

NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Aerospace Engineering Division
Washington, DC 20594



November 15, 2021

COMPONENT EXAMINATION FACTAL REPORT

A. ACCIDENT INFORMATION

Place : Naples, FL
Date : September 3, 2021
Vehicle : Raytheon 390 / N351CW
NTSB No. : ERA21LA350
Investigator: D. Boggs

B. COMPONENTS EXAMINED

The box that the components were shipped in was opened in the presence of the NTSB investigator, and the items unpacked.

Component	Part Number	Serial No.	Note
Skid Digital Control Box	PN: 42-989	SN:160	Date of mfr: 05-00
Wheel Speed Transducer	PN: 140-221	SN: 261	---
Wheel Speed Transducer	PN: 140-221	SN: 240	---
Power Brake & Antiskid Control Valve	PN: 38-811-1	SN: 155	Date of mfr: 01-00

C. DETAILS OF THE EXAMINATION

1. Power Brake & Anti-skid Control Valve:

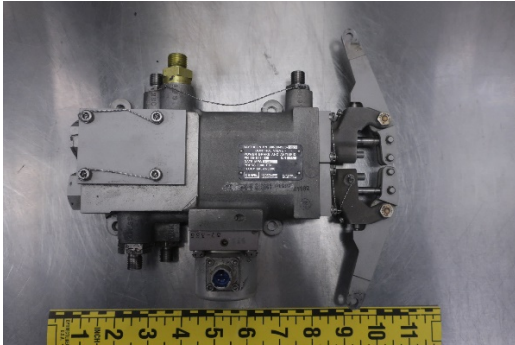


Photo 1 - Power brake and anti-skid control valve assembly.



Photo 2 - Data plate

Visual Examination

No physical damage were noted to the control valve assembly. There were no caps on any electrical or hydraulic ports or connections. The right brake “out” port’s safety wire was present but broken. All other fasteners and ports had safety wire installed. The electrical canon plug connection had all 3 pins present, they were straight, and no corrosion was observed. Both arms (metering valve levers) could be physically moved and automatically returned to original position.

Acceptance Test Procedure (ATP)

Removed all the safety wire from the assembly. Test procedure TP38-811-1 was followed. The hydraulic ports connectors were removed and replaced with connectors for the test bench. The valve assembly was placed into the test fixture. The technician took fluid samples from the return port, left brake, & right brake ports. The fluid is mixture of test bench fluid and what remained in the valve assembly. Performed ATP in accordance with TP38-811-1 (ATP data sheet included as Attachment 1). Hydraulic samples were tested for cleanliness. [REDACTED] All samples tested as contamination level Class 9.

ATP Limit Exceedances:

Right Power Brake Full Brake Pressure (Sec 5.4.1)	Right brake maximum pressure output was 30psi below specified minima (1415 psi).
Leakage on Brake (Sec 5.11.1)	Exceeded allowable leakage rates
Retraction Brake Pressure Leakage (Sec 5.15.1)	Exceeded allowable leakage rate

Note: Some internal leakage was identified that exceeded the ATP limits, however, this is considered normal for an in-service unit of this age (20 years). The unit would have been capable of providing commanded brake pressure to the brake assemblies.

Hydraulic Fluid Testing



Photo 3 - Three hydraulic fluid samples obtained from the valve assembly.

Cleanliness Inspection Results¹

Port	Results
Return	AS4059 Class 9F
Brake Right	AS4059 Class 9F
Brake Left	AS4059 Class 9F

Classification Table²

TABLE 2 - MAXIMUM CONTAMINATION LIMITS FOR CUMULATIVE PARTICLE COUNTS (PARTICLES/100 mL)

Contamination Levels	(1)	>1 μm	>5 μm	>15 μm	>25 μm	>50 μm	>100 μm
	(2)	>4 μm(c)	>6 μm(c)	>14 μm(c)	>21 μm(c)	>38 μm(c)	>70 μm(c)
		μm(c)	μm(c)	μm(c)	μm(c)	μm(c)	μm(c)
000		195	76	14	3	1	0
00		390	152	27	5	1	0
0		780	304	54	10	2	0
1		1560	609	109	20	4	1
2		3120	1217	217	39	7	1
3		6250	2432	432	76	13	2
4		12 500	4864	864	152	26	4
5		25 000	9 731	1731	306	53	8
6		50 000	19 462	3462	612	106	16
7		100 000	38 924	6924	1224	212	32
8		200 000	77 849	13 849	2449	424	64
9		400 000	155 698	27 698	4898	848	128
10		800 000	311 396	55 396	9796	1696	256
11		1 600 000	622 792	110 792	19 592	3392	512
12		3 200 000	1 245 584	221 584	39 184	6784	1024

(1) Size Range, Optical Microscope, based on longest dimension as measured per AS598 or ISO 4407.

(2) Size Range, APC Calibrated per ISO 11171 or an optical or electron microscope with image analysis software, based on projected area equivalent diameter.

¹ Appendix 4 – Cleanliness Inspection Reports

² Ref SAE AS4059F

2. Wheel Speed Transducers:

SN: 240



Photo 4- Wheel speed transducer SN: 240, side view.

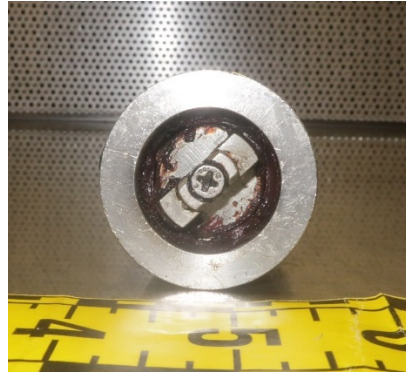


Photo 5 - Wheel speed transducer SN: 240, view of the rotor.

Visual exam

The canon plug connector was absent. The canon plug receptacle pins (4) were undamaged, straight, with no signs of corrosion. There was no external damage, however, there was some wear and gouging on the axle adaptor. Grease was observed in the rotor chamber. The rotor moved when manually manipulated.

Acceptance Test Procedure

The acceptance test procedure (ATP), test plan TP140-221, was performed with all parameters found to be within test limits. [REDACTED]

SN: 261



Photo 6 - Wheel speed transducer SN: 261, side view.

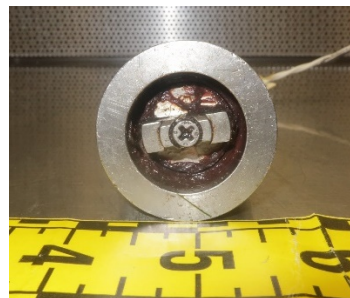


Photo 7 - Wheel speed transducer SN: 261, view of the rotor.

Visual exam

The canon plug remained attached to the transducer and was removed for the ATP. The canon plug receptacle pins (4) were undamaged, straight, with no observed corrosion. No external damage observed, however, there was some wear and gouging on the axel adaptor. There was grease in the rotor chamber. The rotor moved when manually manipulated.

Acceptance Test Procedure

The acceptance test procedure (ATP), test plan TP140-221, was performed with all parameters found to be within test limits. [REDACTED]

3. Digital Skid Control Box:



Photo 8 - Front face of the digital skid control box.



Photo 9 - Overhead view of the digital skid control box.

Visual inspection

The face plate was damaged on the lower left corner. The mounting flange had damage to the rear left corner. The J1 canon plug pins were straight, no corrosion, with no observable pin damage. The factory seals were in place on left and right face plate edges.

Acceptance Test Procedure

Acceptance test procedure (ATP), TP42-989, Rev F, was performed. None of the LED fault indicator lights illuminated when power was applied to the unit. All test items were within test criteria limits. [REDACTED]

[REDACTED]

[REDACTED]

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