



**ERA19LA074**

**McCormick SC**

**December 19, 2018**

**Diamond DA20– N346MA**

**NTSB ENGINE EXAMINATION FIELD NOTES**

**Examination Date: May 7-8, 2019**

**PARTICIPANTS IN THE EXAMINATION**

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## **HISTORY OF FLIGHT**

## **ENGINE INFORMATION**

Engine Manufacturer: Continental Motors

Engine Model Number: IO-240-B17B

Engine Serial Number: 650313

Recent Inspection: December 3, 2018, tach 363.5 TSMOH 1872, estimated TT 4029 – 100-hour inspection

Recent Maintenance: December 19, 2018, tach 440 replaced manifold valve, throttle and metering unit, fuel pump, in response to rough running engine

### Picture 1. Most Recent Inspection (annual inspection)

**INITIAL EXAMINATION AS RECEIVED**

The engine was received crated and sealed. After removal of the crate, the engine was examined and the following discrepancies were noted:

- A fuel pump inlet 'finger' screen was in the bottom of the crate, partially crushed but otherwise unobstructed.



Picture 2. Fuel Pump Inlet "Finger" Screen

- The Nos. 2 bottom sparkplug lead wire was damaged near its clamp location on the cylinder, the No 4 top sparkplug lead wire was damaged near its terminal end. Both were repaired prior to running engine.
- The fuel pump and manifold valve remained intact. The alternator and drive pulley were already removed and lay in the bottom of the crate.
- The lower left engine mount was damaged and could not be used.

The engine was mounted to a portable cart utilizing mount legs for further examination and test run.



Picture 3. Engine as Received

## **DETAILED EXAMINATION**

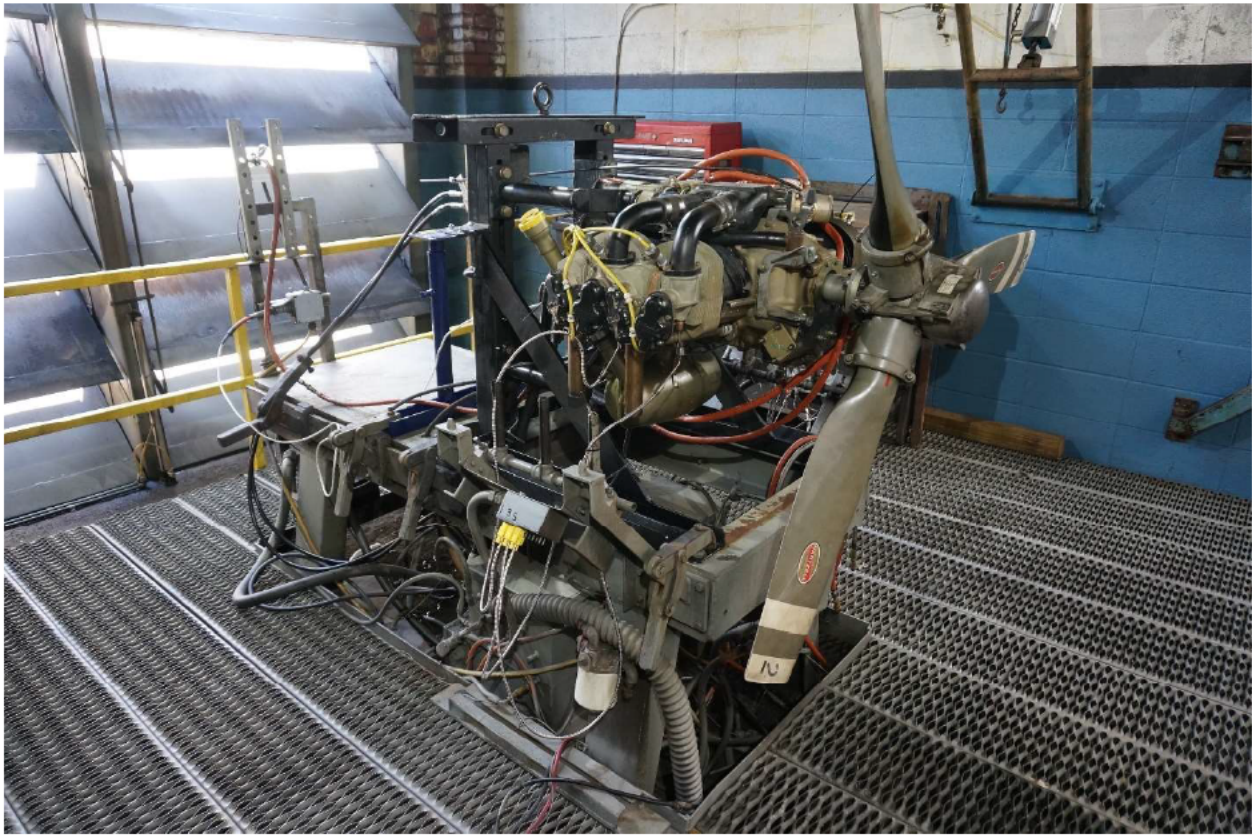
### **Induction and Exhaust System**

The exhaust manifold and muffler were not attached to the engine and were on the bottom of the crate. The air induction tube remained attached to the engine. The throttle and metering unit and intake manifold assembly remained intact.



Picture 4. Engine

The remaining engine accessories and baffling were removed to facilitate the engine test run. The engine was mounted on a stand and prepared for the test run, installing the appropriate fuel connections, exhaust pipes, test equipment and test cell propeller.



Picture 5. Engine in Test Cell

During the initial test run, the engine ran very rough, and would not idle. By increasing the test stand fuel boost pressure, the engine would remain running. As the fuel boost pressure was increased, the metered fuel pressure did not increase appreciably.

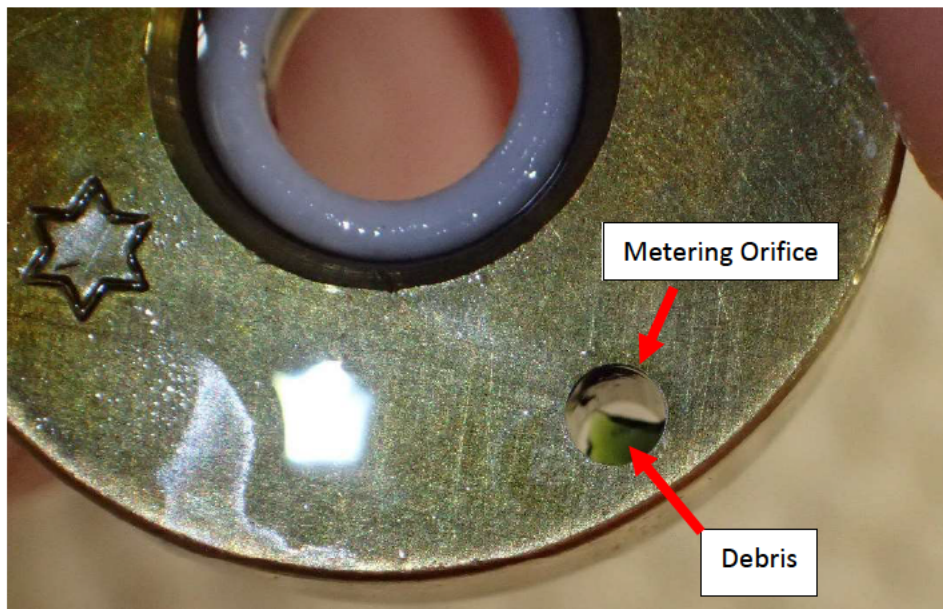
The fuel pump was removed and replaced with an exemplar unit. The subsequent engine test runs were similar to the initial test run.

The original (installed during accident flight) fuel pump was tested on a production test bench and was found to be nearly within the performance specifications (see attached test sheet).

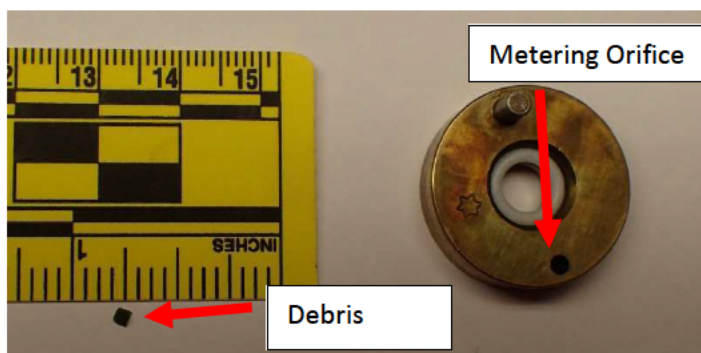
The original throttle and metering unit (installed during accident flight) was removed and tested on a production test bench. The test parameter for fuel flow was below allowable limits at all throttle positions (see attached test sheet).

An exemplar throttle and metering unit was installed on the engine. The engine ran satisfactorily/normally on subsequent tests.

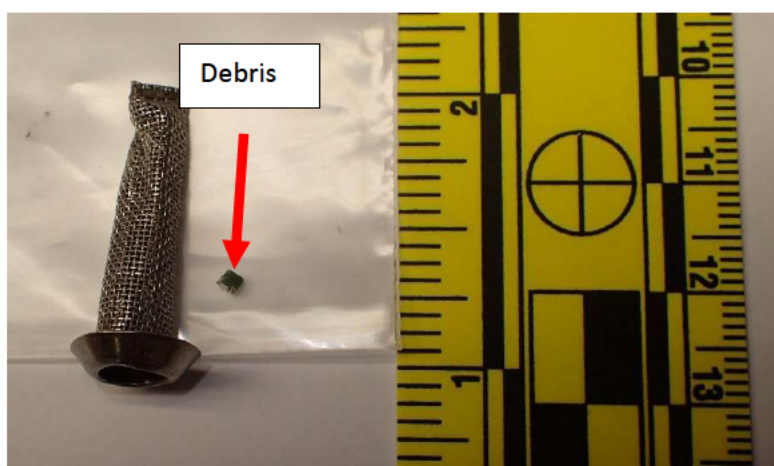
The original throttle and metering unit was disassembled. A piece of debris about 1/16" square and dark green in color, was found lodged in the metering plug orifice.



Picture 6. Debris Lodged in Metering Plug Orifice



Picture 7. Debris Removed and Metering Plug Orifice with Scale



Picture 7. Debris and "Finger" Screen

The debris was removed, and the throttle and metering unit was reassembled and installed on the engine. The original fuel pump was installed on the engine. The engine test ran satisfactorily/normally on subsequent test runs.

The original fuel pump was removed and disassembled. No debris or other abnormalities were found.

- Fuel System Components Removed on 12/19/18, prior to the accident flight:

The fuel system components that were removed from the airplane on 12/19/18 (fuel pump, fuel manifold, throttle and metering unit) were shipped from Falcon Aviation to Continental Aerospace Technologies on 5/8/19.

Some debris was found inside the previously installed fuel manifold. It was downstream of the manifold's filter screen, and similar in color/texture to the debris that was found in the accident throttle and metering unit orifice, though much smaller in size. No debris were found in the previously installed fuel pump or throttle and metering unit.

## Fuel Pump Test Sheet

----- Continental Motors, Inc. -----

Final Report  
OF  
calibration-31\_CW TEST RESULTS  
FOR

Accy Name : 632845 -31

Part Number : 653351-3A5

Serial Number : b04ga017

LOGGED BETWEEN : 5/8/2019 7:49:12 AM

AND : 5/8/2019 7:54:53 AM

BY

Operator : jbraswell

Work Order Number : warranty

Report Generated On : 5/8/2019 7:55:26 AM

----- Continental Motors, Inc. -----

|                 |                       |               |             |
|-----------------|-----------------------|---------------|-------------|
| Airframe Name   | : 632845-31           | Model Number  | : ***       |
| Part Number     | : 653351-3A5          | Test Document | : 632845    |
| Accy Name       | : 632845 -31          |               |             |
| Test Type       | : calibration-31_CW   |               |             |
| Serial Number   | : b04ga017            | Operator      | : jbraswell |
| Test Station ID | : R678                | Work Order    | : warranty  |
| Run Date/Time   | : 5/8/2019 7:49:12 AM | Report Type   | : Final     |

Paragraph Number : 1

Paragraph Name : ----

| Test Point | supply temp F | pump speed RPM | fuel flow Min | fuel flow PPH | fuel flow Max | discharge pressure Min | discharge pressure PSIG | discharge pressure Max |
|------------|---------------|----------------|---------------|---------------|---------------|------------------------|-------------------------|------------------------|
| 3          | 68.4          | 701.1          | 5.300         | 5.660         | 6.000         | 6.60                   | 7.85+                   | 7.20                   |
| 4          | 69.3          | 2798.8         | 85.000        | 84.630        | 86.000        | 47.80                  | 45.12-                  | 48.00                  |
| 5          | 69.2          | 1800.1         | 65.000        | 65.720        | 66.000        | 16.50                  | 16.67                   | 18.50                  |
| 6          | 69.0          | 699.9          | 5.300         | 5.350         | 6.000         | 6.60                   | 7.49+                   | 7.20                   |
| 7          | 68.9          | 698.9          | 0.000         | 0.750         | 2.000         | -                      | 0.92                    | -                      |

----- Continental Motors, Inc. -----

|                 |                       |               |             |
|-----------------|-----------------------|---------------|-------------|
| Airframe Name   | : 632845-31           | Model Number  | : ***       |
| Part Number     | : 653351-3A5          | Test Document | : 632845    |
| Accy Name       | : 632845 -31          |               |             |
| Test Type       | : calibration-31_CW   |               |             |
| Serial Number   | : b04ga017            | Operator      | : jbraswell |
| Test Station ID | : R678                | Work Order    | : warranty  |
| Run Date/Time   | : 5/8/2019 7:49:12 AM | Report Type   | : Final     |

----- Data Variance Report -----

Paragraph Number : 1

Paragraph Name : ----

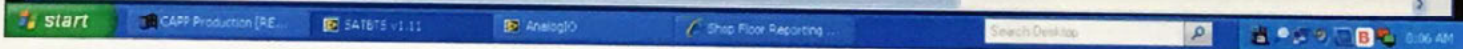
Data for Test Point "3" out of limits

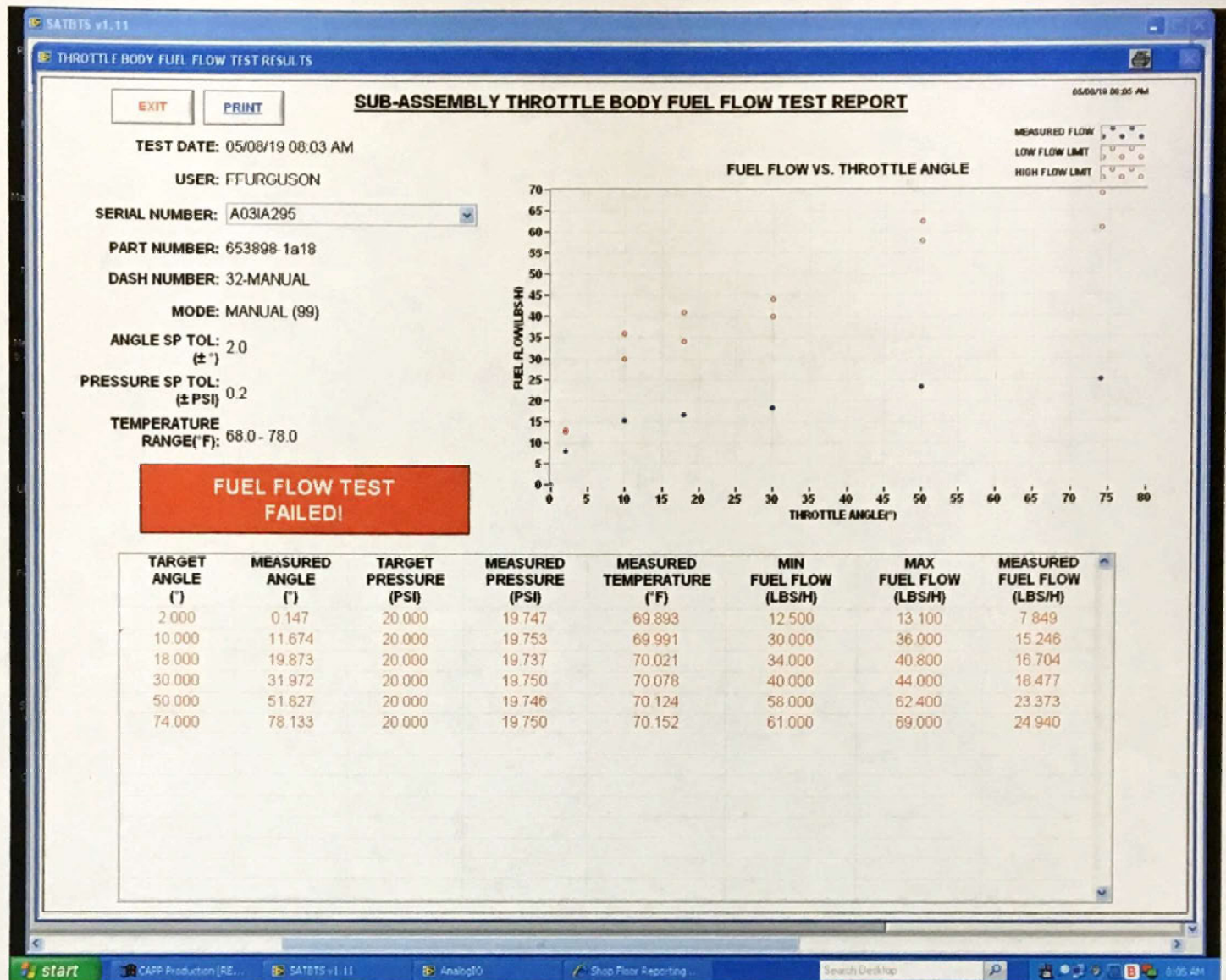
Data for Test Point "4" out of limits

Data for Test Point "6" out of limits

**Throttle Body Test Sheet**

User: ffurguson





## NTSB Materials Laboratory Results

**From:** [McAtee Nancy](#)  
**To:** [Brazy Doug](#)  
**Cc:** [Budinski Michael](#)  
**Subject:** Email report: ERA19LA074-Unknown material found in throttle body)  
**Date:** Wednesday, December 18, 2019 3:17:55 PM

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Doug,

A small sample of an unknown material found in the throttle body of the accident aircraft was submitted to the Materials Laboratory to identify the material. The material was a green, glassy solid. The material was examined using a Fourier Transform Infrared (FTIR) spectrometer with a diamond attenuated total reflectance (ATR) accessory in accordance to ASTM E1252-98 (American Society for Testing Materials E1252-98: *Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis and American Society for Testing Materials*). The spectrometer was used to collect and process infrared wavelength absorbance spectra of the unknown material.

The spectrum contained the following combination of spectral peaks. These peaks correspond to particular functional groups found within molecular structure of the material. The presence of a low broad peak between  $\sim 3400\text{ cm}^{-1}$  is indicative of an oxygen-hydrogen (O-H) functional group. The presence of a strong doublet peak between  $\sim 2920\text{ cm}^{-1}$  and  $\sim 2870\text{ cm}^{-1}$  is indicative of a carbon-hydrogen (C-H) single stretching bond. The presence of a strong single peak  $\sim 1720\text{ cm}^{-1}$  is indicative of a carbon-oxygen double stretching bond (C=O). The presence of a single peak  $\sim 1450\text{ cm}^{-1}$  is indicative of a carbon-hydrogen<sub>3</sub> (C-H<sub>3</sub>) asymmetric stretching bond. The presence of a single peak  $\sim 1380\text{ cm}^{-1}$  is indicative of a carbon-hydrogen<sub>3</sub> (C-H<sub>3</sub>) symmetric stretching bond. The presence of a single peak  $\sim 1250\text{ cm}^{-1}$  is indicative of a carbon-carbon-oxygen-carbon (C-C(O)-C) stretching bond. The presence of a single peak  $\sim 1170\text{ cm}^{-1}$  is indicative of a carbon-oxygen (C-O) aromatic stretching bond. The presence of a single peak  $\sim 860\text{ cm}^{-1}$  is indicative of a carbon-hydrogen<sub>3</sub> (C-H<sub>3</sub>) bending bond.

A sample of bead blast material was submitted for comparison to the unknown sample. The blast media sample was a grey, opaque solid. The spectrum of the bead blast material was not a match for the unknown sample, nor did it contain any similar significant peak signatures to those found in the unknown spectrum.

A sample of known torque putty was submitted for comparison to the unknown sample. The known torque putty sample was a green, glassy solid. The spectrum of the known torque putty sample was very similar to the unknown spectrum but was not an exact match. However, based on peak matches in both spectra at  $\sim 3400\text{ cm}^{-1}$ ,  $\sim 2920\text{ cm}^{-1}$  and  $\sim 2870\text{ cm}^{-1}$ ,  $\sim 1720\text{ cm}^{-1}$ ,  $\sim 1170\text{ cm}^{-1}$ , and  $\sim 860\text{ cm}^{-1}$ , the unknown material was most likely a piece of torque putty of similar composition to the known sample or a degraded sample of the known torque putty.

Nancy B McAtee  
Chemist  
RE-30