

## **SERIES 3 PUMP TEST PROCEDURE**

### **1.0 Purpose**

This procedure is for testing a Series 3 Pump. Test data should be entered on the appropriate datasheet.

### **2.0 Test Sequence**

These tests shall be performed on the pump before it is put into stock. Tests are to be conducted in the order specified. If the pump fails any one of the tests, the responsible subassembly must be replaced or repaired, and the pump must be retested. Apply rejected label to the pump or defective subassembly and place it in the quarantined area for rework. After successful completion of all the tests, the pump is placed into stock.

### **3.0 Test Equipment and Supplies**

- 3.1 Digital Multimeter.
- 3.2 Pressure Test and Calibration Bench (Consists of a series connection of a Solvent Bottle, the Pump Under Test, a Pressure Monitor with Chart Recorder, a Pressure Gauge, a System Dead End Valve, a Restrictor Coil Dead End Valve, a Back Pressure Regulator Dead End Valve, a Restrictor Coil, a Back Pressure Regulator, and a Waste Bottle).
- 3.3 A Solvent Bottle of 20% Isopropyl Alcohol and 80% Distilled Water for use with the Pressure Test and Calibration Bench.
- 3.4 Pump Test System (Consists of a Computerized Flowmeter and Back Panel I/O Tester).
- 3.5 A Solvent Bottle of continuously degassed 20% Isopropyl Alcohol and 80% Distilled Water for use with the Pump Test System.
- 3.6 Priming Syringe.
- 3.7 Hi-Pot Tester.

### **4.0 Initial Setup**

- 4.1 Move the pump to the Pressure Test and Calibration Bench.
- 4.2 Check that the watchdog timer jumper, J1, is set to ON and place a check in the box for "Control PCB jumper J1, Watchdog Timer On" on the datasheet.
- 4.3 Check power line isolation - Set the Multimeter to ohms, attach the black lead to one "hot" pin on the Power Entry Module where the cord plugs in and connect the red lead to the other "hot" pin. With the Power Switch (located on the back panel) in the OFF position, the meter should read -0.L- (there is not a short). Switch the Power Switch to the ON position, the meter should read approximately 6-24 ohms (there is not a short). If the meter does not correspond to the above settings, the Power Entry Module has a short and needs replaced. Toggle the Power Switch again and check for shorts. If there are no shorts, place a check next to "Power Line Isolation Test Passed" on the datasheet.
- 4.4 Head Alignment - visually check that all the head components appear to be in-line.
- 4.5 Connect the pump to the proper line voltage by checking the window on the Power Entry Module then plug the corresponding power cord into the Power Entry Module. On the datasheet, put a checkmark beside the appropriate voltage: "100V Y 115V Y 230V Y"

- 4.7 Verify that the pump is configured for the proper head material and head size. There are two ways to configure the pump head settings:
- 1.) If J4 and J5 are populated on the Pump Control board (16-0332) they will control the pump head settings.
  - 2.) If J4 and J5 are not populated on the Pump Control Board (all PCB assemblies except 16-0332) the pump head must be configured by the front panel at power-up. To set the head type hold down the RUN/STOP button while turning on the pump's power; release the RUN/STOP button after the pump has powered-up. Use the UP ARROW and DOWN ARROW buttons to select the proper head type. Press the RUN/STOP button to accept the setting and exit this mode.

If the head type is correct for this pump, checkmark the head type on the section titled "Pump Head Setting Check" on the datasheet.

- 4.8 Check the Piston Carrier set screws - with the pump running, turn the screws in & out to insure free operation of the piston carrier.

## 5.0 Voltage Checks

- 5.1 Connect a Multimeter to the Pressure Board 1 with the black lead on TP3 (AGND).
- 5.2 Set the Multimeter to its DC voltage mode by pressing the "V $\text{---}$ " button.
- 5.3 Apply power to the pump by flipping the power switch (located on the back panel) to the ON position. Verify that the 7-segment displays on the front panel are on.
- 5.4 On the Pump Control Board, connect the red lead of the Multimeter to the following testpoints and check for the corresponding voltages:
- 5.4.1 TP8 = +5.00 volts  $\pm$  0.15 volts (4.85 to 5.15)
  - 5.4.2 Touch the red lead to the top of the battery (B1) and verify that the voltage is between 2.5 to 4.0 volts.
- 5.5 On the Pressure Board, connect the red lead of the Multimeter to the following testpoints and check for the corresponding voltages:
- 5.5.1 TP1 = +15.0 volts  $\pm$  0.25 volts (14.75 to 15.25)
  - 5.5.2 TP2 = +5.00 volts  $\pm$  0.15 volts (4.85 to 5.15)
  - 5.5.3 TP4 = -5.0 volts + 0.50 volts (-4.5 to -5.0)
  - 5.5.4 TP7 = +5.000 volts  $\pm$  0.015 volts (4.985 to 5.015)
  - 5.5.5 TP8 = +5.000 volts  $\pm$  0.020 volts (4.980 to 5.020)
- 5.6 Checkmark the "Testpoint Voltage Test Passed" box on the datasheet if all of the voltages are within the specified limits.

## 6.0 Pressure Calibration

- 6.1 Connect a Multimeter to the Pressure Board with the black lead on TP3 and the red lead on TP5.
- 6.2 Connect the pump's inlet port to the Solvent Bottle using an inlet line and filter.
- 6.3 Connect the pump's outlet port to the Pressure Test and Calibration Bench's stainless steel inlet tubing.
- 6.4 Check all the tubing connections and tighten if necessary.
- 6.5 Close the following valves on the Pressure Test and Calibration Bench by turning them fully clockwise:
- System Dead-End Valve
  - Restrictor Coil Dead-End Valve
  - Back Pressure Regulator Dead-End Valve
- 6.6 Apply power to the pump and verify that the Lower Pressure Limit is 0 PSI and the Upper Pressure Limit is at its maximum value. If they are not at these values, change them.

- 6.7 Prime the pump at its Prime/Purge Valve with the syringe.
- 6.8 Prime the Pressure Test and Calibration Bench at its Prime/Purge Valve with the syringe.
- 6.9 With the pump stopped and with the pump's Prime/Purge Valve open and the pump at atmospheric pressure, adjust the P-ZERO trimpot until the Multimeter reads approximately 0.000 volts.
- 6.10 Close the pump's Prime/Purge Valve and run the pump at 2.50 ml/min.
- 6.11 Wait for the pump to build pressure and trigger the Upper Pressure Limit. The pressure should stabilize and drop slowly. If the pressure continues to drop quickly, check for leaks.

Caution: The pressure transducer can be damaged if the pressure exceeds the pressure transducer's maximum rating. This can happen if the incorrect Pressure Board is used for a specific pressure transducer. Use the following table to determine if the correct Pressure Board has been installed.

Pump's Maximum Pressure Rating (PSI)	Pressure Transducer Rating (PSI)	Resistor R7 on Pressure Board (ohms)
60	250	1.15K (brn brn grn brn brn)
200	250	1.15K (brn brn grn brn brn)
300	500	590 (grn wht blk blk brn)
500	2500	1.54K (brn grn yel brn brn)
1600	10000	590 (grn wht blk blk brn)
2000	2500	1.54K (brn grn yel brn brn)
5000	10000	590 (grn wht blk blk brn)
6000	10000	590 (grn wht blk blk brn)

- 6.12 Adjust the P-SPAN trimpot until the pressure displayed on the pump's front panel equals the pressure displayed on the Pressure Gauge on the Pressure Test and Calibration Bench.
- 6.13 Vent the pump to atmospheric pressure by slowly opening the pump's Prime/Purge Valve (A rapid release of pressure may damage the pressure transducer.).
- 6.14 Adjust the P-ZERO trimpot if necessary to obtain 0.000 volts  $\pm$  0.001 volt. Note: the syringe must be removed from the Prime/Purge Valve to obtain an accurate zero.
- 6.15 Press the Run/Stop Button or the Mode Button to cancel the pressure fault.
- 6.16 Repeat steps 9 through 15 until no adjustment is required at step 14.
- 6.17 On the datasheet, record the voltage on the blank line: "TP5 at 0 PSI = \_\_\_\_\_ Vdc".
- 6.18 Press the "MN/MX" button on the Multimeter. The display on the Multimeter should be displaying "max". If it isn't, press the "MN/MX" button again. In this mode the Multimeter holds the maximum voltage read.
- 6.19 Close the pump's Prime/Purge Valve and run the pump at 1.00 ml/min.
- 6.20 Wait for the pump to build pressure and trigger the Upper Pressure Limit. When the Upper Pressure Limit is triggered the Fault LED should turn on and the maximum pressure will be displayed at that instant. This information will be used in the next two steps.
- 6.21 On the datasheet, record the maximum pressure and the corresponding maximum voltage on the blank line: "TP5 at \_\_\_\_\_ PSI = \_\_\_\_\_ Vdc".
- 6.22 Place a check in the box next to "Pressure Limit: Upper" if the pump stopped and the fault light came on during step 20.
- 6.23 Disconnect the test leads from the circuit board and press the "V---" button on the Multimeter to cancel the "max" mode.
- 6.24 Place the syringe on the pump's Prime/Purge Valve and release the pressure by slowly opening the valve. (A rapid release of pressure may damage the pressure transducer.).
- 6.25 Create an under pressure fault by running the pump with the lower pressure limit set to a pressure greater than zero. Verify that after the fault occurs (this takes approximately 50 pump strokes), the pump stops and the fault light on the front panel comes on. Place a check in the box next to "Pressure Limit: Lower".

## 7.0 Pressure Pulsation Test

7.1. **Purpose:** To accurately measure pressure pulsation and use the data to determine the mechanical accuracy of the pump.

7.2. **Equipment:** This test requires a Digital Oscilloscope with a 100X sweep rate adjustment similar to LEADER Model LB0-5825.

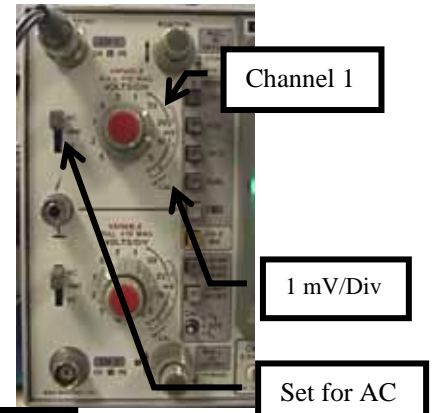
7.3. Pressure test/alignment bench setup.

7.3.1. Oscilloscope Channel setup

7.3.1.1. Set probe for 10X

7.3.1.2. Channel 1, set for 1 mV scale  
 (Volts/Div knob has a secondary scale)

7.3.1.3. Channel 1, set for AC signal



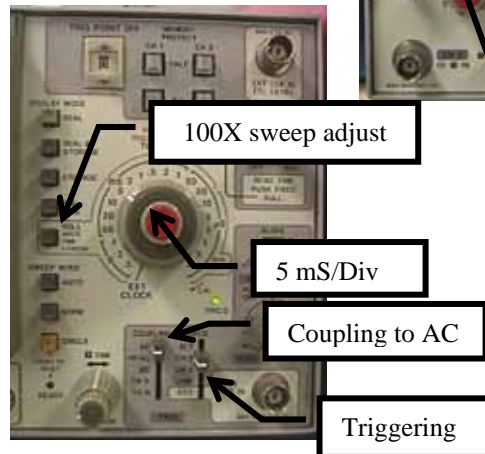
7.3.2. Oscilloscope Frequency setup:

7.3.2.1. Set for 5 mS/Div

7.3.2.2. Set for "Roll write time 100X  
 (this allows for slow signal tracking)

7.3.2.3. Sweep triggering to AUTO

7.3.2.4. Coupling set to AC

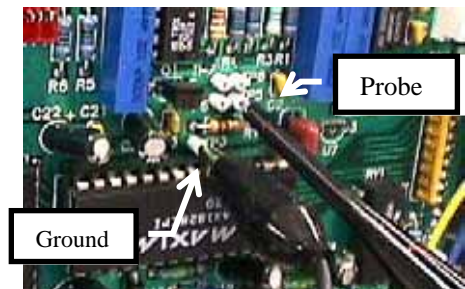


7.3.3. Pump Setup:

7.3.3.1. Connect pump to backpressure device for 1000 PSI @ 2.5 ml/min.

7.3.3.2. Run Pump prior to testing to insure a flooded fluid path free of air bubbles and leaks.

7.3.3.3. Connect Oscilloscope probe to TP5 and the ground clip to TP3.



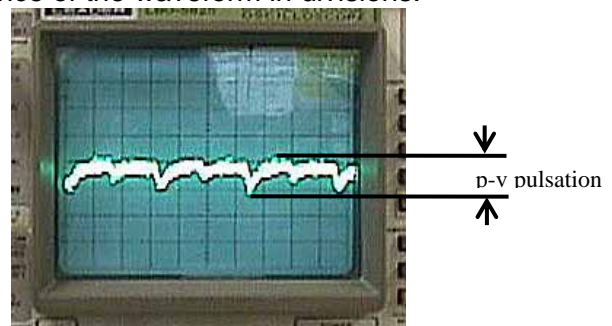
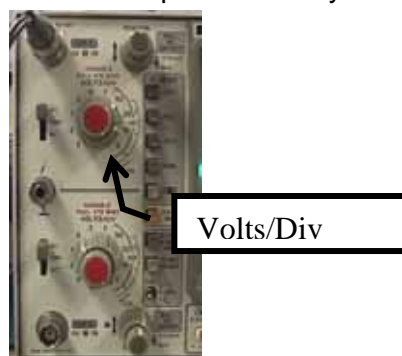
7.4. Testing:

7.4.1. Verify that the pump is set to 1.0 ml/min 1000 PSI and is free of leaks or air bubbles.

**7.4.1.1. To calculate the pressure from the voltage:**

7.4.1.1.1. The Transducer reads in volts with 100 mV as full scale (i.e. 10000 PSI), and the scope will read the mV of the pulsation. Calculating the Pulsation pressure and dividing by the actual pressure will yield the pulsation.

7.4.1.1.2. Measure the peak-to-valley difference of the waveform in divisions.



7.4.1.1.3. Multiply the divisions by the Volts/Div setting value. This is the mV of the pulsation.

7.4.1.1.4. Divide the measured voltage by the Transducer's maximum voltage, this gives the pulsation's peak-to-valley pressure.

7.4.1.1.5. Divide the pulsation pressure by the actual pressure x 100 = % of Pulsation.

$$\frac{(\text{p-v pulsation} * \text{Volts/Div setting}) * \text{Transducers max pressure}}{\text{Transducer's full scale voltage}} = \text{Pulsation p-v Pressure}$$

100 mV \* 10

$$\frac{\text{Pulsation p-v Pressure}}{\text{System Pressure}} * 100 = \% \text{ of Pulsation}$$

10 X probe on O'Scope

#### 7.4.1.2. Simplified method for the above settings & 10,000 PSI transducer:

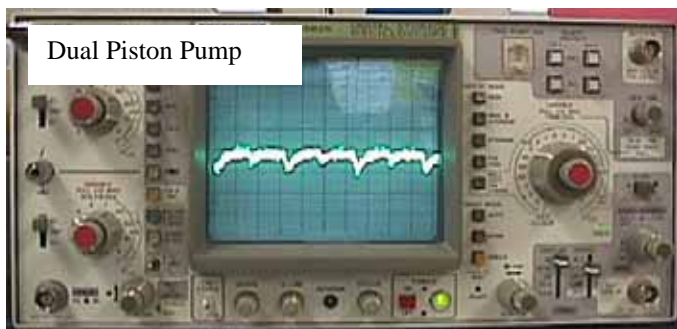
$$\frac{(\text{p-v pulsation}) * 10}{\text{System Pressure}} = \% \text{ of Pulsation}$$

#### EXAMPLE:

$$\frac{(1.3 \text{ divisions} * .001 \text{ Volts/Div}) * 10,000 \text{ PSI}}{1 \text{ Volt}} = 13 \text{ PSI Pulsation p-v}$$

$$\frac{13 \text{ PSI}}{1010 \text{ PSI}} * 100 = 1.28 \% \text{ Pulsation}$$

7.4.1.3. Pulsation should calculate to less than 2 % and show symmetry similar to the example below.



7.4.2. If all functions are completed successfully continue through the testing process.

7.4.3. If any parameter fails move the unit to a quarantine location for final disposition.

7.4.4. On the datasheet record the calculated % of Pulsation

## 8.0 Final Setup

- 8.1 Move the pump to the Pump Test System (PTS).
- 8.2 Turn on the PTS if it is not already on.
- 8.3 Check the Power Entry Module's voltage setting then connect the corresponding power source to the Power Entry Module.
- 8.4 Verify that the adapter cable installed on the PTS's test cable is marked "Series 2 & 3". If it isn't, change the adapter cable to the correct one.
- 8.5 Connect the adapter cable's RJ connector to the RS-232 receptacle on the back of the pump. Connect the adapter cable's 6-pin and 10-pin terminal board plugs to their corresponding receptacles on the back of the pump; depending on the particular model, a Series 3 pump will use both, one, or neither.
- 8.6 Connect the pump's inlet port to the Solvent Bottle using an inlet line and filter.
- 8.7 Prime the pump: attach the syringe to the pump's Prime/Purge Valve; open the Prime/Purge Valve; turn on the pump; put the pump in prime mode; pull on the syringe's plunger and draw a full syringe of liquid; close the Prime/Purge Valve; stop the pump; remove the syringe.
- 8.8 Connect the pump's outlet port to the PTS's stainless steel inlet tubing.
- 8.9 Press 1 on the main menu of the PTS, to select "Series 1, 1x, 2, 2D, 3 and PCR Pumps."
- 8.10 Press T, repeatedly, until the proper pump type is displayed.
- 8.11 Press H, repeatedly, until the proper head type is displayed.
- 8.12 Press I for the pump identification and write the software version on the datasheet.

## 9.0 Flowrate Voltage Calibration

- 9.1 If the 10-pin terminal board receptacle is not present on this model of Series 3 pump or if the pump is a 16-0499, skip to section 10.0; otherwise, proceed to step 9.2.
- 9.2 Set the Multimeter to its DC voltage mode.
- 9.3 Connect the black lead of the Multimeter to TP3 on the Pressure Board.
- 9.4 Connect the red lead of the Multimeter to the lower lead of R5 (square pad) on the Pressure Board.
- 9.5 Press C to set the flowrate calibration voltage. Use the up and down arrow keys on the PTS keyboard to adjust the voltage displayed on the Multimeter to 9.500 volts  $\pm$  0.004 volts.
- 9.6 Turn the wiper adjustment on the V-SPAN trimpot until the pump's front panel display is displaying the correct flowrate then center the wiper on the setpoint as follows:
  - 9.6.1 Turn the the wiper adjustment on the V-SPAN trimpot counterclockwise until the flowrate decrements below the setpoint.
  - 9.6.2 Turn the the wiper adjustment on the V-SPAN trimpot clockwise until the flowrate increments above the setpoint.
  - 9.6.3 Center the wiper adjustment on the V-SPAN trimpot between the two settings determined by steps 9.6.1 and 9.6.2.

R5 Square Pad (volts)	10 mL/min Pump (mL/min)	24 mL/min Pump (mL/min)	40 mL/min Pump (mL/min)	100 mL/min Pump (mL/min)
9.500	9.50	22.80	38.0	95.0

- 9.7 Connect the red lead of the Multimeter to TP6 on the Pressure Board.
- 9.8 On the datasheet, record the voltage at TP6 on the blank line:  
 "Voltage Calibration: TP6 = \_\_\_\_\_ Vdc when Flowrate Voltage = 9.500 Vdc".
- 9.9 Press the escape key to return to the menu.
- 9.10 Disconnect the Multimeter from the Pressure Board.

9.11 If the flowrate voltage cannot be calibrated, apply a rejected label and set aside for rework.

## 10.0 Back Panel I/O Test

10.1 If neither the 6-pin or 10-pin terminal board receptacle is present on this model of Series 3 pump, skip to section 11.0 and checkmark the "N/A Y" at 10 places on the "Remote Control Checks" section of the datasheet; otherwise, proceed to step 10.2.

10.2 Press X for External I/O test and verify that the following tests pass:

If the 6-pin terminal board receptacle is present, the following test must pass:

- (5) Pressure fault output relay test

If the 10-pin terminal board receptacle is present (for all pumps except 16-0499), the following tests must pass:

- (1) Frequency/External enable input test
- (3) Pump run input test
- (4) Pump stop input test
- (6) Voltage input test
- (7) Frequency input test

If the 10-pin terminal board receptacle is present (for 16-0499), the following tests must pass:

- (2) Voltage enable input test
- (3) Pump run input test
- (4) Pump stop input test

10.3 On the datasheet, checkmark "Passed Y" or "N/A Y" at 10 places on the "Remote Control Checks" section of the datasheet.

10.4 If one or more of the required remote control tests fail, apply a rejected label and set aside for rework.

## 11.0 Flow Tests

11.1 Prime the pump at the Prime/Purge Valve with the syringe.

11.2 Press 2 for the automated test and follow the instructions on the screen. The automated test can be stopped at any time by pressing escape.

11.3 When the automated test is completed, copy all the flowrate readings onto the datasheet.

11.4 If all flowrates are within the limits specified on the datasheet, apply an accepted label and proceed. If not, apply a rejected label and set aside for rework.

## 12.0 Continuity Test

12.1 Attach the cabinet lid to the base and secure with the screws.

12.2 Set the Multimeter to ohms, attach the black lead of the meter to the ground terminal of the power entry module. Touch the red lead of the meter to the following: rear of base, inside one of the lid holes for the injection valve bracket, a knurled nut on pump head, and all other exposed metal parts.

12.3 Verify continuity and place a check next to "Ground Continuity Test Passed" on the datasheet.

## 13.0 Hi-Pot Test

13.1 Make sure power switch on Hi-Pot tester is OFF.

13.2 Plug the pump into the receptacle labeled OUTPUT on the Hi-Pot tester and turn the pump power switch on.

- 13.3 Connect the continuity cable from the Hi-Pot tester to one of the knurled nuts used to secure the pump head.
- 13.4 Turn on the power to the Hi-Pot tester and then press the reset button.
- 13.5 Press in the Test button & hold. Verify that the continuity light comes on. If the voltage does not rise, turn the voltage knob to 1900 VDC. Verify that the FAILURE light does NOT light and the BUZZER does NOT sound (both light & buzzer will activate to indicate a failure of the high voltage test). The voltage must be applied for 1 second.
- 13.6 Release the test button and allow the voltage to return to zero.
- 13.7 Turn off the Hi-Pot tester and disconnect from the pump.
- 13.8 Place a checkmark next to "Hi-Pot Test Passed" on the datasheet.

<b>PREPARED:</b> PJG 10/03/02	<b>ENGR APPROVAL:</b>	<b>PROD APPROVAL:</b>
-------------------------------	---------------------------	---------------------------