ThermoFisher SCIENTIFIC

Dionex
AXP/AXP-MS Metering Pump
Operator's Manual

Document No. 031897
Revision 05
December 2011

Revision history: Revision 01 released February 2003
Revision 02 released March 2004
Revision 03 released December 2005
Revision 04 released June 2006
Revision 05 released December 2011

For Research Use Only. Not for use in diagnostic procedures.

SAFETY REGULATIONS

The CE Mark label on the Dionex AXP/AXP-MS indicates that the pump is in compliance with the following standards: EN 61010-1:1993 (safety), CAN/CSA-C22.2 No. 1010.1-92 + A2:97 (safety), UL 6101A-1 (safety), 93/68/EEC and 89/336/EEC (low-voltage directives), and the following EMC Standards: EN61000-6-3: 2001, EN61000-6-1: 2001, EN 55022 Class A, EN 61000-3-2, EN 61000-3-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, and EN 61000-4-11.

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1 INTRODUCTION

This operator's manual contains information needed to install, operate, and perform minor maintenance on the Thermo Scientific Dionex™ AXP Metering Pump (P/N 063973) and the Thermo Scientific Dionex AXP-MS Metering Pump (P/N 060925).

1.1 Description of the Dionex AXP/AXP-MS Pump

The Dionex AXP/AXP-MS high performance metering pump is designed as a dependable metering pump for general laboratory or industrial use.

The Dionex AXP pump flow rate can be set from 0.01 to 10.00 mL/min (in increments of 0.01 mL) with a precision of 0.5%.

The Dionex AXP-MS pump flow rate can be set from 0.01 to 1.00 mL/min (in increments of 0.01 mL) with a precision of 0.5%.

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

1.1.1 *Pump Features*

The Dionex AXP/AXP-MS Pump includes:

- Rapid refill mechanism to reduce pulsation
- PEEK™ pump head
- LED front panel readout of flow rate
- PRIME mode to flush out entrapped air bubbles upon start-up
- Flow adjustment in increments of 10 µL
- Microprocessor advanced control
- Digital stepper motor design to prevent flow rate drift over time and temperature
- Rear panel RS-232 serial communications port for complete control and status
- Remote analog inputs to control flow rate (optional)

1.1.2 *Wetted Materials*

Pump heads, check valve bodies, and tubing are made of PEEK. Other materials are synthetic ruby and sapphire (check valve internals and piston).

1.1.3 *Self-Flushing Pump Head*

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 diaphragm and secondary 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 damage to the pump.

Note: When the Dionex AXP is used as a sample loading pump for trace ion applications, the convoluted diaphragm will cause sample contamination. Remove the diaphragm as described in Section 5.2.1. Once the diaphragm is removed, the seal wash feature must not be used; if it is, wash solution will drain past the piston retainer. Rotate the flush housing 180 degrees so that the self-flush outlet tubing is facing down. This will allow any leaks from the high pressure seal to drain from the head assembly.

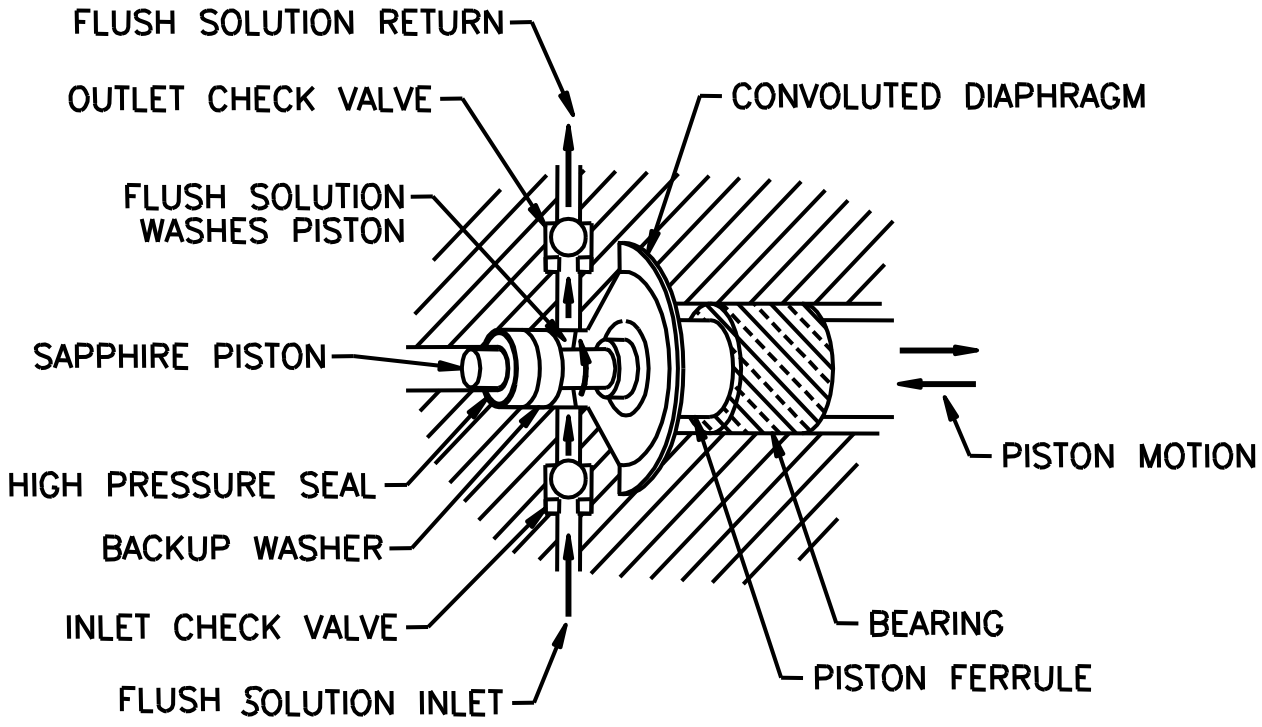


Figure 1-1. Self-Flushing Pump Head

1.2 Specifications for the Dionex AXP/AXP-MS Pump

Flow Rates	0.01 to 10.00 mL/min (Dionex AXP) 0.01 to 1.00 mL/min (Dionex AXP-MS**)**
Pressure	0 to 2500 psi
Flow Accuracy	3%
Flow Precision	0.5% RSD
Dimensions	6.25 in. high x 7.75 in. wide x 14 in. deep
Weight	15 lb
Power	100-240 VAC, 50/60 Hz (1 amp)
Features	Autoprime™ purging Autoflush™ piston wash
Remote Inputs	RS-232

2 INSTALLATION

2.1 Unpacking and Inspection

Prior to opening the Dionex AXP/AXP-MS pump 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 Dionex AXP/AXP-MS pump is normal laboratory conditions. The area should be clean and have a stable temperature and humidity. The specific temperature and humidity conditions are 10 to 30 °C and 20% to 90% relative humidity. The instrument should be located on a flat, stable surface with surrounding space for ventilation and the necessary electrical and fluid connections.

2.3 Electrical Connections

Unpack the Dionex AXP/AXP-MS pump; position the pump so that there is at least 4 in. of 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 this may cause a serious shock hazard.

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 outgassing and cavitation. Filtration of HPLC solvents is also required.

2.4.1 *Solvent Outgassing and Sparging*

Solvent outgassing occurs because the mobile phase contains dissolved atmospheric gases, primarily N_2 and O_2. 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 allow atmospheric gases to dissolve 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 outgassing may occur. Installation of a backpressure regulator 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 in. or with tubing of less than 0.085-in. 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 *Filtration*

Solvent filtration is good practice for the reliability of the Dionex AXP/AXP-MS pump and other components in an HPLC system. Solvents should always be filtered with a 0.5-micron filter prior to use. This ensures that no particles 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 Dionex AXP/AXP-MS pump that contact mobile phase are manufactured of type 316 stainless steel, ceramic, sapphire, or ruby. Some of these materials are extremely sensitive to acids (including some Lewis acids) and acid halides. Avoid using solvents that contain any 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 to 500 mL of 20% methanol in water as a flushing solution. 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.

2.5.3 *Inlet Tubing and Filters*

The replacement parts list shows the inlet tubing and filter used in the Dionex AXP/AXP-MS pump. All inlet lines are 30 in. long and are made of a fluoropolymer material.

2.5.4 *Outlet Tubing*

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

If the Dionex AXP is being used as a sample loading pump for trace ion applications, the convoluted diaphragm will cause sample contamination. Remove the convoluted diaphragm as described in Section 5.2.1. Once the diaphragm is removed, the seal wash feature cannot be used; if it is, wash solution will drain past the piston retainer. Rotate the flush housing 180 degrees so that the self-flush outlet tubing is facing down. This will allow any leaks from the high pressure seal to drain from the head assembly.

2.5.5 *Priming the Pump and the Flushing Lines*

Connect a syringe to the priming adapter. Run the pump at a flow rate of 3.00 to 5.00 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).

To prime the flush lines for a self-flush head, simply place the inlet line in the flush solution and connect a syringe to the outlet line and apply suction until the line is filled with flush solution. Place the outlet line in the flush solution. Secure both flush lines in the flush solution container so they stay immersed during pump operation.

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 one year of operation (i.e., with no backpressure on the pump, a reading of 1 to 9 psi may be displayed). A similar drift may also occur at higher pressures, and is typically less than 1% (e.g., <50 psi at 6000 psi backpressure).

If pressure calibration and/or drift is a concern, contact Technical Support for Dionex products. The pump can be shipped back for recalibration. Alternatively, written calibration and zero-reset procedures are available. To obtain a copy of these instructions, contact Technical Support for Dionex products.

2.6 Preparation for Storage or Shipping

2.6.1 *Isopropanol Flush*

Disconnect the outlet tubing from the pump. Place the inlet filter in isopropanol. Use a syringe to draw a minimum of 50 mL through the pump. 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: Reship the AXP/Dionex AXP-MS 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 in. 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

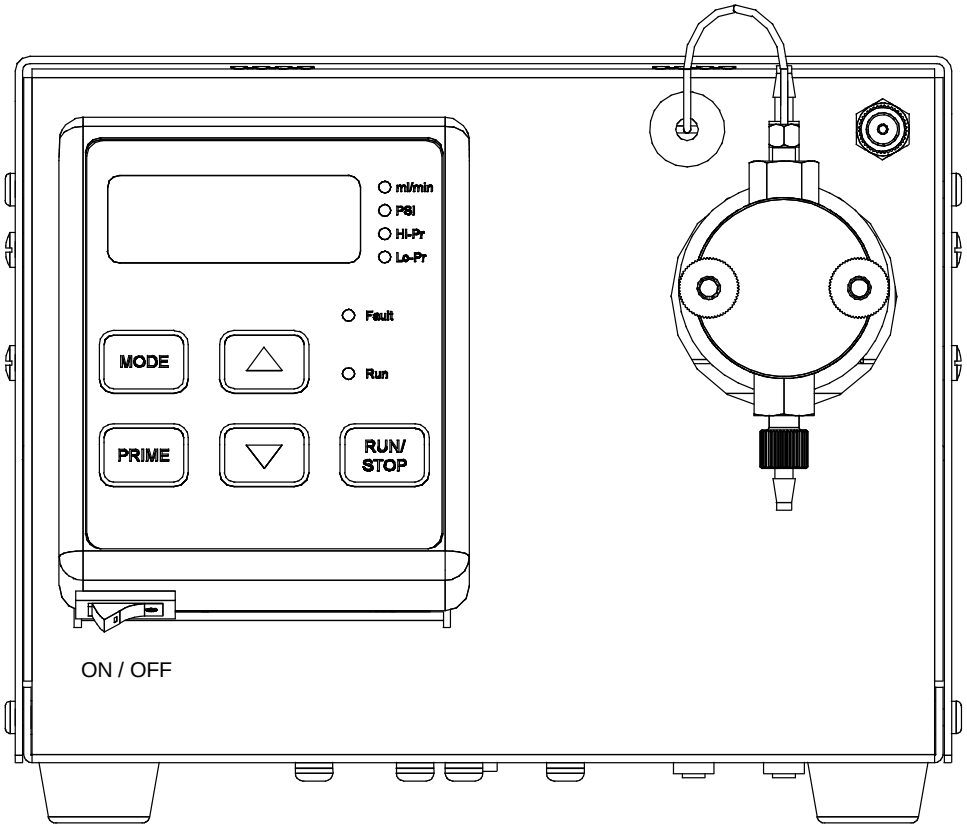


Figure 3-1. AXP/Dionex AXP-MS Pump Front Panel

3.1.1 *Control Panel*

3.1.1.1 Digital Display

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

3.1.1.2 Keypad

RUN/ STOP	When pressed, this button alternately starts and stops the pump.
Δ	When pressed, this button increases the flow rate.
∇	When pressed, 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.
MODE	Use this button to cycle through the four display modes: flow rate, pressure, upper pressure limit, or lower pressure limit. A status LED to the right of the digital display indicates which mode is active.

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 one second, the button press will repeat at a slow rate of approximately 10 times per 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 per second. To switch back and forth between repeat speeds, press and release the second arrow button while keeping the first arrow button held down.

3.1.1.3 Status LEDs

ML/MIN	When lit, the digital display shows the flow rate in mL/min.
PSI	When lit, the digital display shows the 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.

3.1.1.4 Power-up Configuration

Pressure Compensation: On power-up, press the PRIME button on the front panel while pressing the Power On switch on the rear of the pump. The pump will display a number from 0 to 60 that represents the running pressure of the pump from 0 to 6000 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 resume normal pump operation.

Nonvolatile Memory Reset: If the pump is operating erratically, the memory may have 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 nonvolatile memory (i.e., the flow rate, pressure compensation, voltage/frequency selection, lower pressure limit, and upper pressure limit) will be set to the factory-default values. The head type setting is the only parameter not changed by the nonvolatile memory reset function. If the firmware is upgraded to a newer version, a nonvolatile memory reset will automatically occur the first time the power is switched on.

3.1.1.5 Power-Up Tests

Display Firmware Version Mode: The firmware 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 firmware version. To exit this mode, press the RUN/STOP button.

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 reads *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 to signal 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 Loopback Test Mode: If an external device will not communicate with the pump via the serial port, the serial port loopback 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 and then release the buttons. The display must read *C00* for the first half of the test to pass. Plug in the serial port loopback plug (a modular plug with pins 2 and 5 jumpered together and pins 3 and 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

An RS-232C modular jack is provided on the rear panel. To control the pump using Chromeleon® version 6.80 (or later), connect the pump to the serial or USB port on the Chromeleon PC, using the cables included in the Ship Kit. When connecting to a USB port, the driver provided with the serial-to-USB adapter must be installed on the PC *before* the converter cable is attached to the USB port. See Section 7 for details on connection and operation.

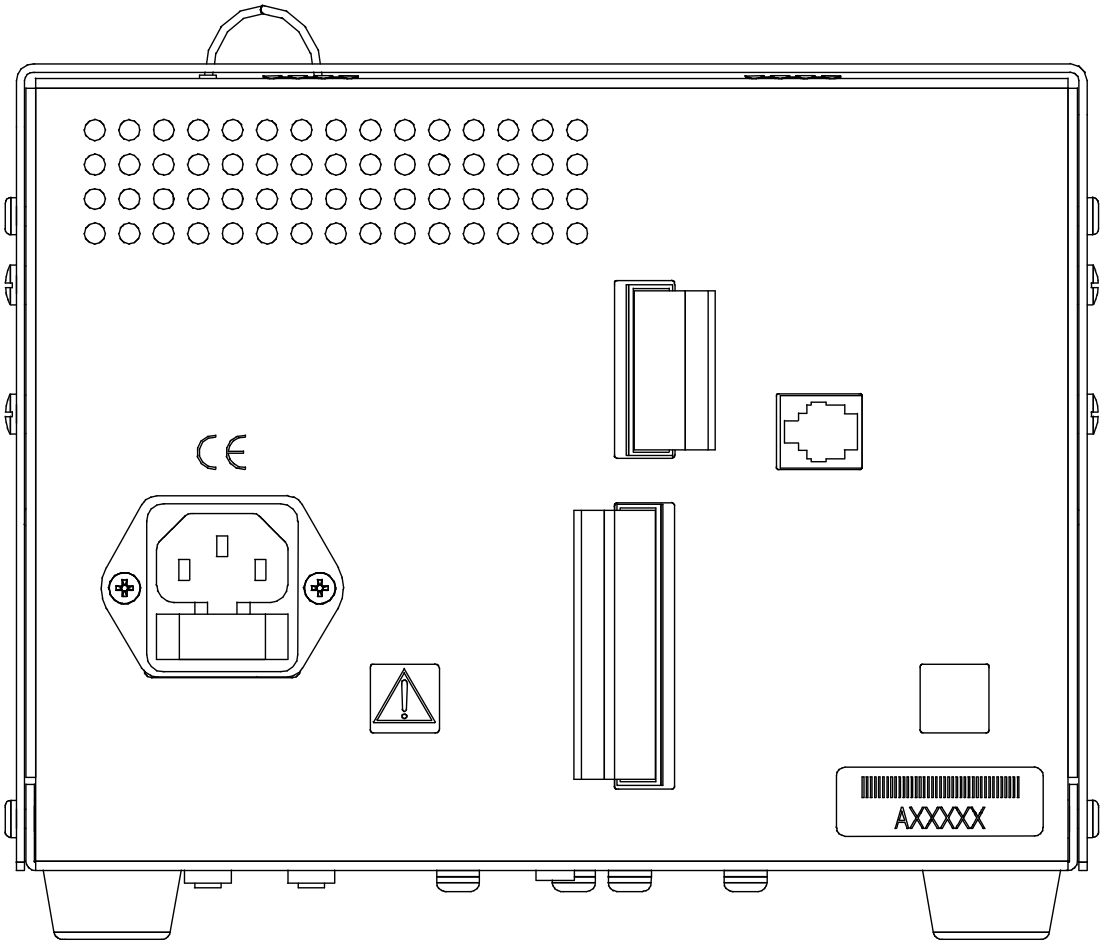


Figure 3-2. Dionex AXP/AXP-MS Pump Rear Panel

4 THEORY OF OPERATION

4.1 Mechanical Operation

4.1.1 *Liquid System Flow Path*

The flow path of the Dionex AXP/AXP-MS pump starts at the inlet reservoir filter, passes through the inlet check valve, then through the pump head, and finally exits through the outlet check valve.

4.1.2 *Pump Cycle*

The pump cycle consists of two phases: the pumping phase, when fluid is metered out of the pump at high pressure, and the refill phase, when fluid is rapidly drawn into the pump.

During the pumping phase, the pump piston moves forward at a programmed speed; this results in a stable flow from the pump. The piston is driven by an eccentric bearing which is directly driven by the motor.

At the end of the pumping phase, the pump enters the refill phase. The piston quickly retracts, refilling the pump head with solvent, and the piston begins to move forward again as the pumping phase begins. The motor speed is increased during refill to reduce refill time and to pre-compress the solvent at the beginning of the pumping phase.

For optimal operation of the check valves, a backpressure of at least 25 psi is required. Operating at lower pressures can lead to improper seating of the valves and cause inaccurate flow rates.

4.1.3 *Pulse Damping*

The diaphragm-type pulse damper consists of a compressible fluid (isopropanol) held in an isolated cavity by an inert but flexible diaphragm. During the pumping phase of the pump cycle, the fluid pressure of the mobile phase displaces the diaphragm, compressing the fluid in the cavity and storing energy. During the pump refill phase, the pressure on the diaphragm is reduced and the compressed fluid expands, releasing the energy it has stored. This helps to stabilize flow rate and pressure. The amount of mobile phase in contact with the pulse damper is small, only 0.9 mL at 2500 psi, and the geometry used ensures that the flow path is completely swept, so solvent “memory effects” are virtually eliminated.

To be effective, the pulse damper requires a backpressure of approximately 500 psi or greater. If the system does not generate 500 psi, a length of small bore tubing (restrictor) can be used between the pulse damper and the application.

4.2 Electronic Control

4.2.1 *Microprocessor Control*

The pump is controlled by hybrid microprocessor circuitry which (1) provides control signals to the motor drive circuitry, (2) interfaces with the keyboard/display, (3) receives signals from the refill flag, and (4) provides external input/output (RS-232) interfacing. Firmware programming is stored in an EPROM.

An eccentric cam provides refill in a fraction of the full cam cycle. The remaining revolution of the cam provides piston displacement for outward flow of the mobile phase. In addition to the rapid refill characteristics of the drive, the onset of refill is detected by an infrared optical sensor. The microprocessor changes the refill speed of the motor to an optimum for the set flow rate. At 1.00 mL/min, the refill rate is more than five times faster than if the motor operated at constant speed. The optimum refill rate minimizes the resulting pulsation while avoiding cavitation in the pump head.

The flow rate of any high pressure pump can vary, depending on the operating pressure and the compressibility of the fluid being pumped. The Dionex AXP/AXP-MS pump is calibrated at 1000 psi, using an 80:20 mixture of water and isopropanol.

4.2.2 *DC Power Supply*

Power for the pump is provided by an isolation transformer which has taps to accommodate voltages of 110-120 or 220-240 VAC. Selection is accomplished by changing the transformer jumpers. A different transformer is supplied for use at 100 VAC. The transformer input is provided with two fuses for line current. A linear rectifier circuit provides 36 VDC, which also has a fuse, to drive the stepping motor. A switching 5 VDC supply is provided to power control and display circuits.

4.2.3 *Motor Stall Detector*

The motor can stall and create a loud buzzing sound if the flow path connected to the pump's outlet becomes plugged, if the pressure exceeds the maximum pressure rating of the pump, or if the mechanism jams. If the motor stalls, the electrical current being supplied to the motor is turned off and the fault light is turned on.

The motor stall detector is enabled or disabled during power-up by pressing and holding the RUN/STOP and the PRIME buttons while the power is switched on. Release the buttons when the display reads *SFE*. To enable the motor stall detector, press the up arrow button and the display will read *ON*. To disable the motor stall detector, press the down arrow button and the display will read *OFF*. To exit this mode and store the current setting in nonvolatile memory, press the RUN/STOP button.

The motor stall detector uses a timer to determine if the camshaft has stopped turning or if the refill switch is defective. The timer begins timing after the pump accelerates or decelerates to its set point flow rate. If the motor stall detector has been enabled, and the camshaft stops turning or the refill switch stops operating, the fault will be detected between the time it takes to complete one to two pump cycles. A pump cycle is defined as the time it takes for the camshaft to complete one complete revolution. One revolution of the camshaft produces a delivery phase and a refill phase. Each specific flow rate has a corresponding cycle time: the cycle time is approximately 30 seconds at 0.1 mL/min, 3 seconds at 1.00 mL/min, and 0.3 second at 10.00 mL/min.

The fault is canceled by using one of the following methods: (1) by pressing the RUN/STOP button on the front panel, (2) by sending a stop command (ST) via the serial communications port on the rear panel, or (3) by connecting the PUMP-STOP input to COM on the rear panel, or removing the connection between the PUMP-RUN input and COM if the PUMP-STOP input is permanently jumpered to COM on the rear panel.

4.2.4 *Remote Interfacing*

An RS-232C modular jack is provided on the rear panel. To control the pump using Chromeleon version 6.80 (or later), connect the pump to the serial or USB port on the Chromeleon PC, using the cables included in the Ship Kit. When connecting to a USB port, the driver provided with the serial-to-USB adapter must be installed on the PC *before* the converter cable is attached to the USB port. See Section 7 for details on connection and operation.

5 MAINTENANCE

Cleaning and minor repairs of the Dionex AXP/AXP-MS pump can be performed as outlined below.

5.1 Filter Replacement

5.1.1 *Inlet Filters*

Inlet filters should be checked periodically to ensure that they are clean and do not restrict 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% to 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.

5.2 Pump Heads

5.2.1 *Removing the Pump Head*

As a guide to pump head assembly, the pump head is shown in Figures 5-1 and 5-2.

1. Turn OFF the power to the Dionex AXP/AXP-MS pump.
2. Remove the inlet line and filter from the mobile phase reservoir. Be careful not to damage the inlet filter or crimp the PTFE (polytetrafluoroethylene) tubing.
3. (Optional) Remove the outlet line from the outlet check valve.
4. Momentarily turn ON the 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.
5. Unplug the power cord.
6. 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.

7. 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. Remove the O-ring.
8. 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 diaphragm from the piston by carefully grasping the sealing flange on two sides and sliding it straight out on the piston, being careful not to exert lateral pressure that may break the piston.

5.2.2 *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.

The replacement seal kit contains one seal, one backup washer, a seal insertion/removal tool, a diaphragm, and a pad to clean the piston when changing the seal.

5.2.2.1 Conditioning New Seals

Note: Use only water or 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 2000 psi of backpressure and a flow rate of 3.00 mL/min.

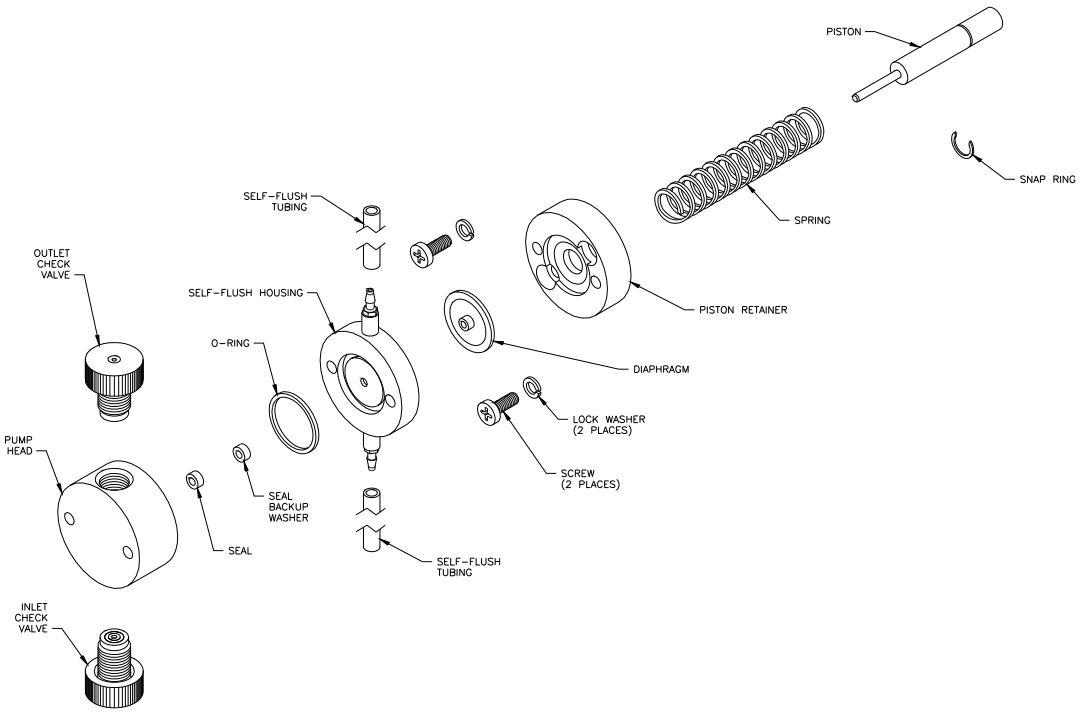


Figure 5-1. Self-Flushing Pump Head Assembly

5.2.3 *Cleaning the Pump Head Assembly*

Note: If you choose to remove the piston seal or self-flush diaphragm, you should have a new set on hand to install after cleaning. It is not recommended that you reinstall the used piston seal or diaphragm, since they may be scratched and damaged during removal and would not provide a reliable seal if reused. If you decide to remove the seal, 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 5.2.2 for seal replacement instructions.

1. Inspect the piston seal cavity in the pump head. Use a cotton swab or equivalent to remove any foreign material, and avoid scratching the sealing surfaces. Be sure no fibers from the cleaning swab remain in the components.

2. The pump head, check valves, and flushing 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 reassembly.

3. If you removed the check valves, tighten each check valve firmly by hand. Each check valve assembly contains two capsules. The sapphire seat in each capsule must be oriented downward in the final pump assembly.

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

   If you removed the piston seal, insert a new seal as described in Section 5.2.2. When you finish, replace the pump head as described in Section 5.2.5.

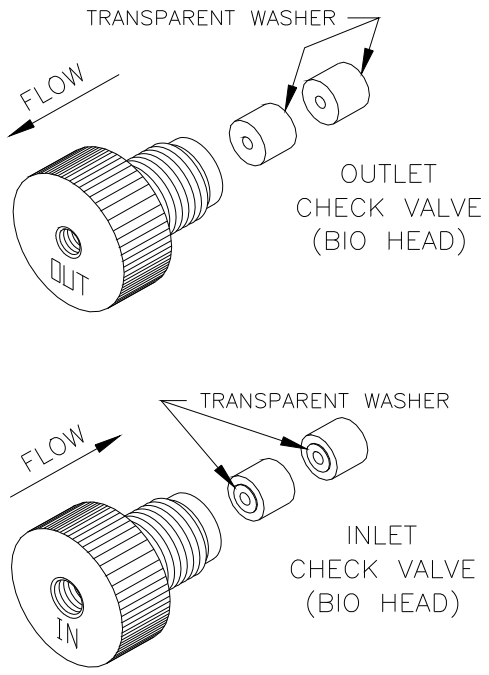


Figure 5-2. Check Valves

5.2.3.1 Removing the Seals

1. Remove the pump head as described in Section 5.2.1.
2. Insert the flanged end of the seal insertion/removal tool into the seal cavity on the pump head. Tilt it slightly, so that the flange is under the seal, and pull out the seal.

CAUTION: Using any other tool will scratch the finish.

3. Inspect, and if necessary, clean the pump head as described in Section 5.2.3.

5.2.3.2 Cleaning the Piston

It is not necessary to remove the piston from the housing to clean the piston. 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 pad frequently to ensure that 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.

5.2.3.3 Replacing the Seal

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. Attach the pump head as described in Section 5.2.5.
3. Condition the new seal as described in Section 5.3.

5.2.4 *Changing the Piston*

1. Remove the pump head as described in Section 5.2.1.
2. With your thumb pressing the piston retainer against the pump housing, remove the two Phillips head screws from the retainer. Do not allow the spring pressure to force the retainer away from the housing as the screws are loosened.
3. After both screws have been removed, slowly allow the spring pressure to push the retainer out of the housing. Gently pull the retainer straight out and carefully remove it from the piston and threaded rods. Also, gently pull the spring straight out of the housing and remove.
4. Grasp the metal base of the piston assembly so that you avoid exerting any pressure perpendicular to the length of the piston, and gently pull it from the pump housing.

5. Remove the snap ring from the groove on the old piston and place it into the groove on the new piston.
6. Place a small amount of high quality grease on the back end of the metal base of the piston assembly. Grasp the metal base of the piston assembly near the front so that you avoid exerting any pressure perpendicular to the length of the piston, and gently slide it into the pump housing.
7. Gently slide the spring over the piston assembly and back into the pump housing. Carefully align the retainer and gently push it straight in against the spring force until the retainer is against the housing. If misalignment with the piston occurs, wiggle while pushing the retainer to align the piston and retainer.
8. Hold the retainer flush against the housing with your thumb. Insert and tighten the Phillips head screws. Do not allow the spring pressure to force the retainer away from the housing. Check that there are no gaps between the retainer and the housing.
9. Attach the pump head as described in Section 5.2.5.

5.2.5 *Replacing the Pump Head*

1. Gently place the diaphragm, with the center hub protruding toward you, onto the piston. Push the diaphragm all the way back into the recess and against the metal base of the piston. Do not exert pressure perpendicular to the length of the piston, as this may break the piston.
2. Carefully align the flush housing and gently slide it into place on the pump. Make sure the inlet valve is on the bottom and the outlet valve is on the top. Insert the O ring into its groove.
3. Line up the pump head and carefully slide it into place. Make sure the inlet valve is on the bottom and the outlet valve is on the top. Do not force the pump head into place.
4. Fingertighten both knurled nuts. To tighten firmly, alternately turn nuts one-quarter turn while gently wiggling the pump head to center it.
5. Reattach the inlet and outlet lines. Change the flushing solution.

5.3 Check Valve Cleaning and Replacement

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 1.00 mL/min for one hour. After washing with detergent, pump distilled water through the pump for 15 minutes. Always direct the output directly to a waste beaker during cleaning. If this does not work, the check valve should be replaced.

5.4 Lubrication

The Dionex AXP/AXP-MS pump has no lubrication requirements. The bearings in the pump housing and piston carrier are permanently lubricated and require no maintenance. Keeping the interior of the pump free of dirt and dust will extend the pump's useful life.

5.5 Fuse Replacement

Three fuses protect the Dionex AXP/AXP-MS 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 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 display does not light, 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 fuse.

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

5.6 Battery Replacement

The battery provides power for the memory that holds the current pump configuration. If the pump is set at a flow rate other than 1.00 or 10.00 mL/min and the power is turned off, the flow rate last selected should still be in effect when the power is turned back on. If this flow rate is not displayed, the battery needs to be replaced.

1. Unplug the unit.
2. Remove the cover.
3. Turn the unit so that the control panel is 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 of the unit.
6. Plug the unit back in.

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

Quick Guide to Problem Solving

You Notice	This May Mean	Possible Cause	You Should
1. Uneven pressure trace. 2. Pressure drops. 3. 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 system directly from outlet check valve. 4. Clean or replace check valves (see Section 5.4). 5. Clean or replace inlet filter (see Section 5.1.1).
1. Uneven pressure trace. 2. Pressure drops. 3. Fluid between the pump head and the retainer.	1. Leaks in system. 2. The piston seal or diaphragm is worn.	1. Fittings not tight. 2. Long usage time since last seal/diaphragm change. 3. Salt deposits on seal or diaphragm (especially if buffered aqueous mobile phases are used).	1. Check all connections for leaks. 2. Replace piston seal and diaphragm (see Sections 5.2 and 5.3). 3. Check piston for salt deposits. Clean as necessary (see Section 5.2.4).
Pump makes a loud clanging or slapping noise (intermittent contact with cam).	Piston carrier is catching in the piston guide.	1. Cap nut screws on pump head are loose. 2. Seal(s) are worn. 3. Piston guide is worn.	1. Check cap nut screws on pump head. Tighten if necessary. 2. Replace seals. 3. Replace piston guide and seals (see Sections 5.2 and 5.3).
No power when pump turned ON.	Blown fuses in the power entry module.	1. Power surge. 2. Internal short.	1. Replace only with the appropriate fuses (1 A for 100-120 VAC or 1/2 A for 220-240 VAC). 2. Contact Technical Support for Dionex products if the problem persists.
Blue dye in mobile phase.	Pulse damper diaphragm has burst.	Sudden pressure drop when purging system.	Replace pulse damper (see Section 5.5).
Pump runs for 50 pump strokes, 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, and 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 Technical Support for Dionex products if the problem persists.
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 Section 5.2). 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 (1 A for 100-120 VAC or 1/2 A for 220-240 VAC). 2. Contact Technical Support for Dionex products if the 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 (5 A). 2. Contact Technical Support for Dionex products if the 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.

6 LIST OF REPLACEMENT PARTS

6.1 PEEK Head

Part No.	Description
061035	PEEK/Bioclean check valve kit
052306	0.010-in. ID x 1/16-in. OD PEEK tubing, 5 ft
052309	0.020-in. ID x 1/16-in. OD PEEK tubing, 5 ft
061038	PEEK/Bioclean coupling
061039	E-Z Grip 1/16-in. gland nut (for outlet tubing)
061040	E-Z Grip 1/16-in. ferrule (for outlet tubing)

6.2 Seals

Part No.	Description
061041	Piston seal kit, 10 mL

6.3 General

Part No.	Description
061491	Backpressure loop
061042	Inlet filter, 20 micron
061043	Replacement filter elements for 061042, pkg. 2
061044	Cable adapter, RJ-11 to DB25
061045	Cable adapter, RJ-11 to DB9
	064590 Cable adapter, USB-B to DB9M with USB cable and driver
061046	Modular RS-232 cable
061047	Piston assembly, 10 mL
061048	Self-flush assembly
061049	Knurled nut for pump head
954720	1 A slow-blo fuse (120 V)
954726	1/2 A slow-blo fuse (240 V)
954736	5 A fast-blo fuse (motor drive)

7 INTERFACING INFORMATION

7.1 Rear Panel Serial Communications Port

An RS-232C modular jack is provided on the rear panel. To control the pump using Chromeleon version 6.80 (or later), connect the pump to the serial or USB port on the Chromeleon PC, using the cables included in the Ship Kit. When connecting to a USB port, the driver provided with the serial-to-USB adapter must be installed on the PC *before* the converter cable is attached to the USB port.

7.1.1 *Hardware Implementation*

The 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 pinout is:

Pin	Function
1, 6	Ground
2	DSR (Handshaking input to pump)
3	RXD (Serial data input to pump)
4	TXD (Serial data output from pump)
5	DTR (Handshaking output from pump)

Special wiring considerations: Refer to the following chart when interfacing the pump's serial communications port to either a 25-pin or a 9-pin COM port on a PC.

Pump (RJ11)	Signal	PC (DB25)[a]	PC (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.

Part Description	Part Number
RS-232 Modular Cable	061046
RJ-11 to DB9 Adapter	061045
RJ-11 to DB25 Adapter	061044

7.1.2 *Handshaking*

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; 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 following command codes are all equivalent: *PR*, *Pr*, *pR*, and *pr*. 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 99.9 mL/min, xxx = 001 to 999).
FOxxxx	OK/	Sets the flow rate to xxx.x mL/min (i.e., for 0.1 to 100.0 mL/min, xxxx = 0001 to 1000).
PR	OK,x/ (x, xx, or xxx)	Reads the pump's current pressure, where: x, xx, or xxx = Current pressure in PSI
CC	OK,x,yyy.y/ (x, xx, or xxx) (y.y, yy.y, or yyy.y)	Reads the pump's current pressure and flow rate, where: x, xx, or xxx = Current pressure in PSI y.y, yy.y, or yyy.y = Flow rate in mL/min

CS	OK,xxx.x,y,z,PSI,w,v,u/ (x.x, xx.x, or xxx.x) (y, yy, or yyy) (z, zz, or zzz)	Reads the current pump setup, where: x.x, xx.x, or xxx.x = Flow rate in mL/min y, yy, or yyy = Upper pressure limit z, zz, or zzz = 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 (0 = present, 1 = not present)
ID	OK,vx.xx SR3P firmware/	Identifies the pump type and EPROM revision x.xx.
UPxxxx	OK/	Sets the upper pressure limit in PSI. The maximum value is 3000; the minimum value is the lower limit plus 10. The value must be expressed as four digits (i.e., for 400 PSI, xxxx = 0400).
LPxxxx	OK/	Sets the lower pressure limit in PSI. The maximum value for xxxx is the current upper pressure limit setting minus 10; the minimum value is 0. The value must be expressed as four digits (i.e., for 50 PSI, xxxx = 0050).
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 0500 PSI, xx = 05).
RC	OK,x/	Reads the pressure compensation value in hundreds of PSI (i.e., for 0 PSI, x = 0; for 0500 PSI, x = 5).
HTx	OK/	Sets the pump head type, where: x = 3 for a stainless steel 50 mL/min pump head x = 4 for a plastic 50 mL/min pump head When the head type is changed, the pump is stopped and the pressure compensation and pressure limits are initialized.
RH	OK,x/	Reads the pump head type, where: x = 2 for a plastic 10 mL/min pump head x = 3 for a stainless steel 50 mL/min pump head x = 4 for a plastic 50 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.a, aa.a, or aaa.a) (c or cc)	Reads the current pump setup, where: a.a, aa.a, or aaa.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 (0 = present, 1 = not present) 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.

7.2 Rear Panel 6-Pin and 10-Pin Terminal Board Connectors

A 6-pin terminal board connector and a 10-pin terminal board connector are provided on the rear 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 6-pin terminal board connector. The pinout is:

Pin	Function
6	EVENT 1
5	No connection
4	EVENT 2
3	No connection
2	EVENT 3
1	No connection

This output is produced internally by a reed relay which has SPDT contacts with a 0.25 amp maximum, 50 VDC maximum, and 0.2 ohm rating. The 6-pin connector allows wires to be connected to the

EVENT 1 (Pole), EVENT 2 (NC), and EVENT 3 (NO) terminals. When the pump stops because the sensed pressure exceeds the set pressure limits or due to a motor stall fault, 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, when it opens. VENT 3 is Normally Open (not connected to EVENT 1) until a fault occurs, when it closes.

7.2.1.1 Upper and Lower Pressure Limit Ranges

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 the 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 shutoff 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. Be sure to set this pressure limit to a pressure higher than the basic pressure; this will ensure that the reduced pressure is sensed.

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. Each input draws approximately 0.008 amp when connected to COM. To activate the PUMP-RUN, PUMP-STOP, or ENABLE IN input, connect it to COM. Any device capable of switching 0.008 amp (including 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 volt) can be connected between the PUMP-RUN, PUMP-STOP, or ENABLE IN input and COM. 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 rear panel inputs when the pump’s flow rate is controlled from the front panel or by the voltage or frequency input. The two modes of operation for the run and stop inputs 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 rear 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:

a.) With the pump plugged in and the rear panel power switch OFF, press and hold the down arrow button while turning the power switch ON.
b.) Release the down arrow button and either a *U* (closest approximation to V for voltage) or an *F* (for frequency) will be displayed.
c.) Select the desired remote operating mode by pressing the down arrow button to toggle between the voltage and frequency modes.
d.) Press the RUN/STOP button to place the pump in the normal operating mode.
e.) To enable the currently selected remote mode (voltage or frequency), connect the rear panel ENABLE IN connection to the COM connection.
f.) 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 10.00 mL/min flow rate. Any device capable of sourcing at least 0.0005 amp will work. Also, the voltage control mode must be selected and enabled as described in Section 7.2.6. To prevent a ground loop current, isolate the voltage source which drives the VOLTAGE IN and VOLTAGE COM connections from the safety ground. If the pump's displayed flow rate jumps up and down erratically, suspect a ground loop problem.

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 amp will work. A 0 to 10,000 Hz input frequency will correspond to a 0 to 10.00 mL/min flow rate. Also, the frequency control mode must be selected and enabled as described in Section 7.2.6.

7.3 Dionex AXP-MS Valve Plumbing and Port Assignments

INJECTOR VALVE PORTS	
PORT	FUNCTION
1	Sample Loop
2	Inlet from Pump
3	Outlet to Column
4	Sample Loop
5	Loop Fill
6	Drain

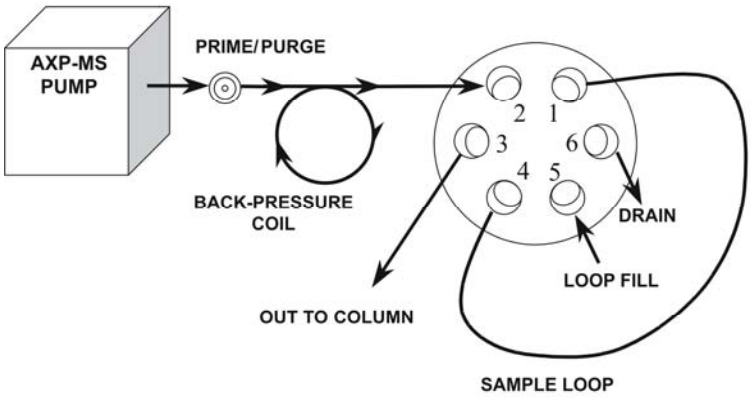
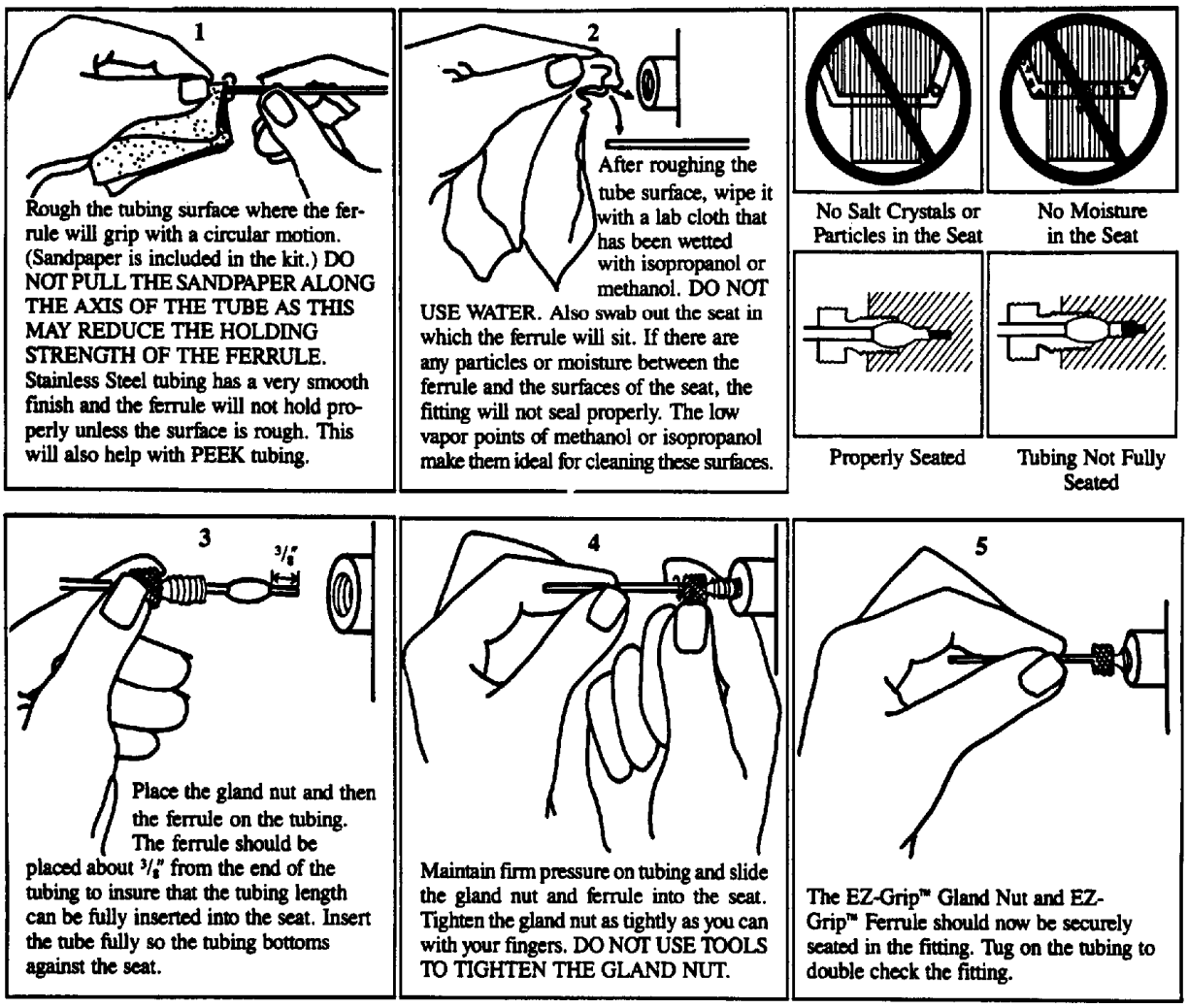


Figure 7-1. Liquid Connections for the Dionex AXP-MS

7.4 EZ Grip Fitting Guide



WARRANTY

The product described in this manual, other than seals, check valves, inlet/outlet filters, pistons, and pulse damper, is warranted against defective material and workmanship for a period of three (3) years from the date of shipment. Seals and valves, whether sold independently or as component parts of other products, are warranted against defective material and workmanship for a period of ninety (90) days from date of shipment. In the event of such a defect, Dionex will repair or replace the product or necessary parts therein, at its discretion, and such repair or replacement shall be the sole remedy of this warranty. This warranty is subject to the following conditions:

1. Any servicing of the products must be performed by trained personnel.
2. The products must not be subjected to abuse or improper installation or application.
3. Warranty does not extend past thirty (30) days for transducer calibration, voltage calibration, and similar features that may be part of the product.
4. This warranty shall be void as to any products exposed to:
   (i) highly corrosive chemicals including, but not limited to halide acids, halide salts, concentrated organic or inorganic acids and their salts, any concentrated chemical that will complex metal ions, and carbon tetrachloride which can contain significant amounts of hydrochloric acid; Tetrahydrofuran and high concentrations of chlorinated solvents (PEEK components);
   (ii)foreign materials in the driving media or pumped media;
   (iii)application of pressures beyond published ratings.

THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED, WHICH EXTEND BEYOND THIS DESCRIPTION. Dionex neither assumes, nor authorizes any person to assume for it, any other liability in connection with the sale and use of the products.

DAMAGES ARE LIMITED STRICTLY TO REPLACEMENT OF THE PRODUCTS. DIONEX EXPRESSLY DISCLAIMS LIABILITY FOR INCIDENTAL AND CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OF THE PRODUCTS.

Claims covered by this warranty will be honored when presented within thirty (30) days from discovery of defect.

CUSTOMER SUPPORT

Thermo Scientific Dionex products are supported by Thermo Fisher Scientific Technical Support Representatives. For assistance, contact Technical Support for Dionex products. In the U.S. and Canada, call 1-800-346-6390. Outside the U.S. and Canada, call the nearest Thermo Fisher Scientific office.