[redacted]

Component Failure Investigation Final Report

On May 7, 2024, Fabian Salazar with the National Transportation Safety Board (NTSB) requesting assistance in a accident investigation in which he believed a magneto failure was the cause. He indicate, in an email from May 8, 2024 that, during an initial engine exam, one set of breaker points would not open even though the cam pushed on the cam follower whiled the other set of points did open. He included a photo, Figure A, with the question, "If one set of points does not open on a dual points system, how would that effect the firing on the spark plugs?" In response to this question on May 9, 2024 we stated, "Looking at the picture one set of points looks burned. If that is the case, the condenser would have been bad and would cause the magneto to miss fire. This would make the engine run extremely rough. If a set of point is not opening, one bank of spark plugs would not fire causing the engine to run on only one set of spark plugs. It also would cause the engine to run rough. Depending on which magneto model this is, the points may be staggered where one opens right after the other and not at the same time." These statements were made prior to receiving and inspecting of the magneto and were based only off of the photo and information provided by Fabian.

The magneto was received on May 10, 2024 at 1:21 PM CST and kept in a secured room pending oversight by the Federal Aviation Administration (FAA). Oversight was provided on July 23, 2024 by Steven W. Henderson, Aviation Safety Inspector (Avionics) and Donald W. Dutra, Avation Safety Inspector (Airworthiness) of the FAA's San Antonio Flight Standards District Office (SAT FSDO). At that time the box was visually inspected for damage done in shipping and none was present on the exterior. The box was then opened and the magneto was removed from the box and visually inspected for damage, none was present. The type number was DF, part number 10-8038-15 and the serial number was 3244 (best estimate, serial number damaged on the data plate).

Throughout this report the various components of the magneto will be referred to as retard and advance. For ease of reference the parts referred to as retard will be considered to the right of the center line of the data plate affixed to the magneto and those referred to as advance will be to the left. When applicable, the attached figures will be labeled for convenience Figure B.

The point cover was removed from the magneto and the the points were visually inspected Figure C. It was found that the the retard points appeared to have grease or oil burned onto the points and that the points themselves were not burned. The points were cleaned. It was found that the screws which hold the advance points in place were loose which caused the advance points to back away from the cam causing their timing to become off Figure D. It appears that the advance point screws were never tightened during the previous overhaul as the yellow tamper indicator was still intact, however it fell off when the advance screws were tightened prior to performing a bench test.

[redacted]

Both the advance and retard coil covers were removed prior to testing for inspection Figure E and F. Upon removal of the advance side coil cover, a P-lead spring fell out. Inspection of this spring indicated that it was not the correct part, and appeared to be modified to fit this magneto by the installing mechanic, or potentially left in the magneto during previous MRO activities. It is within a small margin of possibility that the spring being loose inside the coil area could have caused none, intermittent or complete grounding of the advance side preventing ignition if the magneto was firing during flight. While we can't rule out the possibility of this being a contributing factor of malfunction, it is our opinion that this is very unlikely due to the previously mentioned and the following finding as reported herein.

The magneto was installed on the test bench and given a preliminary test. The test showed that the magneto was firing on the retard side and began firing at 400 to 500 RPM, however, it is required by the maintenance manual to begin firing consistently at 280 RPM for the retard points Figure G. The advance points did not fire at all, but should have began firing consistently at 180 RPM.

The magneto was removed from the test bench and was further inspected. The coils were removed and the resistance was checked. The secondary winding resistance of the retard coil was 2,545Ω Figure H and the primary winding resistance was 2.2Ω Figure I. The secondary winding resistance of the advance coil was 2,554Ω Figure J and the primary winding resistance was 0.7Ω Figure K. Both coils were found to be in tolerance with the maintenance manual for the secondary winding (2,000Ω to 4,000Ω), there is no resistance requirement for the primary winding.

The condensers were checked and the advance condenser was found to be bad and had a value of 2.98µF Figure L, while the retard condenser was found to have a value of 0.935µF Figure M which is higher than it should be but would still be functional. There is no specification of values for the condensers in the maintenance manual, only to use a condenser tester. From many years of experience working on magnetos, we know that a value for the condenser in these magnetos should be around 0.425µF.

The drive was removed from the magneto and the magneto was placed on a timing wheel and a magneto synchronizing timer was used to check the internal timing of the points of the magneto. It was found that the advance point timing was so far off that it could not be properly measured. Because the retard timing is set based on the advance timing the advance timing was set according to the maintenance manual. From there the retard timing was was checked and found to be 7.5° from the advance timing and should have been set at 4.5° for this model of magneto.

[redacted]

It should also be noteworthy that a yellow dot was marked on the magneto above the data plate which indicates that the mag has had a service bulletin complied with. This yellow mark is the indication of SB compliance which was used through out the 1940 through 1970s and it may be speculated and of value to know that the magneto may not have been overhauled since that time.

This completed the inspection and testing portion of the magneto. The magneto was placed in a bag and sealed in the box that it was received in. The owner of the magneto wants the magneto overhauled and we will await release of the magneto by the NTSB prior to beginning work on it.

It is the opinion of this repair station that the magneto experienced a failure due to mechanical and human error, both the MRO facility that overhauled it and the pilot, which was the cause of the issues that the pilot experienced during the incident in question. The condition in which the magneto was found during the inspection would have caused the aircraft engine to misfire on one set of spark plugs and run extremely rough to a point that the engine could have experienced a major loss of power and the need for a forced landing.

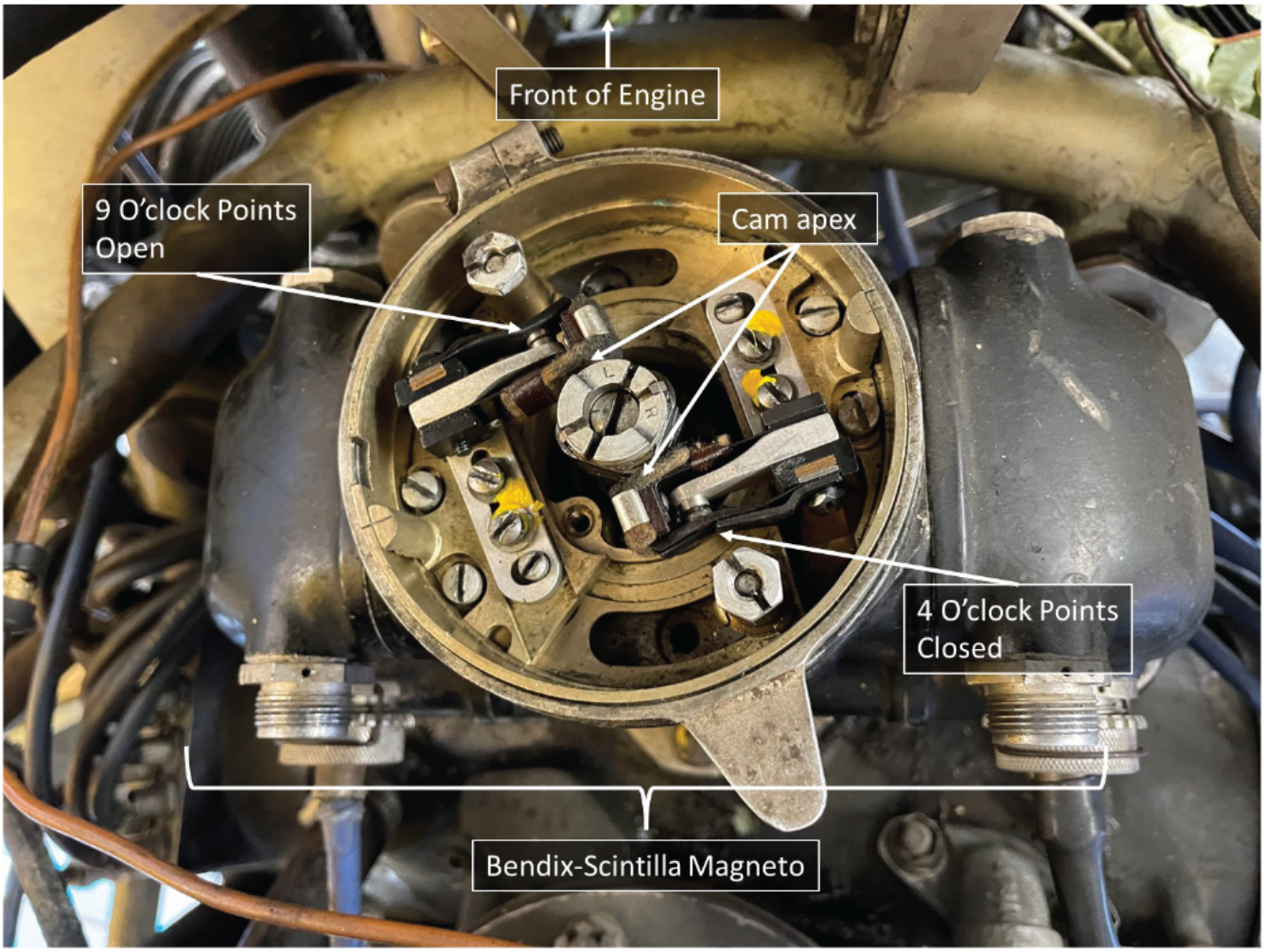
It is worth mentioning that the magneto should have shown indications of malfunction on a prior flight or during the mag drop check portion of the run up test which should have been performed prior to takeoff. This failure could have occurred in flight, but because of how loose the screws holding the advance points were and the degree at which these points were out of time, there should have been prior indications of failure. The series of events that led to this incident are as follows:

1. Failure to adequately tighten screws by the overhauling MRO, which allowed the advance points to fall out of timing and also causing the improper timing of the retard points.
2. Pilot and aircraft maintenance technician failure to recognize the warning signs of a magneto failure and failure to properly conduct the run up checklist.
3. While not typically a requirement, a mag check after flights while the magneto is hot, would have indicated that the advance condenser has failed in the magneto, and that the failure is imminent in the retard condenser.

While point 3 is not currently a requirement as an Airworthiness Directive or a checklist item, this repair station actively recommends to its customers that mag checks be re-performed after landing while the magneto is hot as failures are more indicative in this state. It is our recommendation that the FAA should issue guidance which informs that all aircraft that have magneto ignition systems, perform a mag check after every flight to check for failure that don't appear prior to flight.

[redacted]

Figure A

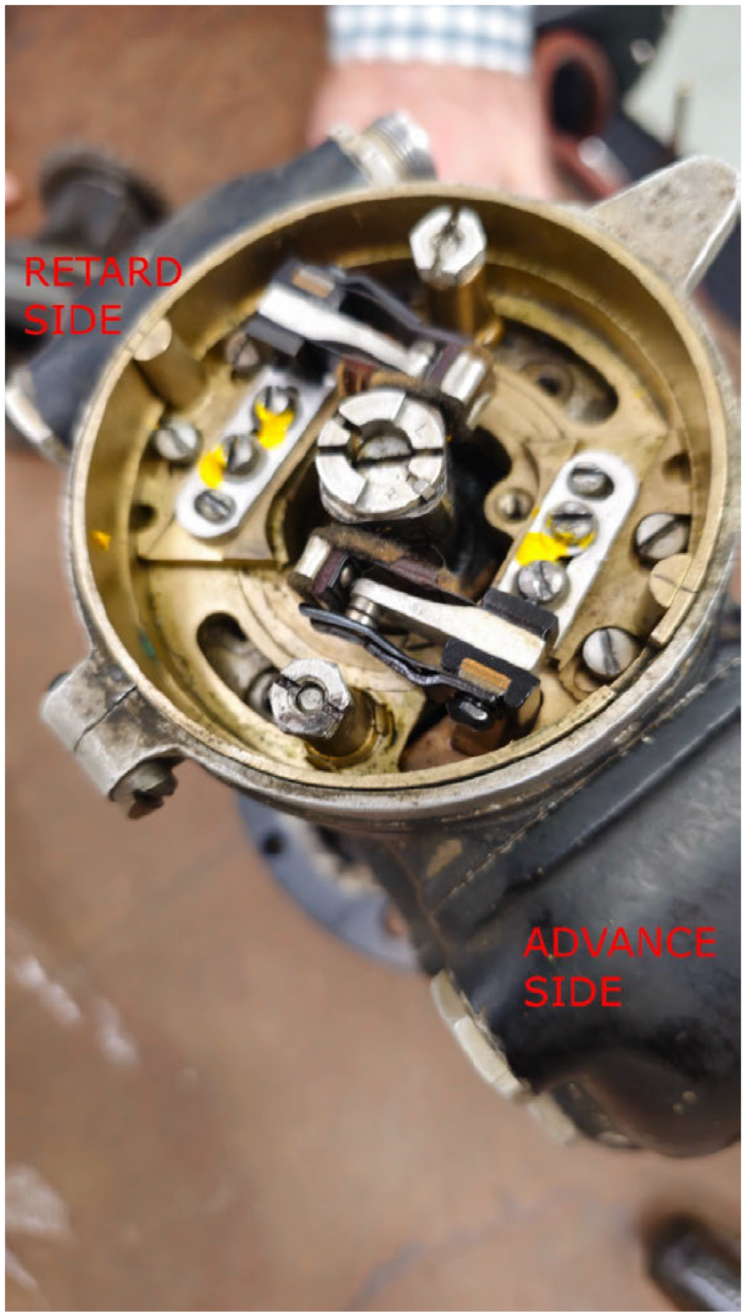


[redacted]

Figure B

[redacted]

Figure C

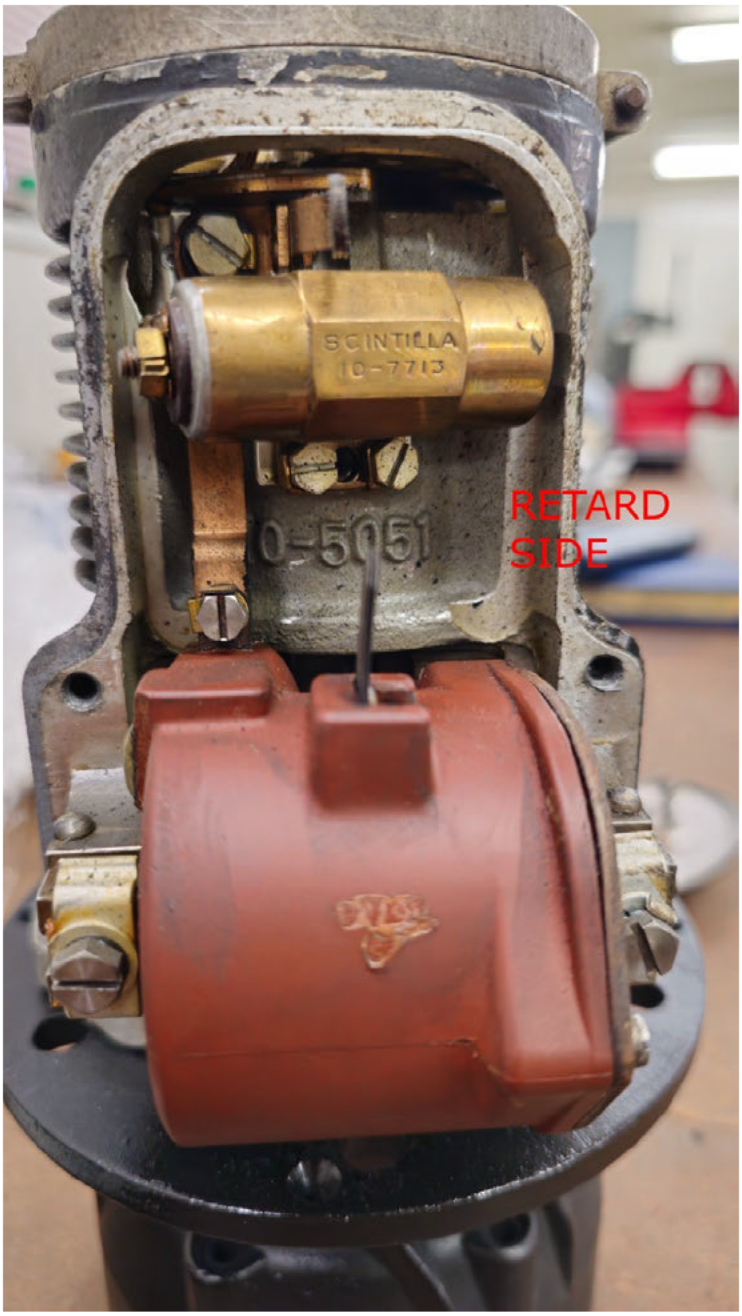


[redacted]

Figure D

[redacted]

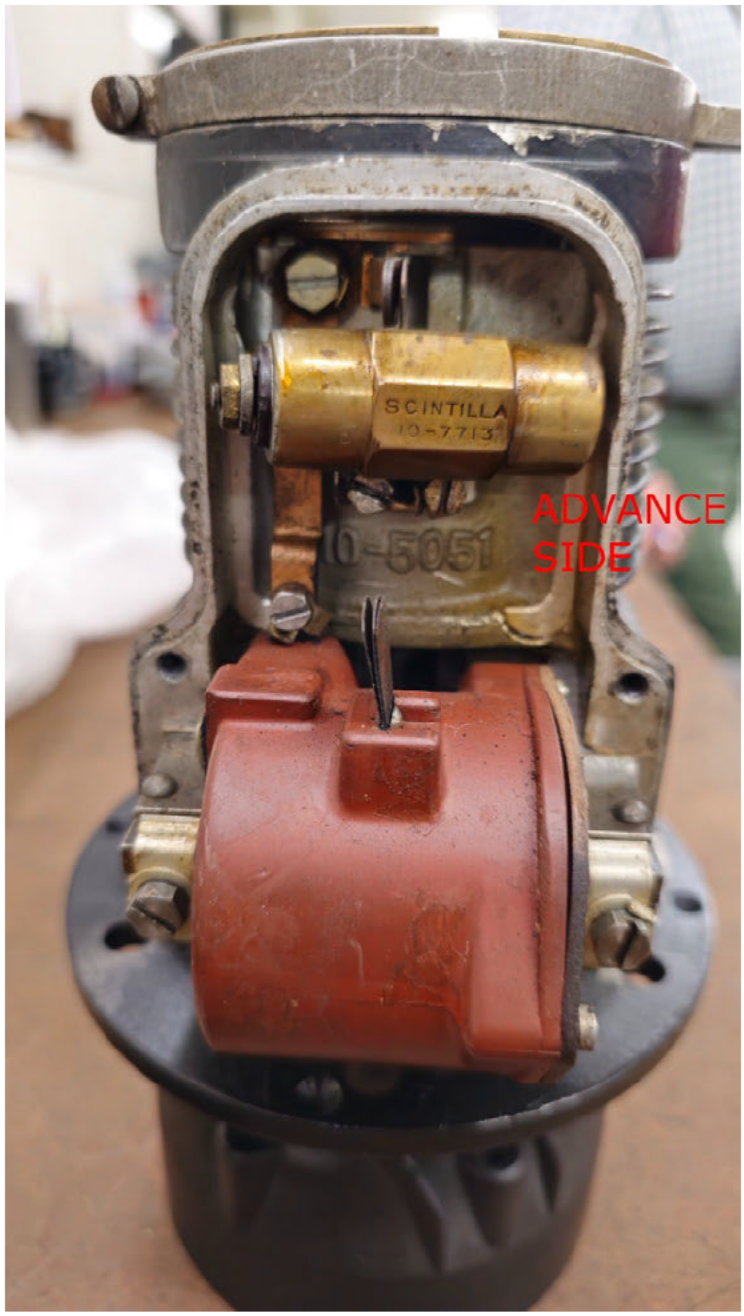
Figure E



The information in this report is final.

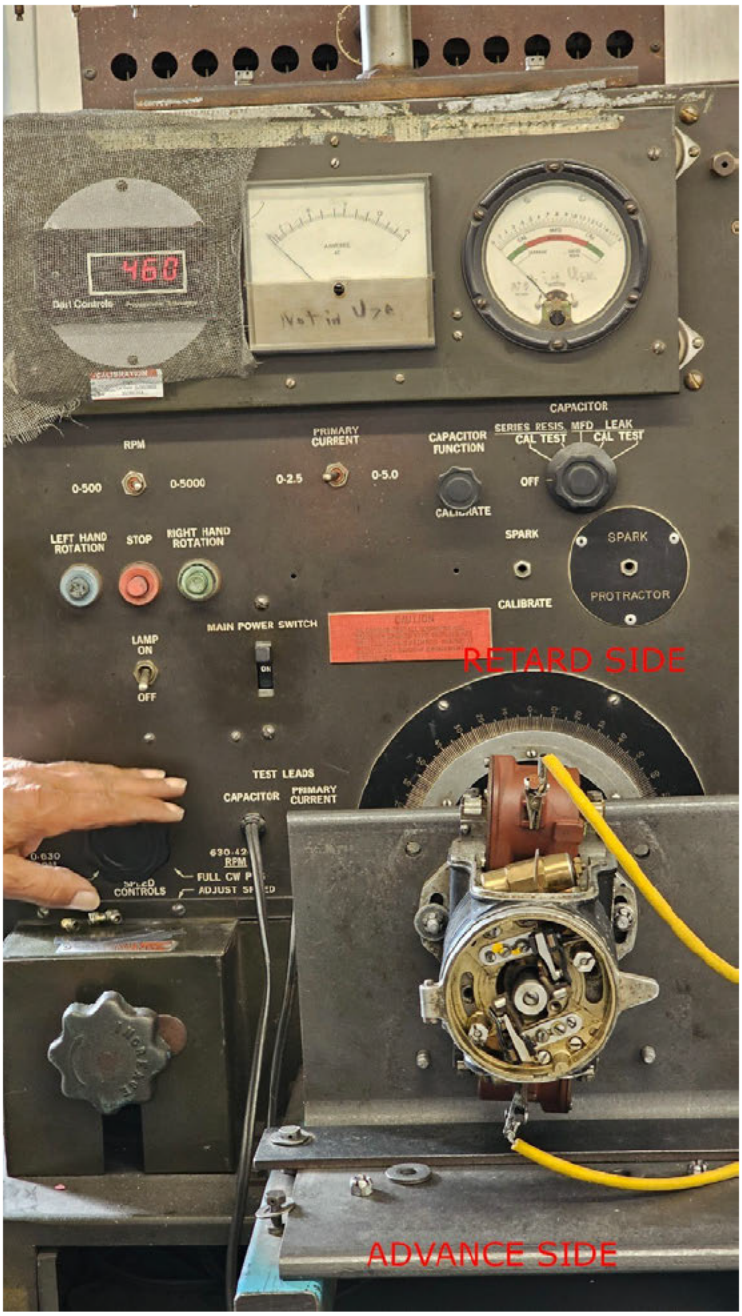
[redacted]

Figure F



[redacted]

Figure G



[redacted]

Figure H

Figure I

[redacted]

Figure J

Figure K

[redacted]

Figure L

Figure M