

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



CEN24LA052

MATERIALS LABORATORY

Factual Report 24-045

August 16, 2024

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A. ACCIDENT INFORMATION

Location: Manitowoc, Wisconsin
Date: November 30, 2023
Vehicle: Cessna 182C, N8880T
Investigator: Zane Brown, ASI-WPR

B. COMPONENTS EXAMINED

Left and right magnetos from a Continental Motors O-470-R engine; Time Since Overhaul: Between 124 h - 200 h.

Type: S6RSC-25

Part number: 10-500556-1

Left magneto serial number: D06DA204R

Right magneto serial number: D18BA005

Spark plug wiring harness assembly.

C. EXAMINATION PARTICIPANTS

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

D. DETAILS OF THE EXAMINATION

The left magneto, right magneto, and ignition system wiring harness from a Continental Motors O-470-R aircraft engine were sent to the NTSB Materials Laboratory for examination (figures 1 and 2). The engine reportedly lost power at an altitude of about 3,000 feet above ground level.

1.0 Wiring harness

All of the spark plug lead wires were checked for electrical continuity using a digital ohmmeter. Electrical continuity was confirmed for all leads.

2.0 Left magneto

Upon opening the left magneto housing, the left magneto exhibited signs of oily residue, carbonization, and arcing damage between the distributor gear's electrode and the distributor block electrodes. None of the rotor bearing components, carbon brush, or coil showed any notable features (figure 3). The rotor itself was damaged as discussed below.

Regions of the distributor gear electrode were covered by a layer of carbonized material (figures 4a - d). The radially inward facing side of the electrode

(figure 4c) exhibited tracks of oily residue that ran from the gear's central shaft to the outer contact surface of the electrode. The distributor block electrodes had melted and resolidified where they came into proximity with the gear electrode, consistent with arcing damage (figures 5a - c). Oil droplets were seen adhered to the felt strip that surrounded the distributor bushing (figure 6).

The rotor exhibited signs of damage from overload. By design, the rotor shaft housed a key that rotationally locked the magnet by mating with a slot in the magnet housing (figures 7a - b). The key (and thus the rotor shaft) had rotated relative to the magnet, fracturing the magnet housing. The fracture surfaces were examined using a stereomicroscope and the fracture features were consistent with overstress.

3.0 Right magneto

The right magneto housing was opened, and internal components also exhibited similar signs of oily residue, carbonization, and arcing damage between the distributor gear's electrode and the distributor block electrodes. None of the rotor bearing components, carbon brush, or coil showed any notable features (figure 8). Regions of the distributor gear electrode were covered by a layer of carbonized material (figures 9a), and the distributor block electrodes had melted and resolidified where they came into proximity with the gear electrode (for example, figures 9b). Oil droplets were seen adhered to the felt strip that surrounded the distributor bushing (figure 10).

The rotor exhibited signs of damage from overload. The key had rotated relative to the magnet, fracturing the magnet housing (figure 11). The fracture surfaces were examined using a stereomicroscope and the fracture features were consistent with overstress.

4.0 Overhaul and assembly instructions

Continental Motors provides overhaul and assembly instructions for S-20-series magnetos in a Service Support Manual (Continental Motors, 2024). Instructions for overhaul and assembly of the distributor block are given in "7-2.3. Distributor Block Inspection" and "9-2.3. Distributor Block and Gear Assembly," respectively.

Section 7-2.3. provides instructions for impregnating the block's bronze bushing, installing the felt strip, and installing the felt washer as follows:

7) Impregnate bronze bushing:

- a) Insert a stopper in one end of the bushing and fill the bushing with 10-391200 Distributor Block Lubricant.

- b) Using care not to spill oil, place the distributor block in an oven and bake the distributor block at 190-210 °F (88-99 °C) for two to three hours.
- c) Remove the distributor block and oil from the oven and allow them to cool to room temperature together (the bushing absorbs residual oil as it cools).
- d) Carefully remove the stopper and allow excess oil to drain from bushing.

CAUTION: Do not lubricate the felt strip (81) with Distributor Block Lubricant.

- 8) Install a new dry felt strip (81) in groove on electrode side of distributor block. When strip is properly installed (Figure 7-1), approximately 0.125 inch of the bushing shall be exposed above the felt strip.
- 9) Before installing new felt washer (82) into the distributor block (79), saturate the washer with 10-391200 Distributor Block Lubricant. Blot excess oil from the washer until the flat surfaces take on a "frosted" appearance, and seat the felt washer in the recess on the tower side of the distributor block.

Section 9-2.3 provides instructions for installing the felt strip and felt washer as follows:

- 3) Form the felt strip (81) in a ring and install it *dry* in the deep groove next to the distributor block bushing so that it does not interfere with the washers (76, 77).
- 4) Saturate a new, or clean serviceable felt washer (82) with P/N 10-391200 distributor block lubricant. Blot excess oil from washer (82), until the flat surfaces take on a "frosted" appearance. Seat washers in the recesses on the tower side of the distributor block (79).

E. REFERENCES

Continental Motors (2024). "Publication X42002 Revision 4: S-20/2-200 Series High Tension Magneto - Service Support Manual", Continental Motors, Mobile, AL.

Submitted by:

Donald Kramer, Ph.D.
Supervisory Materials Engineer



Figure 1. Left magneto components, right magneto components, and ignition system wiring harness as received.

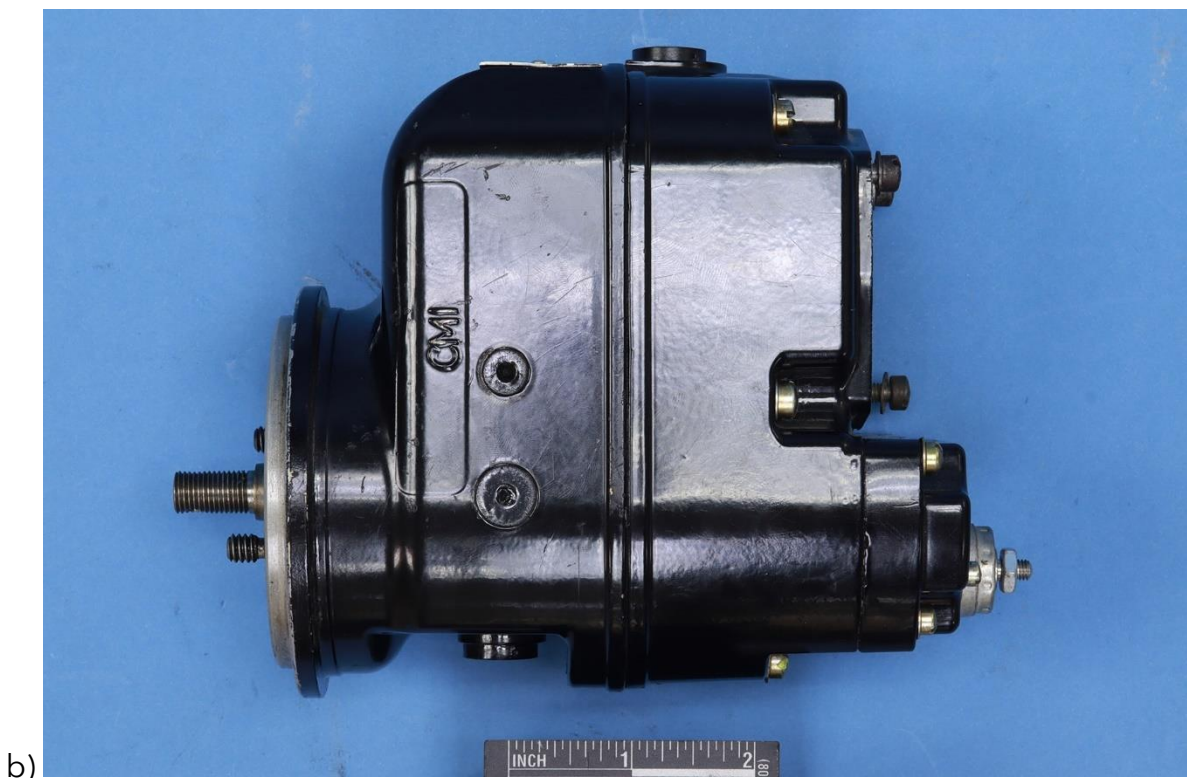


Figure 2. Magnetos as received: a) left magneto with rotor removed and b) right magneto.



Figure 3. Left magneto after separating the housing.

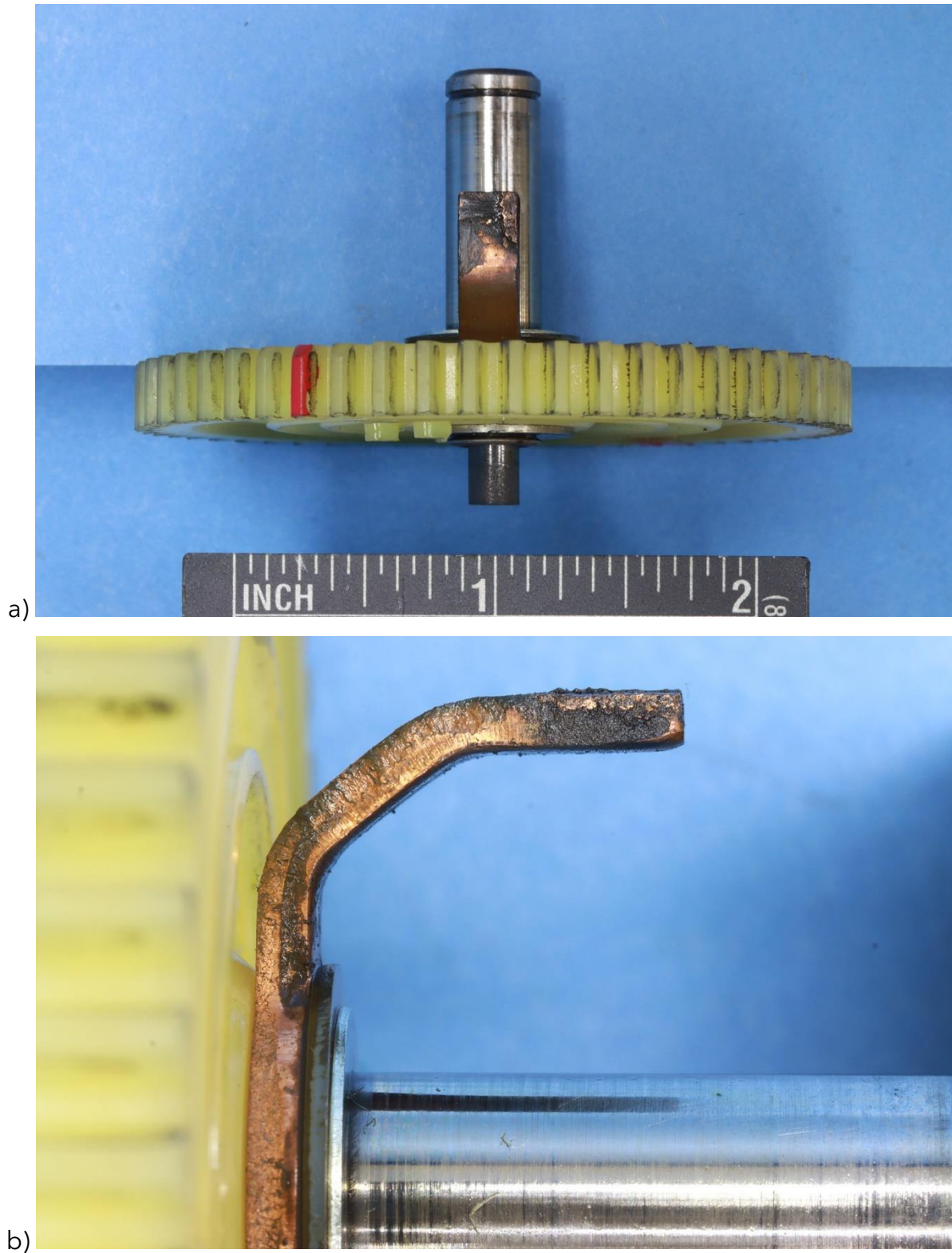


Figure 4. Left magneto gear electrode showing carbonization of oily residue: a) overview of gear; b) side view of electrode;



Figure 4 (cont.). c) electrode viewed radially outward; and d) radially inward view of electrode.

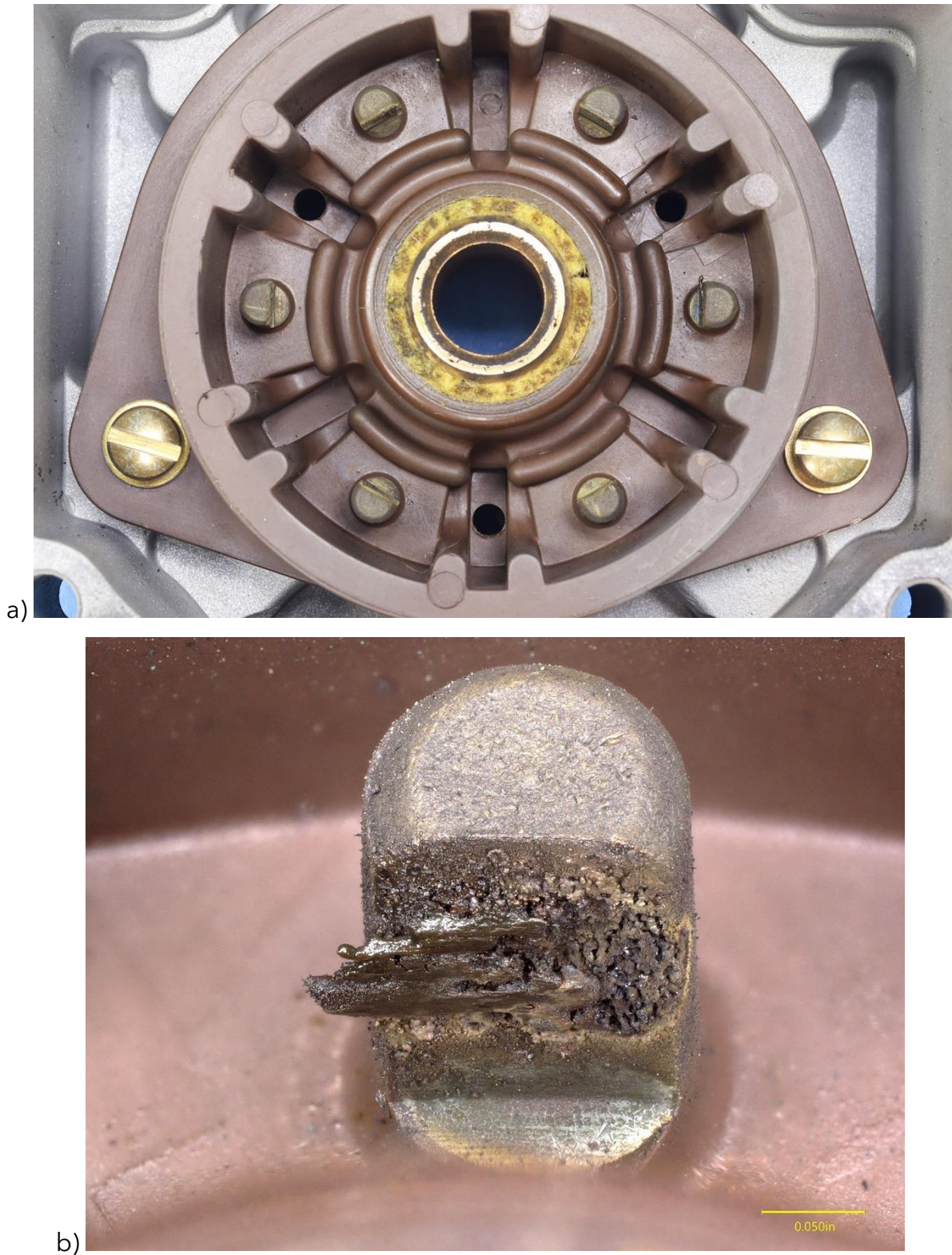


Figure 5. Images of electrodes in the distributor block: a) overview image; b) arcing and metal smearing on a distributor electrode; and

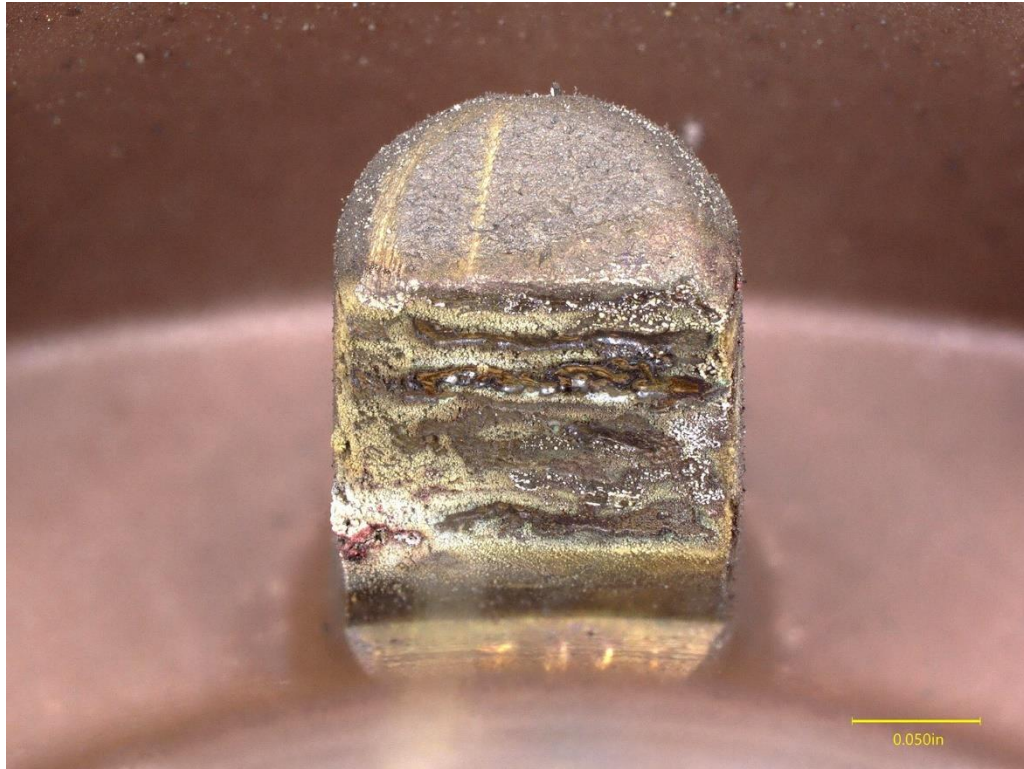


Figure 5 (cont.). c) arcing damage on a second distributor electrode.

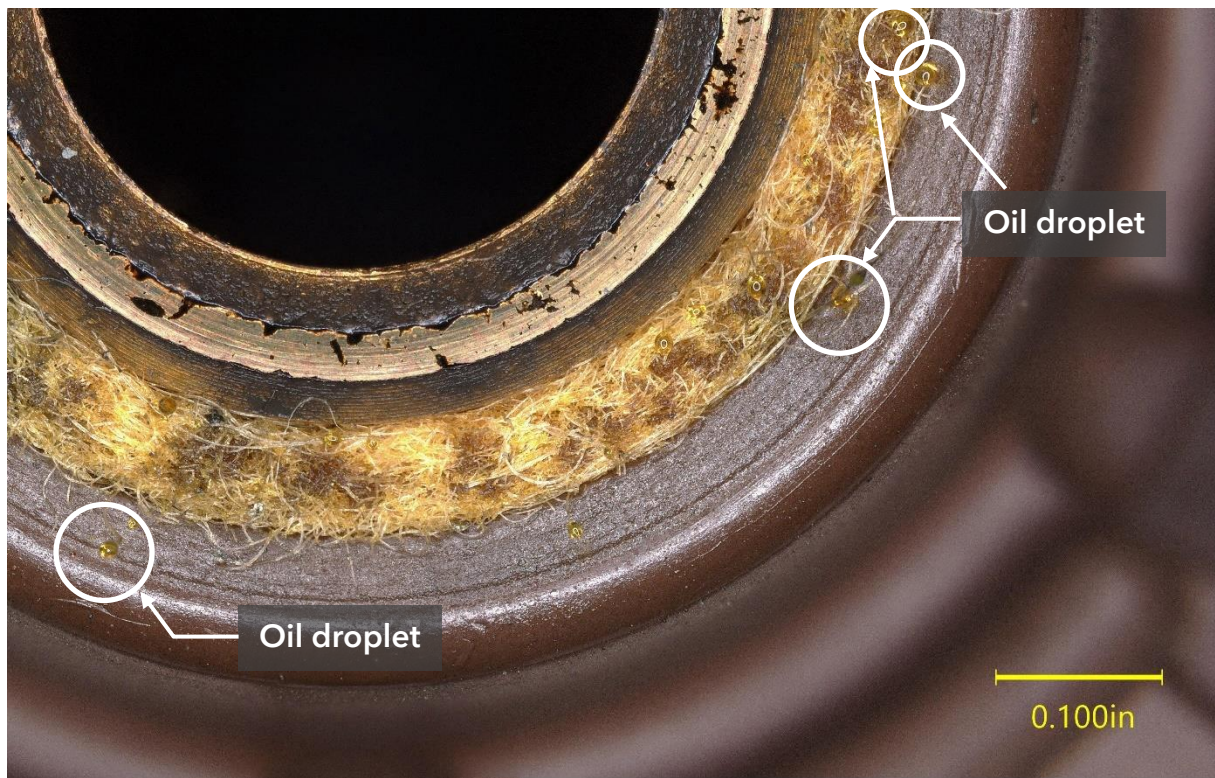
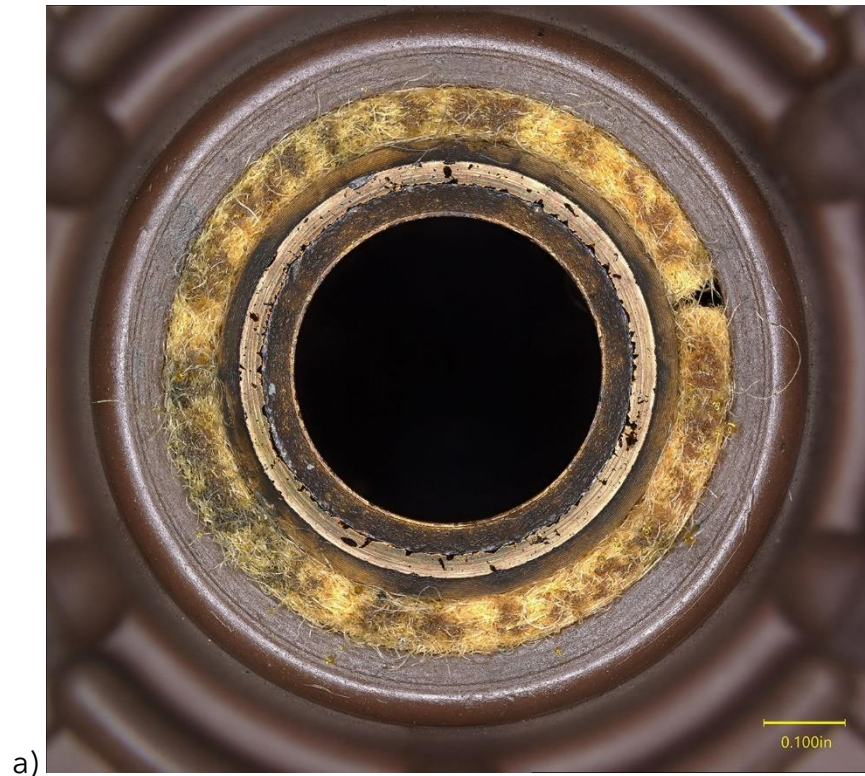
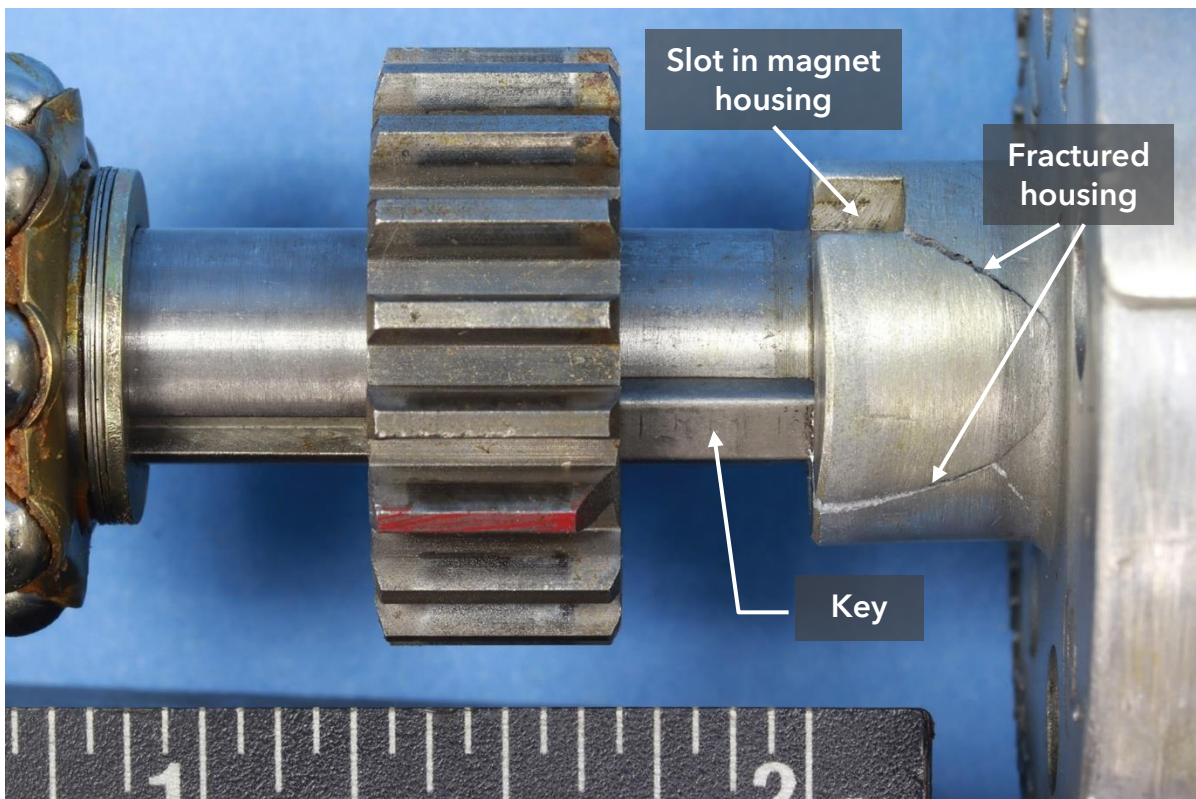


Figure 6. a) Distributor bushing and surrounding felt strip on the electrode side of the distributor block and b) higher magnification image indicating droplets of oil.



a)



b)

Figure 7. a) Image of the left magneto rotor and b) image showing the fractured magnet housing and the rotation of the shaft relative to the magnet.

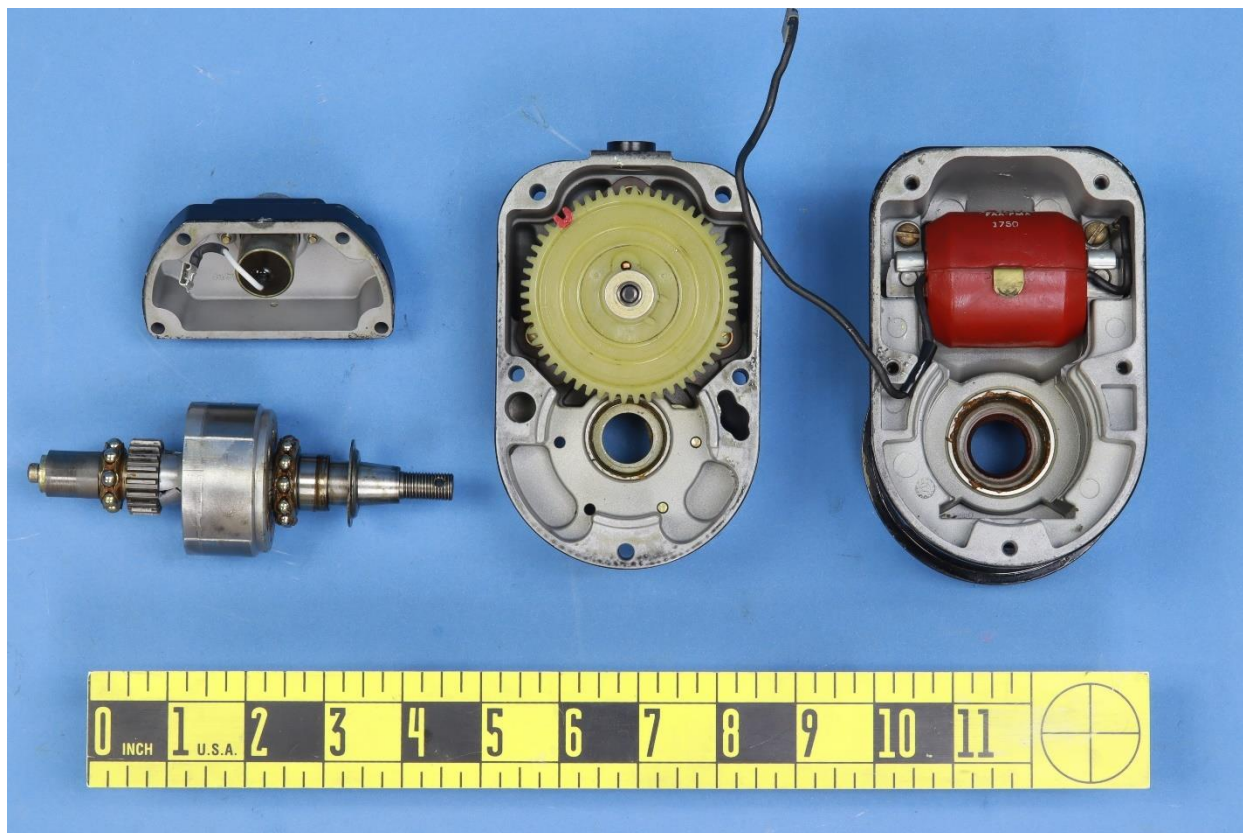


Figure 8. The right magneto after opening the housing.

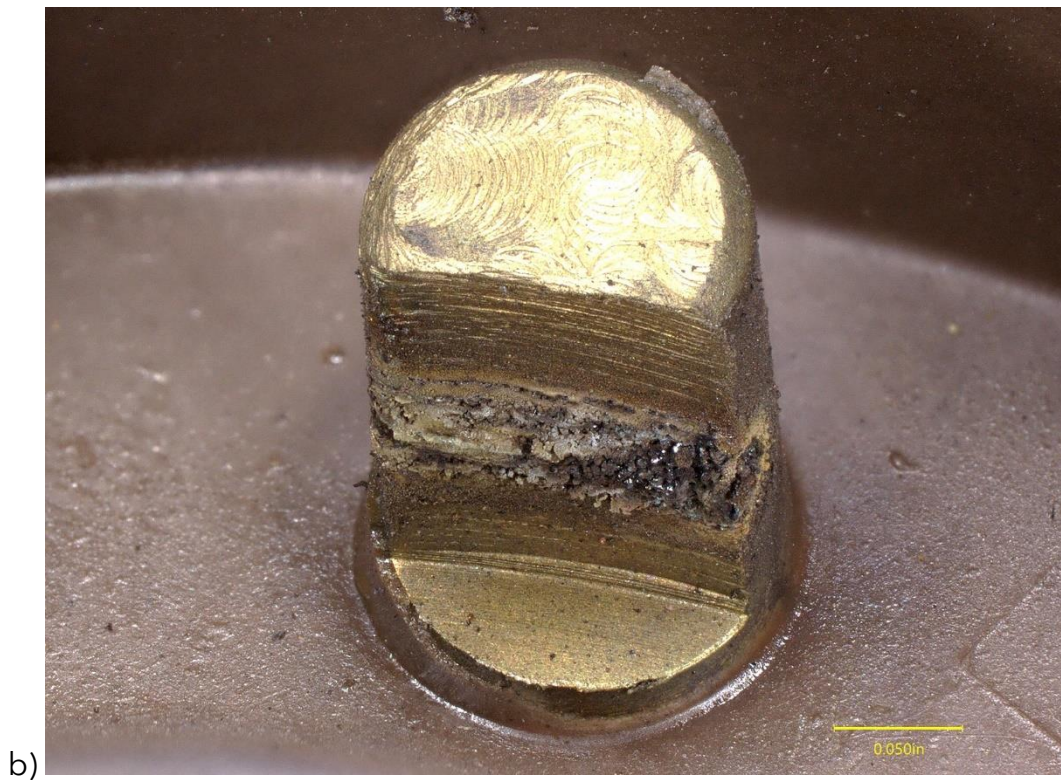
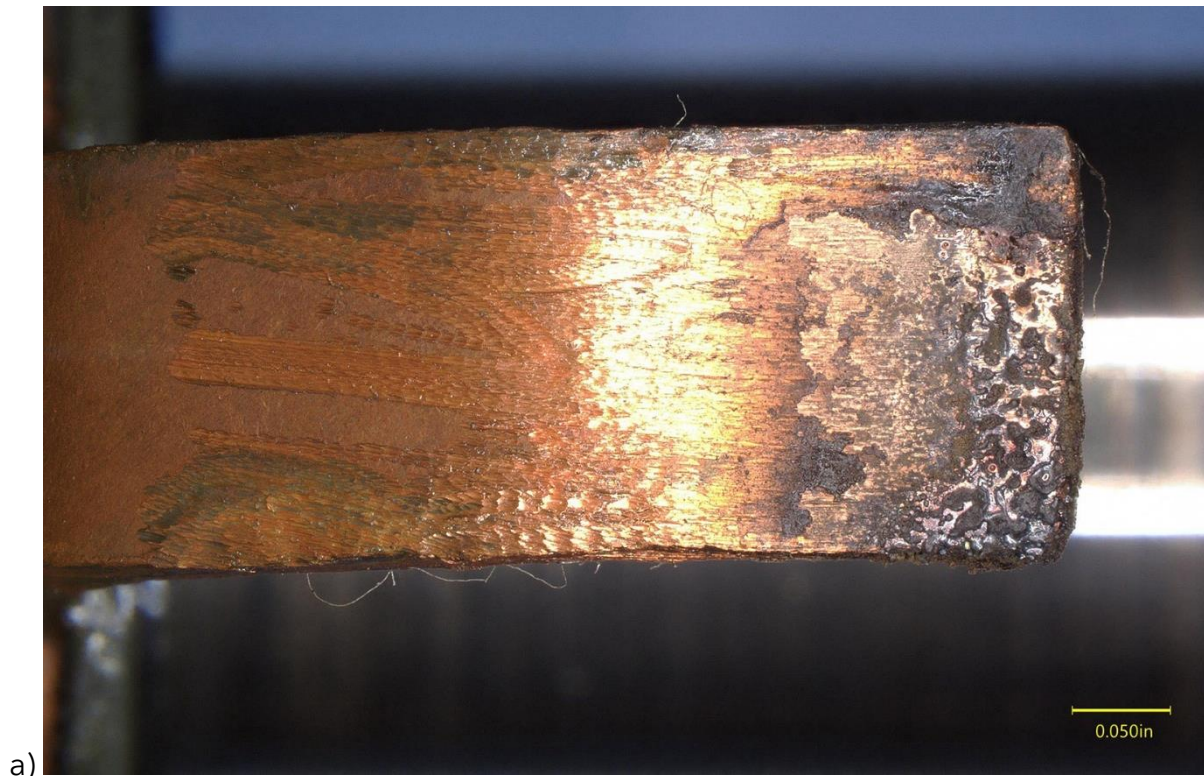


Figure 9. a) Right magneto gear electrode showing carbonization and b) right magneto distributor block electrode showing arcing damage.

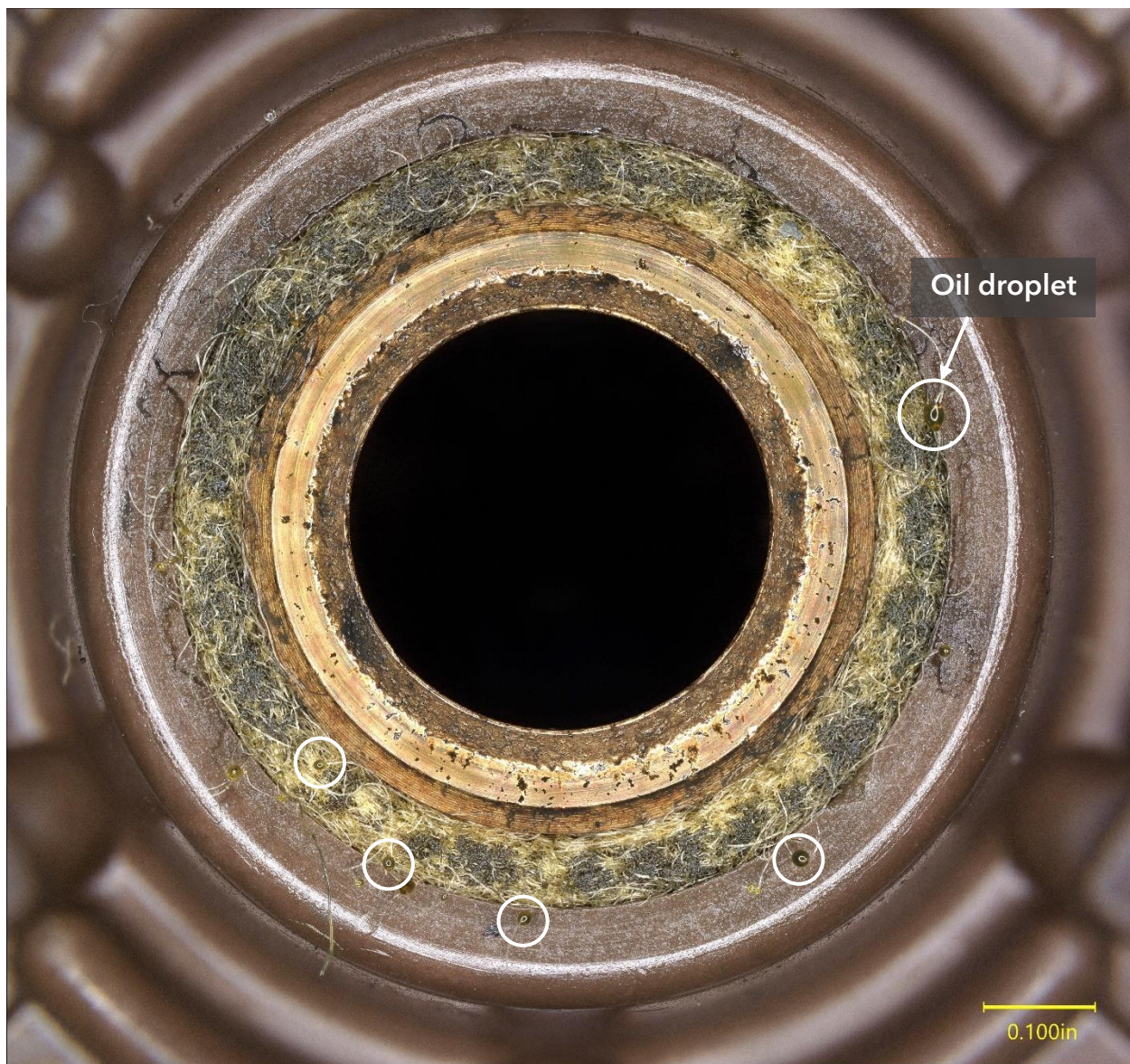


Figure 10. Right magnetos distributor bushing and surrounding felt showing droplets of oil.

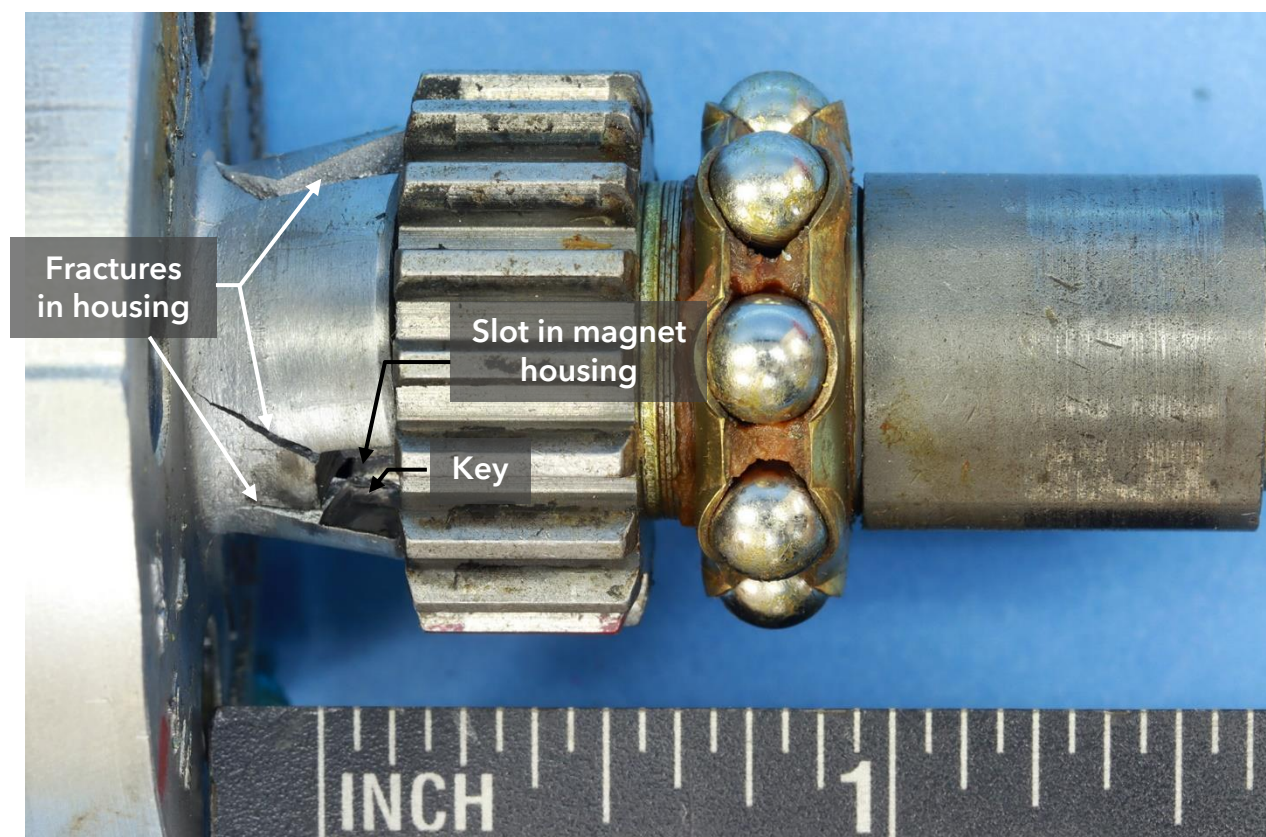


Figure 11. Image of the right magneto rotor showing the fractured magnet housing and the rotation of the key (coupled to the shaft) relative to the magnet.