

DOCUMENT TITLE: **ACQUITY BSM PUMP AUTOMATED FINAL TEST**

SYSTEM/ASSEMBLY NAME: **ACQUITY BSM PUMP**

PART NUMBER AFFECTED **186015000, 186015001, 800000181, 800000240, 800000372,
186015000IVD, 186015082, 800000486**

TEST EQUIPMENT NAME: **ACQUITY SDS FINAL TEST STATION**

TEST EQUIPMENT NUMBER: **TE82943**

TEST SOFTWARE:



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DATE: **17-Dec-2009**

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EQUIPMENT REQUIRED

Quantity	Part Number	Description
1	TE82943	Acquity SDS Automated Test Station
1	N/A	5/16 open ended wrench
1	N/A	5/8 open ended wrench
1	N/A	1/4 open ended wrench
1	430001150	Tube, 316L, SS, 1/16 OD X .020, 16 Roughness Avg. (roughly 36" required – order as required)

DISPOSABLES REQUIRED

Quantity	Part Number	Description
As Required	N/A	100% Virgin Methanol
As Required	N/A	100% IPA

REFERENCE DOCUMENTATION

Document Number	Description
730000710	Creating and Maintaining Technical Files
WAT000050MP	Waters Record Retention Corporate Policy
WAT046538	GENERIC Electrical Safety Test PROC.
735002528	FLUIDICS DIAGRAM, MICRO PUMPS, M-CLASS
721001454	Functional Spec, BSM 18K
N/A	FSD, Acquity Binary Solvent Manager, Date: July 13, 2004
810000422	PERF SPEC, PCB, VISTA PUMP ROHS
710000422	SCHEM, PCB, VISTA PUMP ROHS
735000830	FLUIDICS DIAGRAM, ACQUITY PUMP
279001320	ASSY, BINARY SOLVENT MANAGER, I2V
279002450	ASSY, BSM, 18K PSI, I-CLASS
279002450IVD	ASSY, BSM, 18K PSI, I-CLASS IVD
N/A	Seal Wash Testing for BSM Pumps Memo V04.doc
N/A	Prime Pump Testing for BSM Pumps Memo V02.doc
N/A	High Pressure Testing for BSM Pumps Memo V03.doc
N/A	VV to Output Testing for BSM Pumps Memo V02.doc
N/A	Static Leak Test Decay Limits 186015001.txt

DEFINITIONS AND ABBREVIATIONS

Term	Definition
AC	Alternating Current
ASP	Assembly Procedure
BSM	Binary Solvent Manager Pump
BSM 18K	Binary Solvent Manager 18K PSI Pump
CM	Contract Manufacturer
FSD	Functional Specification Document
IO	Input Output
IPA	Isopropyl Alcohol
LED	Light Emitting Diode
MeOH	Methanol
PC	Personal Computer
PCI	Peripheral Component Interconnect
PS	Performance Specification
PSC	Product Support Check
PSI	Pound per square inch
SAP	Systems Applications and Products
SDS	Solvent Delivery System
SN	Serial Number
TSP	Test and Specification Procedure
USB	Universal Serial Bus
UUT	Unit Under Test
IVD	In Vitro Diagnostics
TUV	Tunable Ultra Violet (Detector)
CPU	Central Processing Unit

I. The ACQUITY BSM Final Test

The ACQUITY BSM Final Test is performed consecutively on two separate test stations. The first test station provides the initial pretest power-up checks and electrical safety testing. The second station provides all of the remaining functional testing.

II. The Pre-Test Power-up Electrical Safety Test Station

The pretest power-up test station is used to perform an electrical safety test per Waters procedure WAT046538. All Test Units must pass this test in order to move to the Final Test Station.

III. The ACQUITY BSM Automated Final Test Station

The ACQUITY BSM Automated Final Test Station is designed to functionally test the Water's Corporation ACQUITY BSM Pump. Tests include: Software Download, Rear Panel Tests, Prime Pump, Degasser Tests, Static Leak Decay, Flow Rate Accuracy, Manifold to Filter Tubing, Dynamic Leak, Fans, LEDs, IPA Fill and Drain.

The test strategy for this assembly is to test the functions that the unit as a whole must be able to provide.

The internal circuit boards will have been through an In-Circuit and a Functional Test, prior to installing into this assembly. The Check Valves and Vent Valve Assembly will also have been tested and inspected.

The ACQUITY BSM Automated Testing will verify that these assemblies, boards and all other assemblies, when assembled together correctly, will produce the expected performance.

For clarity, please note the following information and equivalent descriptions.

Part Number	Class	Description(s)
186015001	Classic	BSM Classic
186015000	I CLASS	BSM-R, BSM 18K, BSM I CLASS
186015000IVD	I CLASS	BSM IVD, BSM 18K IVD, BSM I CLASS IVD
186015082	I CLASS	BSM 18K PLUS, BSM PLUS

Prior to executing this test procedure on any BSM, the operator must check the Calibration Due label on the AnD Balance and the Preventative Maintenance Due label on the TE82943 test box, to confirm these devices are within their valid date window.

IV. Functional Test System Features

The system uses a PC with added serial ports to communicate with the BSM, the test box TE82943, and the AnD balance. An added Ethernet card to the PC, communicates with the BSM for faster firmware downloading.

TE82943 includes a USB digital IO and an analog input module for rear panel testing. A Valco valve controls the direction of the pump's output flow to either one of three restrictors or a dead end

plug. The restrictors flow to waste or to the AnD analytical balance, for flow rate testing. The BSM seal wash output can be connected to a vacuum pump for priming or diverted to the balance for flow rate testing. TE82943 front panel controls are under 'remote control' when the automated program is running.

The Test is controlled through an Operator Interface Test Program written in LabVIEW.

The Test Program has the following controls:

New Test – this button starts the testing on a newly assembled BSM.

Retest – this button will begin testing at a point determined appropriately close to where the last test run failure occurred.

Stop/Pause – this button, when active, will pause the program at the end of the current test step and prompt the operator with a choice to either stop or continue the testing.

Diagnostics – this button will launch the diagnostics page. In Diagnostics, the operator can select any test and verify the result.

Reprint Report – this button, when active, will send another hard copy of the test record to the printer.

The program will prompt the operator for information as required. Examples of inquiries include: BSM Serial Number, Factory Order Number, Operator Name, Part Number, etc... This will mainly occur during the initial launch of the test sequence.

Once the firmware has been loaded, the test runs without operator interaction, until it is time to pull lines from the MeOH and IPA bottles at the end of the test.

Operator Prompts can be easily identified from a distance by a yellow background popup window.

All data collected is sent to the SigmaQuest server.

V. Test Fixture Setup (Initial)

Connect the monitor, keyboard, and mouse to the PC.

Connect the PC RS232 serial ports, USB, and Ethernet port (PCI card) to the proper locations as shown on page 5 of the TE82943 test box schematic drawing diagram.

Connect the PC "main board" Ethernet port to the Waters assigned facility network.

Connect TE82943 test box AC lines as shown on the schematic drawing. Refer to Appendix 1 Electrical Connections for details.

Connect the fluidic lines from TE82943 test box to the AnD scale and to waste as labeled on TE82943 rear panel. Refer to Appendix 2 Fluidic Connections for details.

Turn on TE82943 via the rear panel AC core module switch.

Turn on the AnD balance via the front panel power button.

Turn on the monitor and PC.

Enter the appropriate Login Name and Password.

Launch the Test Program by double clicking on the icon "TE82943 ACQUITY BSM Final Functional Test.exe".

VI. Test Setup/Connections and Test Procedure with Automated Test Program

1. CONNECTIONS

- 1.1. Connect the “remote controlled” AC line from the rear panel of TE82943 to the rear of the BSM.
- 1.2. Verify that the AC power is off. (Press the BSM front panel switch to off if necessary).
- 1.3. Connect the Ethernet cable from the PC to the rear of the BSM.
- 1.4. Connect the RS232 serial cable from the PC to the BSM.
- 1.5. Connect the two cables with green Phoenix connectors from the TE82943 box to the rear of the BSM. Be sure to connect BLOCK I and BLOCK II to the corresponding connection.
- 1.6. Connect the cable with the 3-pin c-grid connector from the TE82943 box to the BSM front panel Leak Detector connector. (Located just behind the mixer).
- 1.7. Connect the fluidic output from the mixer to the input filter port on the TE82943 front panel using the interface tube part number 430001150.
- 1.8. On the BSM, pull the Seal Wash output line from the drip tray’s barbed fitting. Connect the line to the barbed fitting on the seal wash line input located on the front panel of TE82943.
- 1.9. Connect the large waste tubing to the BSM drip tray barb fitting, located just under the front of the BSM.
- 1.10. Place the BSM A1, B1, and Seal Wash Inlet tubes with sinkers into the MeOH bottle.
- 1.11. Place the BSM A2 and B2 Inlet tubes with sinkers into the IPA bottle.

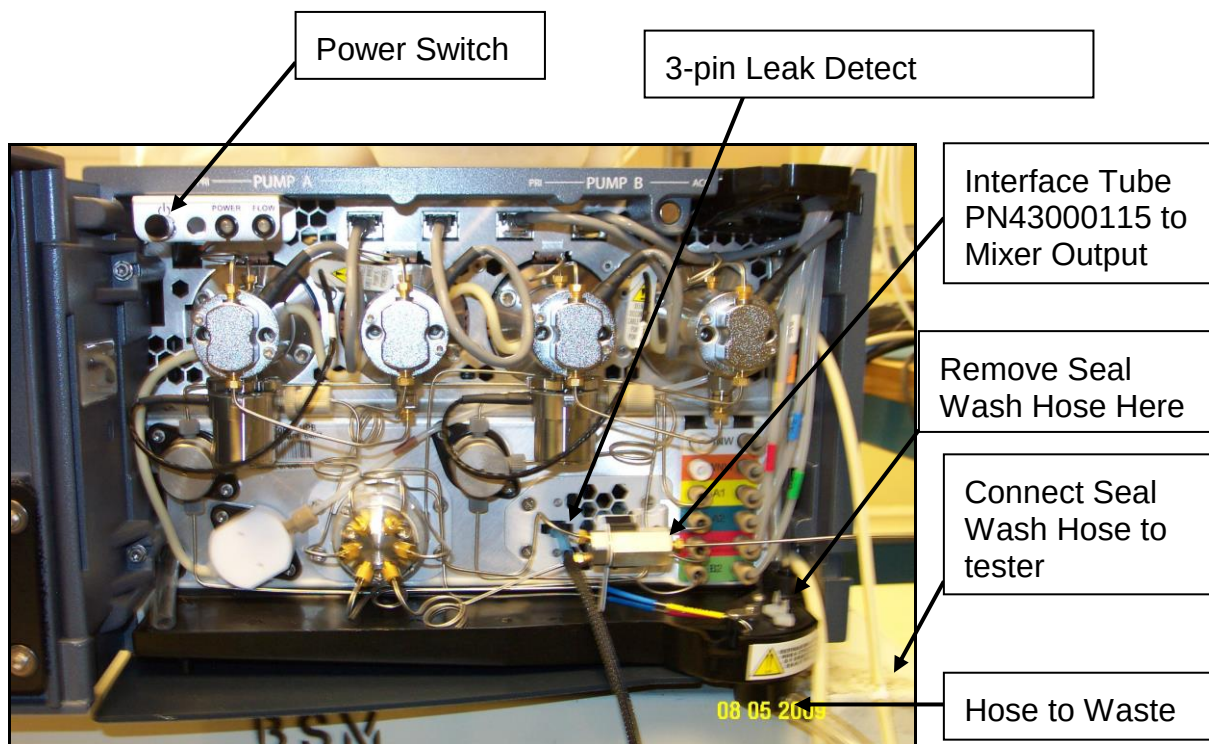
2. TEST PROGRAM

- 2.1. Prepare and install the BSM to the test system following the Test Setup procedure above.
- 2.2. Ensure the test program screen is shown on the PC.
- 2.3. On the Test Program, press the **New Test** button to start the test.
- 2.4. An Input Information window will appear. Enter in all the requested data. The bar code scanner may be used to expedite the data entry. The program will reject any data input that is considered invalid. Press the **OK** button at the end when all data has been entered.
- 2.5. **Note For Repairs Department:** Enter **REPAIR** for the **Operator Name**. This will provide two special options in the test program. First, it will allow any version of firmware to pass. Second, it will prompt the operator if the BSM has Leak Detect Circuitry. If not, in the case of older BSMs, it will skip Leak Detect Testing.
- 2.6. The Test Program will prompt the operator for data entry for the Electrical Safety test. Enter the response necessary.

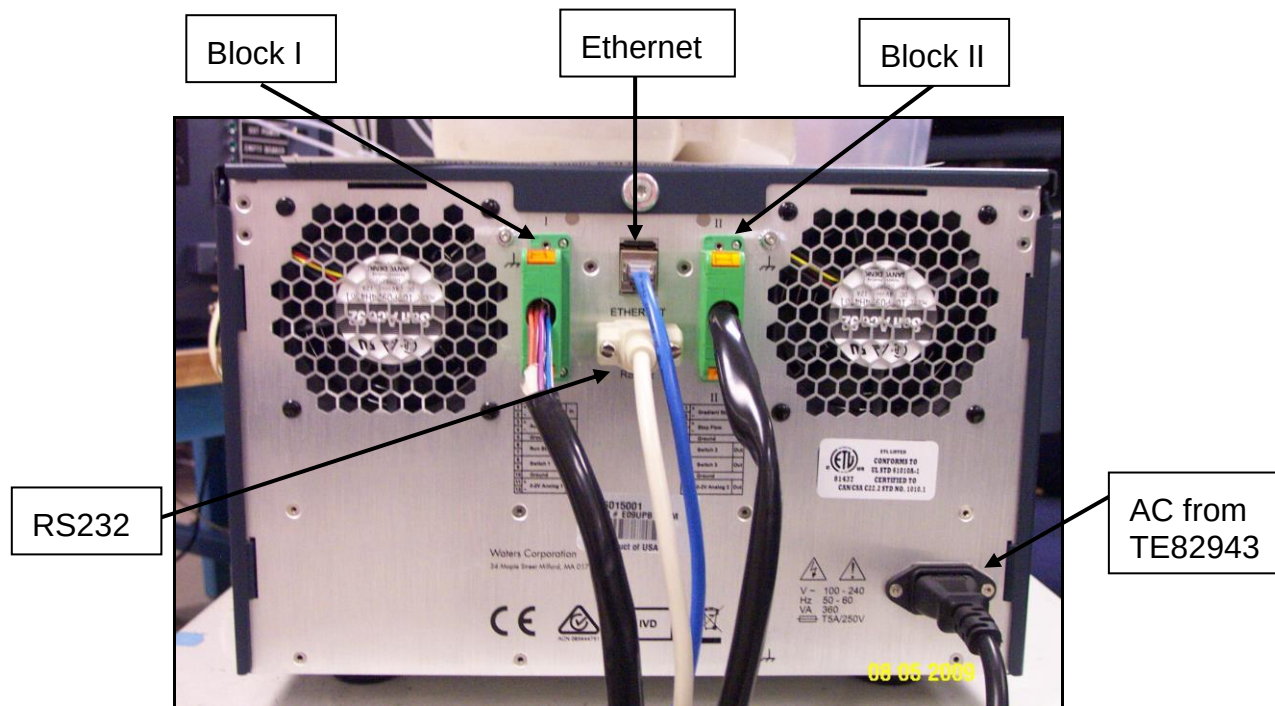
- 2.7. Next, the Test Program will load the latest firmware. Depending on if the BSM has already been loaded or not, the program will prompt the operator to either **Continue** testing or to **Reload** the firmware. Enter the response necessary.
- 2.8. From this point until just before the IPA Prep., the testing can be run unattended.
- 2.9. Any failures can be observed by a yellow popup window prompting the operator for attention.
- 2.10. Enter the response necessary for the popup. (See 2.18 below for operator failure options from here).
- 2.11. The Test Program will prompt the operator for proper operations of the fans. Enter the response necessary.
- 2.12. The Test Program will prompt the operator for proper operations for the Front Panel LEDs. Enter the response necessary.
- 2.13. If the testing is successful, a popup window will now appear at the start of IPA Prep.
- 2.14. The operator will be requested to pull the A1, B1 and Seal Wash lines from the MeOH bottle and to disconnect the interface tube from the mixer. Press **OK** when complete.
- 2.15. The Test Program will continue on until the operator is prompted to pull the A2 and B2 lines from the IPA bottle. Press **OK** when complete.
- 2.16. Once the Test Program completes, a **PASS** window will appear. Press the **OK** button.
- 2.17. Disconnect all electrical and tubing connections from the BSM as referenced in the Test Setup/Connections section above. Test Complete.
- 2.18. In the case of a test failure, the operator has two choices, Diagnostics or Retest.
- 2.19. Diagnostics can be entered by pressing the **Diagnostics** button. The BSM will power up and then a pull down selection will be available to the operator.
- 2.20. This Diagnostic selection can be used as an aid to verify any test the operator chooses to run.
- 2.21. The Diagnostic routine can be exited, repairs made to the BSM, and re-entered again as many times as necessary.
- 2.22. It is recommended that the operator run the failed test in the diagnostics menu and verify a passing result before returning to the testing program.
- 2.23. Note that some repairs, fluidic assembly replacements for example, may require re-priming the BSM before rerunning the failed test. All tests and actions are available in the Diagnostic routine to accommodate the operator's needs.
- 2.24. Once the operator feels the BSM will pass the failed test, the BSM can now be retested. Press the **Retest** button.
- 2.25. The Test Program will power-up the BSM. A popup window will prompt the operator for failure information. From the pull down, select the fail note that most closely corresponds with the repair made to the BSM to correct the failure. Press **OK** to continue.

- 2.26. The Test Program will now pickup in the test sequence at a point appropriate to the place of the last failure. It is usually at the same test, but in some cases may be at a point just before the failure.
- 2.27. Other Test Program features:
- 2.28. If necessary, the Final Test Record that prints at the end of a passing BSM, can be reprinted by pressing the **Reprint Report** button. This button is only active until another BSM is started.
- 2.29. The **Stop/Pause** button on the main Test Program window, when active, can be used to pause the testing at the end of the current test. The operator then has the option to **Continue** with the test or to **Stop** testing.
- 2.30. During some tests, a new window will be present with buttons providing the options of **Abort** or **Stop/Pause at end of test**.
- 2.31. In this case, the **Abort** button will Stop the testing as quickly as it can.
- 2.32. The **Stop/Pause at end of test** button will finish testing the particular test, and then pause. The operator then has the option to **Continue** with the test or to **Stop** testing.
- 2.33. The **Exit** button will exit out of the Test Program.

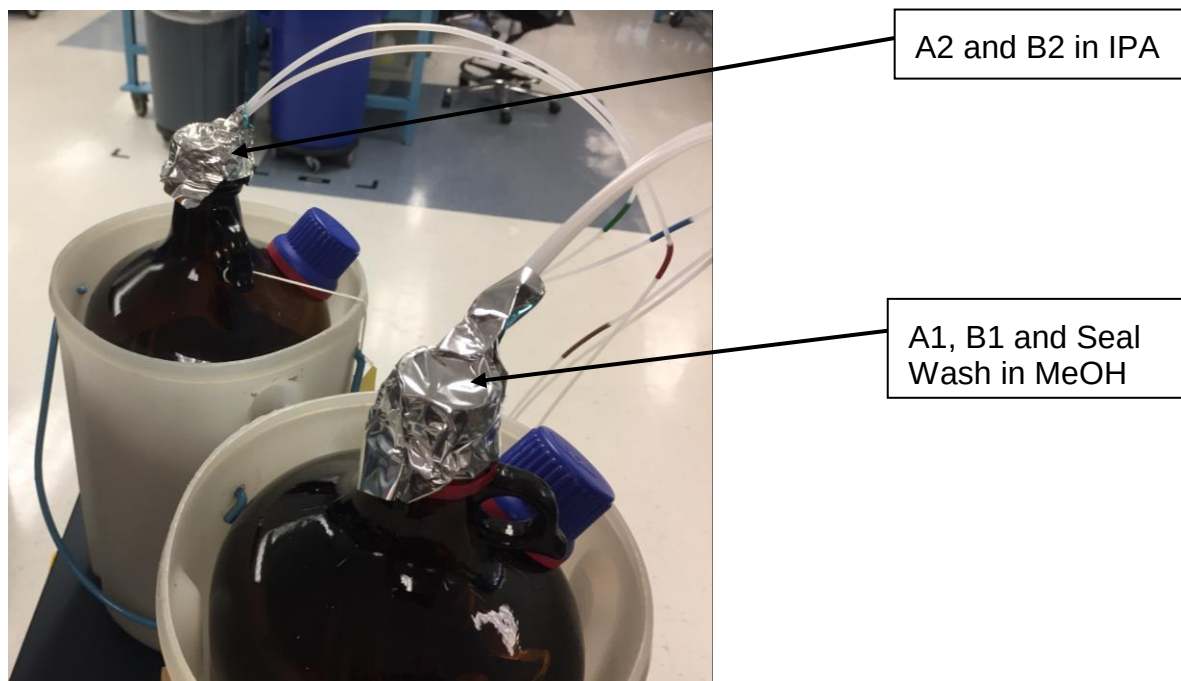
VII. Figures



BSM Front View



BSM Rear View



BSM Input Lines in MeOH and IPA Bottles

Note: 4 liter bottles shown just for fluidic reference

VIII. Test Specifications & Traceability Matrix

Test #			Description of Test	Test		Acceptance Criteria				Reference
Procedure	Report			Operator	Automated Test Fixture	PASS / FAIL	LSL	USL	Unit	FSD, ASP, PS, PSCs, schematics. SAP, etc..
	Classic	I-Class								
			Test Fixture Calibrated and Preventative Maintenance Performed	X		X				1) TSP 735003807 sec.III
										2) TSP 735003807 sec.III
1	1	1	Test Electrical Safety		X	X				1) PSC – Note 1 FSD 13-Jul-2004 sec. 3.7
										2) PSC – Note 1 FSD 721001454 sec. 5.7
2	2	2	Test Loader Download		X	X				1) PSC – Note 1
										2) PSC – Note 1
3	3	3	Test Reboot Firmware for Pump B Download		X	X				1) PSC – Note 1
										2) PSC – Note 1
4	4	4	Test Firmware Version		X	X				1) PSC – Note 1 SAP (CS03)
										2) PSC – Note 1 SAP (CS03)
5	5	5	Test Serial Number		X	X				1) PSC – Notes 1 & 2
										2) PSC – Notes 1 & 2
6	6	6	Test Alarms at Bootup		X	X				1) PSC – Note 2
										2) PSC – Note 2

7	7	7	Test Switch2 Output ON		X	X				1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
										2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18
8	8	8	Test Switch2 Output OFF		X	X				1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
										2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18
9	9	9	Test Switch3 Output ON		X	X				1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
										2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18

									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
10	10	10	Test Switch3 Output OFF		X	X			2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18
									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
11	11	11	Test Run Stopped Output ON		X	X			2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18
									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
12	12	12	Test Run Stopped Output OFF		X	X			2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18

									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
13	13	13	Test Switch1 Output ON		X	X			2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18
									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
14	14	14	Test Switch1 Output OFF		X	X			2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18
									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
15	15	15	Test Gradient Start Input SHORT		X	X			2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18

									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
16	16	16	Test Gradient Start Input OPEN		X	X			2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18
									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
17	17	17	Test Stop Flow Input SHORT		X	X			2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18
									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
18	18	18	Test Stop Flow Input OPEN		X	X			2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18

									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
19	19	19	Test Auxiliary1 Input SHORT		X	X			2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18
									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
20	20	20	Test Auxiliary1 Input OPEN		X	X			2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18
									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
21	21	21	Test Auxiliary2 Input SHORT		X	X			2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18

									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18	
22	22	22	Test Auxiliary2 Input OPEN		X	X			2) PSC – Note 3 FSD 721001454 sec.5.2.5.2, PS 810000422 sec.2.10.18	
									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18	
23	23	23	Test Analog Output2 set to 2.0 VDC		X	X	1.900	2.100	VDC	2) FSD 721001454 sec.5.2.5.2, sec.5.14.9, PS 810000422 sec.2.10.18
										1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
24	24	24	Test Analog Output2 set to 0.0 VDC		X	X	-0.100	0.100	VDC	2) FSD 721001454 sec.5.2.5.2, sec.5.14.8, PS 810000422 sec.2.10.18

									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
									2) FSD 721001454 sec.5.2.5.2, sec.5.14.7, PS 810000422 sec.2.10.18
25	25	25	Test Analog Output1 set to 2.0 VDC		X	X	1.900	2.100	VDC
									1) PSC – Note 3 FSD 13-Jul-2004 sec.3.4.2, PS 810000422 sec.2.10.18
									2) FSD 721001454 sec.5.2.5.2, sec.5.14.6, PS 810000422 sec.2.10.18
26	26	26	Test Analog Output1 set to 0.0 VDC		X	X	-0.100	0.100	VDC
									1) PSC – Note 3 PS 810000422 sec.2.10.3, 710000422 p.19
									2) PSC – Note 3 PS 810000422 sec.2.10.3, 710000422 p.19
27	27	27	Test Leak Detect Connected		X	X			
									1) PSC – Note 3 PS 810000422 sec.2.10.3, 710000422 p.19
									2) PSC – Note 3 PS 810000422 sec.2.10.3, 710000422 p.19
28	28	28	Test Leak Detect Disconnected		X	X			

									1) PSC – Note 3 PS 810000422 sec.2.10.3, 710000422 p.19
29	29	29	Test Leak Detect Input Low		X	X			2) PSC – Note 3 PS 810000422 sec.2.10.3, 710000422 p.19
									1) PSC – Note 3 PS 810000422 sec.2.10.3, 710000422 p.19
30	30	30	Test Leak Detect Input High		X	X			2) PSC – Note 3 PS 810000422 sec.2.10.3, 710000422 p.19
31	31	31	Test Alarms Recheck		X	X			1) PSC – Note 2
									2) PSC – Note 2
32	33	33	Test Seal Wash Pump Prime/Flow		X	X	2.000	5.000	1) PSC – Note 4
									2) PSC – Note 4
									1) FSD 13-Jul-2004 sec.4.1, PSC – Note 5
33	33	33	Test Pump A Input 2 Prime with IPA		X	X	350.000	3100.000	2) FSD 721001454 sec.5.3.2, PSC – Note 5
									1) FSD 13-Jul-2004 sec.4.1, PSC – Note 5
33	34	34	Test Pump B Input 2 Prime with IPA		X	X	350.000	3100.000	2) FSD 721001454 sec.5.3.2, PSC – Note 5
									1) FSD 13-Jul-2004 sec.4.1, PSC – Note 5
34	35	35	Test Pump A Input 1 Prime with MeOH		X	X	2.800	5.400	2) FSD 721001454 sec.5.3.2, PSC – Note 5

34	36	36	Test Pump B Input 1 Prime with MeOH		X	X	2.800	5.400	rel	1) FSD 13-Jul-2004 sec.4.1, PSC – Note 5 2) FSD 721001454 sec.5.3.2, PSC – Note 5
35	37	37	Test Degasser Pressure		X	X	0.000	1.300	PSI	1) PSC – Note 2 2) FSD 721001454 sec.5.14.10, PSC – Note 2
36	38	38	Test Degasser Switch Setting		X	X				1) PSC – Note 3 ASP 279001320 OPER.21 p.22 2) PSC – Note 3 FSD 721001454 sec.5.1.2, ASP 279002450 OPER.20 p.22 ASP 279002450IVD OPER.11.2 p.26
38	39		Test Pump A Static Leak - Accum. Decay Rate		X	X	1.000	200.000	PSI/min	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
39	40		Test Pump A Static Leak - Accum. Compression Stroke		X	X	1.000	30.000	%	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
40	41		Test Pump A Static Leak - Accum. Inferred Leak Rate		X	X	0.010	0.800	ul/min	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
41	42		Test Pump A Static Leak - Accum. Highest Pressure Achieved		X	X	14000.000	15000.000	PSI	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
42	43		Test Pump A Static Leak - Primary Decay Rate		X	X	1.000	200.000	PSI/min	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8

43	44		Test Pump A Static Leak - Primary Compression Stroke		X	X	1.000	30.000	%	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
44	45		Test Pump A Static Leak - Primary Inferred Leak Rate		X	X	0.010	0.800	ul/min	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
45	46		Test Pump A Static Leak - Primary Highest Pressure Achieved		X	X	12000.000	13000.000	PSI	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
46	47		Test Pump B Static Leak - Accum. Decay Rate		X	X	1.000	200.000	PSI/min	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
47	48		Test Pump B Static Leak - Accum. Compression Stroke		X	X	1.000	30.000	%	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
48	49		Test Pump B Static Leak - Accum. Inferred Leak Rate		X	X	0.010	0.800	ul/min	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
49	50		Test Pump B Static Leak - Accum. Highest Pressure Achieved		X	X	14000.000	15000.000	PSI	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
50	51		Test Pump B Static Leak - Primary Decay Rate		X	X	1.000	200.000	PSI/min	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
51	52		Test Pump B Static Leak - Primary Compression Stroke		X	X	1.000	30.000	%	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
52	53		Test Pump B Static Leak - Primary Inferred Leak Rate		X	X	0.010	0.800	ul/min	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8
53	54		Test Pump B Static Leak - Primary Highest Pressure Achieved		X	X	12000.000	13000.000	PSI	1) FSD 13-Jul-2004 sec.6.0 p.34, PSC – Note 8

54	39	Test Pump A Dynamic Leak - Accum. Leak Rate	X	X	1.000	200.000	nl/min	2) FSD 721001454 sec.5.1.9, 5.14.17
55	40	Test Pump A Dynamic Leak - Accum. Percent of Stroke	X	X	-10.000	50.000	%	2) FSD 721001454 sec.5.14.12
56	41	Test Pump A Dynamic Leak - Accum. Max Pressure	X	X	17000.000	18000.000	PSI	2) FSD 721001454 sec.5.14.13
57	42	Test Pump A Dynamic Leak - Primary Leak Rate	X	X	-50.000	200.000	nl/min	2) FSD 721001454 sec.5.14.14
58	43	Test Pump A Dynamic Leak - Primary Percent of Stroke	X	X	-10.000	50.000	%	2) FSD 721001454 sec.5.14.15
59	44	Test Pump A Dynamic Leak - Primary Max Pressure	X	X	15000.000	16000.000	PSI	2) FSD 721001454 sec.5.14.16
60	45	Test Pump A Dynamic Leak Low PSI - Accum. Leak Rate	X	X	1.000	200.000	nl/min	2) FSD 721001454 sec.5.1.9, 5.14.17
61	46	Test Pump A Dynamic Leak Low PSI - Accum. Percent of Stroke	X	X	-10.000	50.000	%	2) FSD 721001454 sec.5.14.18
62	47	Test Pump A Dynamic Leak Low PSI - Accum. Max Pressure	X	X	4000.000	5000.000	PSI	2) FSD 721001454 sec.5.14.19
63	48	Test Pump A Dynamic Leak Low PSI - Primary Leak Rate	X	X	-50.000	200.000	nl/min	2) FSD 721001454 sec.5.14.20
64	49	Test Pump A Dynamic Leak Low PSI - Primary Percent of Stroke	X	X	-10.000	50.000	%	2) FSD 721001454 sec.5.14.21
65	50	Test Pump A Dynamic Leak Low PSI - Primary Max Pressure	X	X	2000.000	3000.000	PSI	2) FSD 721001454 sec.5.14.22
66	51	Test Pump B Dynamic Leak - Accum. Leak Rate	X	X	1.000	200.000	nl/min	2) FSD 721001454 sec.5.1.9, 5.14.17
67	52	Test Pump B Dynamic Leak - Accum. Percent of Stroke	X	X	-10.000	50.000	%	2) FSD 721001454 sec.5.14.12
68	53	Test Pump B Dynamic Leak - Accum. Max Pressure	X	X	17000.000	18000.000	PSI	2) FSD 721001454 sec.5.14.13

69		54	Test Pump B Dynamic Leak - Primary Leak Rate		X	X	-50.000	200.000	nl/min	2) FSD 721001454 sec.5.14.14
70		55	Test Pump B Dynamic Leak - Primary Percent of Stroke		X	X	-10.000	50.000	%	2) FSD 721001454 sec.5.14.15
71		56	Test Pump B Dynamic Leak - Primary Max Pressure		X	X	15000.000	16000.000	PSI	2) FSD 721001454 sec.5.14.16
72		57	Test Pump B Dynamic Leak Low PSI - Accum. Leak Rate		X	X	1.000	200.000	nl/min	2) FSD 721001454 sec.5.1.9, 5.14.17
73		58	Test Pump B Dynamic Leak Low PSI - Accum. Percent of Stroke		X	X	-10.000	50.000	%	2) FSD 721001454 sec.5.14.18
74		59	Test Pump B Dynamic Leak Low PSI - Accum. Max Pressure		X	X	4000.000	5000.000	PSI	2) FSD 721001454 sec.5.14.19
75		60	Test Pump B Dynamic Leak Low PSI - Primary Leak Rate		X	X	-50.000	200.000	nl/min	2) FSD 721001454 sec.5.14.20
76		61	Test Pump B Dynamic Leak Low PSI - Primary Percent of Stroke		X	X	-10.000	50.000	%	2) FSD 721001454 sec.5.14.21
77		62	Test Pump B Dynamic Leak Low PSI - Primary Max Pressure		X	X	2000.000	3000.000	PSI	2) FSD 721001454 sec.5.14.22
78	55	63	Test Flow Rate Accuracy Pump A 2ml/min		X	X	1.980	2.020	ml/min	1) FSD 13-Jul-2004 sec.4.1
										2) FSD 721001454 sec.5.14.23
79	56	64	Test Pump A Pressure Ripple		X	X	0.000	15.000	PSI	1) PSC – Note 3
										2) FSD 721001454 sec.5.14.24
80	57	65	Test Flow Rate Accuracy Pump A 0.5ml/min		X	X	0.495	0.505	ml/min	1) FSD 13-Jul-2004 sec.4.1
										2) FSD 721001454 sec.5.14.25
81	58	66	Test Flow Rate Accuracy Pump B 2ml/min		X	X	1.980	2.020	ml/min	1) FSD 13-Jul-2004 sec.4.1
										2) FSD 721001454 sec.5.14.23

82	59	67	Test Pump B Pressure Ripple		X	X	0.000	15.000	PSI	1) PSC – Note 3 2) FSD 721001454 sec.5.14.24
83	60	68	Test Flow Rate Accuracy Pump B 0.5ml/min		X	X	0.495	0.505	ml/min	1) FSD 13-Jul-2004 sec.4.1 2) FSD 721001454 sec.5.14.25
84	61	69	Test Flow Rate Accuracy Pump A&B 1.0 ml + 1.0 ml/min		X	X	1.980	2.020	ml/min	1) FSD 13-Jul-2004 sec.4.1 2) FSD 721001454 sec.5.14.26
85	62	70	Test High Pressure Flow Pump A&B		X	X	9000.000	14500.000	PSI	1) PSC – Note 6 2) PSC – Note 6
86	63	71	Test Dynamic Leak Manifold to Filter Tube		X	X	0.000	1.000	ul/min	1) PSC – Notes 3 & 7 2) PSC – Notes 3 & 7
87	64	72	Test Serial Number Re-verification		X	X				1) PSC – Notes 1 & 2 2) PSC – Notes 1 & 2
88	65	73	Test Fans	X	X	X				1) FSD 13-Jul-2004 sec.3.4.4 2) FSD 721001454 sec.5.2.1, PSC – Note 3
89	66	74	Test LEDs	X	X	X				1) FSD 13-Jul-2004 sec.6.1 2) FSD 721001454 sec.5.2.6, PSC – Note 3
	67	75	Acquity BSM Final Test Overall Result		X	X				

References:

- 1) References for PN 186015001 BSM Classic
- 2) References for PN 186015000 BSM18K I-Class, 186015000IVD BSM18K I-Class IVD, 186015082 BSM 18K PLUS I-Class

PSC Notes:

1. Pre-test condition.
2. Internal function of instrument firmware.
3. Verify invalidated assembly process.
4. Reference *Seal Wash Testing for BSM Pumps Memo V04.doc* for system test limit calculations.
5. Reference *Prime Pump Testing for BSM Pumps Memo V02.doc* for system test limit calculations.
6. Reference *High Pressure Testing for BSM Pumps Memo V03.doc* for system test limit calculations.
7. Reference *VV to Output Testing for BSM Pumps Memo V02.doc* for system test limit calculations.
8. Reference *Static Leak Test Decay Limits 186015001.doc* for system test limit calculations.

1. ELECTRICAL SAFETY

The operator is prompted to enter the Electrical Safety Test result.

2. LOADER DOWNLOAD

The BSM is powered up. During this time, the serial communications is being monitored. It is then determined what version firmware, if any, is loaded on the BSM. If there is no firmware previously loaded, the test program will load the latest version of firmware. Otherwise it will prompt the operator to continue on testing or reload the latest version.

The “Loader” program is called from the test program to load the firmware via the BSM’s Ethernet port. Once loaded, the BSM is rebooted.

3. REBOOT FIRMWARE FOR PUMP B DOWNLOAD

Upon rebooting, the serial communications is monitored. The BSM is expected to begin loading packets of data onto the pump B CPU 2000 at this time. Once pump B has been fully loaded, the BSM is rebooted.

4. FIRMWARE VERSION

The serial command **version** and **b version** is sent to the BSM. Both pump A and B responses are compared against the latest version name located in the file *TestStringsFile.txt*.

5. SERIAL NUMBER

The scanned serial number from the Input Information Window is loaded into the BSM via the serial command **setserial** *serialnumber*. The serial number is then read back out of the BSM via the command **showserial**. The response is then compared back to the scanned serial number. The BSM is then rebooted to clear Alarms associated with the serial number update.

6. ALARMS AT BOOTUP

Once the BSM reboots, the serial command **printalarm** is sent to the BSM. Any alarms present will be displayed to the operator and the testing will be halted.

7. SWITCH2 OUTPUT ON

The BSM is sent the serial command **swon relay1**. The BSM rear panel output pins labeled **Switch2 Out** are measured and expected to be shorted.

8. SWITCH2 OUTPUT OFF

The BSM is sent the serial command **swoff relay1**. The BSM rear panel output pins labeled **Switch2 Out** are measured and expected to be open.

9. SWITCH3 OUTPUT ON

The BSM is sent the serial command **swon relay2**. The BSM rear panel output pins labeled **Switch3 Out** are measured and expected to be shorted.

10. SWITCH3 OUTPUT OFF

The BSM is sent the serial command **swoff relay2**. The BSM rear panel output pins labeled **Switch3 Out** are measured and expected to be open.

11. RUN STOPPED OUTPUT ON

The BSM is sent the serial command **b swon relay1**. The BSM rear panel output pins labeled **Run Stopped Out** are measured and expected to be shorted.

12. RUN STOPPED OUTPUT OFF

The BSM is sent the serial command **b swoff relay1**. The BSM rear panel output pins labeled **Run Stopped Out** are measured and expected to be open.

13. SWITCH1 OUTPUT ON

The BSM is sent the serial command **b swon relay2**. The BSM rear panel output pins labeled **Switch1 Out** are measured and expected to be shorted.

14. SWITCH1 OUTPUT OFF

The BSM is sent the serial command **b swoff relay2**. The BSM rear panel output pins labeled **Switch1 Out** are measured and expected to be open.

15. GRADIENT START INPUT SHORT

The BSM rear panel input pins labeled **Gradient Start** are shorted together. The BSM is then sent the serial command **show eventin**. The expected serial response is **Eventin.Event1 = True**.

16. GRADIENT START INPUT OPEN

The BSM rear panel input pins labeled **Gradient Start** are left open. The BSM is then sent the serial command **show eventin**. The expected serial response is **Eventin.Event1 = False**.

17. STOP FLOW INPUT SHORT

The BSM rear panel input pins labeled **Stop Flow** are shorted together. The BSM is then sent the serial command **show eventin**. The expected serial response is **Eventin.Event2 = True**.

18. STOP FLOW INPUT OPEN

The BSM rear panel input pins labeled **Stop Flow** are left open. The BSM is then sent the serial command **show eventin**. The expected serial response is **Eventin.Event2 = False**.

19. AUXILIARY1 INPUT SHORT

The BSM rear panel input pins labeled **Auxiliary1** are shorted together. The BSM is then sent the serial command **b show eventin**. The expected serial response is **Eventin.Event1 = True**.

20. AUXILIARY1 INPUT OPEN

The BSM rear panel input pins labeled **Auxiliary1** are left open. The BSM is then sent the serial command **b show eventin**. The expected serial response is **Eventin.Event1 = False**.

21. AUXILIARY2 INPUT SHORT

The BSM rear panel input pins labeled **Auxiliary2** are shorted together. The BSM is then sent the serial command **b show eventin**. The expected serial response is **Eventin.Event2 = True**.

22. AUXILIARY2 INPUT OPEN

The BSM rear panel input pins labeled **Auxiliary2** are left open. The BSM is then sent the serial command **b show eventin**. The expected serial response is **Eventin.Event2 = False**.

23. ANALOG OUTPUT2 SET TO 2.0 VDC

The BSM is sent the serial command **analogoutput 2**. The BSM's rear panel output labeled **Analog Out2** is measured and expected to read 2.0 VDC +/- 0.1 VDC.

24. ANALOG OUTPUT2 SET TO 0.0 VDC

The BSM is sent the serial command **analogoutput 0**. The BSM's rear panel output labeled **Analog Out2** is measured and expected to read 0.0 VDC +/- 0.1 VDC.

25. ANALOG OUTPUT1 SET TO 2.0 VDC

The BSM is sent the serial command **b analogoutput 2**. The BSM's rear panel output labeled **Analog Out1** is measured and expected to read 2.0 VDC +/- 0.1 VDC.

26. ANALOG OUTPUT1 SET TO 0.0 VDC

The BSM is sent the serial command **b analogoutput 0**. The BSM's rear panel output labeled **Analog Out1** is measured and expected to read 0.0 VDC +/- 0.1 VDC.

27. LEAK DETECT CONNECTED

The BSM front panel Leak Detect input pins 1-2 are shorted. The BSM is then sent the serial command **peek 0x50001c**. The expected serial response is **01**.

28. LEAK DETECT DISCONNECTED

The BSM front panel Leak Detect input pins 1-2 are left open. The BSM is then sent the serial command **peek 0x50001c**. The expected serial response is **00**.

29. LEAK DETECT INPUT LOW

The BSM front panel Leak Detect input pin 3 is shorted to GND. The BSM is then sent the serial command **dump adc**. The expected serial response for Channel 1: is less than 0.5 VDC.

30. LEAK DETECT INPUT HIGH

The BSM front panel Leak Detect input pin 3 is pulled up via a 1K ohm resistor to pin 2. The BSM is then sent the serial command **dump adc**. The expected serial response for Channel 1: is greater than 3.5 VDC.

31. ALARMS RECHECK

The serial command **printalarm** is sent to the BSM. Any alarms present will be displayed to the operator and the testing will be halted.

32. SEAL WASH PUMP PRIME/FLOW

The serial command **swpprime** is sent to the BSM to start the seal wash pump. The BSM's seal wash pump can be heard running by a clicking sound. The vacuum pump located inside TE82943 is activated. The vacuum pump helps the seal wash pump prime by pulling MeOH through the seal wash line. After enough time has elapsed to draw the MeOH through the system, the test program then switches from Priming to Establishing Flow. The test waits for a period of time to allow the MeOH to be pumped by the seal wash pump through TE82943 and out into the AnD balance. Next, the Flow Rate Testing begins.

The AnD scale is monitored for 2 minutes. Balance readings are taken at the beginning and end of this time. The measured flow rate is then calculated.

33. PUMP A & B INPUT 2 PRIME WITH IPA

The serial commands **selectsolvent 2** and **b selectsolvent 2** are sent to the BSM to activate the BSM's Biochem valves. A2 and B2 IPA solvent inputs are selected. The serial commands **setprimeflow 4** and **b setprimeflow 4** are sent to the BSM to start pumps A and B priming IPA to waste. The four pressure transducers are monitored and displayed at approximately 1 second intervals.

The priming will run for 6 minutes to allow enough time to draw IPA through the system.

For each pump, the last 60 seconds of accumulator pressure data readings are collected and averaged to provide a test measurement. Also, a counter is set to count any number of accumulator

pressure readings, during the last 60 seconds, that fall outside of the test limits. Greater than six readings outside the limit range constitute a failure.

Note: In the case of a slight intermittent check valve failure, the reading value may not contain enough bad data points to cause a failure consistently with this test. However, the BSM will fail other tests further on in the test program. Consistent failures such as select valves not switching to IPA, bad check valves, gross leaks, etc.. will generally be shown as a low pressure measurement.

34. PUMP A & B INPUT 1 PRIME WITH MEOH

The serial commands **selectsolvent 1** and **b selectsolvent 1** are sent to the BSM to activate the BSM's Biochem valves. A1 and B1 MeOH solvent inputs are selected. The serial commands **setprimeflow 4** and **b setprimeflow 4** are sent to the BSM to start pumps A and B priming MeOH to waste. The four pressure transducers are monitored and displayed at approximately 1 second intervals.

The priming will run for 6 minutes to allow enough time to draw MeOH through the system. For each pump, the last 60 seconds of accumulator pressure data readings are collected and averaged to provide a test measurement. Also, a counter is set to count any number of accumulator pressure readings, during the last 60 seconds, that fall outside of the test limits. Greater than one reading outside the limit range constitutes a failure.

Note: In the case of a slight intermittent check valve failure, the reading value may not contain enough bad data points to cause a failure consistently with this test. However, the BSM will fail other tests further on in the test program.

35. DEGASSER PRESSURE

The serial command **degasstatus** is sent to the BSM. The BSM's degasser pressure reading is returned in response.

36. DEGASSER SWITCH SETTING

The serial command **dump degasser** is sent to the BSM. The serial response should state **ACQUITY Degasser found**.

37. VALVE CONDITIONING ACTION STEP

This routine is used to run-in the pump seals at pressure. This will allow the valve seals to seat. The file *SealConditioningFile.txt* is used to control this action. Parameters for time, pump A flow rate, pump B flow rate, and restrictor number are stored. The routine will set up the specified restrictor. Then a serial command will send the **setflow x** command, where **x** is the desired flow rate. The pressure is displayed and the routine will run for the specified time. Test Engineering will determine the parameters to use for this action based on seal reliability data. Parameters used at this time are 180 sec., 0.5 ml/min, 0.5ml/min., restrictor 1.

38. STATIC LEAK PUMP A – ACCUMULATOR DECAY RATE (BSM CLASSIC ONLY)

The serial command **leaktest** is sent to the BSM. This launches a BSM internal test which does the following:

The vent valve is set to a mid point state between the vent and system outputs. This closes off the output of the pump. Then the Primary and Accumulator are pressured to 12K PSI and 14K PSI respectively. The pressures are internally monitored and the Decay Rate is calculated along with the Inferred Leak Rate. Parameters such as Highest Pressure Achieved and Compression Stroke are also measured. The results are available for display at the completion of the test.

This test is currently called up to three times by the Test Program to give ample opportunity to pass. Consistent failures are an indication of a fitting leak, bad seals, faulty check valve, etc..

Clues to the exact failure can be derived from the data results. Diagnosis information is sometimes given by the internal test. This will be displayed to the operator when available.

39.STATIC LEAK PUMP A – ACCUMULATOR COMPRESSION STROKE (BSM CLASSIC ONLY)

Refer above for test description.

40.STATIC LEAK PUMP A – ACCUMULATOR INFERRED LEAK RATE (BSM CLASSIC ONLY)

Refer above for test description.

41.STATIC LEAK PUMP A – ACCUMULATOR HIGHEST PRESSURE ACHIEVED (BSM CLASSIC ONLY)

Refer above for test description.

42.STATIC LEAK PUMP A – PRIMARY DECAY RATE (BSM CLASSIC ONLY)

Refer above for test description.

43.STATIC LEAK PUMP A – PRIMARY COMPRESSION STROKE (BSM CLASSIC ONLY)

Refer above for test description.

44.STATIC LEAK PUMP A – PRIMARY INFERRED LEAK RATE (BSM CLASSIC ONLY)

Refer above for test description.

45.STATIC LEAK PUMP A – PRIMARY HIGHEST PRESSURE ACHIEVED (BSM CLASSIC ONLY)

Refer above for test description.

46.STATIC LEAK PUMP B – ACCUMULATOR DECAY RATE (BSM CLASSIC ONLY)

The serial command **leaktest** is sent to the BSM. This launches a BSM internal test which does the following:

The vent valve is set to a mid point state between the vent and system outputs. This closes off the output of the pump. Then the Primary and Accumulator are pressured to 12K PSI and 14K PSI respectively. The pressures are internally monitored and the Decay Rate is calculated along with the Inferred Leak Rate. Parameters such as Highest Pressure Achieved and Compression Stroke are also measured. The results are available for display at the completion of the test. This test is currently called up to three times by the Test Program to give ample opportunity to pass. Consistent failures are an indication of a fitting leak, bad seals, faulty check valve, etc.. Clues to the exact failure can be derived from the data results. Diagnosis information is sometimes given by the internal test. This will be displayed to the operator when available.

47. STATIC LEAK PUMP B – ACCUMULATOR COMPRESSION STROKE (BSM CLASSIC ONLY)

Refer above for test description.

48. STATIC LEAK PUMP B – ACCUMULATOR INFERRED LEAK RATE (BSM CLASSIC ONLY)

Refer above for test description.

49. STATIC LEAK PUMP B – ACCUMULATOR HIGHEST PRESSURE ACHIEVED (BSM CLASSIC ONLY)

Refer above for test description.

50. STATIC LEAK PUMP B – PRIMARY DECAY RATE (BSM CLASSIC ONLY)

Refer above for test description.

51. STATIC LEAK PUMP B – PRIMARY COMPRESSION STROKE (BSM CLASSIC ONLY)

Refer above for test description.

52. STATIC LEAK PUMP B – PRIMARY INFERRED LEAK RATE (BSM CLASSIC ONLY)

Refer above for test description.

53. STATIC LEAK PUMP B – PRIMARY HIGHEST PRESSURE ACHIEVED (BSM CLASSIC ONLY)

Refer above for test description.

54. PUMP A DYNAMIC LEAK – ACCUMULATOR LEAK RATE (BSM-I CLASS ONLY)

The serial command **newleaktest 17000 1 0 0 0** is sent to the BSM. This launches a BSM internal test which does the following:

The BSM will fill and empty the Accumulator and Primary cylinders several times to obtain a good solvent intake. The vent valve is set to a mid point state between the vent and system outputs.

This closes off the output of the pump. The Accumulator is pressured to 17K PSI. The Accumulator

pressure is displayed on the graph while the Accumulator motor is stepped 'dynamically' to maintain the set pressure. The Leak Rate is calculated and displayed on the graph. Next the Primary is pressured to 15K PSI. The Primary pressure is displayed on the graph while the Primary motor is stepped 'dynamically' to maintain the set pressure. The Leak Rate is calculated and displayed on the graph.

The results are available for display at the completion of the test.

This test is currently called up to three times by the Test Program to give ample opportunity to pass. Consistent failures are an indication of a fitting leak, bad seals, faulty check valve, etc..

Clues to the exact failure can be derived from the data results. Diagnosis information is sometimes given by the internal test. This will be displayed to the operator when available.

55. PUMP A DYNAMIC LEAK – ACCUMULATOR PERCENT OF STROKE (BSM-I CLASS ONLY)

Refer above for test description.

56. PUMP A DYNAMIC LEAK – ACCUMULATOR MAXIMUM PRESSURE (BSM-I CLASS ONLY)

Refer above for test description.

57. PUMP A DYNAMIC LEAK – PRIMARY LEAK RATE (BSM-I CLASS ONLY)

Refer above for test description.

58. PUMP A DYNAMIC LEAK – PRIMARY PERCENT OF STROKE (BSM-I CLASS ONLY)

Refer above for test description.

59. PUMP A DYNAMIC LEAK – PRIMARY MAXIMUM PRESSURE (BSM-I CLASS ONLY)

Refer above for test description.

60. PUMP B DYNAMIC LEAK – ACCUMULATOR LEAK RATE (BSM-I CLASS ONLY)

The serial command **newleaktest 17000 2 0 0 0** is sent to the BSM. This launches a BSM internal test which does the following:

The BSM will fill and empty the Accumulator and Primary cylinders several times to obtain a good solvent intake. The vent valve is set to a mid point state between the vent and system outputs.

This closes off the output of the pump. The Accumulator is pressured to 17K PSI. The Accumulator pressure is displayed on the graph while the Accumulator motor is stepped 'dynamically' to maintain the set pressure. The Leak Rate is calculated and displayed on the graph. Next the Primary is pressured to 15K PSI. The Primary pressure is displayed on the graph while the Primary motor is stepped 'dynamically' to maintain the set pressure. The Leak Rate is calculated and displayed on the graph.

The results are available for display at the completion of the test.

This test is currently called up to three times by the Test Program to give ample opportunity to pass. Consistent failures are an indication of a fitting leak, bad seals, faulty check valve, etc..

Clues to the exact failure can be derived from the data results. Diagnosis information is sometimes given by the internal test. This will be displayed to the operator when available.

61. PUMP B DYNAMIC LEAK – ACCUMULATOR PERCENT OF STROKE (BSM-I CLASS ONLY)

Refer above for test description.

62. PUMP B DYNAMIC LEAK – ACCUMULATOR MAXIMUM PRESSURE (BSM-I CLASS ONLY)

Refer above for test description.

63. PUMP B DYNAMIC LEAK – PRIMARY LEAK RATE (BSM-I CLASS ONLY)

Refer above for test description.

64. PUMP B DYNAMIC LEAK – PRIMARY PERCENT OF STROKE (BSM-I CLASS ONLY)

Refer above for test description.

65. PUMP B DYNAMIC LEAK – PRIMARY MAXIMUM PRESSURE (BSM-I CLASS ONLY)

Refer above for test description.

66. PUMP A DYNAMIC LEAK LOW PSI – ACCUMULATOR LEAK RATE (BSM-I CLASS ONLY)

The serial command **newleaktest 4000 1 0 0 0** is sent to the BSM. This launches a BSM internal test which does the following:

The BSM will fill and empty the Accumulator and Primary cylinders several times to obtain a good solvent intake. The vent valve is set to a mid point state between the vent and system outputs. This closes off the output of the pump. The Accumulator is pressured to 4K PSI. The Accumulator pressure is displayed on the graph while the Accumulator motor is stepped 'dynamically' to maintain the set pressure. The Leak Rate is calculated and displayed on the graph. Next the Primary is pressured to 2K PSI. The Primary pressure is displayed on the graph while the Primary motor is stepped 'dynamically' to maintain the set pressure. The Leak Rate is calculated and displayed on the graph.

The results are available for display at the completion of the test.

This test is currently called up to three times by the Test Program to give ample opportunity to pass. Consistent failures are an indication of a fitting leak, bad seals, faulty check valve, etc..

Clues to the exact failure can be derived from the data results. Diagnosis information is sometimes given by the internal test. This will be displayed to the operator when available.

67. PUMP A DYNAMIC LEAK LOW PSI – ACCUMULATOR PERCENT OF STROKE (BSM-I CLASS ONLY)

Refer above for test description.

68. PUMP A DYNAMIC LEAK LOW PSI – ACCUMULATOR MAXIMUM PRESSURE (BSM-I CLASS ONLY)

Refer above for test description.

69. PUMP A DYNAMIC LEAK LOW PSI – PRIMARY LEAK RATE (BSM-I CLASS ONLY)

Refer above for test description.

70. PUMP A DYNAMIC LEAK LOW PSI – PRIMARY PERCENT OF STROKE (BSM-I CLASS ONLY)

Refer above for test description.

71. PUMP A DYNAMIC LEAK LOW PSI – PRIMARY MAXIMUM PRESSURE (BSM-I CLASS ONLY)

Refer above for test description.

72. PUMP B DYNAMIC LEAK LOW PSI – ACCUMULATOR LEAK RATE (BSM-I CLASS ONLY)

The serial command **newleaktest 4000 2 0 0 0** is sent to the BSM. This launches a BSM internal test which does the following:

The BSM will fill and empty the Accumulator and Primary cylinders several times to obtain a good solvent intake. The vent valve is set to a mid point state between the vent and system outputs. This closes off the output of the pump. The Accumulator is pressured to 4K PSI. The Accumulator pressure is displayed on the graph while the Accumulator motor is stepped 'dynamically' to maintain the set pressure. The Leak Rate is calculated and displayed on the graph. Next the Primary is pressured to 2K PSI. The Primary pressure is displayed on the graph while the Primary motor is stepped 'dynamically' to maintain the set pressure. The Leak Rate is calculated and displayed on the graph.

The results are available for display at the completion of the test.

This test is currently called up to three times by the Test Program to give ample opportunity to pass. Consistent failures are an indication of a fitting leak, bad seals, faulty check valve, etc..

Clues to the exact failure can be derived from the data results. Diagnosis information is sometimes given by the internal test. This will be displayed to the operator when available.

73. PUMP B DYNAMIC LEAK LOW PSI – ACCUMULATOR PERCENT OF STROKE (BSM-I CLASS ONLY)

Refer above for test description.

74. PUMP B DYNAMIC LEAK LOW PSI – ACCUMULATOR MAXIMUM PRESSURE (BSM-I CLASS ONLY)

Refer above for test description.

75. PUMP B DYNAMIC LEAK LOW PSI – PRIMARY LEAK RATE (BSM-I CLASS ONLY)

Refer above for test description.

76. PUMP B DYNAMIC LEAK LOW PSI – PRIMARY PERCENT OF STROKE (BSM-I CLASS ONLY)

Refer above for test description.

77. PUMP B DYNAMIC LEAK LOW PSI – PRIMARY MAXIMUM PRESSURE (BSM-I CLASS ONLY)

Refer above for test description.

78. FLOW RATE ACCURACY PUMP A 2ML/MIN

The serial command **setflow 2** is sent to the BSM. The output of the pump is routed through a restrictor inside TE82943 which will provide approximately 1000 PSI pressure. The flow is then routed out to the AnD Balance. The pump will run for 90 seconds to initialize the flow to the balance. Then the Flow Rate Testing will begin and run for 60 seconds. Readings are taken from the balance at the beginning and end of this time. The measured flow rate is then calculated.

79. PUMP A FLOW RATE PRESSURE RIPPLE

During the above 2.0ml/min flow rate accuracy testing, the pressure ripple is being recorded. The serial command **getp** is sent to the BSM to retrieve the results.

80. FLOW RATE ACCURACY PUMP A 0.5ML/MIN

The serial command **setflow .5** is sent to the BSM. The output of the pump is routed through a restrictor inside TE82943 which will provide approximately 2000 PSI pressure. The flow is then routed out to the AnD Balance. The pump will run for 90 seconds to initialize the flow to the balance. Then the Flow Rate Testing will begin and run for 300 seconds. Readings are taken from the balance at the beginning and end of this time. The measured flow rate is then calculated.

81. FLOW RATE ACCURACY PUMP B 2ML/MIN

The serial command **b setflow 2** is sent to the BSM. The output of the pump is routed through a restrictor inside TE82943 which will provide approximately 1000 PSI pressure. The flow is then routed out to the AnD Balance. The pump will run for 90 seconds to initialize the flow to the balance. Then the Flow Rate Testing will begin and run for 60 seconds. Readings are taken from the balance at the beginning and end of this time. The measured flow rate is then calculated.

82. PUMP B FLOW RATE PRESSURE RIPPLE

During the above 2.0ml/min flow rate accuracy testing, the pressure ripple is being recorded. The serial command **b getp** is sent to the BSM to retrieve the results.

83. FLOW RATE ACCURACY PUMP B 0.5ML/MIN

The serial command **b setflow .5** is sent to the BSM. The output of the pump is routed through a restrictor inside TE82943 which will provide approximately 2000 PSI pressure. The flow is then routed out to the AnD Balance. The pump will run for 90 seconds to initialize the flow to the balance. Then the Flow Rate Testing will begin and run for 300 seconds. Readings are taken from the balance at the beginning and end of this time. The measured flow rate is then calculated.

84. FLOW RATE ACCURACY PUMP A&B 1.0ML+1.0ML/MIN

The serial commands **setflow 1** and **b setflow 1** are sent to the BSM. The output of the pump is routed through a restrictor inside TE82943 which will provide approximately 1000 PSI pressure. The flow is then routed out to the AnD Balance. The pump will run for 90 seconds to initialize the flow to the balance. Then the Flow Rate Testing will begin and run for 60 seconds. Readings are taken from the balance at the beginning and end of this time. The measured flow rate is then calculated.

85. HIGH PRESSURE FLOW PUMP A&B

The serial commands **setflow .5** and **b setflow .5** are sent to the BSM. The output of the pump is routed through a restrictor inside TE82943 which will provide approximately 12000 PSI pressure. The flow is then routed out to waste. The pump is run for 2 minutes and a final pressure reading is taken.

86. DYNAMIC LEAK MANIFOLD TO FILTER TUBE

The serial command **setflow flowrate** is sent to the BSM. Where *flowrate* is a variable that is dependent on measured pressure. The output of the pump is dead ended inside TE82943. The test begins by ramping the pressure to a set point of 10000 PSI. Once at 10000 PSI, the flow rate is reduced slightly to try and maintain a pressure close to 10000 PSI. The last 60 seconds of this test is used to capture the flow rates taken at approximately 1 second intervals. The average flow rate will equal the leak rate.

Note : This test is intended to test the connections from the vent valve to the mixer. It includes the front connection of TE82943 since the dead end plug is located inside the tester. Any tester leaks have been attributed to a worn out BSM interface tubing assembly. Replace the interface tubing assembly part number 430001150 if necessary.

87. SERIAL NUMBER RE-VERIFICATION

The serial number is read back out of the BSM via the command **showserial**. The response is then compared back to the scanned serial number from the beginning of the test.

88. FANS

The operator is prompted to verify that both fans are on and blowing outward.

89. LEDS

The operator is prompted to verify that the Front Panel Power and Flow LEDs are working properly. The Power LED will be lit Green. Using a serial **poke address** command, the Flow LED will be verified in the Off, Green, and Red states.

IX. Test Program IPA Prep. Action Descriptions

The following list describes the actions performed for the IPA preparation before the BSM can ship. During the test program run, this procedure must be completed in order for the BSM to be considered a passing unit. The final test record is generated at the end of this process.

90. PURGE A1, B1 & SEAL WASH OF MEOH

The operator is instructed to pull the A1, B1 and Seal Wash input lines out of the MeOH bottle and to disconnect the output interface tubing from the mixer.

The serial commands **selectsolvent 1** and **b selectsolvent 1** are sent to the BSM to activate the BSM's Biochem valves. A1 and B1 (removed) MeOH solvent inputs are selected. The serial commands **setprimeflow 4** and **b setprimeflow 4** are sent to the BSM to start pumps A and B priming the residual internal MeOH to waste. The four pressure transducers are monitored and displayed at approximately 1 second intervals.

The priming will run for 100 seconds to allow enough time to purge the MeOH throughout the system. The operator may observe the transducer pressures dropping to near zero when the last of the MeOH is purged.

91. PRIME USING A2 & B2 WITH IPA

The serial commands **selectsolvent 2** and **b selectsolvent 2** are sent to the BSM to activate the BSM's Biochem valves. A2 and B2 IPA solvent inputs are selected. The serial commands **setprimeflow 4** and **b setprimeflow 4** are sent to the BSM to start pumps A and B priming the IPA to waste. The four pressure transducers are monitored and displayed at approximately 1 second intervals.

The priming will run for 3 minutes to allow enough time to prime the IPA throughout the system.

92. SET FLOW USING A2 & B2 WITH IPA

The serial command **setflow 2** is sent to the BSM to start pump A flowing the IPA through the vent valve and out the mixer port. The priming will run for 45 seconds to allow enough time to flow the IPA through the output.

93. PURGE A2 & B2 OF IPA

The operator is instructed to pull the A2 and B2 input lines out of the IPA bottle.

The serial commands **selectsolvent 2** and **b selectsolvent 2** are sent to the BSM to activate the BSM's Biochem valves. A2 and B2 (removed) IPA solvent inputs are selected. The serial commands **setprimeflow 4** and **b setprimeflow 4** are sent to the BSM to start pumps A and B priming the residual internal IPA to waste. The four pressure transducers are monitored and displayed at approximately 1 second intervals.

The priming will run for 100 seconds to allow enough time to purge the IPA throughout the system. The operator may observe the transducer pressures dropping to near zero when the last of the IPA is purged.

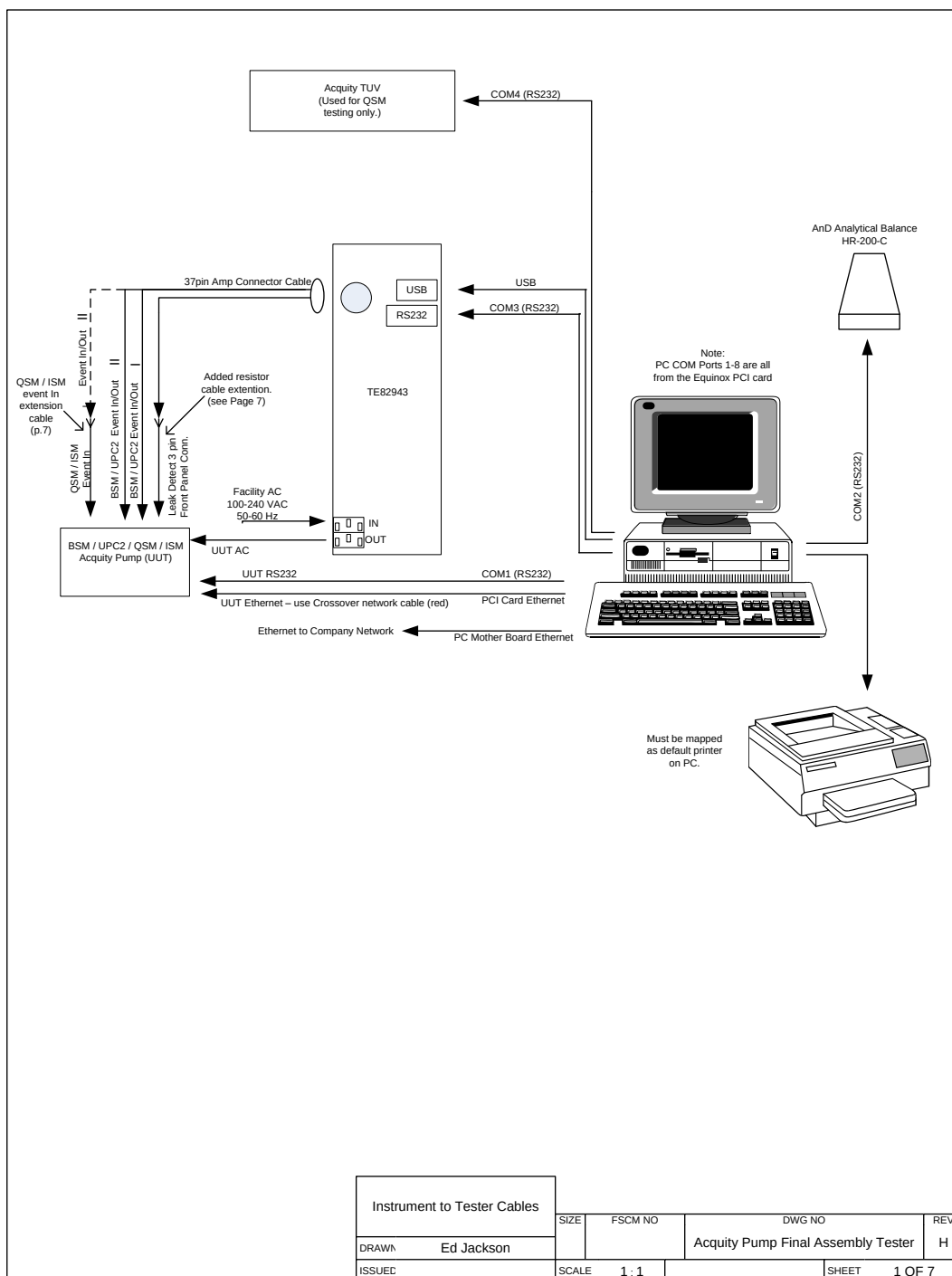
94. SET PURGE FLOW USING A2 & B2 WITH IPA

The serial command **setflow 2** is sent to the BSM to start pump A purging the IPA through the vent valve and out the mixer port. The purging will run for 45 seconds to allow enough time to purge the IPA through the output.

95. MANUAL POWER OFF THE BSM

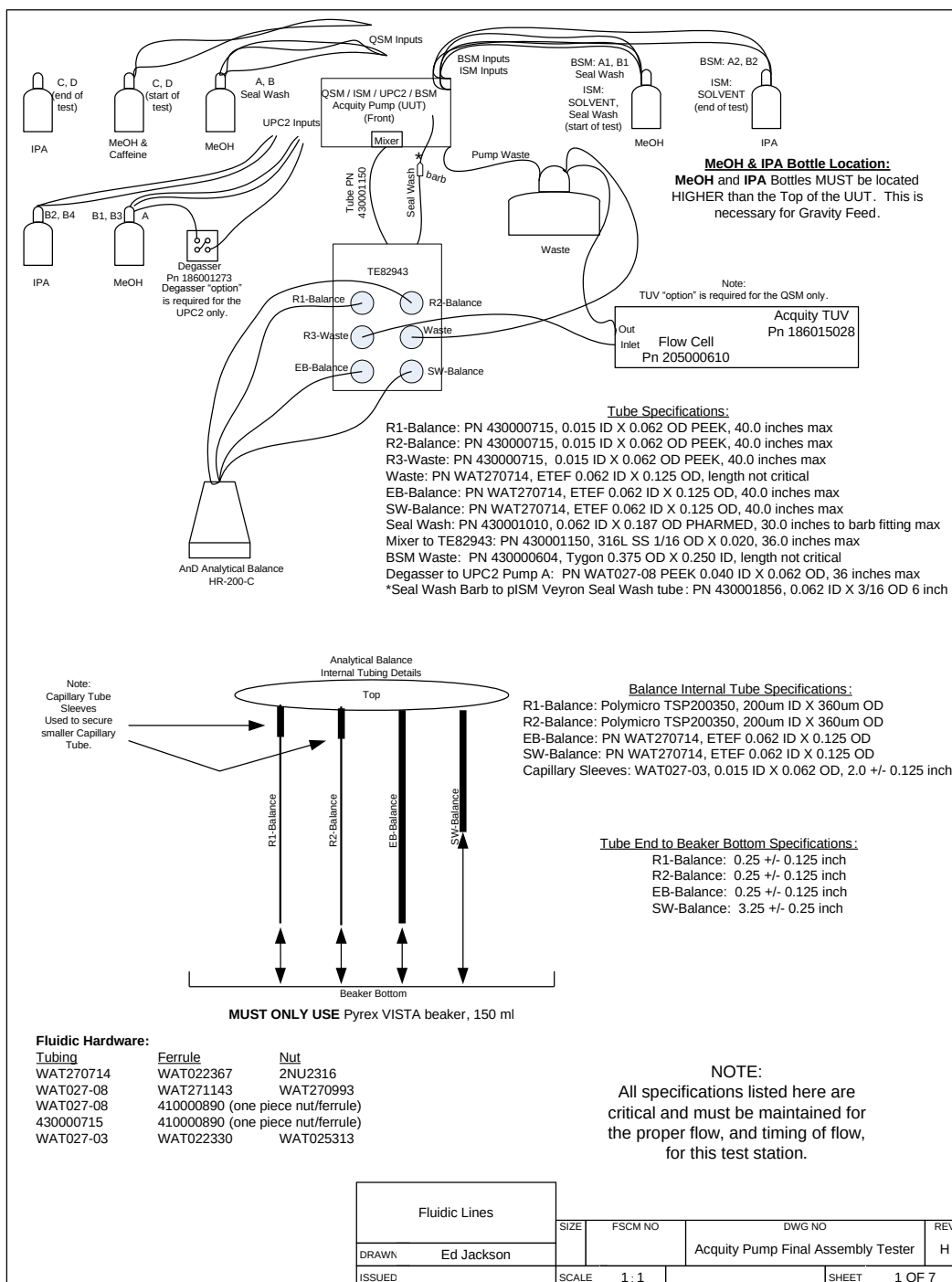
The operator is instructed to press the BSM front panel power switch to power off the UUT. The power state of the BSM is monitored by the test program. The test program will continue to the end of testing when power off is detected.

X. Appendix 1



Electrical Connections

XI. Appendix 2



Fluidic Connections