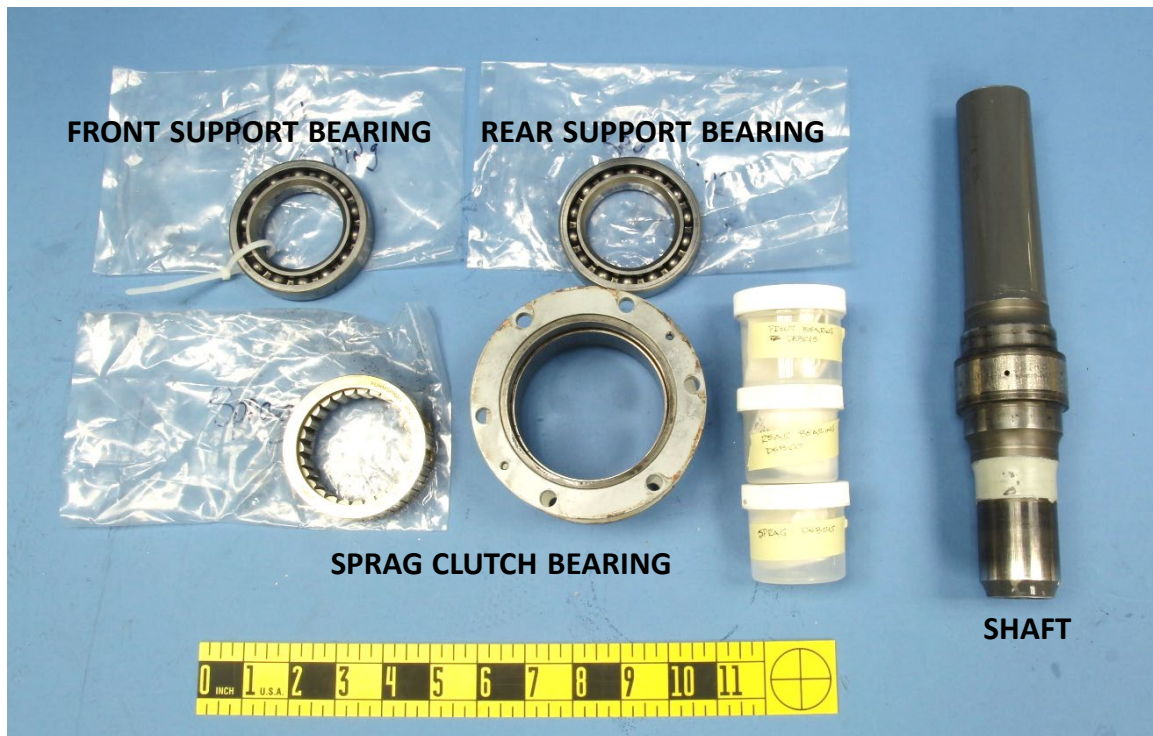


Figure 1: Overall photo showing the submitted components from the sprag clutch assembly.

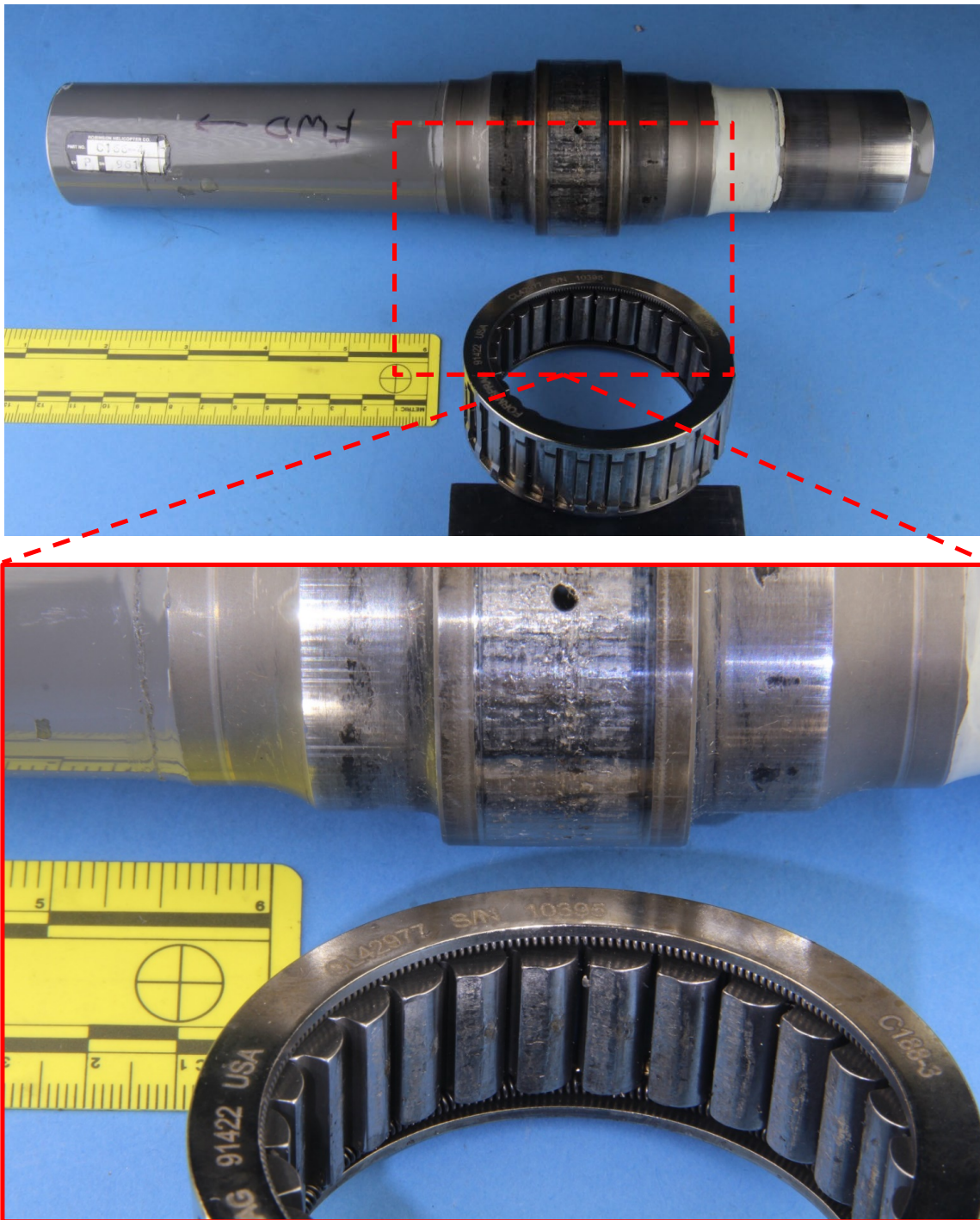


Figure 2: Overall (top) and close-up (bottom) photos showing the shaft race and inner surfaces of the sprags.

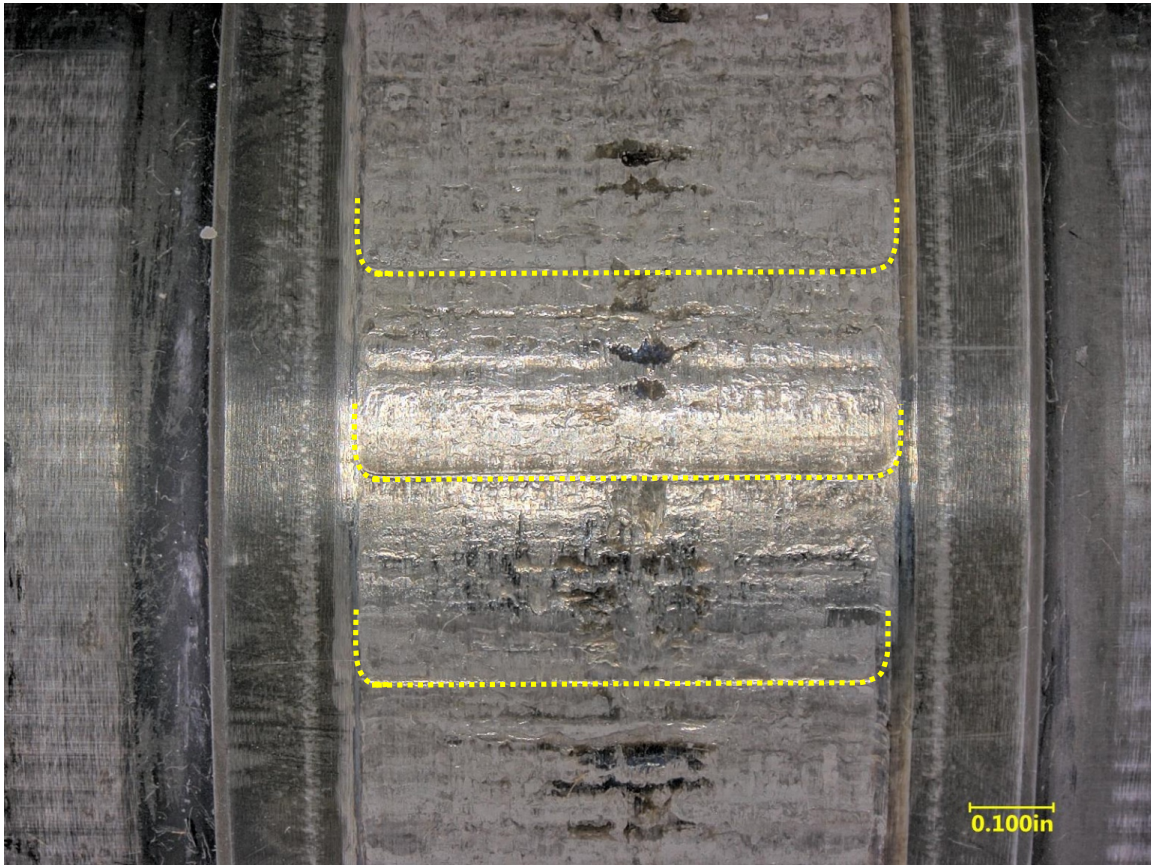


Figure 3: Digital microscope image of the race on the shaft that mated to the sprag clutch bearing. The yellow dotted lines outline impressions on the race.

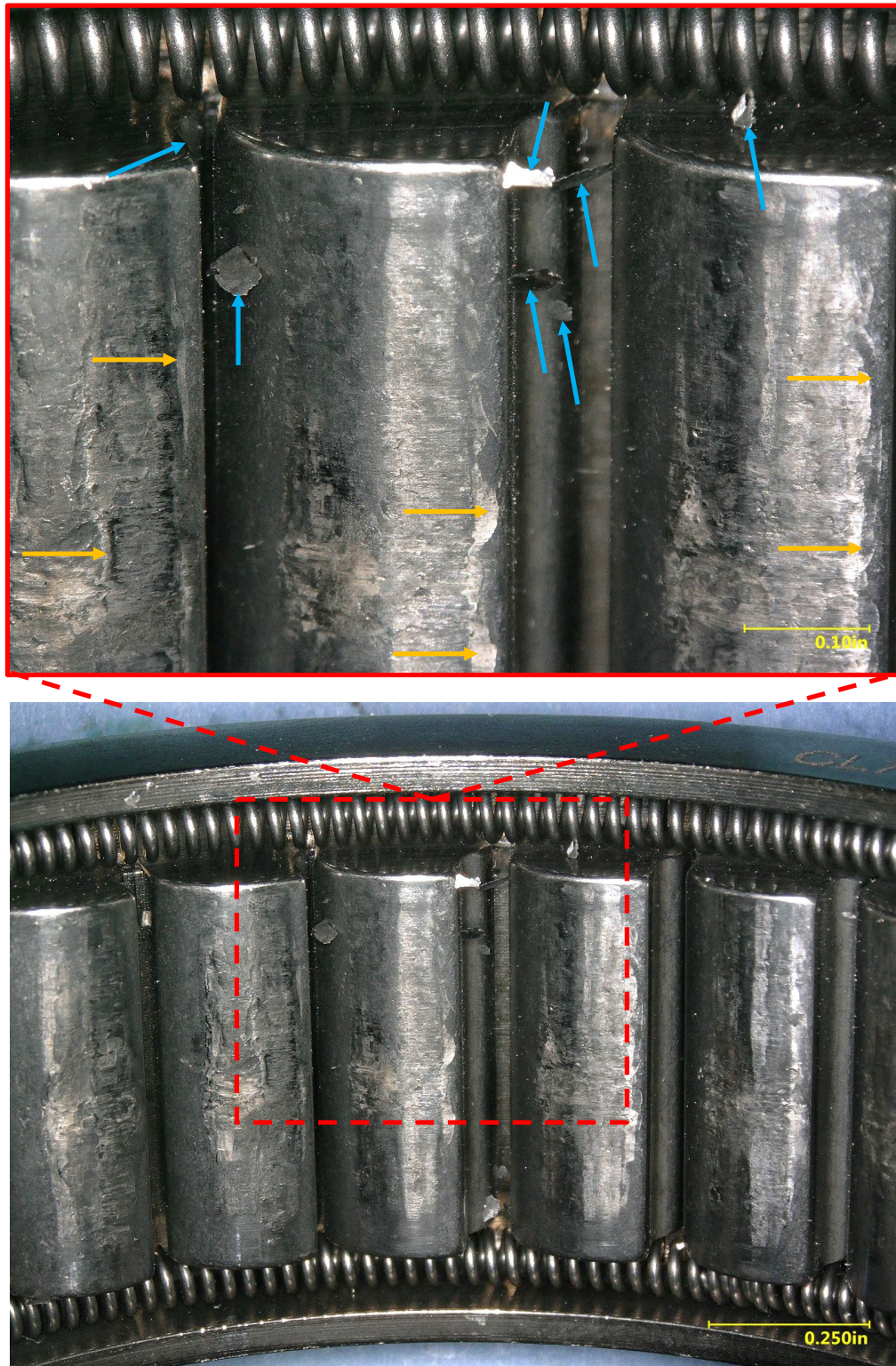


Figure 4: Digital microscope images of the inner surfaces of the sprags. The orange arrows point to material pushed to the edges of the sprags. Blue arrows point to metallic particles in the gaps between the cage and the sprags.

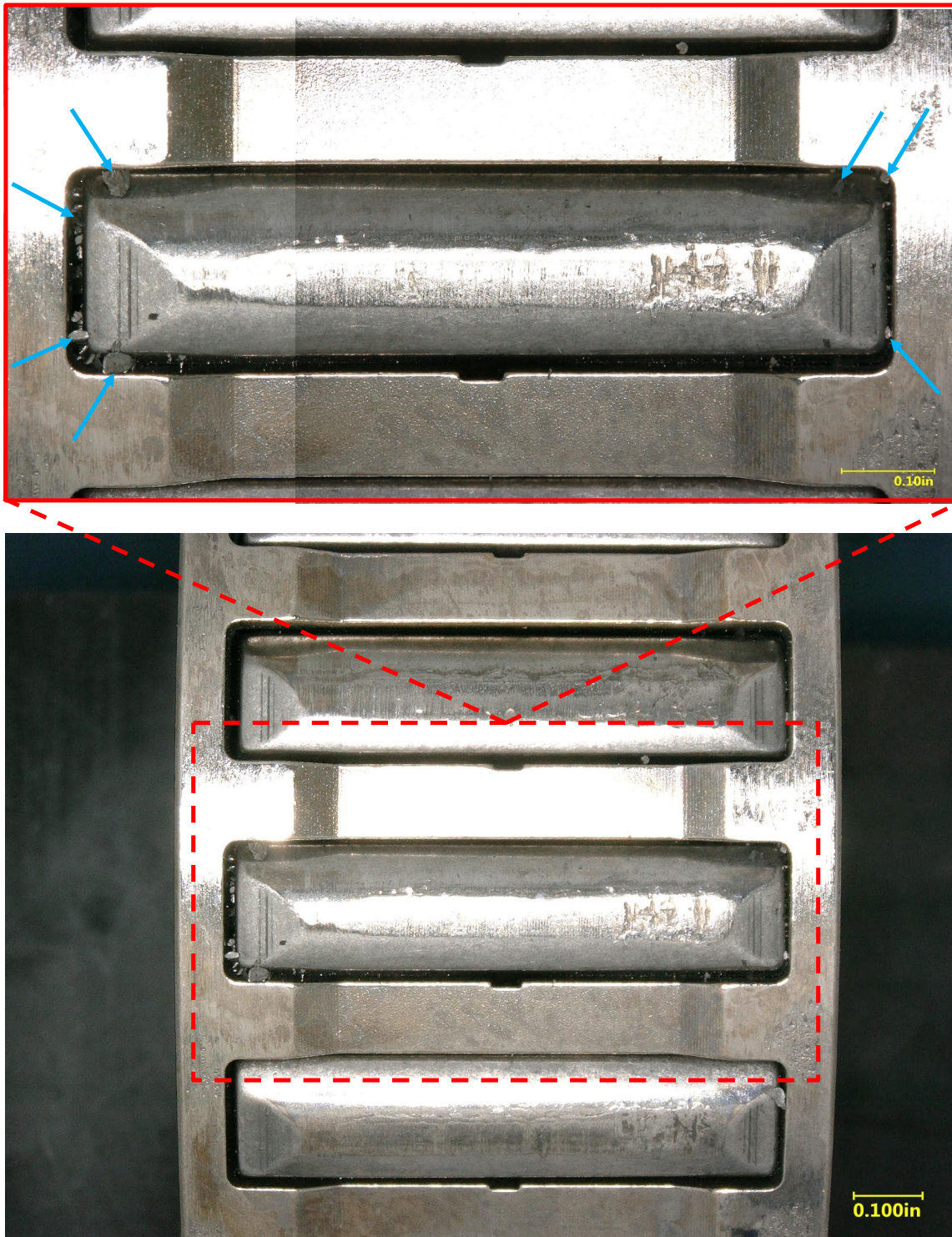


Figure 5: Digital microscope images of the outer surfaces of the sprags. Blue arrows point to metallic particles in the gaps between the cage and the sprags.

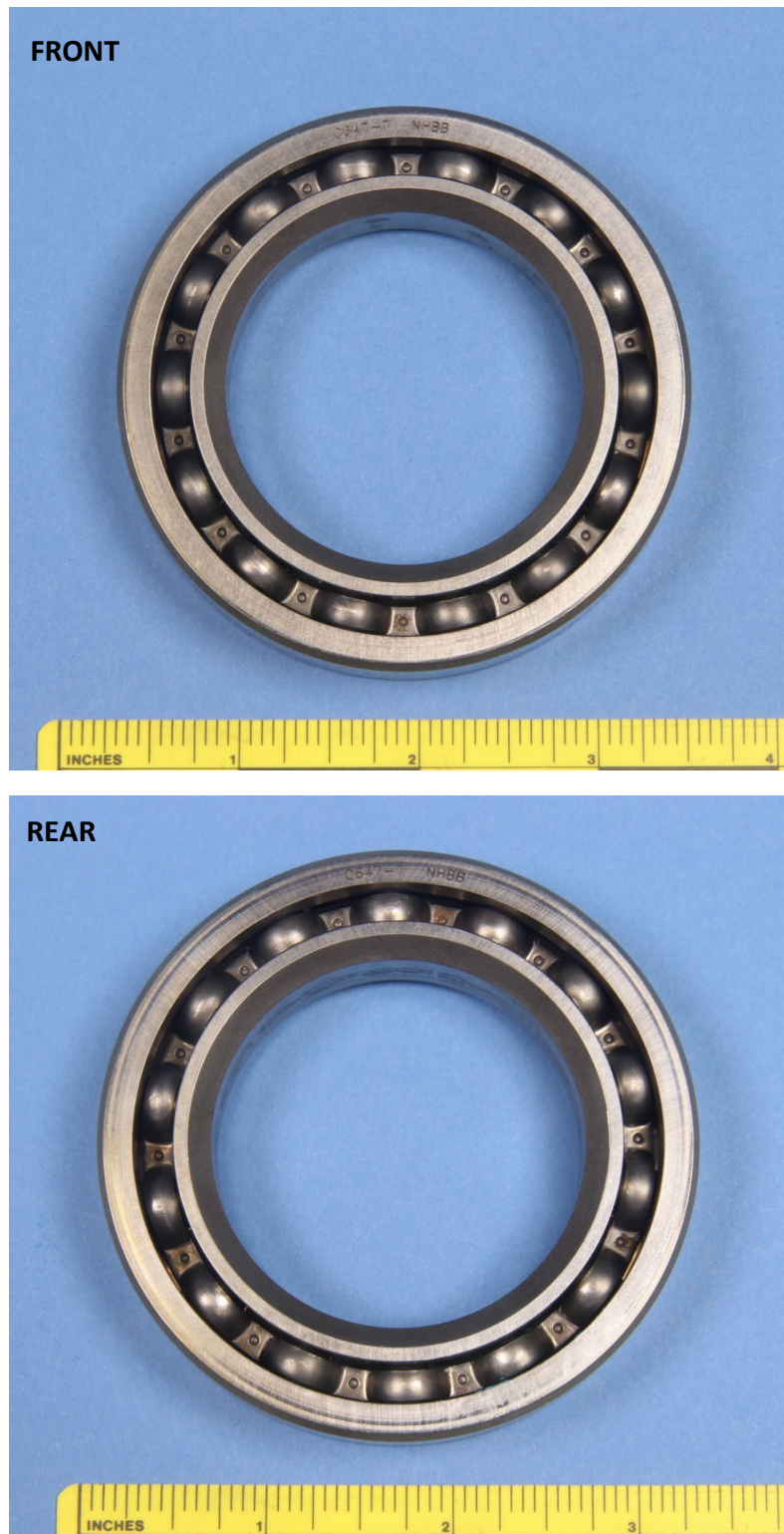


Figure 6: Overall photos showing the front (top) and rear (bottom) support bearings.

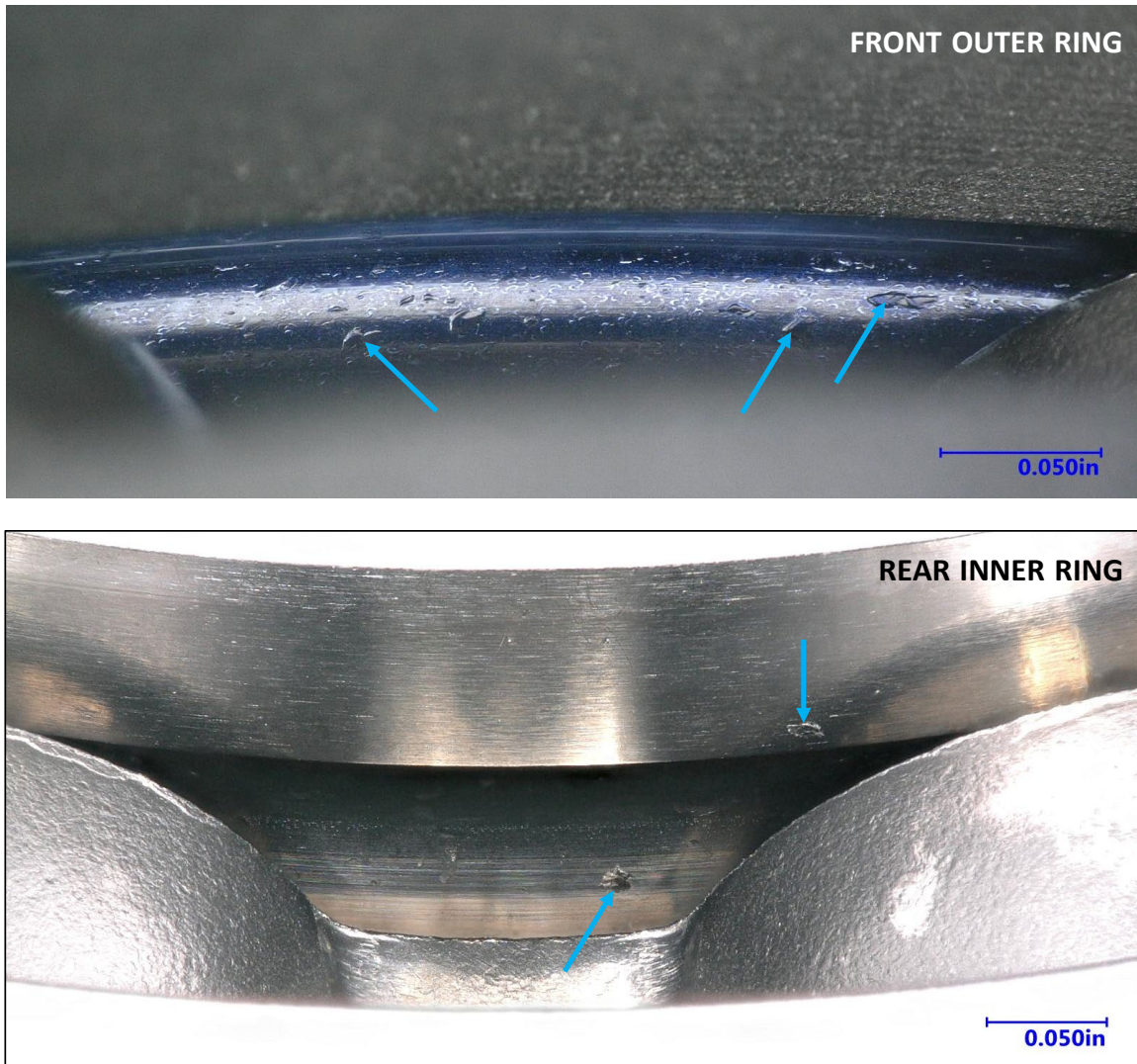


Figure 7: Digital microscope images of the inside of the front (top) and rear (bottom) support bearings. Blue arrows point to metallic particles inside the bearings.

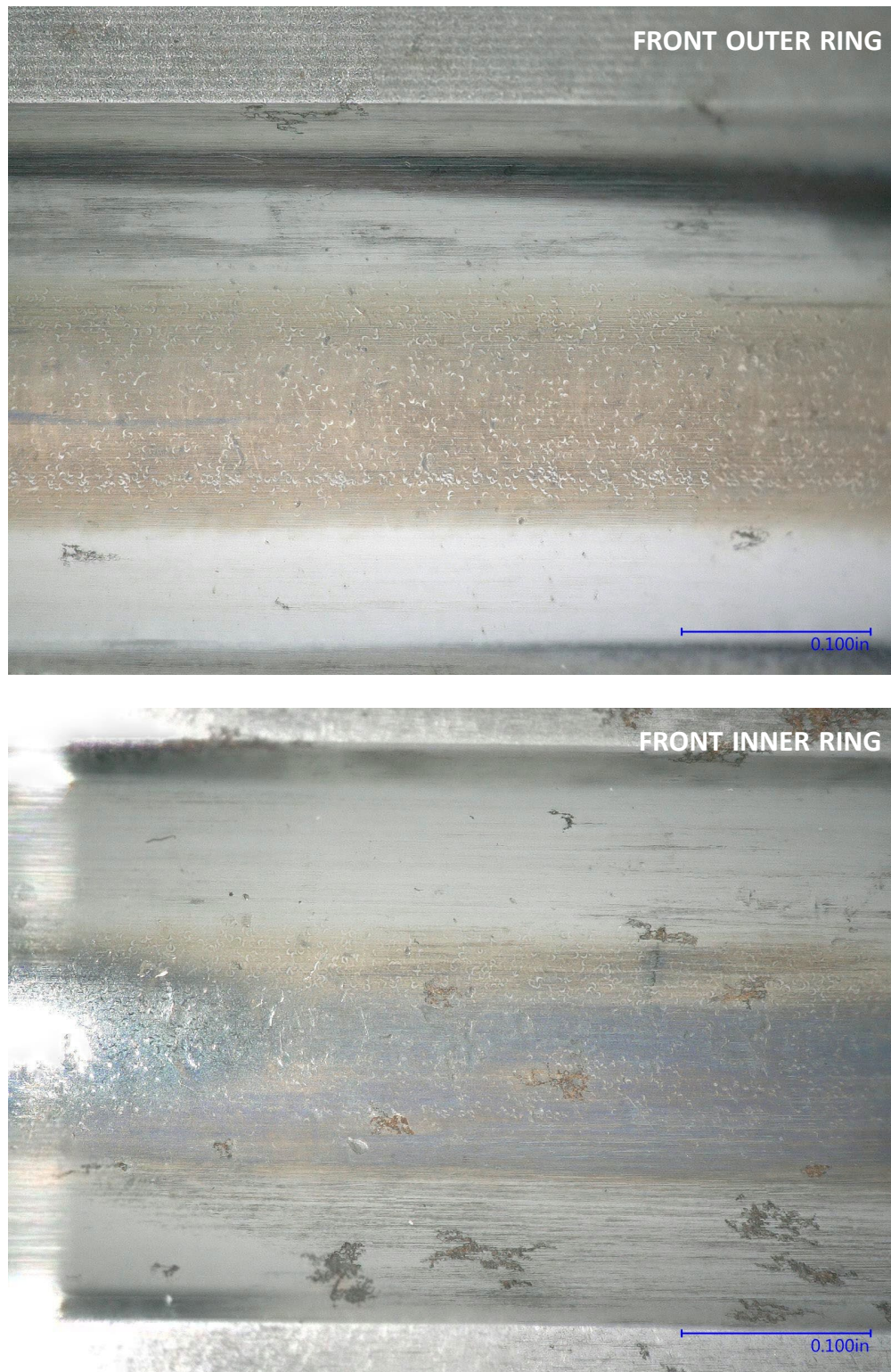


Figure 8: Digital microscope images of the races on the outer (top) and inner (bottom) rings of the front support bearing.



Figure 9: Digital microscope images of the races on the outer (top) and inner (bottom) rings of the rear support bearing.

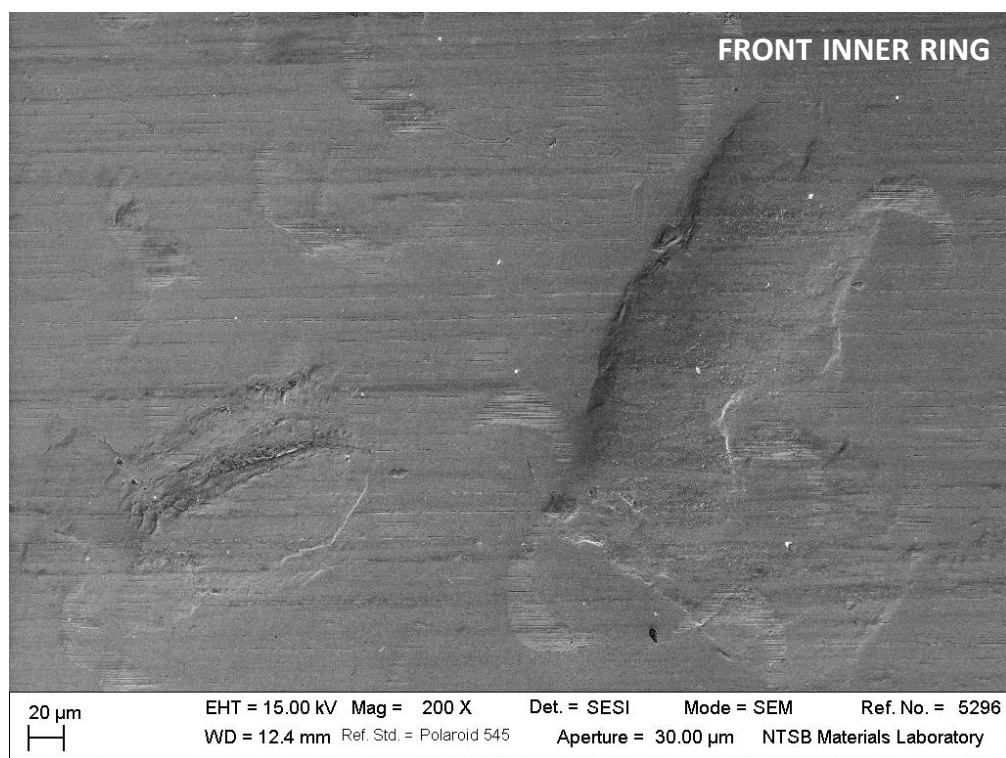
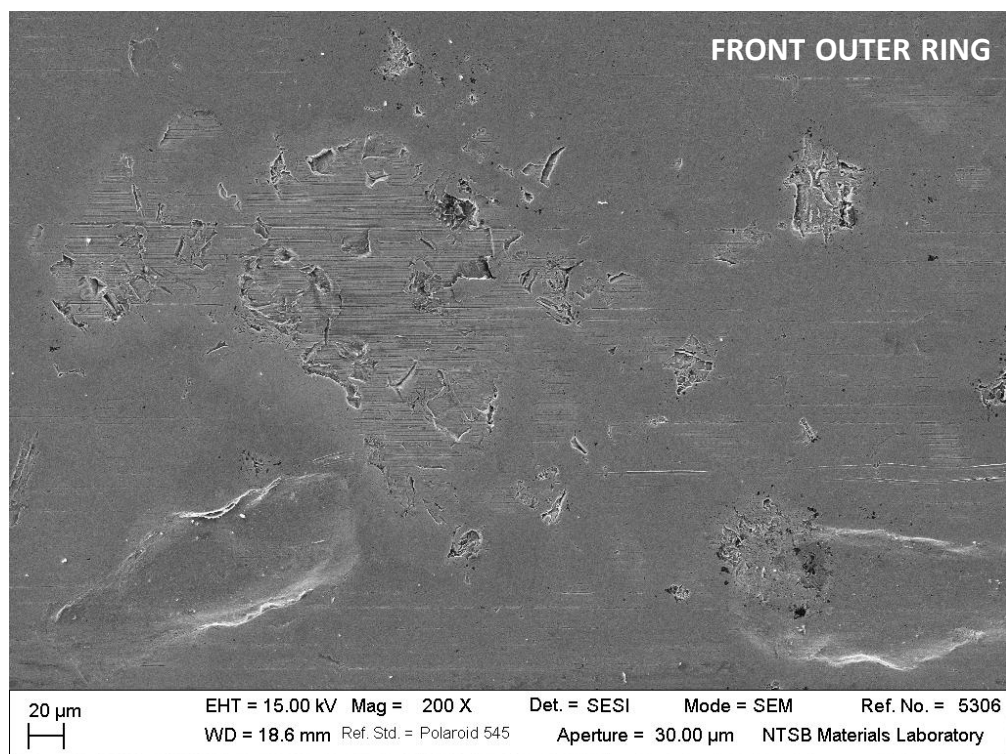


Figure 10: Secondary electron SEM images of the races on the outer (top) and inner (bottom) rings of the front support bearing.

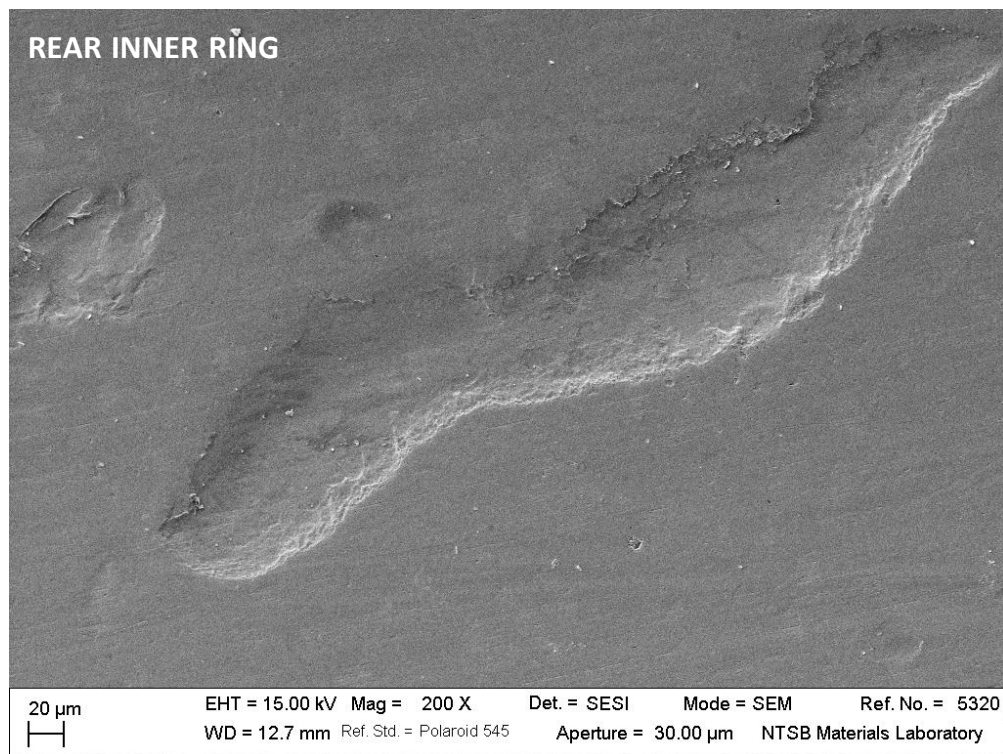
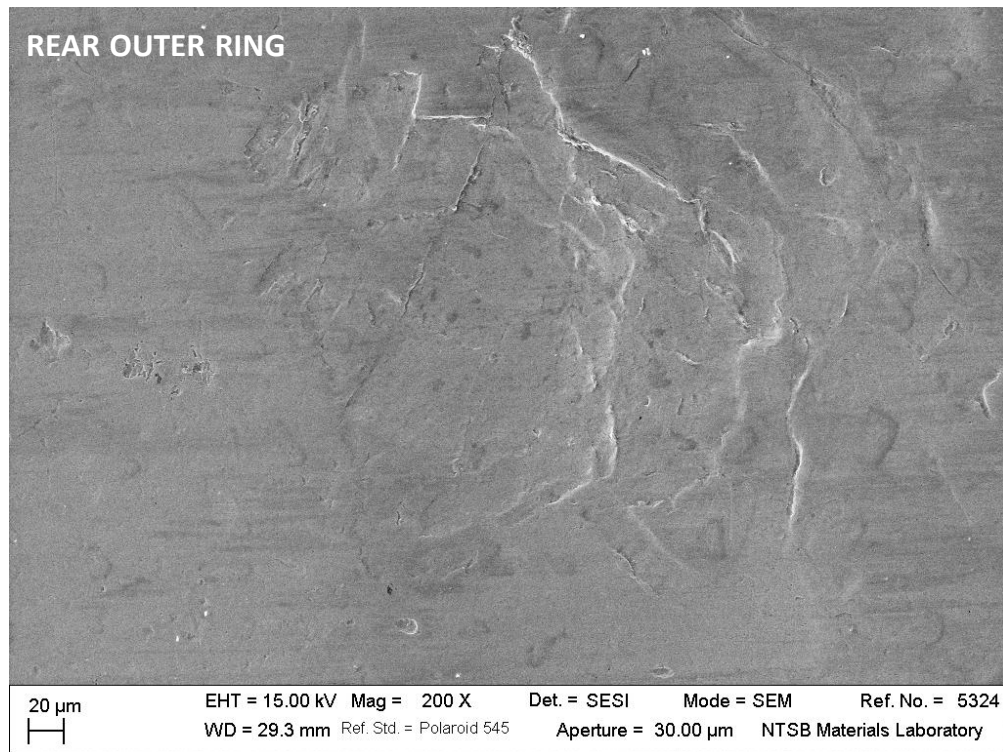


Figure 11: Secondary electron SEM images of the races on the outer (top) and inner (bottom) rings of the rear support bearing.