



6650 Bingle Road
Houston, Texas 77092

September 15, 2010

To Whom It May Concern:
From: Brandy N. Jones, Manufacturing Engineering.

Please review findings in the attached document regarding FPR # 226314 and solenoid part number 223290-63.

Executive Summary:

FPR # 226314:

Description Of Failure:

"DURING PILOT LINE TESTING OF THE PODS, WE HAD A STRONG PULSATION OF THE PILOT LINE PRESSURE ON NINE FUNCTIONS. WE REPLACED THE ASSOCIATED SOLENOID VALVES AND THE PULSATION WENT AWAY. UPON FURTHER BENCH TESTING OF THE FAULTY SOLENOID VALVES A DISTINCT PULSING SOUND COULD BE HEARD FROM INSIDE THE VALVE. THERE 9 VALVES IN TOTAL 8 OFF THE YELLOW MUX SECTION, AND ONE OFF THE BLUE MUX SECTION"

Actions Taken:

1. Blue and Yellow Pod's arrived to Bingle Facility. All solenoids were unplugged from their pie connectors.
2. Identified 23 solenoid valves from a comparison of original setouts to the current MUX.
3. In an effort to determine which solenoids were pulsating on the rig we performed the following tests using test procedure X-065393-05:
 - A. Electrical: Resistance Test
 - B. Electrical: Insulation Test
 - C. Electrical: Function Test: (Pull-in Voltage, & Drop Out Voltage)
 - D. Hydraulic Function Test with Single Activated Coil, with Both Activated Coils
4. After performing tests A- D, the coil termination points were inspected.
5. Additional verification tests performed.
6. Presented results to customer.
7. Engineering recommendations to Rig.

Summary Test/Inspection Results:

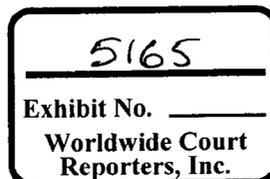
See appendix for a summary chart of test/inspection results.

- A. Electrical: Resistance Test
- B. Electrical: Insulation Test : **1 Failure**
- C. Electrical: Function Test: (Pull-in Voltage, & Drop Out Voltage): **1 Failure**
- D. Hydraulic Function Test with Single Activated Coil, Both Activated Coils: **11 Passed, 12 Failed**

Coil Termination Points Inspection:

- 7 of the nineteen solenoids had wires crossed, reversed polarity, on coil B pins 3 and 4. Specifically, the white wire was soldered to 4 and the black wire soldered to 3.
- 6 of the seven solenoids with reversed polarity failed the leak test.
- F.A.T. results show "no pressure signal" when both coils were energized, however performed properly with a single activated coil
- Only 1 of the two solenoids that failed the electrical test had reversed polarity.

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Additional Notes:

- 4 of the twenty-three identified solenoids were plugged into the original # 11 pie connector, which were identified using solenoid location and the pie chart. These e-connectors were snipped off and sent to Seacon for analysis. A leak test was performed on these prior, but not a coil termination inspection. Pie connector # 11 was also sent to Seacon. Seacon is going to perform an analysis for reason of failure possibly due to the overuse of grease on the wrong area. **Results from Seacon are pending.**
- The remaining (19) solenoids were tested and their coil termination points inspected.
- Further tear down of the failed valves without the reverse polarity was not requested.

In an effort to prove the affect of a solenoid with reverse polarity between the two coils on its function the following actions were taken:

1. Pulled a new solenoid from stock.
2. Reversed the polarity on coil B switching wires 3 and 4. Specifically, the white wire was soldered to pin 4 and the black wire soldered to pin 3.
3. Performed hydraulic function test with Single Activated coil. Both Coil A and Coil B functioned properly.
4. Performed hydraulic function test with both coils activated. Result: Pressure dropped to 0 psig after 2 seconds of holding pressure. Solenoid was in a "locked" position with 0 psig.

The above test proves reverse polarity between coil A and coil B results in two different magnetic fields which cancel each other out.

In order to simulate field conditions and the affects of a solenoid with reverse polarity, we hooked the solenoid up to a Mark II SEM with the following results:

Results:

Coil A Activated: Good

Coil B Activated: Good

Coil A and B Activated: The pulsating sound reported in the field was heard. Pull in and drop out voltage switching quickly.

Conclusion:

It is evident that reverse polarity between Coil A and Coil B in a 223290-63 solenoid valve will not allow it to properly function with both coils energized. Reversing the polarity creates opposing magnetic fields with a canceling affect. It is vital to check function with both coils activated. This step is in the solenoid test procedure X-065393-05, and was in the procedure during the assembly and testing time of the solenoids on the DrillMax 2 Spare Pods. In addition, the power saving software installed on the SEM plays a vital role in producing the pulsation in a solenoid with reverse polarity. It is possible this did not show up on our valve test stand at first pass because those solenoids are fed a constant 24V.

Corrective Action:

Solenoid valves, 223290-63, are sold individually as spares and also as part of an upper level. Therefore, the most appropriate corrective action is to identify any solenoid failures or reversed polarity while the valve is still in production, prior to shipping or POD F.A.T. After reviewing the assembly and test procedure, X-065393-05 for Cameron solenoid valves an ESR, engineering service request, will be sent to engineering requesting the changes below.

1. Section 6.2: Function Test with Both Activated Coils, and Section 6.3 Function Test with One Activated Coil, do not have an attached appendix chart to record results on. A request will be made to add in appendix for the testers to record and review their results.
2. Section 6.2: Function Test with Both Activated Coils should have instructions to watch for a drop in pressure to 0 PSI. If this happens, it is likely that the solenoid has reversed polarity so the coil termination points should be checked.

The changes requested will make the valve room technicians more aware of the importance of coil polarity.

Interim Instructions to the Rig:

These instructions were sent to the rig for an interim testing solution.

September 10, 2010

Subject: Field Solenoid Valve Test

Reference:

Cameron doc: SK-122178-62 Pie connector chart

This procedure is to verify correct operations of solenoid coils for each function.

Both coils "A", and "B" for each function must be operated together to determine correct operation.

Steps:

1. Remove power from pods
2. Open up bleeder ports, and disconnect hoses from direct pilot functions.
3. Turn power back on to ALL SEMS (Blue A, Blue B, Yellow A & Yellow B)
4. Perform function tests for both pods using SK-122178-62 Pie connector chart.
5. Allow function to stay in the energized state for a minimum of 30 seconds.
6. Vent each function after the 30 second hold before going to next function.

NOTE: While firing each Pod function observe that a steady stream of hydraulic fluid flows from each bleeder port. There should be NO oscillations or pulsing of solenoids.

Close bleeder ports, and reconnect direct pilot hoses after each function has been verified.

1. Switch to opposite POD, and perform the above steps.

Jason Van Lue
Manager Field Service
Cameron Drilling Systems

Appendix

A. Summary Chart of Test Results

Serial Number	Leak Test	Electrical Test	Coil Termination Pt. Inspection
110996852-05	No connection to perform test	Pass	Wires # 3 and #4 are crossed otherwise good condition.
110844930-95	Pass	Failed	Hydraulic fluid ingress into the valve. Corrosion on pin #1 and pin # 3
110844930-48	Pass	Pass	Crushed and exposed wire on pin #4 Appears it was smashed between the body and end cap
110996652-04	Fail	Pass	E-connector sent to Seacon
110844930-106	Pass	Pass	Good termination point
110996852-01	Failed	Pass	Wires # 3 and #4 are crossed otherwise good condition. Outlet flange placed incorrectly (didn't sit down all the way). Cap screws are missing. "Pulsation" written on top of valve by rig.
110996652-03	Failed. No pressure signal with both coils activated. Single good.	Pass	Pin # 3 and 4 have reversed polarity
110996852-06	Failed. No pressure signal with both coils activated. Single good.	Pass	Pin # 3 and #4 are reversed.
110996652-07	Fail	Pass	Pin # 3 and #4 are reversed.
110996852-44	Pass	Pass	Good condition
110996852-02	Failed. No pressure signal with both coils activated. Single good.	Pass	Pin #2 has exposed wire due to not being in the pin hole all the way. Wires 3 and 4 were swapped. Arching/short near pin number # 1
110913506-17	Fail	Failed	Pin # 3 and #4 have reversed polarity
110996852-78	Pass	Pass	Good condition.
110996852-72	Pass	Pass	Physical damage to wires 3 and 4. Crushed and pinched but not exposed.
110857410-21	Fail	Pass	Good condition
110996852-09	Fail	Pass	E-connector sent to Seacon
110996852-68	Pass	Pass	E-connector sent to Seacon
111578161-04	Pass	Pass	E-connector sent to Seacon
111611130-02	Pass	Pass	Good condition
111578161-06	Fail	Pass	Discoloration around pin #1
111578161-05	Fail	Pass	Good condition
111611130-01	Pass	Pass	Small not deep arching near pin # 3. Otherwise good condition
110996852-75	Pass	Pass	Good condition. No signs of arching

B. Hydraulic F.A.T Results

* Bad valves denoted with a letter "S" indicates a valve with a switched polarity.

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Appendix 2 - Returned Goods Report (Continued)

Hydraulic Pressure Tests							
Description							
No.	Actual Press. (Test)	Hold Time	Actual Press. (Leak Test)	Hold Time	Leak Rate (Energy) in (mL/s min)	Leak Rate (Energy) in (mL/s min)	Pass/Fail
1	✓ 110996852-68	✓	3,000 PSI	5 MIN	✓	✓	✓
2	✓ 11578161-07	✓	3,000 PSI	5 MIN	✓	✓	✓
3	✓ 110844730-75	✓			0.1	0.1	✓
4	✓ 110844730-78	✓			0	0	✓
5	✓ 110996852-75	✓			0.0	0.1	✓
6	✓ 11161130-01	✓			0	0	✓
7	11161130-02						
8	✓ 11161130-02	✓	3,000 PSI	5 MIN	0.1	0.1	✓
9	✓ 110996852-72	✓	"	"	0.1	0.1	✓
10	✓ 110844730-106	✓	"	"	0.4	0.1	✓
11	✓ 110996852-44	✓	"	"	0.1	0	✓
12	✓ 11578161-06	✓	3,000	5 MIN	2.4 ml	0.6	✓
13	✓ 110996852-07	✓	3,000		Good	Good	✓
14	✓ 11085740-21	✓	3,000		0.7	1.5 ml	✓
15	✓ 11578161-05	✓	3,000		0.9	1.3	✓
16	✓ 11085740-21	✓	3,000		LEAK AFTER FUNCTION		✓
17	✓ 110996852-08	✓	3,000		Good	Good	✓
18	✓ 110996852-06	✓	3,000		Good	Good	✓
19	✓ 110996852-01	✓	3,000		NO LET FLANGE PLATE UNCORRECTLY		✓
20	✓ 110996852-05	✓	3,000		NO CONNECTION TO PERFORM TEST		✓
21	✓ 110996852-07	✓	3,000		Good	Good	✓
22	✓ 110913506-17	✓	3,000		BAD	BAD	N
23	✓ 110996852-04	✓	3,000 PSI		BAD	BAD	N
24	✓ 110996852-07	✓	3,000 PSI		Good	Good	BAD

Remarks: W = Water and Glycol, N = Nitrogen, L = Air, Pressure Recorder Chart attached

Inspector: _____ Date: _____ T.P.I.: _____

Handwritten notes: GOOD (vertical), BAD (vertical), NO PRESSURE SIGNAL (horizontal), NOT SIGNAL (horizontal), NOT SIGNAL BOTH ACTIVATED COILS (horizontal), NOT SIGNAL BOTH ACTIVATED COILS (horizontal), NOT POSSIBLE TO PERFORM TEST (horizontal), NOT POSSIBLE TO PERFORM TEST (horizontal).

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C. Electrical Test Results

 CAMERON	Revised By J. Reading	REVISION 07	X-065393-05
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12. Appendix 2 - Test Protocols

Hydraulic Pressure Tests		
Cameron Order No.	Customer No.	Shop Order No.
Total Quantity	Test Quantity	Test Location
Description		

No.	CAM Part No.	Serial No.	Actual Press. (Hydro. Test)	Hold Time	Pressure Loss (Hydro. Test)	Pass? (Y/N)
1		110996852-68				
2		111578161-04				
3		110996852-07				
4		111578161-06				
5		11161130-02				
6		110913586-17				
7		110996852-44				
8		110996852-78				
9		111578161-05				
10		110996852-72				
11		110996852-06				
12		110996852-08				
13		110996852-07				
14		110996852-01				
15		110844930-106				
16		110996852-04				
17		11161130-01				
18		110996852-02				
19		110844930-95				
20		110844930-48				
21		110996852-75				
22		110857410-21				
23						
24						

Remarks: W = Water and Glycol H = Nitrogen L = Air	Pressure Recorder Characteristics?
Inspector	Date
	T.P.I.

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Appendix 2 - Test Protocols (Continued)

Electrical Tests <i>Sec. 05</i>		
Cameron Order No. <i>400276664</i>	Customer No. <i>400276664</i>	Shop Order No. <i>400276664</i>
Test Quantity:	Test Quantity:	Test Location: <i>Single 5009</i>
Description: <i>1/4" Solenoid Valve</i>		

No.	Resistance (Coil A)	Resistance (Coil B)	Temp (°F)	Insulation Resistance (Coil A & Body)		Insulation Resistance (Coil B & Body)		Insulation Resistance (Coil A & Coil B)		Pass/F (Y/N)
				Sec. 4.3	Sec. 5	Sec. 4.3	Sec. 5	Sec. 4.3	Sec. 5	
	40.00	40.50		999	999	999	999	220		
	40.3	40.3		316		299		140		
	39.3	40.0		999		999		203		
	39.8	40.2		194		5.48		214		
	39.7	40.0		999		999		301		
	39.5	40.2		999		999		221		
	40.2	39.6		999		999		215		
	40.2	39.6		999		999		216		
	40.2	40.1		811		786		177		
	40.4	39.6		999		999		110		
	39.3	40.2		999		999		209		
	40.1	39.5		999		999		219		
	39.3	39.7		999		999		210		
	39.6	39.9		999		999		80.3		
	40.2	39.6		999		999		241		
	40.1	39.5		999		999		230		
	40.0	39.8		999		999		207		
	40.0	39.5		999		999		224		
	40.1	39.7		0		0		0		
	39.5	40.2		999		999		178		
	39.5	40.2		881		937		214		
	39.6	41.1		999		999		201		

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Appendix 2 - Test Protocols (Continued)

Electrical Tests (Continued) Sec 05 400276664
Description 1/4" Solenoid Valve

No.	Coil A Current	Coil B Current	Pass? (V/N)	Pull-In Voltage (Coil A)	Pull-In Voltage (Coil B)	Pass? (V/N)	Drop Out Voltage (Coil A)	Drop Out Voltage (Coil B)
567	567	564		15.0	15.2		1.4	1.4
565	564	564		15.1	15.7		2.1	2.1
577	569	569		14.6	15.4		1.7	1.7
568	563	563		14.7	14.7		2.1	2.1
568	564	564		14.9	15.1		1.7	1.8
576	566	566		0	0		0	0
567	575	575		14.4	14.1		1.3	1.3
565	574	574		16.5	16.2		1.5	1.6
565	566	566		14.5	14.4		1.9	1.8
564	574	574		15.9	15.6		1.4	1.4
580	566	566		13.5	13.8		1.8	1.7
568	575	575		15.1	15.1		1.5	1.6
576	571	571		14.1	14.1		1.7	1.8
574	570	570		18.8	18.3		1.7	1.8
566	574	574		15.6	15.3		2.2	2.3
565	574	574		14.6	14.0		1.7	1.6
568	572	572		15.2	15.1		1.6	1.8
565	571	571		15.9	15.8		1.2	1.1
569	573	573		16.0	15.9		2.1	2.1
571	561	561		16.3	16.4		1.5	1.6
576	568	568		15.5	15.7		1.9	1.9
561	565	565		16.2	15.8		1.1	1.7

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