

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



CEN22LA227

MATERIALS LABORATORY

Factual Report 23-018

February 24, 2023

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A. ACCIDENT INFORMATION

Location: Morgan, Texas
Date: May 29, 2022
Vehicle: Piper PA-28RT-201T, N2148J
Investigator: Michael Folkerts, ASI-CEN

B. COMPONENTS EXAMINED

Continental Motors TSIO-360-FB engine components:

- 1) Number 3 cylinder assembly manufactured by Continental Motors, fractured in two pieces: P/N: 655478B; S/N: AC04AA309.
- 2) Number 3 piston and connecting rod.
- 3) Exhaust and intake valve pushrod assembly components.
- 4) Piston ring fragments.

C. EXAMINATION PARTICIPANTS

Specialist Donald Kramer, Ph.D.
National Transportation Safety Board
Washington, DC

D. DETAILS OF THE EXAMINATION

A cylinder assembly at the number 3 position on a Continental Motors TSIO-360-FB engine was submitted to the NTSB Materials Laboratory for examination along with the other components that are listed. The cylinder barrel had fractured in a smooth-walled region located between the cooling fins and the threaded section used for mounting the cylinder head. The piston crown (figure 2) was clean and exhibited light pitting and mechanical damage. The fractures on the inboard and outboard halves of the cylinder assembly are shown in figures 3a and 3b, respectively. For convenience, the cylinder was assigned clock positions as if viewed outboard looking inboard (i.e., from the rocker box toward the base of the cylinder). Approximately 75% of the fracture surface was tinted black and/or covered with lead deposits, from approximately the 6:00 position to the 3:00 position by way of 12:00. The ID edge of the fracture was worn and rounded over between the 8:00 and 4:00 positions, by way of 12:00. The inboard-facing side of the first cooling fin and adjoining material (figure 3b) was tinted black between the 7:30 position and 1:30 position (an approximately 180° arc) by way of 12:00.

The fracture surface was examined with the aid of a stereomicroscope. Features were observed that were consistent with a fatigue crack that originated along the outer diameter surface of the barrel at a corrosion pit. Figure 4 shows the barrel-side fracture surface between the 11:00 and 12:00 positions. Curved crack

arrest marks, several of which are indicated by yellow dashed lines, exhibited curvature that was consistent with an origin along the outer diameter surface between the 11:00 and 12:00 positions. The crack arrest marks and radial lines were traced back to a corrosion pit located on the outer diameter surface, as indicated in figure 5. The pit was approximately 0.005 inch deep and 0.012 inch across. Additional smaller pits were observed on either side of the origin area. The fracture surface near the pit exhibited radial lines and flat feathery features that were consistent with crack initiation and progression due to cyclic fatigue. The barrel wall thickness was measured on a digital optical image accounting for the rounding of the ID edge. The wall thickness measured approximately 0.103 inch.

Submitted by:

Donald Kramer, Ph.D.
Sr. Materials Engineer



Figure 1. Fractured number three cylinder assembly and associated components, as received.



Figure 2. Number 3 piston crown exhibiting light pitting and impact damage.

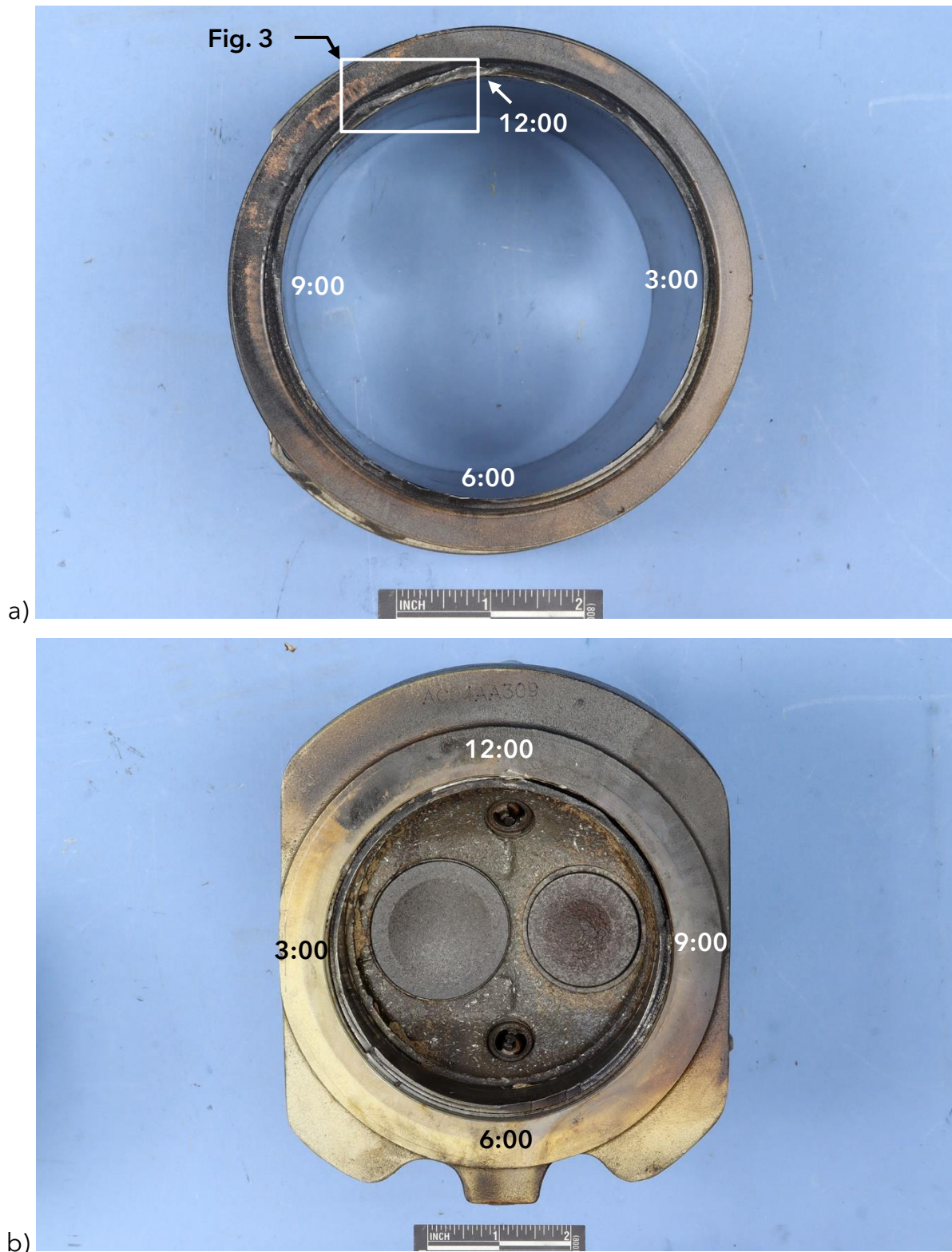


Figure 3. Images of fracture cylinder assembly: a) Cylinder barrel (inboard side of fracture) and b) portion of barrel still threaded into cylinder head (outboard side of fracture).

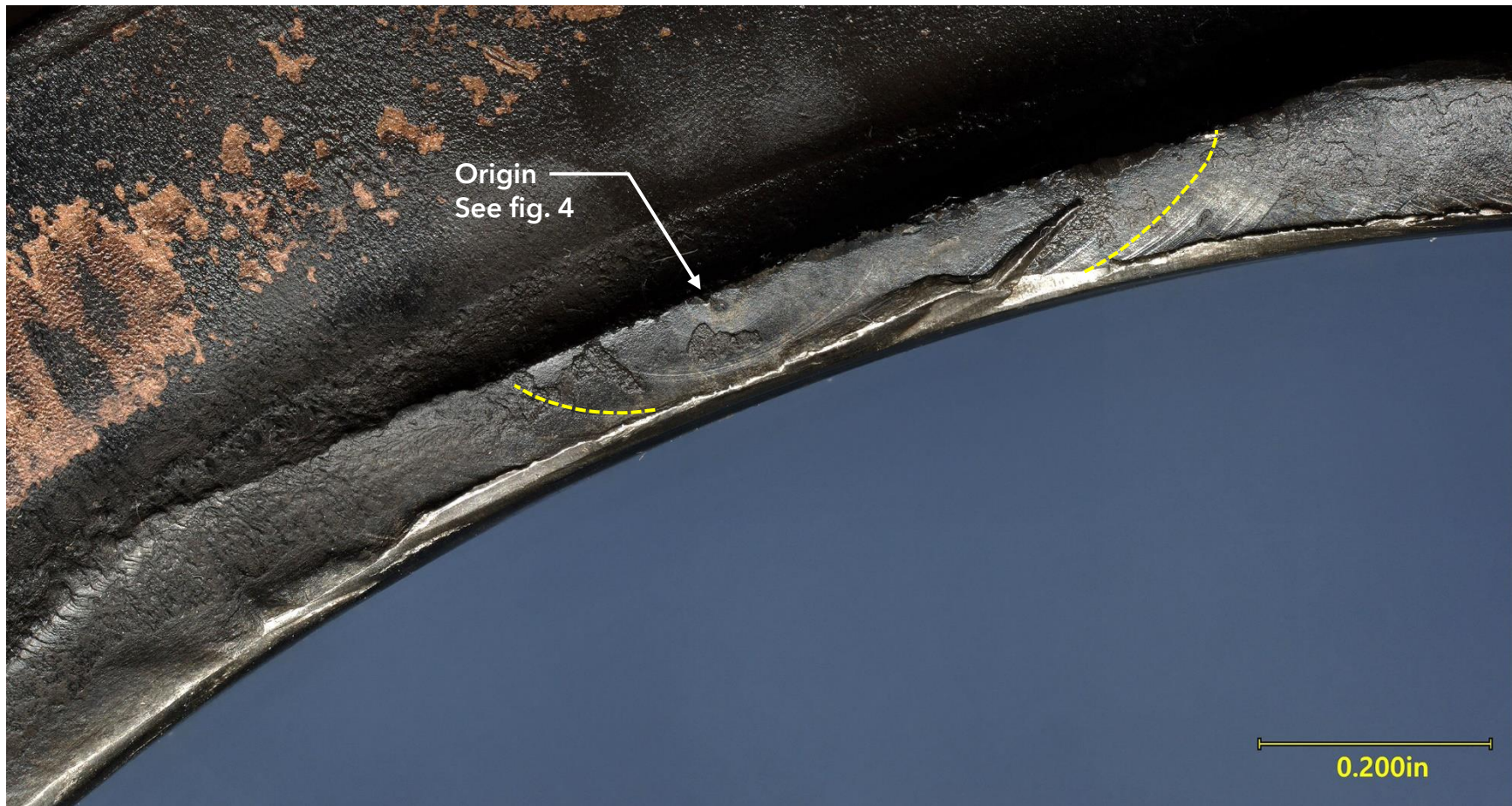


Figure 4. Image of the barrel-side fracture surface between the 11:00 and 12:00 positions showing curved crack arrest marks, several of which are indicated by yellow dashed lines. The curvature is consistent with an origin along the outer diameter surface.

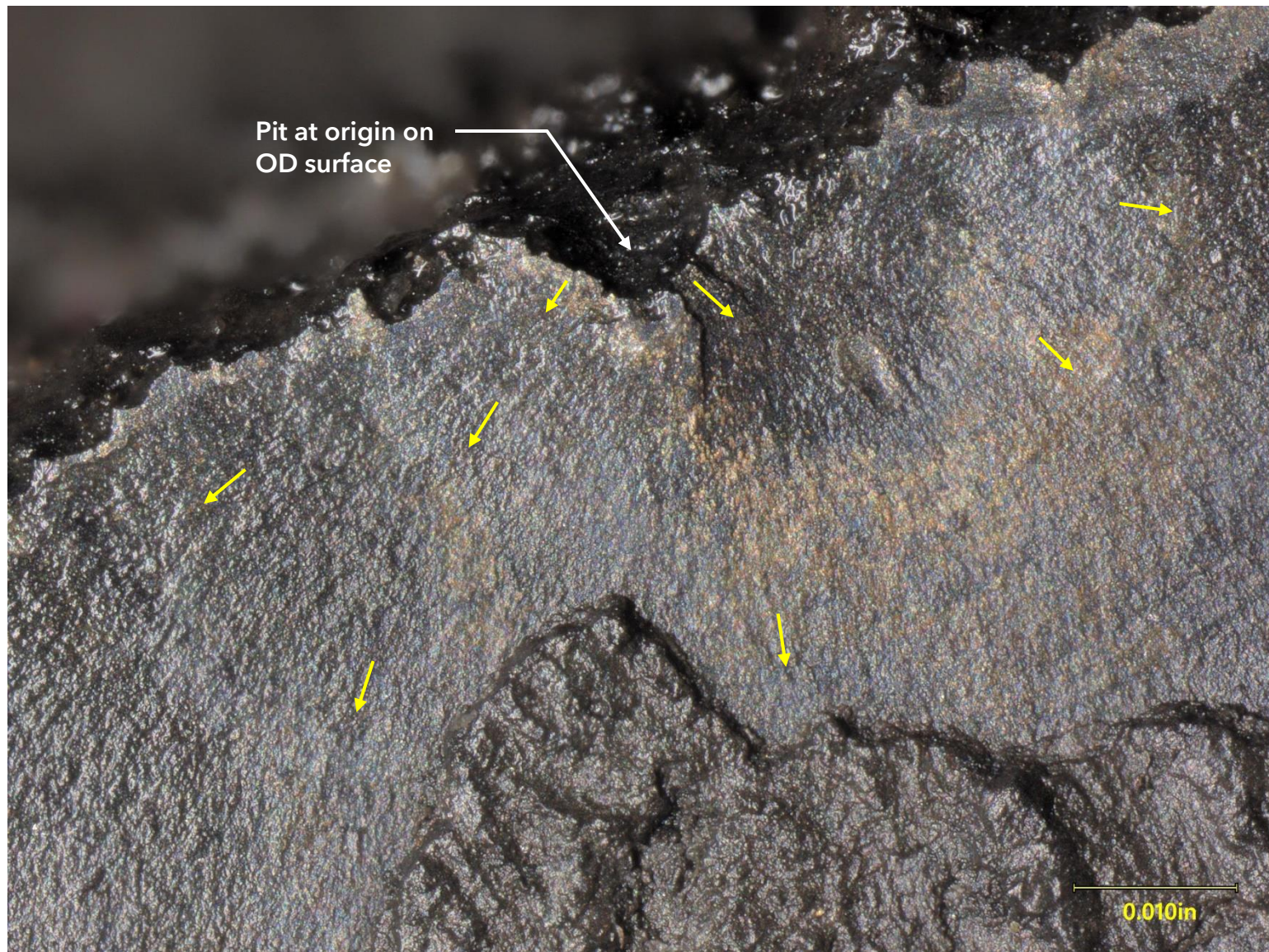


Figure 5. Image of the OD corrosion pit on the outer diameter surface of the cylinder barrel with flat feathery fracture features radiating away from the pit, consistent with cyclic fatigue. Yellow arrows indicated the local direction of crack progression.