

FROM / ÉMETTEUR: RAPHAËL ROCHETTE**TO / DESTINATAIRE:** EXTERNAL**INTERNAL DISTRIBUTION:** JOHN CLOSE, BOGDAN PANTELIMON, RAVI SANGHERA, CRAIG BOVAIRD, ALEX CHEN, MURRAY WYVILLE, GARY LAI, SHAWN KEHOE**SUBJECT/OBJET:** SKYWEST CRJ MSN 7871 RUNWAY EXCURSION INVESTIGATION – KES, SEDC & SLS VISIT REPORT

1. Background

This report relates to the investigation of the off-runway excursion involving SkyWest Airlines CRJ-200 MSN 7871 which happened at Houston's George Bush Intercontinental Airport on May 11, 2022. There were no injuries to any of the passengers or crew, and no damage to the aircraft was reported. The aircraft had 3 points landing, touching down at 109 kts. At about 71 kts, the aircraft started to deviate to the right of the runway. Differential braking and left rudder were applied to counteract and correct the lateral deviation. The aircraft veered off the runway at 50 kts, and came to a stop in a grassy area. FDR data showed that the NWS FAIL Caution parameter was triggered after the aircraft exited the runway. Inspection of the Nose Landing Gear was conducted at SafranLS and did not identify a cause for the incident. A full steering ATP was performed on the NLG assembly and was completed with no findings. The next steps identified were to perform ATP testing of selected individual components of the steering system.

This report summarizes the testing performed on the NLG Steering Harness P/N 17300-233 S/N 7-561, the ADSCU P/N 16900-107 S/N 03-988, Compensator P/N 16789-101 S/N DH-0126-03 and Manifold P/N 16480-101 S/N S00010MPK.

2. NLG Steering Harness Testing – Kanata Electronic Services

Date : August 22nd, 2023**Location :** Kanata Electronic Services, 20 Baywood Rd, Etobicoke, Ontario Canada**Object:** ATP and visual inspection of NLG Steering Harness P/N 17300-233 S/N 7-561 removed from SkyWest CRJ-200 MSN 7871

Attendees:

John Miller	Quality Assurance Manager	Kanata Electronic Services
Max Mancuso	Quality Manager	Safran Electrical Components Canada
Wilmer Auyon	Manufacturing Engineer	Safran Electrical Components Canada
Bryan Peacock	CASS Tech Ops Inspector	SkyWest Airlines
Maurice Montgomery	Flight Safety Investigation	SkyWest Airlines
John Close	Program Chief Engineer	Safran Landing Systems
Alex Chen	Product Support Engineering	Safran Landing Systems
Raphaël Rochette	Product Support Engineering Manager	Safran Landing Systems

Visit Summary

- Reviewed original ATP dated June 8, 2000

FACTORY ACCEPTANCE TEST REPORT		PART NO: <u>7618-7</u>	
OVERHAUL HANDLES ASST..		PART NO: <u>17300-213</u>	
NOSE LANDING GEAR		S.N.: <u>2561</u>	
		MCR NO: <u>7618-7</u>	
		BATCH: <u>110</u>	
ELC CONNECTOR P.N.: <u>142222-2486482</u>	TRACEABILITY NO.: <u>0015</u>		
782-8515-01			
ELC CONNECTOR P.N.: <u>142222-2486482</u>	TRACEABILITY NO.: <u>9923</u>		
782-8515-01			
ELC CONNECTOR P.N.: <u>142222-2486482</u>	TRACEABILITY NO.: <u>0009</u>		
782-8515-01			
ELC CONNECTOR P.N.: <u>142222-2486482</u>	TRACEABILITY NO.: <u>0009</u>		
782-8515-01			
TEST RESULTS AS PER TWR 7618-1		REFERENCE: <u>CMCR 7618-7 Rev A</u>	
4.1 Electrical Bonding & Conduit Conductivity : 12 Places			
R1 : <u>0.25</u> Ω	R2 : <u>0.12</u> Ω	R3 : <u>0.12</u> Ω	
R4 : <u>0.37</u> Ω	R5 : <u>87</u> Ω	R6 : <u>0.12</u> Ω	
R7 : <u>0.20</u> Ω	R8 : <u>44</u> Ω	R9 : <u>0.13</u> Ω	
R10 : <u>0.12</u> Ω	R11 : <u>83</u> Ω		
4.2 Continuity		PASS: ☒	
		FAIL: ☐	
4.3 Insulation Resistance		$> 1 \times 10^6$	PASS: ☒
		$< 1 \times 10^6$	PASS: ☐
4.4 Dielectric Strength		$< 1 \text{ kV}$	PASS: ☒
		$> 1 \text{ kV}$	PASS: ☐



APPROVED BY / DATE

REVISIONS



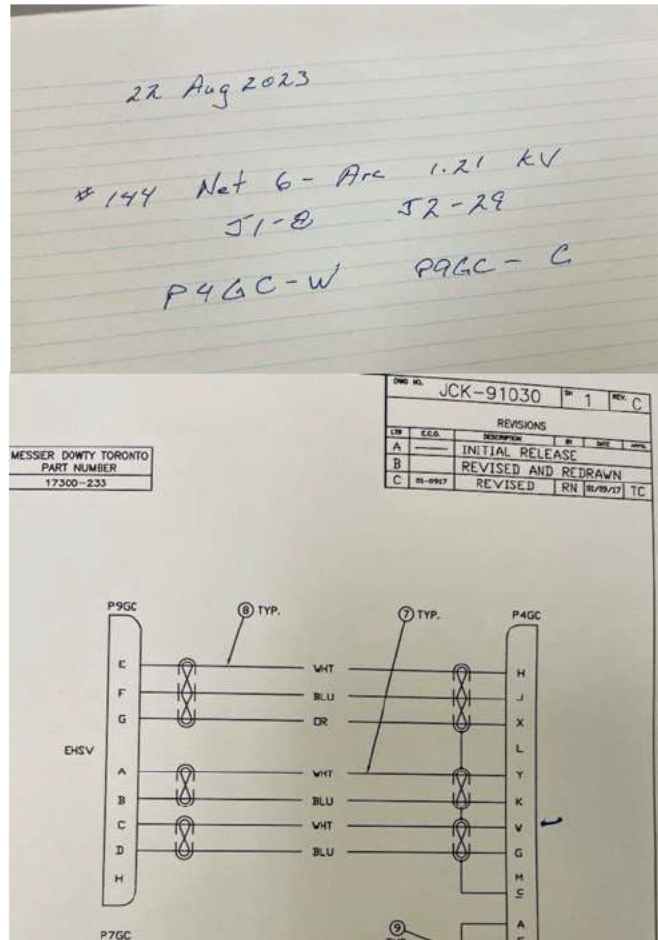
- Unboxed harness and moved to the test area
- Visual inspection revealed that the harness was repaired by a third party based on appearance of the ID label. This was further observed during disassembly based on the quality of the solder joints and some of the products used (unidentified brown tape found under some of the heatshrink). Some fraying of the stainless steel braiding was observed. All connectors appeared to be in generally good condition



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- The harness was connected to the test equipment and tested in accordance with Test Procedure 7619-1 rev.B. This is the same ATP revision as when the harness was manufactured. The harness passed the electrical bonding and conduit conductivity test as well as the continuity test but failed the hipot test for dielectric strength (Error code #144 Net6 DW Arc at 1.21 kV). Result indicated that the failure came from the connection P4GC-W to P9GC-C

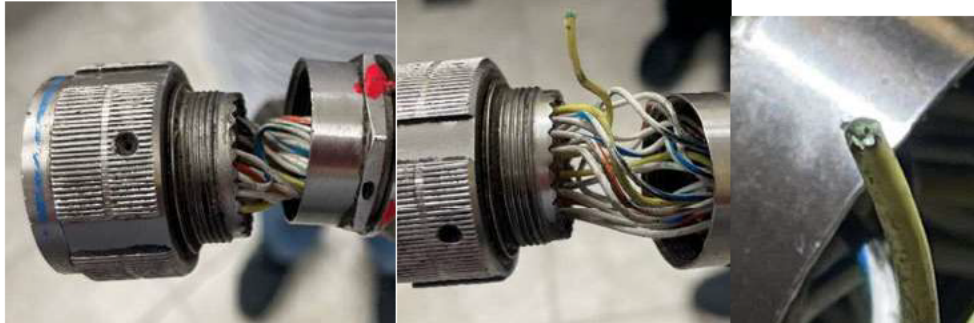


- ATP report:
- The ATP result was confirmed by testing manually on a separate hipot machine and found the failure to occur at about 550V between conductor C-W and shield wire c.
- It was agreed to proceed with a teardown to determine the root cause for the test failure.

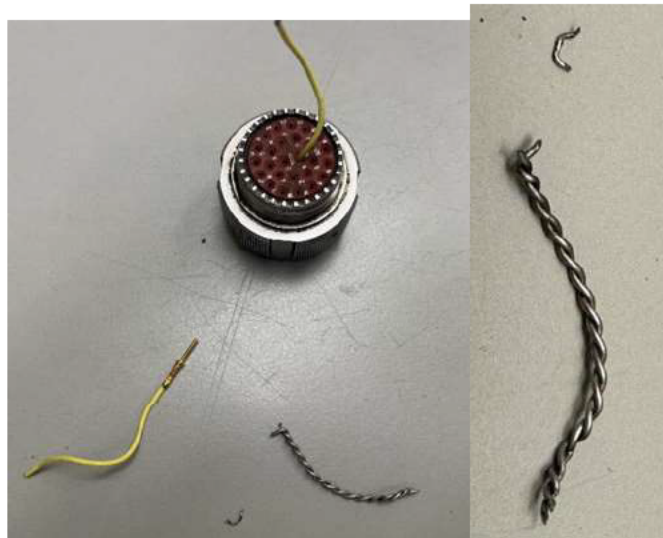
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- It was observed that the connectors on the harness were not torqued to the required 50in-lb. The disassembly torque was not measured.
- The harness was disassembled at the P4GC connector in an attempt to identify the cause of the ATP failure. Upon disassembly, it was observed that the wires were twisted and one of the wires was broken. The broken end appeared green in colour suggesting corrosion of the copper conductor



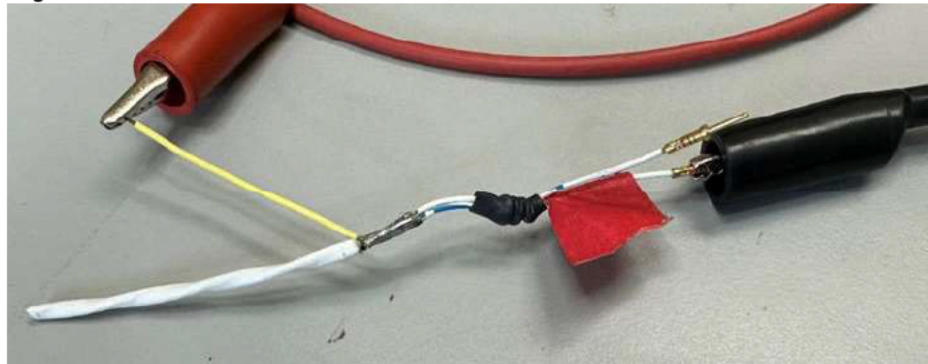
- The connector was removed by pulling each pin. In doing so, a second wire was found to be broken and a piece of FOD fell out. The FOD was similar in appearance to lockwire. Origin of the FOD could not be determined, however it was measure to be smaller in diameter than the lockwire that initially secured the connector in place.



- The two broken wires were identified as the shield wires A and b.
- Disassembly continued to remove all conduit sections and expose all wiring. The rubber boot of connector P9GC was observed to be deformed. There were no other significant findings and the wiring appeared to be in good condition.



- The hipot test was repeated at multiple points during disassembly with always the same results. This lead to the conclusion that the source of hipot failure was located at the connection between the shield wire c and the cable shielding. This conclusion was validated by cutting the wires C-W and D-G just after the connection in question and reproducing the hipot failure on that small section of wiring.



- The solder joint between shield wire c and the cable shielding was removed to allow inspection of the wire C-W. Visual inspection under 10x magnification identified one area of interest where the wire insulation located under the solder joint might have been compromised.



- Further inspection under optical microscope will be performed by SafranLS to confirm the finding.

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3. ADSCU Testing – Safran Electronics & Defense Canada

Date : August 23rd, 2023

Location : Safran Electronic & Defense Canada, Peterborough, Ontario, Canada

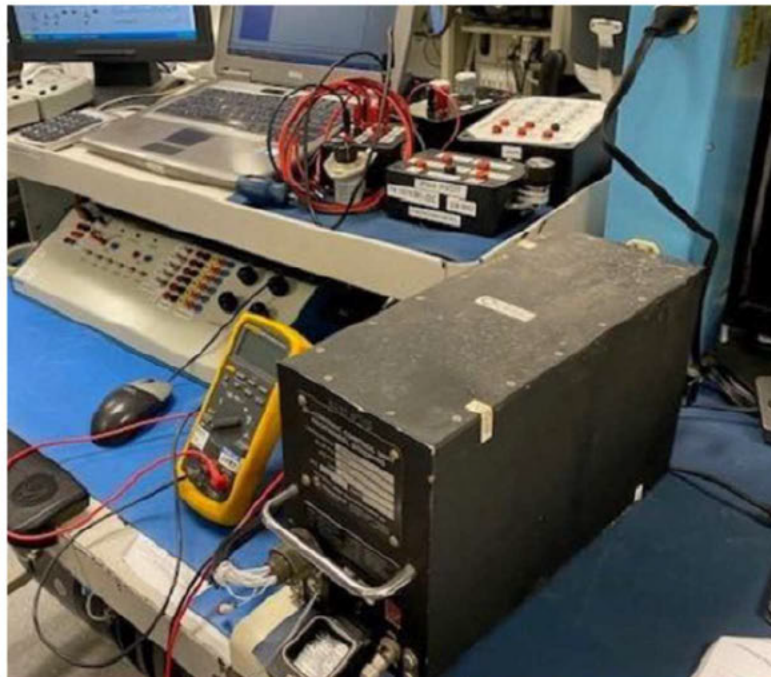
Object: ATP and visual inspection of ADSCU P/N 16900-107 S/N 03-988 removed from SkyWest CRJ-200 MSN 7871

Attendees:

Joel Hayes	Program Manager	Safran Electronics & Defense Canada
Bryan Peacock	CASS Tech Ops Inspector	SkyWest Airlines
Maurice Montgomery	Flight Safety Investigation	SkyWest Airlines
Peter Machete	Regional Senior Investigator	Transportation Safety Board
John Close	Program Chief Engineer	Safran Landing Systems
Shawn Kehoe	Brake Control Systems Engineer	Safran Landing Systems
Raphaël Rochette	Product Support Engineering Manager	Safran Landing Systems

Visit Summary

- The ADSCU was tested per ATP-17424 Rev U and passed.



- ATP result and NVM download:



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- The unit was disassembled and visually inspected. The PCB were inspected under UV light. The inspections revealed no abnormal findings.



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4. Compensator & Manifold Testing – Safran Landing Systems Canada

Date : August 24th, 2023

Location : Safran Landing Systems Canada, Ajax, Ontario, Canada

Object: ATP Compensator P/N 16789-101 S/N DH-0126-03 and Manifold P/N 16480-101 S/N S00010MPK removed from SkyWest CRJ-200 MSN 7871

Attendees:

Bryan Peacock	CASS Tech Ops Inspector	SkyWest Airlines
Maurice Montgomery	Flight Safety Investigation	SkyWest Airlines
Peter Machete	Regional Senior Investigator	Transportation Safety Board
John Close	Program Chief Engineer	Safran Landing Systems
Gary Lai	Systems Engineer	Safran Landing Systems
Alex Chen	Product Support Engineering	Safran Landing Systems
Nick Thomson	LSA Engineering Specialist	Safran Landing Systems
Raphaël Rochette	Product Support Engineering Manager	Safran Landing Systems

Visit Summary

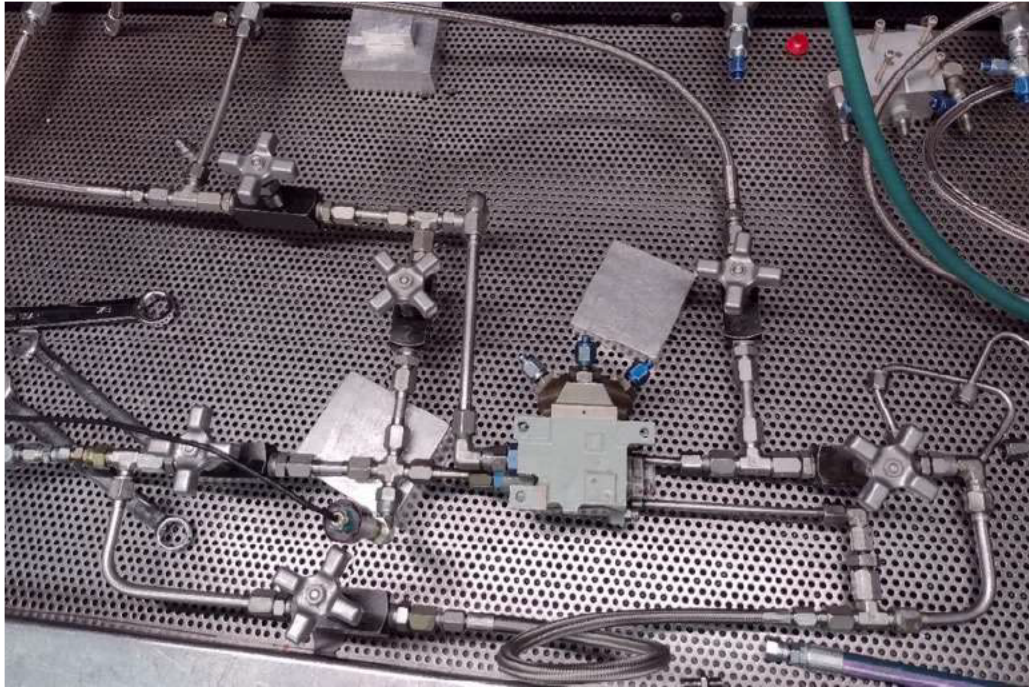
- The Compensator was tested per ATP 16789 rev B and passed.



- The Manifold was tested per ATP 16480 Rev A. The unit failed at Step 5.4.4 where Flow1 is required to be between 0.95 to 1.40 GPM and was measured to be at 1.41 GPM. It was noted that this result is not unusual for a used unit and that this result could be due to wear.

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- The unit passed the remainder of the ATP
- Based on the results of the ATP, it was agreed that there was no need to proceed with disassembly.

- ATP results for both units



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Actions:

The following actions were identified as part of the visits.

LRU	Action #	Action	Owner	Notes
Harness	1	Return harness to SafranLS	Kanata/SECC	
	2	Observe wire under optical microscope to confirm visual finding	SLS	
	3	Analyze findings and determine significance within the steering system	SLS	
	4	Share harness repair history	SkyWest	
ADSCU	5	Explain fault codes found in NVM	SEDC/SLS	Discuss whether certain codes may be usual or unusual
	6	Comment on how codes may relate to the event	SLS	
Manifold	7	Provide statement on the cause and significance of the F1 flow measured slightly above the upper limit	SLS	
N/A	8	Share pictures	SLS	
	9	Circulate draft of visit reports	SLS	

Compiled by / Etabli par	Agreed by / Agrée par:
	CLOSE John (SAFRAN LANDING SYSTEMS TOR) Digitally signed by CLOSE John (SAFRAN LANDING SYSTEMS TOR) Date: 2023.10.18 10:33:41 -04'00'
RAPHAËL ROCHETTE Product Support Engineering Manager	JOHN CLOSE Program Chief Engineer



Air Safety Office
Parker Hannifin Corporation
Parker Aerospace

Examination Location: Parker Dublin Facility

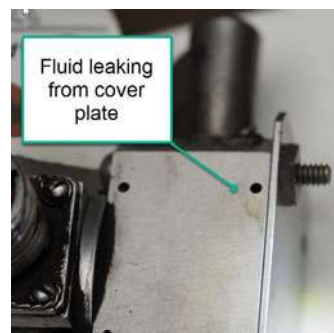
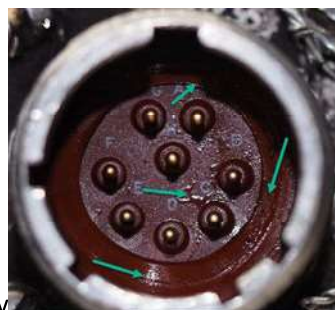
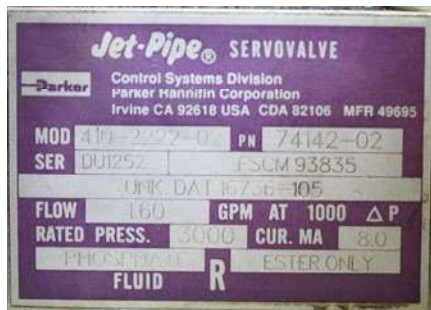
Subject: SkyWest Houston Runway Excursion NWS EHSV Examination

Date: 9/13/2023

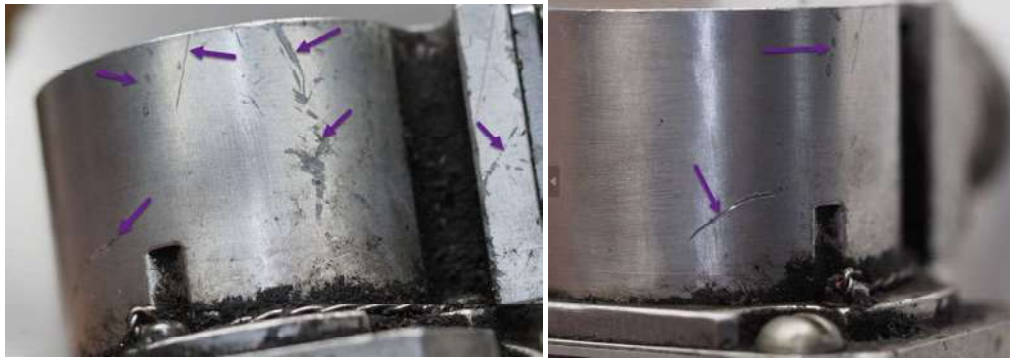
Attendees: See Appendix A for Sign In Sheet

Examination Details:

The EHSV was shipped to Parker Dublin and received on 9/11/2023 and was placed unopened into secured storage. The package was opened during the exam and the EHSV had a cover plate installed and was not bagged but was surrounded by plastic and paper. The connector had some shiny areas with what appeared to be fluid in the bottom of the connector (Green arrows show general areas of shiny fluid). Fluid was also observed coming from the cover plate. EHSV S/N DU1252 was previously repaired in Dublin in May of 2019 and the "DU" signifies the data plate had been replaced as it was missing when it was returned for repair. See Appendix C for Repair ATP data. All lockwire was present and consistent with typical Dublin practices and installation.



The torque motor cover had a gouge mark and other areas of contact marks on the torque motor cover (purple arrows showing some of the contact marks). The gouge or marks did not pierce the cover.



A test plan was proposed as follows:

Cold Soak EHSV and apply hydraulic pressure and electrical commands to the EHSV.

ATP at room temp.

Electrical checks, Dielectric, Insulation Resistance and Bonding

Repeat Cold Soak

Command full input in C1 direction, then remove electrical power to check for hardover

Teardown

The EHSV was cold soaked for 1 hour at -40°F and then install onto the EHSV test fixture and hydraulic pressure applied with a null command to the EHSV. The EHSV was not in a hardover condition and the EHSV responded to command input when the test fixture potentiometer was adjusted.



The EHSV met all ATP requirements except for Null Bias which was 0.21mA and the production requirement is 0.16mA maximum. See Appendix B for ATP results and graphs.

The EHSV met all dielectric, insulation resistance and bonding electrical requirements.

The EHSV was cold soaked for a second time for 45 minutes and hydraulic pressure and null commanded applied. No hardover condition was observed and the EHSV responded normally to command inputs.

The EHSV was disassembled and the torque cover motor was removed. The lacing tape was correctly installed with short cutoff tails and were white in color and not interfering with the torque motor cover environmental O-ring. The torque motor cavity was dry with no evidence of corrosion or moisture. The torque motor armature airgaps were inspected under 10x magnification and no FOD was observed on either side. The inlet filter was removed and inspected under 10x magnification and no debris or FOD observed. The second stage spool and sleeve were removed and the spool had typical velocity marks but no heavy or deep scratching. All metering edges were sharp with no damage observed. The receiver jet had some slight erosion but overall appeared normal.



Armature Gaps under 10x Magnification – No FOD



Inlet Filter – No FOD or Debris Observed

Summary:

The EHSV operated normally and met ATP specifications except for null bias. The null bias shift is very small and would not account for the right input observed on the airplane during the event. The EHSV did not exhibit any hardovers or uncommanded hydraulic outputs to C1 or C2 during any of the cold soak or ATP testing. The teardown examination did not reveal any anomalies or FOD that would have caused the EHSV to provide uncommanded operation to the NWS.

Appendix A – Sign In Sheet / Attendees – 1 page

Exam Date: 9/13/2023

CONDUCTED AT: MFCD Dublin

[illegible]

Appendix B – S/N DU1252 ATP Test Results – 8 Pages

Acceptance Test Data Sheet

Serial No: D41252Date: 9/13/23

Abex NWL Model No. 410-2222-01

Part No. 74142-01

Dowty Part No. 16736-103

Abex NWL Model No. 410-2222-02

Part No 74142-02

Dowty Part No. 16736-105

Error! Bookmark not defined.		REQUIRED			
DESCRIPTION	PARA.	MIN.	MAX.	RESULTS	Q.C. STAMP
Physical Examination	5.1.1	Conformance			
Coil Resistance, ohms	5.1.2	460	540		
Polarity	5.1.3	Conformance		O.K	
Supply Proof, 4725 psi	5.1.4	No Ext. Leak.		none	
Return Proof, 3000 psi		No Ext. Leak.		none	
Null Cylinder Pressure, psi	5.1.5	500	2000	1382	
LVDT Ratiometric Output Gain, V/V/mA	5.1.6	.0111	.0135	.0117	
LVDT Output Linearity	5.1.7		5%		
LVDT Null Voltage mV	5.1.8	-30	30		
LVDT Phase Shift, degree	5.1.9	-10	10		
Insulation Resistance, megohms	5.1.10	50			
Dielectric Strength, mA	5.1.11		1		
Electrical Bonding, milliohms	5.1.12		5.0		
Leakage @ 3000 psi, gpm	5.1.13		.20	.184	
Pressure Gain, psi/mA	5.1.14	10000		60,000	
Null Bias, mA	5.1.15		.16	.21	
Null Shift, mA	5.1.16				
Supply 2400-3600 psi			.16	.04	
Return 50-350 psi			.24	.05	
Hysteresis, mA	5.1.17		.40	.15	
Threshold, mA	5.1.18		.04	.01	
Flow Gain, gpm	5.1.19	1.44	1.76	1.68	
Dynamic Response, Hz	5.1.20				
Phase Lag (90 degree)		80			
Amplitude Ratio (-3 db)		80			

USE OR DISCLOSURE OF THIS DATA IS SUBJECT TO THE RESTRICTION ON THE TITLE PAGE OF THIS DOCUMENT

ABEX NWL
AEROSPACE
a PCT Company

ABEX NWL AEROSPACE
Kalamazoo, Michigan USA

SIZE

A

CAGE CODE

93835

DRAWING NUMBER

TP-1184

SCALE

REV.

G

SHEET

A-2

2.000

Part Number: 74142-02 Model No: 410-2222-02

S/N: DU1252

Tested By: JOHNNIBOY.089

Test Stand: EI-7134D (HTS40)

Date: 9/13/2023

CURRENT

Y Axis Current Range

0.4 MA/DIV

Y Axis Range, PSI

500 PSI/DIV

Temp

88

Second Stage Pressures

Hysteresis

0.04

Null

-0.23

Supply

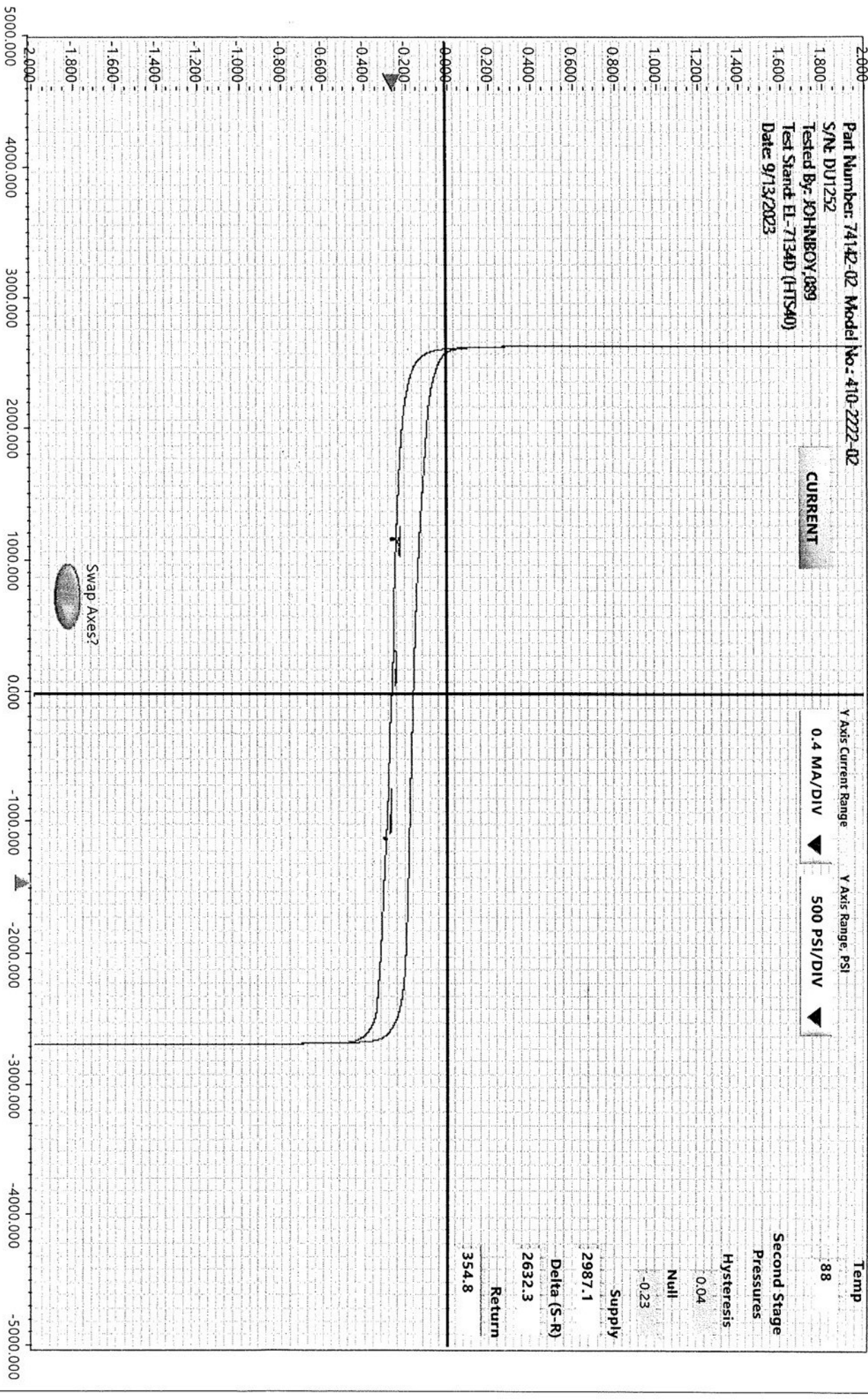
2987.1

Delta (S-R)

2632.3

Return

354.8



Part Number: 74142-02 Model No.: 410-2222-02
S/N: DU1252
Tested By: JOHNBOY,089
Test Stand: EL-7134D (HTS40)
Date: 9/13/2023

CURRENT

Y Axis Current Range

0.5 MA/DIV

Y Axis Range, PSI

500 PSI/DIV

Temp

91

Second Stage
Pressures

Hysteresis

0

Null

-0.2

Supply

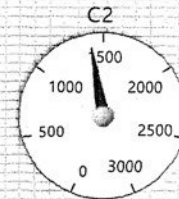
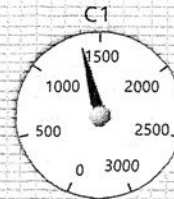
3002.7

Delta (S-R)

2636.0

Return

366.7



Swap Axes?

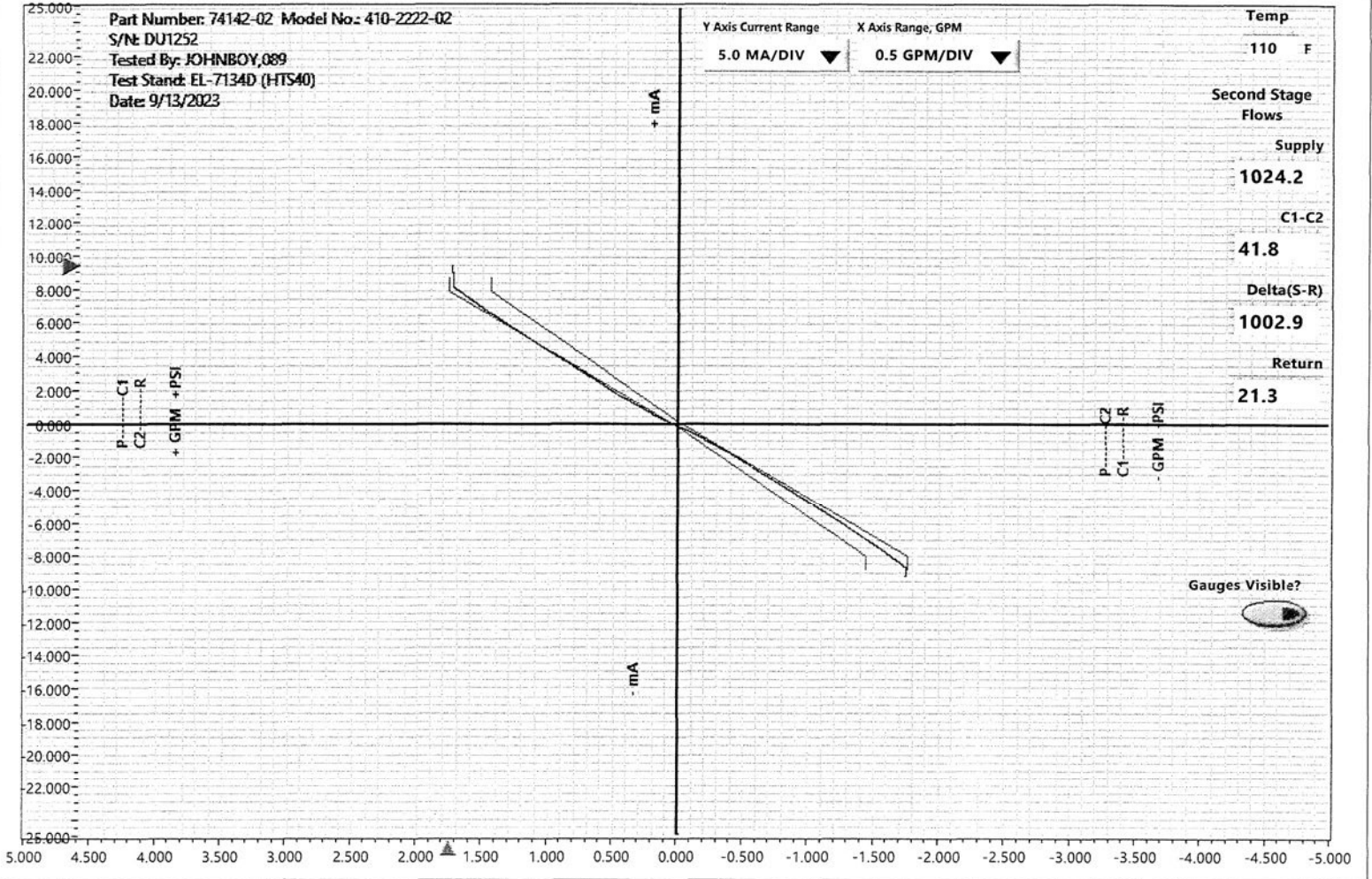
Part Number: 74142-02 Model No.: 410-2222-02
S/N: DU1252
Tested By: JOHNBOY,089
Test Stand: EL-7134D (HTS40)
Date: 9/13/2023

Y Axis Current Range 5.0 MA/DIV
X Axis Range, GPM 0.5 GPM/DIV

Temp 110 F

Second Stage Flows
Supply 1024.2
C1-C2 41.8
Delta(S-R) 1002.9
Return 21.3

Gauges Visible?



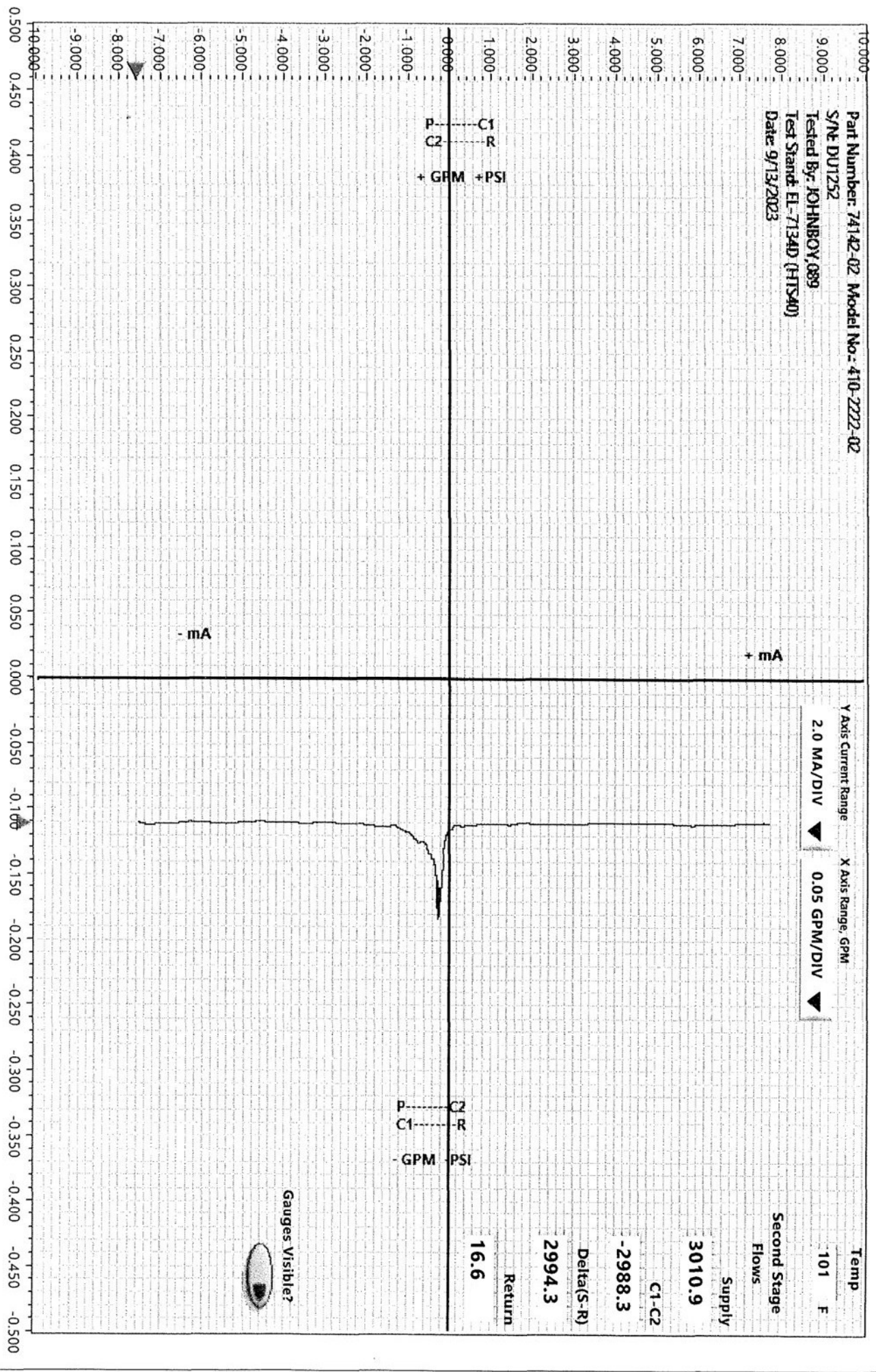
Part Number: 74142-02 Model No.: 410-2222-02

S/N: DUT152

Tested By: JOHNBOW 089

Test Stand: EL-7134D (HTS40)

Date: 9/13/2023



Part Number: 74142-02 Model No: 410-2722-02

S/N: DU1252

Tested By: JOHNBROY 089

Test Stand: EL-7134D (HTS40)

Date: 9/13/2023

CURRENT

Y Axis Current Range

0.4 MA/DIV

Y Axis Range, PSI

500 PSI/DIV

Temp

91

Second Stage Pressures

Hysteresis

0.12

Null

0.16

Supply

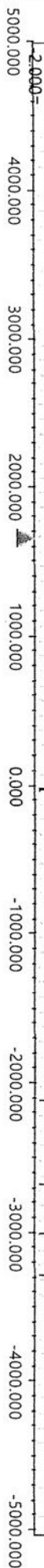
3003.1

Delta (S-R)

2652.7

Return

350.4



25.000

22.000

20.000

18.000

16.000

14.000

12.000

10.000

8.000

6.000

4.000

2.000

0.000

-2.000

-4.000

-6.000

-8.000

-10.000

-12.000

-14.000

-16.000

-18.000

-20.000

-22.000

-24.000

-25.000

-26.000

-27.000

-28.000

-29.000

-30.000

-31.000

-32.000

-33.000

-34.000

-35.000

-36.000

-37.000

-38.000

-39.000

-40.000

-41.000

-42.000

-43.000

-44.000

-45.000

-46.000

-47.000

-48.000

Part Number: 74142-02 Model No.: 410-2222-02

S/N: DU1252

Tested By: JOHNBOW,089

Test Stand: EL-6847D (HTS31)

Date: 9/13/2023

CURRENT

Y Axis Current Range

5.0 MA/DIV

Y Axis Ring, Inches

0.02/DIV

Temp

87

Second Stage

Pressures

Hysteresis

0

Null

0

Supply

3007.7

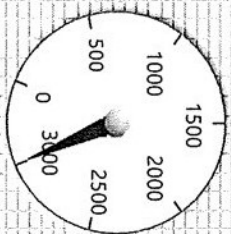
Delta (S-R)

2653.7

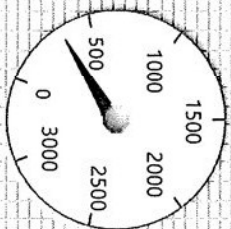
Return

354.0

C1



C2



Manual Gain

0.117

0.072

Swap Axes?

0.200 0.180 0.160 0.140 0.120 0.100 0.080 0.060 0.040 0.020 0.000 -0.020 -0.040 -0.060 -0.080 -0.100 -0.120 -0.140 -0.160 -0.180 -0.200

Date:
9/13/2023 11:31:56 AM

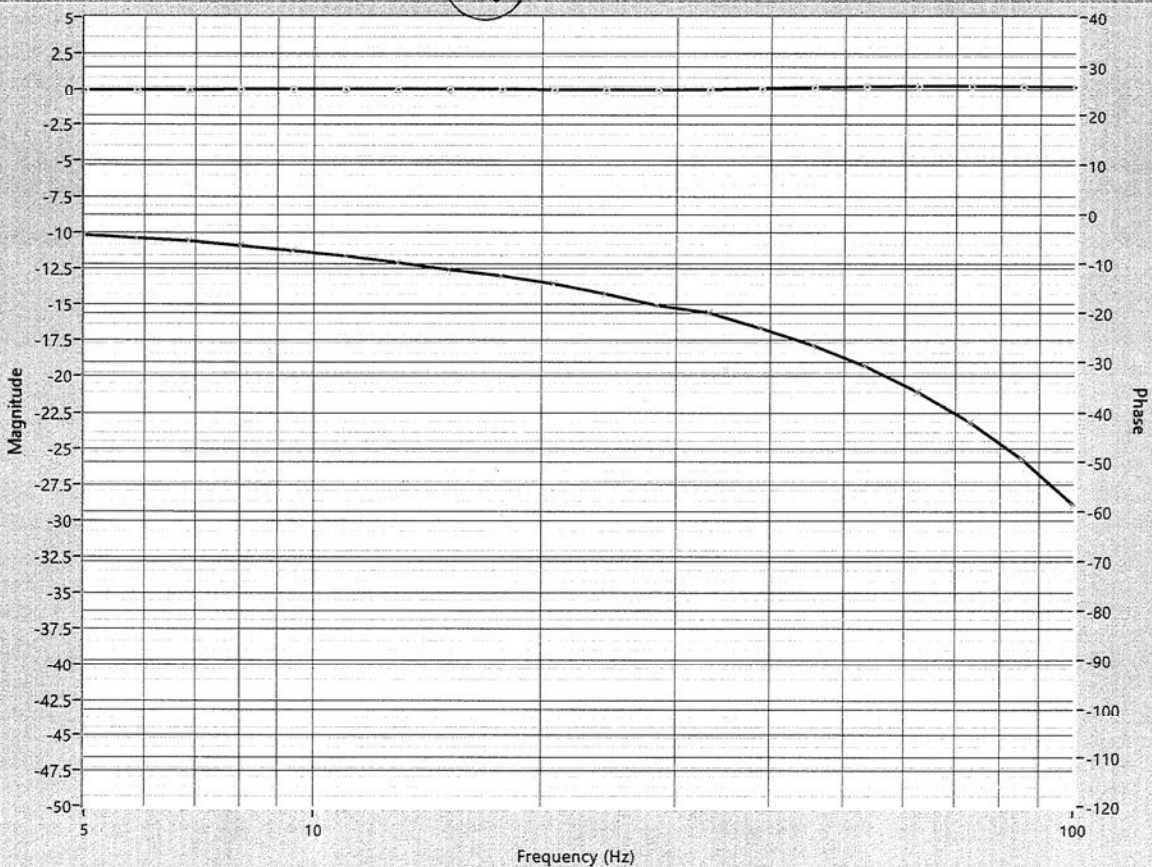
Operator:
JOHNBOY,089



Model Number:
410-2222-02

Serial Number:
DU1252

Magnitude:
Phase:



Freq	Mag	Phase
5	0	-4.0665
5.85	0.014	-4.6805
6.85	-0.009	-5.2792
8.02	0.042	-6.2247
9.39	0.045	-7.2084
11	0.045	-8.2876
12.88	0.028	-9.6536
15.08	0.028	-11.114
17.65	0.055	-12.358
20.67	0.014	-13.981
24.19	-0.017	-16.022
28.33	-0.006	-18.33
33.16	0.026	-19.817
38.83	0.089	-22.984
45.5	0.181	-26.471
53.2	0.221	-30.668
62.3	0.261	-35.906
73	0.26	-42.011
85.4	0.217	-49.552
100	0.198	-58.826
0	0	0
0	0	0
0	0	0

Appendix C – S/N DU1252 ATP Test Results 2019 Repair – 12 Pages

Part Number: 74142-02 Model No.: 410-2222-02

S/N: DU1252

Tested By: AC 321

Test Stand: Test Stand ID

Date: 5/20/2019



CURRENT

Final APP

Y Axis Current Range

0.4 MA/DIV

Y Axis Range, PSI

500 PSI/DIV

Temp

90

Second Stage

Pressures

Hysteresis

0.07

Null

-0.06

Supply (PT5)

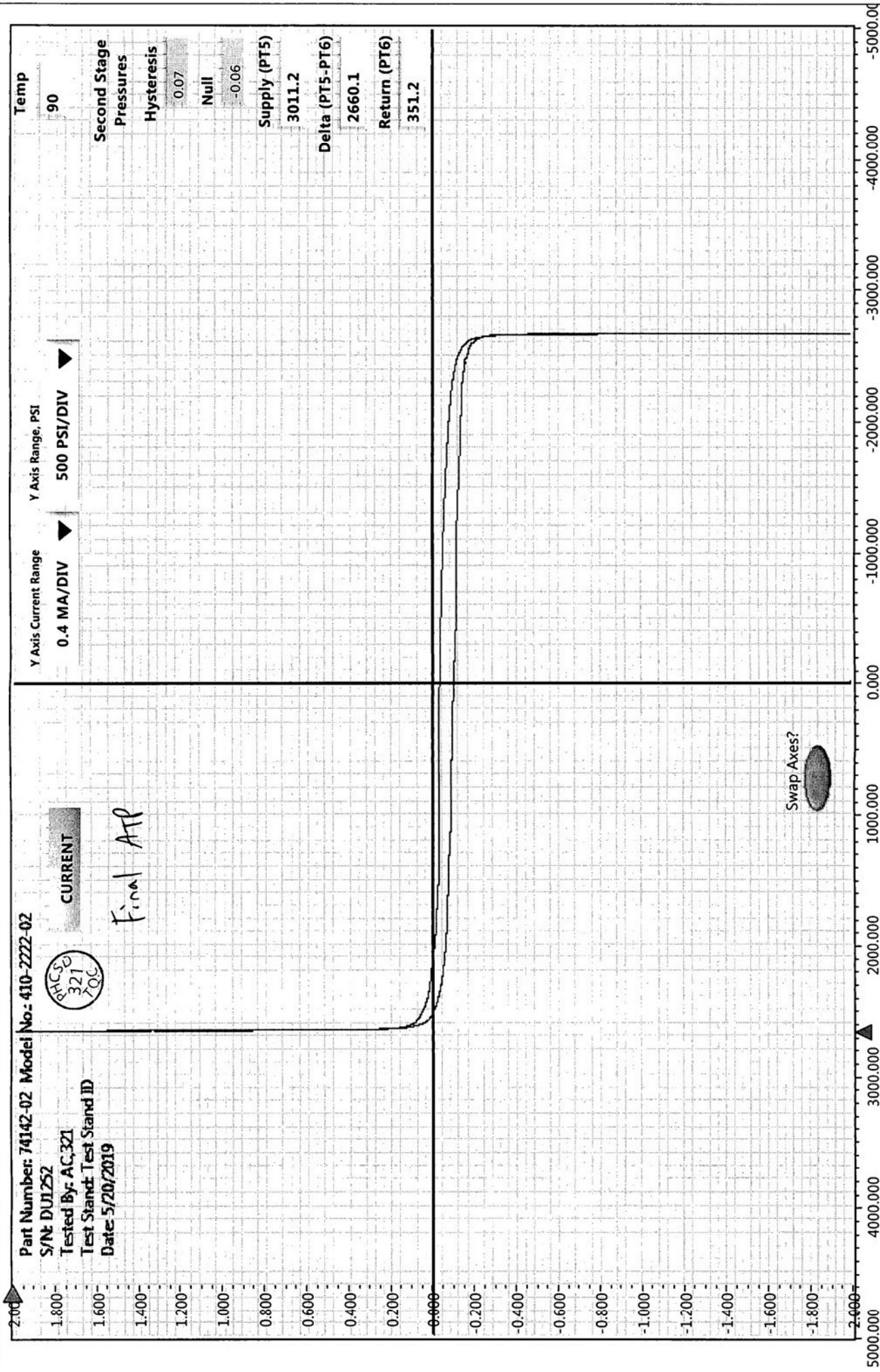
3011.2

Delta (PT5-PT6)

2660.1

Return (PT6)

351.2



Part Number: 74142-02 Model No.: 410-2222-02

S/N: DU1252

Tested By: AC321

Test Stand: Test Stand ID

Date: 5/20/2019



CURRENT

Final ATP

.095

Temp

92

Second Stage

Pressures

Hysteresis

0

Null

0

Supply (PT5)

3010.5

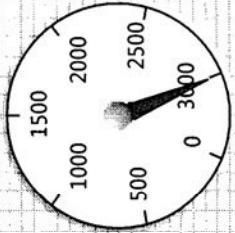
Delta (PT5-PT6)

2661.6

Return (PT6)

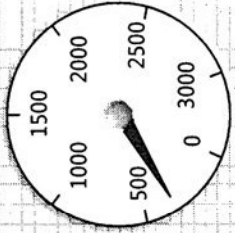
349.0

C2



3009

C1



346.25

.0116

.091

Swap Axes?

10.000

9.000

8.000

7.000

6.000

5.000

4.000

3.000

2.000

1.000

0.000

-1.000

-2.000

-3.000

-4.000

-5.000

-6.000

-7.000

-8.000

-9.000

-10.000

0.200

0.180

0.160

0.140

0.120

0.100

0.080

0.060

-0.200

-0.180

-0.160

-0.140

-0.120

-0.100

-0.080

-0.060

Date:

5/15/2019 8:30:49 AM

Operator:

JOHNBOY,309



Model Number:

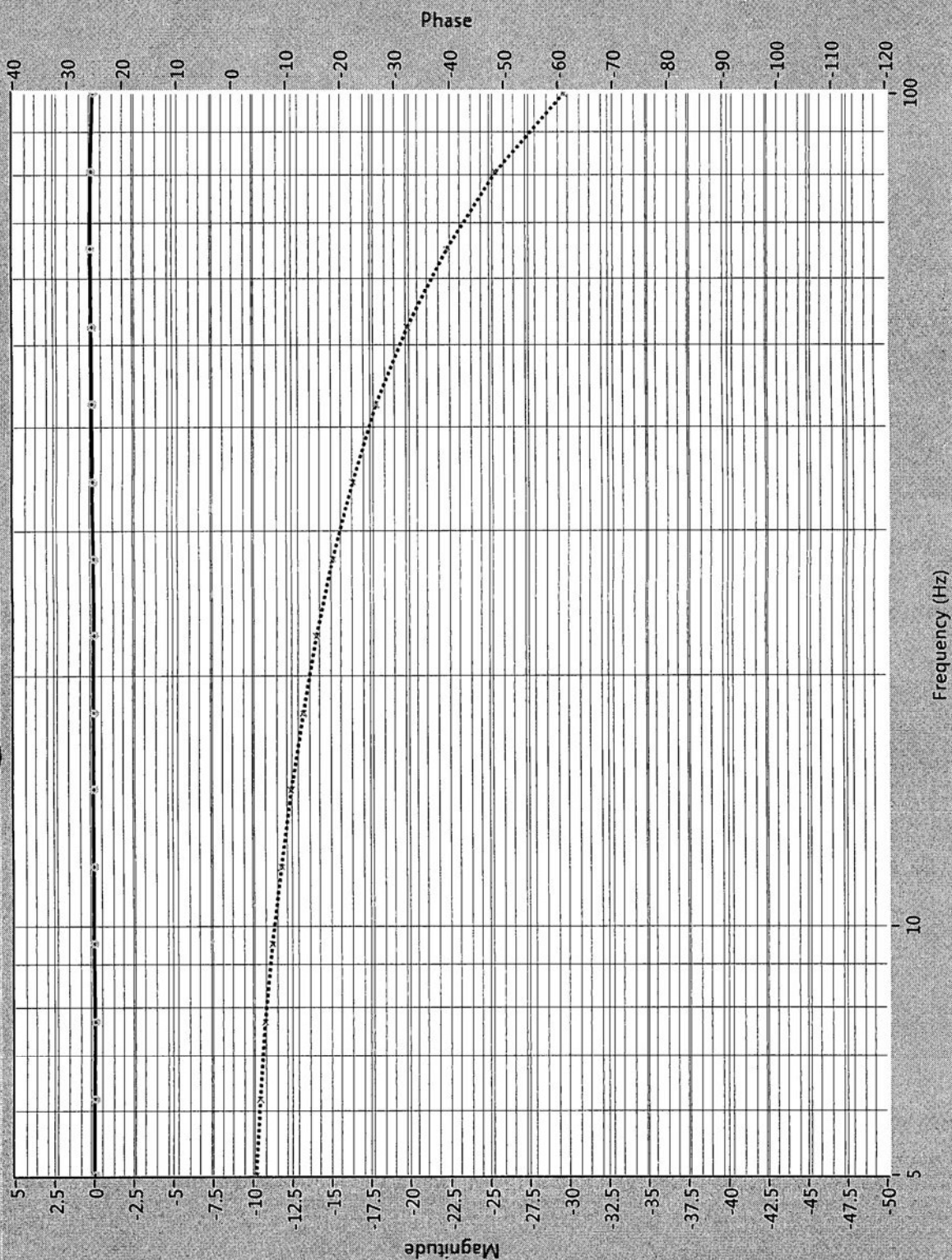
410-2222-02

Serial Number:

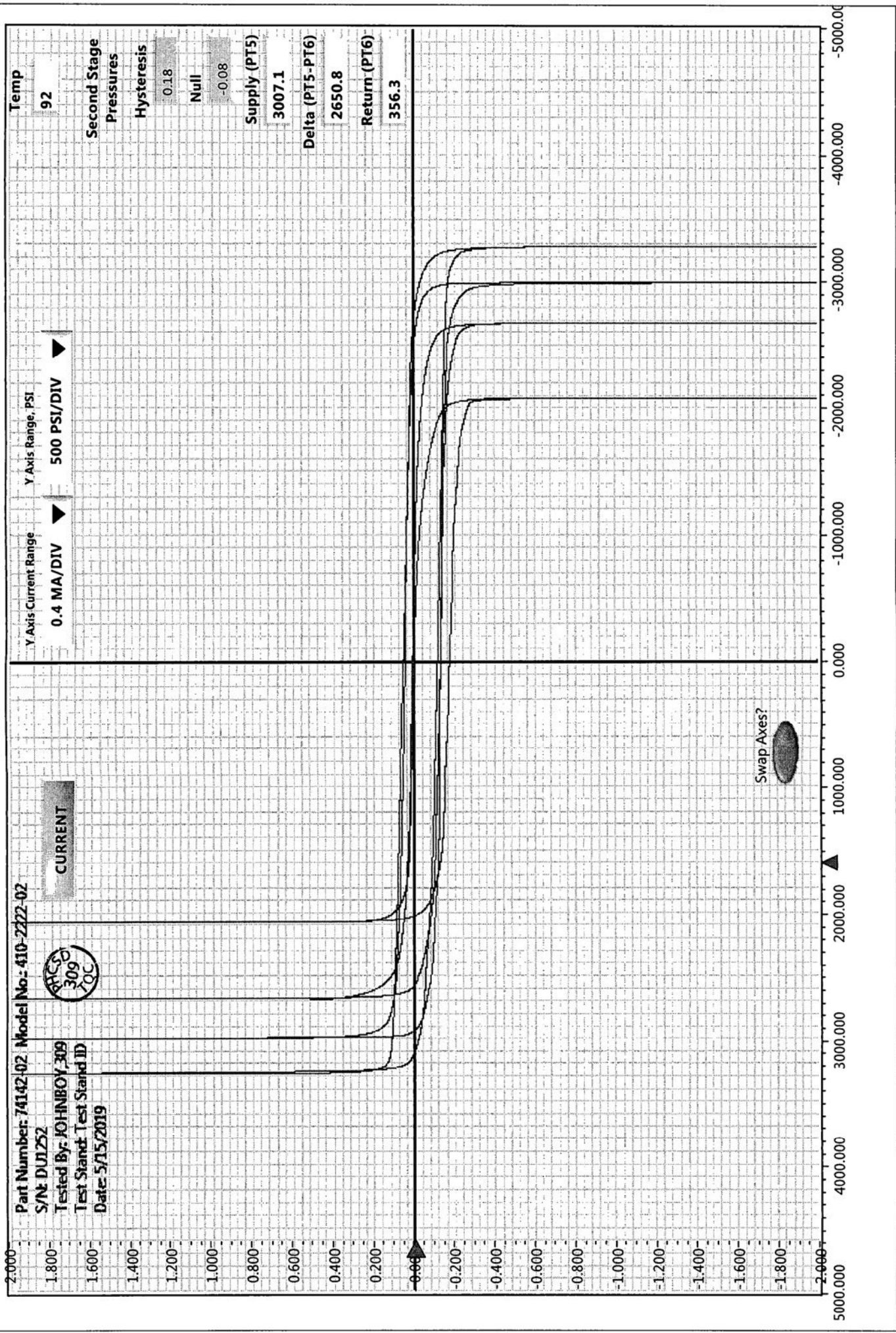
DU1252

Magnitude

Phase

[illegible]

787



287

Part Number: 74142-02 Model No.: 410-7222-02

S/N: DUL252

Tested By: JOHNEOV.309

Test Stand: Test Stand ID

Date: 5/15/2019

CURRENT



Temp 92

Second Stage Pressures

Hysteresis 0

Null 0

Supply (PT5) 3009.7

Delta (PT5-PT6) 2692.5

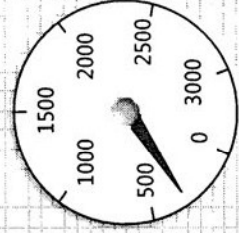
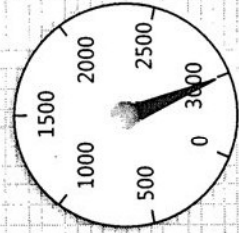
Return (PT6) 317.2

Y Axis Current Range 5.0 MA/DIV

Y Axis Rng. Inches 0.02/DIV

C1

C2



3007.3

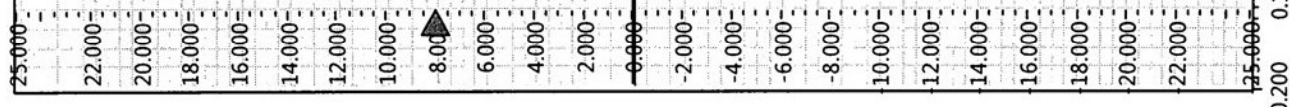
314.64

0.95

0.16

0.91

Swap Axes?



78

Part Number: 74142-02 Model No.: 410-2222-02
S/N: DUI252
Tested By: JOHNBOY,309
Test Stand: Test Stand ID
Date: 5/15/2019

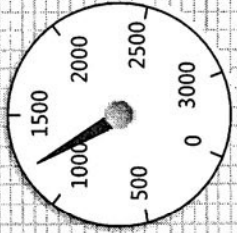
CURRENT



Temp 92
Second Stage Pressures
Hysteresis 0.02
Null -0.06
Supply (PT5) 3007.1
Delta (PT5-PT6) 2654.7
Return (PT6) 352.3

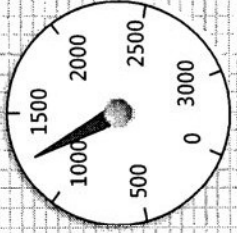
Y Axis Current Range 0.4 MA/DIV
Y Axis Range, PSI 500 PSI/DIV

C1



1213.9

C2



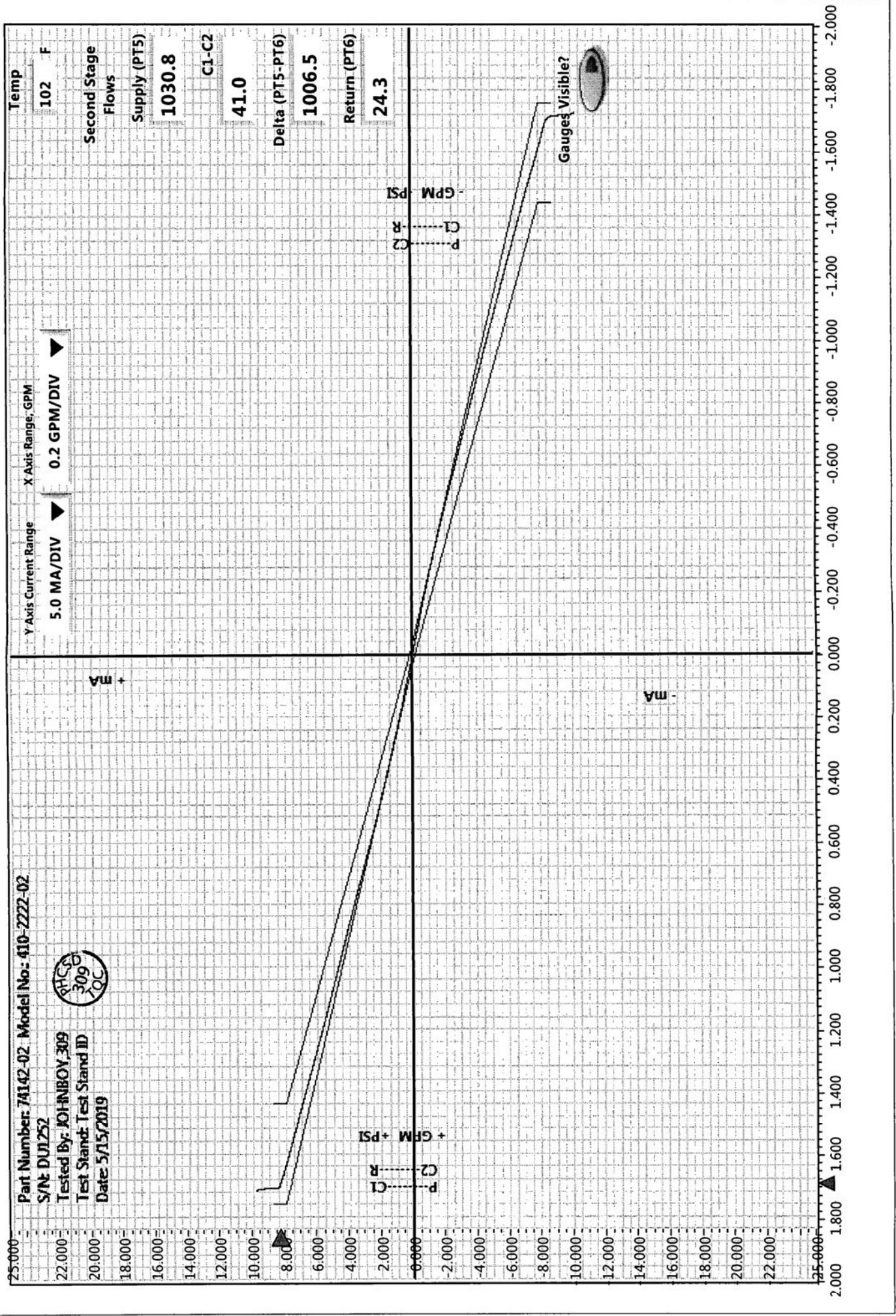
1244.6

Swap Axes?



287

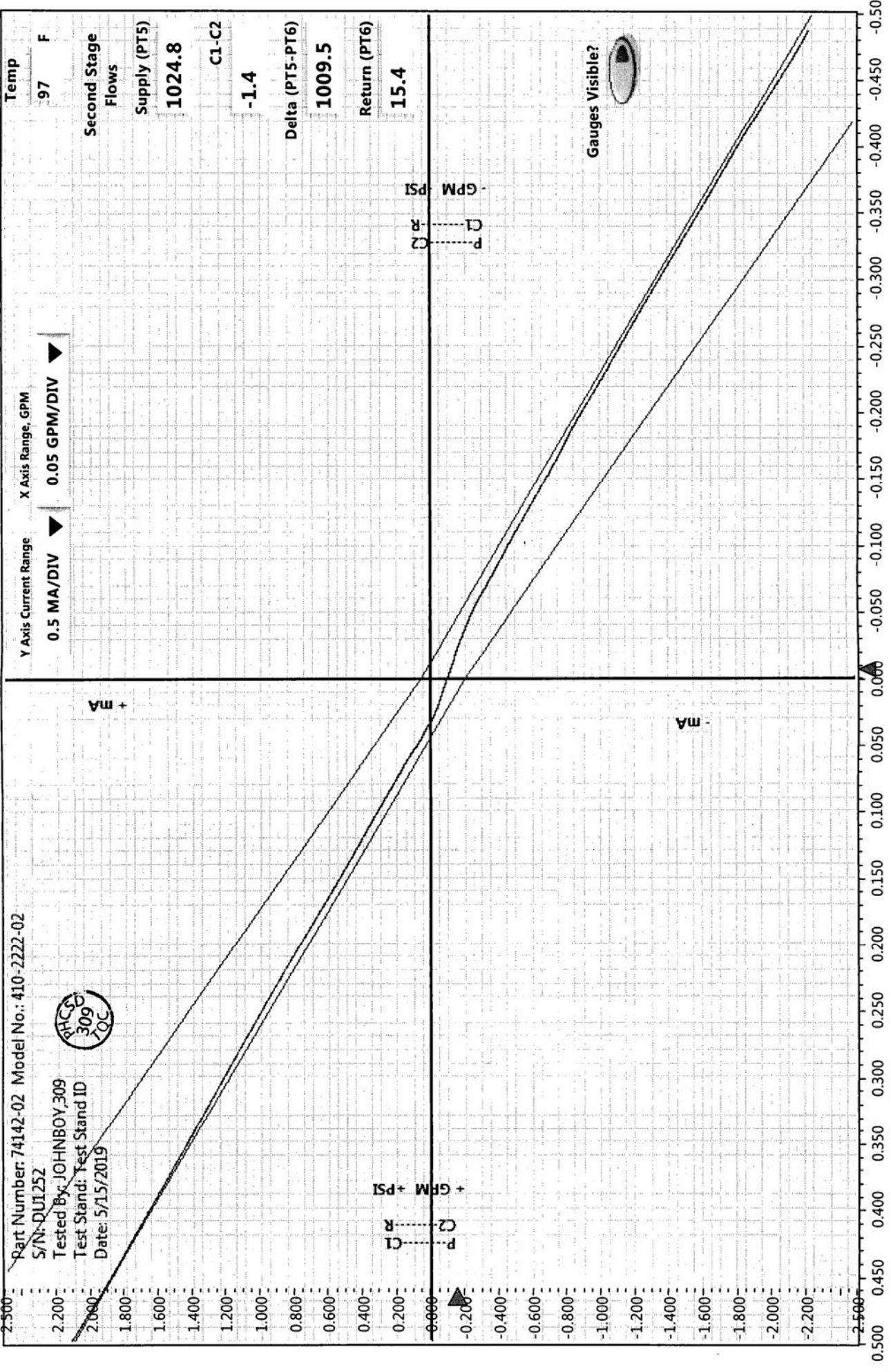
Part Number: 74142-02 Model No.: 410-2222-02
S/N: DJL252
Tested By: JOHNNBOY 309
Test Stand: Test Stand ID
Date: 5/15/2019



Temp
102 F
Second Stage
Flows
Supply (PT5)
1030.8
C1-C2
41.0
Delta (PT5-PT6)
1006.5
Return (PT6)
24.3

281

Part Number: 74142-02 Model No.: 410-2222-02
S/N: QUI252
Tested By: JOHNBOY 309
Test Stand: Test Stand ID
Date: 5/15/2019



Temp 97 F
Second Stage Flows
Supply (PT5) 1024.8
C1-C2 -1.4
Delta (PT5-PT6) 1009.5
Return (PT6) 15.4

287

Part Number: 74142-02 Model No.: 410-2222-02

S/N: DUL252

Tested By: JOHNBOW 309

Test Stand: Test Stand ID

Date: 5/15/2019



Y Axis Current Range
2.0 MA/DIV

X Axis Range, GPM
0.05 GPM/DIV

Temp

95 F

Second Stage
Flows

Supply (PT5)

3010.7

C1-C2

2992.9

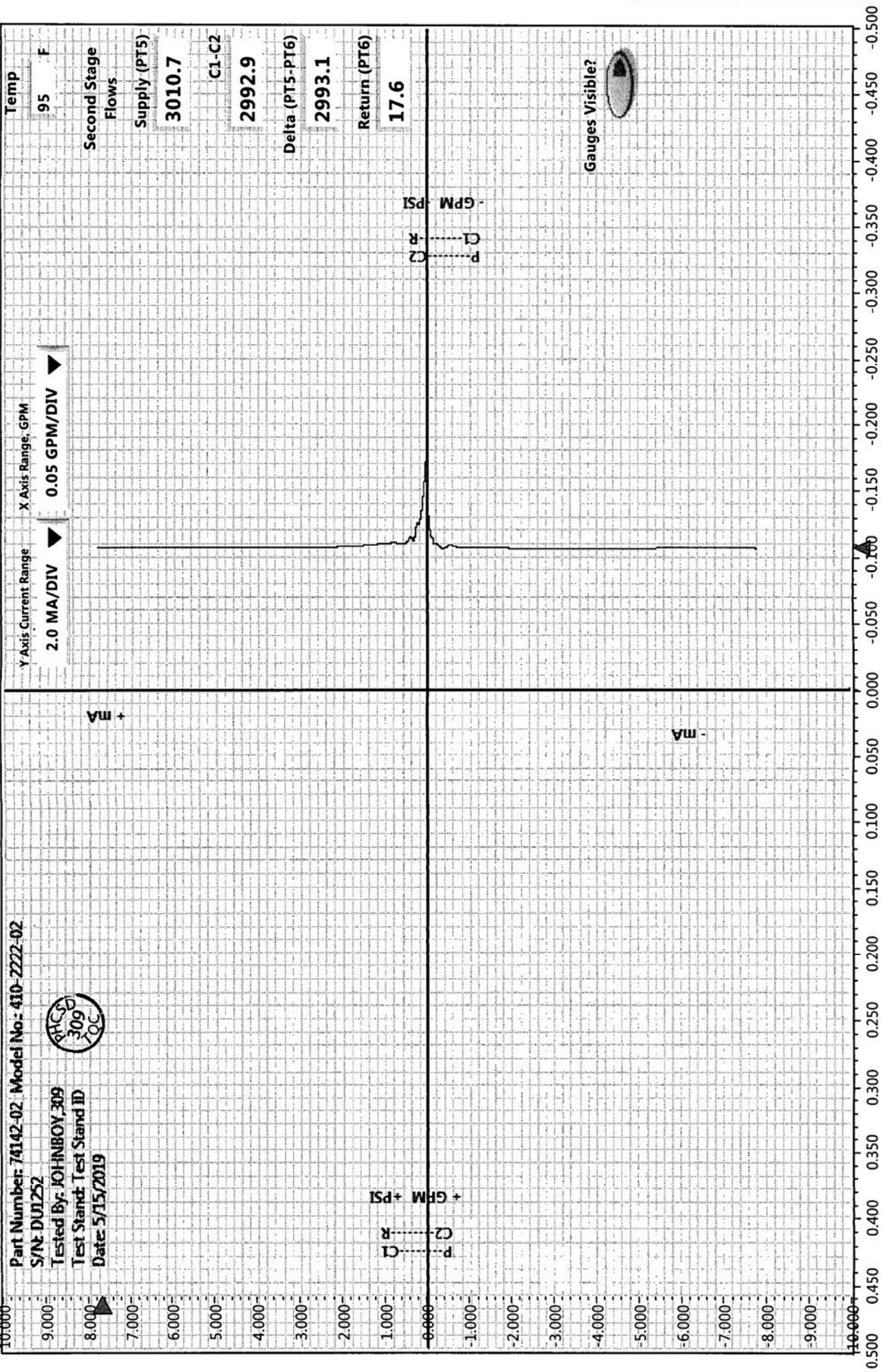
Delta (PT5-PT6)

2993.1

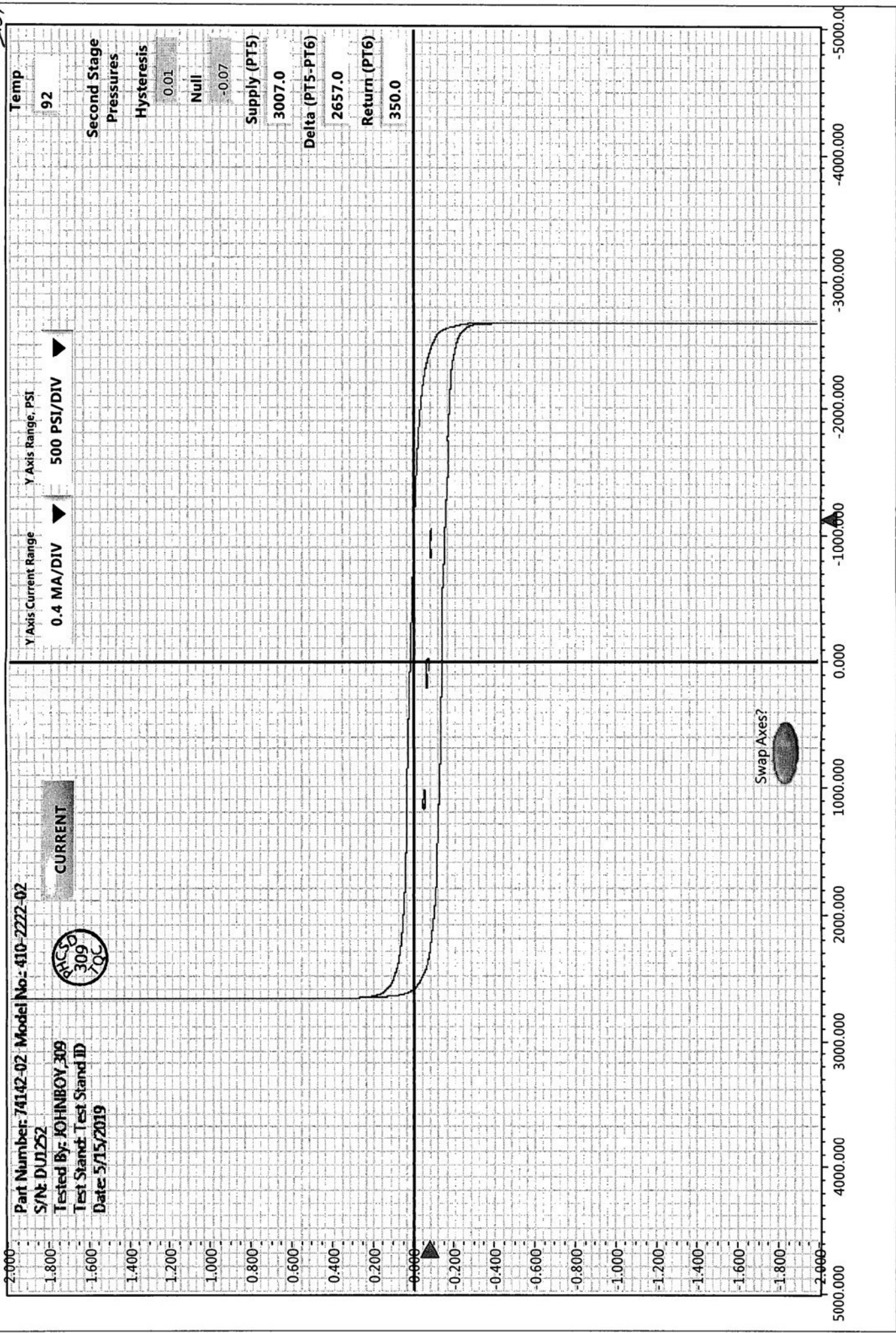
Return (PT6)

17.6

Gauges Visible?



1251



Acceptance Test Data Sheet

Serial No: DUI252Date: 5-20-19

Abex NWL Model No. 410-2222-01

Part No. 74142-01

Dowty Part No. 16736-103

Abex NWL Model No. 410-2222-02

Part No 74142-02

Dowty Part No. 16736-105

Error! Bookmark not defined.		REQUIRED			
DESCRIPTION	PARA.	MIN.	MAX.	RESULTS	O.C. STAMP
Physical Examination	5.1.1	Conformance		OK	PHCS 309 70C
Coil Resistance, ohms	5.1.2	460	540	507	PHCS 321 70C PHCS 360 70C
Polarity	5.1.3	Conformance		OK	PHCS 321 70C PHCS 321 70C
Supply Proof, 4725 psi	5.1.4	No Ext. Leak.		OK	PHCS 321 70C PHCS 321 70C
Return Proof, 3000 psi		No Ext. Leak.		OK	PHCS 321 70C PHCS 321 70C
Null Cylinder Pressure, psi	5.1.5	500	2000	1228	PHCS 321 70C PHCS 321 70C
LVDT Ratiometric Output Gain, V/V/mA	5.1.6	.0111	.0135	.0116	PHCS 321 70C PHCS 321 70C
LVDT Output Linearity	5.1.7		5%	N/A	PHCS 321 70C PHCS 321 70C
LVDT Null Voltage mV	5.1.8	-30	30	N/A	PHCS 321 70C PHCS 321 70C
LVDT Phase Shift, degree	5.1.9	-10	10	N/A	PHCS 321 70C PHCS 321 70C
Insulation Resistance, megaohms	5.1.10	50		100/100/100	PHCS 360 70C PHCS 360 70C
Dielectric Strength, mA	5.1.11		1	.035	PHCS 360 70C PHCS 360 70C
Electrical Bonding, milliohms	5.1.12		5.0	3.69/2.16/1.04	PHCS 321 70C PHCS 360 70C
Leakage @ 3000 psi, gpm	5.1.13		.20	.171	PHCS 321 70C PHCS 321 70C
Pressure Gain, psi/mA	5.1.14	10000		48,000	PHCS 321 70C PHCS 321 70C
Null Bias, mA	5.1.15		.16	-.07	PHCS 321 70C PHCS 321 70C
Null Shift, mA	5.1.16				PHCS 321 70C PHCS 321 70C
Supply 2400-3600 psi			.16	.00	PHCS 321 70C PHCS 321 70C
Return 50-350 psi			.24	.01	PHCS 321 70C PHCS 321 70C
Hysteresis, mA	5.1.17		.40	.07	PHCS 321 70C PHCS 321 70C
Threshold, mA	5.1.18		.04	.01	PHCS 321 70C PHCS 321 70C
Flow Gain, gpm	5.1.19	1.44	1.76	1.70	PHCS 321 70C PHCS 321 70C
Dynamic Response, Hz	5.1.20				PHCS 321 70C PHCS 321 70C
Phase Lag (90 degree)		80		-61	PHCS 321 70C PHCS 321 70C
Amplitude Ratio (-3 db)		80		0	PHCS 321 70C PHCS 321 70C

USE OR DISCLOSURE OF THIS DATA IS SUBJECT TO THE RESTRICTION ON THE TITLE PAGE OF THIS DOCUMENT

ABEX NWL
AEROSPACE
a PCT Company

ABEX NWL AEROSPACE
Kalamazoo, Michigan USA

SIZE
A
CAGE CODE
93835

DRAWING NUMBER

TP-1184

SCALE

REV.

G

SHEET

A-2



FINAL/ BUYOFF CHECKLIST

 PART NO.: 744202 W/O NO.: P129020 SERIAL NUMBER: D41252 DATE: 5/24/19

Hardware Requirements: (stamp off as applicable)	Conforms	
	Yes	No
A.) PART MARKING: Verify the hardware conforms to the part marking requirements of the drawing. Including: Legibility, dash number, revision level and method. Assure Mfg & Cure dates are visible.		
B.) Serialization: Verify that all serial numbers and or lot control numbers are legible and recorded on traceability sheets as required.		
C.) Nameplate/Labels: Verify that all decals are correctly oriented, affixed properly, and meets the drawing requirements for location. Part is marked correctly per customer requirements, drawing, etc. Verify s/n of unit matches s/n on paperwork.		
D.) Cosmetic Appearance: Verify that the hardware does not have any cosmetic discrepancies: (e.g. discoloration, scratches corrosion,...etc.). Check cable length; sleeving; nozzle stop gap; wand etching or banding for damage if required.		
E.) Protective Covers/Caps: Verify that all tubes, ports, electrical connectors...etc., have protective covers installed, and are tight, to preclude intrusion of foreign material, or fluid leakage.		
F.) Electrical Connectors: Verify the electrical connectors conform to drawing requirements for orientation and no damage to the pins exist. Use 10 X Magnification and lighting. Verify screws torque per blueprint requirement as applicable.		
G.) Lockwire: Verify that all lockwire is tensioned in the correct direction and meets drawing requirements routing and tamper seal.		
H.) Potting: Verify that all potting is applied in the proper locations, clearcoats if required, and that it is properly cured. (Tack - Free)		
I.) Base Inspection: Visually inspect the base of the product for nicks, dings, scratches on O-Ring grooves, FOD, or any visible damage. Attach shipping plate with torque wrench. If applicable, verify lockwire on filter plug is present and setscrew on spare torque motors.		
Documentation Requirements: (stamp off as applicable)		
J.) Test Data: Verify test data is present, dated and stamped. The S/N of the unit must be legible on each piece of test data. See below. Paperwork errors must be properly corrected. Verify (if applicable) on Test Data acceptance sheet all readings are within limits. a) Pressure Gain b) Flow Gain c) Lap (If applicable) d) Internal Leakage e) Frequency Response (If applicable) f) LVDT (If applicable) g) Spring Load Test (If applicable) h) Mechanical FBS Plot (If applicable) i) Polarity		
K.) Paperwork: Must be complete, stamped & dated at each operation. Paperwork errors must be corrected. Traceability records are complete. a) Travelers (Torque Motor, Second Stage, Top Level) b) Torque Motor S/A with test plots c) Second Stage S/A with test plots d) Traceability/ pull sheets e) Discrepancy Event Record is properly annotated on traveler and completed (if applicable)		
L.) Shippers: Add Rev and Serial Numbers (if applicable) to Shipper provide by Contracts Dept. Note: Customs shippers require price \$\$. 		
M.) FAA/CAAC Tags: (If required by shipper) After the above is complete, present to FAA certified Repairman/DMIR. A. Verify the new production is on the PMA approved list. B. Part Mark product per FAR 45.15		
N.) When applicable, assure that VRR/ Parker "D" tag No. is reference on cert and is correct.		
O.) If parts are reworked or replaces, verify that the cert contains a statement that parts are rework or replaced.		



PNEUDRAULICS, INC.
PRECISION AEROSPACE HYDRAULIC COMPONENTS
8575 HELMS AVENUE · RANCHO CUCAMONGA, CA 91730-4591

Product Investigation Report

Item:	Valve, Solenoid Operated, 3W 2P NC
PN:	4065-1
Serial Number:	983
RPO Number:	104946
Customer:	Safran Landing Systems, Toronto, Canada
Report No.:	PIR4065-1
Revision	0 (Initial Release)
Date:	3 October 2023
Prepared By:	Greg Burns

1.0 Purpose

This document serves as the record of the investigation into the noted part and its operational performance relative to a prior event of runway excursion. The customer (Safran Landing Systems) description of the event as contained in an email from Raphael Rochette of Safran Landing Systems dated 22 June 2023 was:

"I am contacting you in the scope of an investigation of the off-runway excursion involving SkyWest Airlines CRJ-200 MSN 7871 that happened at Houston's George Bush Intercontinental Airport on May 11, 2022. There were no injuries to any of the passengers or crew, and no damage to the aircraft was reported."

...and on 28 June 2023:

"To give you some additional background into the incident itself, the aircraft had 3 points landing touching down at 109 kts. At about 71 kts, the aircraft started to deviate to the right of the runway. Differential braking and left rudder were applied to counteract and correct the lateral deviation. The aircraft veered off the runway at 50 kts, and came to a stop in a grassy area. FDR data showed that the NWS FAIL Caution parameter was triggered after runway excursion occurred. Inspection of the Nose Landing Gear at SafranLS did not identify a cause for the incident. A full steering ATP was performed on the NLG and it functioned as expected. The next steps are to look into individual components of the steering system such as the SSV as discuss."

2.0 Personnel Involved

The following individuals were present to represent their noted organizations:

<u>Name</u>	<u>Representing</u>
Zi Keng Chen	Safran Landing Systems
Bogdan C. Pantelimon	Safran Landing Systems
Bryan G. Peacock	SkyWest Airlines
Maurice J. Montgomery	SkyWest Airlines
Yvonne C. Huynh	Federal Aviation Administration
Greg Burns	PDI
Gerry Loftis	PDI
Karl Sneider	PDI

3.0 Agenda

The representatives assembled the morning of 26 September 2023 and conducted the following activities:

- a. Reviewed the engineering drawing for the component and discussed the theory of operation.
- b. Reviewed the performance requirements of the component as described in the Acceptance Test Procedure, ATP 4065-1, and categorized those into functional and non-functional tests in order to prioritize the day's activities.
- c. Conducted an inbound filter patch to get a preliminary assessment of the hydraulic service environment of the aircraft from which the component had been removed.
- d. Conducted the functional tests for the assembled group to witness (the non-functional tests were conducted at a later time unwitnessed so that the entirety of the ATP was performed for completeness).
- e. Discussed the results of the witnessed functional tests and organized thoughts for this report.

4.0 Data Collected

4.1 Photographs

Photographs taken during the day's tasks are contained in Appendix A along with suitable captions. There were no remarkable visual conditions noted.

4.2 ATP Results

The ATP data sheets representing the performance results of the component is contained in Appendix B. All of the functional tests were normal, with the non-functional test for insulation resistance showing a nonconforming value (an insignificant finding relative to the event of interest: runway excursion), possibly caused by environmental contamination of the rubber insulator creating a dielectric leakage path (note the component has been operating for 20 years).

5.0 Conclusion

The component functioned in a consistent operating manner that would support expected aircraft hydraulic system performance. It will be held with no further work to be performed until the customer (Safran Landing Systems) instructs otherwise.

Appendix A – Photos



View of nameplate.



View of nameplate – rotated.



View of nameplate – rotated.



View of nameplate – rotated.



View of connector on solenoid showing pins and rubber insulator.



View of mounting holes from one side.



View of mounting holes from the other side.



View of the capped cylinder port.



View of the capped pressure port.



View of the capped return port.



View of the part while plumbed on the hydraulic test bench for the performance of the ATP.

PREPARED BY R. VanNimwegen	Pneudraulics, Inc. 8575 HELMS RANCHO CUCAMONGA, CA 91730-4588	PAGE 1 OF 11
DATE 11-08-91	ACCEPTANCE TEST PROCEDURE	REV. DATE A 12-02-91 B 06-05-97

ACCEPTANCE TEST PROCEDURE
FOR
SOLENOID VALVE, 3-WAY, 2-POSITION
PNEUDRAULICS, INC. PART NO. 4065-1
DOWTY CANADA LIMITED
SCD NO. 16850

NON-FUNC. TESTS: 4.1, DIELECTRIC
4.2, PROOF
4.7, INSUL. RESIST.
4.10, BONDING

PREPARED BY: [REDACTED] DATE: 11-6-91
[REDACTED] Test Engineer

APPROVED BY: [REDACTED] DATE: 11/8/91
Bill Dunn, Chief Engineer

APPROVED BY: [REDACTED] DATE: 11-8-91
Jack Joy, Quality Control Mgr.

FUNCTIONAL TESTS: 4.3, FUNCTIONAL
4.4, INT'L LEAKAGE
4.5, OPERATIONAL
4.6, FLOW SURGE
4.8, LOW V. OP'N
4.9, ACT/DEACT TIME

CODE IDENT NO.
06177

ATP 4065-1

pdf: 08/28/2023. Verify current revision on CRADL prior to use.

View of the cover page of the ATP with the handwritten categorization of the tests into functional and non-functional categories.



View of a volumetric beaker used to assess the amount of internal leakage during the performance of the ATP.



View of technician making visual assessment of volumetric value of internal leakage.



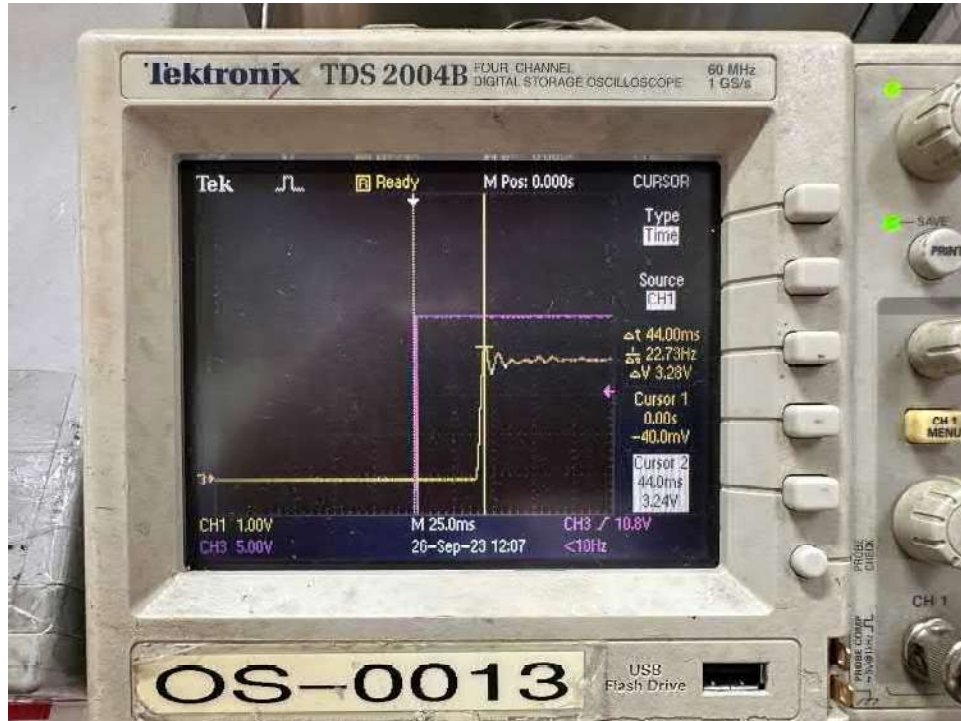
View of the inbound filter patch showing evidence of particulate FOD (deemed irrelevant in this case) from the aircraft hydraulic system upon which the component was installed.



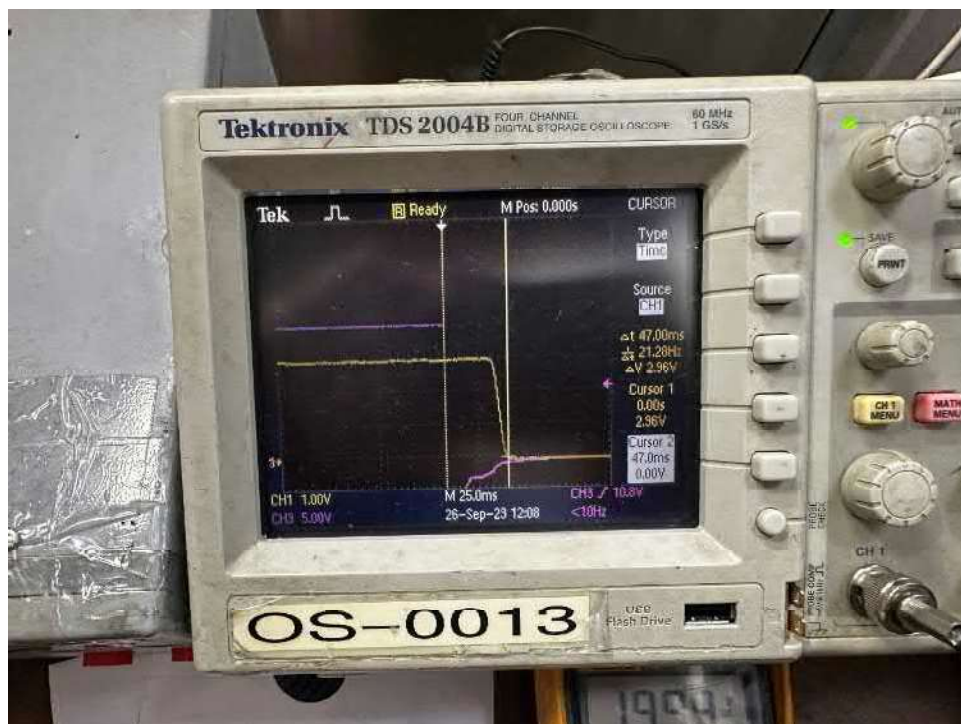
View of oscilloscope screen during performance of the timing tests for actuation/deactuation.



View of oscilloscope screen during performance of the timing tests for actuation/deactuation.



View of oscilloscope screen during performance of the timing tests for actuation/deactuation.



View of oscilloscope screen during performance of the timing tests for actuation/deactuation.

Appendix B – ATP Data Sheets

INBOUND RPO ATP DATA			
PREPARED BY R. VanNimwegen	8575 HELMS RANCHO CUCAMONGA, CA 91730-4588	PAGE 10 OF 11	
DATE 11-08-91	ACCEPTANCE TEST PROCEDURE		REV. DATE
TEST DATA SHEET PNEUDRAULICS, INC. MODEL 4065-1, S/N <u>983</u>			
REF. PARA.	TEST TITLE	TOLERANCE	TEST DATA
2.0	Examination of Product	.97 lbs maximum Conforms to 4065-1, Rev. <u>NC</u>	<u>0.87</u> lbs. (Yes) <u>✓</u>
4.1	Dielectric Strength 1500 volts RMS AC	No arcing or current drain exceeding 1 milliamp	<u>NOT RUN</u>
4.2	Proof Pressure a) "CYLINDER" 4725 PSI b) "CYLINDER" 2 PSI c) "PRESSURE" 4725 PSI d) "PRESSURE" 2 PSI e) "RETURN" 4725 PSI f) "RETURN" 2 PSI	No external leakage or deformation	a) <u>PASS</u> b) <u>PASS</u> c) <u>PASS</u> d) <u>PASS</u> e) <u>PASS</u> f) <u>PASS</u>
4.3	Functional Test a) de-energized b) energized	Substantiate function with low flow	a) <u>PASS</u> b) <u>PASS</u>
4.4	Internal leakage a) de-energized b) energized	Leakage shall not exceed 10 cc per minute	a) <u>0.7</u> b) <u>3.4</u>
4.5	Operational Test a) De-energized at 3000 PSI b) Energized at 3000 PSI c) De-energized at 10 PSI d) Energized at 10 PSI	"CYLINDER" Port at 3000 PSI	a) <u>3000</u> b) <u>3000</u> c) <u>10</u> d) <u>10</u>
CODE IDENT. NO. 06177			ATP 4065-1

prtd. 09/25/2023. Verify current revision on CRADL prior to use.

INBOUND RPO ATP DATA

PREPARED BY R. VanNimwegen	PneuDraulics, Inc 8575 HELMS RANCHO CUCAMONGA, CA 91730-4591	PAGE 11 OF 11	
DATE 11-08-91	ACCEPTANCE TEST PROCEDURE	REV. B DATE 06-05-97	
TEST DATA SHEET			
PNEUDRAULICS, INC. MODEL 4065-1, S/N <u>983</u>			
REF. PARA.	TEST TITLE	TOLERANCE	TEST DATA
4.6	Flow Surge a) Energized at 3000 PSI b) De-energized at 2000 PSI c) De-energized at 3000 PSI d) De-energized at 4000 PSI	There shall be no indication of chatter or squeal.	a) <u>PASS</u> b) <u>PASS</u> c) <u>PASS</u> d) <u>PASS</u>
4.7	Insulation Resistance 500 Volts DC	There shall not be less than <u>500 megohms</u> .	<u>7 MEGOHMS</u> *
4.8	Low Voltage Operation a) De-energized at 3000 PSI b) Energized at 3000 PSI c) De-energized at 10 PSI d) Energized at 10 PSI	"CYLINDER" Port at 3000 PSI	a) <u>3000</u> b) <u>3000</u> c) <u>10</u> d) <u>10</u>
4.9	Actuation/De-actuation Time a) Actuation b) De-actuation	80 Milliseconds (maximum)	a) <u>44</u> b) <u>47</u>
4.10	Electrical Bonding	2.5 milliohms	<u>2.11</u> MILLIOHMS
Ambient Temperature <u>70</u> °F			
Fluid Temperature <u>80</u> °F			
WITNESSED: <u>FAILS</u> <u>4.7, INSULATION</u> <u>RESISTANCE.</u>			
2732 Responsible Test Technician <u>9-26-23</u> Date [Redacted] 9/28/23 PneuDraulics, Inc. Quality Control			
TEST STAND # <u>67</u>		CAGE CODE 06177	ATP 4065-1

INBOUND RPO ATP DATA

PREPARED BY	PneuDraulics, Inc				PAGE 1 of 1	
DATE	TITLE Test Equipment Log				REV	DATE
PN: 4065-1 SN: 983						
TEST PERFORMED: ATP						
TEST TECH: <u>2732</u>						
EQUIPMENT NOMENCLATURE	MANUFACTURER	MODEL	SERIAL NUMBER	LAST CALIBRATION DATE	CALIBRATION DUE DATE	
Pressure Gauge	Permecal	5000 PSI	8899	6/12/23	12/12/23	
Pressure Gauge	Permecal	5000 PSI	8828	4/17/23	10/17/23	
Pressure Gauge	Permecal	5000 PSI	8885	4/24/23	10/24/23	
Pressure Gauge	Permecal	300 PSI	8842	6/12/23	12/12/23	
Graduated Cylinder	PMP	10 mL	B-0384	3/29/23	3/29/24	
Thermometer	Omega	HH378	TH-0210	1/5/23	1/5/24	
Flow Meter	AW-Lake	0.2-7 GPM	F-71768	11/9/22	11/9/23	
Weight Scale	Pennsylvania	7500	296910	4/10/23	10/10/23	
Stopwatch	Jumbo Digit	0-60 +/- 1sec/5min	SW-615	10/14/22	10/14/23	
Multimeter	Fluke	115	MM-0036	10/22/22	10/22/23	
HIPOT	VITREK	V73	019685	8/3/23	8/3/24	
Oscilloscope	Tektronix	TDS 2004B	OS-0013	8/3/23	8/3/24	
Pressure Transducer Interface Box	PneuDraulics	TB013	T-0039	4/6/23	4/6/24	
Micro-Ohmmeter	AEMC	5600	15775	10/20/22	10/20/23	
Pressure Transducer	GP:50	5000 PSI	PT-0228	3/8/23	3/8/24	
Pressure Gauge	Permecal	100 PSI	8837	4/17/23	10/17/23	
Pressure Gauge	Permecal	100 PSI	8921	6/5/23	12/5/23	
CAGE CODE 06177			A			



**FAA Safran Investigation: Off-Runway Excursion (Houston May 11 2022).
Site Visit 09.27.2023 to Sensata for witness of RVDT GM10320 (SN 3091) testing.**

1461 Lawrence Drive.
Thousand Oaks, Ca 91320
805.716.0393
www.sensata.com

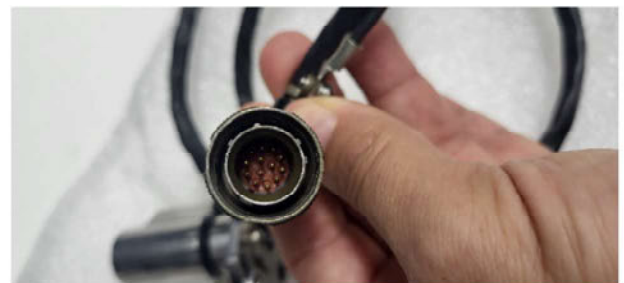
Participants in the visit:

- **FAA:** Yvonne Huynh
- **Sensata/Kavlico:** Dimitri Van Velzen, Steve Szekely, Zach Beal, William Vasquez, Maria Hernandez, Rosalva Sanchez, Kevin Williams, Parminder Kaur, Rigo Lemus-Rabin
- **SkyWest Airlines:** Bryan Peacock, Maurice Montgomery
- **Safran Landing Systems:** Zi Chen, Bogdan Pantelimon

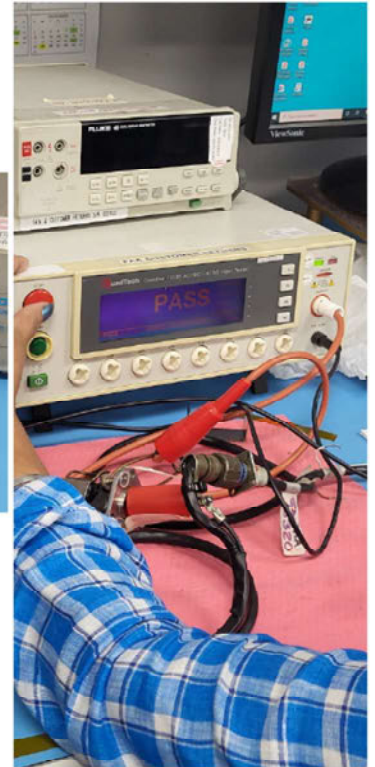
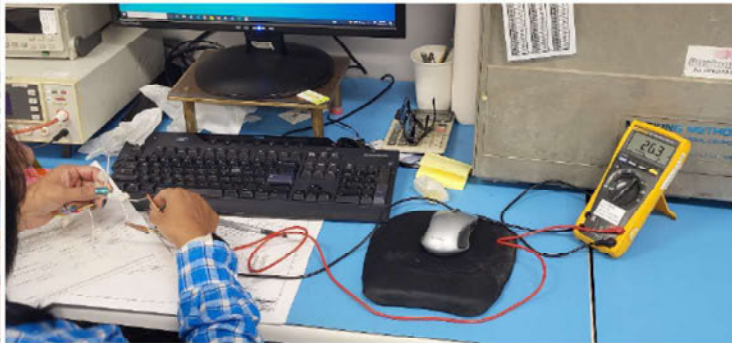
Timeline:

- **9:15am:** Introductions in the FAA Repair Station.
- **9:20am:** Maria opens package for review of unit and corresponding paperwork (typical incoming process). Confirms serial number, part number, mfg date, return history, flight hours and initial review of the unit to ensure no damage or excess visible wear of concern. Information is populated into ERP system recording the transaction into Sensata system and generating internal documents.
- **9:30am:** Initiation of incoming testing process. Parminder performed Dielectric Strength and Insulation Resistance testing with acceptable results (see attached test data sheet and images).
- **9:45am:** Continuation of incoming testing process. Rigo performed remaining testing functions (Phasing, mechanical null position, input and output impedance, phase shift, recorded Channel A/B output voltage ratios and null difference) as per ATP all with acceptable results (see attached test data sheet, graph and images).
- **10:10am:** Completion of testing.
- **10:20am:** Post witness discussion/de-brief and visitors exited repair station.

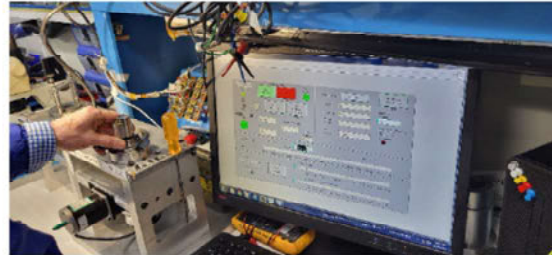
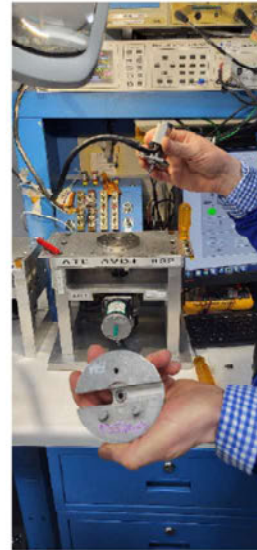
Images captured throughout timeline: Close up of part marking, overall condition.



Images captured throughout timeline: Showing hook up/equipment for Dielectric Strength and Insulation Resistance tests with “Pass” visible.



Images captured throughout timeline: Showing hook up/equipment for remaining testing functions per ATP (Phasing, mechanical null position, input and output impedance, phase shift, recorded Channel A/B output voltage ratios and null difference)



Test Data:

ATE 32Rev. 0.5 EXE

KAVLICO CORPORATION
TRANSDUCER, ROTARY
KAVLICO P/N OM10320
MESSIER-DOWTY P/N 10740-105
TEST DATA

PAGE 1 OF 2
TD10320 REV. B
DATE: 07/09/2001
ATE10320 REV. B
REV: A
REV: A
DATE: 09-27/2023

S/N 3091

EXAMINATION OF PRODUCT: _____ WEIGHT: _____ oz. (12.32 oz max)

TEST LOAD: 100 K Ω across each secondary half (each channel).

EXCITATION: 7 V_{out} @ 3200 Hertz (both channels).

DIELECTRIC STRENGTH: 550 V_{out} @ 60 Hertz between windings and case for 1 minute. PASS ☒ FAIL ☐

INSULATION RESISTANCE: 100 Megohms minimum @ 500 V_{DC} between windings and between windings & case for 1 minute each. PASS ☒ FAIL ☐

PHASING:

CHANNEL A: WITH PIN 4 COMMON WITH 8, PINS 3 & 9 SHALL BE IN PHASE WITH PIN 1 OVER THE ENTIRE RANGE. THE VOLTAGE BETWEEN PINS 3 & 4 SHALL INCREASE WHEN THE SHAFT IS TURNED CW.
CHANNEL B: WITH PIN 5 COMMON WITH 7, PINS 6 & 10 SHALL BE IN PHASE WITH PIN 6 OVER THE ENTIRE RANGE. THE VOLTAGE BETWEEN PINS 6 & 8 SHALL INCREASE WHEN THE SHAFT IS TURNED CW.

PASS ☒ FAIL ☐

MECHANICAL NULL POSITION (Channel "A"):

V_A/V_E .0316 V_B/V_E .3309 (V_A-V_B)/(V_A+V_B) .0011 Angle 0.97 ° (±2° MAX.)

	CHANNEL A	CHANNEL B	MIN	MAX
INPUT IMPEDANCE: (10 ⁶ Ω)	51.6 Ω	57.3 Ω	450 Ω	588 Ω
OUTPUT IMPEDANCE: (V _A @ 40° CW)	37 Ω	37 Ω	30 Ω	50 Ω
(V _B @ 40° CCW)	37 Ω	38 Ω	30 Ω	50 Ω
PHASE SHIFT: (V _B @ 40° CW)	0.1 °	4.0 °	-6°	8°
(V _A @ 40° CCW)	0.1 °	0 °	-8°	8°

TESTED BY: _____

THESE COMMODITIES, TECHNOLOGY OR SOFTWARE IF EXPORTED FROM THE UNITED STATES MUST BE IN ACCORDANCE WITH THE EXPORT ADMINISTRATION REGULATIONS. DIVERSION CONTRARY TO U.S. LAW IS PROHIBITED.

KAVLICO CORPORATION
TRANSDUCER, ROTARY
KAVLICO P/N OM10320
MESSIER-DOWTY P/N 10740-105
TEST DATA

PAGE 2 OF 2
TD10320 REV. B
DATE: 07/09/2001
ATE10320 REV. B
REV: F
REV: A

S/N 3091

DATE: 9/27/2023

CHANNEL A OUTPUT VOLTAGE RATIO (In-Phase)					
ANGULAR POSITION (Degrees)	V _A /V _E	V _B /V _E	* (V _A +V _B)/V _E	(V _A -V _B)/(V _A +V _B)	(V _A -V _B)/(V _A +V _B) Limits
					Min Nom Max
CW					
40	.5322	.1295	.6617	.0066	.6026 .6086 .6146
30	.4836	.1790	.6628	.4522	.4505 .4565 .4625
20	.4326	.2208	.6624	.3062	.2983 .3043 .3103
10	.3816	.2808	.6624	.1522	.1462 .1522 .1582
0	.3312	.3313	.6625	.0062	.0060 .0060 .0060
-10	.2809	.3815	.6624	-.1519	-.1582 -.1522 -.1462
-20	.2299	.4323	.6622	-.3056	-.3103 -.3043 -.2983
-30	.1789	.4831	.6620	-.4595	-.4625 -.4565 -.4505
-40	.1293	.5323	.6616	-.6091	-.6146 -.6086 -.6026
CCW					

CHANNEL B OUTPUT VOLTAGE RATIO (In-Phase)					
ANGULAR POSITION (Degrees)	V _A /V _E	V _B /V _E	* (V _A +V _B)/V _E	(V _A -V _B)/(V _A +V _B)	(V _A -V _B)/(V _A +V _B) Limits
					Min Nom Max
CW					
40	.5338	.1203	.6631	.6100	.5995 .6086 .6177
30	.4836	.1798	.6634	.4570	.4474 .4565 .4656
20	.4335	.2302	.6637	.3063	.2952 .3043 .3134
10	.3830	.2808	.6638	.1540	.1431 .1522 .1613
0	.3324	.3315	.6639	.0014	.0001 .0000 .0001
-10	.2817	.3821	.6638	-.1513	-.1613 -.1522 -.1431
-20	.2306	.4328	.6637	-.3042	-.3134 -.3043 -.2952
-30	.1800	.4834	.6634	-.4573	-.4656 -.4565 -.4474
-40	.1286	.5341	.6638	-.6113	-.6177 -.6086 -.5995
CCW					

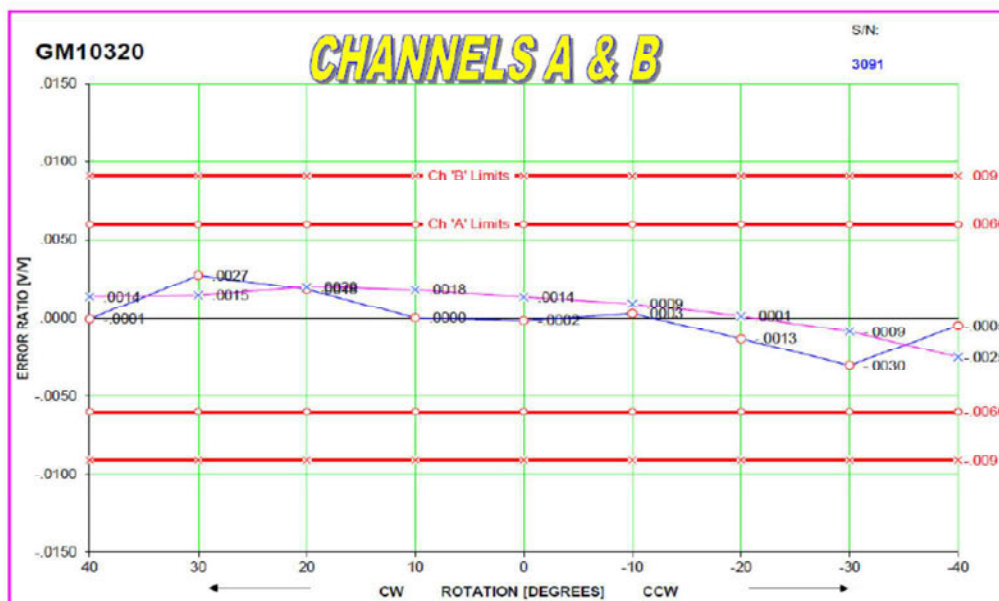
NULL DIFFERENCE = .0015 v/v (.0030 v/v max)

* (V_A+V_B)/V_E limits { .0340 v/v min
.7097 v/v max

TESTED BY: _____

THESE COMMODITIES, TECHNOLOGY OR SOFTWARE IF EXPORTED FROM THE UNITED STATES MUST BE IN ACCORDANCE WITH THE EXPORT ADMINISTRATION REGULATIONS. DIVERSION CONTRARY TO U.S. LAW IS PROHIBITED.

Test Data: Continued..



INCOM TD GM10320 SN 3091 9/29/2023 9:50 AM

Repair Station Formal Quote/Findings Detail:



FAA REPAIR STATION

Customer Name: SAFRAN LANDING SYSTEMS CANADA
Bill To: 20597
NCR:
Ship To: 20598
Claim PO#: TBD

Page: 1 of 1
Date Entered: 06/22/2023
Case: 29907
RMA #: A151250
PO Number: 1034563
Print Date: 9/27/2023

SO#: **Work Order:**

APPROVED
By A1043018 at 9:50 am, Sep 28, 2023

Rejection Code: No Fault Found
Customer Failure Data: S/N:3091 MFG:UNK
REASON FOR RETURN: INVESTIGATION WITH SLS AND KAVLICO

PO / Customer Paperwork
Reviewed - A1043018

Analysis Code: Passed ATP / DC MEG
Analysis Information: RECEIVED IN WITH MINOR SCRATCHES ON HOUSING AND FLANGE AREA.
BACK SHELL AND CONNECTOR HAVE SCRATCHES.
UNIT PASSED THE TEST ATP10320 REV. B, AND GM10320 REV. E,
WITHOUT FINDING ANY FAULTS.

Repair Code: Re-Test Only
Resolution Information: CLEAN, REPLACE MOUNTING HARDWARE, RE-TEST AND CERTIFY COMPLIES
WITH GM10320 REV: E, AND ATP10320 REV: B

Kavlico Part Number	Description	Serial NO./Date Received	Quantity
GM10320R	DUAL RVDT	3091/09272023	1
Total Received:			1

This document was prepared and approved by:

- **Repair Station Manager: Zach Beal**  _____