National Transportation Safety Board
Office of Aviation Safety
Washington, DC 20594

ERA23FA188

# AIRWORTHINESS FACTUAL REPORT

March 7, 2024

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## A. ACCIDENT

| | |
|---|---|
| Location: | Climax, North Carolina |
| Date: | April 11, 2023 |
| Time: | 1132 local<br>1532 UTC |
| Airplane: | Experimental Amateur Built, Van's RV-12, N543GM |

## B. AIRWORTHINESS FACTUAL REPORT

| | |
|---|---|
| NTSB IIC | Adam Gerhardt<br>National Transportation Safety Board<br>Washington, DC |
| Party Member | Bradley McCauley<br>Federal Aviation Administration<br>Greensboro, North Carolina |
| Party Member | Patricia Chriscoe<br>Federal Aviation Administration<br>Greensboro, North Carolina |

## C. SUMMARY

On April 11, 2023, at 1132 eastern daylight time, an Experimental Amateur Built Van's RV-12 airplane, N543GM, was destroyed when it impacted a bridge and terrain near the Greensboro Executive Airport (3A4), Climax, North Carolina. The left seat commercial pilot was fatally injured, and the right seat commercial pilot sustained serious injuries. The airplane was operated as a test flight conducted under the provisions of Title 14 *Code of Federal Regulations* Part 91.

## D. DETAILS OF THE INVESTIGATION

The NTSB investigator-in-charge traveled to the accident site and examined the wreckage on April 12-13, 2023. He was assisted by party members from the Federal Aviation Administration (FAA) Greensboro FSDO, and a non-party member mechanic based at the 3A4 airport. This report contains history of flight information, airplane information, and factual findings from the examination of the wreckage.

## E. AIRPLANE INFORMATION

The Airplane

According to FAA airworthiness records, the airplane was an experimental amateur built Van's RV-12 airplane. It was issued a special airworthiness certificate on August 30, 2021. The airworthiness certificate outlined multiple limitations during Phase 1 flight testing. Notable limitations were:

The airplane must be operated for at least 40 hours with at least 15 takeoffs and landings within certain prescribed geographic areas, which included the accident airport 3A4.

Limitation 19 stated, unless operating per FAA AC 90-116, Additional Pilot Program for Phase 1 Flight Test, only the minimum crew necessary to fly the aircraft during normal operations may be on board.

Limitation 20 stated, upon completion of phase 1 flight testing, compliance with 91.319(b) must be recorded in the maintenance records, denoting an endorsement of, "I certify that the prescribed flight test has been completed and the aircraft is controllable throughout its normal range of speeds and throughout all maneuvers to be executed, has no hazardous operating characteristics or design features, and is safe for operation."[1]

Pilot's Operating Handbook

The pilot's operating handbook (POH) stated that the airplane had 2-seats and was a low wing design. The aerodynamic stall speed with flaps down was 41 knots and with flaps up it was 45 knots. The landing distance published[2] was estimated to be 525 ft. The fuel capacity was 19.8 gallons. According to the POH, approved fuel types were 89 octane or higher automotive fuel with 10% ethanol as a maximum. It further stated that 100 low lead aviation fuel could be used, when automotive fuel was not available.

The Engine

The engine was a 110-horsepower fuel-injected Viking Aircraft Engine, model 110. The serial number (VIN#) was JHMGW8H2XAS024654. The serial number placard had a Honda Motors[3] logo.

[1] No endorsement denoting completion of Phase 1 flight testing was located in the maintenance logbooks.
[2] The conditions noted for this landing distance was maximum gross weight.
[3] Viking Aircraft Engines produce experimental aircraft engines from originally manufactured Honda Fit car engines.

According to the Viking Aircraft Engines operating handbook, Chapter 5, Engine Operation, it stated to use only 100 low lead fuel when 90 or higher octane fuel is not available. The handbook further stated:

FUEL: These are high compression, high performance engines! Use 89 or higher octane fuel. Up to 10% ethanol is permitted. Never run lower grade fuels! It can and will destroy your engine.

The manual further stated, "the engine should never be left with auto type fuel in the fuel rail or fuel pumps for longer than 3 month intervals. The approved storage fuel is 100LL aviation fuel. 100LL was used to test run the engine at the factory, prior to shipping."

According to a representative with Viking Aircraft Engines, the normal compression for a Viking 110 engine was 180 to 210. The spark plugs to be used were NGK brand Iridium Spark Plugs. The representative further reported that the engine may experience detonation, should 87 octane be used.

## F. AIRPORT SECURITY VIDEO OVERVIEW

The Greensboro Executive Airport provided surveillance footage that captured the accident airplane flight activity on the day of the accident. The following is a summary of what was observed:

| Time (Local EDT) [4] | Observations |
|---|---|
| 11:01:54 | The airplane was viewed to cross the hold short line near the main terminal building with one occupant onboard and back taxi on runway 35. |
| 11:03:04 | The airplane was observed to takeoff. The airplane was airborne near the main terminal building. It subsequently climbed out of view and departed the on a right crosswind. |

[4] The security camera system time compared to the actual real world time was behind by 52 minutes and 42 second. A corrective factor has been applied to the local time provided in the table.

Figure 1: View of the airplane's first takeoff at 11:03:04 with one occupant on board.

| Time (Local EDT) | Observations |
|---|---|
| 11:06:53 | The airplane was observed approaching runway 17, touched down briefly and then took off on runway 17 and climbed out of view. |
| 11:09:51 | The airplane was observed to land on runway 17. The airplane completed the ground roll and taxied by the main terminal building. One occupant was onboard. |
| 11:25:12 | The airplane was observed to taxi across the hold short line for runway 35 near the main terminal building with two occupants onboard. [5] |
| 11:27:37 | The first takeoff was initiated on runway 35. About one third of the way down the runway, the takeoff was aborted. There was no evidence of rotation. The airplane back taxied on runway 35 and returned to the turnaround area of runway 35. |
| 11:31:07 | The second takeoff was initiated. The rotation was about half-way down the runway. The airplane climbed on upwind. |

[5] A witness at the airport observed two occupants onboard prior to the accident takeoff and was able to confirm their identities. According to this witness, the pilot that had flown the first takeoff, touch and go, and landing had moved to the right seat and a new pilot was seated in the left seat, whom was the fatally injured pilot. For a memorandum of record (Mechanic), reference the NTSB public docket for additional information.

**Figure 2: The airplane as viewed during the second takeoff roll with both occupants on-board.**

**Figure 3: At 11:31:18 local, the accident flight rotation was observed.**

**Figure 4: At 11:31:47, the airplane after climbing on upwind, entered an abrupt left turn.**

**Figure 5: At 11:31:51, the airplane entered a second abrupt left turn, placing the airplane over the highway and on a downwind for runway 35.**

**Figure 6: At 11:32:22, the airplane was observed near treetop level over the highway.**

**Figure 7: At 11:32:31, the airplane remained at treetop level over the highway, across from the 3A4 terminal.**

**Figure 8: At 11:32:32, the airplane descended below the tree top level while over the highway as observed from the main terminal building.**

**Figure 9: At 11:32 (seconds unknown) a motorist photographed the airplane low over the highway. The airplane appeared to be between the highway mile marker (191.5mi) and the overpass bridge.**

**Figure 10: At 11:32 (seconds unknown), a second photo was captured. The photo showed the view of airplane inside of mile marker (191.5mi) and closer to the bridge impacted.**

**Figure 11: At 11:32(seconds unknown), a third photo was captured. The photo showed the view of airplane further inside of mile marker (191.5mi) and closer to the bridge impacted.**

**Figure 12: A motorist provided a photo of the airplane observed shortly after impact. A post-crash fire ignited and consumed the cockpit and eventually major portions of the airplane.**

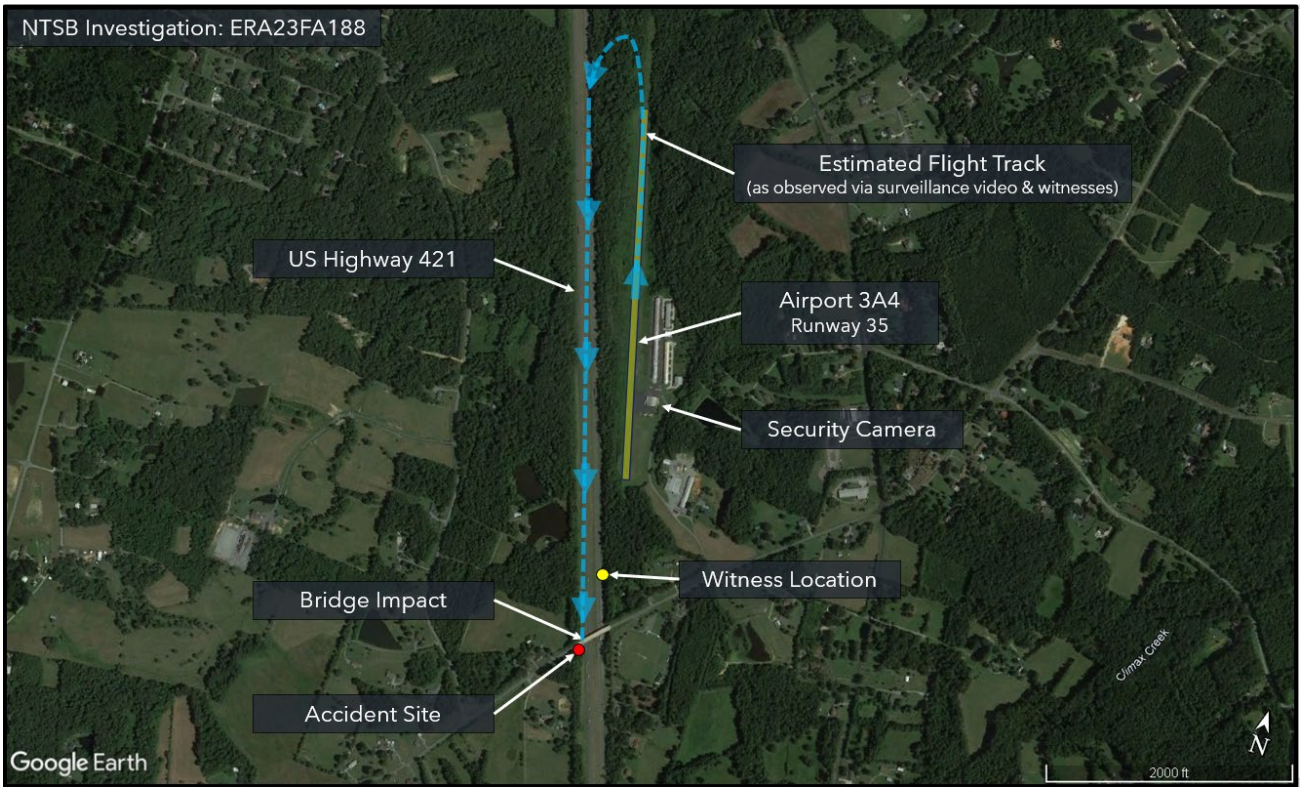


**Figure 13: Overview of the airport environment, flight track, and accident site.**

## G. AIRFRAME EXAMINATION

The airplane's initial impact point coincided with an overpass bridge railing that traveled over US Highway 421. The airplane subsequently impacted terrain shortly beyond the bridge on a hill next to the highway. The airplane came to rest inverted, the wreckage was fragmented, and was located in one compact area.

All major portions of the airframe were located at the accident site. The engine was co-located with the cockpit and firewall debris. A post-crash fire consumed significant portions of the fuselage, cockpit, and left wing.

Flight control continuity was confirmed from the cockpit to the flight controls for the rudder and elevator controls. Multiple breaks consistent with impact related forces and severe thermal damage were observed within the aileron control push pull rods. All cockpit switches, instrumentation, the center fuel tank, and non-volatile memory were destroyed by the post-crash fire.

**Figure 14: Overview of the accident site as viewed from the bridge the airplane impacted. Note the powerlines above the bridge, which spanned across the entire highway from east to west.**

## H. ENGINE EXAMINATION

The engine was located in the debris a few feet from the cockpit. It remained partially attached to the firewall and sustained thermal damage in the post-crash fire.

The engine would not rotate when attempted to be rotated by hand via the forward fly wheel. When the engine was further disassembled, the timing chain system was melted to the chain guides which prevented rotation. The gear reduction box rotated freely and normally with the propeller hub when removed from the engine.

The oil filter was secure in place and thermally damaged. When cut open and observed, it displayed significant thermal damage, was brittle to touch. No metal shavings were observed. The crankcase bolts were secured and removed.

The main fuel line on the engine was secure and was thermally damaged. The chain tensioner was intact and had melted.

The camshaft gear when moved by hand, after the engine had been partially disassembled, moved all piston valves. There was no evidence of metal shavings on the pistons.

The main crankshaft bearings were intact and displayed clean oil signatures. There was no evidence of thermal damage on any of the crankshaft bearings. The internals of the cylinders appeared normal. The pistons and valves were intact and displayed normal combustion signatures. The throttle body remained attached to the engine and its control arm operated the butterfly valve normally.

The engine control unit was severely thermally damaged. The main fuel pump was removed. It was thermally damaged, and the internal components were melted and observed to be protruding from the casing. The fuel filter and fuel injectors were observed thermally damaged and partially melted. The entire fuel line system was wrapped in fire sleeves and were thermally damaged.

The propeller was a composite three-bladed Warp Drive. All three blades splintered from the propeller hub. Two of the blades were located in the debris. One blade exhibited a leading edge gouge.

Spark Plugs

The NGK IR spark plugs (IZFR6K – 13 – NGK-IR) were found securely installed. When the spark plugs were removed and examined, the Nos. 1 and 2 cylinder spark plug ground electrode tips were found obliterated and the remainder of the electrodes on both spark plugs exhibited blackening. The Nos. 3 and 4 cylinder spark

plugs were blackened, however; their electrode tips remained intact. There was no evidence of impact related damage to any spark plug.

Spark Plug Test

The spark plugs were tested with a Model A Spark Plug cleaner and indicator bench test equipment at the 3A4 airport. The test equipment used compressed air to simulate engine compression and had a range of compressions, denoting whether the spark plugs should be replaced or were acceptable for continued use.

The Nos. 1 and 2 spark plugs exhibited a spark around 60-70psi, but with compression at 70-80psi, both spark plugs would immediately lose their continuous spark and would extinguish.[6]

The Nos. 3 and 4 spark plugs operated normally throughout a range of low pressure up to 80psi.

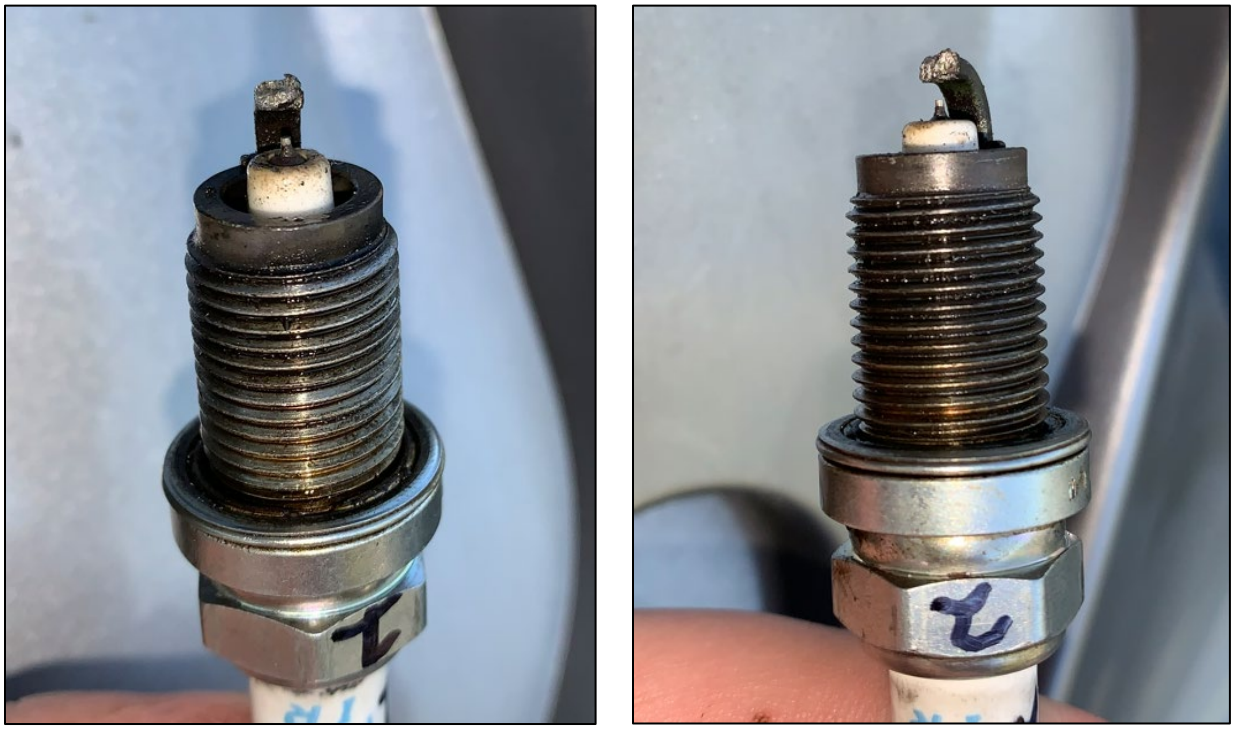

**Figure 15: View of the Nos. 1 and 2 cylinder spark plugs as viewed left to right.**

[6] The NTSB Public Docket has a video of all four spark plug tests.


**Figure 16: Closer view of the No. 1 cylinder spark plug. Note the tip of the electrode was observed to be obliterated.**


**Figure 17: Closer view of the No. 2 cylinder spark plug. Note the tip of the electrode was observed to be obliterated.**

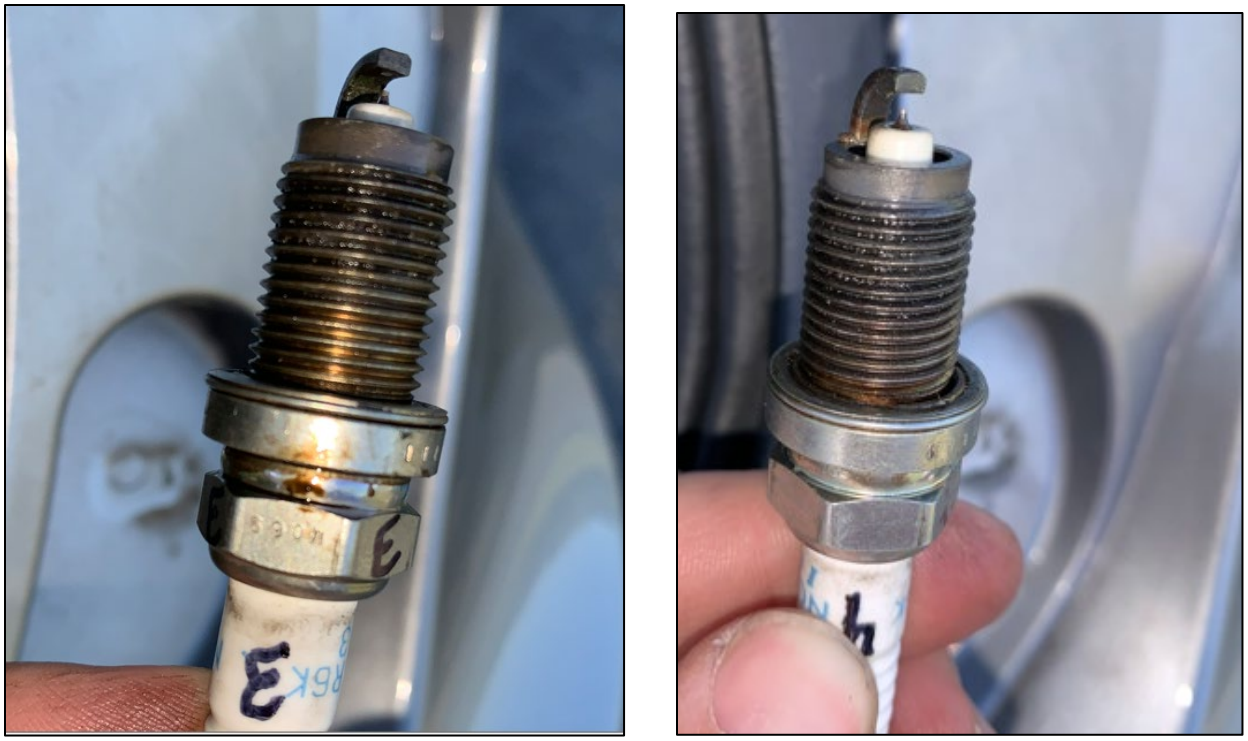

**Figure 18: View of the Nos. 3 and 4 cylinder spark plugs as viewed left to right.**

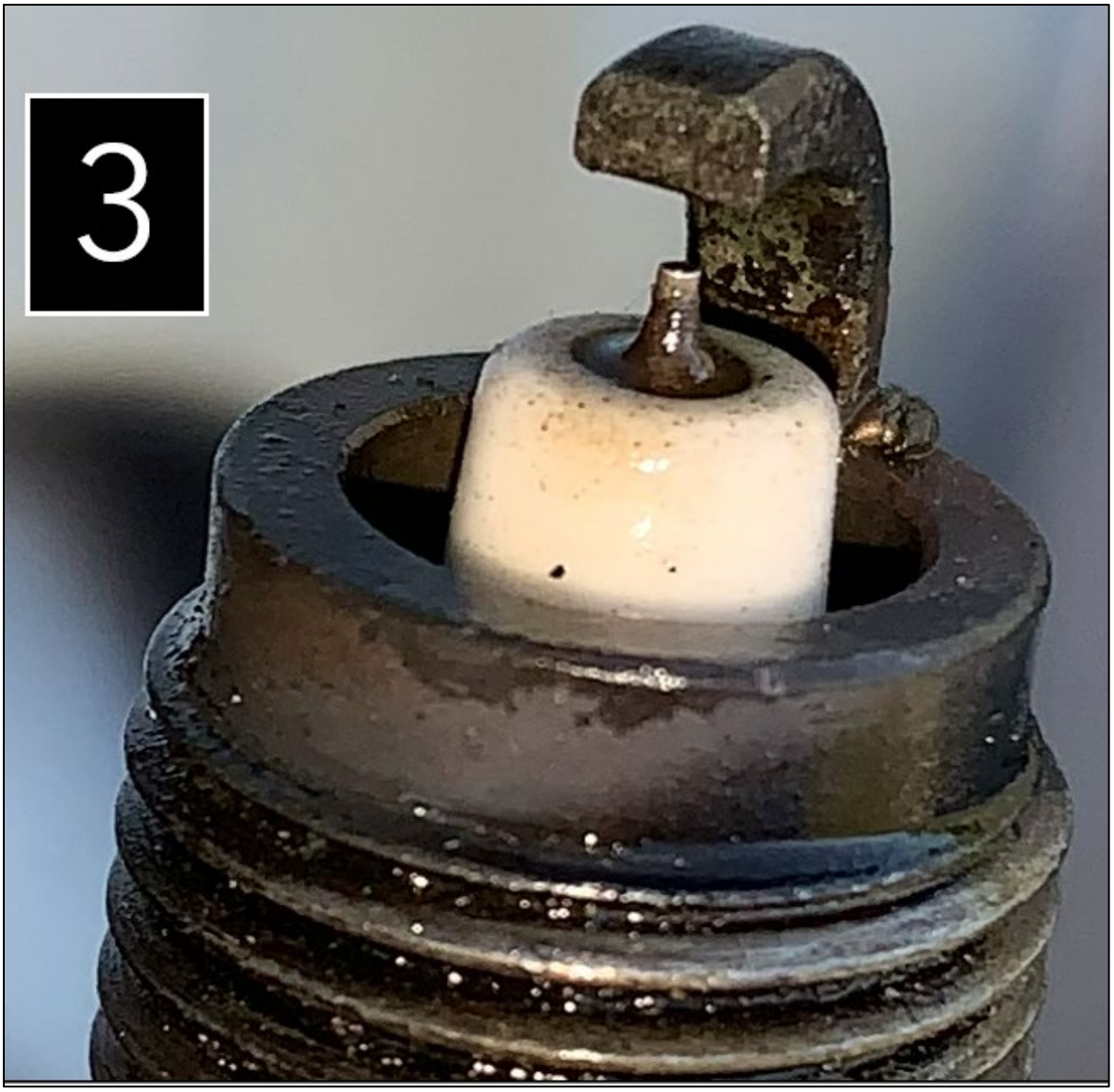


**Figure 19: Closer view of the No. 3 cylinder spark plug. Note the tip of the electrode remained intact.**


**Figure 20: Closer view of the No. 4 cylinder spark plug. Note the tip of the electrode remained intact.**

**Figure 21: View of a new NGK IR spark plug (IZFR6K13) as viewed on Summit Racing Equipment website.**

## I. MAINTENANCE AND AIRPLANE HISTORY INFORMATION

The airframe maintenance record logbook was located in a hangar at 3A4 airport. The most recent conditional inspection was recorded on September 1, 2022; however, the endorsement was not signed. The logbook contained entries denoting engine and flight activity, from October 5, 2021, through August 27, 2022. The final recorded tachometer time in the logbook was noted as 8.6 hours. A total of 3 hours of these 8.6 hours were flight hours, with the other time noted as ground and taxi operation. These hours were flown/ operated by the airplane owner.

According to the surviving pilot, he had flown the airplane 6 hours, and the pilot seated in the left seat who was fatally injured had 8 hours in the airplane. The purpose of the flying was to complete Phase 1 flight testing and meet the required 40 hours of flight testing. The total hours flown on the airplane was likely about 22 hours.

The engine and propeller logbook were not located in the hangar; however, they were later shipped by the airplane owner to the NTSB for review. The engine logbook contained one entry dated July 8, 2021, denoting that the engine was inspected in accordance with Appendix D Part 43. The inspection was signed by the airplane owner and builder. There were no other entries noted in the engine logbook.

The propeller logbook contained one entry dated July 8, 2021, denoting that the propeller was inspected in accordance with Appendix D Part 43. The inspection was signed by the airplane owner and builder. There were no other entries noted in the propeller logbook.

Fuel Type Used

According to the surviving pilot, 12 gallons of fuel was on board for the accident flight. He recalled that he used 93 octane from a gas station down the street from 3A4.

The owner of the airplane was questioned on what type of fuel he used during his time operating the airplane. He reported that he used automotive gasoline. He was asked what octane level, to which he responded that he used 87 octane grade. He stated that it's a small car engine, a Honda Fit engine, and he "felt comfortable" using the "lower grade." He never used 100LL with the airplane.

The owner further reported that he recalled that there was about 1/2 of a tank of fuel onboard the airplane through the more than a year that the airplane did not fly. He recalled that he added a fuel additive to the tank to help preserve the auto fuel that sat in the tank. In October 2022, he recalled performing a run-up and did not

experience any issues. The owner reported that he never had any discussions with either accident pilots on what type of fuel they should use for their test flights.

## J. PHOTOGRAPHS AND FIGURES

**Figure 22: Overview of the airplane at the accident site.**


**Figure 23: Overview of the accident site. The bridge in the background exhibited impact marks consistent with a portion of the airplane colliding with it.**

**Figure 24: Overview of the accident site.**

**Figure 25: View of the bridge impacted and the powerlines that spanned across the entire length of the bridge across the highway. The camera is facing the direction of airplane travel and the accident site is forward and below the bridge, as referenced for this photograph.**

**Figure 26: View of the propeller and hub.**

**Figure 27: View of engine bearings as observed during the engine teardown.**

**Figure 28: View of engine components as observed during the teardown.**

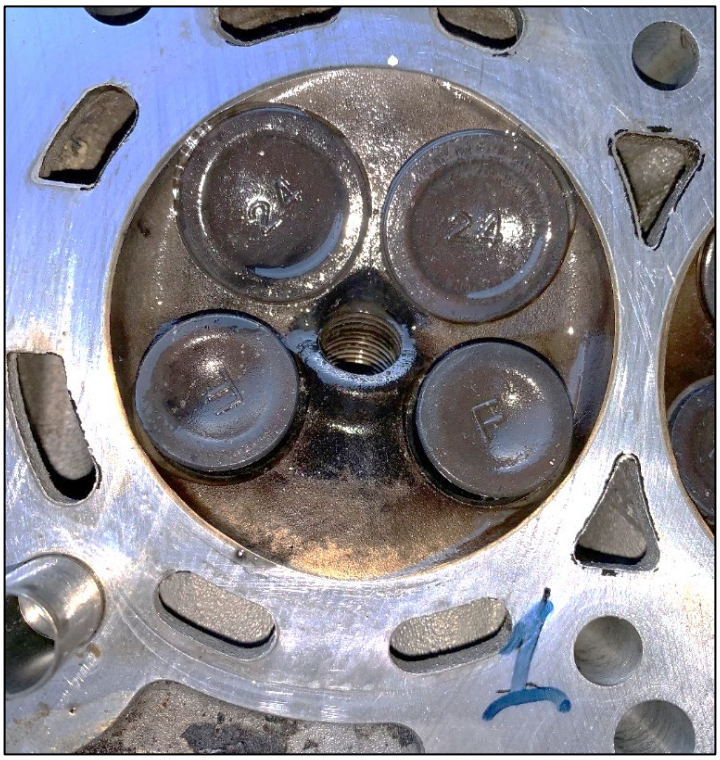

**Figure 29: View of engine components as observed during the teardown. No. 1 cylinder valves.**

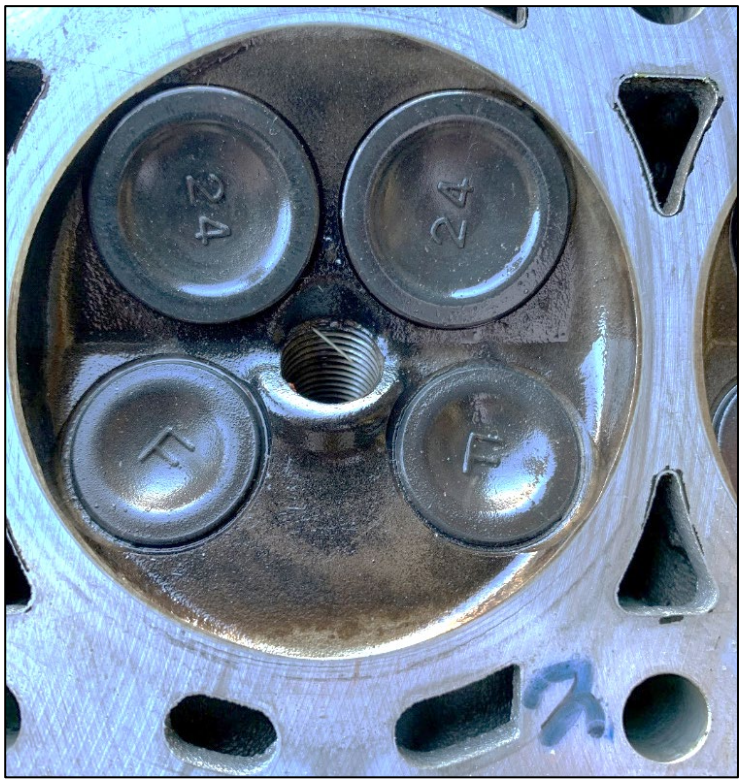

**Figure 30: View of engine components as observed during the teardown. No. 2 cylinder valves.**

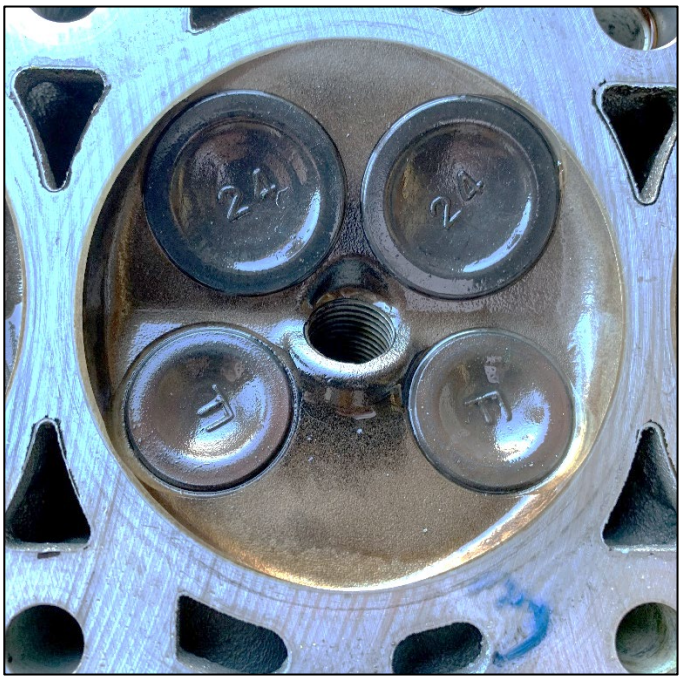

**Figure 31: View of engine components as observed during the teardown. No. 3 cylinder valves.**

**Figure 32: View of engine components as observed during the teardown. No. 4 cylinder valves.**

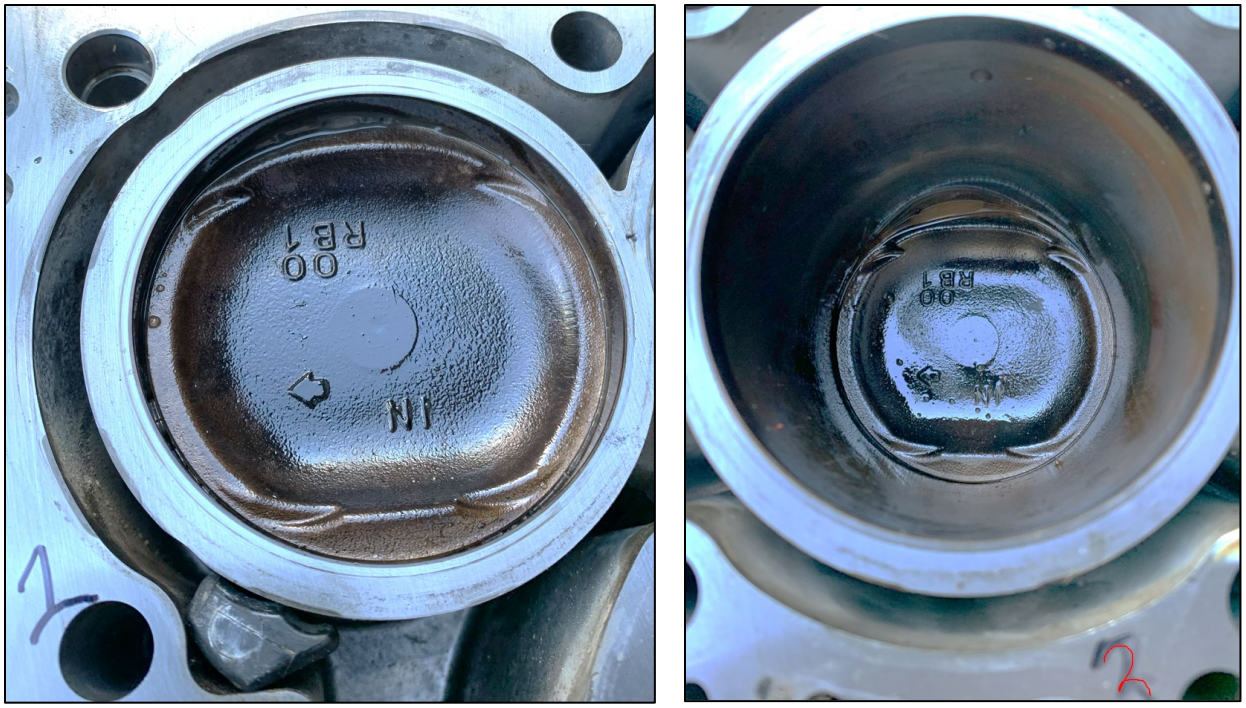


**Figure 33: View of engine components as observed during the teardown. Pistons.**

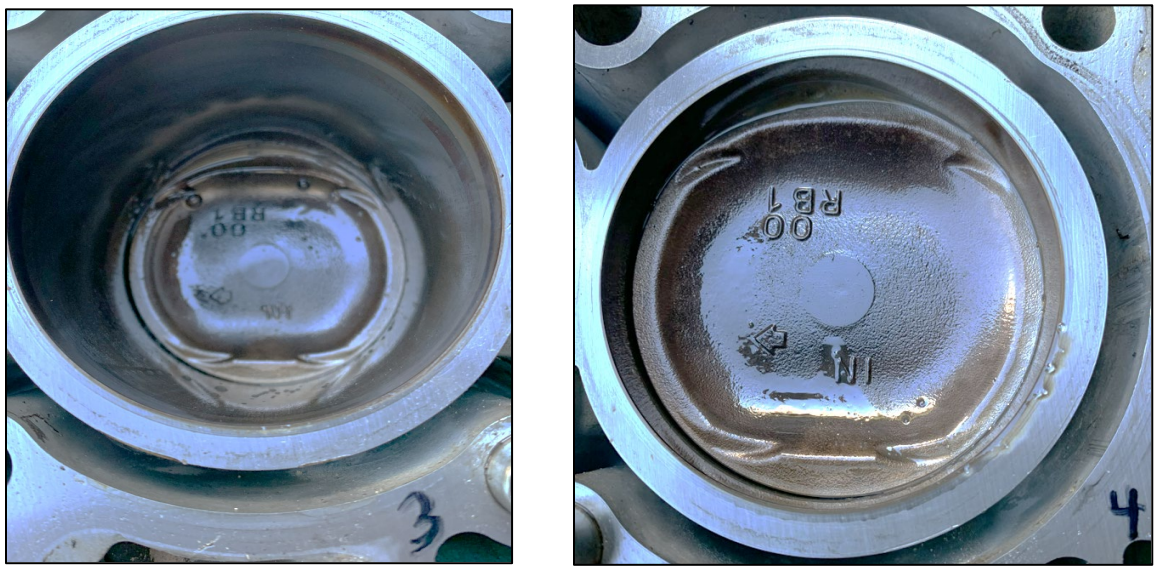


**Figure 34: View of engine components as observed during the teardown. Pistons.**

Submitted by:

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