

**FLUID SYSTEMS DIVISION  
PARKER HANNIFIN CORPORATION**

**[REDACTED]  
ELYRIA, OHIO [REDACTED]**

**28 JUNE 2013**

**133A4 VACUUM REGULATOR  
EXAMINATION**

Prepared By: [REDACTED]  
Daniel E. Scholz P.E.  
Air Safety Investigator

On 13 May 2013, Parker was contacted by Tim Monville, NTSB Air Safety Investigator, requesting assistance in examining a 133A4 Vacuum Regulator recovered from a Piper PA-28-160 that crashed on 16 December 2012.

On 10 June 2013, Arnold Wolfe, FAA Aviation Safety Inspector, brought the vacuum regulator to the Fluid Systems Division of Parker Hannifin in Elyria, Ohio.

The vacuum regulator was not functionally tested due to its damaged condition.

The vacuum regulator was examined by Daniel Scholz, Parker Air Safety Investigator with Arnold Wolfe present.

Upon completion of the examination the vacuum regulator was packaged and Arnold Wolfe took the vacuum regulator with him.

### **AIRCRAFT INFORMATION**

Model:	Piper PA-28-160
Serial No:	28-1215
Manufacture Date:	1963
Registration:	N5714W

### **FUEL PUMP INFORMATION**

Vacuum Regulator Assembly Model:	133A4
Serial Number:	Unidentifiable
Manufacture Date:	Prior to 1975

The vacuum regulator was photo documented as received, during the examination and when packaged for return to the NTSB. Refer to Appendix A for photos.

### **EXTERNAL EXAMINATION**

The unit as received appeared to have been crushed and reportedly it was exposed to fire. Refer to Photos N5714W\_10Jun13\_D009 through N5714W\_10Jun13\_D025. The Diaphragm Cover and Diaphragm were missing. Refer to Photo N5714W\_10Jun13\_D009. The Spider housing was crushed. Refer to Photo N5714W\_10Jun13\_D010. The Lock Wire securing the valve's setting was in place. Refer to Photos N5714W\_10Jun13\_D011 and N5714W\_10Jun13\_D012. Photo N5714W\_10Jun13\_D013 shows the internal thread of the Adjusting Screw, however we were unable to photograph the position of the Valve Spring that attaches the Diaphragm to the Adjusting Screw. The Valve Seat and Diaphragm Rivet can be seen in Photo N5714W\_10Jun13\_D014. The orifice that transmits the Vacuum Systems vacuum level to the top of the Diaphragm can be seen in Photos N5714W\_10Jun13\_D015 and

N5714W\_10Jun13\_D016. The Lock Wire diameter measured approximately 0.022", refer to Photo N5714W\_10Jun13\_D020. Rivets that hold the Diaphragm Cover, Diaphragm and Spider Housing together along with the holes for missing Rivets can be seen in Photos N5714W\_10Jun13\_D021 through N5714W\_10Jun13\_D025.

## **DISCUSSION**

This configuration regulator operates as a controlled leak of air into the vacuum system. This leak is to compensate for changes in RPM of the positive displacement air pump normally driven off of the aircrafts engine.

Vacuum System vacuum level will change over time due to leaks, blockages, contamination, replacement of components and the like. It would be expected that the Vacuum Regulator would be adjusted as needed due to changes within the aircrafts Vacuum System.

Parker is unable to determine the Vacuum Regulator vacuum setting at the time of the incident for the following reasons:

- The extensive damage to the Vacuum Regulator did not allow testing of the unit.
- The Lock Wire being in place is no indication of the Vacuum Regulators vacuum setting.
- The position of the Spring that attaches the Diaphragm to the Adjusting Screw is no indication of the Vacuum Regulator vacuum setting. Due to variations in the Spring, Diaphragm and Vacuum Regulator Assembly.

## APPENDIX A

### PHOTO LOG

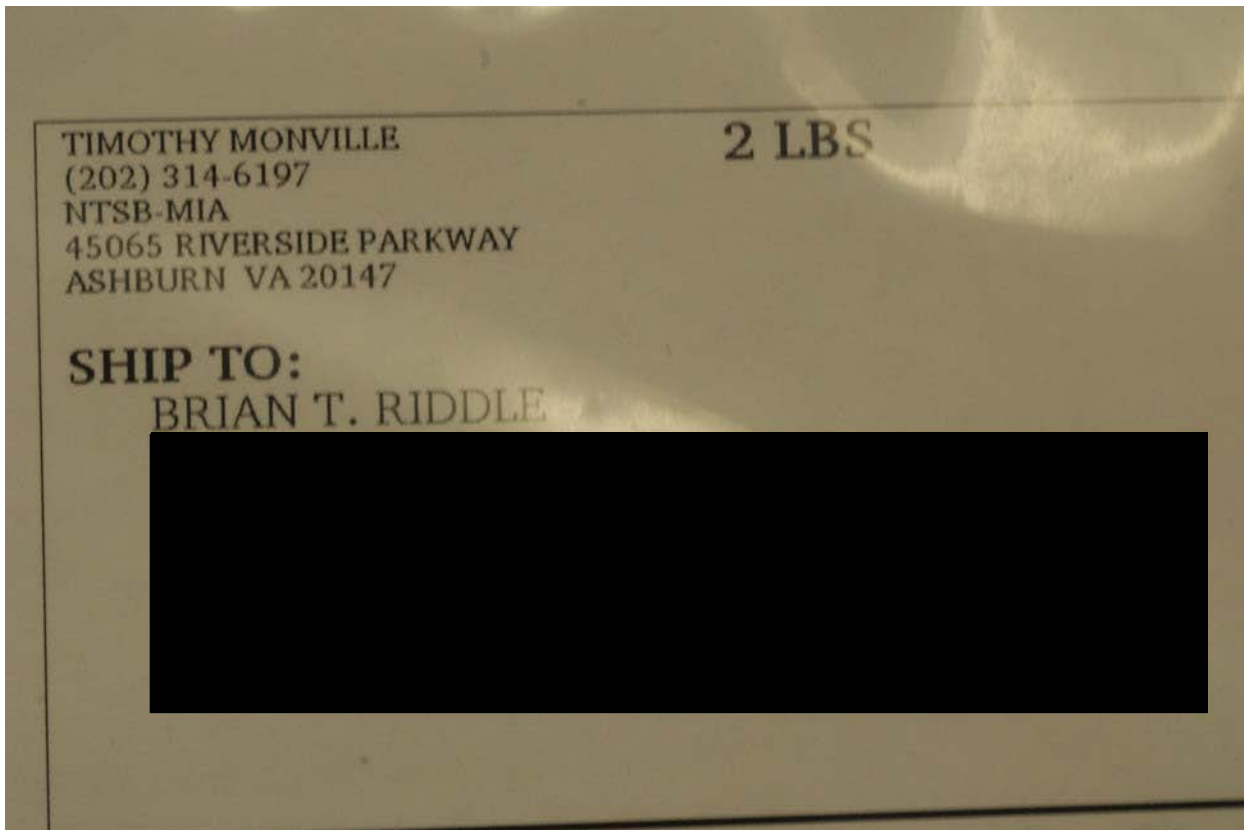
Photograph Numbering Format:

<b><u>N5714W</u></b>	<b><u>10Jun13</u></b>	<b><u>D001</u></b>
Aircraft Registration Number	Date of Photo	Photo Number e.g. "D001"

<b>Photograph Number</b>	<b>Description</b>
N5714W_10Jun_D001	Vacuum Regulator as received
N5714W_10Jun_D002	Vacuum Regulator as received
N5714W_10Jun_D003	Vacuum Regulator as received
N5714W_10Jun_D004	Vacuum Regulator as received
N5714W_10Jun_D005	Vacuum Regulator as received
N5714W_10Jun_D006	Vacuum Regulator as received
N5714W_10Jun_D007	Vacuum Regulator as received
N5714W_10Jun_D008	Vacuum Regulator as received
N5714W_10Jun_D009	Diaphragm Cover and Diaphragm missing
N5714W_10Jun_D010	Spider Housing Crushed
N5714W_10Jun_D011	Lock Wire in place
N5714W_10Jun_D012	Lock Wire in place
N5714W_10Jun_D013	Internal Thread of Adjusting Screw
N5714W_10Jun_D014	Valve seat and Diaphragm Rivet
N5714W_10Jun_D015	Diaphragm Rivet Orifice
N5714W_10Jun_D016	Diaphragm Rivet Orifice
N5714W_10Jun_D017	Vacuum Regulator as received
N5714W_10Jun_D018	Vacuum Regulator as received
N5714W_10Jun_D019	Vacuum Regulator as received
N5714W_10Jun_D020	Lock wire Diameter
N5714W_10Jun_D021	Rivets for attaching Diaphragm and Diaphragm Cover
N5714W_10Jun_D022	Rivet for attaching Diaphragm and Diaphragm Cover
N5714W_10Jun_D023	Rivet for attaching Diaphragm and Diaphragm Cover
N5714W_10Jun_D024	Rivet for attaching Diaphragm and Diaphragm Cover
N5714W_10Jun_D025	Rivet for attaching Diaphragm and Diaphragm Cover
N5714W_10Jun_D026	Vacuum Regulator packaged for return to NTSB
N5714W_10Jun_D027	Vacuum Regulator packaged for return to NTSB
N5714W_10Jun_D028	Vacuum Regulator packaged for return to NTSB
N5714W_10Jun_D029	Vacuum Regulator packaged for return to NTSB
N5714W_10Jun_D030	Vacuum Regulator packaged for return to NTSB
N5714W_10Jun_D031	Vacuum Regulator packaged for return to NTSB



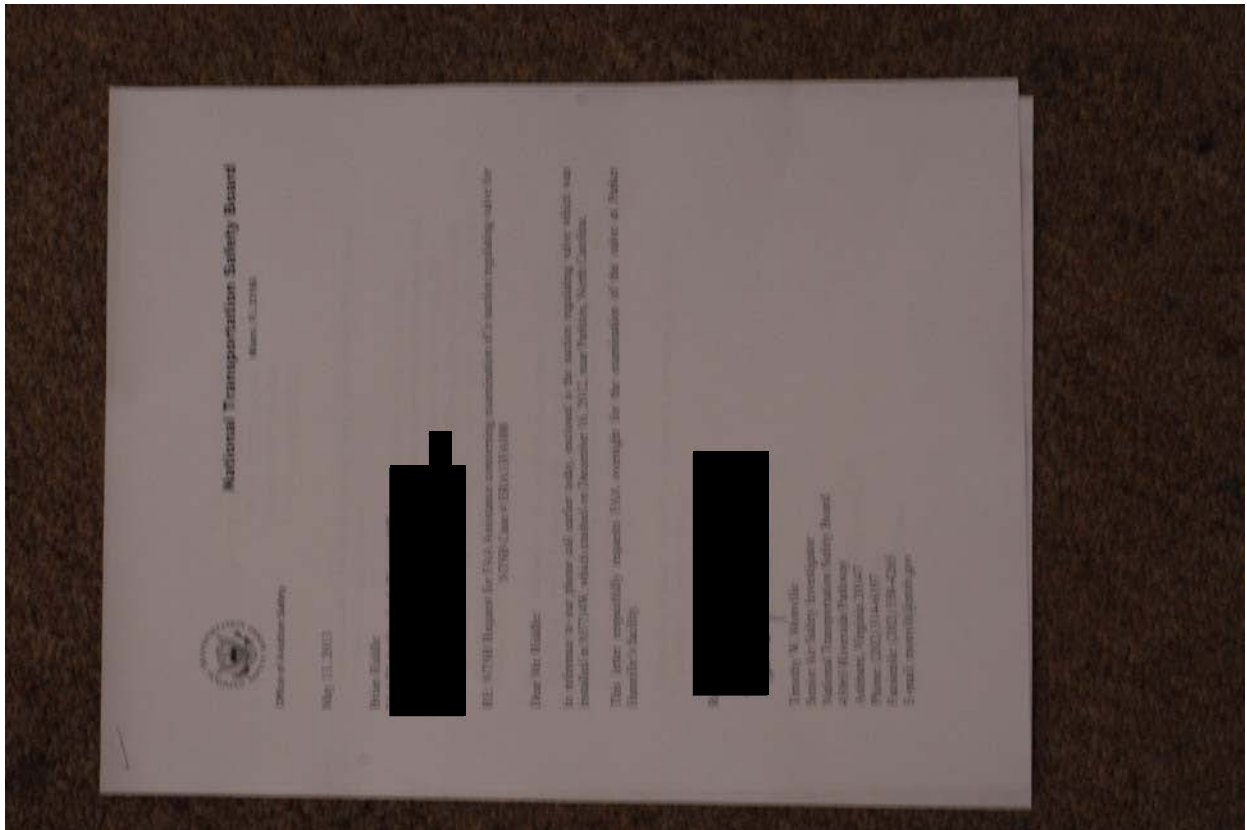
N5714W\_10Jun\_D001, Vacuum Regulator as received



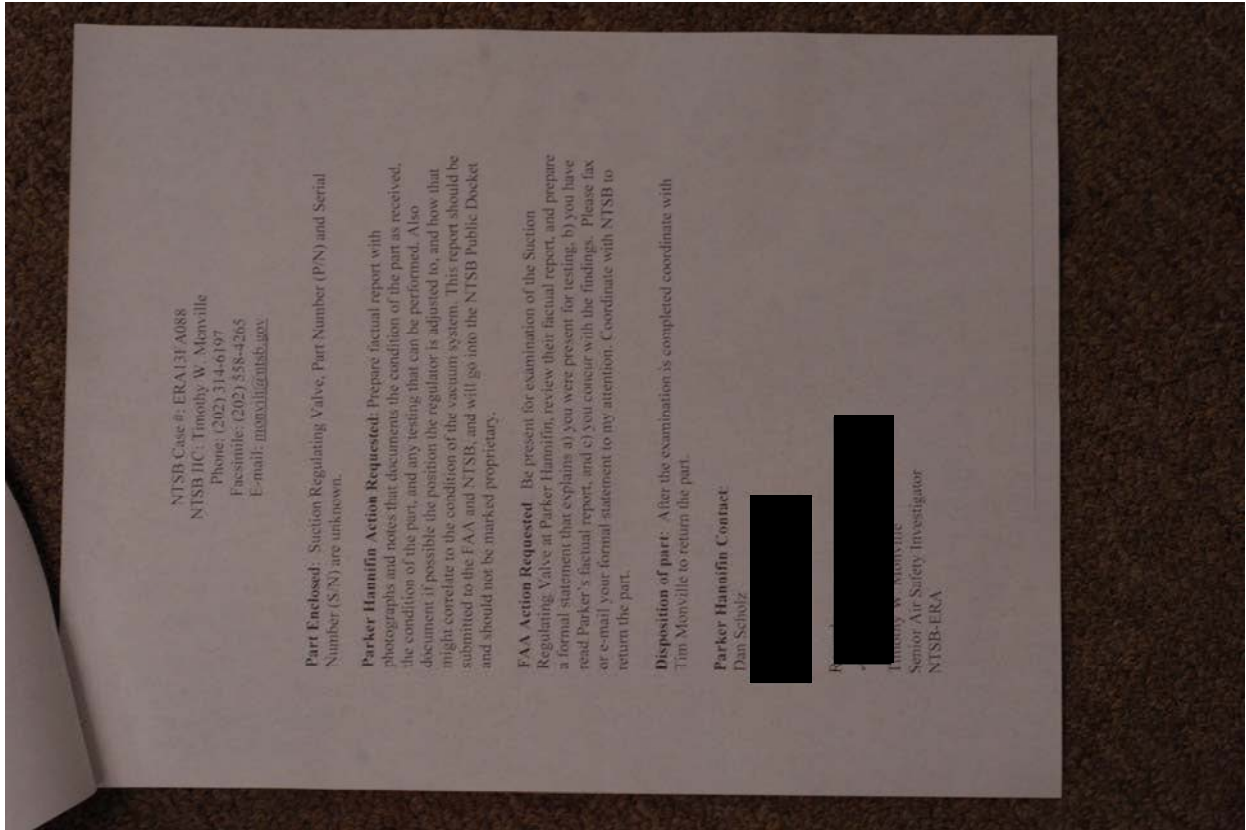
N5714W\_10Jun\_D002, Vacuum Regulator as received



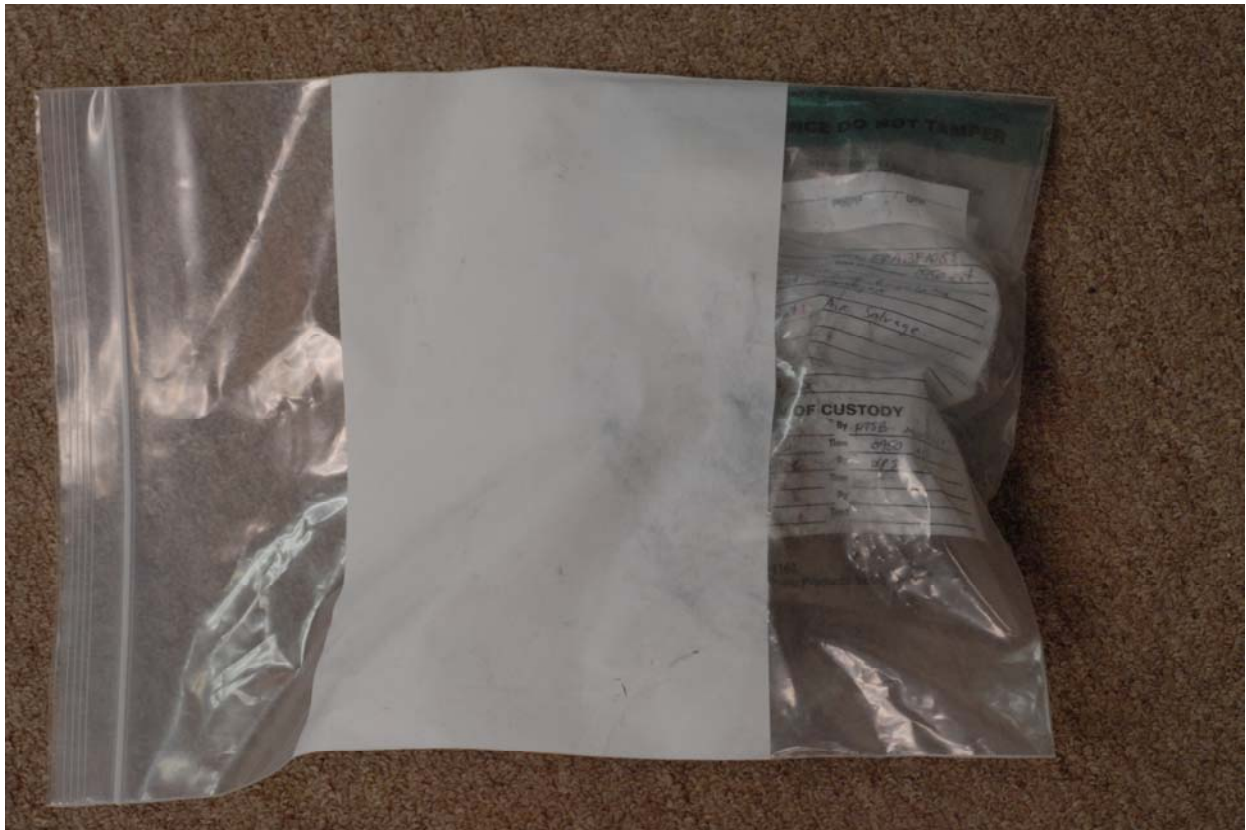
N5714W\_10Jun\_D003, Vacuum Regulator as received



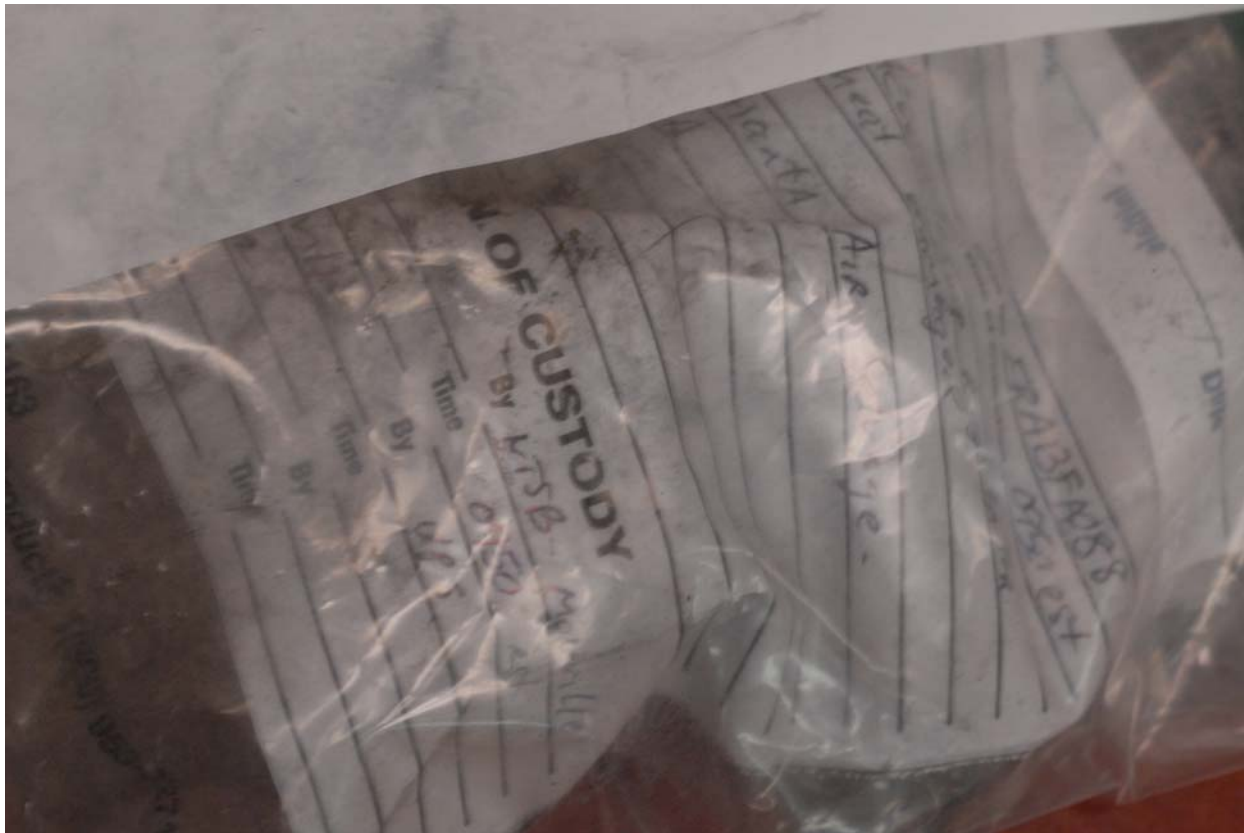
N5714W\_10Jun\_D004, Vacuum Regulator as received



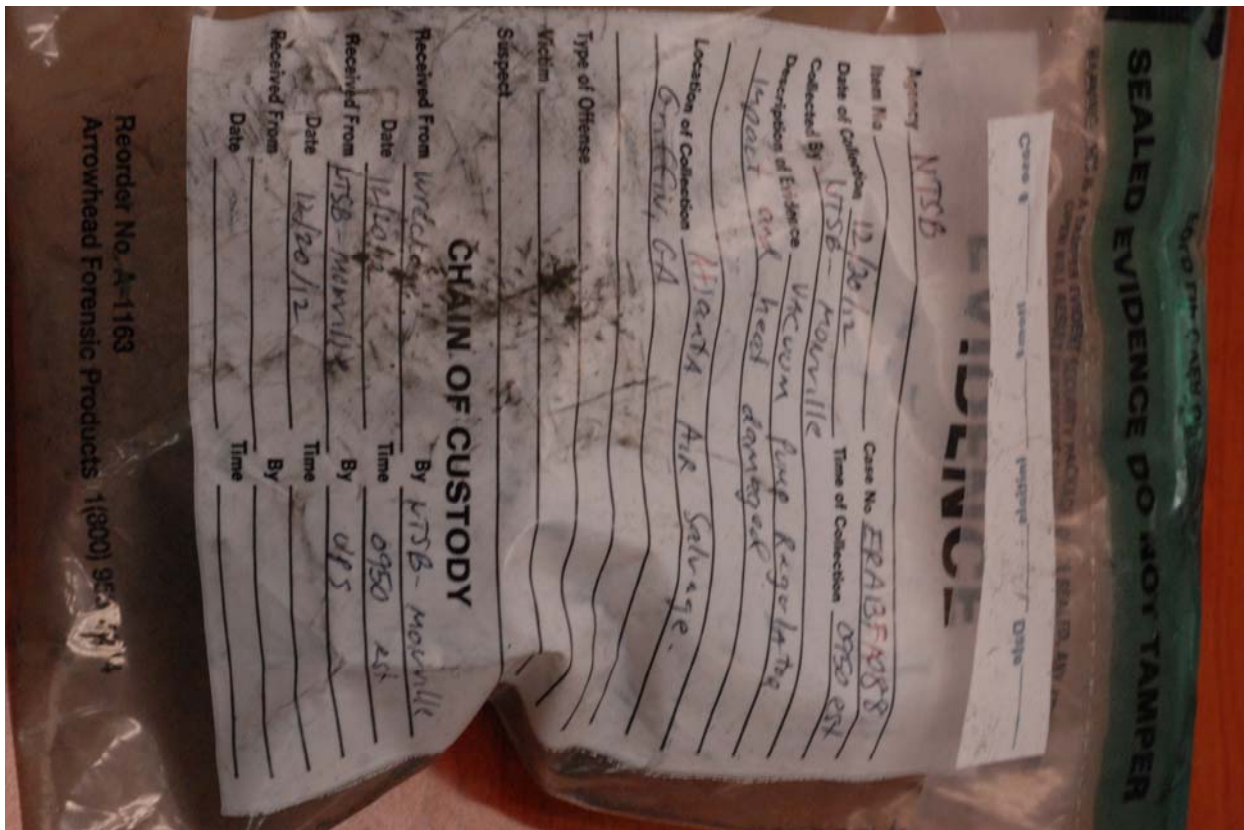
N5714W\_10Jun\_D005, Vacuum Regulator as received



N5714W\_10Jun\_D006, Vacuum Regulator as received



N5714W\_10Jun\_D007, Vacuum Regulator as received



N5714W\_10Jun\_D008, Vacuum Regulator as received



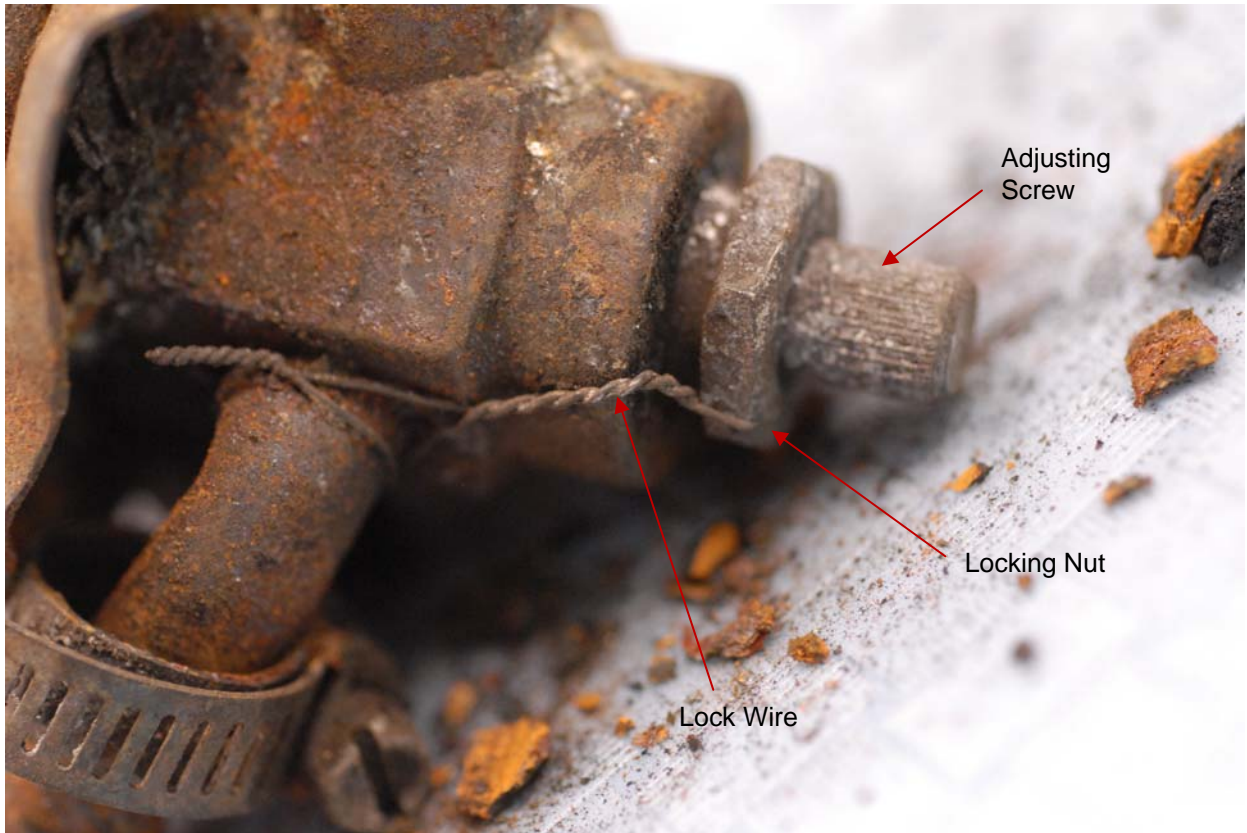
Diaphragm Cover  
and Diaphragm  
missing

N5714W\_10Jun\_D009, Diaphragm Cover and Diaphragm missing



Spider  
Housing

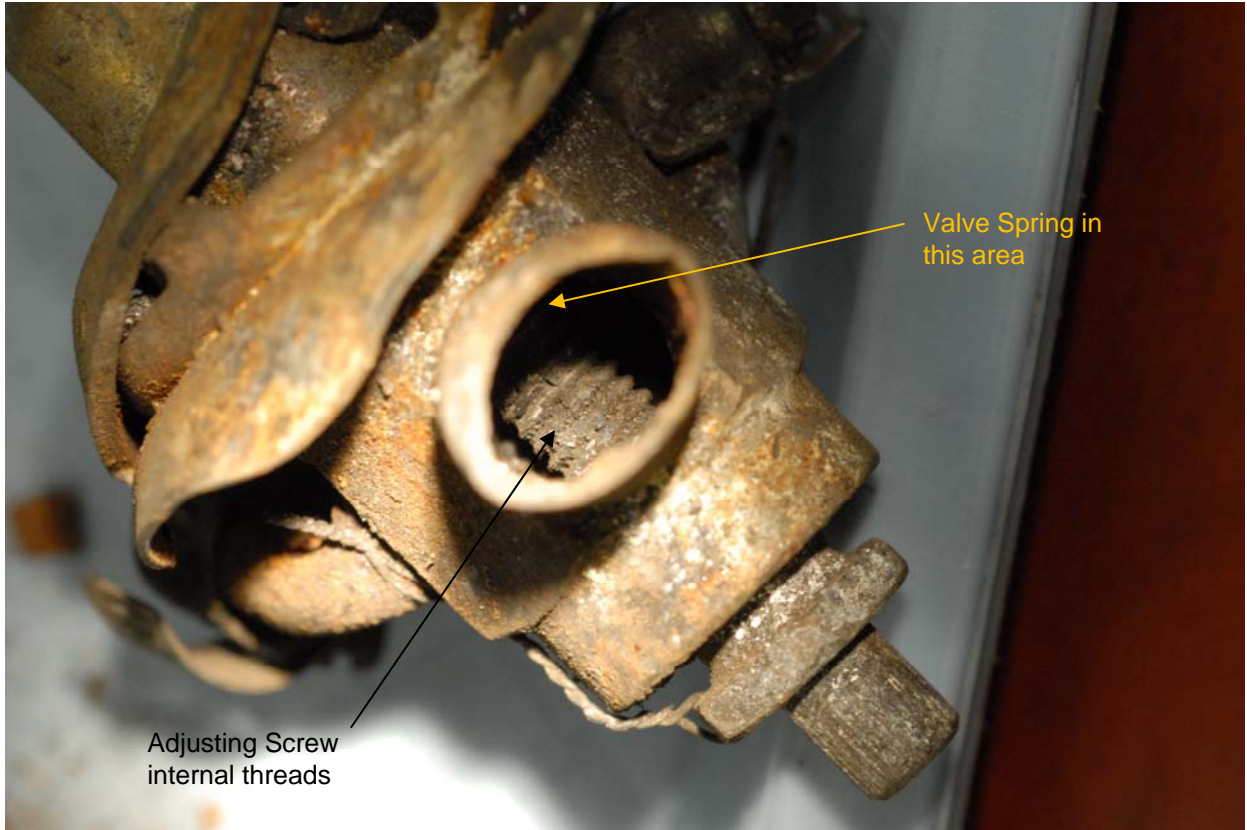
N5714W\_10Jun\_D010, Spider Housing Crushed



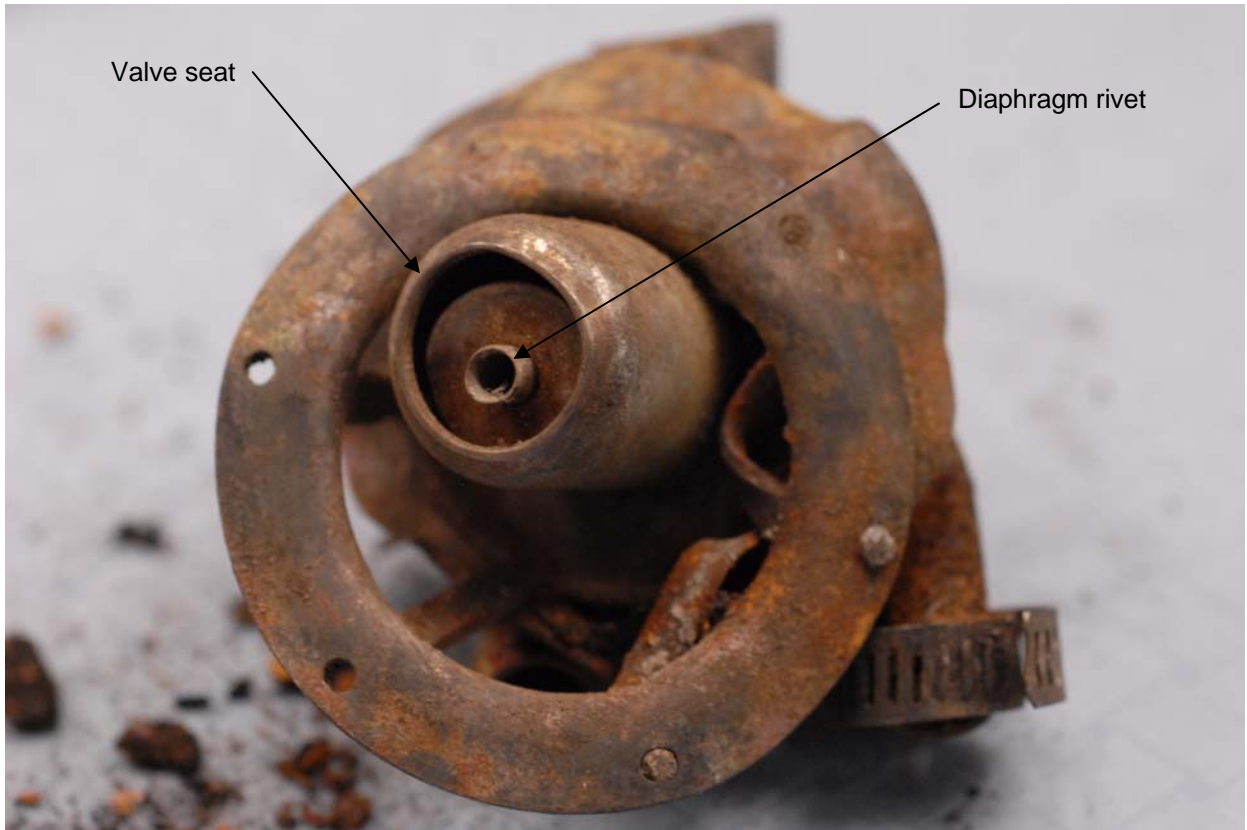
N5714W\_10Jun\_D011, Lock Wire in place



N5714W\_10Jun\_D012, Lock Wire in place



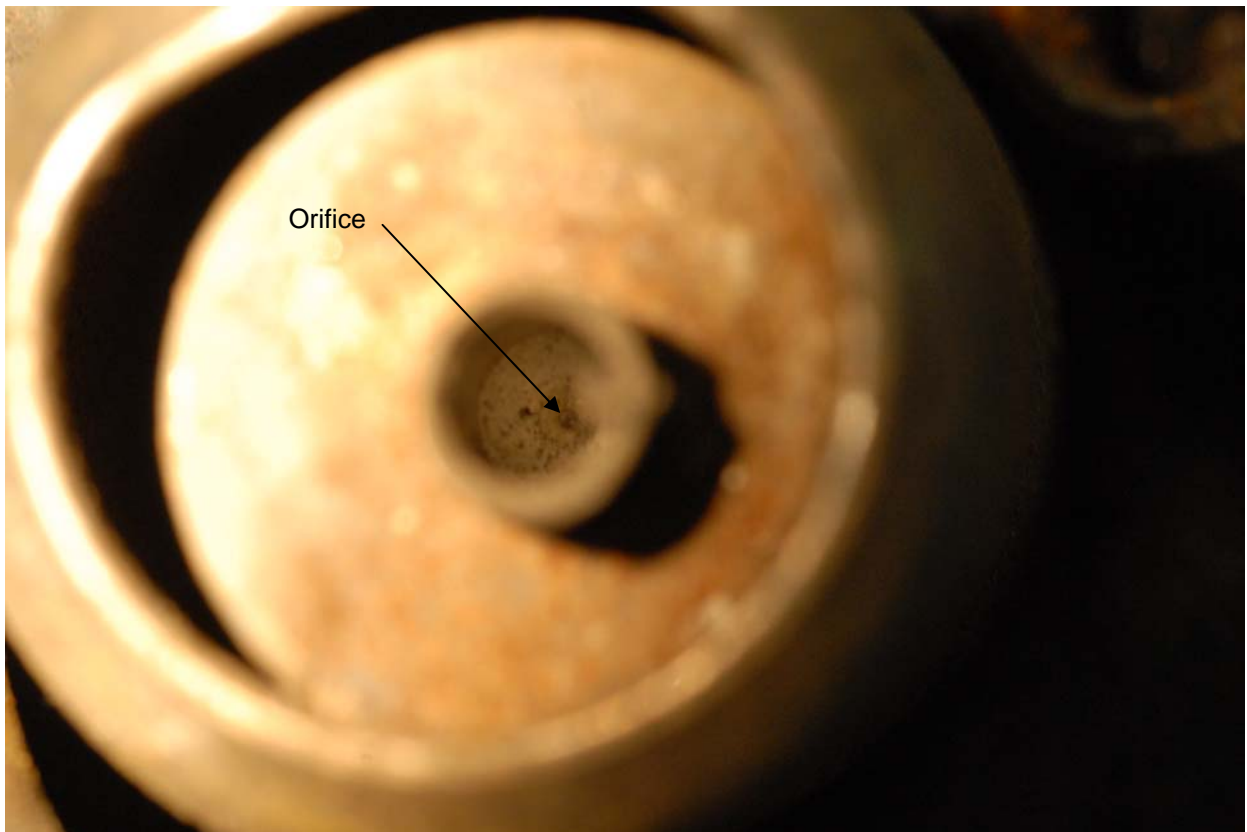
N5714W\_10Jun\_D013, Internal Thread of Adjusting Screw



N5714W\_10Jun\_D014, Valve seat and Diaphragm Rivet



N5714W\_10Jun\_D015, Diaphragm Rivet Orifice



N5714W\_10Jun\_D016, Diaphragm Rivet Orifice



N5714W\_10Jun\_D017, Vacuum Regulator as received



N5714W\_10Jun\_D018, Vacuum Regulator as received



N5714W\_10Jun\_D019, Vacuum Regulator as received



N5714W\_10Jun\_D020, Lock wire Diameter



N5714W\_10Jun\_D021, Rivets for attaching Diaphragm and Diaphragm Cover



N5714W\_10Jun\_D022, Rivet for attaching Diaphragm and Diaphragm Cover



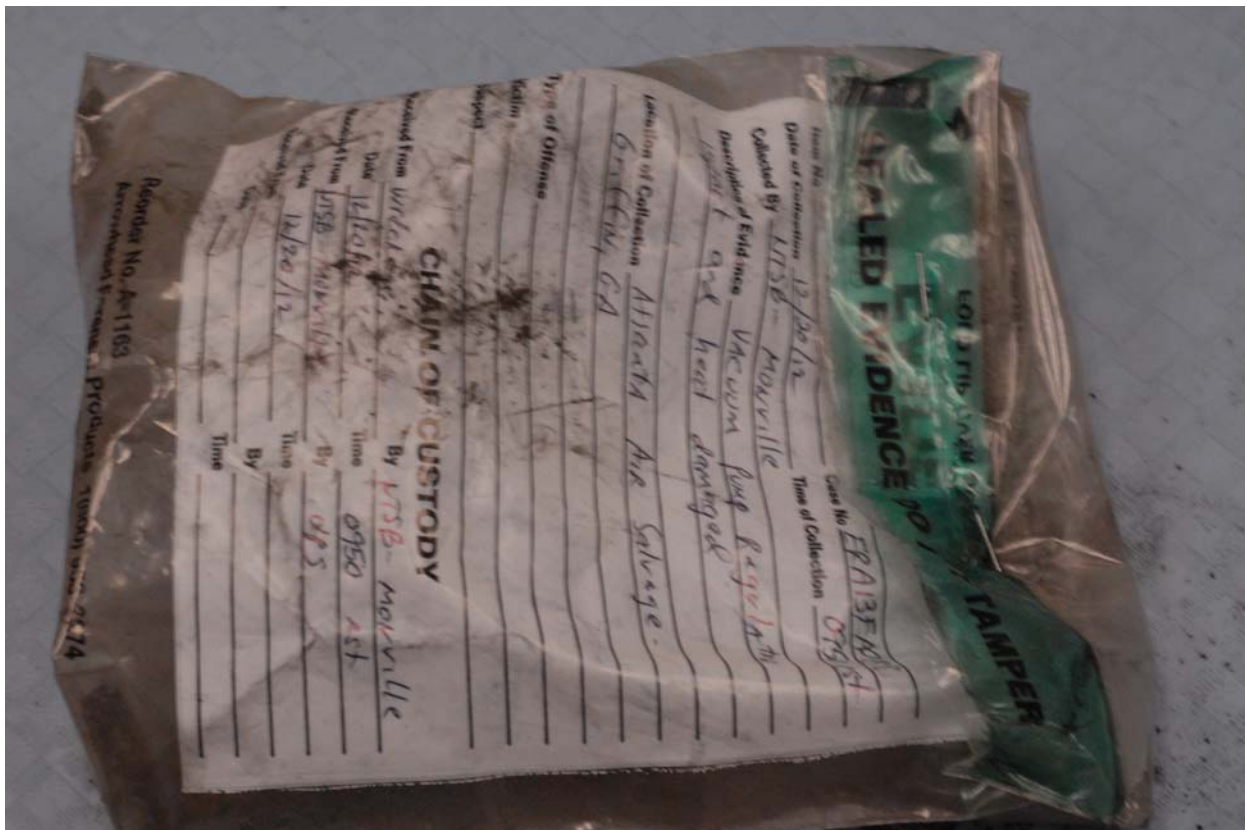
N5714W\_10Jun\_D023, Rivet for attaching Diaphragm and Diaphragm Cover



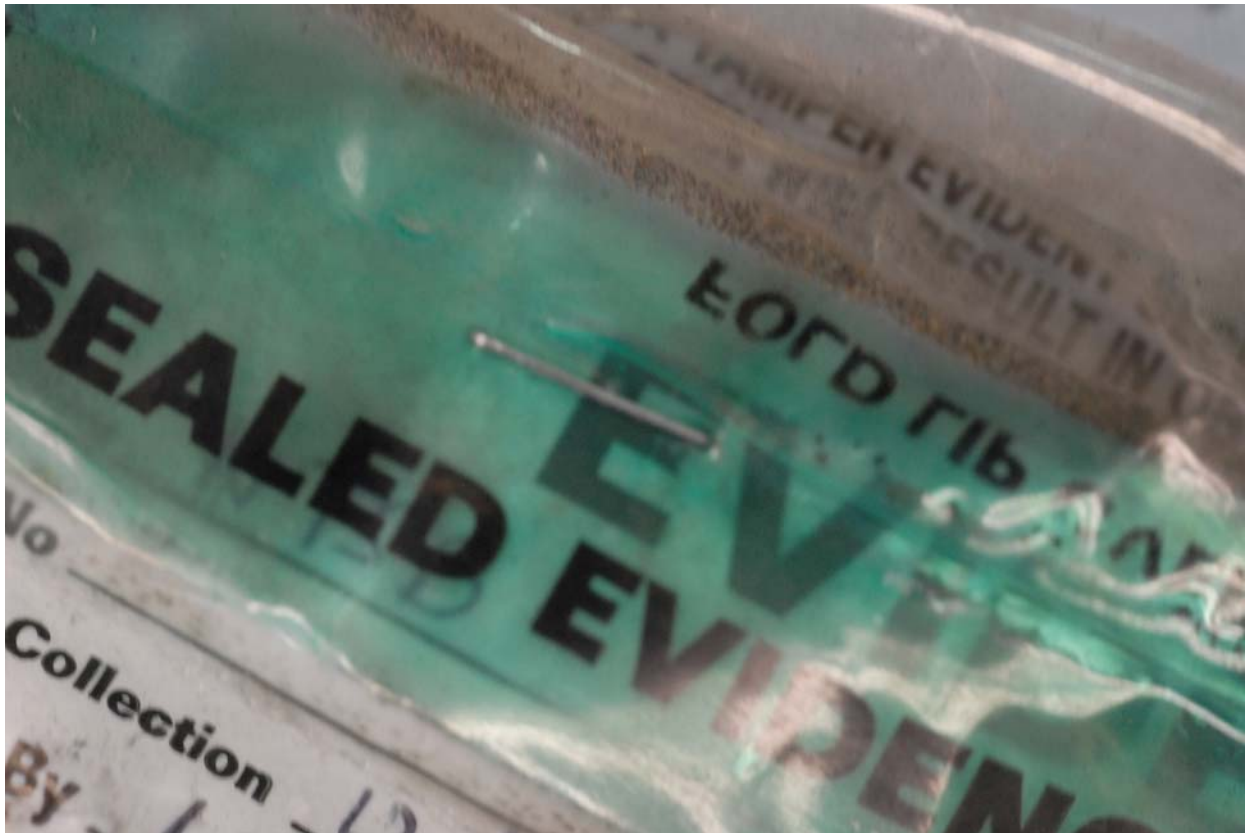
N5714W\_10Jun\_D024, Rivet for attaching Diaphragm and Diaphragm Cover



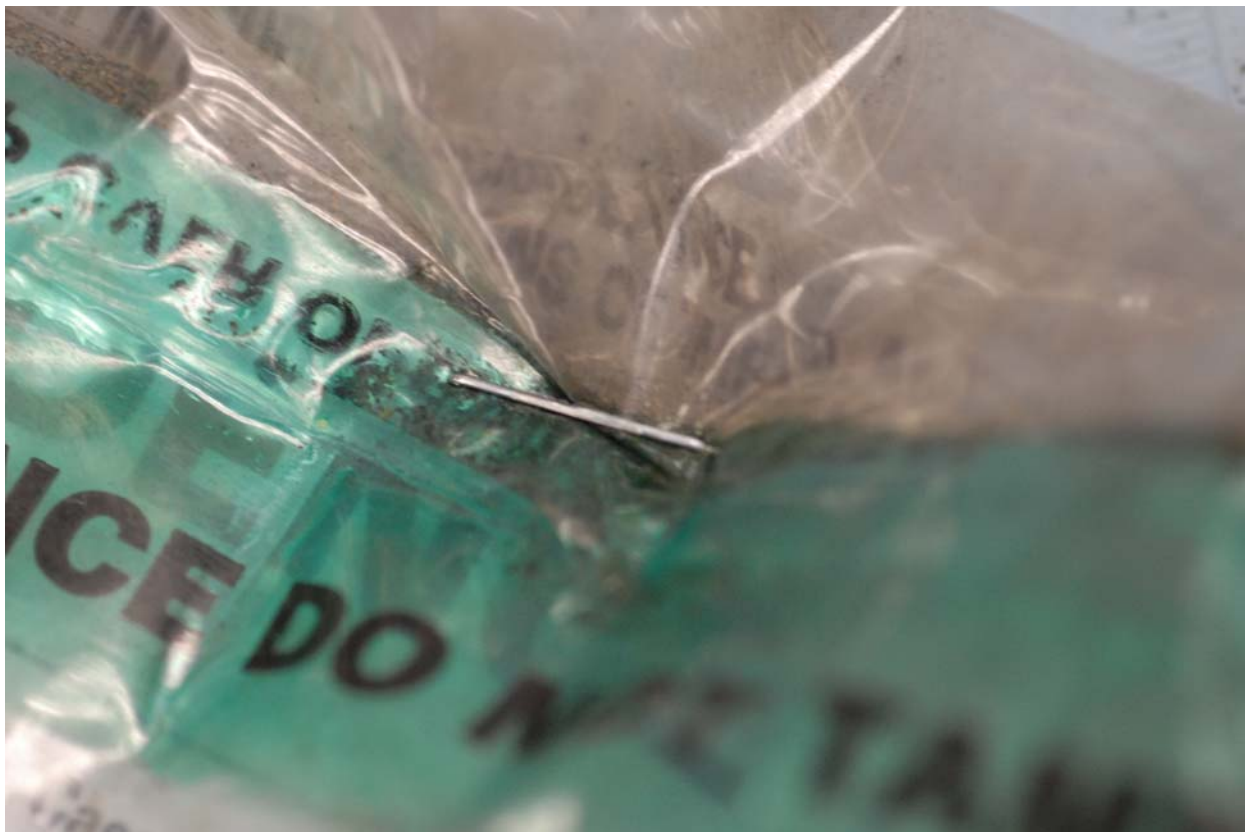
N5714W\_10Jun\_D025, Rivet for attaching Diaphragm and Diaphragm Cover



N5714W\_10Jun\_D026, Vacuum Regulator packaged for return to NTSB



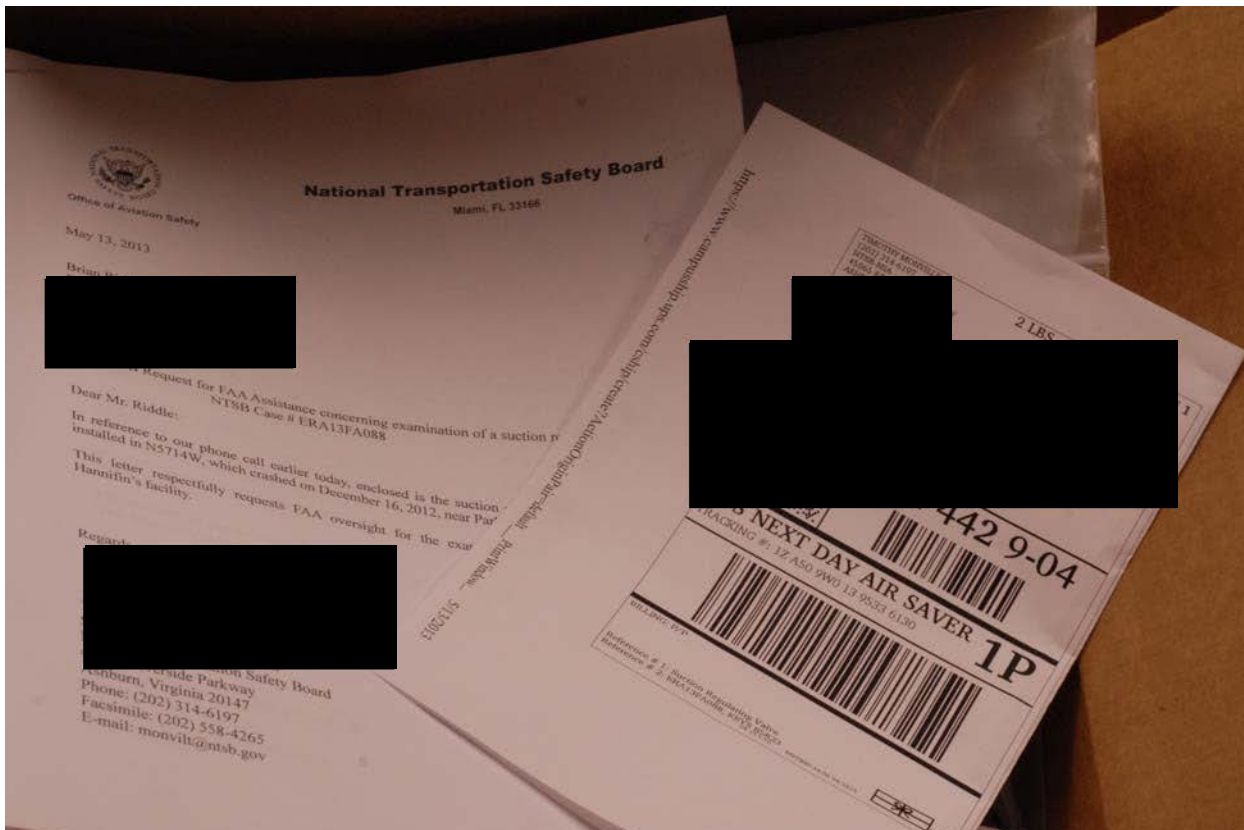
N5714W\_10Jun\_D027, Vacuum Regulator packaged for return to NTSB



N5714W\_10Jun\_D028, Vacuum Regulator packaged for return to NTSB



N5714W\_10Jun\_D029, Vacuum Regulator packaged for return to NTSB



N5714W\_10Jun\_D030, Vacuum Regulator packaged for return to NTSB



N5714W\_10Jun\_D031, Vacuum Regulator packaged for return to NTSB



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**

July 3, 2013

Timothy Monville  
National Transportation Safety Board  
45065 Riverside Parkway  
Ashburn Virginia 20147

Subject: June 10, 2013 Examination of a 133A4 Vacuum Regulator for the NTSB (ERA13FA088)

Dear Mr. Monville,

On June 10, 2013 I hand carried 1ea. Vacuum Regulator to Parker Hannifin for examination. I was present for the visual examination of the Vacuum Regulator. The testing was not able to be accomplished due to the condition of the unit. I have read the factual report from Parker Hannifin, written by Mr. Daniel Scholz, and concur with his findings.

Sincerely,

[REDACTED]  
Arnold Wolfe  
Aviation Safety Inspector  
Cleveland Flight Standards

[REDACTED]  
North Olmsted, Ohio

Phone: [REDACTED]

Facsimile: [REDACTED]

E-mail: [REDACTED]

Enclosures:

Letter from Daniel Scholz

133A4 Vacuum Regulator Examination, dated 28 June 2013

DVD of 133A4 Vacuum Regulator Examination, dated 28 June 2013