

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA22LA159

MATERIALS LABORATORY

Factual Report 22-091

December 6, 2022

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A. ACCIDENT INFORMATION

Location: Spring Hill ,FL
Date: March 17, 2022
Vehicle: Q200 N3QP
Investigator: Robert Gretz

B. COMPONENTS EXAMINED

Starter motor with clutch assembly and fractured pinion gear (Figure 1)

C. EXAMINATION PARTICIPANTS

Specialist Joseph Panagiotou
National Transportation Safety Board
Washington, DC

D. DETAILS OF THE EXAMINATION

A starter motor with a clutch assembly and fractured pinion gear were submitted for examination. The starter motor exhibited modifications that deviated from the original design. These modifications included a missing starter motor power switch, a shortened pivot lever and a relocated power cable (Figure 2). It is unclear how this starter motor was being used without the pivot lever and power switch. The pivot lever controls the inward motion of the clutch and pinion gear and activates the power switch once the pinion gear and crankshaft gear are properly engaged.

The clutch assembly (Figure 3) consisted of an overriding type of clutch mechanism. The clutch carrier would move the pinion gear forward to mesh with the crankshaft gear under the force of the pinion lever. The clutch carrier body exhibited corrosion pitting on the shaft portion (Figure 4) and deformation and raised burrs on the bearing pockets of the clutch carrier head (Figure 5) where the pinion gear would be held. The head and shaft portions of the clutch carrier body were off axis by approximately 0.015 inch.

The pinion gear was fractured with approximately half of the gear teeth still present (Figure 6). The teeth that were still present exhibited fractured edges and indentations from the crankshaft gear. The indentations from the crankshaft gear teeth onto the pinion gear teeth exhibited only partial depth of engagement. The fracture surface of the missing portion of the pinion gear was consistent with overstress. The bearing race at the base of the pinion gear exhibited brinelling and case cracking (Figure 7). The damage to the pinion gear was not consistent with a sudden failure but instead the result of prolonged abuse.

Submitted by:

Joseph Panagiotou
Engineer



Figure 1. Starter motor and clutch assembly components as received.

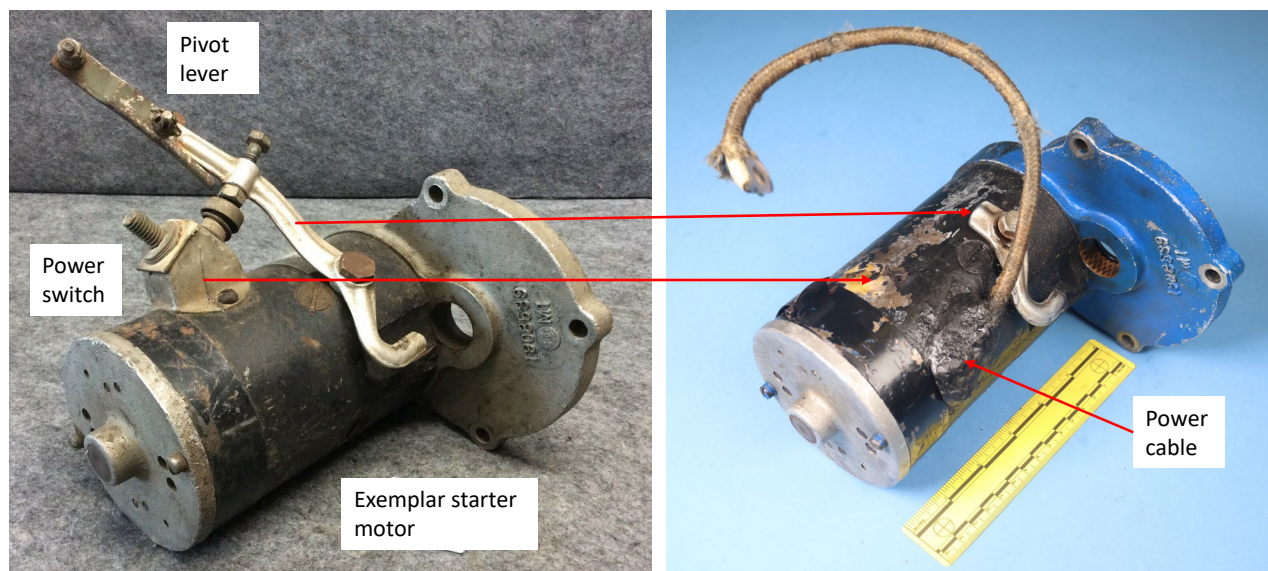


Figure 2. Deviations from original design. Exemplar on the left, incident starter on the right.



Figure 3. Clutch assembly components.

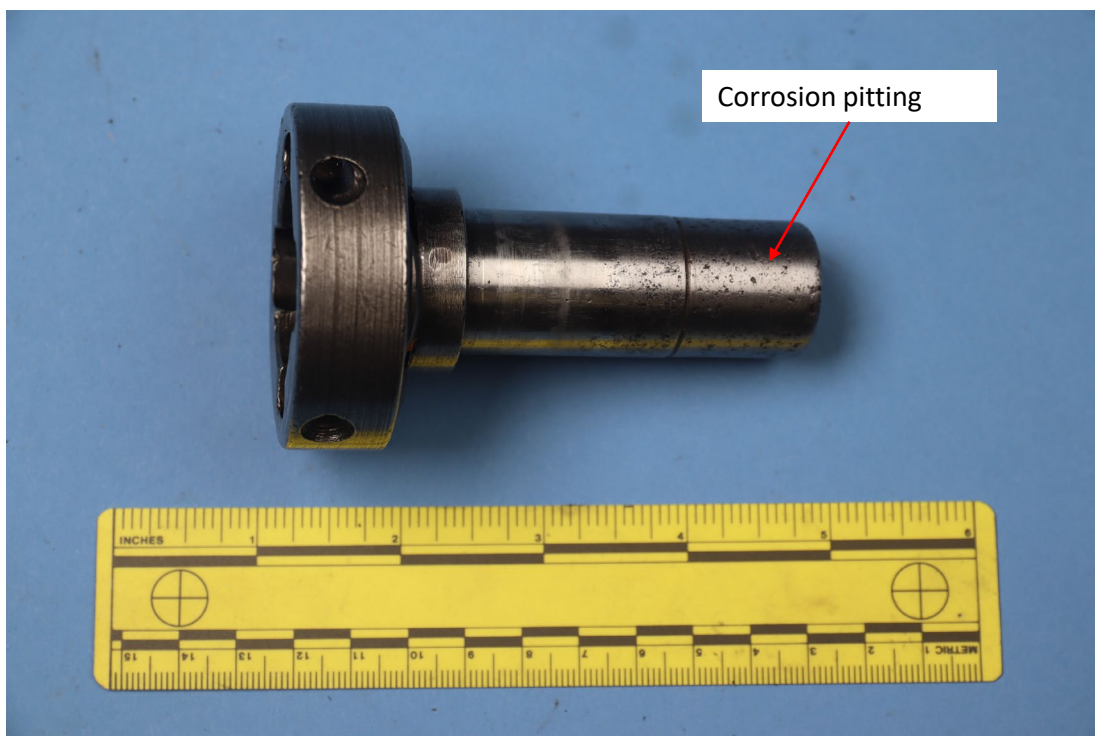


Figure 4. Clutch carrier body exhibiting corrosion pitting on the shank.

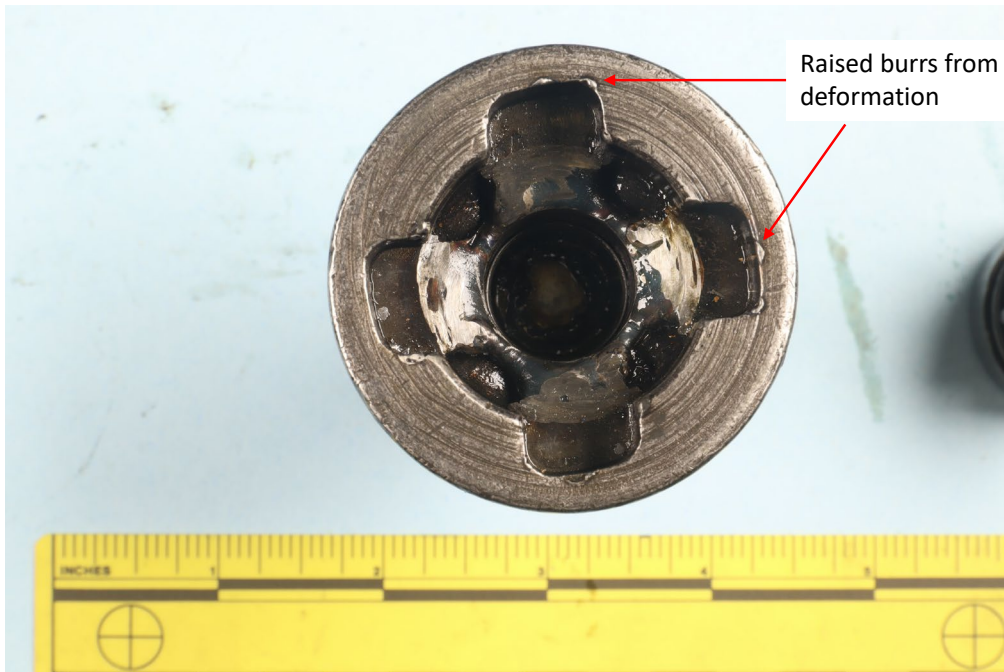


Figure 5. Clutch carrier body exhibiting raised burrs on the bearing pockets.



Figure 6. Pinion gear with missing portion of gear teeth and overstress fracture.

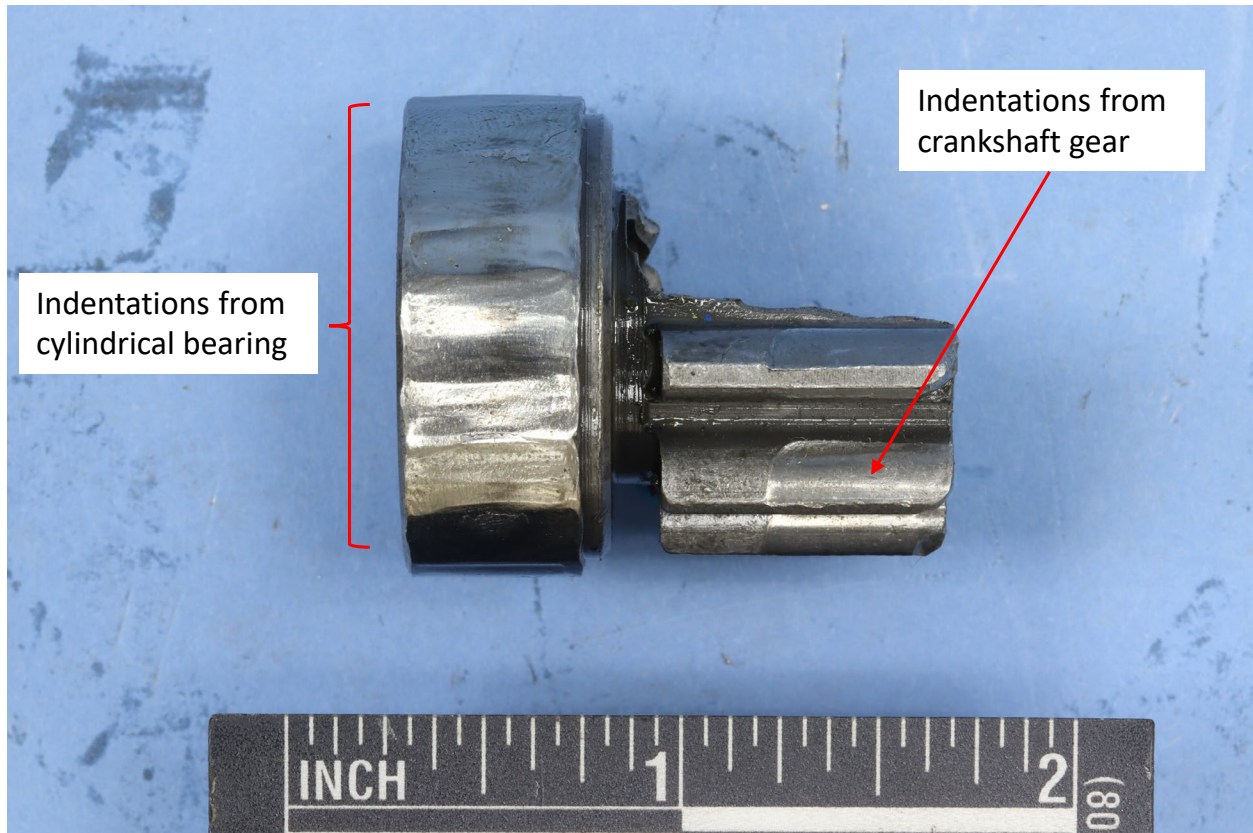


Figure 7. Pinion gear bearing race exhibiting indentations and case cracking from brinelling.