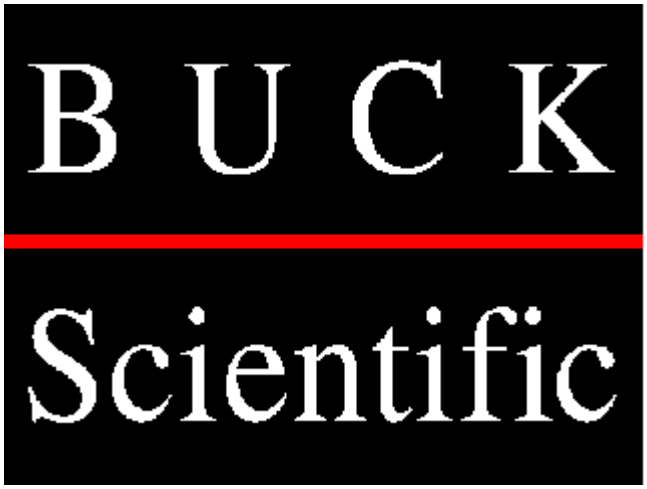
BLC-30 Series

HPLC Systems



with

Peak Simple HPLC Management System

BLC-30/BLC-30G HPLC

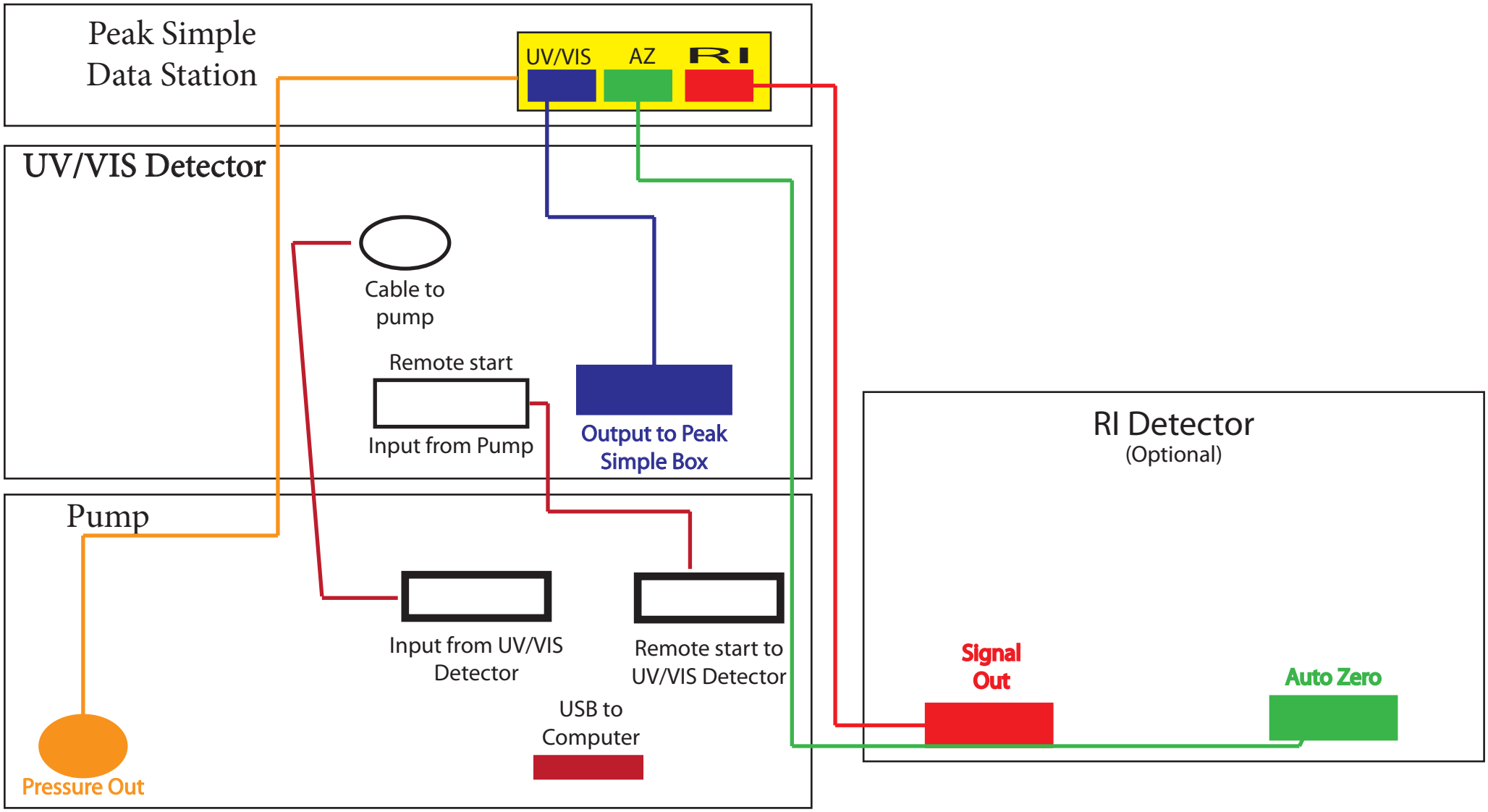
Installation:

- Remove HPLC components from boxes and place on work surface
- Make all wiring connections (see attached diagram)
- Connect USB cord from back of HPLC to PC
    - If Windows 7, the driver for this should automatically be found. If older than Windows 7, will need to go to http://www.ftdichip.com/Drivers/VCP.htm and download the appropriate version.
    - Check the device manager to determine the port number that was assigned to the pump USB
- Install Peak Simple
    - Follow the enclosed Instructions for the initial installation.
    - After installation is complete, copy the files in the folder named "HPLC Setup Files" into the Peak Simple folder. It will ask if you want to overwrite some files, choose yes.
    - Double click the icon on the desktop (there will be an error message when Peak Simple first loads)
    - Go to Edit/Overall and choose the 333 board for single channel data station and 302 for six channel data station on the left side of the screen and put the USB number in the box below
    - Go to Edit/Channels/Details and choose "gradient" under "control by"
    - Input the number of the port number that you found in device manager.
    - Under File menu, choose "save control file", name it default, and all changes you have made will come up every time you open Peak Simple.
- Connect all tubing/fittings/column

Operation:

- Turn on all components
- Prime pump
- Make sure injection handle is turned to “Load”
- Open Peak Simple
- Edit/Channels/Gradient
    - For Isocratic operation, the gradient should be set to 100% for the length of the run by clicking “Add” and then setting the initial gradient to 100%, and the hold time for the length of the run.
    - For Gradient operation (BLC-30G only), the gradient can be programmed as necessary by adding as many segments as necessary to the gradient program. (note: to reduce the flow %, the ramp should be negative.
- Set the overall pump flow rate by going to View/Pump Relay Control. The pump speed control will be found at the bottom of the window.
- Turn on Pump(s) in the pump Relay Control Screen
- Inject Sample into valve with syringe.
- Turn Injection valve to “Inject”, the data acquisition should begin automatically.

Buck Scientific BLC series
HPLC schematic



BLC-30 Connections

- 15 pin cable from detector – 5 wire bunch
  - Green/Yellow – Ground
  - Red – (+) signal in Ch. 1
  - Black – (–) signal in Ch. 1

- 15 pin cable from detector – 10 wire bunch
  - Blue – RS1
  - Orange – NO Event H
  - Black – C Event H

- Pressure Cable (6 Channel Systems Only)
  - White – (+) Signal in Ch. 6
  - Blue – (–) Signal in Ch. 6

- Refractive Index Detector (if purchased)
  - Center Wire – (+) signal in Ch. 2
  - Outer Wire – (–) signal in Ch. 2
  - Autozero Wire – NO Event G
  - Ground Wire – C Event G

TABLE OF CONTENTS

1 INTRODUCTION

This operator's manual contains information needed to install, operate, perform user maintenance, and service the Series III Digital HPLC Pump.

1.1 Description of the Series III Pump

The Series III high performance liquid chromatography (HPLC) pump is designed to be a reliable component within basic analytical or sophisticated research instruments. While ideal for HPLC applications, the Series III pump is also useful as a metering pump for general laboratory or industrial use.

The flow rate of the Series III pump fitted with the standard 10 mL pump head can be set in 0.01 mL increments from 0.00 to 10.00 mL/min; the optional 40 mL pump head allows flow rates from 0.0 to 40.0 mL/min. Both sizes are available in type 316 stainless steel or biocompatible (metal-free) PEEK™.

The low pulsation flow produced by the reciprocating, single-piston pump is achieved by using an advanced rapid-refill cam design, programmed stepper motor acceleration, and an internal pulse damper.

1.1.1 Pump Features

The Series III Pump:

- Can easily be modified for analytical and semi-preparative techniques.
- Incorporates a diaphragm-type pulse damper, which reduces pulsation in the system by as much as 90% and includes an isolated pressure transducer (i.e., the transducer adds no dead volume).
- Automatically turns the pump OFF if the pressure exceeds the maximum pressure limit determined by the pump head type (6000 psi for the 10mL/min stainless steel pump heads; 5000 psi for PEEK™, 10mL/min pump heads; or 1600 psi for the 40mL/min pump heads). The operator may program upper and lower pressure limits within the maximum range set by the pump head type.
- Integrated prime/purge valve.
- Autoprime™ one button toggles flowrate to maximum for rapid solvent change
- Outlet filter
- Autoflush™ piston wash
- LED readout on the front panel—shows the flow rate and pressure limits.
- Tactile response, chemically resistant front panel keypad.
- Microprocessor advanced control.
- Digital stepper motor design prevents flow rate drift over time and temperature, which is a common problem found in analog design.
- Back panel USB and RS232 serial communications ports for complete control and status monitoring.

1.1.2 Wetted Materials

Pump heads, check valve bodies, and tubing are made out of type 316 stainless steel or PEEK™, depending on version ordered. Other materials common to either stainless steel or PEEK™ models are synthetic ruby and sapphire (check valve internals and piston) and fluorocarbon damper (diaphragm).

1.1.3 Self-Flushing Pump Heads

Self-flushing pump heads provide continuous washing of the piston surface without the inconvenience of a manual flush or gravity feed arrangement. The self-flushing pump head uses a secondary seal and set of check valves to create a continuous and positive flow in the area behind the high-pressure pump seal. The flushing solution washes away any buffer salts that have precipitated onto the piston. If not removed, these precipitates can abrade the high-pressure seal and cause premature seal failure, leakage, and can possibly damage the pump.

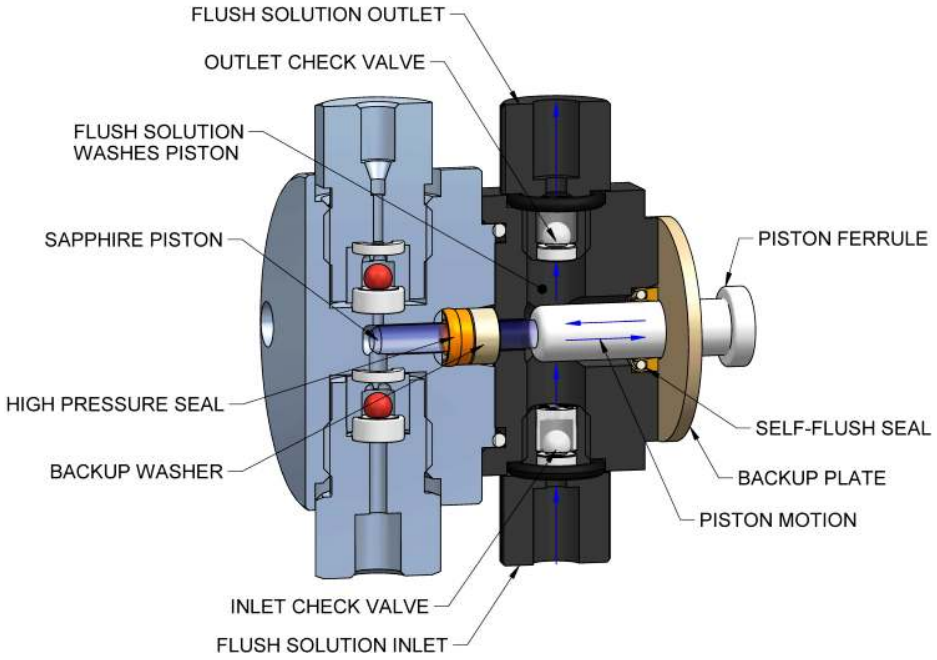


Figure 1-1. Self-Flushing Pump Head

1.1.4 Self-Flush and Seal Life

It is recommended that the Self Flush feature be used to improve seal life in a number of applications. In particular, (as stated above) if pumping Buffers, Acids/Bases or any inorganic solution near saturation, the pump should utilize the Self Flush feature. With every piston stroke, an extremely thin film of solution is pulled back past the seal. If this zone is dry (without use of Self Flush), then crystals will form with continuous operation, which will ultimately damage the seal.

Another application where Self Flush is highly recommended is when pumping Tetrahydrofuran (a.k.a. THR, Diethylene Oxide) or other volatile solvents such

as acetone (Note: THF and most solvents are compatible only with all-Stainless Steel systems. THF will attack PEEK). Volatile solvents will dry rapidly behind the seal (without the use of Self Flush), which will dry and degrade the seal.

IPA, Methanol, 20% IPA/water mix or 20% Methanol/water mix are good choices for the flush solution. Consult the factory for specific recommendations.

1.2 Specifications for the Series III Pump

Flow Rates*	0.00 to 10.00 mL/min for 10 mL/min head 0.0 to 40.0 mL/min for 40 mL/min head
Pressure	0 to 6,000 psi for 10 mL/min SS pump head, 0 to 5,000 psi for 10 mL/min PEEK™ head, 0 to 1,600 psi for 40 mL/min pump heads
Pressure Accuracy	±1% of full-scale pressure
Pressure Zero Offset	±2 PSI
Flow Accuracy	±2% for a flow rate of 0.20 mL/min and above for 10 mL/min head, with 80:20 Water/IPA @ 1000 psi ±2% for 0.1 to 40.00 mL/min for 40 mL/min head
Flow Precision	0.2% RSD
Dimensions	5.5" high x 10.375" wide x 17.5" deep
Weight	24 lb
Power	100-120 VAC, 50-60 Hz; 45 W (The main voltage supply shall not exceed ±10%
Environmental	Indoor Use Only
Altitude	2000 M
Temperature	10º to 30º C
Humidity	20 to 90 % Relative Humidity
Remote Inputs	RS-232

* Flow rate is dependent on solvent selection and operating pressure.
See **Section 3** to adjust flow rate for solvent and pressure.

2 INSTALLATION

2.1 Unpacking and Inspection

Prior to opening the shipping container, inspect it for damage or evidence of mishandling. If it has been damaged or mishandled, notify the carrier before opening the container. Once the container is opened, inspect the contents for damage. Any damage should be reported to the carrier immediately. Save the shipping container. Check the contents against the packing list.

2.2 Location/Environment

The preferred environment for the Series III pump is normal laboratory conditions. The area should be clean and have a stable temperature and humidity. The instrument should be located on a stable flat surface with surrounding space for ventilation and the necessary electrical and fluid connections. (Reference IEC 1010 installation category II, and Pollution degree 2 environment)

2.3 Electrical Connections

Unpack the Series III pump; position the pump there so that is at least a four-inch clearance on all sides to permit proper ventilation. Using the power cord supplied with the pump, or equivalent, plug the pump into a properly grounded electrical outlet.

WARNING: Do not bypass the safety ground connection as a serious shock hazard could result.

2.4 Solvent Preparation

Proper solvent preparation will prevent a great number of pumping problems. The most common problem is bubble formation, which may affect the flow rate consistency. Aside from leaky fittings, the problem of bubble formation arises from two sources: solvent out-gassing and cavitation. Filtration of HPLC solvents is also required.

2.4.1 Solvent Out-gassing and Sparging

Solvent out-gassing occurs because the mobile phase contains dissolved atmospheric gases, primarily N2 and O2. These dissolved gases may lead to bubble formation and should be removed by degassing the mobile phase before or during use. The best practical technique for degassing is to sparge the solvent with standard laboratory grade (99.9+%) helium. Helium is only sparingly soluble in HPLC solvents, so other gases dissolved in the solvent diffuse into the helium bubbles and are swept from the system. Solvent filtration is not an effective alternative to helium degassing.

It is recommended that you sparge the solvent vigorously for 10 to 15 minutes before using it. Then maintain a trickle sparge during use to keep atmospheric gases from dissolving back into the mobile phase. The sparged solvent must be continually blanketed with helium at 2 to 3 psi. Non-blanketed sparged solvents will have atmospheric gases dissolved back into the mobile phase within four hours.

Solvent mixtures using water and organic solvents (like methanol or acetonitrile) hold less dissolved gas than pure solvents. Sparging to reduce the amount of dissolved gas is therefore particularly important when utilizing solvent mixture.

Even with sparging some out-gassing may occur. A backpressure regulator installed after the detector flow cell will help prevent bubbles from forming and thus limit baseline noise.

WARNING: Always release pressure from the pump slowly. A rapid pressure release could cause the pulse damper diaphragm to rupture.

2.4.2 Cavitation

Cavitation occurs when inlet conditions restrict the flow of solvent and vapor bubbles are formed during the inlet stroke. The key to preventing cavitation is to reduce inlet restrictions. The most common causes of inlet restrictions are crimped inlet lines and plugged inlet filters. Inlet lines with tubing longer than 48" (120 cm) or with tubing of less than 0.085" (2 mm) ID may also cause cavitation.

Placing the solvent reservoirs below the pump level also promotes cavitation. The optimal location of the reservoirs is slightly above the pump level, but it is adequate to have them on the same level as the pump.

2.4.3 2.4.3 Filtration

Solvent filtration is good practice for the reliability of the Series III pump and other components in a HPLC system. Solvents should always be filtered with a 0.5 micron filter prior to use. This ensures that no particles will interfere with the reliable operation of the piston seals and check valves. Solvents in which buffers or other salts readily precipitate out will need to be filtered more often. After filtration, the solvents should be stored in a closed, particulate-free bottle.

2.4.4 Solvents With Harmful Effects

Except for PEEK™ pump heads, all portions of the Series III pump that contact mobile phase are manufactured of type 316 stainless steel, sapphire, ruby, or fluorocarbon polymer. Some of these materials are extremely sensitive to acids (including some Lewis acids) and acid halides. Avoid using solvents that contain any amount of hydrochloric acid.

Some solvents you should specifically avoid are:

Aqua Regia	Hydrochloric Acid
Bromine	Hydrofluoric Acid
Chlorine Anhydrous	Hydrofluorsilicic Acid
Copper Chloride	Hydrogen Peroxide
Ferric Chloride	Iodine
Ferrous Chloride	Mercuric Chloride
Freon 12 (wet)	
Guanidine	
Hydrobromic Acid	

In addition, some users of HPLC systems have observed that chloroform and carbon tetrachloride slowly decompose to liberate hydrochloric acid, which, as noted above, attacks stainless steel. Do not leave these solvents in the systems for a prolonged period.

You may also want to avoid ammonium hydroxide. Although ammonium hydroxide will not harm the pump itself, it is likely to damage the stator and rotor in injection valves.

2.5 Instrument Installation

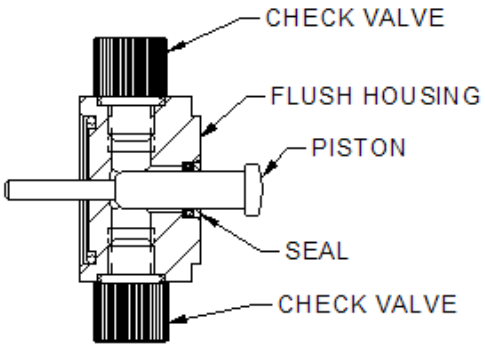
2.5.1 Mobile Phase Reservoirs

The mobile phase reservoir should be placed at the same level or slightly higher than the pump, never below the pump, and the inlet tubing should be as short as practical. These steps minimize pressure losses on the inlet side of the pump during refill and help to avoid bubble formation. These steps are particularly important when using high vapor pressure solvents (hexane, methylene chloride, etc.). Mobile phases should be degassed, filtered and covered. (See Section 2.4.)

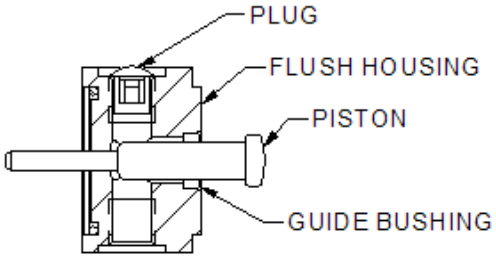
2.5.2 Self-Flush Solution

Self-flush heads require 250-500 mL of flushing solution. See section 1.1.4 for self-flush solution recommendations. A pH indicator that will indicate the concentration of salts in the solution is recommended as a reminder to change the solution. This flush solution should be replaced with a fresh solution weekly to avoid frequent pump maintenance.

WARNING: If you do not use the self-flush feature of this pump, you must carefully remove the self-flush seal with the seal tool provided, replace with the guide bushing provided (See illustration below). If this is not done; low flow rates, excessive noise and shortened pump life will result.



SELF-FLUSH ASSEMBLY



NON-FLUSH ASSEMBLY

2.5.3 Inlet Tubing and Filters

All inlet lines are supplied in a 36" (91 cm) length, with a 0.085” ID and a 1/8” OD, and are made of a Teflon-based material Use a 20 micron slip-on inlet filter.

2.5.4 Outlet Tubing

Outlet tubing (not supplied with the pump) should have a 1/16" outer diameter. It is available in type 316 stainless steel, or PEEK™. Tubing with a 0.020" inner diameter is normally used before the injection valve. Tubing with a 0.010" inner diameter is normally used after the injection valve. The tubing must be cut squarely with no burrs. The tube itself should not be crimped and the center hole must be open. A tubing cutter is recommended for cutting stainless steel tubing. PEEK™ tubing may be cut with a plastic tubing cutter or razor knife.

2.5.5 Priming the Pump and the Flushing Lines

Be sure all of the connections downstream of the prime/purge valve are closed. Connect a syringe to the prime/purge valve. Open the prime/purge valve 1 to 2 turns (counter-clockwise). Run the pump at a flow rate of 3 to 5 mL/min. Prime the pump by pulling mobile phase and any air bubbles through the system and into the syringe (a minimum of 20 mL). Close the prime/purge valve and stop the pump.

To prime the flush lines for a self-flush head, connect one of the small Luer-to-barb fittings to a syringe and pull 10-20 mL of flush solution through the outlet line (at the top of the pump head).

2.5.6 Long Term Pressure Calibration Accuracy

This note applies if your pump is equipped with an electronic pressure transducer. The transducer has been zeroed and calibrated at the factory. Over the life of the pump, some drift may occur. For example, it is typical for the zero to drift < 10 psi. after about 1 year of operation (i.e., with no back pressure on the pump a reading of 1-9 psi. may be displayed). A similar drift may also occur at higher pressures, and are typically less than 1% (e.g. <50 psi. at 6,000 psi. back pressure).

If pressure calibration and/or drift are a concern, consult the factory. The pump can be shipped back to SSI for recalibration. Alternatively, written calibration and zero-reset procedures are available. Consult the factory to receive these instructions.

2.6 Preparation for Storage or Shipping

2.6.1 Isopropanol Flush

Disconnect the outlet tubing from the pump. Insert the inlet filter in isopropanol. Open the prime/purge valve and use a syringe to draw a minimum of 50 mL. Close the prime/purge valve and pump a minimum of 5 mL of isopropanol to exit. Leave the inlet tubing connected to the pump. Place the inlet filter in a small plastic bag and attach it to the tubing with a rubber band. Plug the outlet port with the shipping plug, leave a length of outlet tubing on the pump, or cover the outlet port with plastic film.

2.6.2 Packaging for Shipping

CAUTION: Re-package in the original carton, if possible. If the original carton is not available, wrap the pump in several layers of bubble wrap and cushion the bottom, top, and all four sides with 2" of packaging foam. Although heavy, an HPLC pump is a delicate instrument and must be carefully packaged to withstand the shocks and vibration of shipment.

3 OPERATION

3.1 Front Panel Controls and Indicators

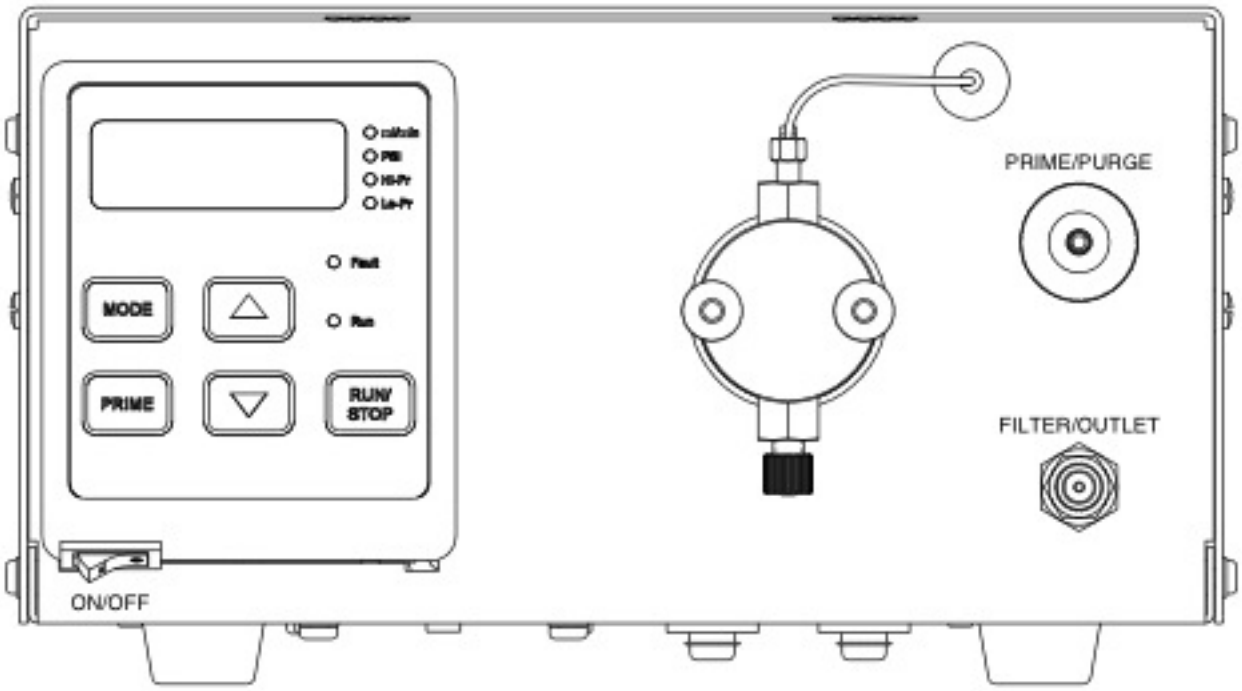


Figure 3-1. Series III Pump Front Panel

3.1.1 Prime/Purge Valve

CAUTION: When you press the PRIME key, the pump will run at the maximum flow rate. Be sure the prime/purge valve is open.

The prime/purge valve vents the flow to atmosphere and permits efficient priming of the Series III pump. When the valve is closed (fully clock-wise) firmly, high-pressure flow is directed to the Filter/Outlet port. When the valve is opened (counter clock-wise) one-half to one full turn, pressure is vented and flow exits through the drain port in the prime/purge valve stem assembly. Suction with a Luer tip syringe at the drain port will purge air bubbles from the pump and reservoir lines (provided there are no open valves to lines down-stream at the injector/column interface). To prime the pump, draw about 20 to 30 mL of mobile phase.

3.1.2 Filter/Outlet

A high-pressure in-line filter (0.5 micron rating) is included at the output of the Series III pump. The Filter/Outlet port is the high-pressure filter closure and is designed for a 1/16" OD tubing connection.

3.1.3 Control Panel

3.1.3.1 Digital Display

The 4-digit display shows the pump flow rate (mL/min), system pressure (psi), or the set upper or lower pressure limit (psi) when operating. Choice of display is selected with the MODE key.

3.1.3.2 Keypad

RUN/ STOP	This button alternately starts and stops the pump.
Δ	This button increases the flow rate.
∇	This button decreases the flow rate.
PRIME	When the PRIME button is pressed, the pump runs at the maximum flow rate for the pump head. It will stop when any button is pressed.

Fast And Slow Button Repeat On The Up And Down Arrow Buttons: If the UP-ARROW or DOWN-ARROW button is held down for more than approximately one half of a second, the button press will repeat at a slow rate of approximately 10 times a second. Once slow button repeat has begun, fast button repeat can be initiated by using a second finger to press down the second arrow button. During fast button repeat, the button press will repeat at a rate of approximately 100 times a second. Switching back and forth between repeat speeds can be accomplished by pressing and releasing the second arrow button while keeping the first arrow button held down.

3.1.3.3 Status LEDs

ML/MIN	When lit, the digital display shows flow rate in mL/min.
PSI	When lit, the digital display shows system pressure in psi.
HI PRESS	When lit, the display shows the user-set upper pressure limit in psi.
LO PRESS	When lit, the display shows the user-set lower pressure limit in psi.
PUMP RUN	Lights to indicate that the pump is running.
FAULT	Lights when a fault occurs and stops the pump.

3.1.3.4 Power-up Configuration

Pressure Compensation: On power-up, press the PRIME button on the front panel while pressing the Power On switch under the front display panel. The pump will display a number from 0 to 60 (10ml head) or 0 to 16 (40ml head). This represents the running pressure of the pump from 0 psi to 6000 psi or 0 psi to 1600 psi. Each digit represents 100 psi. To change the pressure compensation number use the up arrow and down arrow buttons. When you have selected the correct pressure compensation press the RUN button to return to normal operation of the pump.

Non-volatile Memory Reset: If the pump is operating erratically, there is the possibility that the memory has been corrupted. To reset the memory and restore the pump to its default parameters, press and hold the UP-ARROW button when the power is switched on. Release the button when the display reads "rES". The parameters stored in non-volatile memory, i.e., the flow rate, the pressure compensation, the voltage/frequency select, the lower pressure limit, and the upper pressure limit will be set to the factory default values. The head type setting is the only parameter not changed by the non-volatile memory reset function. If the firmware is upgraded to a newer version, a non-volatile memory reset will automatically occur the first time the power is switched on.

3.1.3.5 Power-Up Tests

Display Software Version Mode: The software version can be displayed during power-up by pressing and holding the RUN/STOP and the UP-ARROW buttons when the power is switched on. Release the buttons when the display reads "UEr". The decimal point number displayed on the display is the software version. To exit this mode, press the RUN/STOP button.

Display Software Checksum Mode: If the pump is operating erratically, there is the possibility that the firmware stored in the program memory integrated circuit (EPROM) has been corrupted. Each version of firmware has a checksum which is printed on the EPROM's label. The pump's cover must be removed to gain access to the EPROM which is located on the Pump Control Board; therefore, this should be only done by a qualified technician. To verify that the firmware has not been corrupted, do the following: The software checksum can be displayed during power-up by pressing and holding the RUN/STOP and the DOWN-ARROW buttons when the power is switched on. Release the buttons when the display reads "CHE". After approximately 25 seconds, the 4-digit hexadecimal checksum will be displayed. To exit this mode, press the RUN/STOP button. If the checksum displayed does not match the checksum printed on the EPROM's label, the EPROM must be replaced. Note: If the pump is operating correctly, the firmware version and checksum can be displayed then written in the manual for future comparison. This will save time during future troubleshooting since the pump's cover will not have to be removed to read the EPROM's label.

Align Refill Switch Mode: The signal that initiates the refill phase can be displayed during power-up by pressing and holding the PRIME and the UP-ARROW buttons when the power is switched on. Release the buttons when the display displays "rFL". When the slotted disk allows the light beam to pass from the emitter to the detector on the slotted optical switch a pulse will be generated which signals the beginning of refill. When this pulse occurs the three horizontal segments displayed at the top of the display will turn off and the three horizontal segments at the bottom of the display will turn on. To exit this mode, press the RUN/STOP button.

Serial Port Loop back Test Mode: If an external device will not communicate to the pump via the serial port, the serial port loop back test can be used to verify that the serial port is functioning properly. During power-up press and hold the UP-ARROW and the DOWN-ARROW buttons when the power is switched on and then release the buttons. The display must display "C00" for the first half of the test to pass. Plug in the serial port loop back plug (A modular plug with pins 2 & 5 jumpered together and pins 3 & 4 jumpered together.). The display must read "C11" for the

second half of the test to pass. To exit this mode, press the RUN/STOP button.

3.2 Rear Panel Remote Input

USB and RS-232C ports are provided on the back panel. A computer with appropriate software can be used as a remote control device for pump operation via this connection. The USB interface has precedence, and when connected will disable RS-232 communication.

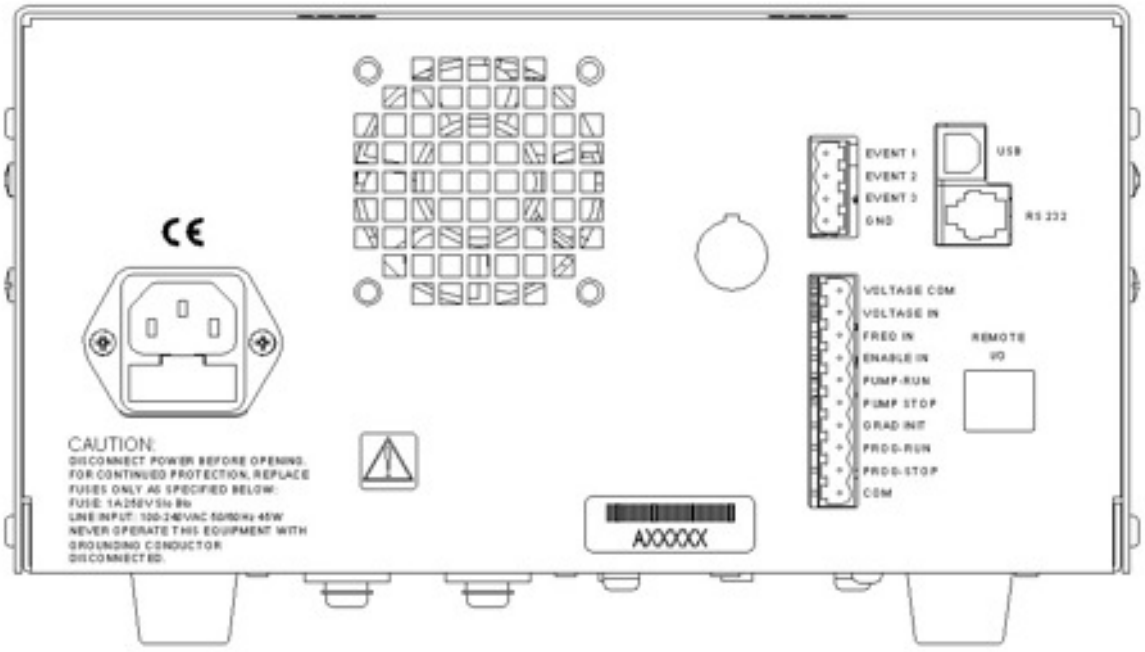


Figure 3-2. Series III Pump Rear Panel

Note: For external connections and serial communications see Appendix A.

4 MAINTENANCE

Cleaning and minor repairs of the Series III pump can be performed as outlined below.

Note: Lower than normal pressure, pressure variations, or leaks in the pumping system can all indicate possible problems with the piston seal, piston, or check valves. Piston seal replacement could be necessary after 1,000 hours of running time. See Section 4.2.3.

4.1 Filter Replacement

4.1.1 Inlet Filters

Inlet filters should be checked periodically to ensure that they are clean and not restricting flow. A restriction could cause cavitation and flow loss in the pump. Two problems that can plug an inlet filter are microbial growth and impure solvents. To prevent microbial growth, use at least 10-20% organic solvent in the mobile phase or add a growth-inhibiting compound. If you pump 100% water or an aqueous solution without any inhibitors, microbes will grow in the inlet filter over time, even if you make fresh solution every day. Always use well filtered, HPLC grade solvents for your mobile phase.

4.1.2 Outlet Filter

To service the outlet filter on stainless steel pumps:

1. Unscrew the filter closure from the filter housing.

CAUTION: Do not use a metal object such as a screwdriver or paperclip to remove the seal. Doing so can scratch the precision surface of the seat and may cause the filter to leak.

2. Use a seal insertion/removal tool or a non-metallic object (such as a wooden toothpick) to remove the large seal that remains in the housing.
3. Unscrew the old filter and remove the small seal from the filter closure.
4. Place one of the small seals included in the replacement element kit over one of the new filters from the kit. Screw the new filter into the filter closure (finger tight).
5. Place one of the large seals from the replacement kit on the filter closure. Insert the filter closure into the housing and tighten.

To service the PEEK™ outlet filter, simply open the filter housing and clean or replace the filter element inside.

4.2 Changing Pump Heads

4.2.1 Removing the Pump Head

As a guide to pump head assembly, the standard pump heads are shown in Figures 4-1 through 4-4. All of the Series III pump heads have a similar arrangement.

1. Turn OFF the power to the Series III pump.

2. Remove the inlet line and filter from the mobile phase reservoir. Be careful not to damage the inlet filter or crimp the Teflon™ tubing.
3. Remove the inlet line from the inlet check valve.
4. Remove the outlet line from the outlet check valve.
5. Remove inlet and outlet self-flush lines.
6. Momentarily turn ON the Series III pump and quickly turn OFF the power upon hearing the refill stroke. This reduces the extension of the piston and decreases the possibility of piston breakage.
7. Unplug the power cord.
8. Carefully remove the two knurled nuts at the front of the pump head.

CAUTION: Be careful not to break the piston when removing the pump head. Twisting the pump head can cause the piston to break.

9. Carefully separate the pump head from the pump. Move the pump head straight out from the pump and remove it from the piston. Be careful not to break or damage the piston. Also remove the seal and seal backup washer from the piston if they did not stay in the pump head.
10. Carefully separate the flush housing from the pump. Move the flush housing straight out from the pump and remove it from the piston. Be careful not to break or damage the piston. Also remove the self-flush seal from the piston if it did not stay in the flush housing.

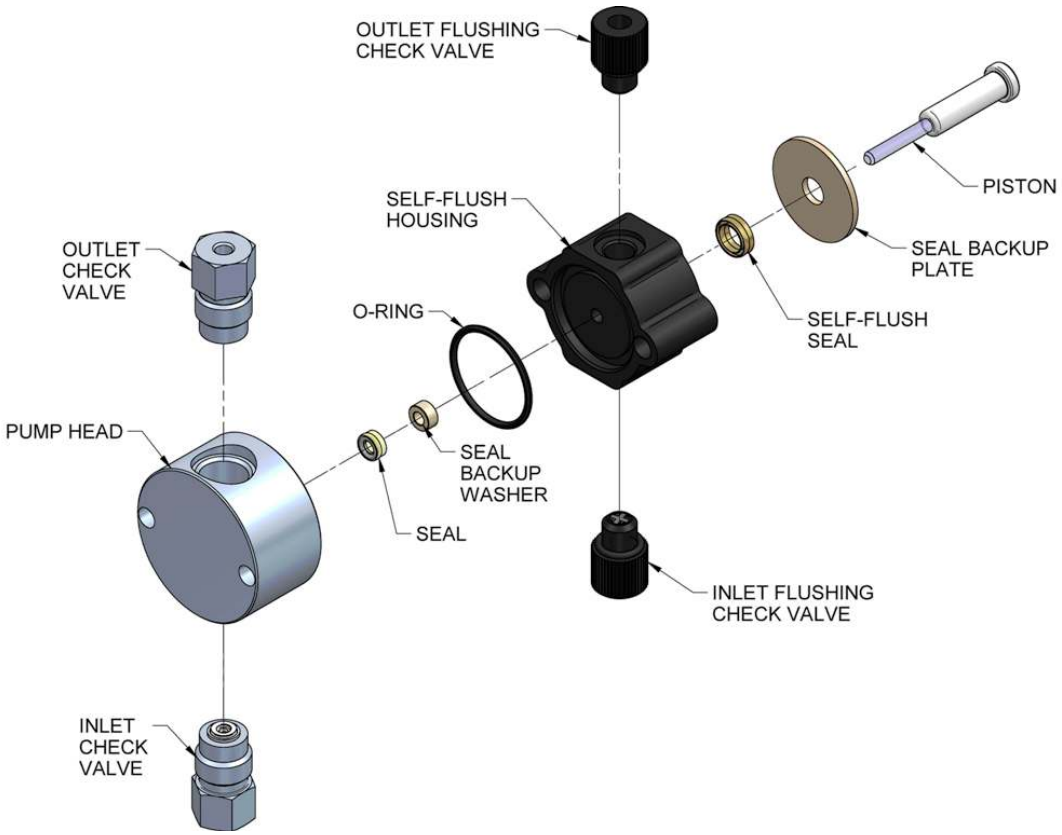


Figure 4-1. Stainless Steel Self-Flushing Pump Head Assembly

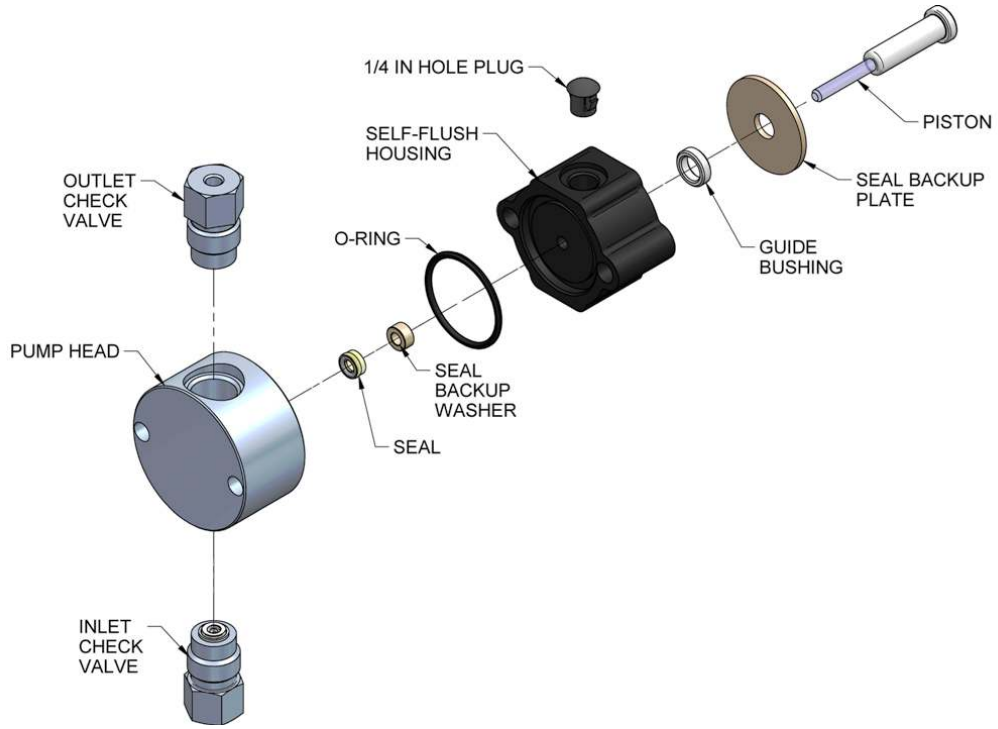


Figure 4-2. Stainless Steel Non-Self-Flushing Pump Head Assembly

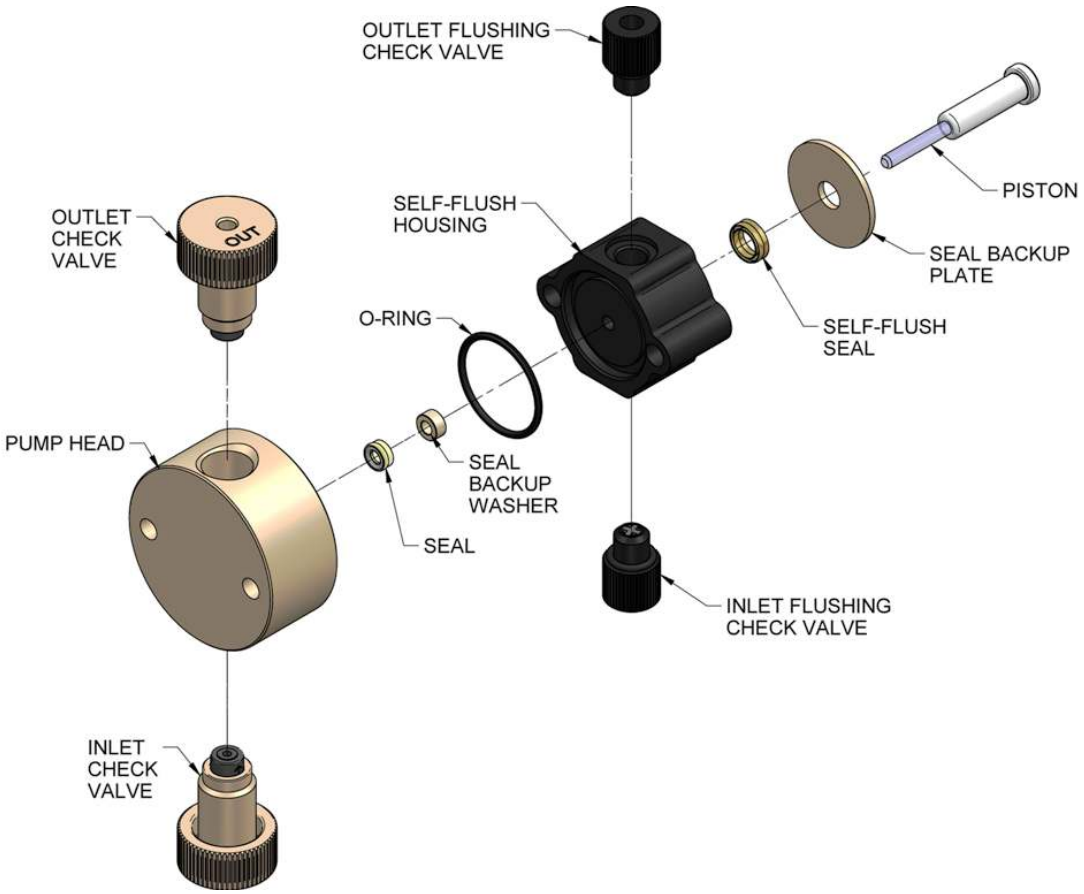


Figure 4-3. Bioclean (PEEK™) Self-Flushing Pump Head Assembly

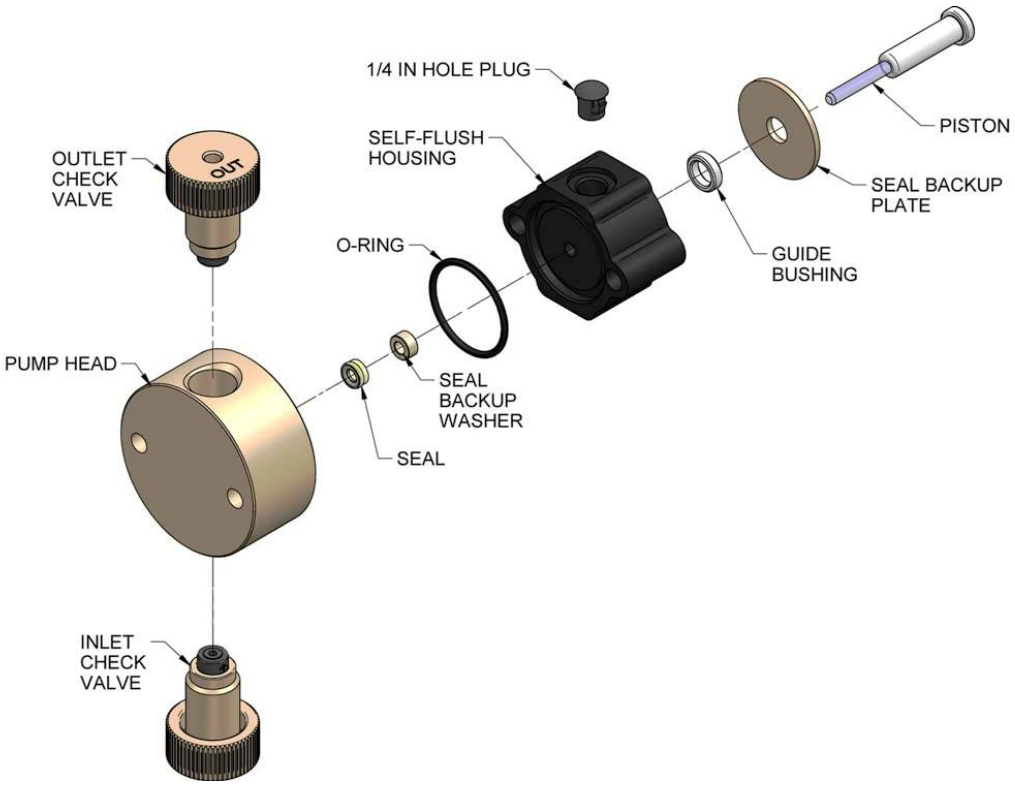


Figure 4-4. Bioclean (PEEK™) Non-Self-Flushing Pump Head Assembly

4.2.2 Cleaning the Pump Head Assembly

Note: If you choose to remove the piston seal or self-flush seals, you should have a new set on hand to install after cleaning. It is not recommended that you reinstall used piston or self-flush seals since they are likely to be scratched and damaged during removal and would not provide a reliable seal if reused. If you decide to remove the seals, use only the flanged end of the plastic seal removal tool supplied with the seal replacement kit and avoid scratching the sealing surface in the pump head. See Section 4.2.3 for seal replacement instructions.

1. Inspect the piston seal cavity in the pump head. Remove any foreign material using a cotton swab, or equivalent, and avoid scratching the sealing surfaces. Repeat for the self-flush housing. Be sure no fibers from the cleaning swab remain in the components.
2. The pump head, check valves, and self-flush housing may be further cleaned using a laboratory grade detergent solution in an ultrasonic bath for at least 30 minutes, followed by rinsing for at least 10 minutes in distilled water. Be sure that all particles loosened by the above procedures have been removed from the components before re-assembly.
3. If the check valves have been removed, tighten the check valves on stainless steel pumps to 75 inch-pounds or enough to seal at maximum pressure. For Bioclean (PEEK™) pumps, tighten each check valve to 10-15 inch-pounds.

Note: The inlet check valve has a larger opening (1/4"-28, flat-bottom seat) for the 1/8" inlet tubing; the outlet check valve has a smaller opening (#10-32, cone seat) for the 1/16" outlet tubing. For 10 mL heads only, the inlet check valve must be connected at the larger opening in the pump head. See Figure 4-5.

If the piston and flushing seals have been removed, insert new seals as described in Section 4.2.3, then continue with Section 4.2.5 to replace the pump head.

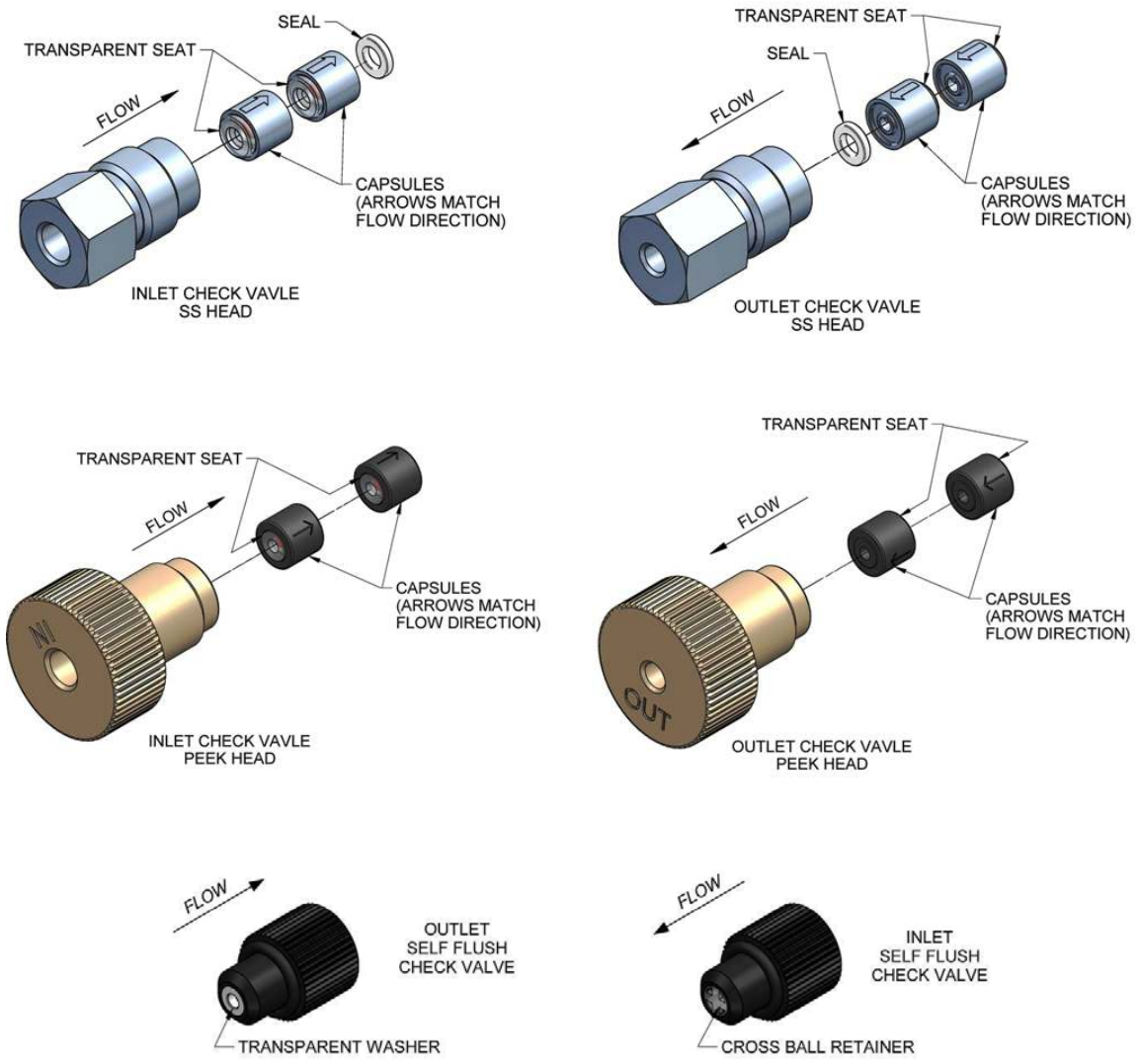


Figure 4-5. Check Valves

4.2.3 Replacing Piston Seals

Lower than normal pressure, pressure variations, and leaks in the pumping system can all indicate possible problems with the piston seal. Depending on the fluid or mobile phase used, piston seal replacement is often necessary after 1000 hours of running time.

Each replacement seal kit contains one seal, one backup washer, one self-flush seal, one non-flush guide bushing, two seal insertion/removal tools, and a pad to clean the piston when changing the seal.

4.2.3.1 Removing the Seals

1. Remove the pump head as described in Section 4.2.1.
2. Insert the flanged end of the seal insertion/removal tool into the seal cavity on the pump head. Tilt it slightly so that flange is under the seal and pull out the seal.

CAUTION: Using any other “tool” will scratch the finish.

3. Repeat the procedure for the low-pressure seal in the flush housing.
4. Inspect, and if necessary, clean the pump head as described in Section 4.2.2.

4.2.3.2 Cleaning the Piston

1. Once the pump head and self-flush housing are removed, gently remove the seal back-up plate by using either a toothpick or small screwdriver in the slot on top of the pump housing.
2. Grasp the metal base of the piston assembly so that you avoid exerting any side load on the sapphire rod, and remove the piston from the slot in the carrier by sliding it up.
3. Use the scouring pad included in the seal replacement kit to clean the piston. Gently squeeze the piston within a folded section of the pad and rub the pad along the length of the piston. Rotate the piston frequently to assure the entire surface is scrubbed. Do not exert pressure perpendicular to the length of the piston, as this may cause the piston to break. After scouring, use a lint-free cloth, dampened with alcohol, to wipe the piston clean.
4. Grasp the metal base of the piston assembly, and insert it into the slot in the piston carrier until it bottoms in the slot.

4.2.3.3 Replacing the Seals

1. Place a high-pressure replacement seal on the rod-shaped end of the seal insertion/removal tool so that the spring is visible when the seal is fully seated on the tool. Insert the tool into the pump head so that the open side of the seal enters first, facing the high-pressure cavity of the pump head. Be careful to line up the seal with the cavity while inserting. Then withdraw the tool, leaving the seal in the pump head. When you look into the pump head cavity, only the polymer portion of the seal should be visible.
2. Place a self-flush replacement seal on the seal insertion/removal tool so that the spring in the seal is visible when the seal is on the tool. As in the previous step, insert the tool and seal into the seal cavity on the flushing housing, taking care to line up the seal with the cavity, and then withdraw the tool. When the seal is fully

inserted only the polymer part of the seal will be visible in the seal cavity.

3. Place seal back-up washer over the high-pressure seal. Place seal back-up plate back into pump housing if it was removed. Orientation is not important in these cases.
4. Attach the pump head as described in Section 4.2.5.
5. Condition the new seal as described in Section 4.3.

4.2.4 Changing the Piston

1. Remove the pump head as described in Section 4.2.1.
2. Grasp the metal base of the piston assembly so that you avoid exerting any side load on the sapphire rod, and remove the piston from the slot in the carrier by sliding it up.
3. Grasp the metal base of the replacement piston assembly, and insert it into the slot in the piston carrier until it bottoms in the slot.
4. Attach the pump head as described in Section 4.2.5.

4.2.5 Replacing the Pump Head

1. Make sure that the inlet valve is on the bottom and the outlet valve is on the top. Carefully align the self-flush housing and gently slide it into place on the pump. If misalignment with the piston occurs, gently push up on the piston holder.
2. Line up the pump head and carefully slide it into place. Be sure that the inlet valve is on the bottom and the outlet valve is on the top. Do not force the pump head into place.
3. Finger tighten both knurled nuts into place. To tighten firmly, alternately turn nuts 1/4 turn while gently wiggling the pump head to center it.
4. Re-attach the inlet and outlet lines. Reconnect the self-flush lines and fittings to the self-flush check valves. Change the flushing solution.

4.3 Conditioning New Seals

Note: Use only organic solvents to break-in new seals. Buffer solutions and salt solutions should never be used to break-in new seals.

Using a restrictor coil or a suitable column, run the pump with a 50:50 solution of isopropanol (or methanol) and water for 30 minutes at the back pressure and flow rate listed under PHASE 1 below and according to the pump head type. Then run the pump for 15 minutes at a backpressure and flow rate listed under PHASE 2 below.

	PHASE 1		PHASE 2	
Pump Head Type	**Pressure**	**Flow Rate**	**Pressure**	**Flow Rate**
10 mL SS/PEEK™	2000 psi	<3 mL/min.	3000-4000 psi	3-4 mL/min.
40 mL SS/PEEK™	1000 psi	<3 mL/min.	1500 psi	<6 mL/min.

4.4 Check Valve Cleaning

Many check valve problems are the result of small particles interfering with the operation of the check valve. As a result, most problems can be solved by pumping a strong solution of liquid, laboratory grade detergent through the check valves at a rate of 1 mL/min (3 mL/min for the 40 mL pump head) for one hour. After washing with detergent, pump distilled water through the pump for fifteen minutes. Always direct the output directly to a waste beaker during cleaning. If this does not work, the check valve should be replaced.

4.5 Pulse Damper Replacement

4.5.1 Removing the Pulse Damper

WARNING: There are potentially lethal voltages inside the pump case. Disconnect the line cord before removing the cover. Never bypass the power grounds.

1. Make certain that the system has been depressurized. Unplug the power cord and remove the cover.
2. Disconnect the tubing from the pulse damper.
3. Disconnect the transducer from the circuit board.
4. Remove the four screws that secure the pulse damper from the underside of the pump.
5. Remove the pulse damper.

4.5.2 Pulse Damper Refurbishing

Refurbishing the pulse damper is a time-consuming procedure. You may want to return the pulse damper to have it rebuilt. Do not attempt to refill or refurbish the pulse damper until you have a refurbishing kit. Instructions are furnished with the kit.

4.5.3 Pulse Damper Installation

1. Position the pulse damper, aligning it with the four mounting holes in the bottom of the cabinet. The pressure transducer should be pointed toward the rear of the cabinet.
2. From the underside of the pump cabinet, tighten the four screws to hold the pulse damper in place.
3. Connect the tubing from the pump head to the port at the rear of the pulse damper (i.e., toward the rear of the cabinet). Connect the line from the prime/purge valve to the other port, toward the front panel.
4. Connect the transducer's wire harness connector to pressure board connector P3.
5. Replace the cover on the pump.

4.6 Cleaning the Pump

1. Disconnect the column inlet tube from the column.

2. Direct the column inlet tube (the tube from the injector outlet) to a waste beaker.
3. Set the flow rate to maximum.
4. Turn the injector to the INJECT position.
5. Pump 100% isopropanol through the pump and injector for 3 minutes.
6. Pump 100% filtered, distilled water through the pump and injector for 3 minutes.

   For stainless steel flow paths, proceed to Step 7; For PEEK ™ flow paths, the cleaning procedure is completed.

WARNING: Use standard laboratory procedures and extreme care when handling strong acids and bases.

7. Pump a 20% nitric acid/water solution through the pump and injector for 3 minutes.
8. Flush the pump and injector with 100% filtered, distilled water for at least 3 minutes.
9. Pump 100% isopropanol through the pump and injector for 3 minutes.

The pump is now prepared for any mobile phase or short- or long-term shutdown.

4.7 Cleaning the Cabinet

Cabinet may be cleaned with tap water or mild soap solution.

4.8 Lubrication

The Series III pump has modest lubrication requirements. The bearings in the pump housing and piston carrier are permanently lubricated and require no maintenance. A small dab of a light grease such as Lubriplate 630-AA on the cam is the only recommended lubrication. Be sure not to get lubricant on the body of the piston carrier, as this can retard its movement and interfere with proper pumping.

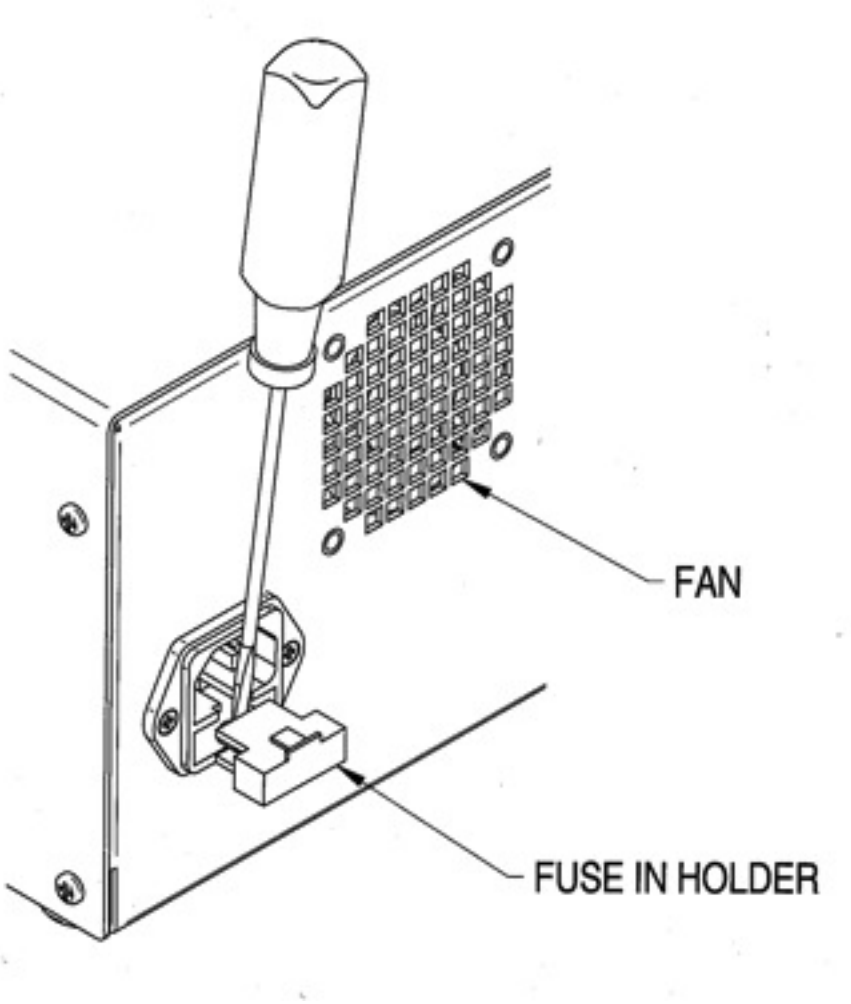
Note: Keeping the interior of the pump free of dirt and dust will extend the pump's useful life.

4.9 Fuse Replacement

Three fuses protect the Series III pump. Two of the fuses are located in the power entry module at the rear of the cabinet and are in series with the AC input line. The other fuse is located on the motor power circuit board and is in series with the 48 Vdc supply.

Troubleshooting the fuses is straightforward. If the power cord is plugged in and the ON/OFF power entry switch is ON and the fan does not run, check the two fuses in the power entry module. To gain access to these fuses, gently pry off the cover plate with a small flat-bladed screwdriver. Replace with fuses of the correct rating: 1 A slow-blo 250 Vac.

If the front panel appears to function normally but the pump motor does not run, check the fuse located on the motor power circuit board. Replace it with a 5 A slo-blo fuse.



4.10 Battery Replacement (if applicable)

Depending on the version of drive board assembly installed, the board may not have a battery. If the printed circuit board does not have a battery, it is designed with circuitry that does not require a battery backup and you should disregard the following instructions.

The battery provides power for the memory that holds the current pump configuration. If the pump is set at a flowrate and the power is turned off, when the power is turned back on the flowrate should appear as it was set. If this flowrate does not appear the battery will need replaced.

CAUTION: Be sure to disconnect power cord before removing cover to insure there is no voltage present.

CAUTION: Circuit boards can be damaged by Electro Static Discharge (ESD). Follow standard ESD procedures when handling circuit boards.

1. Unplug the unit.
2. Remove the cover.
3. Turn the unit so that the pump heads are to the right. The battery can be seen in the lower right corner of the circuit board. The battery is circular and has a positive pole mark (+) on the top. Gently pull it from its socket.
4. With the positive mark (+) up, gently slide the new battery into the battery socket. Be sure the battery is all the way into place. It must contact the base of the battery socket.
5. Replace the cover to the unit.
6. Plug the unit back in.

PCA with Battery

PCA without Battery

5 Quick Guide to Problem Solving

You Notice	This May Mean	Possible Cause	You Should
1. Uneven pressure trace. 2. Pressure drops. 3. Pump shuts OFF. 4. No flow out the outlet check valve.	1. Bubble in check valve. 2. Leaks in system. 3. Dirty check valve. 4. Bad check valve.	1. Solvent not properly degassed. 2. Fittings are not tight. 3. Mobile phase not properly filtered. 4. Particles from worn piston seal caught in check valve. 5. Plugged inlet filter.	1. Check to be certain that mobile phase is properly degassed. 2. Check connections for leaks by tightening fittings. 3. Prime the system directly from the outlet check valve. 4. Clean or replace the check valves. See Section 4.4. 5. Replace inlet filter. See Section 4.1.1.
1. Uneven pressure trace. 2. Pressure drops. 3. Fluid between the pump head and the chassis.	1. Leaks in system. 2. The piston seal(s) are worn.	1. Fittings not tight. 2. Long usage time since last seal change. 3. Salt deposits on seal (especially if buffered aqueous mobile phases are used without the self-flush head.)	1. Check all connections for leaks. 2. Replace piston seal. See Sections 4.2.3 and 4.3. 3. Check the piston for salt deposits. Clean as necessary. See Section 4.2.3.2
Pump makes a loud clanging or slapping noise (intermittent contact with cam).	Piston carrier is catching in piston guide.	1. Cap nut screws on the pump head are loose. 2. Seal(s) are worn. 3. Piston guide is worn 4. Salt build-up on piston carrier from use of buffers. 5. Excess lubricant on piston carrier.	1. Check cap nut screws on pump head. Tighten if necessary. 2. Replace seals. 3. Replace seal backup washer and seal. See Sections 4.2 and 4.3. 4. Consider changing to a self-flushing pump head if using buffers. 5. Clean excess lubricant and dirt off piston carrier. See Section 4.8.
Blue dye in mobile phase.	Pulse damper diaphragm has burst.	Sudden pressure drop when purging system.	Replace pulse damper. See Section 4.5.
Pump runs for 50 pump strokes, and then shuts down.	Lower pressure limit is activating.	1. Mobile phase is not properly filtered. 2. Particles from worn seal trapped in the system (e.g., tubing, filters, injection valve, column inlet).	1. Check to be certain the low-pressure limit is set to 0 psi. 2. Only increase the low-pressure limit after the pump attains operating pressure. 3. Contact service technician.
1. Pump shuts down after run is called even with no column connected. 2. Pump runs to maximum pressure and shuts down.	Clog in fluid system.		1. Remove and clean both the inlet and bulkhead filters. See Sections 4.1.1 and 4.1.2. 2. If the problem persists, remove tubing from system one piece at a time until you find the clogged piece. Most clogs occur outside the pump itself.
No power when pump turned ON. Fan does not run.	Blown fuses in the power entry module.	1. Power surge. 2. Internal short.	1. Replace only with the appropriate fuses 1A 250Vac. 2. Contact service technician if problem persists.
Front panel appears OK but pump motor does not run.	Blown fuse on the motor power circuit board.	1. Power surge. 2. Internal short.	1. Replace only with the appropriate fuse. 2. Contact service technician if problem persists.
PEEK fittings or components leak.	You cannot force PEEK parts with interference to seal by brute force tightening.	1. Film of fluid between surfaces. 2. Salt crystals between surfaces. 3. Scratches in mating surfaces.	1. Clean and dry mating surfaces. 2. If scratched, replace defective part.
Self-flush heads leak flush solution.	Flush area not sealed.	1. Large (Size 016) O-ring is flattened and no longer seals. 2. Head not sufficiently tightened. 3. Scratches in mating surfaces. 4. Leaky self-flush seal.	1. Replace O-ring. 2. Tighten head. 3. Replace leaky parts.

6 List of Replacement Parts

6.1 Series III, Stainless Steel, 10 mL

880203EV.....Seal Kit, Aqueous, 10mL
880204.....Seal Kit, Organic, 10mL
880401.....Check Valve Kit
880701.....Repl. Outlet Filter Element
880723EV.....Repl. Inlet Filter Elements (2)

880651.....Prime Purge Valve Rebuild Kit
880603.....Pulse Damper Rebuild Kit

880334EV.....Head & S/F Kit, 10Ml
880334EVORG.....Head & S/F Kit, 10Ml, Organic
880354.....Series II-IV Piston, 10mL
880414.....Self-Flush Check Valve Kit
880611.....Repl. Pulse Damper
880503.....Series II-IV Drive Assembly
880132.....Series III SMT Board Set (Pump Serial # > 20,000)
880103.....Series III Board Set (Pump Serial # < 20,000)
880122.....Front Panel Assembly
880904.....Series III Overlay

6.2 Series III, Stainless Steel, 40 mL

880205.....Seal Kit, Aqueous, 40mL
880206.....Seal Kit, Organic, 40mL
880401.....Check Valve Kit
880701.....Repl. Outlet Filter Element (2)
880723EV.....Repl. Inlet Filter Elements (2)

880651.....Prime Purge Valve Rebuild Kit
880603.....Pulse Damper Rebuild Kit

880336EV.....Head & S/F Kit, 40mL
880355.....Series II-IV Piston, 40mL

880414.....Self-Flush Check Valve Kit
880611.....Repl. Pulse Damper
880503.....Series II-IV Drive Assembly
880132.....Series III SMT Board Set (Pump Serial # > 20,000)
880103.....Series III Board Set (Pump Serial # < 20,000)
880122.....Front Panel Assembly
880904.....Series III Overlay

6.3 Series III, PEEK, 10 mL

880203EV.....Seal Kit, Aqueous, 10mL
880204.....Seal Kit, Organic, 10mL
880402.....Check Valve Kit
880711.....Repl. Outlet Filter Element
880721.....Repl. Inlet Filter Elements (2)

880652.....Prime Purge Valve Rebuild Kit
880603.....Pulse Damper Rebuild Kit

880333 .....Head & S/F Kit, 10mL
880354.....Series II-IV Piston, 10mL
880414.....Self-Flush Check Valve Kit
880612.....Repl. Pulse Damper
880503.....Series II-IV Drive Assembly
880132.....Series III SMT Board Set (Pump Serial # > 20,000)
880103.....Series III Board Set (Pump Serial # < 20,000)
880122.....Front Panel Assembly
880904.....Series III Overlay

6.4 Series III, PEEK, 40 mL

880205.....Seal Kit, Aqueous, 40mL
880206.....Seal Kit, Organic, 40mL
880402.....Check Valve Kit
880711.....Repl. Outlet Filter Element
880721.....Repl. Inlet Filter Elements (2)

880652..... Prime Purge Valve Rebuild Kit
880603..... Pulse Damper Rebuild Kit

880335 ..... Head & S/F Kit, 40mL
880355..... Series II-IV Piston, 40mL
880414..... Self-Flush Check Valve Kit
880612..... Repl. Pulse Damper
880503..... Series II-IV Drive Assembly
880132..... Series III SMT Board Set (Pump Serial # > 20,000)
880103..... Series III Board Set (Pump Serial # < 20,000)
880122..... Front Panel Assembly
880904..... Series III Overlay

7 APPENDIX A

7.1 Rear Panel Serial Communications Port

USB and RS-232C ports are provided on the back panel. The USB interface has priority, and is automatically selected when present -- communication via the modular RS232 jack is disabled when the USB port is occupied. A computer with appropriate software can be used as a remote controlling device for pump operation via this connection. Additional drivers may be required for utilization of the USB port. The proper driver is FTDI FTD2XX and may be downloaded from the SSI website at the following address:

www.ssihplc.com — From the home page, under the Support section, select the Downloads link

7.1.1 Hardware Implementation

The RS-232 REMOTE INPUT serial communications port is configured for 9600 baud, 8 data bits, 1 stop bit, and no parity. The connector is a standard RJ-11 modular telephone type jack. When looking at the connector on the rear panel of the pump, pin 1 is at the top and pin 6 is at the bottom.
The pin-out is:

Pin	Function
1, 6	Ground
2	DSR (Input)
3	RXD (Input to Series I pump)
4	TXD (Output from pump)
5	DTR (Output)

Special wiring considerations: Use the following chart for interfacing the pump's serial communications port to either a 25-pin or a 9-pin COM port on an IBM-PC type computer.

Pump (RJ11)	Signal	IBM (DB25)a	IBM (DB9)b
1, 6	Ground	7	5
2	DSR	20	4
3	RXD	2	3
4	TXD	3	2
5	DTR	6	6

[a] Jumper pins 4, 5, and 8 on DB25.

[b] Jumper pins 1, 7, and 8 on DB9.

Cable	**Part Number**
Modular Cable	12-0677
Adapter RJ-11 to DB9	12-0672
Adapter RJ-11 to DB-25	12-0671

7.1.2 Hand Shaking

The pump uses hardware handshaking. The pump will not transmit on the TXD output if the DSR input is at a low logic level. And, the pump will not receive on the RXD input when the DTR output is at a low logic level. A low logic level is -3.0 to -15 volts and a high logic level is 3.0 to 15 volts.

7.1.3 Command Interpreter

The pump's high-level command interpreter receives and responds to command packets. The pump will not send a message except when prompted, and it will send a response to every valid command as described below. The response to an invalid command is "Er/".

Each command is characterized by a unique two-letter command code, and only one command can be issued per line. Case is not important; that is, the command codes "PR" "Pr" "pR" and "pr" are all equivalent. Response strings sent by the pump are terminated by the "/" character.

If the pump's response is "Er/", send a "#" to clear any characters which may be remaining in the command buffer. The pump will automatically clear all characters in the command buffer after one second elapses from the time at which the last character of an incomplete command was sent.

The command packets are as follows:

Command	Response	Comments
RU	OK/	Sets the pump to the RUN state.
ST	OK/	Sets the pump to the STOP state.
FLxxx	OK/	Sets the flow rate to x.xx or xx.x mL/min where the range is fixed for the pump head size, i.e., for 0.01 to 9.99 mL/min xxx = 001 to 999, for 0.1 to 39.9 mL/min xxx = 001 to 399.
FOxxxx	OK/	Sets the flow rate to xx.xx or xxx.x mL/min where the range is fixed for the pump head size, i.e., for 0.01 to 10.00 mL/min xxxx = 0001 to 1000, for 0.1 to 40.0 mL/min xxxx = 0001 to 0400.
PR	OK,x/ (x, xx, xxx, or xxxx)	Reads the pump's current pressure, where: x, xx, xxx, or xxxx = Current pressure in PSI
CC	OK,x,y.yy/ (x, xx, xxx, or xxxx) (y.yy, yy.yy, or yy.y)	Reads the pump's current pressure and flowrate, where: x, xx, xxx, or xxxx = Current pressure in PSI y.yy, yy.yy, or yy.y = Flow rate in mL/min The format is y.yy and yy.yy for a standard pump head or yy.y for a macro pump head.
CS	OK,x.xx,y,z,PSI,w,v,u/ (x.xx, xx.xx, or xx.x) (y, yy, yyy, or yyyy) (z, zz, zzz, or zzzz)	Reads the current pump setup, where: x.xx, xx.xx, or xx.x = Flow rate in mL/min y, yy, yyy, or yyyy = Upper pressure limit z, zz, zzz, or zzzz = Lower pressure limit PSI = Units (PSI, ATM, MPA, BAR, or KGC) w = Pump head size (0 = standard, 1 = macro) v = Run status (0 = stopped, 1 = running) u = Pressure Board present = 0; otherwise 1
ID	OK,vx.xx SR3O firmware/	Identifies the pump type and EPROM revision x.xx

UPxxxx	OK/	Sets the upper pressure limit in PSI. The maximum value for xxxx is 5000 for the plastic head or 6000 for the steel head; the minimum value is the lower limit plus 100. The value must be expressed as four digits, i.e., for 900 PSI xxxx = 0900.
LPxxxx	OK/	Sets the lower pressure limit in PSI. The maximum value for xxxx is the current upper pressure limit setting minus 100; the minimum value is 0. The value must be expressed as four digits, i.e., for 100 PSI xxxx = 0100.
SF	OK/	Puts the pump in fault mode. Turns on the FAULT LED and stops the pump immediately.
RF	OK,x,y,z/	Reads the fault status, where: x = Motor stall fault (0 = no, 1 = yes) y = Upper pressure limit fault (0 = no, 1 = yes) z = Lower pressure limit fault (0 = no, 1 = yes)
KD	OK/	Disables the keypad. (Default status at power-up is enabled.)
KE	OK/	Enables the keypad.
PCxx	OK/	Sets the pressure compensation value, where xx = the operating pressure (in PSI divided by 100), i.e., for 0 PSI xx = 00, for 5000 PSI xx = 50.
RC	OK,x/ (x or xx)	Reads the pressure compensation value in hundreds of PSI, i.e., for 0 PSI x = 0, for 5000 PSI xx = 50.
HTx	OK/	Sets the pump head type, where: x = 1 for a stainless steel 10 mL/min pump head x = 2 for a plastic 10 mL/min pump head x = 3 for a stainless steel 40 mL/min pump head x = 4 for a plastic 40 mL/min pump head The pump is stopped; and, the pressure compensation and pressure limits are initialized, when the head type is changed.
RH	OK,x/	Reads the pump head type, where: x = 1 for a stainless steel 10 mL/min pump head x = 2 for a plastic 10 mL/min pump head x = 3 for a stainless steel 40 mL/min pump head x = 4 for a plastic 40 mL/min pump head

PI	OK,a.aa,b,c,d,e,f,g,h,i,j,k,l, m,n,o,p,q/ (a.aa, aa.aa, or aa.a) (c or cc)	Reads the current pump setup, where: a.aa, aa.aa, or aa.a = Flow rate in mL/min b = Run status (0 = stopped, 1 = running) c or cc = Pressure compensation d = Pump head type (see RH command) e = Pressure Board present = 0; otherwise 1 f = External control mode (0 = frequency, 1 = voltage) g = 1 if pump started and frequency controlled, else 0 h = 1 if pump started and voltage controlled, else 0 i = Upper pressure limit fault (0 = no, 1 = yes) j = Lower pressure limit fault (0 = no, 1 = yes) k = Priming (0 = no, 1 = yes) l = Keypad lockout (0 = no, 1 = yes) m = PUMP-RUN input (0 = inactive, 1 = active) n = PUMP-STOP input (0 = inactive, 1 = active) o = ENABLE IN input(0 = inactive, 1 =active) p = Always 0 q = Motor stall fault (0 = no, 1 = yes)
RE	OK/	Resets the pump configuration to its default power-up state.
#	(no response)	Clears all characters from the command buffer.

If the pump's response is "Er/", send a "#" to clear any characters which may be remaining in the command buffer. The pump will automatically clear all characters in the command buffer after one second elapses from the time at which the last character of an incomplete command was sent.

7.2 Rear Panel 4-Pin and 10-Pin Terminal Board Connectors

A 4-pin terminal board connector and a 10-pin terminal board connector are provided on the back panel. Any device capable of providing the proper run/stop logic level, flow rate control frequency, or flow rate control voltage can be used as a remote controlling device for pump operation via this connection. The terminal board connectors can be removed for ease of connecting wires, if desired, by pulling firmly rearward and should be reinserted firmly afterward.

7.2.1 Pressure Fault and Motor Stall Fault Output

The pump's output is on the 4-pin terminal board connector.
The pinout is:

Pin ..... Function
4..... EVENT 1
3..... EVENT 2
2..... EVENT 3
1..... GROUND

This output is produced internally by a reed relay which has SPDT contacts with a 0.25 amp maximum, 50 VDC maximum, 0.2 ohm rating. The 4-pin connector allows wires to be connected to the EVENT 1 (Pole), EVENT 2

(NC), and EVENT 3 (NO) terminals. When the pump stops due to the sensed pressure exceeding the set pressure limits or if a motor stall fault occurs, the connection between the EVENT 1 terminal and the EVENT 2 and EVENT 3 terminals is affected. EVENT 2 is Normally Closed (connected to EVENT 1) until a fault occurs and then opens. EVENT 3 is Normally Open (not connected to EVENT 1) until a fault occurs and then closes.

7.2.1.1 Upper and Lower Pressure Limit Range

The pressure sensing transducer provides accurate, wide range pressure monitoring. Because of the sensitivity of the transducer, the zero reading may shift up to 0.1% of the full pressure scale over years of operational use. The user should also be aware that the resistance to flow of the fluid being pumped through the tubing and fittings may cause the pressure to vary with the flow rate and the viscosity of the mobile phase employed.

If absolute accuracy is needed for the pressure safety limits:

1. Disconnect the column from pumping system and operate the pump with the mobile phase and flow rate to be used in the analysis. Observe the resulting pressure displayed on the pump readout. The column will cause a pressure reading that adds to this basic reading due to system flow resistance.
2. Set the upper limit shut-off to a pressure equal to the basic reading plus the safe operating pressure for the column to be used. For example, if the basic pressure reading (without the column) is 7 PSI and the safe limit for the column is 25 PSI, set the maximum pressure limit to 32 PSI or less.
3. If the mobile phase or flow rate is changed, reset the pressure limit as appropriate.
4. Note that a lower pressure limit is available to prevent continued operation in the event of a leak. For proper operation, this must be set to a pressure higher than the basic pressure or it may not sense the reduced pressure.

7.2.2 General Information on Inputs

The pump's inputs are on the 10-pin terminal board connector. The pinout is:

Pin	Function
10	VOLTAGE COM
9	VOLTAGE IN
8	FREQ IN
7	ENABLE IN
6	PUMP-RUN
5	PUMP-STOP
4	No connection
3	No connection
2	No connection
1	COM

7.2.3 General Information on Run, Stop, and Enable Inputs

The PUMP-RUN, PUMP-STOP, and ENABLE IN inputs operate from an internal 5 VDC source and each one draws approximately 0.008 amps when connected to COM. To activate either the PUMP-RUN, PUMP-STOP, or ENABLE IN input connect it to COM. Any device capable of switching 0.008 amps can be connected between the PUMP-RUN, PUMP-STOP, or ENABLE IN input and COM, such as: a switch contact, a relay contact, an open collector output, an open drain output, or any output with a high logic level output of 3.8 to 6.0 volts and a low logic level output of 0.0 to 0.5 volts. A switch contact or a relay contact is preferred since this type of connection will provide isolation between the pump and the controlling device. The COM terminal is internally connected to the pump's chassis ground and should be connected to the controlling device's ground or zero volt terminal when the controlling device has an open collector output, an open drain output, or any output with logic level output.

7.2.4 Run and Stop Inputs

The pump's motor can be commanded to run or stop from the back panel inputs when the pump's flow rate is controlled from the front panel or when the pump's flow rate is controlled by the voltage or frequency input. There two modes of operation for the run and stop inputs which are described below:

Dual Signal Pulse: In this mode of operation both the PUMP-RUN and PUMP-STOP inputs are normally at a high logic level. To start the pump, pulse the PUMP-RUN input to a low logic level for a minimum of 500 mS. To stop the pump, pulse the PUMP-STOP input to a low logic level for a minimum of 500 mS.

Single Signal Level: To enable this mode of operation the PUMP-STOP input must be permanently connected to COM with a jumper wire. To start the pump, put a low logic level on the PUMP-RUN input. To stop the pump, put a high logic level on the PUMP-RUN input.

7.2.5 Enable Input

When activated (ENABLE IN is at a low logic level), the ENABLE IN input disables flow rate control on the front panel and enables flow rate control on the back panel.

7.2.6 General Information on Voltage and Frequency Inputs

Special programming and circuitry allows this pump to be operated remotely with the flow rate controlled by voltage or frequency inputs. To select the remote mode of operation:

1. With the pump plugged in and the rear panel power switch OFF, press in and hold the "DOWN ARROW" button while turning the power switch ON.
2. Release the "DOWN ARROW" button and either a U (closest approximation to V for voltage) or an F (for frequency) will be displayed.

3. Select the desired remote operating mode by pressing the "DOWN ARROW" button to toggle between the voltage and frequency mode.
4. Press the "RUN/STOP" button to place the pump in normal operating mode.
5. To enable the currently selected remote mode (voltage or frequency), connect the rear panel ENABLE IN connection to the COM connection.
6. When in the remote mode (ENABLE IN at a low logic level) all front panel buttons remain active except the flow setting increase/decrease capability.

7.2.7 Voltage Input

The remote voltage flow control is implemented by connecting a negative input to the rear panel VOLTAGE COM connection and a positive input to the VOLTAGE IN connection. A 0-10 VDC input corresponds to a 0 to 10 mL/min for 10mL pumps and 0 to 40 mL/min for 40 mL pumps. Any device capable of sourcing at least 0.0005 amps will work. Also, the voltage control mode must be selected and enabled as described in section “7.2.5” above. The voltage source, which drives the VOLTAGE IN and VOLTAGE COM connections, must be isolated from the safety ground to prevent a ground loop current. If the pump’s displayed flow rate jumps up and down erratically, suspect a ground loop problem. Flow rate instabilities may exist for input voltages below 10mV.

7.2.8 Frequency Input

The remote frequency flow control is implemented by connecting a negative input to the COM connection and +5 VDC square wave input to the FREQ IN connection. Any device capable of sinking and sourcing at least 0.008 amps will work. A 0 to 10,000 Hertz input frequency will correspond to a 0 to 10 mL/min flow rate for 10mL pumps and 0 to 40 mL/min for 40mL pumps. Also, the frequency control mode must be selected and enabled as described in section “7.2.5” above.

8 Warranty Statement

Scientific Systems, Inc. (SSI) warrants that instruments or equipment manufactured by the company for a period thirty-six (36) months from date of shipment to the original purchaser (or to the drop ship location as indicated on the Purchase Order from the original purchaser), against defects in materials and workmanship under normal installation, use and maintenance. Products sold by SSI but not manufactured by SSI carry the Original Manufacturer's Warranty, beginning as of the date of shipment to SSI's original purchaser. Expendable items and physical damage caused by improper handling or damage caused by spillage or exposure to any corrosive environment are excluded from this warranty. The warranty shall be void for Polyetheretherketone (PEEK) components exposed to concentrated Nitric or Sulfuric acids which attack PEEK, or methylene chloride, DMSO or THF which adversely affect UHMWPE seals and PEEK tubing. Any defects covered by this warranty shall be corrected by replacing or repairing, at SSI's option, parts determined by SSI to be defective.

Spare or replacement parts and accessories shall be warranted for a period of twelve (12) months from date of shipment to the original purchaser against defects in materials and workmanship under normal installation, use and maintenance. Defective Product will be accepted for return to SSI only if the request for return is made within thirty (30) days from the time of discovery of the alleged defect, and prior to return, the original purchaser obtains a Return Goods Authorization (RGA) number from SSI, and provides SSI with the serial number of each instrument to be returned.

The warranty shall not apply to any Product that has been repaired or altered except by SSI or those specifically authorized by SSI, to the extent that such repair or alteration caused the failure, or to Product that has been subjected to misuse, negligence, accident, excessive wear, or other causes not arising out of a defect in material or workmanship.

The warranty shall not apply to wear items, specifically:

Check Valves	Pistons	Piston and Wash Seals
Pulse-Damper Diaphragms	Inlet Lines	Filter Elements

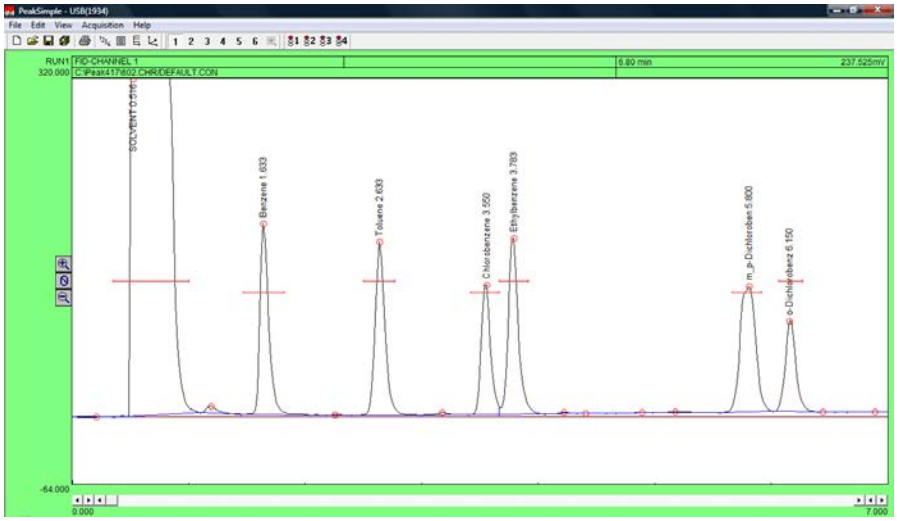
The following is the exclusive procedure by which to make claims under this warranty. Customer shall obtain SSI's oral or written authorization to return the Product and receive a Return Goods Authorization (RGA) number. The Product must be returned with the RGA number plainly visible on the outside of the shipping container to SSI. It must be securely packed in a rigid container with ample cushioning material, preferably the original packaging. All claimed defects must be specified in writing, including the RGA number, with the written claim accompanying the Product. Freight costs for the return of reported defective Product from the original purchaser to SSI is the responsibility of the original purchaser. Freight costs for the return of reported defective spare parts is the responsibility of SSI. SSI shall specify the freight carrier for returns. SSI shall bear the expense of return shipment to original purchaser (or to the drop ship location as indicated on the Purchase Order from the original purchaser).

If it appears to SSI that any Product has been subjected to misuse, negligence, accident or excessive wear, or is beyond the warranty period, the original purchaser and/or customer shall be notified promptly. SSI shall communicate its finding and provide an estimate to repair such Product at the then current rates for parts and service. SSI shall either repair the Product per customer's authorization or shall return such Product not repaired to customer at customer's expense. SSI may invoice customer for the freight costs of any Product shipped back to the original purchaser and/or customer by SSI which is not covered under the warranty.

Limitations of Warranty. THE FOREGOING WARRANTIES AND LIMITATIONS ARE CUSTOMER'S EXCLUSIVE REMEDIES AND ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

PeakSimple Advanced Tutorial

Version 4.17, September 2012



Installing PeakSimple from the CD or USB thumb drive:

A. Start the Windows operating system in use on your computer. (Windows XP, Vista, or 7)

B. Insert the CD or USB thumb drive into the computer.

C. Open **My Computer** and open either the CD or thumb drive.

D. Double-click on the **Setup.exe** file. Make sure to select the right version of PeakSimple to install (32– or 64-bit). Windows XP and some Vista computers need to install the 32-bit version, other Vista computers and Windows 7 need to install the 64-bit version. If you are unsure, right-click on **My Computer** then select **Properties** in order to determine what bit operating system you are using.

E. To complete installation follow the onscreen instructions provided by the installation wizard.

F. For instructions on loading the driver, please refer to the Quick Start Documents located in the PeakSimple folder

Installing PeakSimple from software download:

A. Start the Windows operating system and use an online browser to access www.srigc.com.

B. From the menu on the left hand side of the screen select **Download PeakSimple** and then download the latest version. Windows XP and some Vista computers need to download the 32-bit version, other Vista computers and Windows 7 need to download the 64-bit version. If you are unsure, right-click on **My Computer** then select **Properties** in order to determine what bit operating system you are using.

C. Save the file to a temporary folder and double-click on the setup file when it is finished downloading, or, just click **Run** to install PeakSimple without saving the setup file.

D. Follow the onscreen instructions provided by the installation wizard.

E. For instructions on loading the driver, please refer to the Quick Start Document located in the PeakSimple folder

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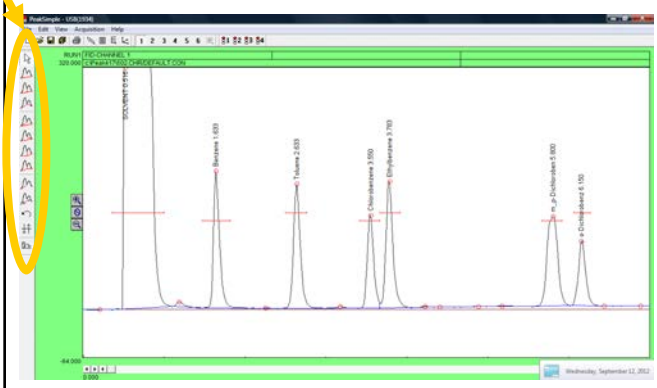
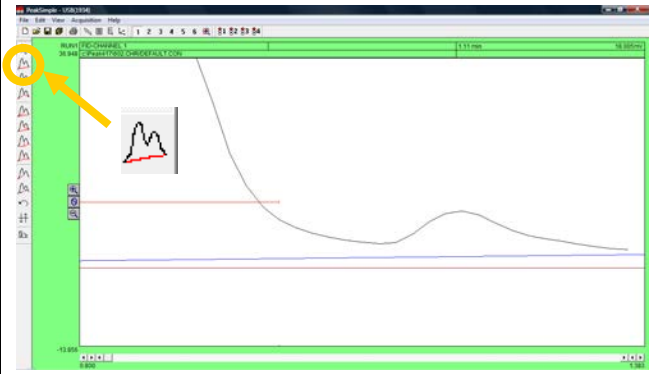
Manual Integration

1. To manually integrate the PeakSimple baseline in a chromatogram use the manual integration tools found in the manual integration toolbar. To open the manual integration toolbar first have chromatogram 602.CHR and component file 602.CPT loaded and then select **Edit** from the PeakSimple menu bar. From the drop down menu select **Manual integration** with the mouse cursor. The manual integration toolbar will now be displayed on the left-side of the PeakSimple screen.

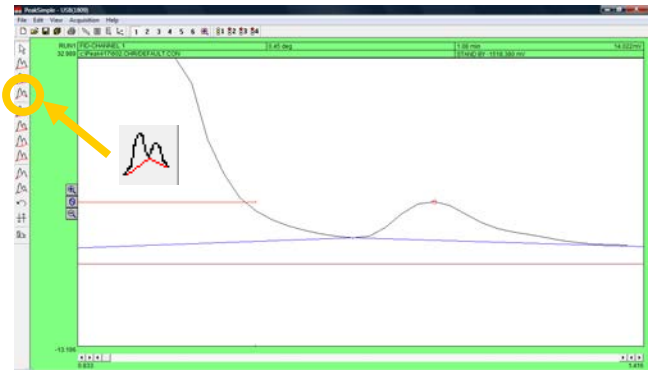


2. Use the None integration tool to add the area of the smaller peak to the area of the Solvent peak. First, zoom in on the solvent peak, the smaller peak to its right, and their baselines. Once the chromatogram is zoomed in select the **None** integration tool from the manual integration toolbar. With the None integration tool selected click once, using the left mouse button, on the valley between the solvent peak and the smaller peak.

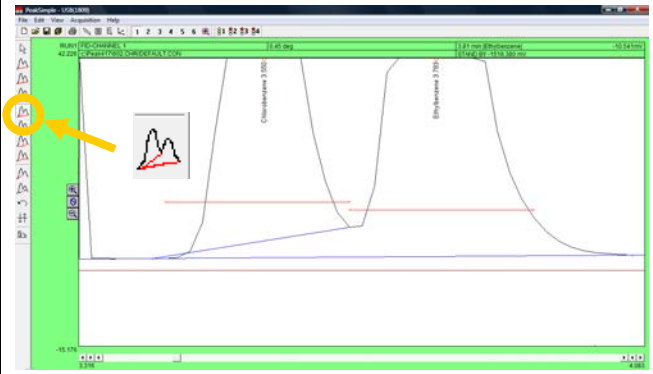


3. Use the Drop integration tool to drop the baseline from the valley of the two peaks to an existing baseline. To drop the baseline select the **Drop** integration tool from the manual integration toolbar. Using the mouse cursor, click on the valley between the solvent peak and the smaller peak to drop the baseline.

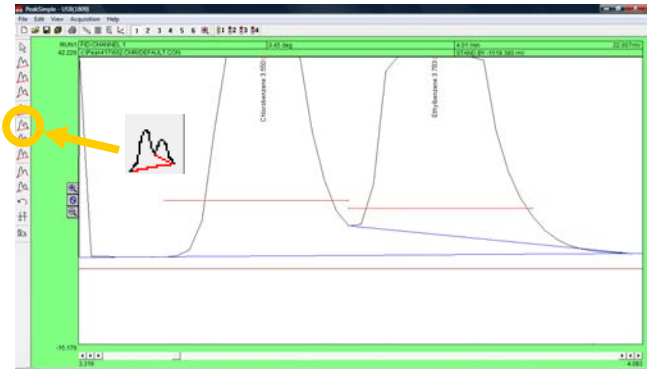
4. The Based integration tool raises the baseline to the valley between two specified peaks. With the baseline dropped, click on the **Based** integration tool button and then click on the valley between the solvent peak and the smaller peak to its right to raise the baseline to the valley.



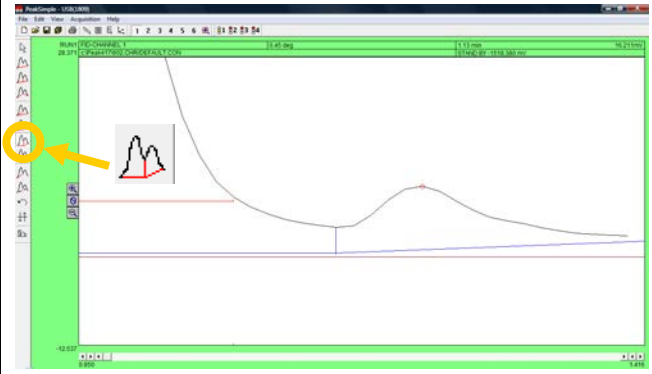
5. The Lead skim integration tool allows a peak's area to be skimmed off of the leading edge of another peak. To use the Lead skim tool first unzoom off of the solvent peak and the other smaller peak and then zoom in on the Chlorobenzene peak, the Ethylbenzene peak, and the baseline. After the chromatogram is zoomed click on the **Lead skim** integration tool button and then click on the valley between the two peaks with the mouse cursor.



6. The Trail skim integration tool is similar to the Lead skim tool except a peak's area is now skimmed off of the trailing edge of another peak. Select the **Trail skim** tool button from the manual integration toolbar and then click on the valley between the Chlorobenzene and Ethylbenzene peaks with the mouse cursor to see the Ethylbenzene peak skimmed off of the Chlorobenzene peak.



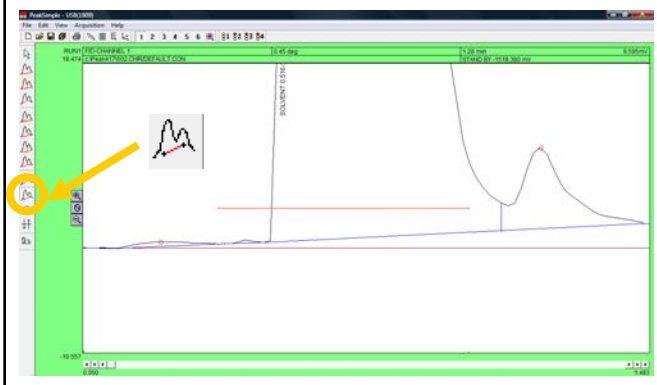
7. The Lead horizontal tool constructs the baseline horizontally for the leading peak while the trailing peak's baseline stretches from the horizontal line to the next valley. Unzoom off of the Chlorobenzene and Ethylbenzene peaks and instead zoom in on the Solvent peak, the smaller peak to its right, and the baseline. Click on the **Lead horizontal** integration tool in the manual integration toolbar and then click, using the left mouse button, on the valley between the solvent peak and the other smaller peak.



8. The Trail horizontal integration tool drops the baseline horizontally for the trailing peak while the lead peak's baseline stretches from the horizontal line to the previous valley in the chromatogram. After selecting the **Trail horizontal** tool in the manual integration toolbar click with the mouse cursor on the valley between the two zoomed in peaks.

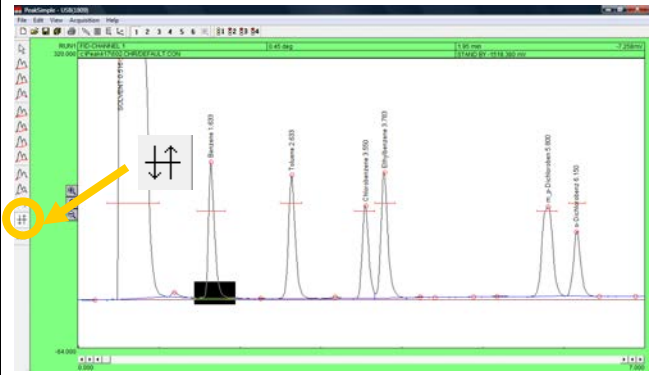
9. The Inhibit tool ends the baseline after a valley effectively inhibiting a peak's area from being counted with the rest of the chromatogram. To use the Inhibit integration tool select the **Inhibit** tool button from the manual integration toolbar and click on the valley of the Solvent peak and the smaller peak to its right.

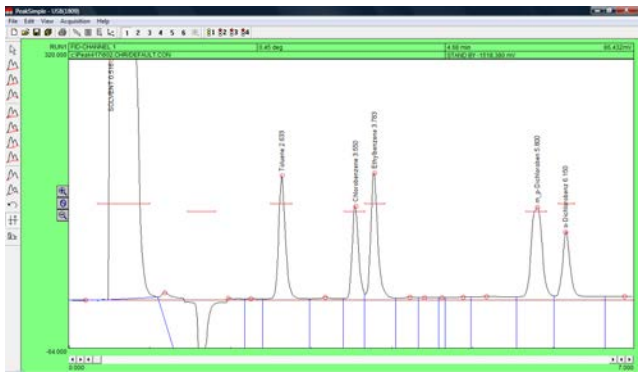
10. The Rubber Band tool is used to manually draw the baseline in a chromatogram. To use the Rubber Band tool first scroll the X-axis scrollbar all the way to the left to **0.000**. Select the **Rubber Band** tool from the manual integration toolbar and draw a line from the valley between the Solvent peak and the small peak to its left to the valley between the smaller peak to the right of the Solvent peak and the peak to its right.



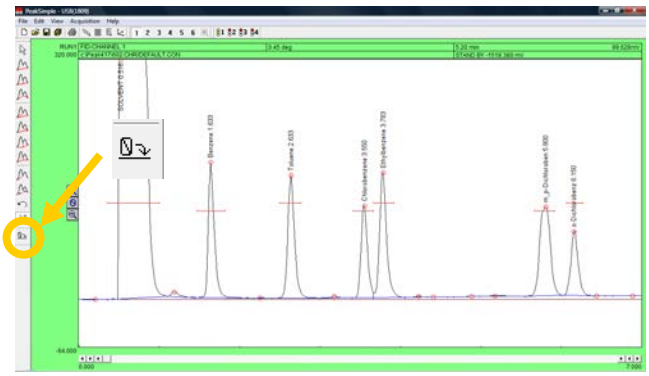
11. To undo a change made to the baseline of a chromatogram with the manual integration tools use the Undo button found in the manual integration toolbar. To undo the changes made to the baseline using the Rubber band tool click on the **Undo** button with your mouse cursor. All changes made to the baseline will now be undone.

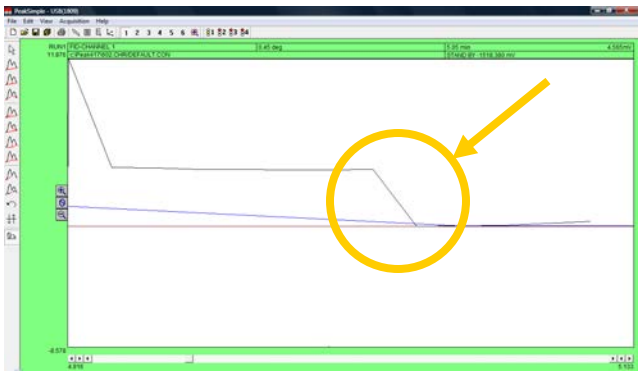
12. The Reverse tool allows the inverting of a peak in a chromatogram. First unzoom off of the Solvent peak and the smaller peak to its right and then select the **Reverse** tool from the manual integration toolbar and click and hold the left mouse button while the area of the chromatogram you want to reverse is dragged over with a black box. Let go of the mouse button when the desired area is selected to reverse the orientation.





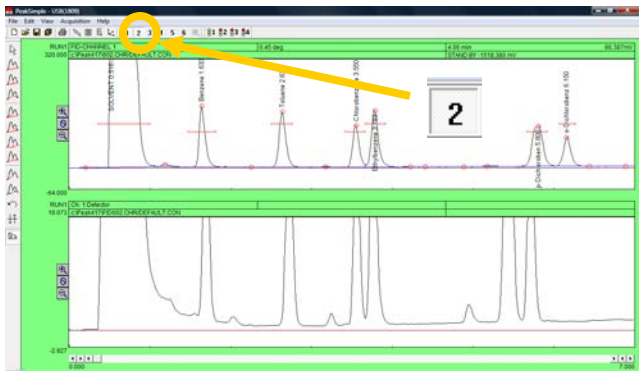
13. The Zero tool is used to set the value of the data line at a selected point and following in the chromatogram to zero. First undo the changes done to the chromatogram by the Reverse tool by reopening 602.CHR in the PeakSimple menu bar. ***Note:*** *Changes made to a chromatogram by the Reverse tool and the Zero tool cannot be undone with the Undo tool.* Once the file is reopened click on the **Zero** tool and click anywhere on the baseline between the Ethylbenzene peak and the two peaks to its right with the mouse cursor to set the data line at zero.



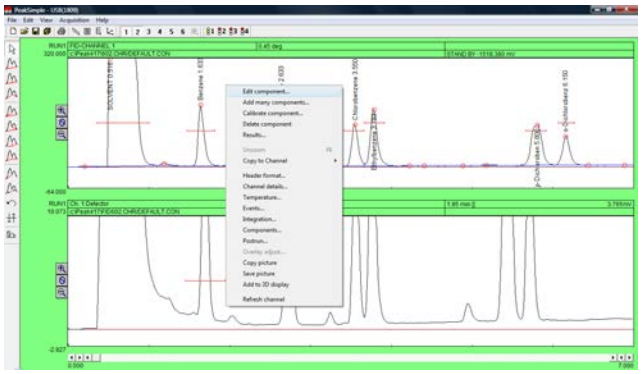


Creating Component Tables

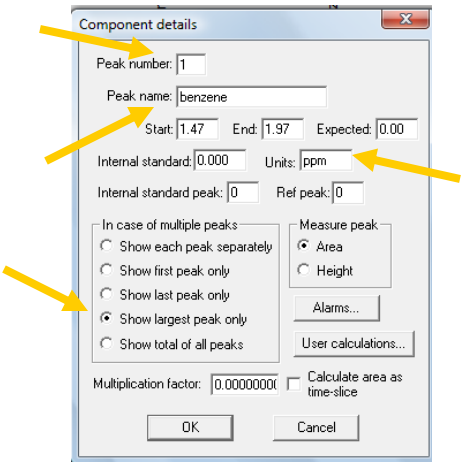
1. To create a component table from scratch open up a second channel in the PeakSimple window by clicking on the Display Channel **2** button in the PeakSimple toolbar. Once the second channel is open click on **File** and then **Open** to get to the Load chromatogram file window. Select the Channel 2 radio button and then file **FID602.CHR** from the list of files to open the file in channel 2. Click **OK** with the mouse cursor to load the file.



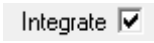
2. In channel 2 locate the second tall peak from the left and right click on it with the mouse cursor. From the resulting menu select **Add component** to add a retention window bar to the peak. Once again right click on the peak and select **Edit component** from the menu to open up the Component details window.

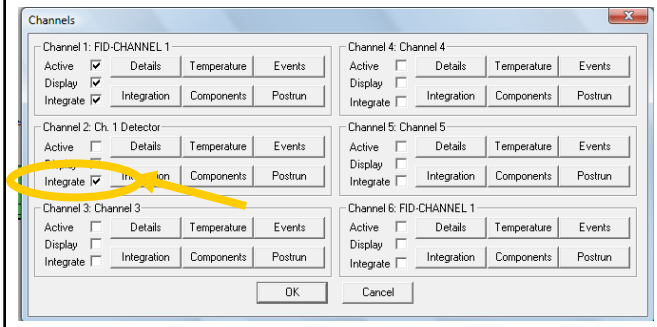


3. Once the Component details window is open locate the Peak number dialogue box and add the number **1**. Immediately underneath the Peak number box is the Peak name dialogue box. In the Peak name dialogue box input **benzene** to name it. Locate the Units box and put **ppm** to make the units parts per million. Locate the In case of multiple peaks options box and select the radio button for **Show largest peak only**. Click on **OK** with the mouse cursor to close the window.

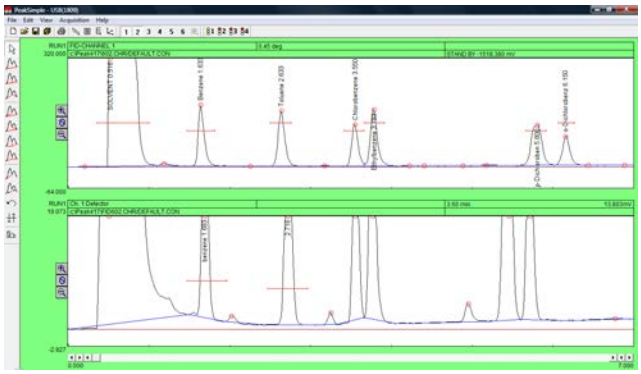


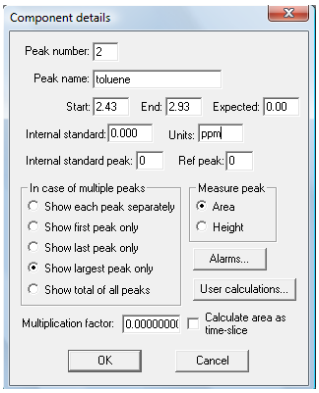
4. Go to **Edit** in the PeakSimple menu bar and then **Channels** from the resulting menu. The Channel controls window is now open. Locate the Channel 2 options box and the Integrate checkbox. Check the **Integrate** checkbox and then click on **OK** with the mouse cursor to close the window. The peak in the second channel should now identify itself as benzene.



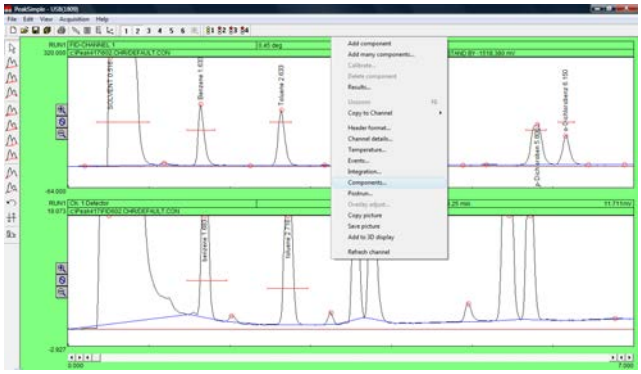


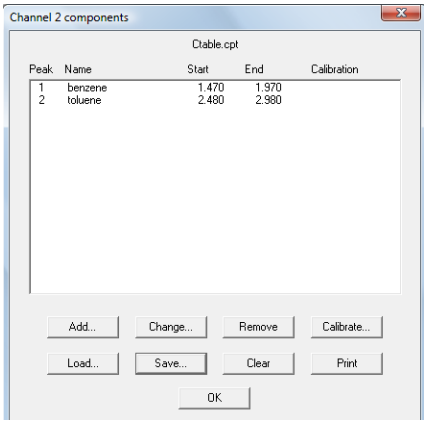
5. Locate the large peak to the right of the benzene peak in the second channel. Right click and then select **Add component** to add a retention window bar to the peak. Right click again and go to **Edit component** to open up the Component details window. Change the Peak number to **2**, the Peak name to **toluene**, the Units to **ppm**, and the In case of multiple peaks options box to **Show largest peak only**. Click on **OK** with the mouse cursor to exit the window.





6. Right click anywhere on the second channel and select **Components** from the list of options. Once the Channel 2 components window is open make sure all the data is correct and then click on **Save** to save the Component data to disk. Name the file **Ctable** and then click on **OK** to close the window. An unlimited number of component windows may be added to the component table.





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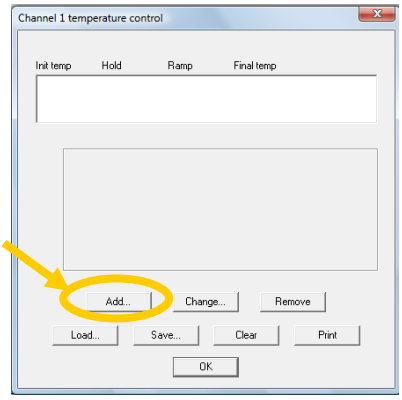
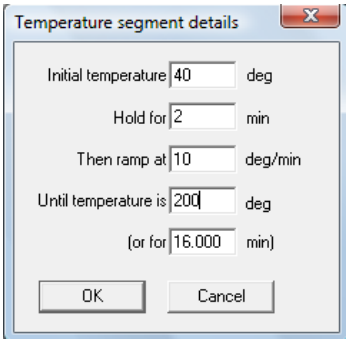
Temperature Programming

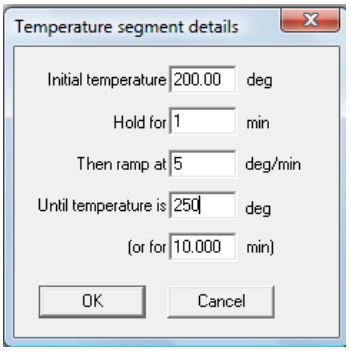
1. To modify the temperature programming in PeakSimple right click anywhere on the chromatogram and choose **Temperature f**rom the drop down menu. This will open up the Temperature control window.

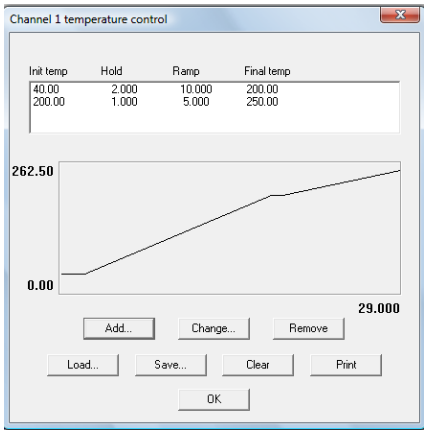
2. In the Temperature control window select **Add** from the group of buttons. The Temperature segment details window will open allowing the addition or modification of the temperature programming. Enter the numbers shown in the picture to the right in the appropriate fields. Click on **OK** to close the window and go back into the Temperature control window.

3. Select the **Add** button from the Temperature control window to open up the Temperature segment details window once again. Leave the Initial temperature at 200 and insert a **1** in the Hold for dialogue box. Change the Then ramp at dialogue box to **5** and the Until temperature is box to **250**. Click on **OK** to close the window and to see the new temperature data added to the temperature box. Click on **OK** to close the window.





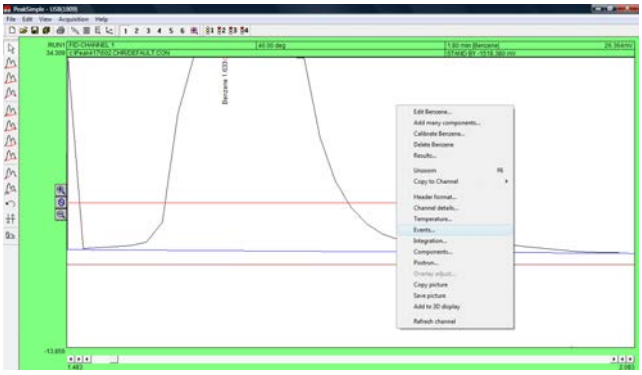


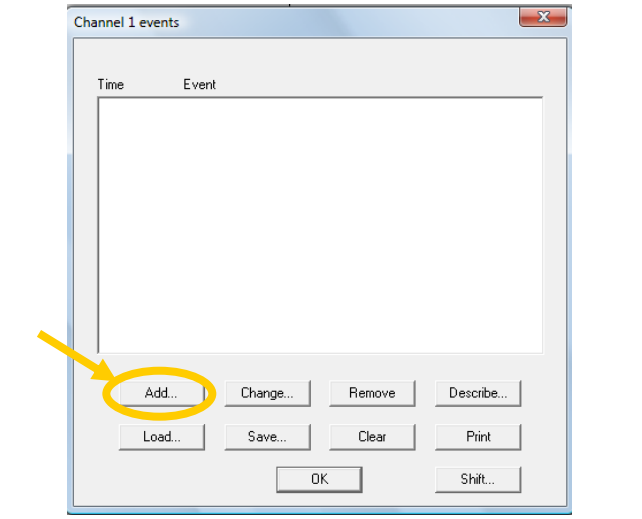


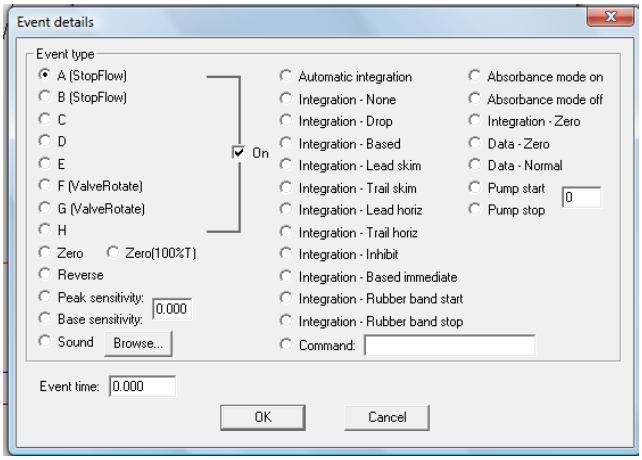
Events Table

1. To modify the Events table in PeakSimple open up chromatogram 602.CHR and zoom in on the benzene peak, the smaller peak to its right, and the baseline. Right click anywhere on the chromatogram and select **Events** from the drop down menu. Doing this will open up the Events window where specific events can be added to the chromatogram.

2. Click using the mouse cursor on the **Add** button to view the Event details window. A list of event types are available with their radio buttons to either select or deselect the event. ***Note:*** *The event types to the left of the window are real-time and thus will only affect the chromatogram when A/D hardware is connected. The event types to the right are concerned only with integration and their changes will be immediately evident after returning to the main screen and selecting* ***Re-integrate*** *from the* ***Edit*** *menu bar.*

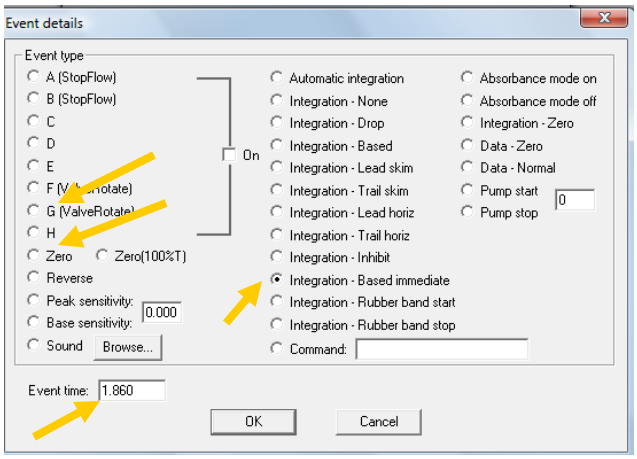


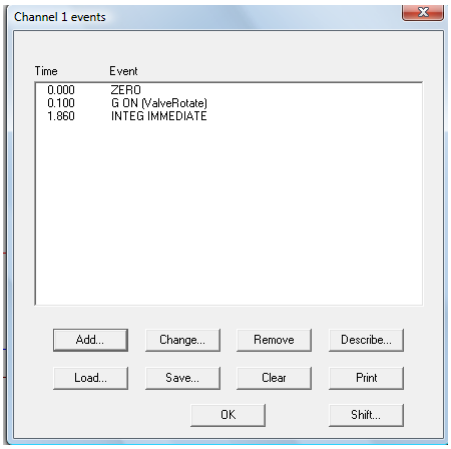




3. In the Event details window locate and select the relay **G** radio button with the mouse cursor and then locate the Event time dialogue box and enter **.1** in the box. Click on **OK** to exit the window. ***Note:*** *The relay might be used to actuate a valve when hardware is connected.* The event type will now be added to the Events table. Select the **Add** button and now locate and select the **Zero** event type radio button. Leave the Event time box at 0.000 and once again click on **OK** to exit the window and add the event to the Events table. ***Note:*** *The Zero event auto-zeros the detector signal at the beginning of the run.* Click on the **Add** button again and select the **Integration-Based immediate** radio button in the Event details window and input **1.86** in the Event time dialogue box. Select **OK** to exit the window.

4. There are now three events in the Events table. Click on **OK** to exit the Events window and then hit the **Enter** button on the keyboard to reintegrate the baseline according to the events in the Events table. Notice that the baseline is connected to the data line at 1.86 minutes.





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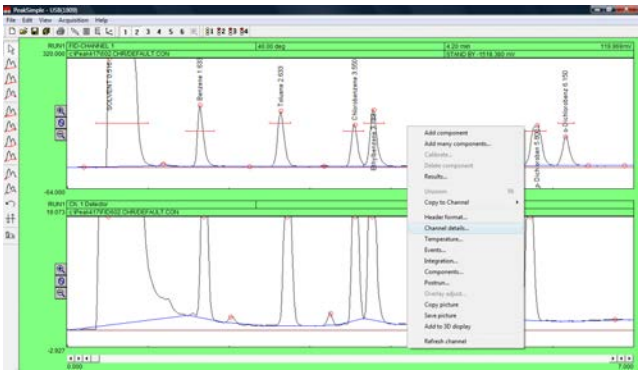
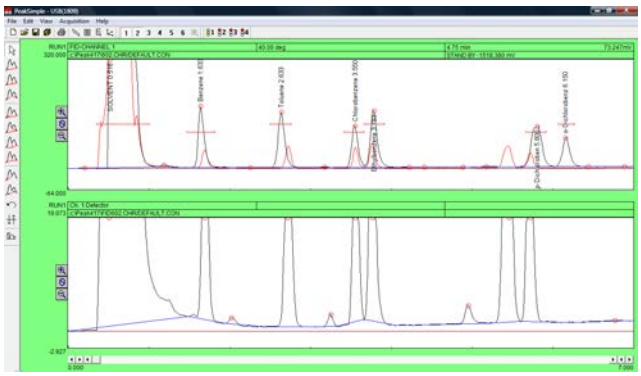
Overlay and Subtract

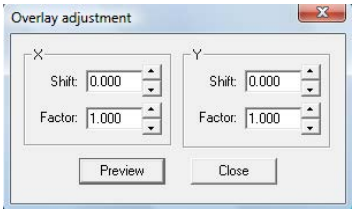
1. To overlay one PeakSimple chromatogram on top of another chromatogram open up a second channel in the main screen and load chromatogram 602.CHR in the first channel and chromatogram FID602.CHR in the second channel. Right click anywhere in the first channel and select **Channel details** from the drop down menu.



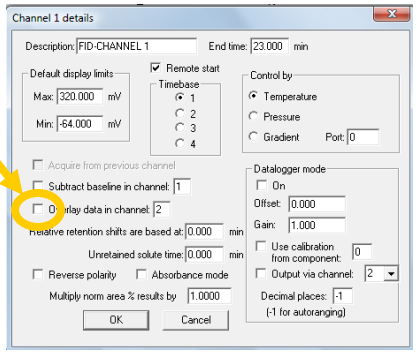
2. In the Channel 1 details window locate the Overlay data in channel checkbox and check it and then input a **2** in the dialogue box to the right. The chromatogram in channel 2 is now overlaid on top of the chromatogram in channel 1. The overlay appears in a different color.



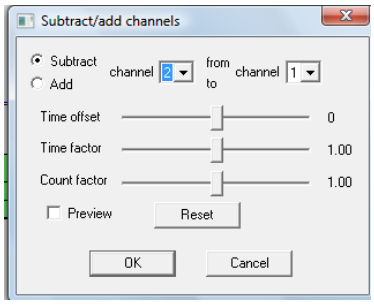
3. Right click anywhere on the first channel and select **Overlay adjustment** from the drop down menu. In the Overlay adjustment window locate the Factor scroll box in the X box. Experiment scrolling the X factor up or down to shift the overlaid chromatogram to its right or left. Locate the Factor scroll box in the Y box and experiment scrolling the Y factor up or down to move the overlaid chromatogram up or down. Click on the **Close** button to close the window.

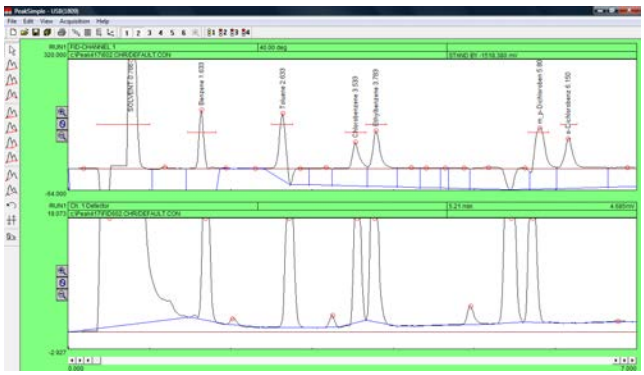


4. To subtract a chromatogram in one channel from another channel, right click using the mouse cursor on channel 1 and select **Channel details**. From the Channel 1 details window deselect the Overlay data in channel checkbox and then click on the **OK** button to exit the window.



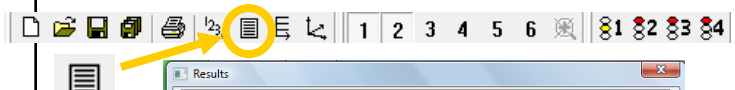
5. Go to the **Edit** menu bar and select **Subtract/Add channels** from the drop down menu. In the Subtract/add channels window make sure the Subtract radio button is selected and that channel 2 is being taken from channel 1. Click on the **OK** button to make the changes take effect and have channel 2 subtracted from channel 1. The normal way to use this feature is to subtract a drifting baseline from a chromatogram.

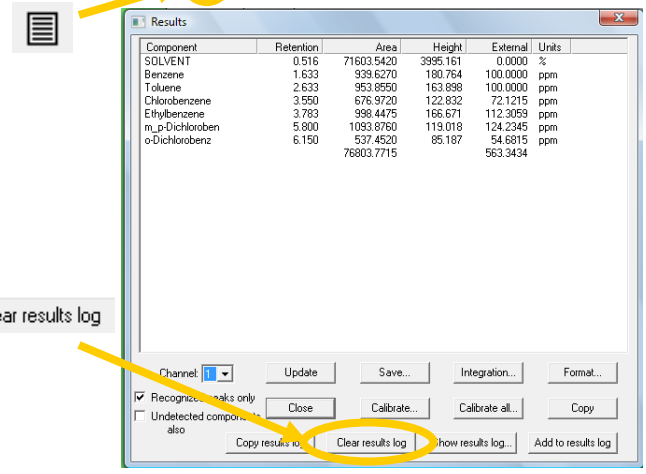




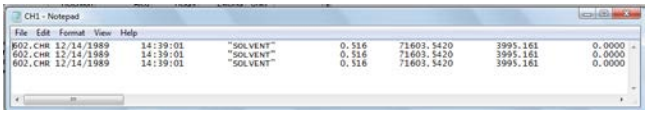
Results Log

1. Open chromatogram 602.CHR in the PeakSimple main screen and then select the **Results** button from the PeakSimple toolbar. In the Results window click on the **Clear results log** button at the bottom of the window. Click on **Yes** from the resulting window to clear the results.

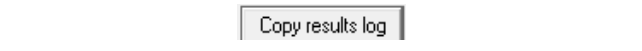


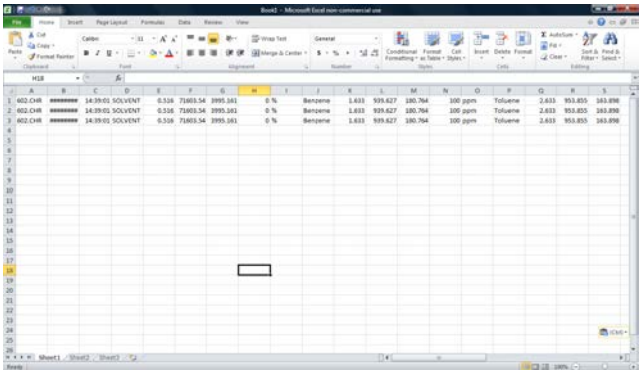


2. Locate the **Add to results log** button and click on it three times to add the results on the screen to the Results log three times. Click on the **Show results log** button to view the results log in the Windows Notepad. Exit the Windows Notepad program by selecting **File** from the menu bar and then **Exit**.

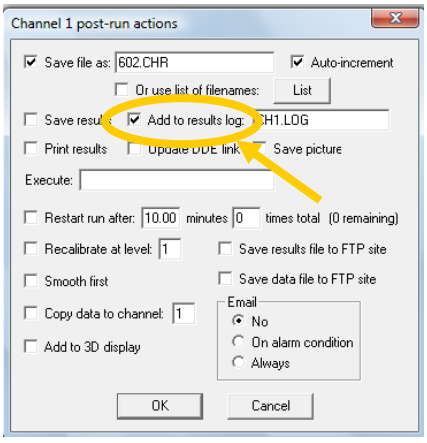


3. In the Results window locate the **Copy results log** button at the bottom of the window and click on it with the mouse cursor (don't confuse the Copy button with the Copy results log button). Open up Microsoft Excel (or if Excel is not loaded Microsoft Word or PowerPoint) and select **Edit** from the menu bar and then **Paste** to copy the results log to Excel.





4. Go back into PeakSimple and close the Results window by selecting the **Close** button. Right click using the mouse cursor on the chromatogram and select **Postrun** from the drop down menu to open the Post-run actions window. From the window locate the Add to results log checkbox and add a check to the box. By selecting the Add to results log checkbox all results from data analysis will automatically be added to the results log after the run is done. Click on **OK** to exit the window. In this way a summary of many analyses can be automatically created and then exported from PeakSimple.



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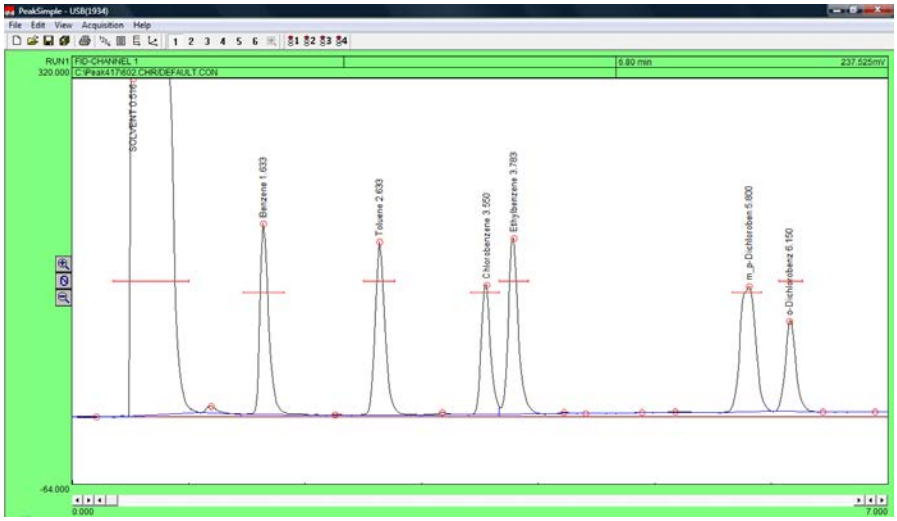

Installing PeakSimple from the CD or USB thumb drive:

A. Start the Windows operating system in use on your computer. (Windows XP, Vista, or 7)

B. Insert the CD or USB thumb drive into the computer.

C. Open **My Computer** and open either the CD or thumb drive.

D. Double-click on the **Setup.exe** file. Make sure to select the right version of PeakSimple to install (32– or 64-bit). Windows XP and some Vista computers need to install the 32-bit version, other Vista computers and Windows 7 need to install the 64-bit version. If you are unsure, right-click on **My Computer** then select **Properties** in order to determine what bit operating system you are using.

E. To complete installation follow the onscreen instructions provided by the installation wizard.

F. For instructions on loading the driver, please refer to the Quick Start Documents located in the PeakSimple folder

Installing PeakSimple from software download:

A. Start the Windows operating system and use an online browser to access www.srigc.com.

B. From the menu on the left hand side of the screen select **Download PeakSimple** and then download the latest version. Windows XP and some Vista computers need to download the 32-bit version, other Vista computers and Windows 7 need to download the 64-bit version. If you are unsure, right-click on **My Computer** then select **Properties** in order to determine what bit operating system you are using.

C. Save the file to a temporary folder and double-click on the setup file when it is finished downloading, or, just click **Run** to install PeakSimple without saving the setup file.

D. Follow the onscreen instructions provided by the installation wizard.

E. For instructions on loading the driver, please refer to the Quick Start Document located in the PeakSimple folder

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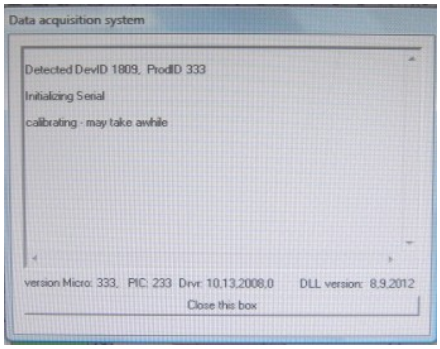
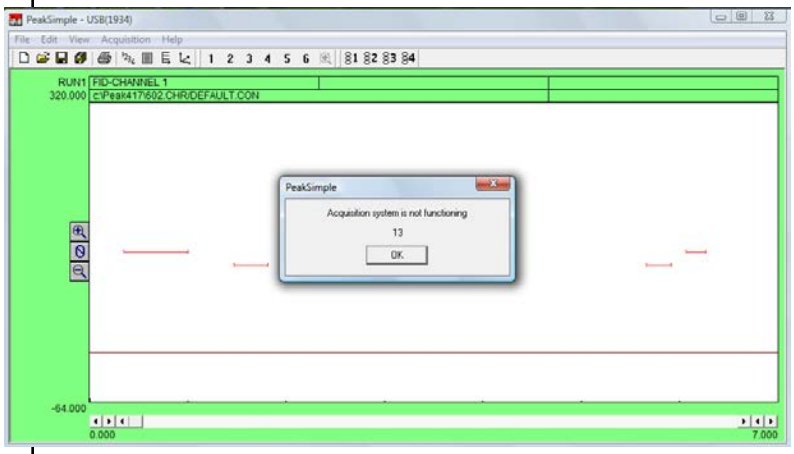
Launching PeakSimple

1. Double-click on the Desktop Peak-Simple icon to launch PeakSimple.

2. The data acquisition system will attempt to initiate communications between the computer and the data system.

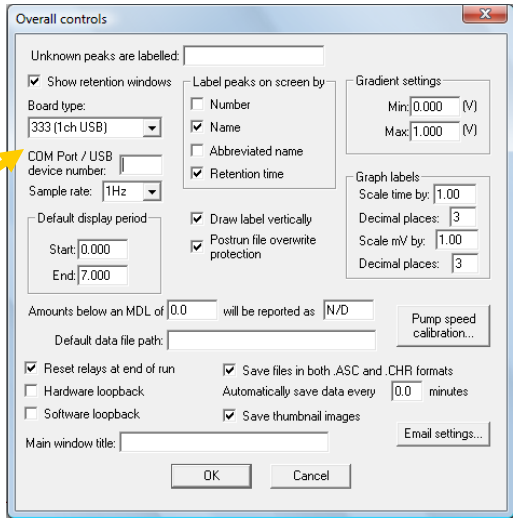


3. If PeakSimple comes up with an error message stating "Acquisition system is not functioning" with a countdown timer, it is indicating that there is a communication problem between the computer and the data system or that the data system and the hardware is not connected. Click OK to continue working with PeakSimple.



4. The first time PeakSimple connects to a GC or data system open the **Edit** menu and select **Overall** to get to the **Overall Controls** Screen.

5. Enter the proper **Board type** (202, 203, 302, or 333) and **COM Port/ USB device number** (Found on data system or GC). Select OK and PeakSimple will establish communications with the data system.



6. Most of the commands and options in PeakSimple are equipped with tool tips that will automatically pop up to display useful information when the mouse cursor is held over a command. To turn off the tool tips deselect the tool tips option in the Help menu.

Enter the A/D board type. Your choices are Model 203 single channel serial connection,Model 202 4 channel serial connection, Model 333 single channel USB and Model 302 6 channel USB.

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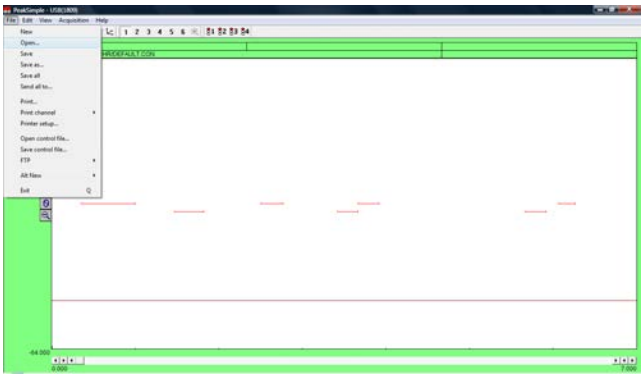
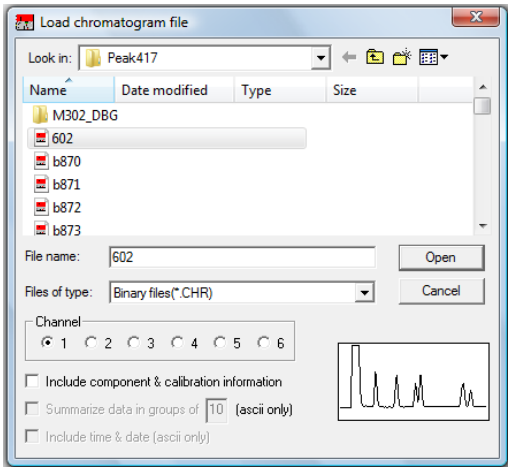
Opening a PeakSimple Data File

1. To open a PeakSimple data file or chromatogram, begin by selecting **File** in the PeakSimple menu bar and then choose **Open…** from the set of options.

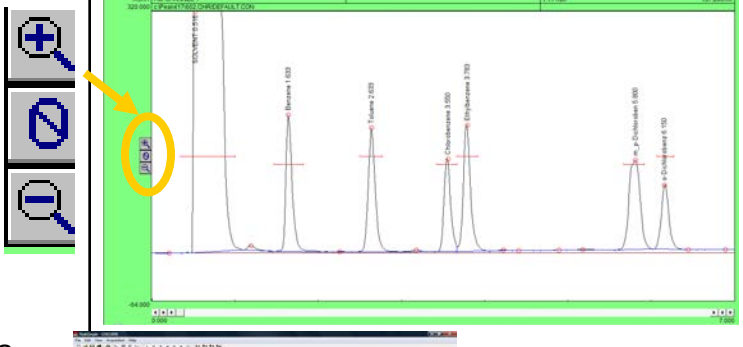


2. The Load Chromatogram File window is now open. The PeakSimple software includes a number of sample chromatogram data files that can be opened, displayed, and manipulated. One file, 602.CHR, will be used throughout the rest of the tutorial. Select file **602.CHR** from the PeakSimple directory, choose **Channel 1** as a destination channel, and then select **Open** to load the file.

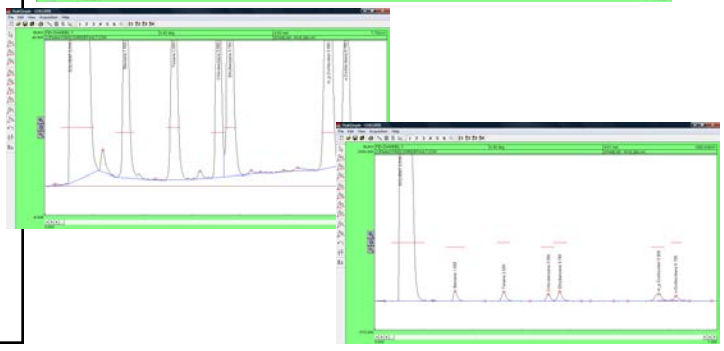


Adjusting Display Limits

1. To adjust the display limits of a chromatogram click on either the **+** magnifying glass icon or the **-** magnifying glass icon to the left of the chromatogram. This will increase or decrease the limits by a factor of two each time you click on the icons.



2. After opening chromatogram 602.CHR, practice making the display limits smaller but the peaks larger by clicking the **+** magnifying glass icon.



3. Practice making the display limits larger but the peaks smaller by clicking on the **-** magnifying glass icon.

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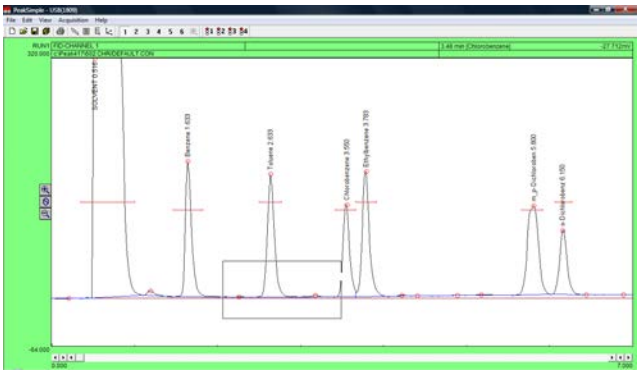
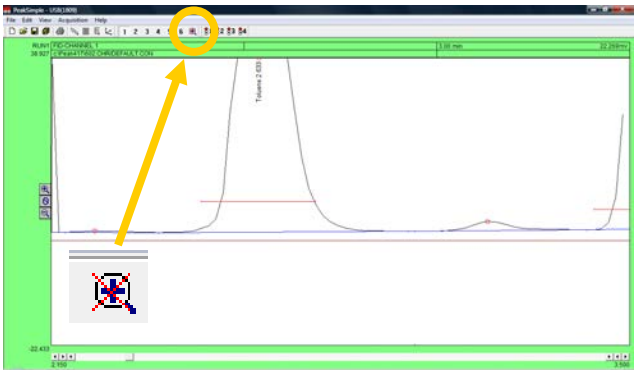
Zooming

1. To zoom in on a specific part of a PeakSimple chromatogram, click and hold the left mouse button and drag it over the desired area.

2. After opening chromatogram 602.CHR hold the left mouse button and drag it over the base of the toluene peak. Let go of the mouse button and there will be a larger view of the area that was selected.

3. To return to the original display limits of the chromatogram and unzoom the area selected press **F6** or select the unzoom icon located in the PeakSimple toolbar at the top of the screen or right-click and select **Unzoom**.

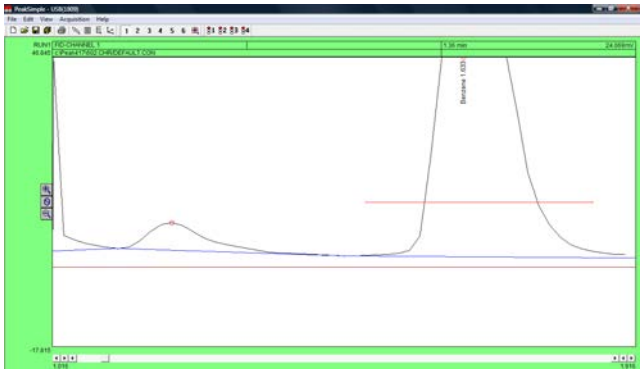


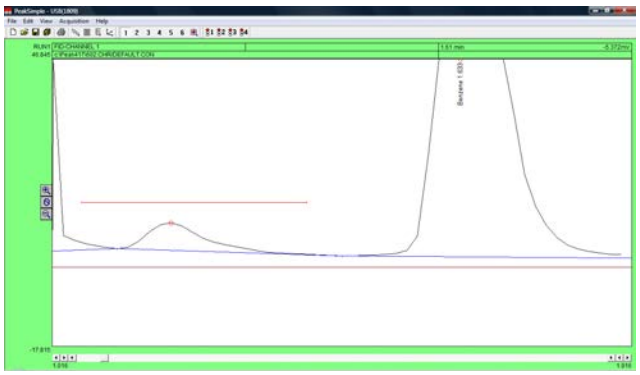


Dragging Retention Windows

1. To drag a retention window bar place the mouse cursor on the bar until a double sided arrow pops up. Click on the left mouse button and hold and then drag the retention window bar to its desired place.

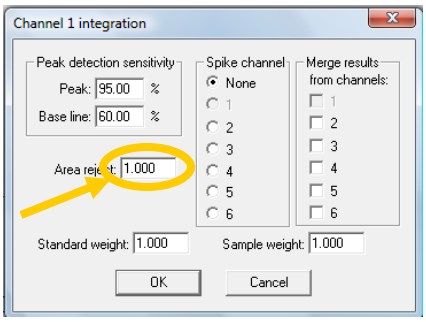
2. After opening the chromatogram 602.CHR zoom in on the benzene peak and the smaller peak to its left. Locate the benzene retention window bar and drag it over to the smaller unnamed peak to the left of the benzene. Because this is a small peak it is not immediately recognized.



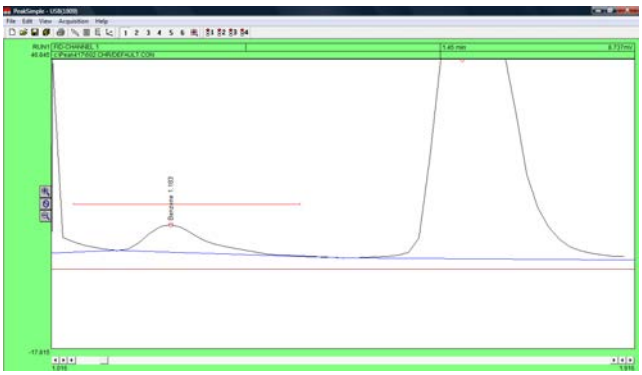


3. Right click on the chromatogram over the unnamed peak and select **Integration** from the resulting menu.

4. From the integration window locate the **Area Reject** dialogue box, erase the 100.0 in the box, and add the number **1.0** to the dialogue box. Click **OK** and the integration window will exit.



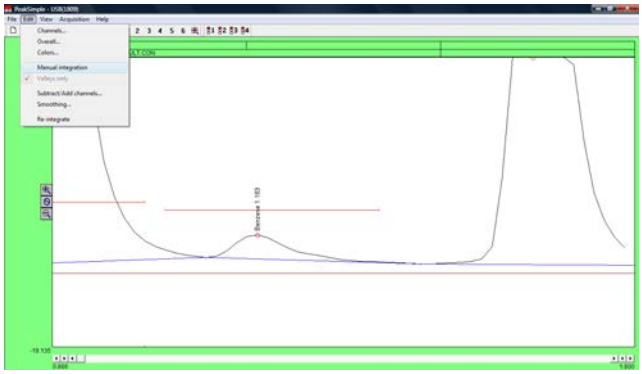
5. Press the **Enter** or **Return** key on your keyboard and the smaller peak will now be recognized as Benzene.

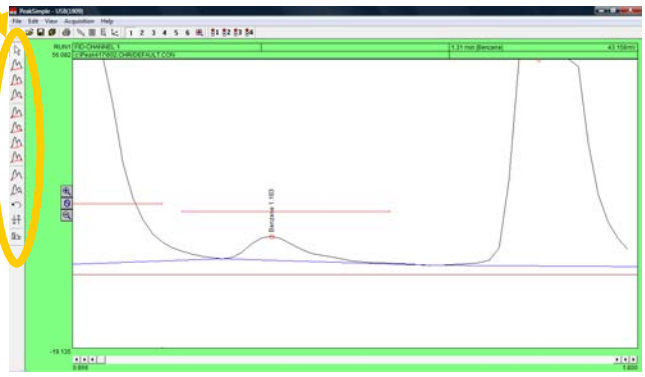


Manual Integration

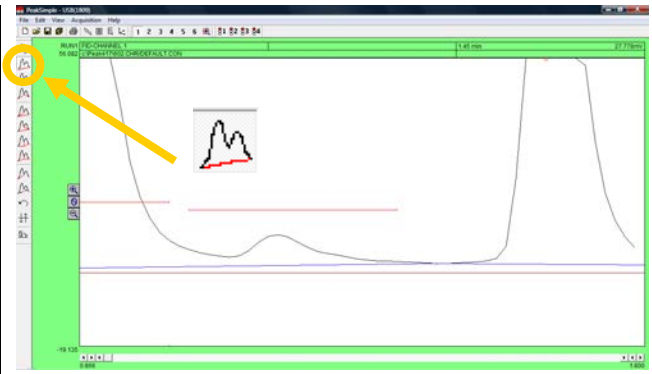
1. To manually adjust the integration baseline and peak separation in a chromatogram use the manual integration toolbar provided by PeakSimple. To open up the manual integration toolbar select **Edit** in the PeakSimple menu bar and then click on the **Manual Integration** option. The manual integration toolbar will now appear to the left of the chromatograph.

2. The manual integration toolbar contains nine types of manual integration options. Four of the most commonly used options are **None** integration, **Drop** integration, **Based** integration, and **Rubber Band** integration.



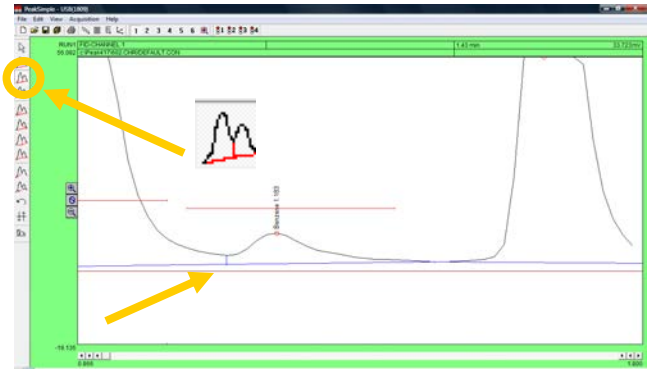


3. To make a baseline “ignore” a peak use the None integration tool. After opening chromatogram 602.CHR and the manual integration toolbar, zoom in on the baseline of the solvent peak and the smaller unrecognized peak immediately to its right. Click on the **None** integration tool in the manual integration toolbar with the mouse cursor and then click on the valley between the two peaks where they meet the baseline. The area of the small peak is now added to the solvent peak.

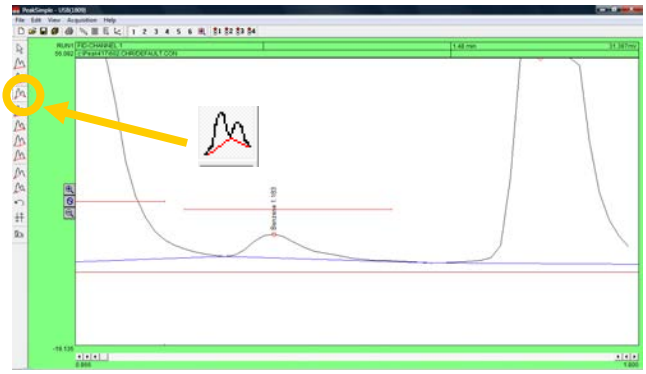


4. To undo the changes made to a chromatogram at any time simply click on the **Undo** integration tool in the manual integration toolbar. After selecting this tool all integration changes made to the chromatogram will be undone.

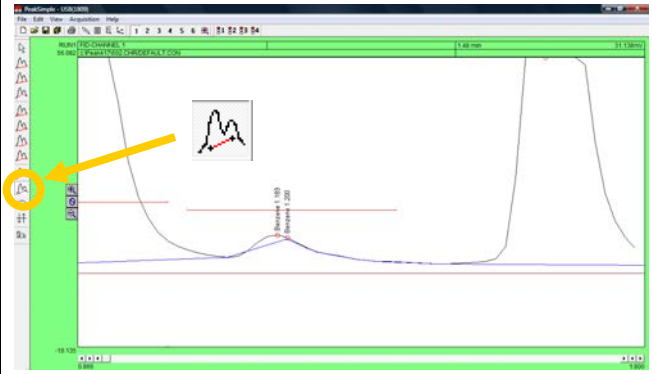
5. Click on the **Undo** tool with your mouse cursor and select the **Drop** integration tool to enable the dropping of the baseline below the two peaks. After selecting the Drop tool click where the valley of the peaks meet the baseline with the cursor. The baseline should now be dropped below the base of the peaks and a line should extend from it to the baseline.



6. After the manual integration between the two peaks is dropped use the **Based** integration tool to raise the baseline to the valley between the peaks. Once the Based integration tool is selected, click on the valley between the solvent peak and the smaller peak to its right with the mouse cursor. The baseline will now extend up to meet the valley of the two peaks.

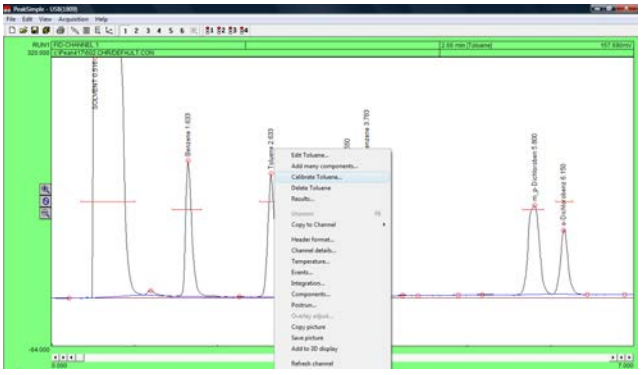


7. Once again click on the **Undo** tool in the manual integration toolbar to remove all changes done to the chromatogram. Select the **Rubber Band** integration tool to manually draw a baseline. Once the Rubber Band tool is selected take the mouse cursor and click on a part of the baseline. While holding down the left mouse button extend the line to another part of the baseline further to the right of the starting point and let go of the mouse button. The base line will now be drawn according to the line that was drawn using the Rubber Band integration tool.



Calibration

1. To turn the raw area of a peak into a real-world number the peak first needs to be calibrated. To calibrate the Toluene peak in chromatogram 602.CHR, open up the file and then right click using the mouse on the Toluene peak. After right clicking on Toluene select **Calibrate Toluene** from the resulting menu.



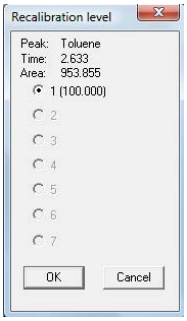
2. From the Recalibration level window click on the first level radio button **1 (100.000)** and then select **OK** with your mouse cursor.

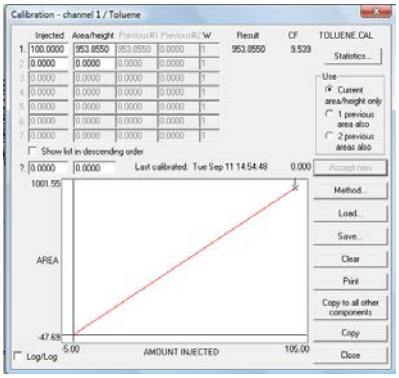
3. After selecting OK from the Recalibration level menu the Calibration menu for Toluene will pop up. Check to make sure the flashing asterisk on the calibration curve is on level 1 and then click on the **Accept New** button to the right of the window.

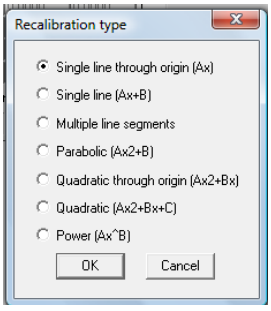
4. Once the new data is accepted, click on the **Method** button immediately below the Accept New button. The Recalibration type window will now open allowing the user to select a method of calibration. By default the calibration type is set at Multiple Line Segments. Select the **Single line through origin (Ax)** radio button and then click on **OK** with the mouse cursor.

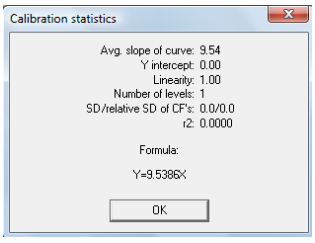
5. After changing the method of calibration click on **Statistics** in the upper right hand corner of the Calibration level window. The Calibration statistics window will pop up revealing the statistics for the calibration of Toluene. Click **OK** with the mouse cursor to close the Calibration statistics window and then select **Close** from the Calibration window to finish calibrating Toluene.

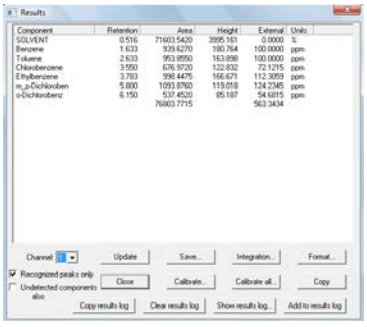
6. View the calibrated results in the Results screen by right-clicking on the chromatogram and selecting **Results**.









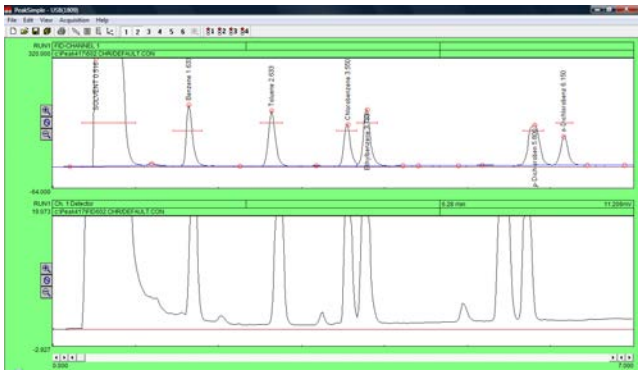


PeakSimple Basic Tutorial
Version 4.17, September 2012

Overlay

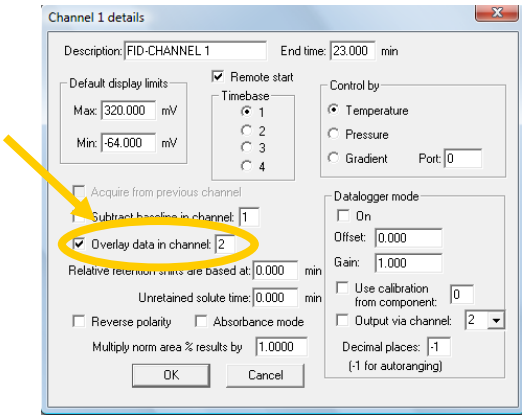
1. To compare two or more chromatograms overlay them using PeakSimple. To overlay two chromatograms first open chromatogram 602.CHR and then click on the **2** button in the PeakSimple toolbar. A second chromatogram channel is now open in the PeakSimple window.

2. Once the second channel is open select **File** from the PeakSimple menu bar and then click on **Open**. The Load chromatogram file window will open up displaying a list of files to load. Select chromatogram **FID602.CHR** to load and then select the **2** channel radio button to load the chromatogram in the second channel.

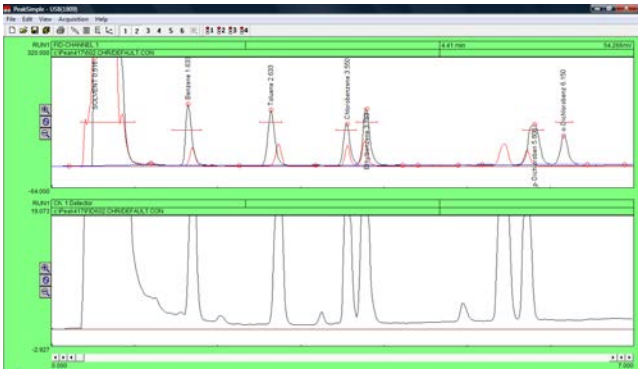


3. Once FID602.CHR is open in the second channel right click using the mouse on the first channel and select **Channel Details** from the list of options.

4. After the Channel 1 details window appears on the screen locate the **Overlay data in channel** check box and select it. Look to the dialogue box to the right of the Overlay data in channel check box and insert the number **2** in place of the 1. Click on **OK** with the mouse cursor to exit the Channel 1 details window.



5. The chromatogram FID602.CHR is now in place overlaid on top of chromatogram 602.CHR in channel 1. Chromatogram 602.CHR is in black while FID602.CHR is in red.



PeakSimple Basic Tutorial
Version 4.17, September 2012

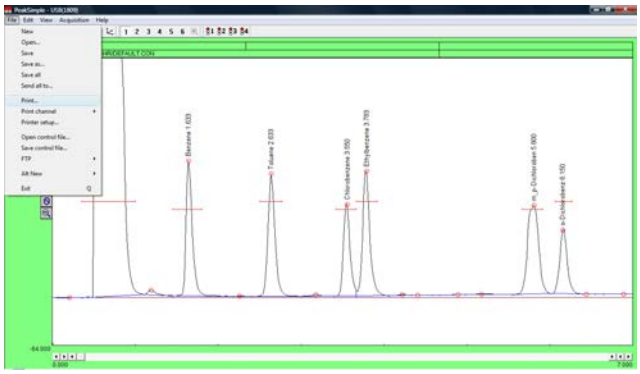
Printing a Chromatogram

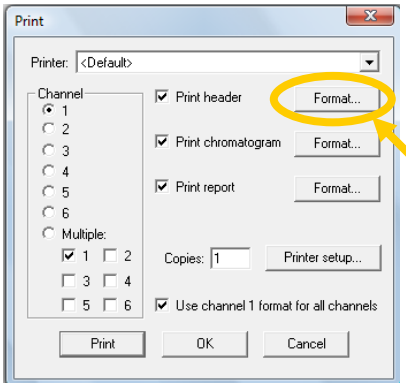
1. To print a chromatogram first open chromatogram 602.CHR. Once the chromatogram is open select **File** from the PeakSimple menu bar and then select **Print** from the drop-down menu.

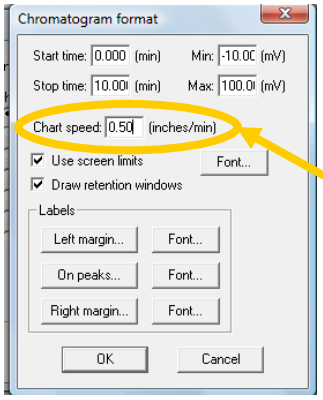
2. The Print window will open and will allow the user to customize the printing of a chromatogram. Click on the **Format** button for the Print header to open up the Header format window. Add or delete any information in the window by clicking on the fields and inserting the desired information. Click on the **OK** button when all the desired information is inputted to close the window.

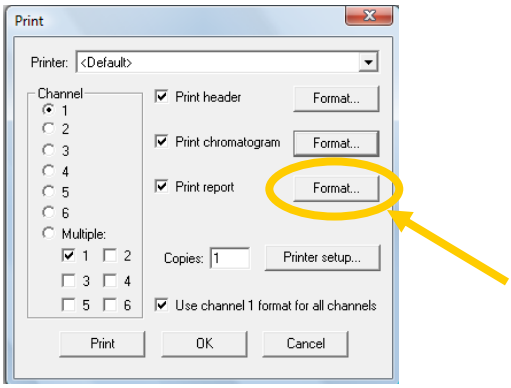
3. In the Print window click on the **Format** button for Print chromatogram to open up the Chromatogram format window. Locate the **Chart speed** dialogue box and insert the number of inches each minute on the chromatogram will take up when printed (for a nine minute run try **0.50** inches per minute). After the Chart speed is entered click on **OK** to exit the window.

4. In the Print window locate the Print report check box and click on the **Format** button to its right.

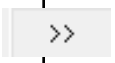


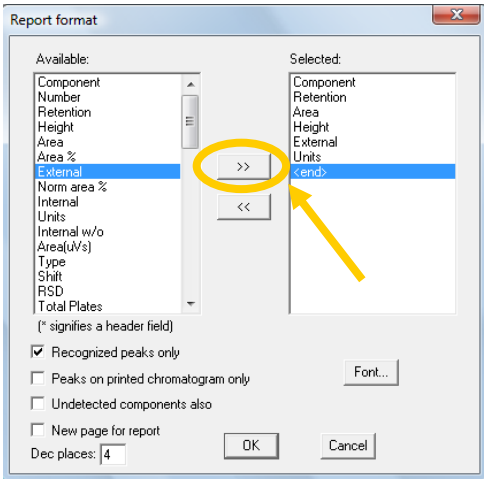






5. Once the Report format window is open click on **External** in the Available dialogue menu (on the left) and then click with the mouse cursor on the right facing arrow button to add External to the Selected dialogue box (on the right). After External is added to the Selected dialogue box click on **Units** with the mouse cursor and click on the right facing arrow button to add Units to the Selected dialogue box. Click on **OK** with the mouse cursor to exit out of the Report format window.

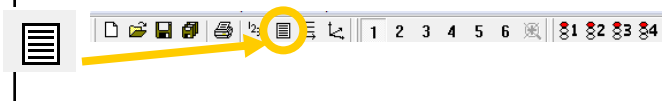


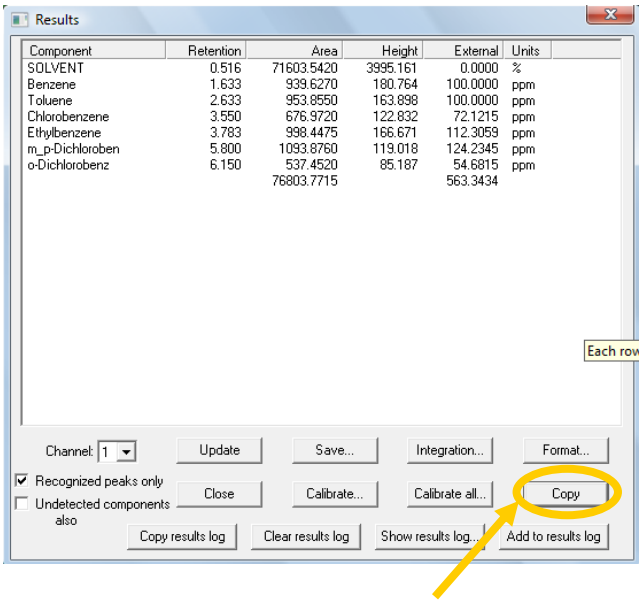


6. Select **Print** in the Print window to print the chromatogram or click on **OK** in the Print window to exit the window.

Exporting to Excel

1. In the PeakSimple toolbar click on the **Results** window button to open up the Results window. Once the Results window is open click on the **Copy** button to copy the results data to the Windows clipboard.

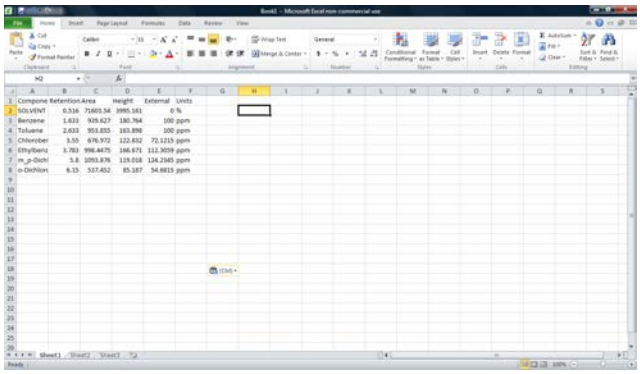


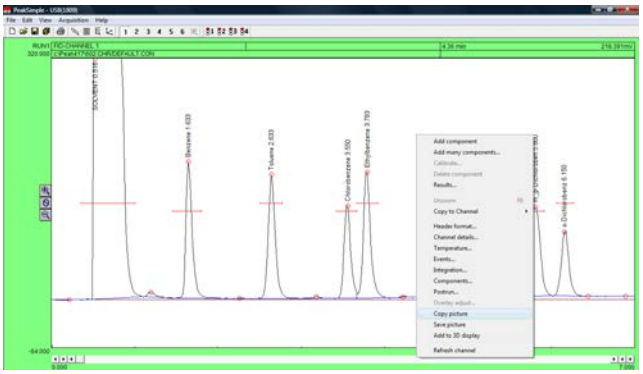


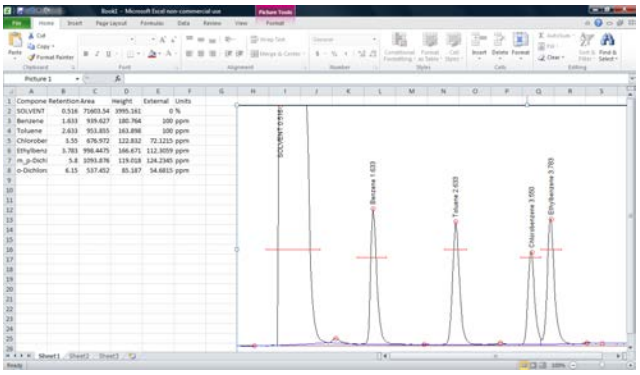
2. Make sure Microsoft Excel is loaded on the computer. If Excel is not loaded you can copy results data and chromatograms to Microsoft Word or PowerPoint. Open up Microsoft Excel by clicking with the mouse cursor on the **Start** button in the bottom left of the Windows screen and then **Programs** and then **Microsoft Excel** in the Windows Program menu.

3. Once Excel is opened select **Edit** from the Excel menu bar and then **Paste** from the drop down menu. The results data is now placed into the columns and rows of Excel. Using the mouse cursor, select a box to the right of the results data in the Excel spreadsheet. Go back into the PeakSimple program and hit **Close** to exit the Results window.

4. Right click with the mouse cursor anywhere on chromatogram 602.CHR and select **Copy picture** from the resulting menu. Go back into Excel and select **Edit** from the Excel menu bar and then **Paste** from the drop down menu. The PeakSimple chromatogram will now be displayed next to its results data in the rows and columns of Microsoft Excel.







MODEL DVW-10
VARIABLE WAVELENGTH UV-VIS DETECTOR

OPERATOR'S MANUAL

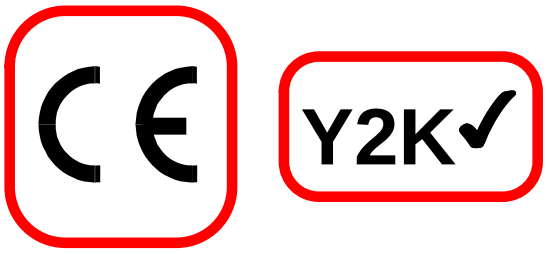


TABLE OF CONTENTS

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PART A: GENERAL

PART B: DETECTOR OPERATION

PART C: MISCELLANEOUS

PART A: GENERAL

Section 1.0 Introduction

1.1 General This manual contains information for the installation, operation, and minor maintenance of the DVW-10 Variable Wavelength UV-VIS Detector.

1.2 Layout This manual is divided as follows:

Part A - Sections 1.0 through 4.0 contain instrument information and safety warnings.

Part B - Sections 5.0 through 8.0 contain information on operation of the variable wavelength detector.

Part C - Sections 9.0 through 13.0 contain information on power management, troubleshooting, shipping and storage, and accessories, spare and replacement parts.

1.3 Graphics Conventions The following symbols and graphics are used in this manual to alert the operator to essential information.

Electrical Shock Hazard - Information is necessary to prevent operator injury due to electrical shock.

Caution - Information is necessary to prevent operator injury or equipment damage due to mechanical or chemical condition(s).

Shadow Box or

NOTE - Information concerning operator required action or for optimizing instrument performance.

1.4 DVW-10 Features

The DVW-10 system is the first in a new generation of variable wavelength detectors. Some of the key features of the detector are:

- Complete UV-Vis operation from 195 nm to 800 nm.
- Double beam optics.
- All wettable components constructed of PEEK™, Teflon™, Tefzel™, and quartz for total compatibility with biochemical systems.
- Flowcells available for analytical, industrial prep work, and biocompatible systems.
- Eight absorbance ranges via scrolling up and down controls.
- Sensitivity levels available for over 95% of all applications.
- Digital read-out of absorbance and wavelength.

- Analog outputs for absorbance and wavelength available at rear of instrument.
- Absorbance and wavelength remote control available via rear connector contact closures.
- Scrolling selection of wavelength.
- Voltage selection - simple, external user access.

1.5 Common Applications

The DVW-10 Series was designed to offer absorbance detection of high performance liquid chromatography (HPLC) separations at the best price/performance ratio. The unit can be used for the most complex analyses, as well as for routine assays. The detector provides the chromatographer with automation capability during separation runs not previously possible on similarly priced detectors. Integrated with current sophisticated personal computer (PC) data acquisition systems such as *Star-Chrom*™, the DVW-10 can be controlled by the PC to respond to pre-set methods that have been stored by the operator. The DVW-10 also allows simple manual operation with a standard stripchart recorder or integrator. Lamps and flowcells are easy to change, making the detector a versatile workhorse for analytical, semi-prep or preparative work.

D-Star is committed to offering a broad range of components to the chromatography market. Therefore, it will be continuously adding to its product line not only detectors but a complete assortment of flowcells and accessories for many applications.

Contact your Dealer/Representative for additional product offerings.

1.6 Warranty

No other warranty exists, expressed or implied, except as shown here and in D-Star Instruments' Conditions of Sale.

Fitness to a particular application must be determined by the user.

Parts & labor are warranted for one (1) year, provided the unit is not damaged by improper use, abuse or by chemical spill.

Request a Return Authorization (RA) before returning any parts.

Return defective unit to Dealer/Representative for repair. Clean/sterilize all components prior to shipment. No parts will be accepted which present a health or safety hazard to service personnel. Repaired unit will be returned via parcel service or mail.

The flowcell and all tubing supplied with the instrument are warranted at the time of installation only.

Lamps are warranted on a pro-rated basis only. The deuterium (D2) lamp is warranted for six (6) months from the sale by D-Star, or for 1000 hours, whichever occurs first. If the lamp fails prior to 500 hours, and the lamp is returned to D-Star within the warranted six months, it will be replaced at no charge. The lamp will be replaced within the time frame on a pro-rated basis after the first 500 hours on the lamp, at a cost consistent with the hours on the lamp divided by the lamp warranty of 1000 hours times the lamp replacement cost.

1.7 DVW-10 Detector Specifications

Wavelengths:	195 to 800 nm
Lamps:	Standard - Deuterium (D2) (195-360 nm) Accessory - Tungsten (W) (360-800 nm)
Flowcells	
Analytical:	7mm pathlength, 10µl volume, 200 psi; wetted materials: PEEK, quartz or sapphire, Tefzel, Teflon; 1/16" O.D. tubing.
Preparative:	2.0 mm pathlength, 4 µl volume, 100 psi; wetted materials: PEEK, quartz or sapphire, Tefzel, Teflon, 1/8" O.D. tubing.
Linearity:	Better than 2%
Wavelength Accuracy:	2 nm
Wavelength Reproducibility:	1 nm
Spectral Resolution:	5 nm
Stability (Drift):	Less than 2.5×10^{-4} AU/Hr (at 254 nm and constant temperature)
Noise:	Less than $\pm 2.5 \times 10^{-5}$ AU (5×10^{-5} AU peak to peak) at 254nm and constant temperature
Recorder Output (A):	10mV
Integrator Output:	1.0 V/AU to 2V (Equivalent to 2.0 AU)
Display:	
Absorbance:	4.5 digits to 1.999 AU
Wavelength:	3 digits for operating range 195-800 nm
Absorbance Ranges:	0.005, 0.01, 0.02, 0.05, 0.10, 0.20, 0.50, 1.0 AU
Front Panel Controls:	Wavelength (λ) selection, Range selection, Autozero, Event Mark
Rear Panel Controls:	Subminiature D-type, 15 position female connector for detector recorder/ integrator output, and remote control (Wavelength [λ] Up/Down, Event Mark, Autozero, Lamp On/Off, Sample/Reference Energy)
Power:	110/115, 220/230V factory preset
Dimensions:	7.1" H x 8.6" W x 16.0" L
Shipping Weight:	23 lbs

Tubing used in the biocompatible systems (standard analytical):

Column to Detector Flowcell Inlet: 1/16" OD, 0.015 ID PEEK
Detector Flowcell Outlet to Waste: 1/16" OD, 0.015 ID PEEK

Section 2.0 SYSTEM ORIENTATION

2.1 Front Panel

Manual controls for the DVW-10 Detector are located on the front of the unit (Figure 1). Each function is described in the Detector Operation Section. Additional types of controls are described in the Remote paragraphs of the same section.

The "1.000" Range LED and Absorbance/Wavelength Display should be lighted when the power is turned on.

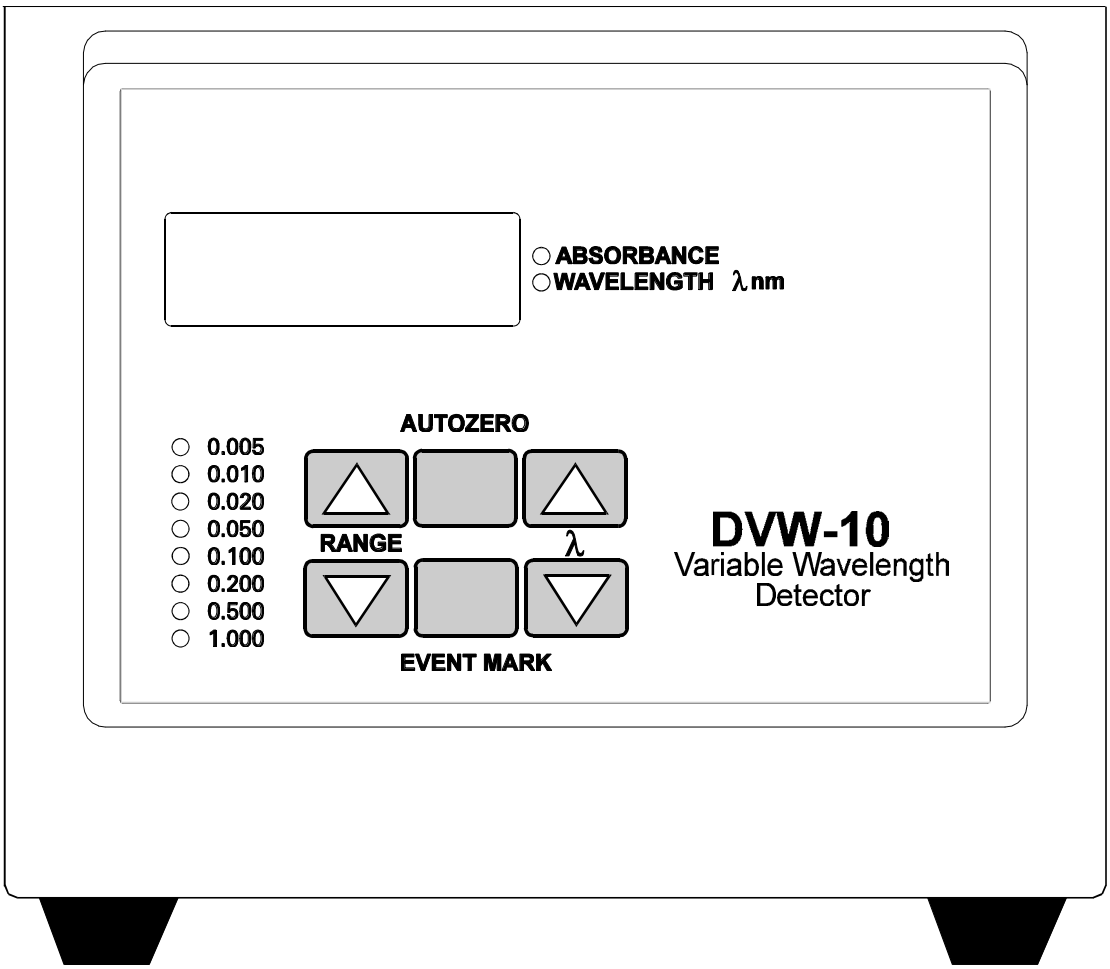


Figure 1 Front Panel

2.2 Rear Panel

The rear panel or chassis rear is shown at Figure 2.

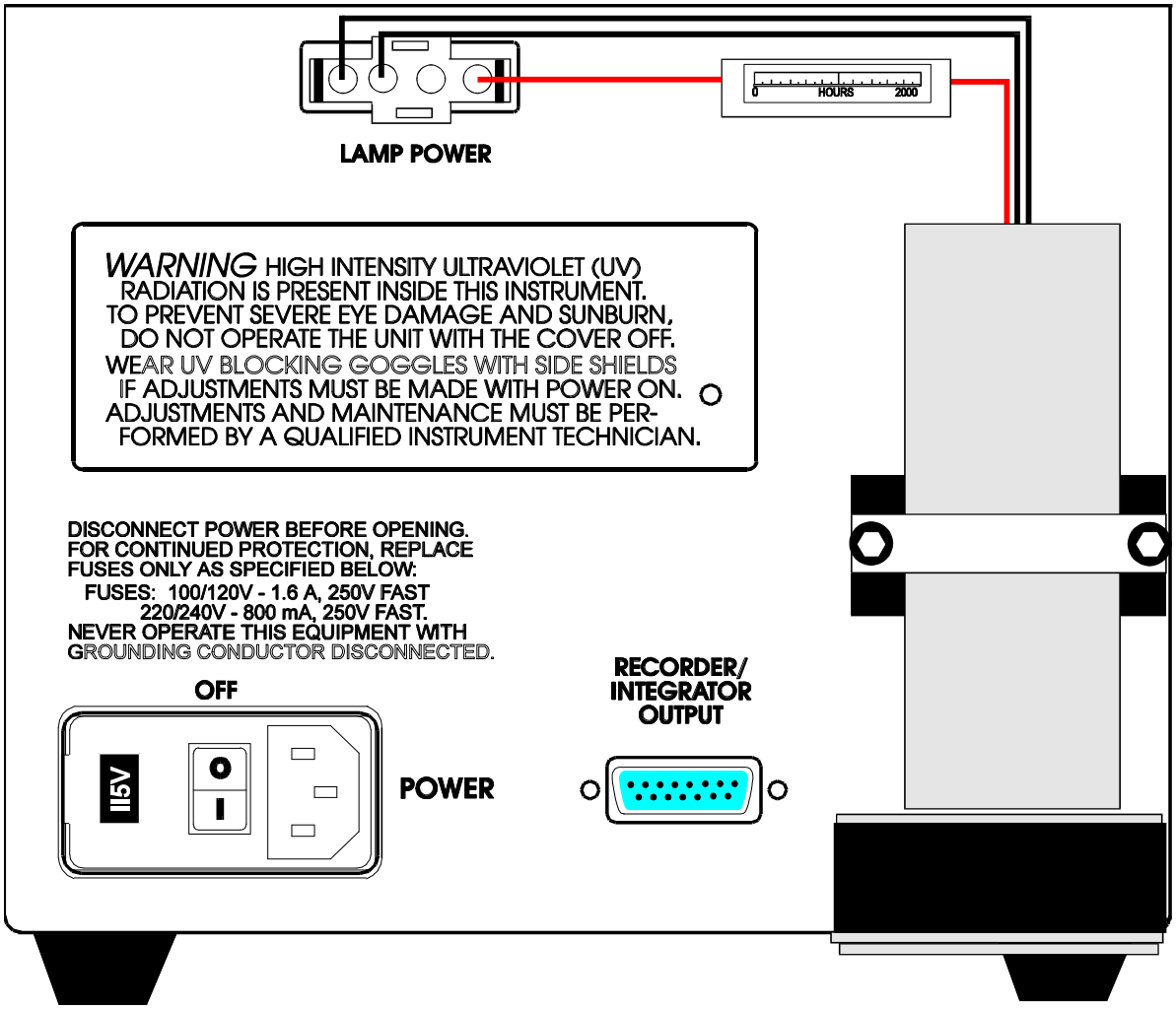


Figure 2 Rear Panel

The ON (I) and OFF (O) power switch is located on the Corcom™ power module. The Corcom may be programmed for 110/115 or 220/240 volt operation. No other power changes are required in the system. See the Fuse Changing/Replacement section in Part C for additional details.

The data output and remote control port (Recorder/Integrator Output) is located on the rear panel.

The DVW-10 lamps are mounted on the rear for easy access.

Notice the UV warning labels on the chassis and on the D2 lamp. Do not remove the flowcell without turning the power off or attempt to operate the unit with the cover off. UV energy will cause severe eye damage and sunburn.

See the Safety section for additional discussion.

2.3 Side Panel

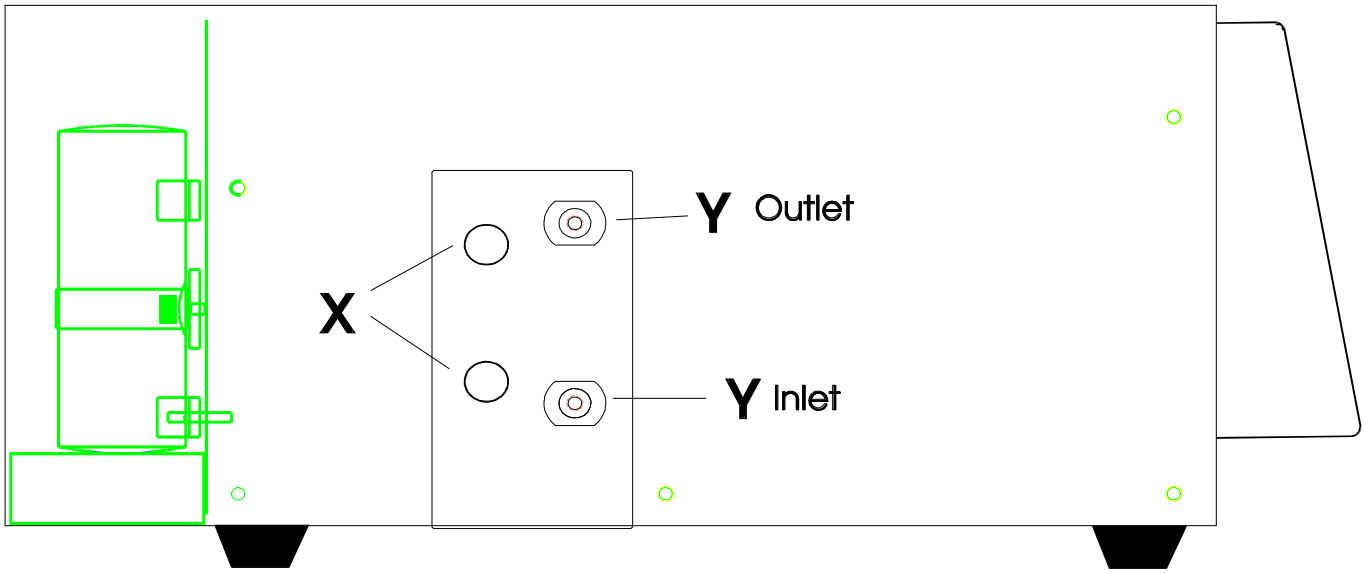


Figure 3 Side Panel

Figure 3 shows the side panel. An analytical flowcell is shown in its mounted position with the cover on. Thumbscrews (X) hold the cell assembly on the monochromator. The bulkhead fittings (Y) enable plumbing the unit from the column and to waste or other system components. The lamp and fan assembly are shown for reference. The lamp is located behind and under the cover to preclude possible side/top damage, as well as to prevent stray ultraviolet energy from causing operator injury.

Do not operate the unit with the cover/cabinet lid removed.

CAUTION: The lamp may be HOT. Do not remove the lamp while it is turned ON. There is danger of electrical shock and exposure to ultraviolet (UV) energy which causes severe damage to eyes and skin.

Section 3.0 Safety

The DVW-10 has been designed with user and application safety in mind. The following are the detector safety features and their purposes:

Grounding plug on AC power cord - must be plugged into a grounded wall outlet.
Factory supplied power transformer - do not substitute.
Enclosure/Cabinet/Cover - for electrical grounding and shielding, protection from liquid spray, UV energy blockage, and to minimize stray light.

WARNINGS:

DANGER!! Lethal voltages are present on the D2 Power Supply & Signal Processor Boards. With power OFF, the D2 Board can still be Dangerous. Wait until all RED LEDs go out. **SEE SECTION 8 OF THIS MANUAL**

Do Not Try To Defeat Any of the DVW-10's Safety Features

Do not attempt any electrical repairs without unplugging the power cord.
Unplug the power cord before opening the cabinet lid.
Do not remove or defeat the grounding pin on the power plug.
Do not attempt to defeat power grounds.
Do not defeat any of the system's other grounding schemes.
Contact an electrician if you are not sure of wall outlet voltage or grounding.
Do not operate the unit with the cabinet lid off or unscrewed.
The cover is attached to the chassis by a ground wire!
Ensure liquid fittings and connections are tight to avoid spraying solvents.
Do not operate the detector with liquid without eye protection.
Tubing may weaken with time, pressure and solvents. Inspect periodically.
The liquid system may be under injury-causing high pressure.
Exercise safe practices when using solvents, especially under pressure.
Do not look at the UV energy source. Damage to the eyes will occur. **Use UV blocking goggles to prevent injury.**
Exposure to UV energy will also cause *sunburn* to eyes and skin.

Section 4.0 INSTALLATION

4.1 PACKING LIST (Standard for DVW-10)

DVW-10 Variable Wavelength Detector with Deuterium lamp, 110/115V [DS014-0014], or
220/240V [DS014-0014-1]
Analytical Flowcell Assembly [DS010-0067] Standard
Accessory Kit Package - DVW-10 [DS010-0081] includes:
Recorder/Integrator Cable [DS 010-0024] ...1 ea
Hex Key Wrenches:
for Flowcell Sockethead Cap Screws - 3/32" [DS 540-0004] ...1 ea
for Lamp Sockethead Cap Screws - 9/64" [DS 540-0011] ...1 ea
Fuses:
Corcom (115V): 5 x 20 mm, FAST, 250V, 1.6A [DS430-0009]...2 ea
Corcom (230V): 5 x 20 mm, FAST, 250V, 800mA [DS430-0014]...2 ea
Signal Processor Board: 5 x 20 mm, FAST, 250V, 200mA [DS430-0012]...2 ea
D2 Power Supply Board: 5 x 20 mm, FAST, 250V, 500mA [DS430-0004]...1 ea
External Bulkhead Fittings, 1/16" O.D. Tubing (Male 10-32 Nut with Ferrule) [DS250-0043/250-0044]...2 sets
US Power Cord (115V) [DS610-0004] ***or*** Int'l Power Cord (230V) [DS610-0005]...1 ea
Operating Manual (this document) [DS 050-0004]...1 ea

NOTES:

1. Part numbers shown above are for shipped kits. Parts numbers shown elsewhere in the manual are for accessory/replacement/spare parts ordering.
2. Items indicated in the manual with the word "optional" or "accessory" are not supplied unless specifically ordered (additional cost).

4.2 INSTALLATION

4.2.1 General

1. After opening the shipping container, inspect the DVW-10 for any damage. Record damage to the shipping container and the detector in the event a claim needs to be filed.

CAUTION: Do not pick up the DVW-10 by the plastic front control panel enclosure (with overlay). Hold on to the base of the chassis.

2. Check the packing list (4.1 above) to ensure all items were shipped.

3. Place the unit in a well-ventilated area to avoid heat build-up.

4. Ensure that the factory set voltage setting on the Corcom is correct for your power supply. If it is different, consult the fuse changing section of this manual or contact your Dealer/Representative.

5. Ensure that the cover/cabinet lid is positioned correctly and the cover screws are tightened.

6. Check that the lamp plug and the lamp screws are tightly connected.

4.2.2 Flowcell

Two nylon flowcell plug screws are installed on the analytical flowcell prior to shipping to prevent flowcell contamination and to protect the bulkhead fittings from damage. Remove the plug screws and save them for future shipping or storage. The bulkhead fittings are located in the Accessory Kit Package. Instructions for preparing your flowcell for operation are located as Appendices at the rear of this Manual.

Write the name of each flowcell on the table of contents to provide easy reference to its location.

4.2.3 Power Cord and Recorder/Integrator Cable.

Attach the Power Cord to the Corcom.

Attach the data cable to the output plug. Screw in, but DO NOT OVERTIGHTEN, the screws on the external cable shell to the hex nut head on the output plug.

Use the wire hook-up instructions located on the end of the cable for the appropriate data device.

4.2.4 Problems.

If problems are encountered, consult the Troubleshooting Guide in Part C.

PART B: DETECTOR OPERATION

Section 5.0 Description of the DVW-10 Detector

5.1 Introduction

This instrument is a variable wavelength spectrophotometer that uses a flow-through cell to measure solute concentration in liquid streams. A special signal processing system converts the signal from a photodetector to a voltage directly proportional to concentration (absorbance). An autozero system provides push-button nulling of the output voltage level. There are output connections for a computing integrator of 1 volt per absorbance unit to 2 volts (equivalent to 2.0 AU). In addition, there is an output with eight levels of sensitivity provided for a 10 millivolt strip chart recorder. Front Panel LED characters display the same absorbance measurement. An Event Mark system triggers a voltage spike output to the data system.

5.2 Operating Principles

Photon energy supplied by an energy source lamp (UV or Visible) is passed through a flowcell monochromator to a photodetector. Electronic circuitry comprised of a differential logarithmic amplifier and signal conditioning system processes the photometric signal to provide an output voltage proportional to absorbance of the solution in the flowcell. Output sensitivity is a function of flowcell pathlength, concentration, and molecular extinction coefficient of the substance in solution (Beer's law). For measurements at specific wavelengths, a high efficiency plane ruled grating is rotated by a stepper motor to break out the energy to the desired wavelength in nanometers (nm).

5.3 Optical System

The monochromator, a unique optical bench design, is the heart of the DVW-10 detector. The optical system is shown below.

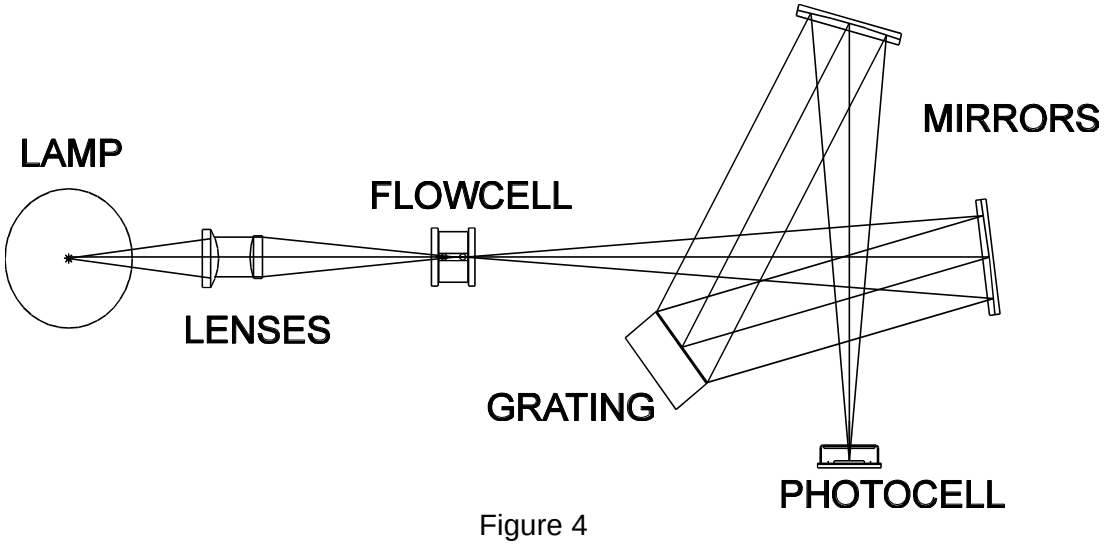


Figure 4

The double beam system with its sample and reference beams traveling the same paths to a matched dual element photodiode provides the most accurate (optimal) means for absorbance detection. The monochromator is compact and easily accessible to qualified service technicians.

5.4 Operating Wavelengths

A pre-aligned deuterium (D2) lamp is used to obtain maximum UV energy from 195 nm to 360 nm. A Tungsten (W) lamp assembly (accessory) provides visible light from 360 nm to 800 nm. Lamps may be easily changed by the operator. Only one lamp may be installed at one time. Using a lamp outside of the optimal ranges shown above will result in substandard performance.

The lamps are powered by a custom designed power supply.

5.5 Flow-Through Fluid Cells (Flowcells)

Various models are available. The standard cell for Analytical HPLC has a pathlength of 7.0 mm and an illuminated volume of 10 µL. The analytical flowcell assembly is standard on the DVW-10.

A Preparative (Prep) cell is available as an accessory with a pathlength of 2.0 mm (4 µL volume).

Wetted materials are chosen for chemical resistance as shown below:

Analytical cell: PEEK, quartz or sapphire, Teflon, and Tefzel.
Prep cell: PEEK, quartz or sapphire, Teflon, and Tefzel.

5.6 Limits to Performance

Solvents and/or mobile phases must be selected that will be compatible with the materials of construction (see list of materials above) for safety, proper operation and to prevent damage to the components of the flowcell assembly.

Backpressure on the flowcell may be necessary to prevent bubbles from forming which can cause poor baselines and noise.

See the Flowcell Appendix for backpressure advice.

Linearity depends upon the correspondence between the absorbance maximum of the sample substance and the measurement wavelength. For optimum performance these should be matched as closely as possible. Also, at absorbances above 0.5 AU, linearity can be expected to be less than at lesser absorbances.

Noise & drift are affected adversely by many factors including:

- Non-degassed mobile phases.
- Entrapped gas bubbles in the flowcell.
- Certain gradient combinations.
- Large or rapid temperature changes in the environment or fluids.
- Accumulation of residues in the flowcell.
- Mobile phases which absorb energy at the measurement wavelength.
- Faulty check valves on a pump.
- Chemical vapors in the atmosphere.

- Contaminated (dirty) windows and/or optics.
- Insufficient time allowed for warm-up of lamp and electronics.
- Source lamp aging or damage.
- Improper grounding (including ground loops).

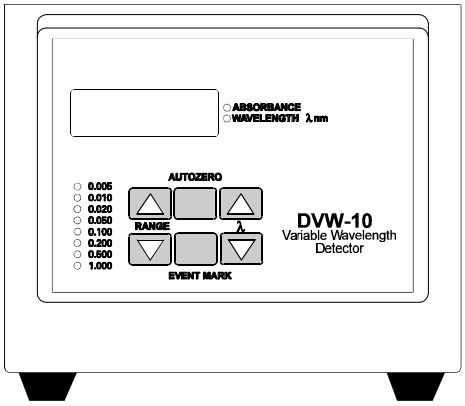
Consult the Troubleshooting Guide in Section C for problem identification and possible solutions.

Section 6.0 - INSTALLATION AND OPERATION

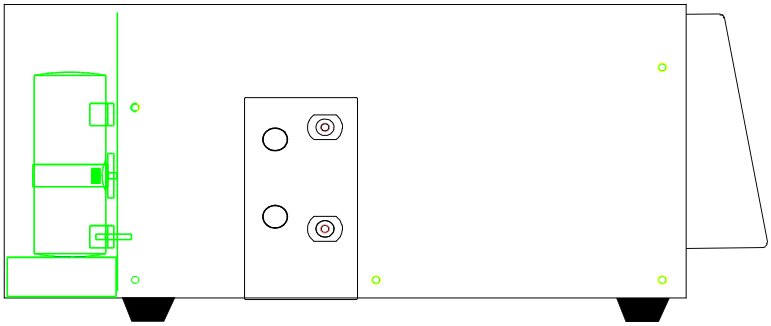
6.1 Orientation of the Detector

To simplify description of the detector component locations, the following terminology is used:

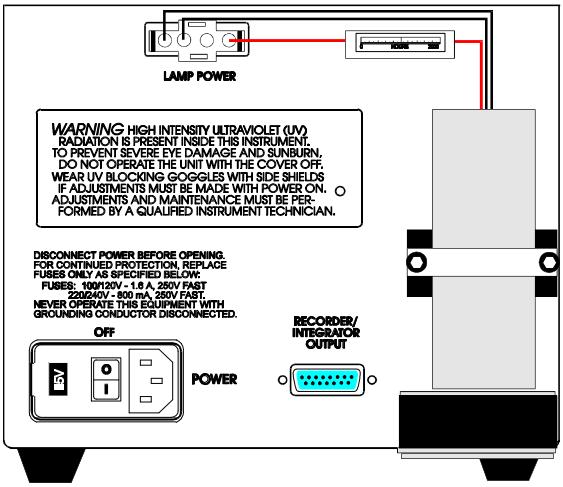
Front Panel:	The surface where the controls, switches and displays are located.
Side Panel:	The surface where the flowcell assembly is mounted.
Rear Panel:	The surface where the lamp, and electrical and input/output connectors are located.



Front panel



Side Panel



Rear Panel

Figure 5

6.2 Flowcell and Tubing Connections

Consult the Appendix for each flowcell for installation instructions.

It is a good idea to check the tightness of the bulkhead fittings occasionally to prevent leaks. Do not overtighten.

NOTE: Metallic tubing and fittings may damage biocompatible flowcell parts and may require special strain relief considerations. Contact your Dealer/ Representative for details.

6.3 AC Power

CAUTION: **Do not remove or defeat the grounding pin on the power plug. Contact an electrician if you are not sure whether the wall outlet is properly grounded.**

AC power is required for operation of this instrument. The unit is internally wired to the transformer and is grounded to operate at 115 VAC. No 230 VAC adjustment is required except at the Corcom.

6.4 Controls

Figure 6 highlights the controls of the DVW-10 Variable Wavelength Detector. Individual graphics are shown with the specific descriptions.

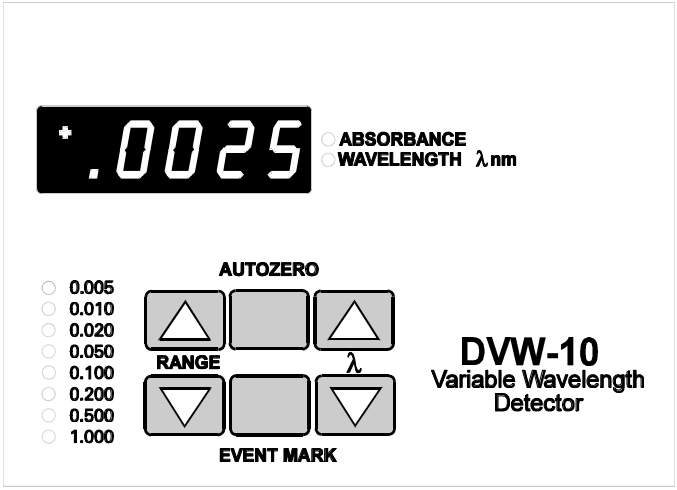
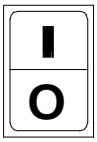


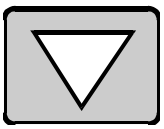
Figure 6 Detector Control Panel



Power ON/OFF (Rear Panel) - Switch to the ON position [**I**] to operate the detector.

Range UP (Control Panel) - Press anytime to change recorder range. The detector "wakes up" in the 1.000 AU position. Actuation does not affect the integrator output level.

RANGE



Range DOWN (Control Panel) - Press anytime to change recorder range. Actuation does not affect the integrator output level.

NOTE: A sudden shift in the recorder position is normal when changing the range.

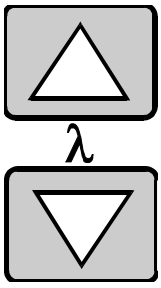
AUTOZERO

Autozero (A/Z) (Control Panel) - Press anytime to return output signal level to the baseline position. The autozero affects both the recorder and integrator outputs.

EVENT MARK

Event Mark (Control Panel) - Press to trigger an "event mark" on the recorder. The Event Mark should deflect the recorder approximately 1 to 3% full scale, depending on recorder pen speed.

In order to obtain an event mark signal for an integrator a remote cable is required. (See Section 7 and your Integrator manual for "Start Integration Input")



Wavelength UP (Control Panel) - Press to increase the wavelength display setting step by step. Holding down the button enables rapid stepping.

Wavelength DOWN (Control Panel) - Press to decrease the wavelength display setting.

Internal limit switches prevent the monochromator grating from rotating too far and binding. ***Please note that it is advisable*** NOT TO OPERATE BELOW 185 NM OR ABOVE 800 NM TO FURTHER SAFEGUARD THE WAVELENGTH LIMIT CONTROL FROM BEING DAMAGED AND FAILING TO MEET SPECIFICATION.

6.5 Indicators

6.5.1 Range Selection Status

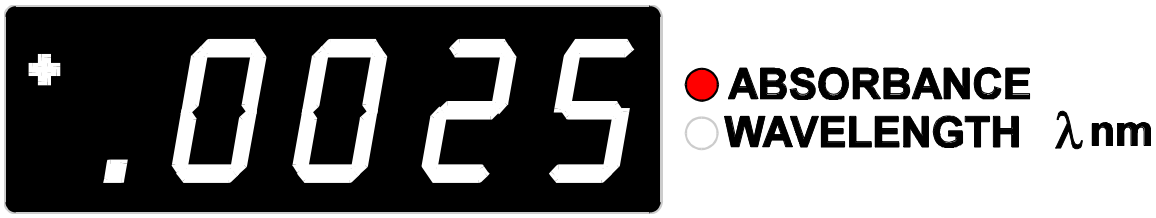
- 0.005
- 0.010
- 0.020
- 0.050
- 0.100
- 0.200
- 0.500
- 1.000

Absorbance ranges (8 red/orange LEDs).

The LEDs display the full scale output range (AUFS) to a recorder attached to the Recorder/Integrator Cable on the rear panel. The range selected does not affect the 1V/AU output to an integrator.

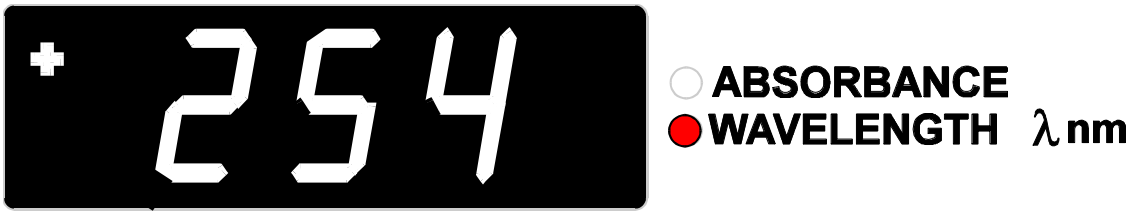
Power On is indicated by one of the red/orange Range LEDs being lighted.

6.5.2 Absorbance Display



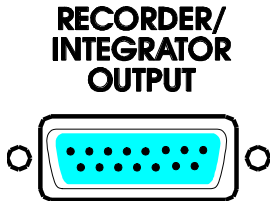
When powered ON, the Absorbance Display will be lighted as will the red/orange "ABSORBANCE" status LED. The display will output both positive and negative voltages, with a range of .0000 to 1.999 absorbance units (AU).

6.5.3 Wavelength Display



The Wavelength Character Display and the "WAVELENGTH NM" status LED will be lighted when either the Wavelength (λ) UP or DOWN buttons is pressed. The display will revert (or time-out) to the ABSORBANCE display ten (10) to twenty (20) seconds after the last λ button push.

6.6 Input/output Connectors



15-position female subminiature D-type on rear panel for:
Recorder - 10 mV full scale range
Integrator - 1.0 V equivalent to 1.0 Absorbance
Remote Control - Contact closure inputs (see Section 7 of this manual for details).

6.7 Recorder/Integrator Cable

Attach the Recorder/Integrator cable to the Recorder/Integrator Output port on the rear of the unit. Do not over-tighten the cable hood screws onto the output hex nuts.

The cable supplied has a 15-position male subminiature D-type connector on one end and stripped and tinned leads on the other. The colors of the wires are associated with their purpose:

Black	- Integrator [-]
Red	- Integrator [+]
Green	- Recorder [-]
White	- Recorder [+]
Green/Yellow	- Shield

The recorder cable is also marked with the wire connections.

! ***IMPORTANT FOR BEST OPERATION:***
Connect the Green/Yellow wire of the recorder/integrator cable to the recorder or integrator's guard terminal, if available. Otherwise, connect the Green/Yellow wire to the recorder or integrator's ground terminal. Make sure that the recorder or integrator power cord is plugged into the same outlet as the DVW-10. Isolate (cover) the tinned leads of unused wires so that they do not create ground loops and introduce noise into the system.

6.8 Power-on and Warm-up

Switching the unit ON at the CORCOM turns on power for both the electronics and the lamp. The deuterium (D2) lamp will cycle through a 10 second filament warm up before it ignites. The tungsten (W) lamp will ignite almost immediately.

NOTE: Allow the measurement electronics and the source lamp a minimum of 60 minutes to warm up prior to initiating your analytical run.

The absorbance display will show a large reading, either + or - before, during, and after the lamp is turned on. Once the lamp has been on for approximately 30 seconds, push the autozero (AZ) button. The absorbance LED characters should display from +.0000 to +.0030. See the Troubleshooting Guide in Section C if the display is outside of the above range.

If the unit still shows instability please contact your dealer. The warm-up requirement should be reduced with the continued use of the instrument.

6.9 Wavelength

6.9.1 Wavelength Lamps

Wavelength is dependent on the energy source. The optimum wavelength ranges for DVW-10 lamps are:

195-360 nm for the Deuterium (D2) Lamp.
360-800 nm for the accessory Tungsten (W) Lamp.

Select the lamp appropriate for the wavelength range desired before beginning operations. See Section 8 for lamp changing instructions.

Attempting to use a lamp outside its optimum wavelength range will result in substandard performance.

6.9.2 Wavelength Selection

Wavelength selection is achieved by moving the system optics with a high ratio geared stepper motor. Each push of the wavelength button advances the grating position approximately 0.45 nm. As in all geared mechanisms, there is a certain amount of slack or backlash between the gears when the motor changes direction. The DVW-10's backlash has been minimized to enable precision wavelength location. Due to the backlash, there is a slight hesitation when changing directions, as the gears reverse and the slack is taken out of the system. The direction change takes up to four (4) pushes of the wavelength button.

To assure wavelength reproducibility, it is recommended that the operator always select the final wavelength setting from the same direction: <u>Downward</u>

Example: Use the DOWN direction as standard. Determine the desired wavelength (λ). If the desired setting is at a **lower** wavelength than the current wavelength, push the DOWN button until the desired λ is reached.

However, if the desired wavelength is **above** the current setting, push the UP button until the desired λ is passed by at least five (5) nanometers. Then push the DOWN button several times (do not hold it down) until the wavelength display reaches the target λ.

To display the current wavelength, always press the UP button to change the display from absorbance to wavelength. The backlash will prevent the current wavelength from being disturbed for about two or three presses of the button. After that, each pressing of the button may cause the wavelength to move upward. If this happens, move the wavelength upward by another five nanometers and then downward to the desired wavelength. Again, downward should be the last button pressed when setting the wavelength.

Each time the instrument power is turned on, wavelength may start to change. Each power up sequence is equivalent to one UP button press. Always check to see that the wavelength displayed is the wavelength you want for the next chromatographic run.

6.9.3 Wavelength Scrolling

The wavelength selection may be sped up or scrolled by holding down one of the buttons. After about two seconds, the scrolling will begin on the display.

Internal limit switches prevent the monochromator grating from rotating too far and binding. ***Please note that it is advisable*** NOT TO EXCEED 185 NM OR 810 NM TO FURTHER SAFEGUARD THE WAVELENGTH LIMIT CONTROL FROM BEING DAMAGED AND FAILING TO MEET SPECIFICATION.

6.10 Performing Chromatography Runs

6.10.1 Test Runs

After setting the wavelength and range (for recorders) it is recommended that a test run be performed.

- Autozero the detector.
- Inject the sample.
- (For Recorders) Push the Event Mark button and note the mark that it makes.
- Observe the peaks on the data collection system and determine which settings or parts of the system need to be adjusted to provide the best chromatography.
- Make the adjustments and retest.

6.10.2 Record Runs

Ensure that the detector has had at least one hour to warm up, and that the baseline noise is stable.

Autozero the unit before each sample run or injection.

6.11 Shutting the Unit Down

It is recommended that the detector be shut down during long periods of inactivity. This will extend lamp life.

After use, it is also recommended that the flowcell be flushed with a fresh, non-ionic solution. Flushing the cell will help remove any retained sample or other contaminants. Flushing is also essential if ionic buffers have been used (to remove buffer salts). Flush the flowcell with several volumes (flowcell and connector tubing volumes) of solution. Typical non-ionic solutions include:

- Distilled water
- Isopropyl alcohol
- Methyl alcohol

DO NOT PUSH OR INJECT THE FLUSH SOLUTION. Always draw fluid into the flowcell to avoid over-pressuring the cell or spraying eluant and causing injury or spillage.

SECTION 7.0 - REMOTE CONTROL (ACCESSORY CABLE)

7.1 External Control

One of the unit's key attributes is that it enables the operator to remotely control the detector with a personal computer (PC). This section outlines the remote control features and the 15-pin D Subminiature connections.

In order to avoid damaging the unit and voiding the warranty due to improper wiring, it is strongly recommended that a factory supplied Remote Control Cable (PN: 025-0079) be obtained from your Dealer/Sales Representative.

In order to ensure that the remote control works properly with your PC (and to avoid damaging your PC) it is recommended that a technician qualified to install interactive instrument control devices be contacted to assist in selection of the correct interface module for your computer system.

D-Star's *Star-Chrom*™ HPLC Management System will control the detector, acquire data, and provide analysis capability. Contact companies such as Keithley Metrabyte, National Instruments, or your data acquisition system supplier and provide them with the technical information in the table below.

7.2 Remote Operation of the DVW-10

The following detector functions may be controlled through the remote cable:

7.2.1 Lamp On / Lamp Off Control (Digital Input)

The Lamp On/Off function enables the operator to turn the lamp OFF during times when measurements are not being made but the detector remains ON. This function helps to conserve lamp life. Once the lamp is turned back on, sufficient time must be allowed for the lamp to warm up and to stabilize.

7.2.2 Photocell Energy - Sample & Reference (Analog Output)

Sample Energy and Reference Energy from the photocell may be monitored with these outputs. This facilitates external diagnosing of suspected flowcell or photocell problems if changes from factory specifications/measurements are observed.

7.2.3 Wavelength UP/Wavelength DOWN

This function is the same as pushing the Front panel buttons to select a wavelength. When these functions are selected they will cause the front panel LED display to show the wavelength changing. Each instrument has a constant wavelength setting of 1.0 mV/nm.

To initialize the computer wavelength:

1. Determine the Wavelength Voltage (in mV) from the wavelength output (see chart below).
2. Subtract the Front panel wavelength display from the Wavelength Voltage. This is the Wavelength Voltage Offset and is constant for each individual instrument and is always positive.
3. Configure the computer's software to subtract the Wavelength Offset (voltage) from the Wavelength Voltage to provide the PC Wavelength measurement.

Activating the Up or Down function will cause the motor drive to move the grating to a new position. The new wavelength setting is calculated by subtracting the Wavelength Offset from the Wavelength Voltage.

7.2.4 Offset (Analog Output)

The Offset function measures the amount of coarse autozero required to compensate for flowcell imbalance. Possible uses include the detection of protein or other deposit buildups on the flowcell windows.

7.2.5 Event Mark

This function enables the operator to trigger a voltage spike to the recorder. It does not affect an integrator. It may also be used to detect that the internal event mark function has been triggered by the front panel pushbutton or another device on this line. For the DVW-10 that would be from pushing the Front panel Event Mark Button.

7.2.6 Autozero

The Autozero function is the same as the Front panel AZ button. It returns the output signal level to the baseline position for both recorders and integrators.

7.3 Remote Control Technical Details

7.3.1 Recorder/Integrator and Remote Connections

Signal Name	DB-15M Pin No.	Wire No./Color	Logic or Analog	Description
Recorder (+)	1	1 / White, Rec/Int Cable	Analog output	Output to 10 mV strip chart recorder, positive terminal
Digital Ground	2	3 / Black, Remote Cable	Digital	Signal return wire, logic low
Wavelength	3	5 / Gray, Remote Cable	Analog output	Voltage proportional to wavelength setting, approximately 1.0 mV/nm, requires zero offset
Integrator (-)	4	7 / Black, Rec/Int Cable	Analog output	Output to integrator or data system negative terminal, at analog ground potential
Offset	5	9 / Red, Remote Cable	Analog output	Voltage proportional to last autozero balance operation
Wavelength Up	6	11 / Green, Remote Cable	Digital input	Steps wavelength upscale, approximately 0.6 nm/step
Sample Energy Out	7	13 / White, Remote Cable	Analog output	Remote sample energy monitoring (photocell)
Autozero	8	15 / Orange, Remote Cable	Digital input	Starts autozero sequence to balance (null) integrator and recorder outputs
Reference Energy Out	15	14 / Violet, Remote Cable	Analog output	Remote reference energy monitoring (photocell)
Wavelength Down	14	12 / Yellow, Remote Cable	Digital input	Steps wavelength downscale, approximately 0.6 nm/step
Lamp On/Off Control	13	10 / Brown, Remote Cable	Digital input	Remote lamp shut down
Shield	None	8 / Green-Yel. Rec/Int Cable	Chassis Ground	Cable shield, ground potential, tie to recorder or integrator **guard** or to chassis ground
Recorder (-)	11	6 / Green, Rec/Int Cable	Analog output	Output to strip chart recorder negative terminal, at analog ground potential
Event Mark	10	4 / Blue, Remote Cable	Digital input or output	Generates a marking pulse on the recorder output; also used to start data collection when used with Star-Chrom
Integrator (+)	9	2 / Red, Rec/Int Cable	Analog	Output to integrator or data system positive terminal, 1 volt per absorbance

7.3.2 Alternate uses of Pins/Wires

Certain of the Remote Cable 15-pin DB Connector (DB-15M) pins and wires may be reprogrammed

(see below). The different functions include Range Up, Range Down, and Range Reset (to least sensitive recorder range); however you may lose Energy readings and/or Lamp On/Off functions.

Additionally, a customized cable to enable a 200 mV per absorbance output to an integrator or data system positive terminal may be ordered. Consult Factory for options.

7.3.3 Technical Discussion

The output impedance of the integrator (+) terminal is less than 100 ohms, the recorder output (+) terminal is 5.0K ohms or less depending upon the range selected. All digital inputs are to be driven with a momentary open collector or contact closure to digital ground; active LOW; open circuit voltage is approximately +5 V. Contact closure time should be between 10 and 200 milliseconds to assure proper actuation of the remote function.

Optical isolation is recommended to prevent ground loop noise being induced into the measurement system.

The Autozero selection may be actuated by a momentary external contact closure. Using opto-isolators or isolated relay contacts are the preferred methods of providing external control since no ground loops are created (a potential source of noise) and release time of the contact is predictably fast.

Open collector logic drivers may be used. However, since the common of the logic circuit must be tied to power ground of the detector, a ground current between the controlling device and the detector may be induced into the measurement circuit. Please be aware that a ground loop may occur that increases measurement noise.

Lamp Off requires that the circuit be pulled low to ground (green/yellow) and held for the period that *Lamp Off* is required.

Event mark signal is both a logic input and an output (open collector OR or "party line"). Data systems may use this signal output to begin data collection when a front panel EVENT pushbutton is pressed (selected models) or an external signal is received (consult Factory).

Caution: Disconnect the power cord from AC power (mains) when it is necessary to open the instrument cover to make any internal changes or to perform maintenance.

Alternate uses for remote control connections require program jumper changes from factory default positions. Consult the Factory for further information.

7.4 Circuit Protection

Although the detector's circuitry has static protection, it is best to avoid static discharge to any line. Each controlled circuit has a **4.7K** pull-up resistor to an internal **+5 V**. A pull-down to logic low discharges a 0.1 uF capacitor through a 100 ohm resistor on the signal processor PC board of the detector.

Section 8.0 - SAFETY AND MAINTENANCE

8.1 Safety

8.1.1 General

The DVW-10 has been designed with the user's safety in mind. The following are the safety features of the detector:

Enclosure - for UV blockage, electrical grounding and shielding, and to minimize stray light;
Cover is attached to the chassis by a ground wire;
Power Entry Module (CORCOM) - for power OFF only fuse changing, as well as RFI filter, and IEC connector.

NOTE: ***Do Not Try To Defeat Any Safety Feature***

8.1.2 Electrical Shock Hazard

In addition to normal line voltage hazards at the Corcom, and the transformers, there is line voltage on both the Signal Processor circuit board and the D2 Power Supply board. Location of the boards is shown in figure 7 below.

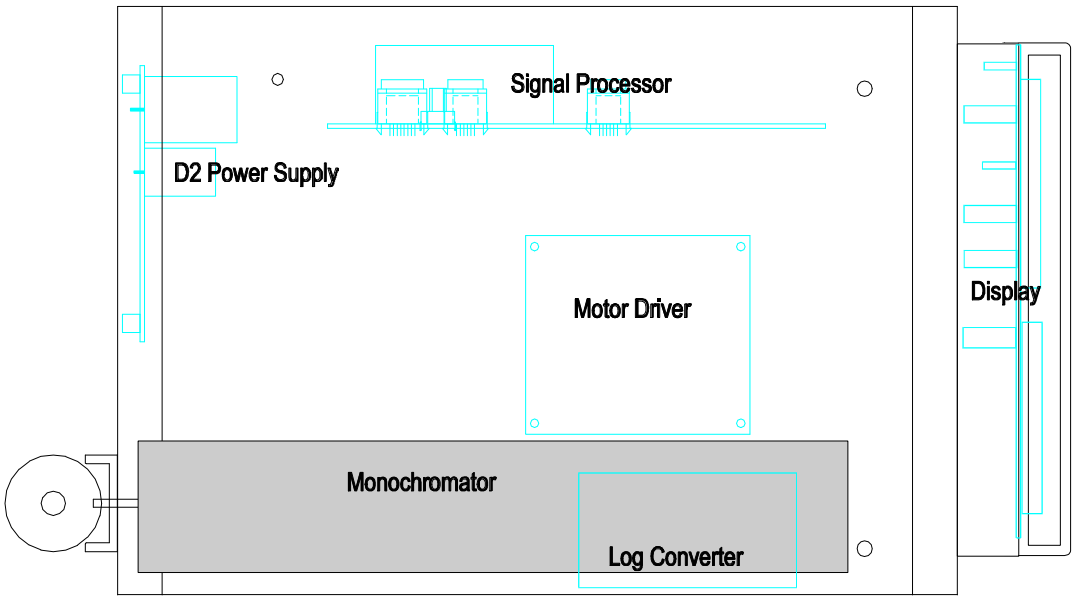


Figure 7

DANGER!!! WITH POWER OFF, THE D2 BOARD CAN STILL PRESENT A SHOCK HAZARD. Wait until all three of the red LEDs go out. Illuminated, they indicate that the capacitors are still charged. Location of the LEDs is shown in figure 8 below

.

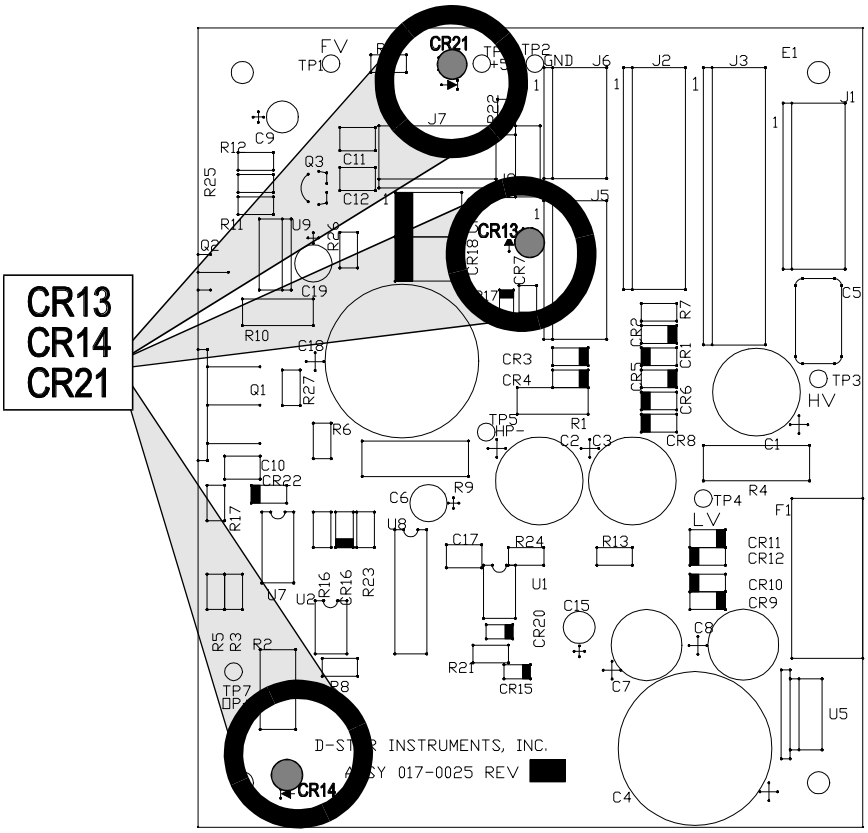


Figure 8

8.1.3 UV Radiation

When in use the Deuterium (D2) lamp (and to a lesser extent, the Tungsten lamp) emits ultraviolet radiation.

The lamps were placed at the rear of the case to allow easy changing by the operator and to reduce heat in the case. The lamps have been encased and the energy path into the instrument enclosure has been shielded. There is, however, danger of UV exposure if you look directly at the D2 lamp or operate the lamp outside of its housing.

UV is also present in the flowcell housing (direct or reflected) when the flowcell has been removed with power ON. Turn power OFF before removing the flowcell.

CAUTION: Only a qualified Technician should open the Monochromator. Damage to the optical system may occur.

8.2 MAINTENANCE

User/Operator Maintenance includes:

- Cleaning the Flowcell cavity
- Cleaning leaks on the floor of the chassis
- Changing or Cleaning the Flowcell
- Changing or Replacing the Lamp (D2, W)
- Changing or Replacing Corcom Fuses (see Section 9).

All other maintenance and service should be performed by a qualified instrument technician.

8.2.1 Electrical

Disconnect the instrument from the power outlet before attempting any maintenance **(including flowcell removal).**

Avoid chemical or mechanical damage to cables and the enclosure.

Do not substitute components such as power transformer or internal electrical components.

There are no user serviceable parts inside the enclosure. Refer servicing of the internal components of the detector to a qualified instrument technician.

Power supply is user set at the Corcom on the Rear Panel.

Internal power supply jumpers - factory setting only.

8.2.2 Chemical Cleanup

Clean up any chemical or solvent spills immediately.

Do not allow liquids to spill into the detector enclosure.

In the unlikely event of a leak, the DVW-10 flowcell enclosure has been sealed to prevent liquid flow into the rest of the monochromator. It also has a drain hole to channel liquid to the underside of the chassis, away from the optics, electronics, and electrical components. Clean up the housing with a non-ionic solution to eliminate vapors and contaminants. Rinse off the flowcell bulkhead assembly with the same solution.

CAUTION. Exercise safe practices when using solvents. Liquids are under pressure and may cause injury. Wear eye protection, even when performing routine maintenance.

8.2.3 UV Radiation

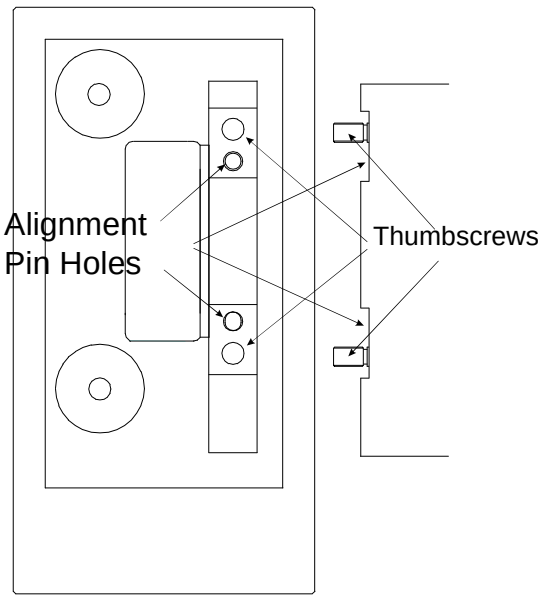
Disconnect power cord from the Corcom and the power outlet before removing the flowcell or performing any maintenance inside the DVW-10 Detector.

Wear UV protective goggles or safety glasses with side shields if the lamp must be operated during maintenance of the monochromator or while the flowcell is removed.

8.2.4 Flowcells

NOTE: The design of the DVW-10 DOES NOT require that you take off the cover/cabinet lid.

You DO NOT have to take out the flowcell if you must remove the cover/cabinet lid.



Flowcell Bulkhead Assembly

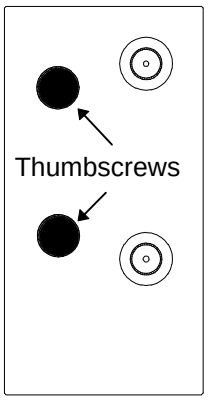
8.2.4.1 Installing/Removing a Flowcell

The flowcell bulkhead assembly is factory pre-aligned and is designed to enable precise orientation of the flowcell sample and reference paths with the optical path. Alignment of the flowcell on the bulkhead is a factory operation.

Two pins in the monochromator guide the bulkhead into place. Two thumbscrews secure the bulkhead to the internal wall of the optical bench. The thumbscrew is held on to the bulkhead by an "E" ring.

8.2.4.1.1 Installation

- Ensure flowcell windows are free of fingerprints, lint, and contaminants. Clean with pure Isopropyl Alcohol.
- Attach external tubing to the bulkhead fittings provided with the flowcell in use. Consult the Appendix for your flowcell. Always attach tubing and secure fittings to components before introducing liquid into the flowpath. Dry fittings assure the best seals.
- Ensure fittings are tight. Do not attempt to loosen and tighten fittings while there is liquid in the flow path. THIS CAN CAUSE LEAKS.
- Insert the flowcell into the flowcell housing.
- Push the bulkhead on to the alignment pins.



Dressplate

- Slowly turn the thumbscrews clockwise. Alternate between the upper and lower screws after several turns. If both screws are turned equally, you will feel no resistance.

Caution! The bulkhead does not require any force to be installed or removed. If you feel any resistance there is something binding. Reverse procedures and start over.

- Finger tighten the screws. The flowcell should be rigid.

8.2.4.1.2 Removing a Flowcell

If the flowcell is to be changed or stored, clear liquid from the flowpath and disconnect external tubing. Clean the cell as provided below.

- DO NOT REMOVE THE COVER/CABINET LID.
- Turn the thumbscrews counter clockwise, alternating between each screw after several turns. IF THE UNIT BINDS, SLIGHTLY REVERSE THE LAST SCREW TURNED.
- Once the screws turn freely, pull the bulkhead assembly straight out to avoid damaging the alignment pins.

NOTE: If the bulkhead assembly is to be removed for an extended period of time, cover the flowcell housing hole to keep dust and particles from contaminating the optical system.

8.2.4.2 Cleaning Flowcells

Use a syringe to clean the flowcell with solvents or other chemical solutions. DRAW THE LIQUID into the cell. DO NOT FORCE the cleaning solution into the cell. A luer adapter attached to the flowcell tubing facilitates connecting the syringe, thereby reducing the likelihood of leaks.

If the flowcell must be disassembled for cleaning or to replace items, see the Appendix for the particular flowcell.

8.2.5 Replacing/Changing the Standard DVW-10 Deuterium (D2) Lamp (195-360 nm)

1. The D2 lamp is equipped with a lamp power chronometer (see figure 9 below). The meter indicates elapsed time that the lamp has been on. The expected useful life of the lamp is 1000 hours (or 1/2 of the original energy). To ensure good chromatography, the lamp should be changed before the 1000 hour mark. Lamps which fail under 500 hours will be replaced. Lamps failing with over 500 hours will be replaced at a prorated cost.

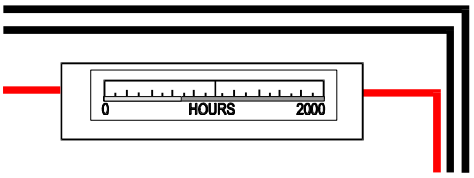


Figure 9

2. Removing the D2 Lamp Assembly

- Turn the power OFF and disconnect the power cord at the Corcom (rear panel).
- Disconnect the lamp plug on the rear panel.

CAUTION: Allow the lamp to cool off before handling to avoid burns!

- Using the 9/64" hex key wrench, remove the socket head screws holding the lamp and the "U" clamp (attached by ground wire to the chassis).

CAUTION: The lamp assembly and housing are attached to the monochromator. DO NOT TURN OR TWIST THE LAMP ASSEMBLY!

- Gently pull the lamp straight out from the rear panel. The lamp is held to the monochromator by a pin on the lower lamp housing clamp and by a lamp transition tube at the center lamp housing clamp.
- Do not touch the center hole of the lamp. Fingerprints on the lamp will absorb energy and degrade performance. Clean the lamp with Isopropyl Alcohol to remove any lint.
- Do not remove lamp end caps, wires or connectors.
- Store the lamp in a cushioned container if it is to be used again.
- Consult local ordinances for instructions on disposing of the lamp.

3. Installing the D2 Lamp Assembly

NOTE: ALWAYS KEEP LAMP TIGHT IN THE LAMP HOUSING.

Moving the lamp from its prealigned position will degrade detector performance.

- Ensure that the exposed lamp surface is free of finger prints and lint.
- Orient the lamp with the wires on top of the lamp.
- Slide the lamp tube onto the center lamp transition tube and the lower clamp pin. DO NOT FORCE THE LAMP. The lamp should slide easily onto the tube and pin.
- Secure the lamp with the "U" clamp and the hex screws. The lamp should be snug. The U clamp may be distorted if there is any twisting movement. Push in slightly at the center of the U until the lamp is snug against the housing to ground the lamp.
- Connect the lamp plug to the receptacle on the rear panel. It will only fit onto the receptacle in one direction. Ensure that the wing clips snap into place to avoid a lamp power disconnect.

8.2.6 Changing/Replacing the Tungsten (W) Lamp (360-800 nm) [Accessory]

1. The pre-aligned Tungsten lamp is an accessory item and may be ordered from your Dealer/Sales Representative.

2. The average life of the Tungsten Lamp is about 1000 hours.

The W lamp should be used at wavelengths above 360 nm. The D2 lamp may appear to have energy at wavelengths above 360 nm; however, this energy is usually second order spectrum of D2 and cannot be relied upon to be true energy at the displayed wavelength.

For visible operations (360 to 800 nm), remove the D2 lamp assembly per instructions above and replace it with the pre-aligned W lamp assembly.

3. Installing the W Lamp Assembly

NOTE: ALWAYS KEEP LAMP TIGHT IN THE LAMP HOUSING.

Moving the lamp from its prealigned position will degrade detector performance.

- Ensure that the exposed lamp surface is free of finger prints and lint.
- Orient the lamp with the wires on top of the lamp.
- Slide the lamp tube onto the center lamp transition tube and the lower clamp pin. DO NOT FORCE THE LAMP. The lamp should slide easily onto the tube and pin.
- Secure the lamp with the "U" clamp and the hex screws. The lamp should be snug. The U clamp may be distorted if there is any twisting movement. Push in slightly at the center of the U until the lamp is snug against the housing to ground the lamp.
- Connect the lamp plug to the receptacle on the rear panel. It will only fit onto the receptacle in one direction. Ensure that the wing clips snap into place to avoid a lamp power disconnect.

4. Removing the W Lamp Assembly

- Turn the power OFF and disconnect the power cord at the Corcom (rear panel).
- Disconnect the lamp plug on the rear panel.

CAUTION: Allow the lamp to cool off before handling to avoid burns!

- Using the 9/64" hex key wrench, remove the socket head screws holding the lamp retaining clamp.

CAUTION: The lamp assembly and housing are attached to the monochromator. DO NOT TURN OR TWIST THE LAMP ASSEMBLY!

- Gently pull the lamp straight out from the rear panel. The lamp is held to the monochromator by a pin on the lower lamp housing clamp and by a lamp transition tube at the center lamp housing clamp.
- Do not touch the center hole of the lamp. Fingerprints and lint on the lamp will absorb energy and degrade performance. Clean the lamp with Isopropyl alcohol to remove any lint.
- Do not remove lamp end caps, wires or connectors.
- Store the lamp in a cushioned container if it is to be used again.

8.2.7 Calibration

The DVW-10 is pre-calibrated at the factory and is expected to remain in calibration under normal (controlled) operating conditions.

Due to the dynamic nature of HPLC, all detectors produce slight variation in their output in response to chromatographic peaks. These differences are a function of numerous chromatographic variables which include: time, temperature, tubing volume, fittings, eluent concentration, pump, column, and other system components, and the integrator/data acquisition response time.

To assure that your detector provides accurate and consistent performance, it is recommended that you conduct standardization runs for your applications or methods.

Test the unit with substances of known composition and concentration under static and repeatable conditions. Record and save the data so that instrument performance can be compared over time. An Instrument Standardization Log format is provided at Appendix B.

This methodology is also helpful in eliminating the detector as a source of problems. (See also Troubleshooting Guide.)

If the instrument exhibits major change from its historical standardization, contact your Dealer/Sales Representative.

8.2.8 Replaceable Parts (see also Section 12, Part C)

Flowcell Assembly - Prep or Analytical

Source Lamp - D2 or W

Cables, Tubing, Fittings

PC boards (Maintenance technician)

8.2.9 Tubing Preparation

8.2.9.1 Cutting and Finishing (Roughening) PEEK Tubing

Make certain that all tubing ends are cut square with the tube axis, and that both the ID and the OD are thoroughly deburred.

Inspect the end of the tubing where the ferrule will seat for visible scratches which are not acceptable. Scratches behind the front edge of the ferrule will not interfere with the integrity of the fitting. Minor scratches can often be eliminated by folding a small piece of fine emery cloth or wet-or-dry sandpaper (200 to 400 grit) around the end of the tubing and rolling the tubing between two fingers. This leaves concentric axial lines in the area where the ferrule seats, which, while not ideal, are less likely to cause a leak than longitudinal scratches.

8.2.9.2 Cleaning

After it has been finished, the tubing should be cleaned to remove residual shavings and grit caused by the sandpaper. This is best accomplished by using a syringe or pipette to flush a solvent such as methyl or isopropyl alcohol or acetone through the tubing and then drying it with clean, dry compressed air or carrier gas.

CAUTION: Exercise good laboratory safety practices when using solvents, particularly when subjecting them to pressure.

8.2.10 Fitting Assembly

1. Slide the nut and ferrule onto the tubing.

2. Insert this assembly into the fitting detail, screwing the nut in two or three turns by hand.

3. Push the tubing all the way forward into the detail so that it seats firmly. This is essential for a proper zero dead volume connection.

4. Manually turn the nut into the detail until it is finger tight.

5. Turn the nut 1/4 turn (90°) past the point where the ferrule first starts to grab the tubing. Fittings larger than 1/8" may require more than 1/4 turn (as much as 120°). The amount of force required can vary considerably due to the friction between the nut and the

threads and the composition and wall thickness of the tubing used. Because of these variables a torque specification is unreliable.

6. Remove the fitting and inspect it. When made up properly, the ferrule may be free to spin axially on the tubing, but should have no lateral movement along the tubing. If the ferrule moves laterally, reinstall the fitting into the detail and tighten it another 1/8 turn past finger tight.

7. Remove, reinspect, and repeat, if necessary.

PART C: MISCELLANEOUS

Section 9.0 Power Management

9.1 General

CAUTION: Do not remove or defeat the grounding pin on the power plug. Contact an electrician if you are not sure whether the wall outlet is properly grounded.

9.1.1 AC Power

The DVW-10's AC power configuration is shown at the rear panel on the Corcom above the power cord inlet hole. Plug the AC power plug into a ***grounded***, operating 115 VAC outlet (or 230 VAC if so required). Other voltages such as 100V (for parts of Japan) require a power transformer change.

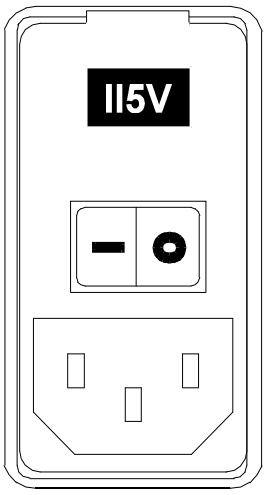
A different power system must be supplied for use at 100 volts AC. Contact your Dealer/ Sales Representative.

9.1.2 DC Power Supply

DC power for the detector is provided by the DVW-10's transformers.

9.2 Power Entry Module

9.2.1 Description



The DVW-10 Corcom power entry module (referred to as "the Corcom"), provides dual voltage selection integrated into the fuse holder. It has a SPST switch for the dual primary transformer.

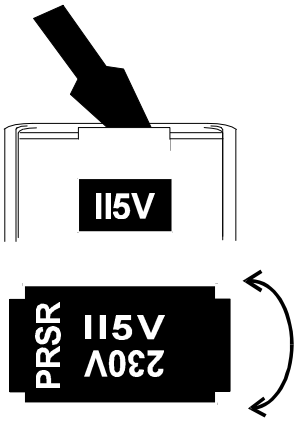
The fuse holder can hold two 5 x 20 mm (supplied) or two 1/4" x 1-1/4" fuses. Use 250V rated fuses.

The Corcom provides general filtering for both line-to-ground and line-to-line noise and will generally allow compliance with FCC and EC limits for line power supplies.

The Corcom also provides an RF shield of the filter components. The shield covers the filter portion of the module and increases performance of the filter by protecting the components from radiated noise. The shield improves RF ground connection to the case.

9.2.2 Changing Voltages (Conversion)

WARNING: Unplug the power cord from the Corcom before attempting to check the fuses.



Gently pry off the Corcom panel cover plate with a small flat-bladed screwdriver to access to the voltage fuses. Remove the fuses and set them aside. Check the replacement fuses to ensure that they are for the correct voltage conversion (see below). Rotate the fuse holder 180° to make the voltage conversion. Seat the correct fuses into the clips on the holder. Smaller 5 x 20 mm fuses must be located towards the rear of the fuse holder. Reinsert the power entry fuse holder with the correct voltage showing through the small window.

Fuse, Corcom 115V, 5 x 20 mm, FAST, 250V, 1.6 A
Fuse, Corcom 230V, 5 x 20 mm, FAST, 250V, 800 mA
Fuse, Signal Processor Board, 5 x 20 mm, FAST, 250V, 200 mA
Fuse, D2 Power Supply, 5 x 20 mm, FAST, 250V, 500 mA

9.3 Fuse Replacement

A total of five fuses protect the DVW-10 system. Two of the fuses are located in the power entry module (Corcom) at the rear of the cabinet and are in series with the AC input line. One fuse is located on the D2 Power Supply. The other two are located on the Signal Processor circuit board [under plastic fuse block covers] and are in series with an on-board transformer.

Troubleshooting the fuses is straightforward. The following table will assist in identifying fuse problem areas.

DANGER. For fuses other than the Corcom, only a qualified technician should work with the electrical system inside the unit.

		SYMPTOM		
Lamp	Fan*	Display	AZ	Check Fuses @
OFF	OFF	OFF	OFF	Corcom
OFF	OFF-12V	ON	OFF	D2 Power Supply
ON	OFF-24V	OFF	OFF	Signal Processor

*Models have both 12V and 24V fans. See 12V marking on the underside of fan bracket.

DANGER!!! WITH POWER OFF, THE D2 BOARD CAN STILL PRESENT A SHOCK HAZARD. Wait until all three of the red LEDs go out. Illuminated, they indicate that the capacitors are still charged.

If fuses have been changed by a competent technician and service manual troubleshooting cannot correct the electrical problem, a board replacement is probably required. Contact your Dealer/Sales Representative for assistance.

WARNING: Unplug power cord from the Corcom before checking fuses.

To gain access to the Corcom fuses, gently pry off the cover plate with a small flat-bladed screwdriver. Replace with fuses of the correct rating shown below. Smaller 5 x 20 mm fuses must be seated in the rear of the fuse holder. Insert the power entry fuse holder with the correct voltage showing through the small window.

WARNING: Unplug power cord from the Corcom before removing cabinet lid.

10.0 Preparation for Storage or Shipping

10.1 Isopropyl Alcohol Flush

Disconnect the tubing from the column. Insert inlet tubing into Isopropyl Alcohol. Use the syringe to draw a minimum of 50 mL through the flowcell.

10.2 Storage

Clean the detector with an Isopropyl Alcohol solution. Then drain and dry it and its tubing.

Seal the solvent inlet port and outlet ports on the flowcell bulkhead assembly with the nylon flowcell plug shipping screws.

10.3 Shipping

Flush, drain, and dry the detector as above and seal it with the shipping plug screws.

CAUTION: Reship in the original carton, if possible. If the original carton is not available, wrap the system in several layers of bubble wrap and cushion the bottom, top, and all four sides with 2" of packaging foam. Although heavy, the DVW-10 is a delicate instrument and must be carefully packaged to withstand the shock and vibration of shipment.

Section 11.0 Troubleshooting Guide

There are numerous causes and solutions for problems with chromatograms. Only those caused by or affecting the detector are addressed here. Consult your Dealer/Sales Representative for additional troubleshooting references.

You Notice	This May Mean	Possible Cause	You Should
No power when detector turned ON.	Blown fuses in the power entry module.	1. Power surge, failed component. 2. Wall outlet dead.	1. Replace only with the appropriate fuses (See Section 9). 2. Check wall outlet and building circuit breakers.
Front panel appears OK but detector does not work.	Blown fuse on the circuit board.	1. Power surge. 2. Internal short.	1. Replace only with the appropriate fuse (See Section 9). 2. Check board (Maintenance Tech).
Fittings or components leak.	Interference with fittings seal	1. Film of fluid between surfaces. 2. Salt crystals between surfaces. 3. Scratches in mating surfaces.	1. Clean and dry mating surfaces. 2. Clean and dry mating surfaces. 3. If scratched, replace defective part.
Flowcell leaks	1. Cell gasket 2. Cracked windows 3. Leaky fittings 4. Blocked outlet line	1. Over pressure limit. 2a. Over pressure limit. 2b. Cell re-assembled incorrectly. 3. Interference with seals. 4. Lodged particles or tubing crimped.	1a. Reduce excess backpressure. 1b. Clean and reseal. 1c. Replace cell gasket. 2. Reduce excess backpressure and replace cell window. 3a. See above. 3b. Dry out cell reference path. 4a. Clear tubing (backflush). 4b. Replace tubing.
Baseline Drift/Noise	1. Column 2. Mobile Phase 3. Flowcell 4. Detector 5. Recorder input voltage	1a. Column temperature. 1b. Equilibrium. 2a. Not homogeneous. 2b. Mixing problem. 2c. Contaminated/Age. 2d. Recycled. 3a. Air bubbles. 3b. Contamination. 3c. Leaks. 3d. Loose assembly. 4a. Absorbance setting. 4b. External device. 4c. Insufficient warmup time. 5a. Wrong setting. 5b. 1 mV Recorder. 5c. 100 mV Recorder	1a. Regulate - Consult column guide. 1b. Flush - Consult column guide. 2a. Degas/sparge; replace. 2b. Correct flow. 2c. Replace. 2d. Reset detector baseline - AZ 3a. Apply backpressure (100 psi); flush with strong solvents; check for leaks in the system. 3b. Flush; Clean cell windows. 3c. See above. 3d. Tighten bulkhead assembly. 4a. Reset wavelength to maximum absorbance. 4b. Check electrical lines for interference; check for ground loops, especially recorder and data system hookup. 5a. Set recorder to normal input: 10 mV. 5b. Reduce sensitivity (range 3 steps down). 5c. Increase sensitivity (range 3 steps up).
Spurious noise in the detector readout	1. Bad lamp. 2. External influence	1a. Dirty lamp. 1b. Lamp at end of useful life or is damaged in transit. 2. Temperature fluctuation	1a. Clean lamp (see Lamp section). 1b. Change/replace lamp (see Lamp section). 2a. Attempt to stabilize ambient temperature. 2b. Avoid hot and cold drafts. Check for overhead air ventilators.
Peak size	1. Too small. 2. Too large.	1. Attenuation too high. 2. Attenuation too low.	1. Reduce attenuation (increase range sensitivity). 2. Increase attenuation (decrease range sensitivity).
Autozero Fails	Flowcell imbalance	1. Flowcell not inserted correctly 2. Flowcell dirty/contaminated. 3. Liquid in reference side.	1. Remove flowcell & reinstall per Appendix directions. 2. Flush; flowcell windows. 3. Flush (if non-volatiles in mobile phase); dry thoroughly.

Section 12.0 Accessories, Replacement and Spare Parts

	PART NO.	NOTES
ENERGY SOURCES		
Lamp Assembly, Deuterium (D2), Prealigned, Variable UV (195-360 nm)	025-0078	RSP
Lamp Assembly, Tungsten (W), Prealigned, Variable Vis (360-800 nm)	025-0076	RSP
FLOWCELL ASSEMBLIES		
Analytical: 7mm, 10 µL, 1/16" tubing	025-0077	RSP
Preparative: 2.0 mm, 4 µL, 1/8" or 1/16" tubing	025-0074	RSP
Analytical: 7mm, 10 µL, STAINLESS STEEL, 1/16" tubing	025-0123	
FLOWCELL FITTINGS & TUBING (see also Flowcell Appendix)		
Nut, Flangeless, Delrin, 1/16" ID (Analytical) 10pc/pkg	025-0047	RSP
Ferrule, Flangeless, Tefzel, 1/16" ID 10pc/pkg	025-0048	RSP
Nut, Flangeless, Delrin, 1/8" ID, X-Long (Prep) 10pc/pkg	025-0090	RSP
Ferrule, Flangeless, Tefzel, 1/8" ID (Prep) 10pc/pkg	025-0052	RSP
Nut, Flangeless, Delrin, 1/16" ID, X-Long (Prep) 10pc/pkg	025-0089	
Nut, Bulkhead, Analytical Flowcell Assy 2pc/pkg	Contact Dealer	
Male nut, 1/16" (for Analytical bulkhead fitting) 10pc/pkg	025-0012	RSP
Ferrule, double-ended, 1/16" (for Anal bulkhead fitting) 10pc/pkg	025-0013	RSP
Tubing, TFE Teflon, 1/16" OD, 0.010" ID 5ft	025-0066	RSP
Tubing, TFE Teflon, 1/16" OD, 0.030" ID 5ft	025-0050	
Tubing, TFE Teflon, 1/8" OD, .062" ID, Black (Prep) 5ft	025-0054	
Tubing, PEEK, 1/16" OD, 0.030" ID 5ft	025-0049	
Tubing, PEEK, 1/16" OD, 0.010" ID 5ft	025-0061	
FUSES:		
Fuse, Signal Process, 5 x 20 mm, FAST, 250V, 200 mA 20pc/pkg	025-0118	RSP
Fuse, D2 Power Supply, 5 x 20 mm, FAST, 250V, 500 mA 20pc/pkg	025-0084	RSP
Fuse, Corcom 115V, 5 x 20 mm, FAST, 250V, 1.6 A 20pc/pkg	025-0083	RSP
Fuse, Corcom 230V, 5 x 20 mm, FAST, 250V, 800 mA 20pc/pkg	025-0124	RSP
RECORDER/INTEGRATOR CABLE	025-0026	
REMOTE CONTROL CABLE-Variable (Includes Recorder/Integrator)	025-0079	
POWER CORD, No. AMERICA, NEMA 5-15P/IEC320	025-0091	
POWER CORD, INTERNATIONAL, CEE 7 STD/IEC 320	025-0108	
PC BOARDS	Contact Dealer	Tech
REPLACEMENT ACCESSORY KIT (CABLE, TOOLS & FUSES)	025-0075	
OPERATOR'S MANUAL (Paper Copy)	050-0004	
DATA ACQUISITION AND CONTROL		
Star-Chrom™ (*S-C*) HPLC Management System w/ Calibration	015-0013	
S-C Automated Remote Control Cable-Variable (Incl Rec/Integr)	025-0150	

LEGEND: RSP = Recommended spare part Tech = Maintenance Technician Recommended

Section 13.0 Trademarks

Trademarks used in this manual are for identification purposes only and are the property of their respective trademark owners:

Delrin, Teflon and Tefzel - Du Pont Co.;
PEEK - VICTREX;
Cheminert, PAEK - VICI/Valco;
Omnifit - Omnifit Ltd.;
Corcom - Corcom, Inc.

Appendix B

INSTRUMENT STANDARDIZATION LOG

DATE: _____ OPERATOR:_____

SAMPLE/STANDARD:

CONDITIONS:

RESULTS:

==========

DATE: _____ OPERATOR:_____

RESULTS:

==========

DATE: _____ OPERATOR:_____

RESULTS:

==========

DATE: _____ OPERATOR:_____

RESULTS:

==========

DATE: _____ OPERATOR:_____

RESULTS:

MANUFACTURER'S DECLARATION OF CONFORMITY

D-STAR INSTRUMENTS, INC.
8424 QUARRY ROAD, #203
MANASSAS, VIRGINIA 20110-5326, USA

DECLARES UNDER SOLE RESPONSIBILITY THAT THE FOLLOWING PRODUCT(S):

DFW-20/21 Fixed Wavelength Detector Series
DVW-10 Variable Wavelength Detector Series
DDW-10 Dual Wavelength Detector Series
DLC-10/11 Integrated HPLC System Series
DLC-20 Integrated HPLC System Series
DGP-10 HPLC Gradient Pump Series

Serial Numbers: Valid with assigned D-Star serial numbers.

TO WHICH THIS DECLARATION RELATES ARE IN CONFORMITY WITH THE FOLLOWING STANDARD(S):

EN55011: 1991 CLASS A, GROUP 1
and
EN50082-1: 1997 to include:
EN50140; ENV50204; IEC 1000-4-2; IEC 1000-4-4; ENV50142; EN61000-4-11
and
EN61010-1

FOLLOWING THE PROVISIONS OF:

EC DIRECTIVE 73/23/EEC; EC DIRECTIVE 89/336/EEC; EC DIRECTIVE 93/68/EEC

An internal production control system to ensure compliance between the manufactured products and the technical documentation is in effect.

These products are marked CE in July 1998

ON BEHALF OF THE COMPANY

MANASSAS, VIRGINIA USA
July 10, 1998

Dennis W. Janzen
VP Product Development

YEAR 2000 SOFTWARE COMPLIANCE CERTIFICATE (Y2K ✓)

D-STAR INSTRUMENTS, INC.
8424 QUARRY ROAD, #203
MANASSAS, VIRGINIA 20110-5326, USA

DECLARES THAT THE FOLLOWING PRODUCT:

Star-Chrom™ HPLC Management System

Serial Number: Valid with assigned D-Star serial number

Equipment and software used for the purpose of collecting and processing data, and controlling certain analytical equipment used in high pressure liquid chromatography (HPLC)

TO WHICH THIS CERTIFICATE RELATES IS IN CONFORMITY WITH THE FOLLOWING:

BSI DISC PD2000-1 *A Definition of Year 2000 Conformity Requirements*

The date may be entered by the user at the start of a run or automatically entered into logs by the software. The year may be entered in two-digit or four-digit format. The performance of the software is not affected by the format. The Year 2000 is considered as a leap year.

This(ese) product(s) is(are) not impacted by the Year 2000, provided the user's **Windows 95 Operating System** is updated with the Microsoft Y2K modification. Caution may have to be exercised in the case where the dates are reprocessed by other software.

FURTHER, THE FOLLOWING PRODUCTS, USED FOR COLLECTING AND TRANSMITTING ANALOG DATA, ARE NOT DEPENDENT ON SOFTWARE/FIRMWARE AND ARE NOT IMPACTED BY THE YEAR 2000 PROBLEMS:

DFW-20/21 Fixed Wavelength Detector Series
DVW-10 Variable Wavelength Detector Series
DDW-10 Dual Wavelength Detector Series
DLC-10/11 and DLC-20 Integrated HPLC Systems Series
DGP-10 HPLC Gradient Pump Series

FURTHER ALL PROGRAMS IN COMPANY BUSINESS SYSTEMS:

Are Windows operating system based and have been updated with Microsoft Y2K modifications.

ON BEHALF OF THE COMPANY

MANASSAS, VIRGINIA USA
JUNE 11, 1998

Dennis W. Janzen
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APPENDIX C

Appendix A - 1

7mm ANALYTICAL HPLC FLOWCELL BULKHEAD ASSEMBLY

(Variable UV-Vis Detector)

OPERATOR'S MANUAL

Part Numbers
PEEK - DS 025-0077/025-0077-1
Stainless Steel - DS 025-0123/025-0123-1

Appendix A - 1

Operator's Manual
7mm ANALYTICAL HPLC FLOWCELL ASSEMBLY
Part Numbers DS 025-0077 & 025-0123
(Variable UV-Vis Detector)

Contents

Section 1.0 Introduction

This manual outlines the specifications, correct use, and maintenance procedures for the PEEK™ Analytical Flowcell PN 025-0077 (0077-1 Sapphire windows) and the Stainless Steel (SS) Flowcell PN 025-0123 (0123-1 Sapphire windows) used in the Variable Wavelength high performance liquid chromatography (HPLC) detectors. The PEEK flowcell is bio-compatible and is intended for use in HPLC applications where bio-inert or neutral materials are called for. The Stainless Steel flowcell is universal for all solvents except for applications requiring bio-compatibility. Sapphire windows should be used when quartz windows will be etched (pH above 8).

Write the name of each flowcell on the table of contents of your instrument manual to provide easy reference to its location. Then, place this manual in Appendix A.

Consult your instrument's Operator's Manual to determine if this flowcell assembly is appropriate for use in a particular detector.

2.0 Specifications - Analytical Flowcell Bulkhead Assembly

Sampling Technique:	Double Beam - Sample and Reference (see Section 3)
Pathlength:	7 mm
Cell Volume:	10 µl
Type:	HPLC
Max Operating Pressure:	200 psi
Wetted materials:	
Cell body:	PEEK™, Stainless Steel
Sealing Gaskets:	Teflon™
Windows:	Fused Silica (quartz); Sapphire (special "A1" cell)
Fittings:	1/16" ID, Tefzel™ Ferrules (PEEK)/ Tefzel™ & SS Rings (SS)
Tubing:	0.015" ID, 1/16" OD (PEEK)/ 0.010" SS Inlet & 0.020" SS Outlet
Bulkhead Union:	PEEK™/SS
Bulkhead Ferrules:	PEEK™/SS
Other Materials:	

Flowcell Housing	Anodized Aluminum
Bulkhead Housing	Anodized Aluminum
Fittings:	Flowcell: Nut, Flangeless 1/16" ID, Delrin™/PEEK™
	Bulkhead: Nut, 10-32, PEEK™/SS
Hardware:	Stainless Steel, Nylon

3.0 Unpacking, Orientation, and Installation

3.1 Packing List

DESCRIPTION	PART NO*	QTY	
Analytical Flowcell Bulkhead Assembly, 7mm, 10 µL, 1/16" tubing, PEEK			
010-0067 [or 010-0067-5 Sapphire windows]		1 ea	or;
Analytical Flowcell Bulkhead Assembly, 7mm, 10 µL, 1/16" tubing, SS			
010-0067-1 [or 010-0067-6 Sapphire windows]		1 ea	
External Bulkhead Fittings:			
Male nut, 10-32, 1/16" ID, PEEK	250-0043	2 ea	
Ferrule, double-ended, 1/16" ID, PEEK	250-0044	2 ea	or;
Nut, hex head, 10-32 CPI Seat, 1/16" ID, SS	250-0033	2 ea	
Ferrule, 10-32 CPI Seat, 1/16" ID, SS	250-0031	2 ea	
Hex Key Wrench for Flowcell Sockethead			
Cap Screws - 3/32"	540-0004	1 ea	
Operator's Manual (this document)	090-0013	1 ea	

*See Section 7 for Spare Part Numbers

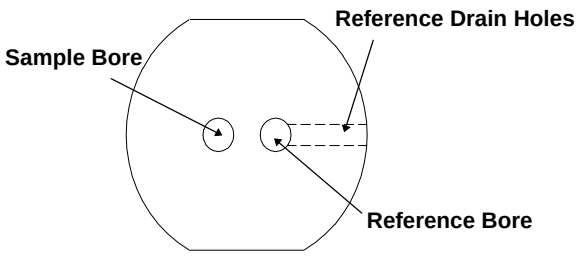
If the Analytical Flowcell was installed in your detector, the fittings and wrench will be in the Accessory Kit.

3.2 Orientation

3.2.1 The Flowcell

NOTE: Numbers in [ ] after parts refer to the numbers in the "Exploded View of Flowcell" diagram, in Section 5.2 (page A-5) below.

The unique design of the D-Star dual path Analytical Flowcell was developed to maximize HPLC performance while maintaining cost at a reasonable level. The Cell Body [1] is made of PEEK® polymer and is held in place in the Cell Holder [2] by two flat bottom flangeless fittings [6], pressure exerted by the Cell Clamp [3] and the Cell Mounting Plate [4]. Belleville Springs [13] apply balanced pressure on the windows [12]. TFE gaskets [5] seal the windows and body together. The flangeless ferrules [7] of the fittings (or flanged tubing, if so equipped) seal against flat surfaces machined into the cell body.



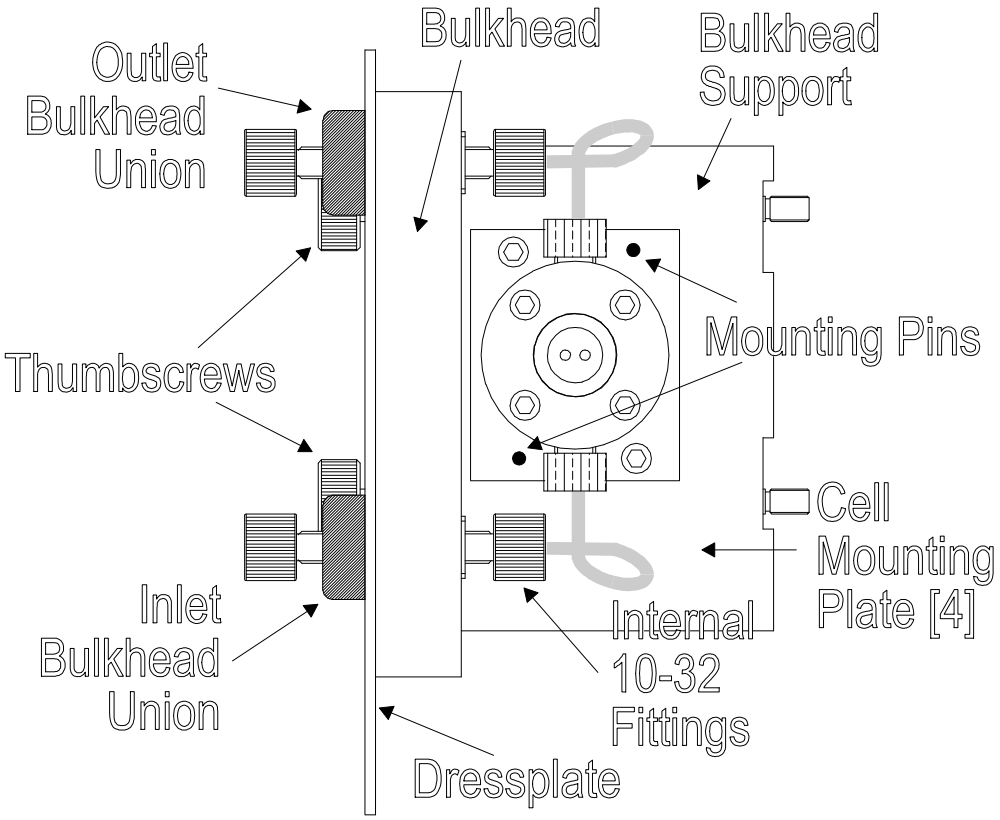
Cell Body [1]

The cell body [1] has two passages for absorbance measurement. One is used for the sample fluid (Sample Bore), the other for a reference (Reference Bore). The sample passage is connected to the fittings by small bore "vias" to allow fluid to flow from the inlet tubing to the

measurement passage and then on to the outlet tubing. An air reference passage has two vent holes (Reference Drain Holes) opening to the outside to equalize pressure with the environment and to prevent vapors that permeate through the gasket from the sample side from accumulating in the reference passage.

3.2.2 The Bulkhead Assembly

The entire Flowcell Bulkhead Assembly, with mounted Analytical flowcell, is shown below:

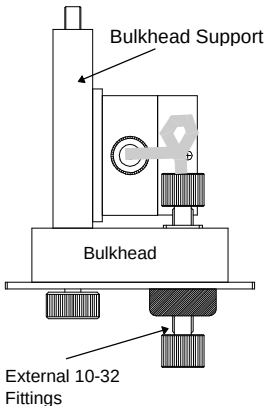


Analytical Flowcell Bulkhead Assembly

3.3 Installation

Two nylon flowcell plug shipping screws are installed on the analytical flowcell bulkhead union inlet and outlet ports prior to shipping to prevent flowcell contamination and to protect the bulkhead fittings from damage. Remove the plug shipping screws and save them for future shipping or storage. The bulkhead fittings are located in a marked bag. If the Analytical Flowcell was installed in your detector, the fittings will be in the Accessory Kit.

The flowcell is pre-aligned on the bulkhead assembly. Prior to mounting the assembly into the detector, ensure that the dry cell is clean and that the fittings are tight.



Analytical Flowcell Bulkhead Assembly Top View

Insert the flowcell assembly into the detector flowcell housing carefully. The flowcell is guided in place by two pins inside the housing. Once the pins are aligned in the holes, begin screwing in the Thumbscrews clockwise. Alternate each screw after a few turns to make sure the Support plate is advancing evenly. If one of the screws binds, back it off and retry using fewer turns. If both screws are snug and the Dressplate is flush against the cover/cabinet lid, the flowcell is mounted correctly.

If there is a gap between the Dressplate and the cover, or the cell is tilted, remove the assembly, check for obstructions, and then restart the mounting process.

It is recommended that a backpressure regulator be installed on the outlet fluid line of the detector to prevent air bubbles in the flowcell. Use a 40 -100 psi regulating device. See also Section 6.

3.4 Chemical Incompatibility

It is the user's responsibility to determine which solvents are compatible with the materials of construction listed in Section 2 above. Please note that the following advisories have been provided by suppliers of parts and materials:

PEEK - ***Concentrated Nitric Acid and concentrated Sulfuric Acid*** attack PEEK chemically and will cause severe effects. **NOT RECOMMENDED**.

Methylene Chloride (MeCl), DMSO, and THF cause PEEK to swell. ***MeCl*** has been observed to cause flaking. **NOT RECOMMENDED**.

FUSED SILICA (windows)- Avoid high pH solvents (8.0 - 8.5+) which will etch the window (synthetic quartz). High pH solutions may be used for short periods of time (one minute) to clean protein buildups.

SAPPHIRE (windows)- The alpha form monocrystal is non-porous and unaffected by any weathering, hydration, solvents, or mineral acids at room temperature. It is slowly etched by hydrofluoric or phosphoric acid and strong caustics at temperatures exceeding 600° C.

TEFZEL - Some ***chlorinated chemicals*** may cause swelling.

DELRIN - Not suitable for use with ***acids, bases, or oxidizing agents*** [This is usually a non-wetted part in normal operation].

Contact your Dealer/Representative or D-Star Instruments for information on other flowcells which may be better suited for your application.

Section 4.0 Maintenance I - Cleaning the Flowcell

Use a syringe to clean the flowcell and fittings with solvents or other chemical solutions. DRAW THE LIQUID into the cell. DO NOT FORCE the cleaning solution into the cell. A luer adapter such as Upchurch P-658 or P-659 attached to the flowcell tubing facilitates connecting the syringe, thereby reducing the likelihood of leaks.

Use only cleaning solvents compatible with the materials of construction listed in Section 2 above. Avoid the solvents mentioned in Section 3.4 above.

If the flowcell must be disassembled for cleaning or to replace items, see Section 5 below.

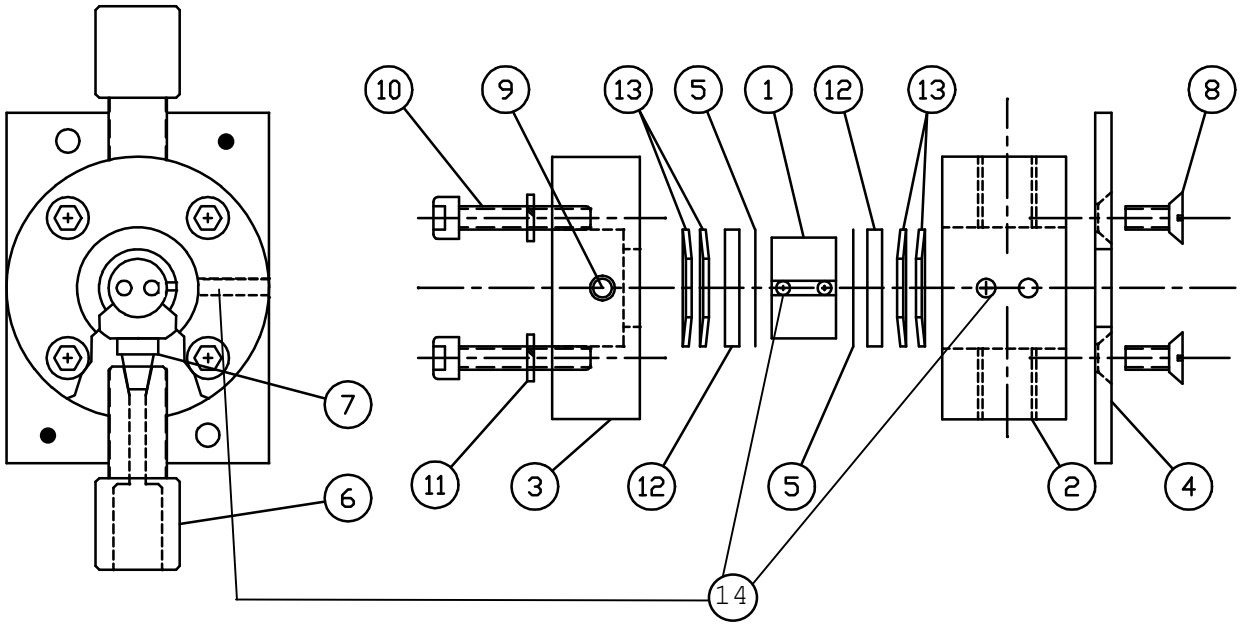
Section 5.0 Maintenance II - Disassembly and Reassembly

5.1 Tools Required

3/32" Hex Key Wrench - included with unit
Lens Tissue
Tweezers - to handle Body, Windows, Gaskets, Bellevilles
Cleaning Solvent
Spray Dust Remover Can (Pressurized Air)

5.2 Disassembling the Flowcell

NOTE: Numbers in [ ] after parts refer to the numbers in the *Exploded View of Flowcell* diagram, below.



DS010-0003
Exploded View of Flowcell

ITEM*	QTY	DESCRIPTION
1	1	Flowcell Body, 7mm Path, 10 µL Vol, PEEK®/SS
2	1	Cell Holder
3	1	Cell Clamp
4	1	Cell Mount
5**	2	Cell Gasket, 0.005" Thick, TFE®
6	2	Nut, Flangeless, 1/16" Tubing, Delrin®[Short]/Super Flangeless PEEK for SS
7	2	Ferrule, Flangeless, 1/16" Tubing, Tefzel® [PEEK]/Super-Flangeless Tefzel & SS Ring [SS]
8**	4	Screw, Machine, Flathead, Phillips, 4-40 X 1/4" Long, SS
9**	2	Setscrew, Socket Cup, 4-40 x 1/4" Long, SS
10**	4	Screw, Sockethead Cap Screw, 4-40 x 9/16" Long, SS
11**	4	Lockwasher, Split, #4, SS
12**	2	Window, Quartz (or Sapphire), 1/2" Diameter
13**	4	Spring, Belleville, SS
14		Reference Drain Holes

* See Section 7 for Spare Part Numbers ** Included in Flowcell Rebuild Kit, PN 025-0045

1. Identify each part as the flowcell is disassembled with the diagrams and the parts list to successfully rebuild the cell.

2. Disconnect the internal PEEK/SS 10-32 fittings and tubing from the bulkhead unions.

3. Loosen the two 3/8" sockethead cap screws on the mounting plate with the 3/32" wrench included with your unit. Remove the flowcell from the Bulkhead Support. Remove the flowcell fittings (and the PEEK/SS fittings and tubing) and set them aside.

4. Loosen and remove the four flowcell sockethead cap screws [10] with the 3/32" wrench. Remove the Cell Clamp [3] and set it aside. Turn the flowcell over and carefully dump the parts onto a soft surface. Separate the Cell Body [1] from the other parts. *Note the orientation of the parts, especially the belleville springs, for reassembly*.

5.3 Cleaning the Flowcell Parts

1. Clean the aluminum parts with 50/50 mixture of Isopropanol and water. Dry the parts with a lint-free towel.

2. Clean the Cell Body [1], the belleville springs [13], the windows [12], and the Teflon gaskets [5] in the IPA/water solution. Leave the gaskets in the solution until assembly. Dry all parts. Ensure that they are clean and lint- and particle-free.

3. Inspect the parts, particularly the windows. If any parts need to be replaced, order the Flowcell Rebuild Kit, PN 025-0045.

5.4 Reassembling the Flowcell

1. Insert two belleville springs [13] into the Cell Holder ***with the spring curvature pointing up*** (away from the Cell Mount [4]). Next, insert a clean window [12]. Avoid touching the faces of the window, and ensure that it is particle-free.

2. Place a gasket [5] on the window with the holes oriented as in the diagram. Place the PEEK Cell Body [1] over the gasket. Check the alignment of the gaskets with the sample and reference holes on the Cell Body, and the Reference drain holes [14] of the Cell Holder with those of the Cell Body [14]. If necessary, use a thin, dull wire inserted into the Reference Drain Holes to hold the Cell Body aligned in place.

3. Place the other gasket on the Cell Body and align the holes. Carefully place the second window over the gasket. Then place the remaining two belleville springs on the center of the window, ***with the curvature down***, facing the Cell Body.

IMPORTANT: The **raised inner edge** of the two pairs of belleville springs [13] must face inward toward the windows. If installed raised portion out, the windows may break.

4. Insert the sockethead cap screws [10] and lockwashers [11] in the Cell Clamp [3].

5. Place the Cell Clamp on the bellevilles and finger-tighten the cap screws. Using the 3/32 hex wrench, tighten the cap screws, alternating corners (gradual crisscross fashion) to apply equal force. Check the belleville springs to ensure that they are centered. Tighten the cap screws until resistance is encountered. Overtightening will not make the cell seal any better. While this is not likely to break the windows, it could break off the screw or strip the cell holder threads. Dust the parts to remove any metal particles from the screws.

6. Replace the flangeless ferrules and nuts.

NOTE: For the SS flowcell, the Inlet tubing (lower) should be 0.010" ID (blue tag) and the Outlet tubing (upper) should be 0.020" ID, (yellow tag).

7. Pressure test the flowcell to 200 PSI if possible. If the cell leaks, disassemble it and clean and dry the components. Reassemble the parts and heat the cell at 200° F for eight hours [use a "cookie sheet" in a pre-heated oven]. Pressure test as above.

8. Reconnect the tubing and the fittings to the flowcell.

9. Push the Cell Mount on to the Bulkhead Support pins with the reference holes to the right. Press firmly and evenly to obtain a snug fit.

10. Secure the flowcell to the Support with the 3/8" sockethead cap screws and lockwashers.

11. Reattach the 10-32 PEEK or SS fittings and tubing to the bulkhead unions.

Section 6.0 Troubleshooting

6.1 Preventing Leaks

Although we do not generally expect problems which may be associated with flowcell leakage, we do offer the following information. For our discussion of potential leak problems please refer to the illustration "Exploded View of Flowcell" in Section 5 above. To understand the effects of leaks caused by loose fittings, exceeding pressure limits of the cell and gasket seal failure, it is important to review the nature of the design of the flowcell in Section 3.2 Orientation.

If liquid leaks from either of the fittings or from a poor gasket seal, liquid can accumulate between the cell body and the cell holder. If the liquid does not evaporate quickly, some of it can enter the Reference Drain Holes of the reference passage and eventually get into the reference bore side of the cell. The result is an unstable baseline (drift), often causing off scale readings. Buffers can cause additional problems because of evaporation. Residues in the reference side are not easily flushed out and may require disassembly to adequately clean the flowcell.

The most common causes of leaks can be prevented. **Do not remove or loosen the fittings while there is liquid in the tubing**. Sufficient liquid can get between cell components to cause it to get into the reference side. The best way prevent this is to **dry out the cell before removing the fittings** from the cell. A plastic disposable syringe (10 to 50 ml) may be used to draw liquid out of the sample side of the cell. A luer to 1/16" tubing adapter (Upchurch P658) is useful to make a leak-tight connection to the outlet tubing and allows the syringe to easily remove liquid from the cell. **Disconnect the inlet tubing from the outside of the bulkhead fitting before attempting to draw the liquid out**.

Over-pressure of the liquid in the cell is another cause of leaks. In this design, the windows rarely break from over-pressure. Usually a leak occurs that will heal upon release of the pressure. The healing time could, however, take a few days to achieve the rated sealing pressure. **Do not block the flow from the outlet tubing in an attempt to clear bubbles**. Excessive pressures are likely to result. **Use degassed solvents and a backpressure regulator** (75 psi, spare PN 025-0184) to prevent bubbles from interfering with operation of the cell.

Using the wrong size or type of fitting will probably result in a leak. The flowcell is designed to use 1/4-28 flangeless or super-flangeless fittings.

If liquid does get into the reference passage, ensure the fittings are tight. Then attempt to remove the liquid by using inert gas to flow liquid from around the cell parts and out of the reference vents and passage. Allow the cell to dry. If the liquid remains in the cell or residue is evident, the flowcell will need to be disassembled and dried out and /or cleaned.

The cell must be reassembled exactly as detailed in Section 5.4 above.

IMPORTANT: The **raised inner edge** of the two pairs of belleville springs (13) must face inward toward the windows. If installed raised portion out, the windows may break. Avoid getting finger marks, dust and lint on the cell body, windows or gaskets. Re-tighten the hex socket screws in a gradual crisscross fashion until snug. Overtightening will not seal the cell any better. While this is not likely to break the windows, it could break off the screw or strip the cell holder threads.

6.2 Troubleshooting Table

OBSERVATION	POSSIBLE PROBLEM	POSSIBLE CAUSE	POSSIBLE SOLUTION
Fittings or components leak.	Interference with fittings seal	1. Film of fluid between surfaces. 2. Salt crystals between surfaces. 3. Scratches in mating surfaces.	1. Clean and dry mating surfaces. 2. Clean and dry mating surfaces. 3. If scratched, replace defective part.
Flowcell leaks	1. Cell gasket 2. Cracked windows 3. Leaky fittings 4. Blocked outlet line	1. Over pressure limit. 2a. Over pressure limit. 2b. Cell re-assembled incorrectly. 3. Interference with seals. 4. Lodged particles or tubing crimped.	1a. Reduce excess backpressure. 1b. Clean and reseal. 1c. Replace cell gasket. 2. Reduce excess backpressure and replace cell window. 3a. See above. 3b. Dry out cell reference path. 4a. Clear tubing (backflush). 4b. Replace tubing.
Baseline Drift/Noise	Flowcell	a. Air bubbles. b. Contamination. c. Leaks. d. Loose assembly.	a. Apply backpressure (100 psi); flush with strong solvents; check for leaks in the system. b. Flush; Clean cell windows. c. See above. d. Tighten bulkhead assembly.
Spurious noise in the detector readout	1. Lamp. 2. External influence	1a. Dirty lamp. 1b. Lamp at end of useful life or is damaged in transit. 2. Temperature fluctuation	1a. Clean lamp (see Lamp section). 1b. Change/replace lamp (see Lamp section). 2a. Attempt to stabilize ambient temperature. 2b. Avoid hot and cold drafts. Check for overhead air ventilators.
Peak size	1. Too small. 2. Too large.	1. Attenuation too high. 2. Attenuation too low.	1. Reduce attenuation (increase range sensitivity). 2. Increase attenuation (decrease range sensitivity).
Display flashes "0000"	1. High Absorbance 2. Lamp 3. Flowcell	1a. Contaminated Mobile Phase. 1b. Concentration exceeds detector capacity. 2. Lamp failure. 3. Flowcell improperly seated.	1a. Replace with new mobile phase(s). 1b. Reduce sample size. 2. Check lamp circuitry. Replace if necessary. 3. Reinsert flowcell assembly, evenly tightening both thumbscrews.
Displays high negative absorbance value	1. Leak 2. Startup	1. Liquid in the reference bore. 2. Not AutoZero'd.	1. See above. 2. AutoZero the detector.

7.0 Replacement and Spare Parts

PART	PART NO.	NOTES
Replacement Assy, PEEK, Analytical: 7mm, 10µL, 1/16" tube	025-0077	RSP
Replacement Assy, SS, Analytical: 7mm, 10µL, 1/16" tube	025-0123	RSP
Flowcell Rebuild Kit, Analytical 7mm, 10 µL [see below]	025-0045	RSP
Flowcell Assembly Fittings & Tubing		
Nut, Flangeless, Delrin, 1/16" ID (PEEK) 10pc/pkg	025-0047	RSP
Ferrule, Flangeless, Tefzel, 1/16" ID (PEEK) 10pc/pkg	025-0048	RSP
Nut, Super-Flangeless, PEEK, 1/16" ID (for SS) 10pc/pkg	025-0166	RSP
Ferrule, Super-Flangeless, Tefzel/SS , 1/16" ID (for SS) 10pc/pkg	025-0167	RSP
Nut, Bulkhead, Analytical Flowcell Assy 2pc/pkg	Contact Dealer	
Male nut, 1/16" (for PEEK bulkhead) 10pc/pkg	025-0012	RSP
Ferrule, double-ended, 1/16" (for PEEK bulkhead) 10pc/pkg	025-0013	RSP
Male nut, 1/16" (for SS bulkhead) 10pc/pkg	025-0043	RSP
Ferrule, 10-32 CPI, 1/16" (for SS bulkhead) 10pc/pkg	025-0041	RSP
Tubing, TFE Teflon, 1/16" OD, 0.030" ID 5ft	025-0050	
Tubing, PEEK, 1/16" OD, 0.030" ID 5ft	025-0049	
Tubing, PEEK, 1/16" OD, 0.010" ID 5ft	025-0061	
Tubing, SS, 1/16" OD, 0.010" ID, 10 cm [FC Inlet] 10pc/pkg	025-0174	
Tubing, SS, 1/16" OD, 0.020" ID, 10 cm [FC Outlet] 10pc/pkg	025-0175	
Tubing, SS, 1/16" OD, 0.030" ID 5ft	025-0172	
Tubing, SS, 1/16" OD, 0.010" ID 5ft	025-0173	

LEGEND: RSP = Recommended spare part

Flowcell Rebuild Kit (Analytical) Parts List [025-0045]

2 EA	Cell Gasket, 0.005" Thick, TFE®
5 EA	Screw, Machine, Flathead, Phillips, 4-40 X 1/4" Long, SS
3 EA	Setscrew, Socket Cup, 4-40 x 1/4" Long, SS
5 EA	Screw, Sockethead Cap Screw, 4-40 x 9/16" Long, SS
5 EA	Lockwasher, Split, #4, SS
2 EA	Window, Quartz, 1/2" Diameter
5 EA	Spring, Belleville, SS

NOTE: Consult factory for Sapphire window cell information [025-0077-1 PEEK & 025-0123-1 SS].

8.0 Warranty

The flowcell, and tubing supplied with the flowcell, are warranted at the time of installation only.

No other warranty exists, expressed or implied, except as shown here and in the D-Star Instruments' Conditions of Sale. D-Star disclaims any implied warranties of merchantability and fitness for a particular application or purpose.

Fitness to a particular application must be determined by the user.

Request a Return Authorization (RA) before returning any parts.

Return defective unit to your Dealer or Sales Representative for repair. Clean/sterilize all components prior to shipment. No parts will be accepted which present a health or safety concern such as radioactive or biohazard contamination. Repaired unit will be returned via parcel service or mail.