

**Accident Investigation Results
Aero Commander 500S
National Transportation Safety Board**

Simmonds Precision Products, Inc.
Tank Unit Assembly
P/N EA515B-1404M

**Simmonds Precision Products, Inc.
A Part of Collins Aerospace**

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1.0 Introduction

This document provides the results of the investigation for Tank Unit Part Number EA515B-1404M, being returned to Collins Aerospace as part of an accident investigation. This Tank Unit was equipped on the Aero Commander 500S which had a flight accident on August 28, 2020.

1.1 Reference Documents

1.1.1 Simmonds Precision Products, Inc. (SPPI)

EA515B-1404M	Tank Unit
ST-714-95	Acceptance Test Procedure Per EA515B-1404M Drawing
Procedure 1014	Test Equipment Substitution
Procedure 1111	Calibration System for Monitoring and Measuring Devices and Standards
Procedure 2762	Safety of Visitors and Contractors on Company Property
Procedure 2789	Personal Protective Equipment (PPE)
QEI-41	Calibration Manual
E-8026	Test Plan for Tank Unit Part Number EA515B-1404M Serial Number 982

1.1.2 Simmonds Atlantic and Inertial Systems (SAI)

SAIS-PRO-0122	Electrostatic Discharge Sensitive Devices and Assemblies
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1.1.3 Collins Aerospace

COL-PSM-GUI-1001-05	Externally Driven Investigation Handbook
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1.2 Background Information

1.2.1 Notification

Collins Aerospace was notified of this incident by way of an External Investigation Notification on February 3, 2022. The Notification and the accident report ERA20LA297 are attached in Appendix A.

1.2.2 Articles Under Investigation

The article under investigation is Tank Unit Part number EA515B-1404M Serial Number 982. The date of manufacture of this unit was September 11, 1978, based on an Inspection Acceptance stamp located on the housing cover. There are no records of prior returns of this unit within Collins Aerospace's previous or current ERP System.

1.2.3 Receipt of Article

The article was received to Collins Aerospace on February 28, 2022.

Pursuant to COL-PSM-GUI-1001-05 Appendix A, the article was isolated and contained in government bonded storage. The shipping container remained sealed until the investigation commenced.

2.0 Investigation Location

The investigation occurred at Collins Aerospace Maintenance, Repair and Overhaul Department in Vergennes Vermont on March 28, 2022, at 10am EST. and concluded at 11:15am EST. MRO FAA Repair Station certificate is attached in Appendix B. Additional pictures to support the investigation have been made available to the National Transportation Safety Board (NTSB).

Attendees:

Table 1

Name	Role	Organization
Brian Crossman	Engineering Technical Lead	Collins
Russ Buck	MRO Manufacturing Engineer	Collins
Beth Ziegler	MRO Quality Manager	Collins
Sean Postlewaite	MIS Product Safety Manager Via ZOOM	Collins
Rollin Brown	F&SS Program Chief Engineer	Collins
Tomomi Ueda	Product Support Engineering Manager Via ZOOM	Collins
Josh Gale	Materials and Process Engineer	Collins
Mark Hampson	Materials and Process Engineer	Collins
John Donaldson	MRO Quality Inspector	Collins
Timothy Monville	Lead Investigator Via ZOOM	NTSB

3.0 Visual Examination

There was no sign of external damage to the box. The tank unit was well wrapped and secure within the center box and encased in bubble wrap. There were no signs of damage incurred during shipping. The Tank Unit was removed from its container and packaging and placed on a lab bench. The article was visually examined and photographed from all sides. Examiners looked at the following per procedure E-8026.

- Structural damage
- Surface corrosion on any surface
- Damaged or missing paint
- Damaged or missing sealant
- Damaged or missing lock wire

3.1 Observations

Visual inspection was performed and compared to assembly drawing EA515B-1404M.

3.1.1 Damage or missing sealant:

Small opening in the seal between the main housing and the connector body, refer to Figure 1.

3.1.2 Nameplate:

The nameplate was deformed and only attached by one of the two rivets, refer to Figure 6

3.1.3 Damaged or Missing Paint:

Several small scratches on the housing, refer to Figure 1.



Figure 1: Housing with Nameplate and Seal Gap

3.1.4 Damaged or missing lock wire:

Lock wire on top of the housing had been replaced and was not installed per Collins Aerospace requirements and appeared not to be original. Safety wiring shall be made so that any movement tending to loosen the part safety wired shall exert a pull causing a greater tension in the wire holding it. Safety wiring must always be to a part or location which cannot move other than to cause increased tension in the safety wire. Refer to Figure 2 lockwire installation for improper method and figure 3 for proper Lockwire representation.

The unit was returned with a portion of the aircraft wire harness and connector installed on the Tank Unit.



Figure 2: Housing Lockwire

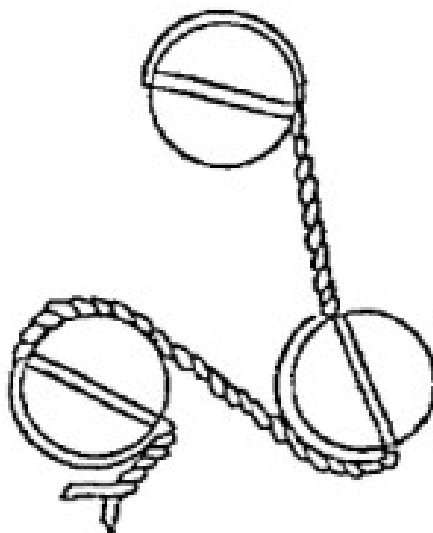


Figure 3: Proper Lockwire application

3.1.5 Cover Removal:

To gain access within the Tank Unit housing, the cover was removed. One of the three lock wire screws used to secure the cover was not original per the drawing. Figure 4 shows the incorrect screw annotated with a red circle. The two original screws appeared to have been fully seated and did not turn freely. The incorrect screw had been modified to accept lockwire. It was also noted that it is made from a different material than the original screws. This screw also required only a small amount of counterclockwise force to turn the screw for removal. The washer under the incorrect screw was also of a different material as compared to the parts list and broke easily into two pieces upon removal. One of the original screws did not have a washer, as per the assembly drawing.



Figure 4: Cover Components

3.1.6 Structural damage:

A Slight bend was identified in the float arm assembly (Figure 5) which per design should be parallel to the actuation arm. The part number printed on the float was verified to match the one called out on the drawing.



Figure 5: Bent in Float Arm

Template Date 10/02/2013

3.1.7 Interior of Tank Unit Housing:

The interior of the Tank Unit housing was clean with no evidence of loss of either the fuel seal on the bottom of the housing or the environmental seal. Refer to Figure 6.

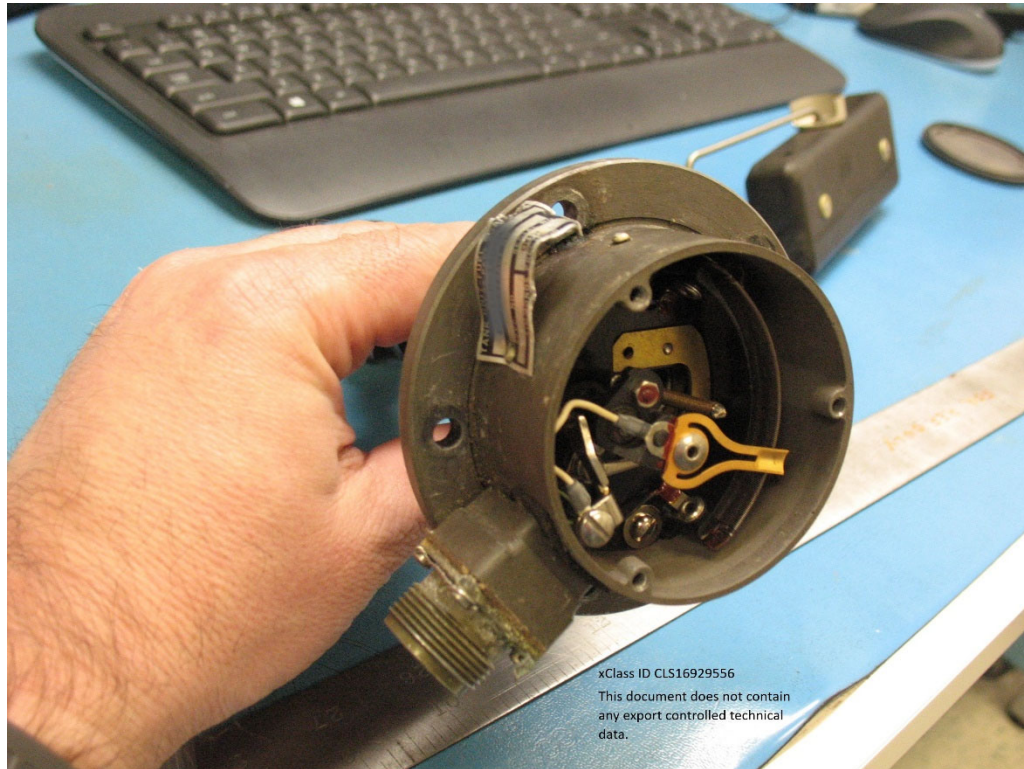


Figure 6: Interior of Tank Unit Housing

3.1.8 Surface Corrosion:

The only oxidation present appeared to be on the mating connector and its back shell (Figure 7) which is to be expected of an aluminum connector after prolonged exposure in an uncontrolled environment. The harness assembly is not provided by Collins Aerospace.



Figure 7: Aircraft Harness

4.0 Functional Verification/Testing

Functional testing was to be performed per E-8026 as follows;

- Verify that the float operates freely.
- Verify the Resistance between Pin A and Pin B.
- Monitor the resistance along the Potentiometer (Pin C).
- Inspect for null spots in the resistor element or gaps between wiper and resistive element.
- Inspect connector pins for damage that could cause damage to mating connector or test equipment.

4.1 Observations/Results

- **Verify that the float operates freely:** Float arm assembly moved throughout its range freely without any binding. There was a small amount of drag consistent with the wiper dragging on the resistive element inside the housing.

Template Date 10/02/2013

- **Verify the Resistance between Pin A and Pin B:** Pins A and B are the ends of the resistor element inside the housing. The result of the resistance test is acceptable and falls within 5 ohms of the specification on the resistor drawing.
- **Monitor the resistance along the Potentiometer Pin C:** When monitoring the wiper (pin c) there was no resistance reading measured, indicating an open circuit between the wiper and the resistor element.
- **Inspect for null spots in the resistor element or gaps between wiper and resistive element:** No null spots in the resistor element were identified. Wiper maintained contact with resistor element throughout the float arm travel,
- **Inspect connector pins for damage that could cause damage to mating connector or test equipment:** No signs of damage to pins or connector.

As a result of the open circuit no further acceptance testing could be done.

5.0 Disassembly and Inspection

Additional pictures have been made available to the NTSB. Inspected internal components for the following:

- **Remove lock wire and screws from housing cover:** 2 of the 3 screws securing the cover were tight. The one screw that was not original was not tight.
- **Inspect housing cover seal:** Seal around the inside of the cover was intact with no signs of damage.
- **Structural damage to electrical component:** No visual signs of structural damage to the wires or resistor element inside the housing (Figure 8)
- **Structural damage to mechanical components:** No visual signs of damage to the wiper or any other mechanical components inside the housing (Figure 8).

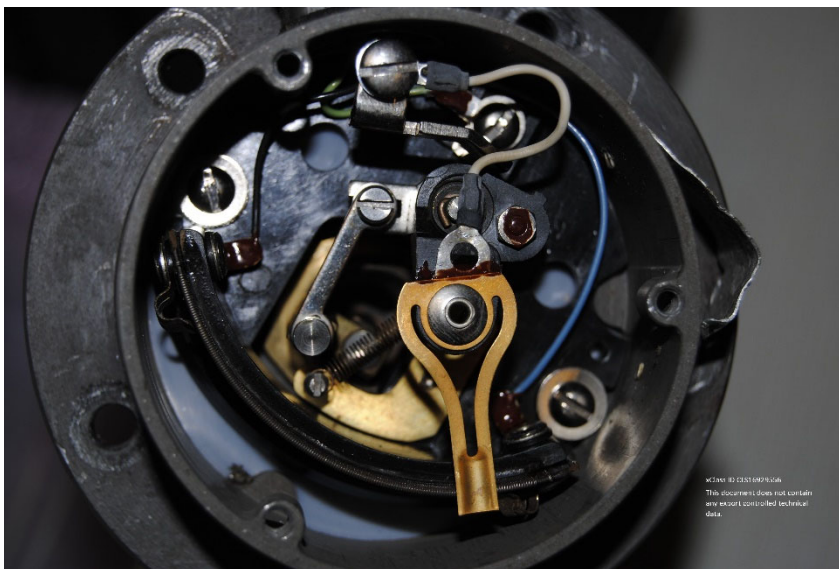


Figure 8: Interior of Housing

- **Test for continuity from the end of the wiper to connector pin C:** Testing revealed an open circuit between the back of the wiper to connector pin C. Movement was applied to the white wire to see if vibration or movement of the wire had any affect however there was no change in the reading.
- **Test for continuity across the white wire and lug assembly:** Testing revealed an open circuit between the lugs at each end of the wire.
- When the test lead was connected to the back of the wiper, the resistive readings followed the position of the float arm consistent with normal operation.
- The screw connecting the wire lug to the post was tight and visual inspection of the wire revealed no evidence of a shorting, burning or damage to the wire insulation.
- Unit was returned to Quality to await x-ray.

X-Ray Examination

The unit was returned to the Collins Failure Analysis Lab for x-ray on March 31, 2022 at 2:00pm EDT.

At the direction of the NTSB Investigator and concurrence from Collins Aerospace Engineering, the wire was x-rayed for further investigation of the open condition. Although, the insulation of the white wire to the wiper arm was found to be intact. X-ray imaging of the wire revealed that there was a gap in the conductor strands of the wire. This gap is located approximately 0.23mm from the terminal lug connected to the wiper. The gap in the conductor is about 0.30mm wide, refer to Figure 9.

Approximate Location of break in the assembly view is identified in Figure 10. No other anomalies were discovered during the x-ray of the wire or surrounding area. The identified wire is part number EA7959. The properties are stranded silver plated copper conductor with white silicone rubber insulating 26 AWG.



Figure 9: X-ray of Gap in White Wiper Wire

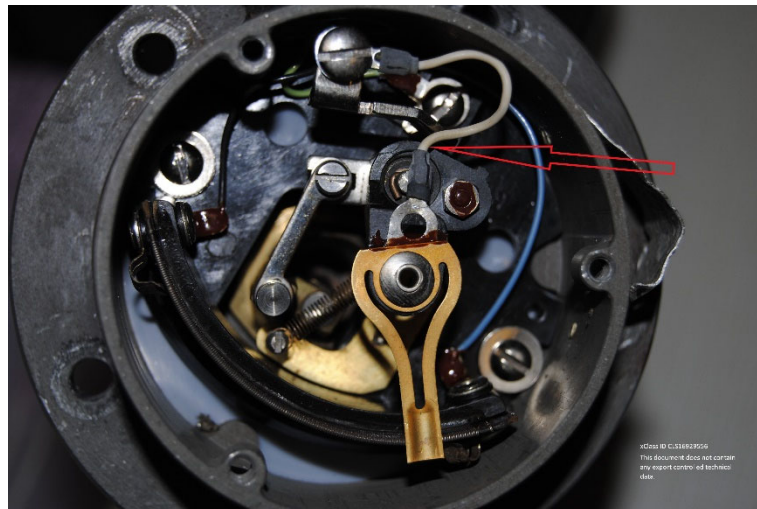


Figure 10: Location of Gap in White Wire

6.0 Summary and Results

The result of the investigation revealed an open connection between the back side of the tank unit wiper arm and pin C of the tank unit connector. All measurements were taken with a calibrated digital multimeter in a climate controlled lab setting.

Collins Aerospace can only confirm that the coils that power the needle in the indicator would be lost due to an open in the identified wire based on the schematic of the tank unit. As Collins Aerospace does not manufacture the mating indicator, it is unknown what the reaction of the indicator needle would be with the loss of coil power, whether it would be pulled to "E" by mechanical means or through an electrical circuit that senses the loss of coil power.

7.0 Appendix A



Aero Commander
500S EA515B-1404M



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8.0 Appendix B



1-FAA Repair
Station Air Agency C