

Profilers **Samplers** Flotation



mclanelabs.com

Phytoplankton System

User Manual



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PPS User Manual Table of Contents

Chapter 1 Introduction and System Description	1-1
McLane Phytoplankton Sampler (PPS).....	1-1
PPS Options.....	1-1
Using this Manual.....	1-1
User Key.....	1-2
Customer Resources.....	1-2
Technical Support.....	1-3
Instrument Training.....	1-3
Mechanical Components.....	1-4
Frame.....	1-4
Controller Housing.....	1-5
Top and Bottom End Caps.....	1-6
O-Rings.....	1-6
End Cap Bulkhead Connectors.....	1-7
Pressure Relief Valve.....	1-7
Pressure Relief Valve Upgrade.....	1-8
25-Port Valve.....	1-9
Pump.....	1-9
Filter Holders.....	1-10
Home Port Water Flush.....	1-10
Optional Antifouling Solution Reservoir.....	1-11
Optional Fixative Valve.....	1-12
PPS Toolkit.....	1-14
Serial Number.....	1-14
Electronics Components.....	1-15
Communications Bulkhead Connector Styles.....	1-16
Main Battery.....	1-17
Backup Battery.....	1-18
Chapter 2 Getting Started with your McLane Sampler	2-1
Section 2.1 Setting up a Computer for the Sampler	2-1
Installing MotoCross.....	2-2
Section 2.2 Connecting the Sampler to a Computer	2-4
Connecting a Computer.....	2-4
Configuring MotoCross Communications Settings.....	2-5
Control Character Transmission.....	2-6
Creating a Capture File.....	2-6
Troubleshooting the USB Adaptor.....	2-7
Section 2.3 Powering on the Sampler	2-8
Opening the Controller Housing Equipped with the PRV.....	2-8
Connecting the Battery and COM Cable.....	2-10
Opening a Controller Housing not Equipped with the PRV.....	2-12
Section 2.4 Waking the Sampler from Low Power Sleep	2-13

Chapter 3 User Interface.....	3-1
Section 3.1 Main and Configuration Menus.....	3-1
Main Menu.....	3-1
Configuration Menu.....	3-2
Section 3.2 Instrument Settings	3-3
<1> Set Time	3-3
<2> Diagnostics.....	3-4
Battery Warnings	3-4
<3> Manual Operations.....	3-5
Option <1> Find Port: home.....	3-6
Option <2> Find Port:.....	3-6
Option <3> Next port:advance	3-6
Option <4> Next port:retreat	3-7
Option <5> Run pump: forward	3-7
Option <6> Run pump: reverse	3-8
Option <7> Run pump: programmable.....	3-8
Option <8> Fixative Valve	3-9
<4> Sleep.....	3-10
Section 3.3 Deployment Settings.....	3-11
<8> Contacting McLane.....	3-12
Chapter 4 Operations	4-1
Section 4.1 Priming the PPS Filter Holders and Plumbing	4-1
Section 4.2 Installing the Water Flush Filter	4-7
Section 4.3 Preparing the Fixative Valve for a Deployment.....	4-8
System Hydraulics w/Fixative Valve Option During Sample	4-9
System Hydraulics w/Fixative Valve Option During Post-Sample Fixative Flush ...	4-9
Determining the Total Amount of Fixative	4-10
Prime the Fixative Plumbing	4-11
Fill the Fixative Intake Bag	4-14
Fill the Fixative Collection Bag.....	4-16
Section 4.4 Preparing the Post Sample Acid Flush Reservoir	4-18
Section 4.5 Programming Deployment Parameters.....	4-20
Create a Deployment Schedule.....	4-20
Option <1> Enter each event time	4-23
Option <2> Enter start date & interval	4-23
Option <3> Enter start date & end date	4-24
Event Parameters Menu	4-25
Optional Post-Sample Antifouling Flush.....	4-27
Schedule Verification and Modifying Individual Event Parameters	4-28
Checking for Event Overlap	4-29
Proceeding with the Deployment.....	4-31
Chapter 5 Deployment and Recovery	5-1
Attaching to a Mooring.....	5-1
Deployment Preparation	5-1

Recovery Procedure.....	5-1
Emptying Water and Removing the Filters	5-1
Offloading Data	5-2
Chapter 6 Maintenance and Storage	6-1
Cleaning the PPS Fluid Paths and Filter Holders	6-1
Preparing To Clean:	6-1
Pump Cleaning Solution Each Port:	6-2
Rinse Each Port:.....	6-2
Cleaning the Optional Fixative Plumbing	6-2
Final Flush	6-3
Clean and Inspect Filter Holders	6-3
Pump Gears.....	6-4
Storage	6-5
Appendix A Adaptive Sampling Firmware	A-1
Adaptive Deployment.....	A-1
Command Prompt.....	A-2
Waking the Instrument from the Command Prompt	A-2
AWT Commands (Adaptive PPS Sampling).....	A-3
Command Help.....	A-3
Using Automated Adaptive Commands	A-17
SET Command.....	A-17
Deploy Commands	A-17
Sample Command.....	A-17
Ending the Deployment	A-19
Offload Command	A-21
Using Manual Commands	A-22
Configuring the Fixative Valve and Antifouling Options	A-23
Fixative Valve Option.....	A-23
Antifouling Flush Option.....	A-24
Adaptive Deployment with Solenoid Fixative and Antifouling	A-25
Using On-Demand Fixative and Antifouling Commands	A-27
Appendix B External Power and RS-422 Communication.....	B-1
Electronics	B-1
Power Requirements.....	B-3
Estimated Battery Endurance Calculation with RS-422 Communication	B-3
Example of Determining Battery Life for One Year Deployment	B-4
Changing the Communication Protocol.....	B-5
Appendix C Training Videos	C-1
Appendix D System Overview with Fixative Valve Diagram	D-1

PPS User Manual List of Figures

Figure 1-1: McLane Contact Information.....	1-3
Figure 1-2: PPS Full View.....	1-4
Figure 1-3: Controller Housing.....	1-5
Figure 1-4: O-Ring Installation.....	1-6
Figure 1-5: Controller Housing End Cap Bulkhead Connectors	1-7
Figure 1-6: Valve	1-9
Figure 1-7: Pump Head Gear and Replaceable Magnet	1-9
Figure 1-8: Filter Holders	1-10
Figure 1-9: Water Flush Filter Holder	1-10
Figure 1-10: Pumping Operation Schematic	1-11
Figure 1-11: Fixative Valve Water Intake, Fixative and System Exhausts	1-12
Figure 1-12: PPS with Fixative Valve and Fixative Box	1-13
Figure 1-13: PPS Toolkit	1-14
Figure 1-14: USB Communications	1-15
Figure 1-15: Communications Cable Connector Style.....	1-16
Figure 1-16: Drop-in Battery Holder for ‘D’ Cell Batteries.....	1-17
Figure 1-17: A21-1000 Battery Pack.....	1-17
Figure 1-18: Backup Battery 9V and AAA Styles (Older Model PPS systems).....	1-18
Figure 2.1-1: MotoCrossML Setup Wizard Screens 1 and 2.....	2-2
Figure 2.1-2: MotoCrossML Setup Wizard Screens 3 and 4.....	2-3
Figure 2.1-3: MotoCrossML Setup Wizard Screen 5	2-3
Figure 2.2-1: Communications Cable.....	2-4
Figure 2.2-2: Device Manager COM Port list	2-5
Figure 2.2-3: Confirm Motocross Configuration.....	2-6
Figure 2.2-4: Do Not Include Buffer Text.....	2-7
Figure 2.3-1: Releasing Pressure Relief Valve (Flat Style).....	2-8
Figure 2.3-2: Releasing Pressure Relief Valve (Style with Release Tool).....	2-9
Figure 2.3-3: Separating the Housing and End Cap	2-10
Figure 2.3-4: Connecting the Battery	2-10
Figure 2.3-5: Connecting the COM Cable.....	2-11
Figure 2.3-6: Controller End Cap, No PRV.....	2-12
Figure 2.4-1: Main Menu.....	2-13
Figure 3-1: PPS Main Menu	3-1
Figure 3-2: Configuration Menu.....	3-2
Figure 3-3: Set Time	3-3
Figure 3-4: Diagnostics.....	3-4
Figure 3-5: Manual Operation Menu	3-5
Figure 3-6: Find Port: Home.....	3-6

Figure 3-7: Next Port: Advance.....	3-6
Figure 3-8: Next Port: Retreat	3-7
Figure 3-9: Run Pump Forward.....	3-7
Figure 3-10: Run Pump Reverse.....	3-8
Figure 3-11: Fixative Valve.....	3-9
Figure 3-12: Suspend Mode.....	3-10
Figure 3-13: McLane Contact Information.....	3-12
Figure 4.1-1: Priming Setup.....	4-2
Figure 4.1-2: Priming Setup.....	4-3
Figure 4.1-3: Injecting Water with Syringe	4-3
Figure 4.1-4: Reattaching Top and Bottom of Filter	4-4
Figure 4.1-5: Connecting to Filter Base Plate.....	4-5
Figure 4.1-6: Pump in Reverse	4-5
Figure 4.2-1: Disassembling Water Flush Filter.....	4-7
Figure 4.3-1: PPS System Schematic with Fixative Valve Option	4-9
Figure 4.3-2: System Operation.....	4-11
Figure 4.3-3: Opening the Fixative Box	4-12
Figure 4.3-4: Aligned to Home Port, Fixative ON	4-13
Figure 4.3-5: Inject Syringe Contents into Fixative Bag.....	4-15
Figure 4.3-6: Place Hose-F into Fixative Container.....	4-15
Figure 4.3-7: Pinch Fixative Bag Hose, Attach to Intake-2 Hose	4-16
Figure 4.3-8: Roll Fixative Bag to Release Air	4-17
Figure 4.5-1: System Reboot Required.....	4-21
Figure 4.5-2: Schedule Menu.....	4-22
Figure 4.5-3: Schedule – Option 2.....	4-23
Figure 4.5-4: Schedule – Option 3.....	4-24
Figure 4.5-5: Schedule Verification.....	4-24
Figure 4.5-6: Event Parameters Menu	4-25
Figure 4.5-7: Configuration Menu.....	4-27
Figure 4.5-8: Event 1 Parameters	4-28
Figure 4.5-9: Schedule Verification.....	4-29
Figure 4.5-10: Overlap Reminder.....	4-30
Figure 4.5-11: Deploy System.....	4-31
Figure 4.5-12: Proceed with Deployment.....	4-31
Figure 4.5-13: Deploy System	4-32
Figure 5-1: Offload/Display Data File Menu	5-3
Figure 5-2: Display All Data	5-4
Figure 5-3: Offload/Display Data File – Display All (2 of 3)	5-5
Figure 5-4: Offload/Display Data File – Display All (3 of 3)	5-6
Figure 6-1: Pump Housing, Gears, and Pump Head Magnet.....	6-4
Figure A-1: Adaptive Deployment Mode.....	A-2

Figure A-2: Command Help	A-3
Figure A-3: SET Command.....	A-17
Figure A-4: STARTDEPLOY Command.....	A-17
Figure A-5: SAMPLE and SET Commands.....	A-18
Figure A-6: Deployment Ends After Last Sample.....	A-19
Figure A-7: End Deployment Using STOPDEPLOY	A-20
Figure A-8: OFFLOAD Command.....	A-21
Figure A-9: Manually Commanding Pumping	A-22
Figure A-10: Enabling the Fixative Valve Option.....	A-23
Figure A-11: Defining the Available Fixative.....	A-23
Figure A-12: Setting the Fixative Parameters.....	A-23
Figure A-13: Enabling the Antifouling Option.....	A-24
Figure A-14: Defining the Available Antifouling Solution.....	A-24
Figure A-15: Setting the Antifouling Parameters	A-24
Figure A-16: Adaptive Deployment, Solenoid Fixative and Antifouling (1 of 2)	A-25
Figure A-17: Adaptive Deployment, Solenoid Fixative and Antifouling (2 of 2)	A-26
Figure A-18: Applying Fixative	A-27
Figure A-19: Applying Antifouling.....	A-28
Figure B-1: Endcap with External Power and RS-422 Option.....	B-1
Figure B-2: Electronics with External Power/RS-422 Circuit Board.....	B-1
Figure B-3: RS-422 Cable Drawing	B-2
Figure B-4: RS-422 and RS-232 Labels on Circuit Board	B-5
Figure B-5: Gently Grasp Jumper with Extractor.....	B-5
Figure B-6: Lift Jumper Out of Socket.....	B-5
Figure B-7: Place the Jumper in Socket.....	B-6
Figure B-8: Press to Secure Jumper.....	B-6

Chapter 1

Introduction and System Description

McLane Phytoplankton Sampler (PPS)

The McLane Phytoplankton Sampler (PPS) is an autonomous time-series particulate sampler that filters up to 24 individual water samples through 47mm filters. Samples are collected by user-defined time-series events. The multi-port valve keeps samples separate and pumps water directly onto the filter before passing through a 125 or 250 ml/min pump. The maximum volume is 10L per filter, 250L total volume. The data recorded during a deployment includes flow rates, volume pumped, pump feedback, power, temperature and event times. This data is offloaded from the PPS after deployment and used for sample analysis.

PPS Options

Optional PPS features include:

- **Fixative Valve** – provides a secondary system intake and exhaust path that can be used to flood a filter holder with fixative after a sample is collected.
- **Antifouling Solution Reservoir** – A 500 ml reservoir plumbed to port 24 is used to supply a post-sample flush with antifouling fluid of the user's choice to prevent biofouling between sample events.

Using this Manual

This User Manual provides:

- Descriptions and specifications of mechanical and electrical parts of the system.
- Operating instructions.
- Suggested maintenance procedures to extend sampler performance.

This user manual is designed to provide support from the first steps of powering on and communicating with the instrument, to the final steps of recovering data from a recently deployed system, and storing the instrument. Sampler operators and technicians should read this manual and keep a copy as a reference.

User Key

This User Manual contains the following symbols that call attention to information:



Note

This symbol indicates information and tips that are helpful for operating the instrument.



Important

This symbol indicates information that could affect key product operations.



Caution

This symbol indicates information that must be followed to prevent instrument damage or user injury.

Customer Resources

McLane Research Laboratories is on the Web at <http://www.mclanelabs.com> or via email at mclane@mclanelabs.com. The [PPS pages](#) on the McLane website contain links to documentation including Technical Bulletins, and papers that describe the development and use of the PPS.

Technical Support

When contacting McLane for technical support, please provide the following:

- Firmware version and instrument serial number. Serial number is printed on a label attached to the controller housing and on the Contact screen, (Figure 1-1). Serial number also displays on the Main Menu screen.
- A description of the problem.
- A text file of data created using the Motocross file capture utility.

```
Selection [] ? 8

      McLane Research Laboratories, Inc.
      Falmouth Technology Park
      121 Bernard East Saint Jean Drive
      East Falmouth, MA 02536-4444 USA

      Email: McLane@McLaneLabs.com
      Web: http://www.McLaneLabs.com
      Tel: 508-495-4000 Fax: 508-495-3333

      Configuration: WTS-125M-SV
      Source file: CF2-2.05.c

      Electronics S/N: ML12345-03

      Compiled: May 9 2016 14:09

Press any key to continue.
```

Figure 1-1: McLane Contact Information

Instrument Training

McLane also offers a 1 day PPS training course at our facility free of charge with the purchase of a new instrument. Participants conduct trial deployments and work directly with members of the McLane engineering staff. Conducting trial deployments is a beneficial way to learn system operations before actual field investigations. For more [product training](#) information refer to www.mclanelabs.com.

Mechanical Components

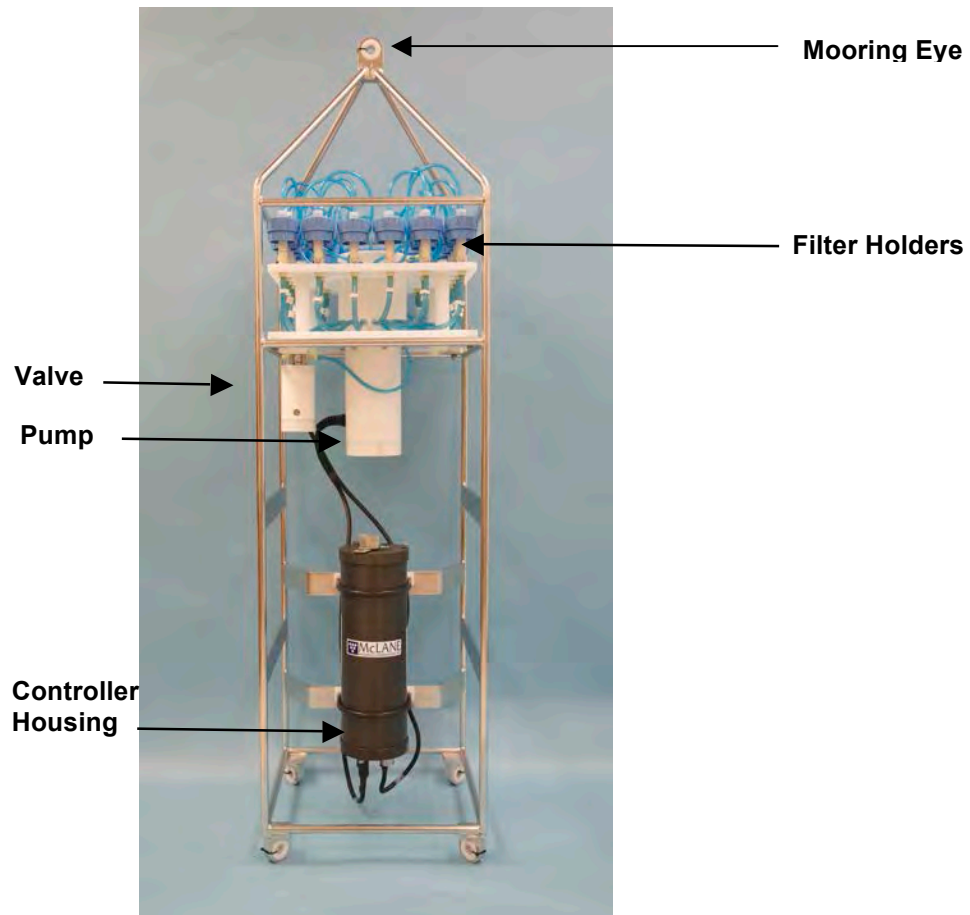


Figure 1-2: PPS Full View

Frame

Components are protected in an electro-polished stainless steel welded frame (titanium frame is optional). The frame can be an inline part of a high-tension (up to 2,200 kg) ocean mooring and has a built-in top bridle and four mooring eyes at the bottom for a chain or cable bridle. Each mooring eye accommodates a 5/8" shackle, and has an insulator for corrosion protection. The frame has extra mounting space near the controller housing for other instruments.

Controller Housing

The PPS controller housing is a heat-treated aluminum alloy cylinder, rated to a depth of 5,500m. The housing holds the battery and electronics. Chapter 2 of this User Manual contains detailed instructions for opening the controller housing. Follow these instructions and the recommended safety precautions when opening the controller housing.



Figure 1-3: Controller Housing

Top and Bottom End Caps

The battery and electronics are fastened to the inside of the controller housing top end cap.

O-Rings

Each end cap includes two 70 durometer Buna-N round section o-rings (2-246 and 2-242) and one 90 durometer backup ring (8-242). O-rings and surfaces should be regularly cleaned with isopropyl alcohol. O-rings should be lubricated with provided Parker O-Lube and replaced when necessary. The toolkit has spare O-rings. More o-rings can be purchased from McLane.



O-ring maintenance and correct placement is critical to keep the controller housing sealed from water intrusion. Incorrect o-ring placement results in cracks or splits that could affect the o-ring seal and cause water damage to the controller. Water damage from incorrectly placed or maintained o-rings could void the sampler warranty.

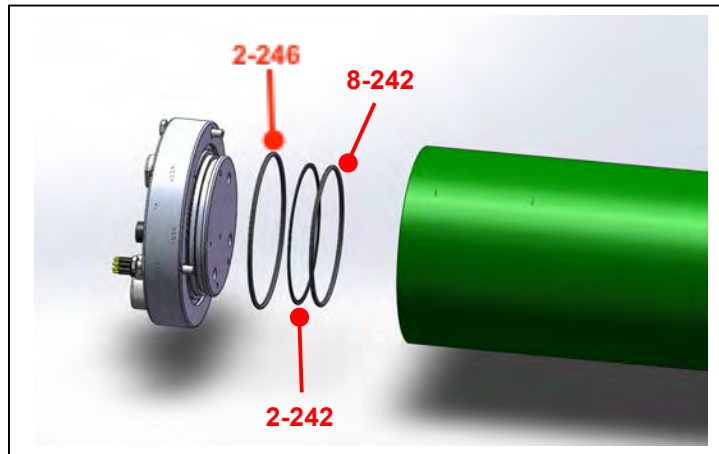


Figure 1-4: Sampler O-Ring Installation – Correct Placement is Critical

End Cap Bulkhead Connectors

The end cap has bulkhead connectors for the Communications connector, Pump, and Valve (Figure 1-5). The bulkhead assignment (P, V, C) is etched into the end cap. A zinc anode is attached to each end on the controller housing end cap to prevent corrosion. Spare zincs are included in the toolkit.

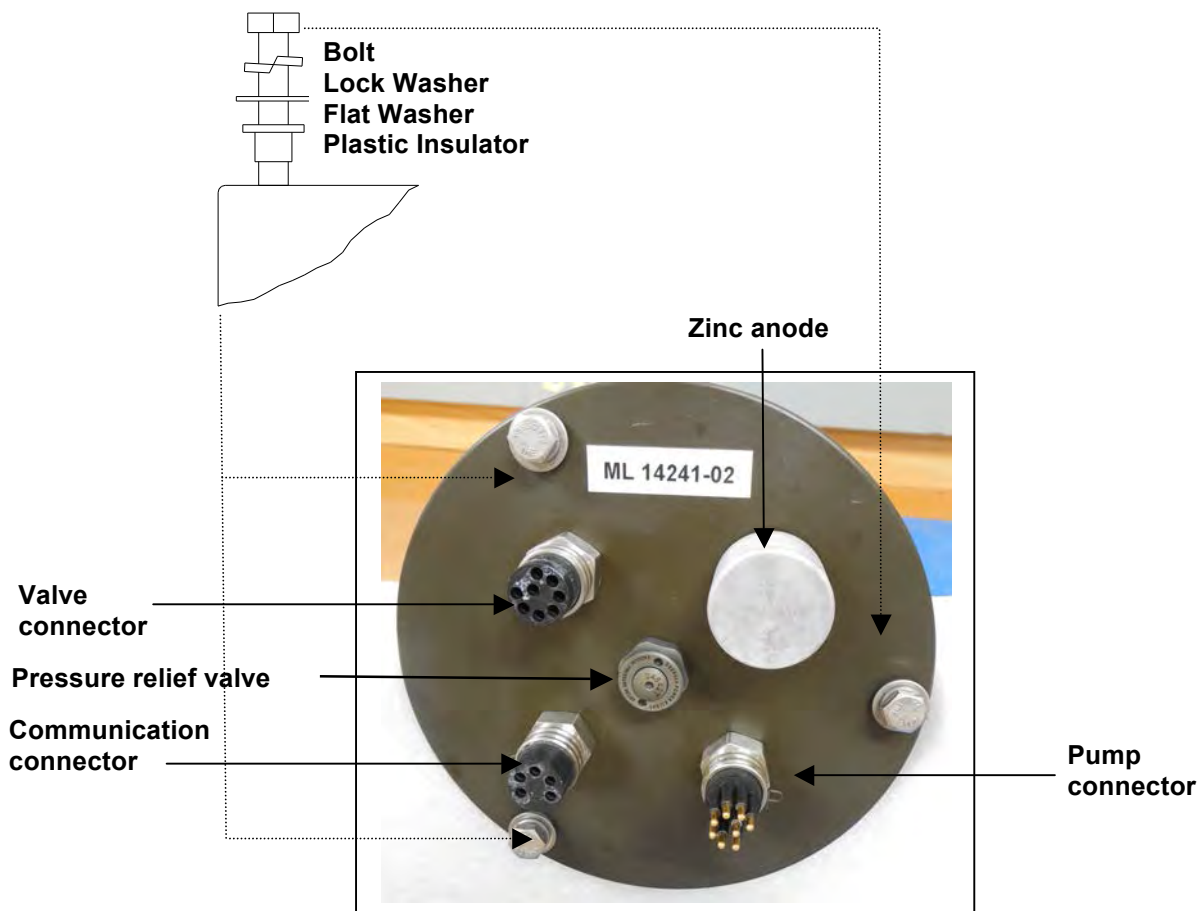


Figure 1-5: Controller Housing End Cap Bulkhead Connectors

Pressure Relief Valve

Attention and care should be taken in maintaining, operating, and opening the pressure housing. All PPS systems shipped after summer 2015 have a pressure relief valve (PRV) on the controller housing.



Though unlikely, an unsafe internal controller housing pressure is possible, resulting from the chemical reaction between alkaline electrolyte and anodized aluminum due to battery failure with or without the intrusion of seawater. There can be enough pressure to cause the endcap bolts to fail, especially when one or more are loosened or removed.

Instructions in Chapter 2 under ‘Powering on the Sampler’ explain how to use the end cap pressure relief valve.

Pressure Relief Valve Upgrade



McLane offers a Pressure Relief valve upgrade retrofit for all controller housings (includes installation, not including shipping and insurance costs). The end-cap and anodizing must be in suitable condition for PRV retrofits.

Contact mclane@mclanelabs.com for more information about the PRV retrofit.

25-Port Valve

The PPS dual-head, 25-port rotary valve directs water through 24 individual filters at programmed times during a deployment. The top head has a single intake port and 25 exhaust ports, and the bottom head has 25 intake ports and a single exhaust port. An optical sensor and slotted disk determine rotor position. The motor, gear head, and optical sensor are in a pressure compensated PVC plastic housing filled with Dow Corning 200 fluid (200cSt.). The valve top shows the port numbers, and the rotor position indicator points to the currently aligned port. The filter holders are connected between two valve heads. One port is open on each head at one time.

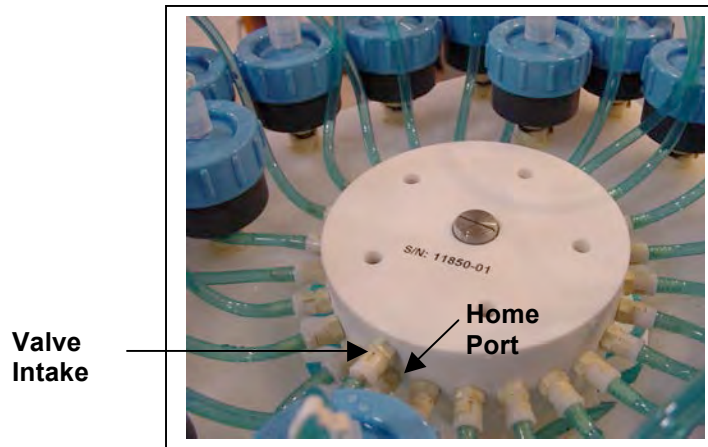


Figure 1-6: Valve

Pump

The PPS can have a 125, or 250 ml/min positive displacement graphite gear pump installed. The pump head is type 316 stainless steel and has user replaceable carbon gears and magnet. A brushless DC 3-phase motor is magnetically coupled to the pump head, and driven by an algorithm designed to limit differential pressure at filters while maximizing battery life.

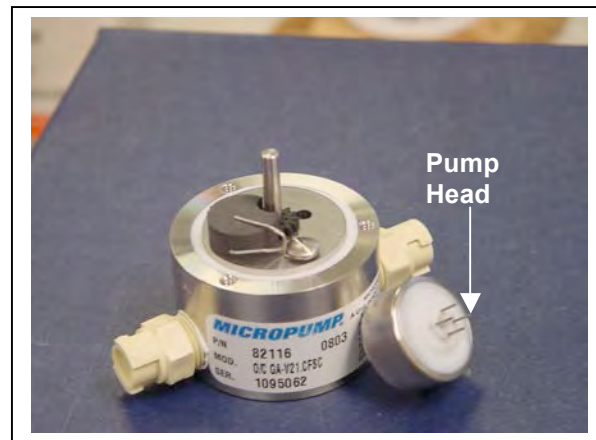


Figure 1-7: Pump Head Gear and Replaceable Magnet

Filter Holders

The PPS collects samples on twenty-four 47 mm filter holders. Each filter holder is connected in series between the intake head (top half of the valve) and the exhaust head (lower half of the valve). The pump draws water out from the bottom of the filter creating a pressure gradient that pulls ambient seawater into the filter holder and through the filter. After each sample is taken, the valve returns to Home Port (Port 0), and seals the sample in the filter holder.



Figure 1-8: Filter Holders

Home Port Water Flush

Home Port (Port 0) can be used to flush standing water from the valve intake tube and valve heads before each sample is collected. This water flush prevents sample contamination and reduces accumulated bio-fouling. A filter assembly with a 25mm filter holder holds a filter with a pore size between 3 and 20 microns to prevent large suspended particles from entering the pump while the valve is being flushed. Replace this filter before every deployment.

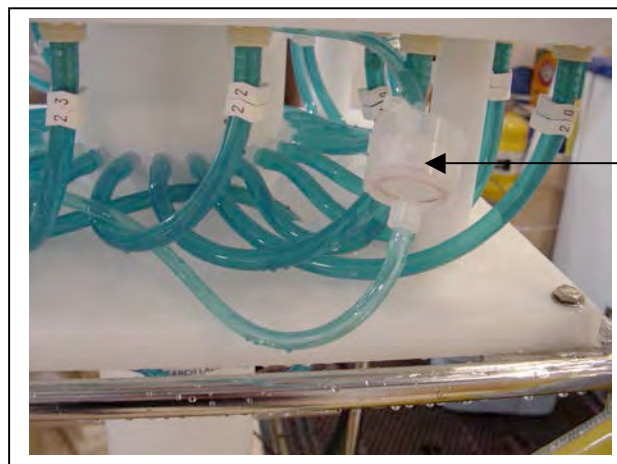


Figure 1-9: Water Flush Filter Holder

As illustrated by Figure 1-10, the samples and the pump are isolated from each other to prevent sample contamination.

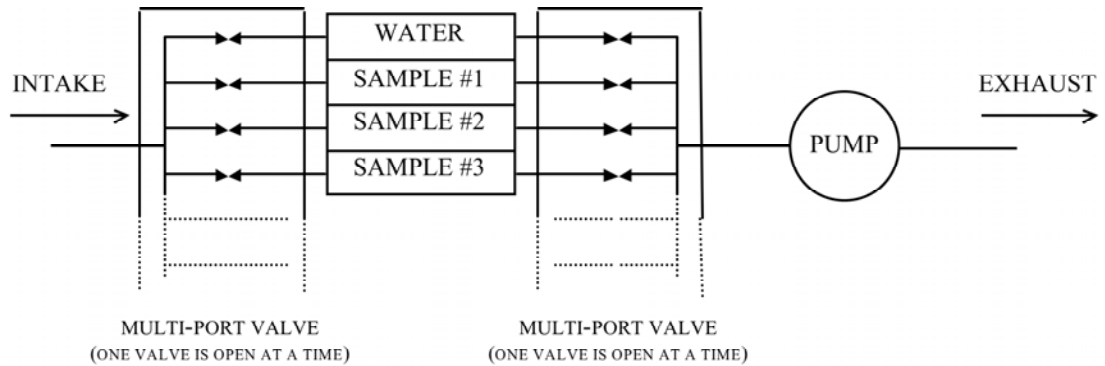


Figure 1-10: Pumping Operation Schematic

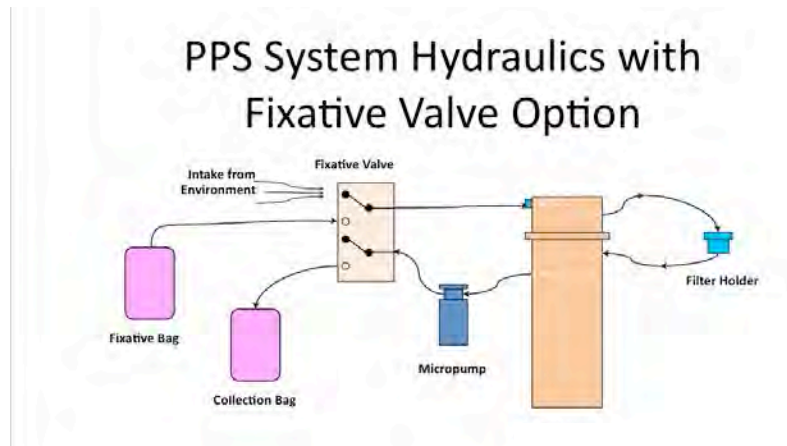
Optional Antifouling Solution Reservoir

A 500 ml antifouling solution reservoir can be plumbed to port 24 of the 25 port rotary valve and used to perform a post-sample antifouling flush. When an antifouling solution reservoir is installed on a PPS, a deployment is reduced to 23 events. This is a post-sample flush only.

Optional Fixative Valve

The optional fixative valve offers a secondary intake and exhaust fluid path that floods filter holders with fixative immediately after a sample is taken. The dual Fixative Valve is made of two manifold mount three-way isolation valves:

- One valve isolates water and fixative intake paths.
- The other valve isolates water and fixative exhaust paths.



More detailed Fixative Valve descriptions are included in Chapter 4, 'Operations' in the section "Preparing the Fixative Valve for a Deployment".



Figure 1-11: Fixative Valve Water Intake, Fixative and System Exhausts

The fixative and sample water intake and exhaust paths are labeled on the Fixative Valve and share a common system intake and exhaust path to and from the 25 port valve.

PPS systems with the Fixative Valve option have a 2000 ml fixative reservoir bag and a 2000 ml exhaust collection bag installed inside of a fixative box. Different fixative bag sizes can be configured in the firmware. The exhaust bag must be the same size as the intake bag, or larger.

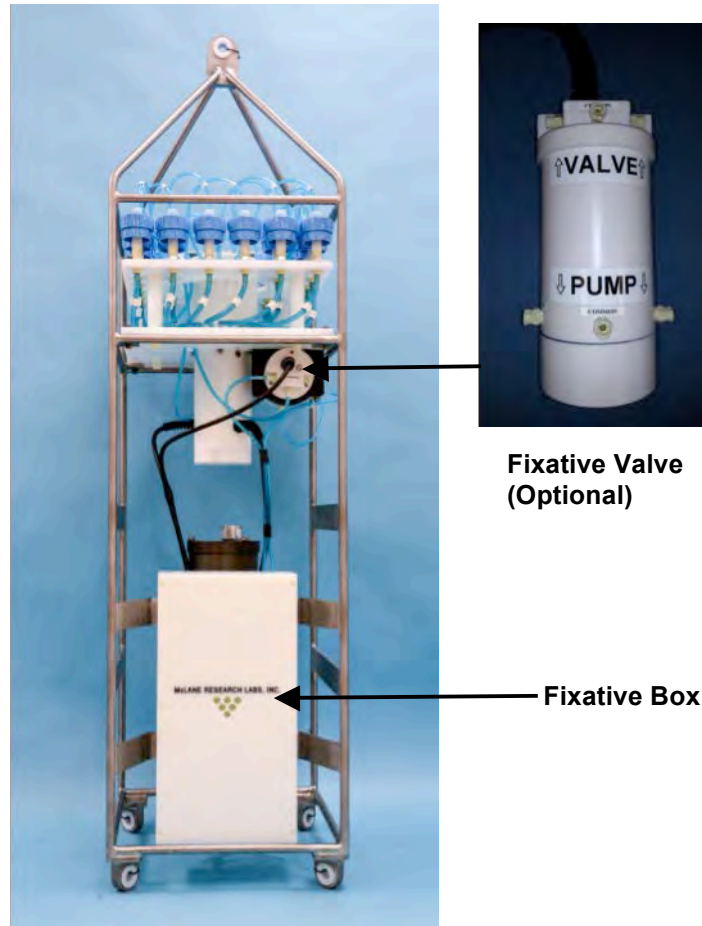


Figure 1-12: PPS with Optional Fixative Valve Box



The fixative valve option can be added to a CF2-based PPS. Contact mclane@mclanelabs.com for information about this retrofit.

PPS Toolkit

Each PPS is shipped with a toolkit that contains the necessary tools, materials and devices to use the PPS. The toolkit and contents are referred to throughout this User Manual, and should remain with the instrument at all times.



Figure 1-13: PPS Toolkit



The PPS toolkit in Figure 1-13 is shown only as an example. Do not use the photo to compare with your actual toolkit contents.

Serial Number

The white plastic base plate contains a serial number label. The controller housing end cap, pump assembly, valve assembly, and system menu also display the serial number.

Electronics Components

The PPS firmware runs on the Persistor CF2 microcontroller. Older PPS systems use the TattleTale 8 (TT8) microcontroller. The TT8 was discontinued, and McLane instruments now use the CF2. While most of this User Manual can apply to both current and older McLane instruments, significant firmware, hardware, and procedural changes have been made to the PPS with the CF2 microcontroller and some sections will not apply to older systems.



Contact mclane@mclanelabs.com for information about upgrading from the TT8 to the CF2 microcontroller. McLane recommends this upgrade. We offer only limited support on devices that use the TT8 microcontroller.

McLane electronics are designed to use minimal power while achieving the longest possible deployment durations. Instrument electronics spend most of their time in low power sleep mode. In this suspended state, the system consumes very little power (micro-amps) while keeping track of time to start and complete scheduled events.

The PPS electronics communicate using RS-232 serial communications and a terminal emulator. A communications cable included in the toolkit connects the PPS controller with a computer. Computers that do not have a built-in RS-232 serial port use a USB to RS-232 converter that is also included in the toolkit.

Computer COM Setup

Connection Style 1: Computers with Built-in Serial Port



Connection Style 2: Computers with USB, no Serial Port

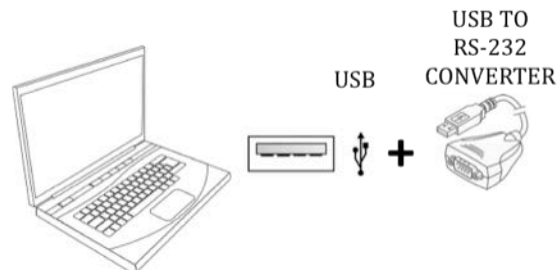


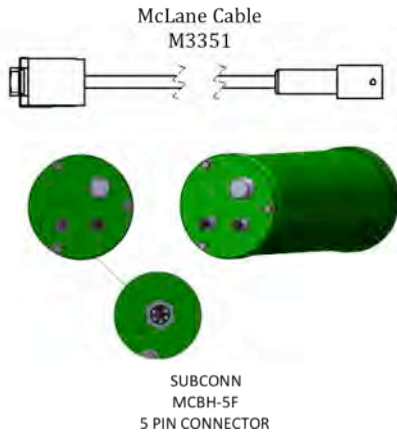
Figure 1-14: USB Communications

Communications Bulkhead Connector Styles

The communications cable bulkhead connector (connection to the sampler) is a 5-pin MCBH style. Some older instruments may have a 3-pin XSG style bulkhead connector.

COM Cable Setup

Cable Style 1: Subconn 5-pin connector



Cable Style 2: Impulse 3-pin connector

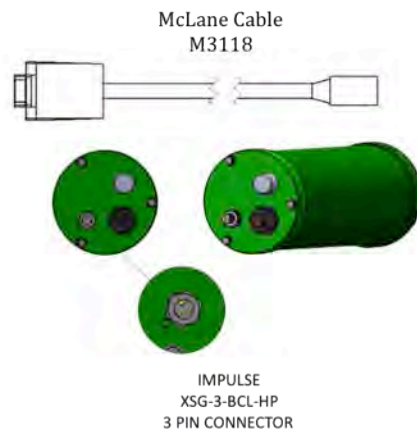


Figure 1-15: Communications Cable Connector Style

Main Battery

Depending on the PPS manufacture date, the battery style could have a battery holder for user replaceable 'D' cell alkaline batteries as shown in Figure 1-16 or a battery pack as shown in Figure 1-17.

If using the battery holder with user replaceable drop-in 'D' cell batteries, be sure to install the batteries with the correct orientation in the holder terminals. An instructional video showing drop in battery replacement is shown on the PPS video pages at www.mclanelabs.com.



Figure 1-16: Drop-in Battery Holder for 'D' Cell Batteries



Figure 1-17: A21-1000 Battery Pack

Both battery styles deliver approximately the same power, a nominal voltage of 31.5 VDC. The instrument can perform pump and valve operations while the system voltage is above 18 VDC. When the system voltage drops below 18 VDC, the instrument will enter low power sleep mode, and when awake, only limited functions will be available at the Main Menu.



Always take standard electrostatic discharge (ESD) precautions when handling the electronics.

Backup Battery

After the spring of 2015, new McLane CF2-based instruments no longer require a backup battery. Prior to this change, the backup batteries served as a voltage source for the electronics while in low power sleep mode. Electronics hardware changes made the backup battery unnecessary, and it was eliminated.

If using an older PPS system, check for backup batteries. If your system has backup batteries, be sure to replace them before each deployment. On the TT8 microcontroller based devices, the backup battery was a 9 volt battery mounted beside the electronics. On the Persistor CF2 microcontroller based devices, the backup battery was two AAA batteries mounted near the electronics.

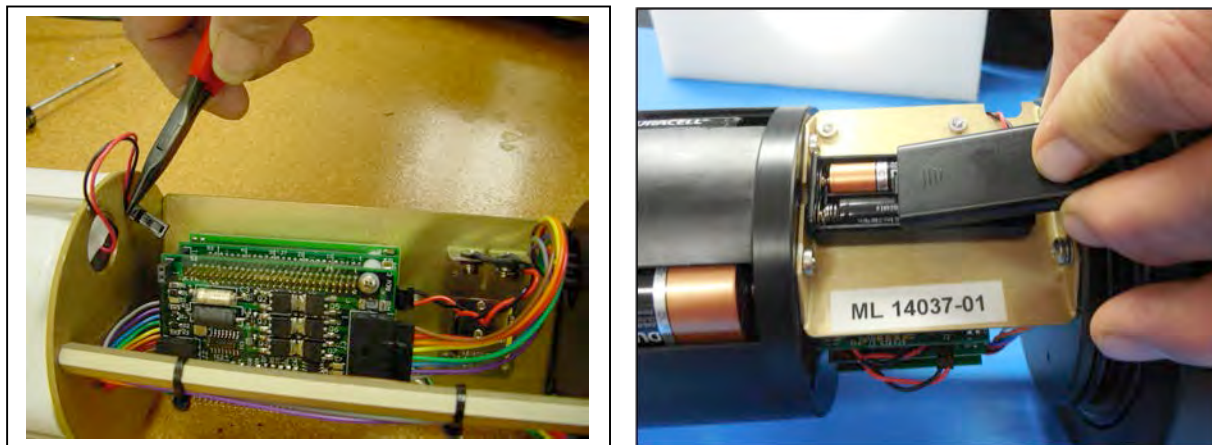


Figure 1-18: Backup Battery 9V and AAA Styles (Older Model PPS systems)

Chapter 2

Getting Started with your McLane Sampler

This chapter provides the information that will help you become familiar with your sampler, connect to a computer, and power on the system. This includes the following:

- Setting up a computer for the sampler.
- Connecting the sampler to a computer.
- Powering on the sampler.
- Waking the sampler from low power sleep.

Section 2.1

Setting up a Computer for the Sampler

You will need a computer and a terminal emulation program to communicate with your sampler. Ideally, the computer will have a built-in RS-232 serial port. A USB to RS-232 adapter is included in the sampler toolkit for computers without the built-in serial port. While different terminal emulators can be used to communicate with McLane instruments, only MotoCross, a terminal emulator for Windows, can be used to upgrade McLane firmware.

A MotoCross installer is located in the firmware directory of the USB drive shipped with your system. The MotoCross installer can also be downloaded from the sampler's Software page on the McLane website: www.mclanelabs.com.



Motocross is available from other sources, but the version provided by McLane is programmed with default settings to work with McLane instruments.

Installing MotoCross

1. Find and double-click the file “Setup_Motocross.exe” on your USB drive (or directory if you downloaded “Setup_Motocross.exe” from the Mclane website mclanelabs.com).
2. The installer program will guide you through a series of screens.
3. When prompted to choose a destination for the extracted files, navigate to C:\Program Files (x86) and create a new folder named MotoCross.
4. When MotoCross is extracted, right-click the executable ‘MotoCrossML’ and create a shortcut on the desktop for easy access.

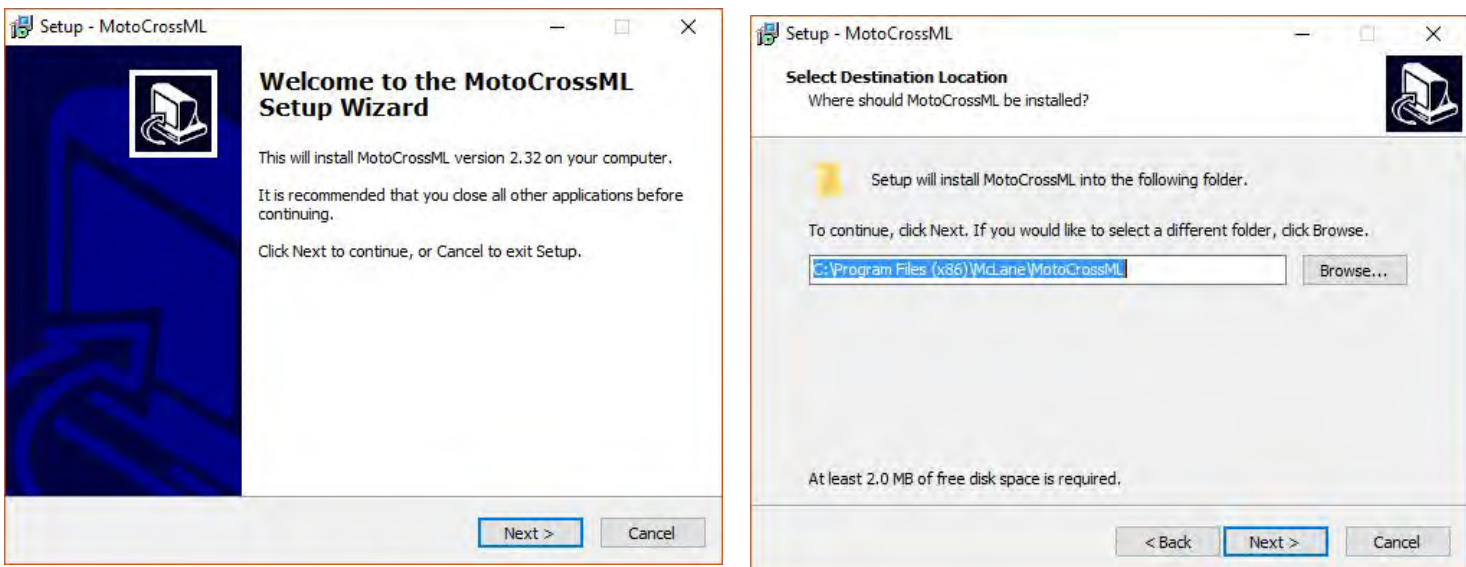


Figure 2.1-1: MotoCrossML Setup Wizard Screens 1 and 2

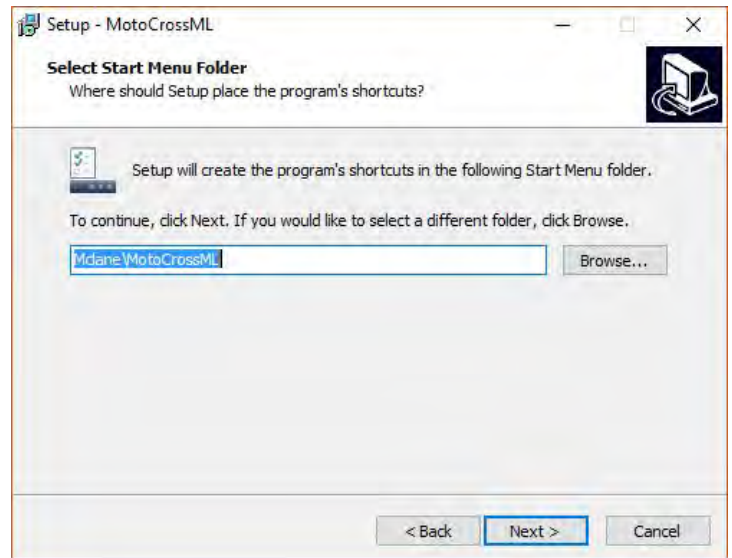
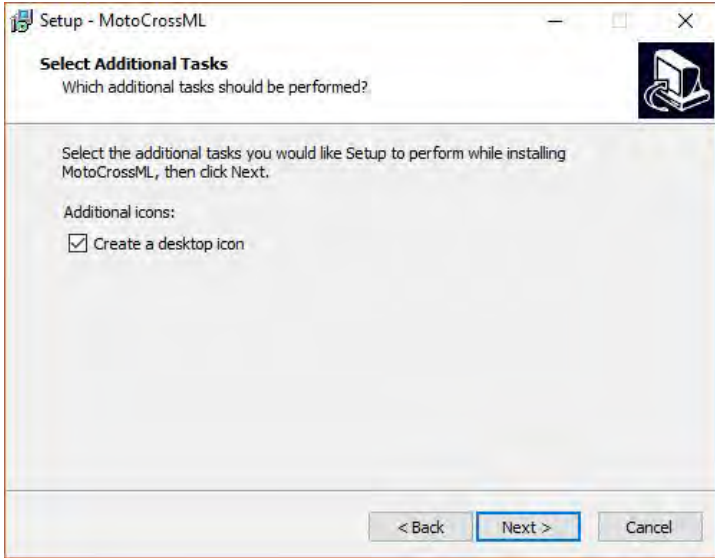


Figure 2.1-2: MotoCrossML Setup Wizard Screens 3 and 4

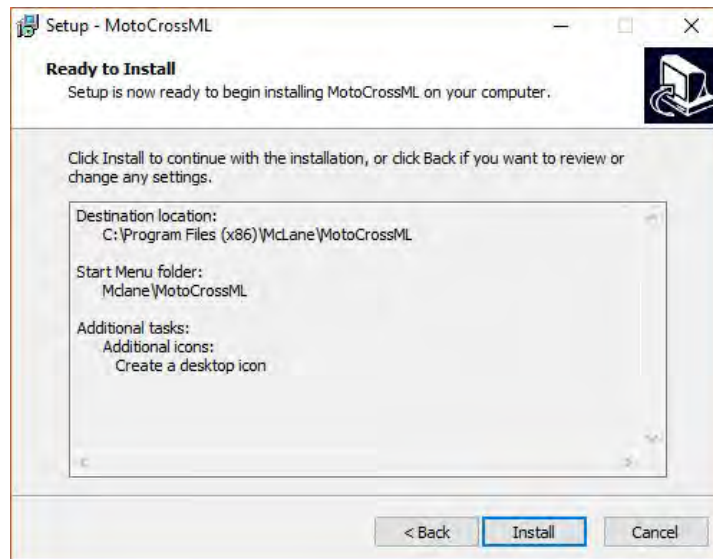


Figure 2.1-3: MotoCrossML Setup Wizard Screen 5

Section 2.2

Connecting the Sampler to a Computer

Communicating with the instrument requires connecting the communications cable to the computer that has the terminal emulation and configuring the terminal emulation software, MotoCross.

Connecting a Computer

Connect to the sampler by plugging the communications cable from the communications bulkhead on the end cap to a computer RS-232 serial port.

For a computer without a built-in RS-232 serial port, locate the USB to RS-232 adapter included in the sampler toolkit. Using the USB to RS-232 adapter, plug in the USB port, wait for the drivers to install, and then check the computer's Device Manager for the new USB Serial Port. Windows downloads and installs the necessary drivers automatically when the USB to RS-232 adapter is plugged into a USB port.



Figure 2.2-1: Communications Cable

Configuring MotoCross Communications Settings

1. From the Windows start menu – search the Control Panel for the device manager.
2. Open the device manager.
3. Scroll down to “Ports (COM & LPT)”.
4. If you are using a USB to RS232 adapter and you see a device named USB Serial Port, you can verify this is your adapter by unplugging the adapter and waiting for it to disappear from the device manager COM Port list.
5. If your device is not listed, contact McLane Research Labs (mclane@mclanelabs.com) for assistance.

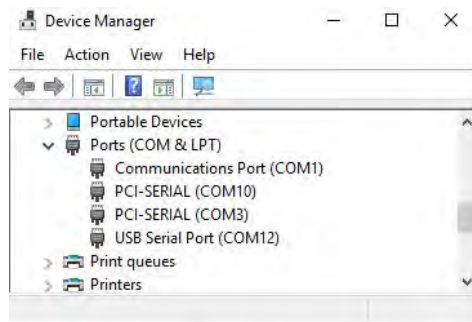


Figure 2.2-2: Device Manager COM Port list

Once you have identified your communication port, you will have the information needed to configure Motocross communication settings.

1. Select “Communication Settings” from the MotoCross File menu.
2. Enter the following values:

Port :	Communications Port # identified in the previous steps.
Baud Rate:	9600
Mx Download Baud:	115200
Parity:	None
Data Bits:	8
Stop Bits:	1
Flow Control:	None

Control Character Transmission

All McLane instruments use the control character [CTRL]-[C] to wake from Suspend mode, navigate the menu system, and cancel operations. The McLane version of MotoCross is pre-configured to transmit control characters.

MotoCross offers a configurable option to either transmit control characters, or to perform standard Windows editing functions with CTRL-key combinations. It is possible to switch to perform standard Windows editing functions with CTRL-key combinations by accidentally pressing [CTRL]-[SHIFT]. If this switch is made, [CTRL]-[C] will not transmit the control characters needed to wake McLane instruments from Suspend mode.

Always ensure MotoCross is configured to transmit control characters by selecting “Copy – Paste Options” from the Edit menu, and confirming the configuration as displayed in Figure 2.2-5.

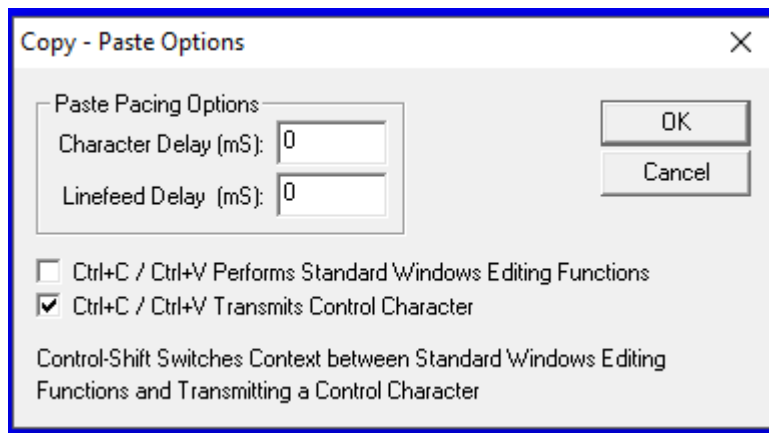


Figure 2.2-3: Confirm Motocross Configuration

Creating a Capture File

MotoCross and other terminal emulators have a “Capture” or “Log” feature. It is **very important** that all communications to your McLane instruments are captured to file. Capture files are used for troubleshooting with McLane technical support, and provide a record of your deployment settings, bench tests, and so on.

Follow these steps to log communications in MotoCross to a file:

1. Select Capture Test > Start from the MotoCross Transfer Menu.
2. Select a location to save the file.

3. To clear any existing file contents, select 'Overwrite'. To add to existing file contents select 'Append'.
4. When asked to include buffer text, select no.

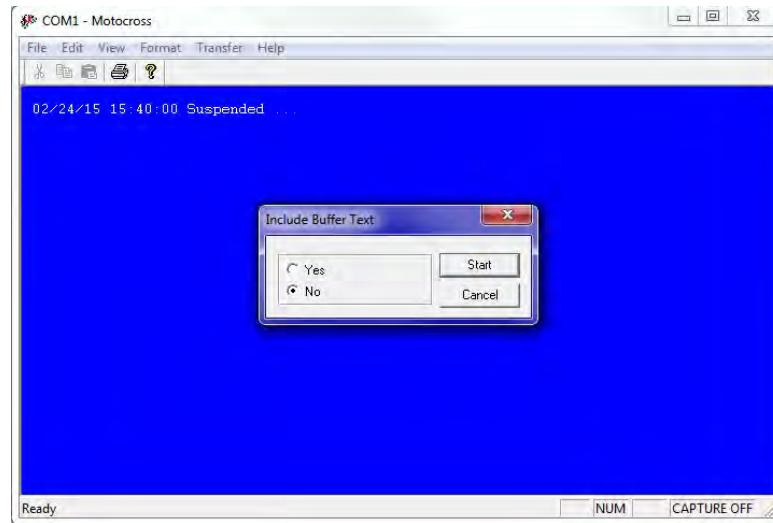


Figure 2.2-4: Do not include Buffer Text

If MotoCross has been running for a long time, a large buffer can crash the program if it is included in the buffer. If you must, save data that has already printed to the screen.

1. Use Windows Notepad to create a text file.
2. Copy and paste the data you wish to include.
3. Save and close the file.
4. Start capturing communications to the file you created, Append data to the file instead of Overwriting data.

Troubleshooting the USB Adaptor

The USB adaptor has LED indicator lights for transmitting and receiving data. Typing any key in Motocross terminal emulation should be indicated by the LED. If no LED light flashes on keystrokes, you may have selected the incorrect COM Port. Refer to the section that follows for instructions on MotoCross setup.

Section 2.3 Powering on the Sampler

Connecting the battery is the only way to power on the sampler electronics. This step requires opening the controller housing. Be sure to perform this procedure in a dry area and familiarize yourself with steps for using the Pressure Relief Valve.

Opening the Controller Housing Equipped with the PRV

Attention and care should be taken in maintaining, operating, and opening the pressure housing. All samplers shipped after summer 2015 have a pressure relief valve (PRV) on the controller housing. This valve releases automatically at a pressure differential greater than 10psi. The PRV style may have a center hole and release tool, or the style may have a flat relief valve that must be manually pulled out.



Observe safety precautions including removing personnel and objects from the path of the end-cap when removing the controller housing.



Figure 2.3-1: Releasing Pressure Relief Valve (Flat Style)

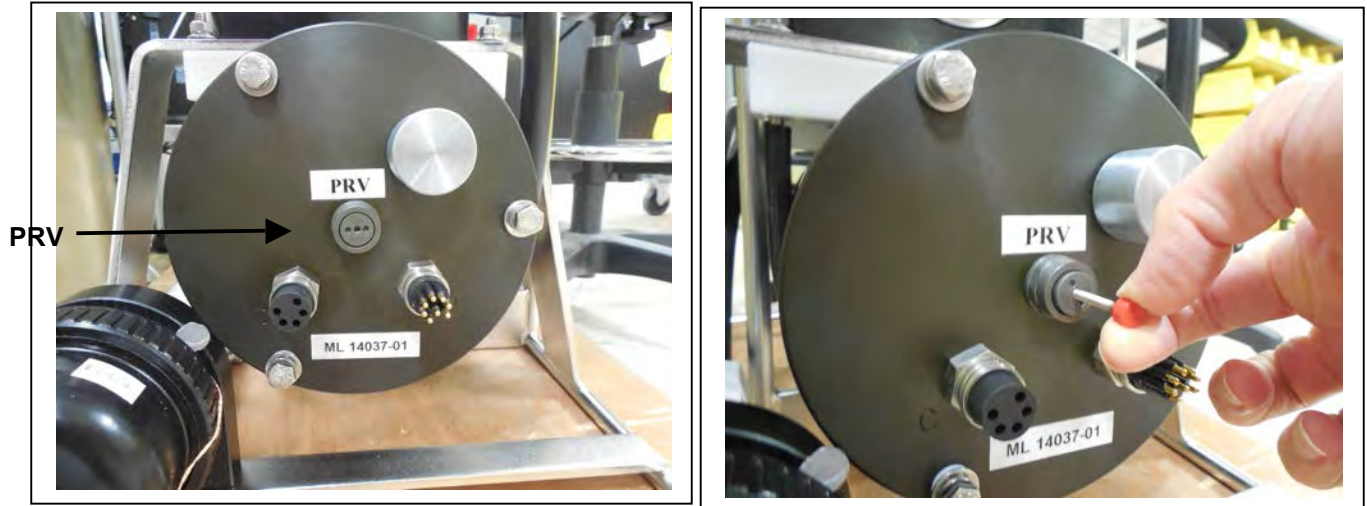


Figure 2.3-2: Releasing Pressure Relief Valve (Style with Release Tool)

As a safety measure, the valve should be manually released prior to opening the controller housing by following the steps below. Steps for opening a controller housing that does not have a PRV installed are included at the end of this section. Follow those steps if you have a controller housing manufactured before 2015 that does not include a PRV.

1. Disconnect the cables from the end cap (if connected).
2. Slowly pull on the pressure relief valve to release any vacuum or built up pressure in the housing.
3. Loosen each end cap bolt a few turns at a time in a star pattern.



If the end cap separates from the housing as you loosen the bolts, this could indicate a possible pressure buildup inside of the housing. Stop loosening bolts and continue to gently pull on the pressure relief valve.

4. Remove and place the end cap hardware somewhere safe. Typically plastic inserts have a snug fit and will remain in the end cap.
5. Grasp the end cap lip with fingertips and pull the end cap out of the housing (Figure 2.3-2).

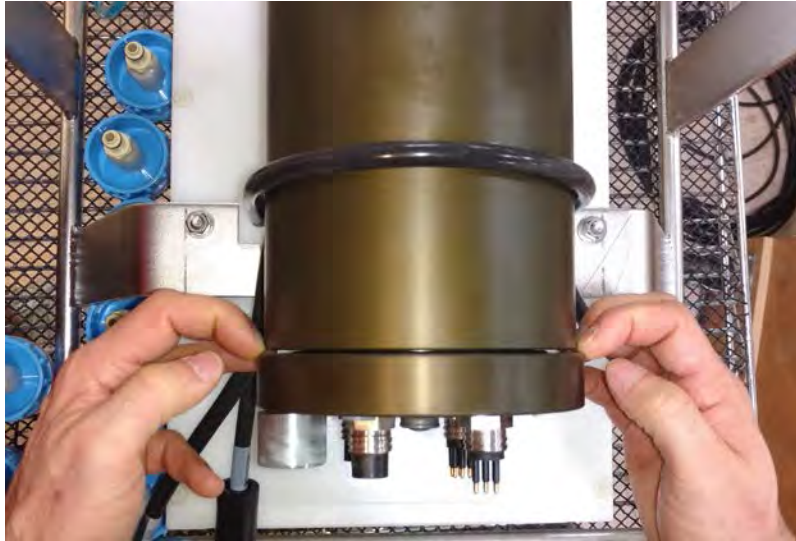


Figure 2.3-3: Separating the Housing and End Cap

The end cap to housing seal is tight and sometimes difficult to open. Do not use a tool to pull open the housing. The end cap o-rings can be damaged if objects are used to separate the end cap from the housing.

Connecting the Battery and COM Cable

Once the controller housing is open, the battery can be connected.

1. Locate the battery conductors. The black two pin MTE connector will only fit into one connector on the electronics stack. Find the two pin female connector that mates with the battery connector on the Aux / Stepper board and plug in the batteries.



Figure 2.3-4: Connecting the Battery



Backup batteries are not installed with firmware v2.05 and higher. Electronics hardware changes made the backup battery unnecessary and it was eliminated. If deploying a PPS that still has a backup battery, install a fresh battery before every deployment.

2. Find the communication cable provided in the toolkit.
3. Connect the communications cable to the computer serial communication port before connecting to the communications connector on the controller end cap.
4. Align the bulkhead connection pins, and push bulkhead in place on the controller end cap.



Figure 2.3-5: Connecting the COM Cable

5. On the computer, open a properly configured MotoCross window.
6. Connect the DB9 end of the communication cable to the computer communication port configured in MotoCross.
7. Enter [CTRL]-[C] in MotoCross. If the computer setup procedures were completed correctly, the Main Menu, a system clock confirmation message, or a message that indicates the system is Suspended will print to the screen.

Opening a Controller Housing not Equipped with the PRV

To open a controller housing without a PRV installed, follow the steps below, otherwise skip this section and continue with the steps to power on the sampler. Steps to detect and release a pressure build up are also provided.

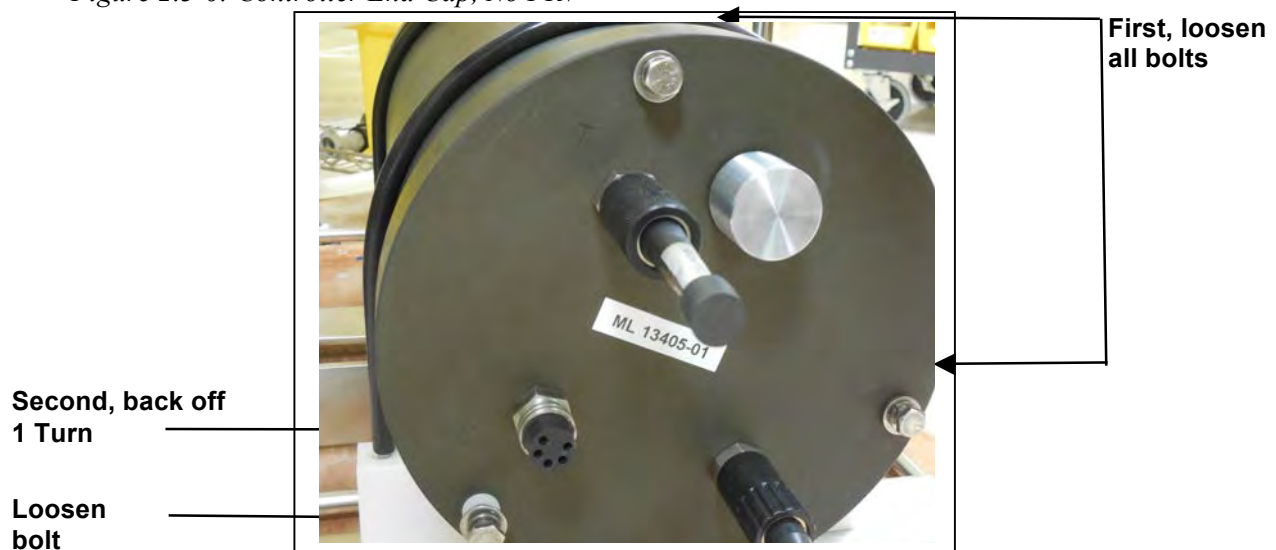
1. Loosen all end cap bolts slightly. Do not completely remove the bolts.



Do not remove any individual bolts until pressure has equalized.

2. Observe whether the end cap moves once the bolts are loosened. Movement could indicate a pressure build-up inside the controller housing.
3. If a pressure build-up is suspected, loosen a bulkhead connector only one turn (do not remove the bulkhead connector) to allow the pressure to equalize.
4. Let the controller sit undisturbed to allow pressure to equalize before attempting to further loosen the end-cap bolts.

Figure 2.3-6: Controller End Cap, No PRV



Section 2.4

Waking the Sampler from Low Power Sleep

The sampler will enter a low power mode if it sits idle for more than 20 minutes. To wake the system from this suspended state, hold down [CTRL]-[C]. After three seconds of holding down [CTRL]-[C], the Main Menu will display (Figure 2.4-1).

If [CTRL]-[C] is held down for more than 5 seconds and nothing happens, check the previous sections of this chapter to make sure procedures were followed correctly. If your system has backup batteries, confirm they are properly seated in the backup battery housing, and make sure they are plugged into the electronics.

```
CF2-WTS-2.05 R9 L2.3 | WTS-2.05.c compiled May  9 2016 at 14:09
      WTS-250M S/N ML00000-00 Water Transfer System
      © 1996-2016 McLane Research Laboratories. All rights reserved.
-----
Clock reads 01/01/70 00:00:00.  Change [N] ? y
Format is mm/dd/[yyyy or yy] hh:mm:ss
Enter correct time [01/01/1970 00:00:04] ? 10/24/2016 09:58:35
Clock reads 10/24/16 09:58:35.  Change [N] ?
-----
Configuration: WTS-250M                CF2 V2_05 of May  9 2016
                McLane Research Laboratories, Inc.
                Water Transfer System
                ML00000-00
-----
                        Main Menu
-----
                        Mon Oct 24 09:58:36 2016
-----
                        Port 99

      <1> Set Time           <5> Create Schedule
      <2> Diagnostics       <6> Deploy System
      <3> Manual Operation   <7> Offload Data
      <4> Sleep              <8> Contacting McLane

      <C> Configure
```

Figure 2.4-1: Main Menu

See Chapter 3 for more information about the Main Menu and other user interface menus.

Notes

Chapter 3

User Interface

This chapter introduces the user interface including the Main and Configuration Menus, and explores some basic functions of the PPS menu driven user interface. See Chapter 2 for information about connecting the PPS to a computer and powering on the system. Topics covered in this chapter include:

- Main and configuration Menus
- Instrument Settings (time, diagnostics, manual operations, sleep)
- Deployment Settings (create schedule, deploy PPS)

Section 3.1

Main and Configuration Menus

Main Menu

The Main Menu is the PPS home screen. All operations end up back at the Main Menu when completed. The Main Menu automatically displays after system initialization.

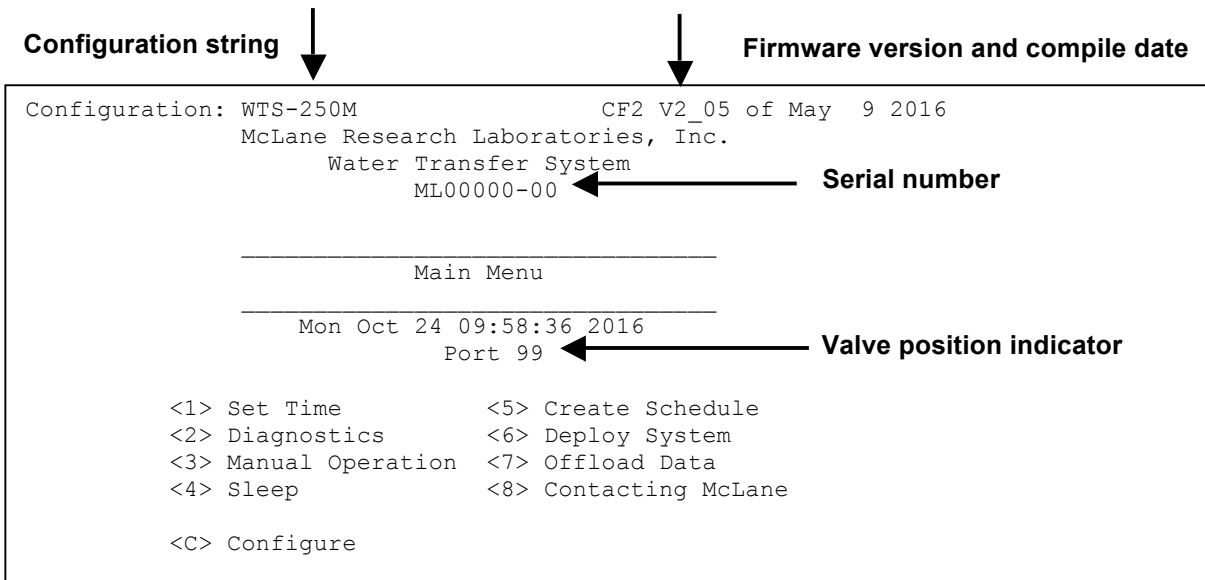


Figure 3-1: PPS Main Menu

- **Configuration String:** The configuration string indicates the current instrument configuration. The configuration string in Figure 3-1 indicates the PPS is part of the WTS (Water Transfer System) family, and has a 250 ml/minute Maxon Pump.

- **Firmware Version and Compile Date:** The currently running firmware version and the compile date are displayed on the top right corner of the main menu.
- **Serial Number:** The McLane Serial Number can be found on the Main Menu and should be included in all system inquiries to McLane Research Labs.
- **Valve Position Indicator:** The currently aligned port is displayed here. When a PPS first starts up it has not yet established a home port reference point, and this value will be 99. Before any pumping or valve operation is completed, the system will establish a home port reference and the correct valve position will be displayed.

Configuration Menu

The Configuration Menu allows the user to program which components are installed on the system. McLane properly configures the instrument before shipping. You may need to reconfigure the system if mechanical components are added or the system firmware is updated.

```

-----
Configuration: WTS-250M                      CF2 V2_05 of May  9 2016

-----
                        Configuration
-----

                Mon Oct 24 09:59:05 2016

<1>          50ml pump: No
<2>          125ml pump: No
<3>          250ml pump: Yes
<M>          Maxon motor: Yes
<P>          Pittman motor: No
<S>          Fixative valve: No
<A> Antifouling fluid: No

<X> Save & Exit      <^C> Cancel & Exit

```

Figure 3-2: Configuration Menu

To configure the PPS:

1. Enter “C” at the Main Menu.
2. When asked for a password, enter “CON”.
3. Use menu option 1 – 3 to select the system pump head capacity.
4. Use menu option M or P to select the pump motor manufacturer.

5. If a Fixative Valve is installed on the system, use menu option S to enable the Fixative Valve and program the fixative bag size. PPS systems with the Fixative Valve option installed are shipped with one 2 liter fixative reservoir bag and one 2 liter exhaust collection bag installed in the fixative box. The system allows users to program bag sizes of up to 5 liters.



If different bag sizes are used, the bags must be the same on the fixative and exhaust ports.

6. If the optional Antifouling Fluid Reservoir is installed on the PPS, use menu option A to configure the system to have Antifouling Fluid.
7. Save and exit using Configuration Menu option <X>.

Section 3.2 Instrument Settings

<1> Set Time

The set time menu option allows you to program the system real time clock (RTC). McLane recommends setting the RTC during the power-up sequence. When the PPS is powered on, the clock defaults to January 1,1970, 00:00:00. The clock can be set to any date and time in the allowed range and the count will continue from the new value.

Systems with a backup battery will retain the date and time as long as the backup batteries are installed and have an acceptable voltage. Systems without a backup battery will not keep time when the main battery pack is unplugged. To set the time:

1. Select the Set Time menu option.
2. Enter the date and time using the provided format.
3. Accept the changes to the system clock.

```
Clock reads 02/08/70 02:20:25. Change [N] ? y
Format is mm/dd/[yyyy or yy] hh:mm:ss
Enter correct time [02/08/1970 02:21:25] ? 03/04/2015 11:29:11
Clock reads 03/04/2015 11:29:11. Change [N] ?
Initializing data array .....
```

Figure 3-3: Set Time

<2> Diagnostics

The Diagnostics menu option will continuously print system data to the screen. The data printed to the screen will vary between system configurations, but always includes the date, time, main battery voltage, and the temperature according to the thermistor on the system electronics.

```
Selection [] ? 2

Press any key to pause/continue display, ^C to exit

10/24/16 09:59:57 31.7Vb 23°C Port 99
10/24/16 09:59:58 31.7Vb 23°C Port 99
10/24/16 09:59:59 31.7Vb 23°C Port 99
10/24/16 10:00:00 31.7Vb 23°C Port 99
10/24/16 10:00:01 31.7Vb 23°C Port 99
```

Figure 3-4: Diagnostics

- Diagnostics data printed to the screen can be paused and resumed by entering any key into MotoCross. Exit and return to the main menu by entering [CTRL]-[C].

Battery Warnings

- Low battery voltage triggers warning messages during the exit from Diagnostics. If the main battery pack falls below 28 V, a message displays to replace the battery before deployment.
- If the main battery pack falls below 18 V, the Diagnostics program terminates and displays the message below before returning to the Main Menu.
- If a critically low battery is detected and a data file exists in memory that has not been offloaded, an additional warning displays before returning to the Main Menu.



Confirm that deployment data is offloaded and is accurate before disconnecting the battery. The firmware detects only the successful execution of the Offload Data option and not whether the data file was successfully logged by MotoCross. Any deployment data in RAM is lost if the battery is unplugged.

- Type [X] or [CTRL]-[C] to exit from Diagnostics and return to the Main Menu.

<3> Manual Operations

The Manual Operations menu allows you to operate the different peripherals such as the valve and pump installed on your PPS. The manual operations available in this menu will vary depending on the system configuration.

- **Manual Valve Operations:** Options 1 – 4 of the PPS Manual Operation Menu move the 25 Port Valve to the specified positions.
- **Manual Pumping Operations:** Options 5 – 7 of the PPS Manual Operation Menu allows the user to perform manual pumping operations based on predefined, or user-defined pumping parameters.
- **Manual Fixative Valve Operation:** If the PPS has a Fixative Valve installed, the Manual Operation Menu will have an option that switches between the OFF (Water sample) and ON (Fixative) positions.

```
Configuration: WTS-125M-SV                CF2 V2_05 of May  9 2016

-----
Manual Operation
-----
Mon Oct 24 10:00:04 2016

Port 99

<1> Find port : home
<2> Find port : J
<3> Next port : advance
<4> Next port : retreat
<5> Run pump  : forward (250 ml @ 100 ml/min)
<6> Run pump  : reverse (250 ml @ 100 ml/min)
<7> Run pump  : programmable
<8> Fixative Valve: OFF

<M> Main Menu
```

Figure 3-5: Manual Operation Menu



Do not run the pump dry. If conducting a bench test, submerge the PPS intake and exhaust lines in water.

Option <1> Find Port: home

This option moves the valve to a reference position located at the water flush port, also known as the Home Port or Port 0.

```
Selection [] ? 1
Seeking home port.. located. Aligning... Confirmed.
```

Figure 3-6: Find Port: Home

Option <2> Find Port:

This option moves the valve to a specified port.

Option <3> Next port:advance

This option moves the valve forward one port position (for example, from Home Port 00 to Port 01).

```
Seeking port 01.. located. Aligning... Confirmed.
-----
Configuration: WTS-125M-SV          CF2 V2_05 of May  9 2016
-----
                Manual Operation
-----
                Mon Oct 24 10:00:49 2016
                Port 01

<1> Find port : home
<2> Find port : J
<3> Next port : advance
<4> Next port : retreat
<5> Run pump  : forward (250 ml @ 100 ml/min)
<6> Run pump  : reverse (250 ml @ 100 ml/min)
<7> Run pump  : programmable
<8> Fixative Valve: OFF

<M> Main Menu

Selection [] ?
```

Figure 3-7: Next Port: Advance

Option <4> Next port:retreat

This option moves the valve backwards one port position (for example, from Port 01 to Home Port 00).

```
Selection [ ] ? 4
Seeking port 00.. located. Aligning... Confirmed.
```

Figure 3-8: Next Port: Retreat

Option <5> Run pump: forward

This option pumps 500 ml of water at 75 ml/min. in the forward direction. The pump can be stopped at any time before the operation is complete by pressing [CTRL]-[C]. Each row of the display shows the pump speed control value; the instantaneous pump speed in Hertz, the average pump speed in Hertz, the cumulative volume pumped, the instantaneous flow rate in ml/min, and the elapsed time in seconds.

```
Selection [ ] ? 5

Counts |Hall Freq |Hall Avg | Volume Pumped |FlowRate | Elapsed Seconds | Batt. V | Pump Current
|Code
1920 h  179  I_Hz   44  A_Hz   1.2 ml   74.8 ml/min   1 secs   31.7 V   81 mA   0
1921 h  239  I_Hz  104  A_Hz   2.9 ml   99.9 ml/min   2 secs   31.7 V   71 mA   0
1901 h  249  I_Hz  166  A_Hz   4.6 m   104.1 ml/min  3 secs   31.7 V   78 mA   0
. . . ← Display shortened to save space
1921 h  238  I_Hz  238  A_Hz  246.3 ml   99.5 ml/min  148 secs  31.7 V   91 mA   0
1923 h  238  I_Hz  238  A_Hz  247.9 ml   99.5 ml/min  149 secs  31.7 V   87 mA   0
1919 h  241  I_Hz  239  A_Hz  249.6 ml  100.8 ml/min  150 secs  31.7 V   84 mA   0

Volume reached

Total volume pumped      = 250 ml
Elapsed time of event     = 151 sec
Lowest battery detected   = 31.7 V

Average pump current      = 83 mA
Highest pump current      = 96 mA
```

Figure 3-9: Run Pump Forward

Option <6> Run pump: reverse

This option pumps 500 ml of water at 75 ml/min. in the reverse direction. The pump can be stopped at any time before the operation is complete by pressing [CTRL]-[C].

```
Selection [] ? 6

Counts | Hall Freq | Hall Avg | Volume Pumped | FlowRate | Elapsed Seconds | Batt. V | Pump Current |
Code

1926 h  176 I_Hz   44 A_Hz    1.2 ml      73.6 ml/min   1 secs      31.7 V    88 mA      0
1939 h  233 I_Hz   102 A_Hz   2.9 ml      97.4 ml/min   2 secs      31.7 V    86 mA      0
1925 h  246 I_Hz   163 A_Hz   4.6 ml      100.8 ml/min  3 secs      31.7 V    82 mA      0
...
1921 h  238 I_Hz   238 A_Hz  246.3 ml    99.5 ml/min  148 secs    31.7 V    91 mA      0
1923 h  238 I_Hz   238 A_Hz  247.9 ml    99.5 ml/min  149 secs    31.7 V    87 mA      0
1919 h  241 I_Hz   239 A_Hz  249.6 ml   100.8 ml/min  150 secs    31.7 V    84 mA      0

Volume reached

Total volume pumped      = 250 ml
Elapsed time of event    = 151 sec
Lowest battery detected  = 31.7 V

Average pump current     = 83 mA
Highest pump current     = 96 mA

Press any key to continue.
```

Figure 3-10: Run Pump Reverse

Option <7> Run pump: programmable

Use this option to enter the volume, time limit and direction for pumping. The pump can be stopped at any time before the operation is complete by pressing [CTRL]-[C].

The various software features controlling and safeguarding pump operation are in effect whenever the pump is running.

Option <8> Fixative Valve

If the PPS has an optional Fixative Valve installed, this option switches between the Off (Water) and On (Fixative) positions.

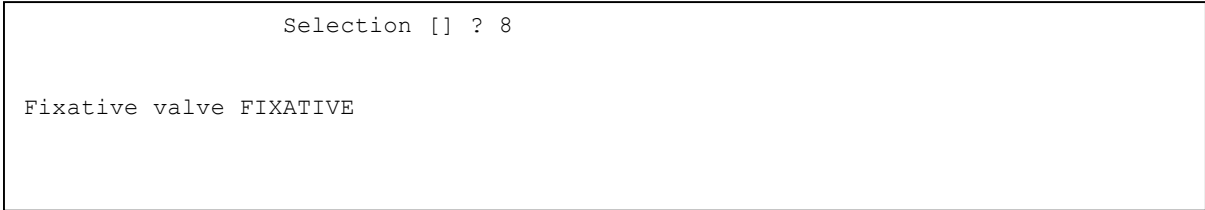


Figure 3-11: Fixative Valve

<4> Sleep

The PPS automatically enters Sleep mode if left idle for 20 minutes, to suspend the drain of battery power. You can also put the PPS in Suspend mode indefinitely by selecting the Sleep option of the Main Menu.

```
Selection [ ] ? 4
10/24/16 10:10:51 Suspended ...
```

Figure 3-12: Suspend Mode

Prior to Suspend mode, the current time will display. During Suspend mode, the system will wake every 20 minutes to check system status, display the time and then return to Suspend mode. This is also the operation mode after the last event of a schedule is completed and during the intervals between events. To wake the system and return to the Main Menu, press [CTRL]-[C] three times (with three second pauses between each keystroke).

Section 3.3

Deployment Settings

The remaining Main Menu options are used to prepare and perform a deployment. These options are:

- **Create Schedule:** Used to create a sampling schedule before the actual deployment. The schedule specifies the number of samples to be taken (from 1 through 25), and consists of preprogrammed dates and times that will trigger pumping events.
- **Deploy System:** Checks EEPROM and requires a reboot if data is stored there, confirms that the valve is aligned to Home Port (00), and warns if there is data ready to be offloaded. Confirms the date and time, changes or keeps the existing sampling schedule, and displays a final sampling parameter check with options to make changes.
- **Offload Data:** Works with the “Capture to file” feature of MotoCross. After recovering the PPS and re-connecting the communications cable to the electronics and the computer, this option captures data to a text file.

Deployment Settings (create schedule, deploy system are explained in Chapter 4 ‘Operations’ of this user manual. Offload Data options are explained in Chapter 5 of this user manual.

<8> Contacting McLane

This option displays McLane contact information and includes the software version and serial number of your instrument.

```
Selection [ ] ? 8

      McLane Research Laboratories, Inc.
      Falmouth Technology Park
      121 Bernard E. Saint Jean Drive
      East Falmouth, MA 02536-4444 USA

      Email: McLane@McLaneLabs.com
      Web: http://www.McLaneLabs.com
      Tel: 508-495-4000 Fax: 508-495-3333

      Configuration: PPS-125M500
      Source file: CF2-3_03.c
      Electronics S/N: ML12345-02
      Compiled: Aug  4 2014 13:07

Press any key to continue.
```

Figure 3-13: McLane Contact Information

Chapter 4 Operations

This chapter describes the procedures involved in preparing the PPS for a deployment.

Topics include:

- Priming the PPS Filter Holders and Plumbing.
- Installing the Water Flush Filter
- Preparing the optional Fixative Valve for a Deployment.
- Preparing the optional Post-Sample Acid Flush Reservoir
- Programming deployment parameters.

Section 4.1 Priming the PPS Filter Holders and Plumbing

The ultimate goal of the priming procedure is to clear all fluid lines and valve ports of trapped air. This is a wet process and should be completed by two people.

The hoses and parts listed below are included in the toolkit for priming.

Parts for the Priming Process Included in Toolkit	
Hose A	
Hose B	
Hose C	
Hose D	
Hose E	
Hose F	
Water Syringe	
Fixative Syringe	Optional if fixative valve is installed

To prime the PPS:

1. Follow the steps in the Getting Started chapter of this User Manual to establish communications with the PPS.
2. Close and seal the controller housing.

3. From the Manual Operation Menu select option 1 to align the 25 port valve to the home port.
4. Check option 8 of the Manual Operations Menu to make sure the Fixative Valve is OFF (the water position).
5. Locate the Water Syringe, Hose-A, Hose-B, and Hose-C in the toolkit.
6. Disconnect all of the filter bodies from the filter base plate, but keep the tops of the filter bodies connected to the 25 port valve.



Figure 4.1-1: Priming Setup

7. Place a container of neutral water on top of the 25 port valve.
8. Connect Hose-A to the common intake on the 25 port valve. If the fixative valve is installed, connect Hose-A to the water intake port of the fixative valve instead. Place the opposite end of Hose-A in the water container.
9. Connect Hose-B to the exhaust port of the micro-pump. If the fixative valve is installed, connect Hose-B to the water intake port of the fixative valve instead. Place the opposite end of Hose-B in the water container.
10. Connect Hose-C to the syringe, fill the syringe with water, and remove air from the syringe.
11. Select option 3 of the Manual Operation Menu to advance to the next port (Port 1).

12. Open filter holder 1 by twisting the top half from the bottom half, and connect the bottom half of the filter to Hose-C which is connected to the syringe.



Figure 4.1-2: Priming Setup

13. Use the syringe to inject water through the bottom half of the filter holder until all air is removed and water pools on the top.



Figure 4.1-3: Injecting Water with Syringe

14. Place a filter on the bottom half of the filter holder, and allow it to soak up the pool of water. Continue to slowly inject water if the filter requires more to become completely saturated.

15. Reattach the bottom half to the top half of the filter body. The top filter ring of the filter holder must be fully engaged and tightened down to the filter holder body. To avoid introducing air back into the purged bottom half of the filter body, the syringe can be used to inject water very slowly while attaching the top and bottom halves.



Figure 4.1-4: Reattaching Top and Bottom of Filter

16. Once the two halves of the filter body are connected, slowly inject the remaining contents of the syringe through the filter body to remove all air from the remaining plumbing. Lightly tapping the filter against the PPS frame while doing this will remove any trapped air. As water is injected, air bubbles should appear in the water container.
17. Continue injecting until air bubbles stop, the syringe may need to be refilled during this process.



The filter body has a valved connection and will seal immediately when disconnected quickly. This seal will protect from introducing air while refilling the syringe. Remember to remove all air from the syringe before reconnecting the syringe to the filter body.

18. When all air has been purged from the filter position plumbing, disconnect the syringe from the filter body.

19. Connect Hose-G to port 1 on the filter base plate, and place the other side of the hose in the water container.

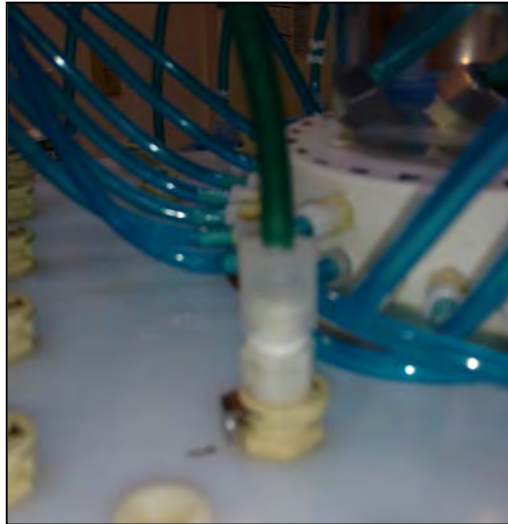


Figure 4.1-5: Reattaching Top and Bottom of Filter

20. Select option 6 of the Manual Operation Menu to pump 500 ml of water at 125 ml/minute in reverse [R]. While the system pumps in reverse, air is pushed from the plumbing into the water container. Once all air has been removed from the filter position plumbing, cancel the pumping operation with [CTRL]-[C].

```
Configuration: WTS-125M-SV          CF2 V2_05 of May  9 2016
-----
Manual Operation
-----
Mon Oct 24 10:04:13 2016
Port 00
<1> Find port : home
<2> Find port : J
<3> Next port : advance
<4> Next port : retreat
<5> Run pump  : forward (250 ml @ 100 ml/min)
<6> Run pump  : reverse (500 ml @ 125 ml/min)
<7> Run pump  : programmable
<8> Fixative Valve: OFF

<M> Main Menu

Selection [] ? 6

Counts | Hall Freq | Hall Avg | Volume Pumped | FlowRate | Elapsed Seconds | Batt. V | Pump Current | Code
1942 h  168  I_Hz   42  A_Hz     1.2 ml    70.2 ml/min    1 secs   31.7 V    86 mA     0
1949 h  236  I_Hz   101 A_Hz    2.8 ml    98.7 ml/min    2 secs   31.7 V    84 mA     0
. . . ← Display shortened to save space
```

Figure 4.1-6: Pump in Reverse



While pumping air, bubbles can become trapped in the bends of the tubing below the base plate. These air bubbles should be helped out of the tubing by gently tilting the hose upward to let the bubble to travel through the tube.

21. Select option 3 of the Manual Operation Menu to advance to the next port.
22. Disconnect Hose-G and reattach the filter body to port 1 of the filter base plate.
23. Repeat steps 12 – 22 for all filter positions.
24. After priming port 24, select option 3 of the Manual Operation Menu one last time to advance to the home port.
25. Once priming is complete, disconnect Hose-A and Hose-B from the Fixative Valve, remove the water container from the top of the 25 Port Valve and move on to the next step, Installing the Water Flush Filter.

Section 4.2

Installing the Water Flush Filter

The water flush filter installed in-line to Home Port (Port 0) accepts a 25mm filter with a pore size from 5 to 10 microns. The filter protects the pump head from damage by large particles when the water flush clears the fluid lines between samples. This is an optional feature. To install the water flush filter, complete the following steps:

1. Place the pump exhaust tube in a bucket of neutral water.
2. Connect the large syringe filled with neutral water to the valve intake.

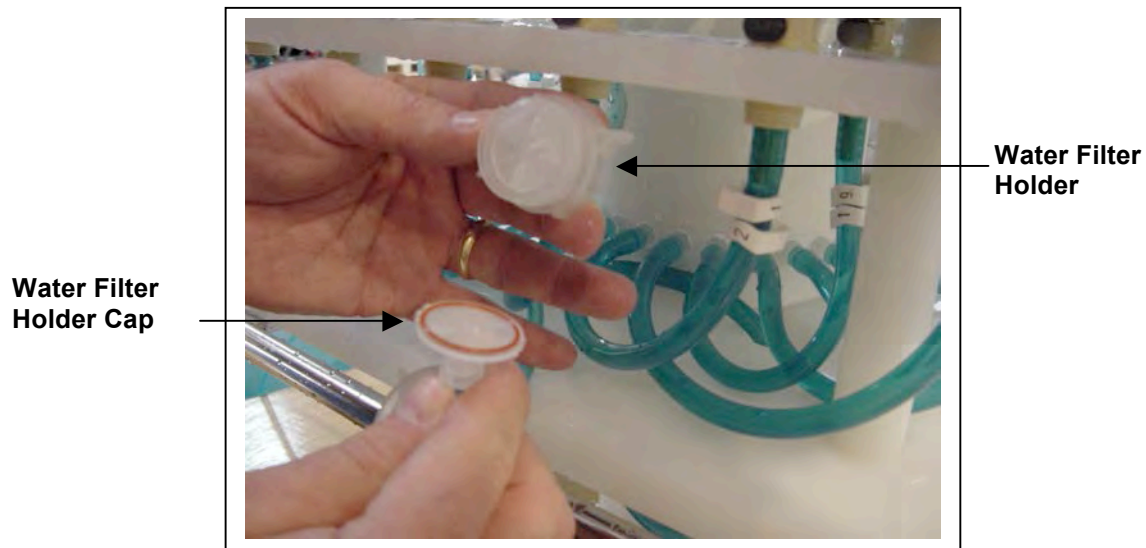


Figure 4.2-1: Disassembling Water Flush Filter

3. Disassemble the water flush filter by unscrewing the filter cap (see Figure 4.2-1).
4. From the Manual Operation menu, select option 1 Find port: home.
5. From the Manual Operation menu, select option 6 Run pump: reverse.
6. Run the pump until water flows out of the water filter holder.
7. Push the syringe to inject water into the tubing until water flows through the water filter holder frit.
8. Place the filter in the water filter holder (on top of the frit).
9. Reassemble the water filter holder.
10. Remove the syringe from the intake valve.

Section 4.3

Preparing the Fixative Valve for a Deployment

If the PPS has the optional Fixative Valve, the steps that follow can be used for priming.



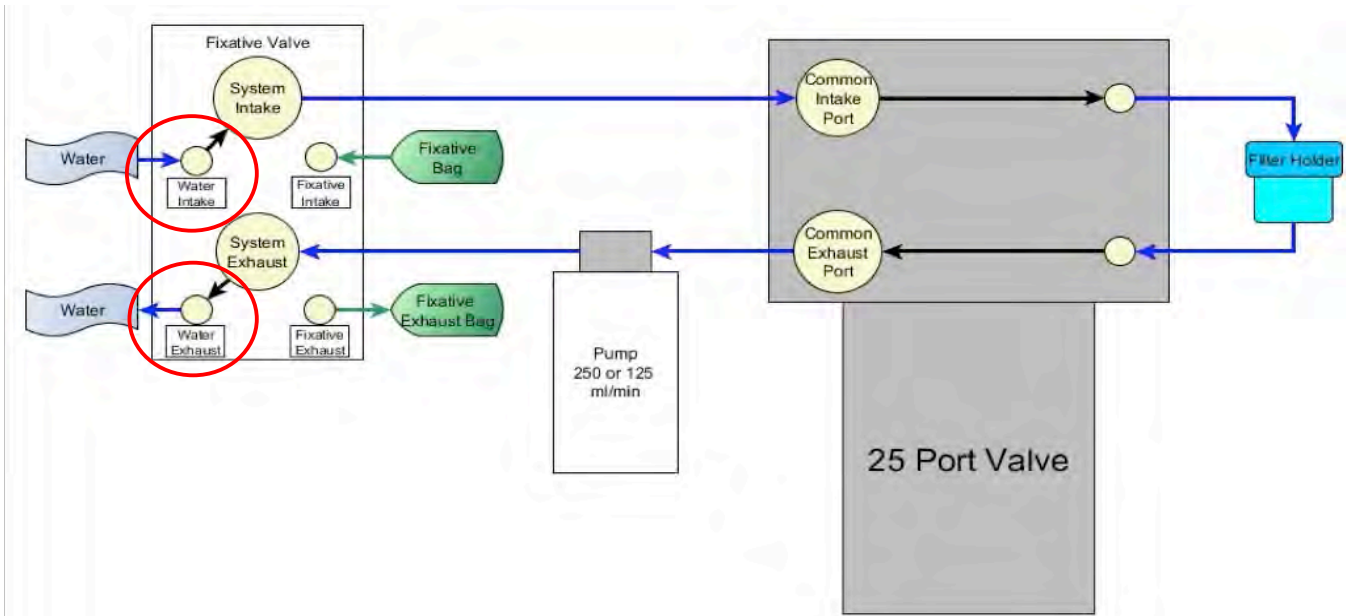
Skip section 4.3 and proceed to section 4.4 if you do not have the Fixative option installed.

Understanding System Operation with Fixative Valve

The illustrations that follow show operations of the water (environment) intake and output and the fixative intake and output. A diagram of the system overview is also provided. Review these diagrams prior to priming.

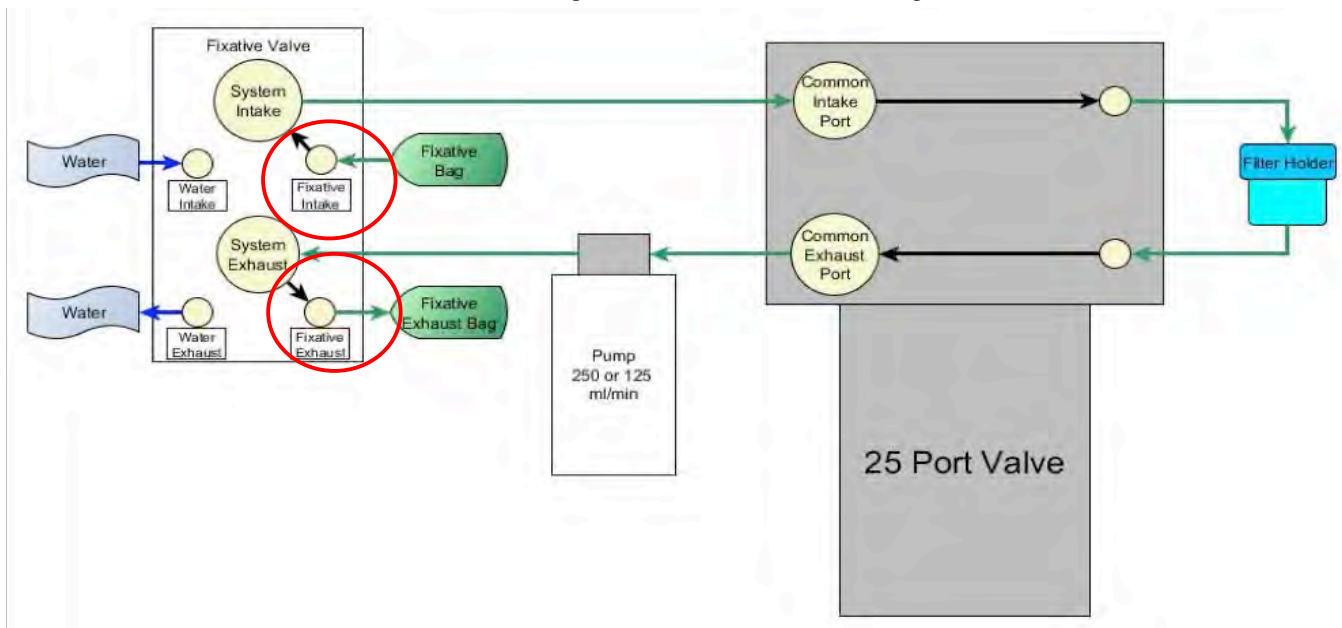
PPS System Hydraulics with Fixative Valve Option During a Sample

During a sample, the Fixative Valve is de-energized and in the water position. Water is pumped from the water intake port of the Fixative Valve, to the 25 Port Valve intake port, through the filter holder of the aligned port, out of the 25 port valve exhaust port, and out of the fixative valve water exhaust port.



PPS System Hydraulics with Fixative Valve Option During a Post-Sample Fixative Flush

Immediately after a sample is taken, the Fixative Valve is energized and switched to the fixative position. Fixative is pumped from the fixative bag through the fixative intake port of the fixative valve, to the 25 Port Valve intake port, through the filter holder of the aligned port, out of the 25 port valve exhaust port, and out of the fixative valve fixative exhaust port into the fixative exhaust bag.



Determining the Total Amount of Fixative

Consider the following when determining the total amount of fixative for a deployment:

- **Chemical Compatibility:** The PPS and Fixative Valve are compatible with most fixative solutions. Before deploying the PPS with the Fixative Valve option, confirm fixative concentrations by running tests to determine sufficient fixative for your specific needs. Contact mclane@mclanelabs.com for questions about compatibility.
- The PPS with Fixative option includes 2000 ml bags. Contact mclane@mclanelabs.com for information about using bags of a different size.
- A Fixative Flush of 4x the internal volume of the filter holder should be sufficient for a fixative that requires a high end concentration.
- The internal volume of each PPS filter holder and tubing is approximately 22 ml.
- The maximum allowable fixative flush volume for a single event is 95% of the available fixative volume divided by the number of events in the deployment.

Therefore:

Total Required Fixative = (Fixative Flush volume * number of events) + (1.05 * Fixative Reservoir Bag size)



While the provided fixative reservoir bag capacity is labeled as 2000 ml, it is capable of holding approximately 2200 ml of fluid.

The deployment setup process requires an understanding of how much fixative is inside of the Fixative Intake Bag prior to a deployment. The measurements on the Fixative Syringe can be used to measure the amount of fixative added, although the purging process described in the following steps can add or subtract from the injected amount. The most accurate way to measure the fixative added to the fixative reservoir bag is to weigh the bags before, and after filling them.



Follow the recommended chemical safety precautions for the Fixative being used.

Priming the Fixative Plumbing

These instructions assume that the filter holder plumbing has already been primed, and the 25 port valve has been aligned to the home port per the final instructions of the Filter Holder Priming procedure in section 4.1. If these steps have not been completed, go back and follow them before continuing. The system overview below can be used as a reference for priming. This diagram shows the flow through each of the 24 collection ports. See Appendix C for a larger version of this System Version overview.

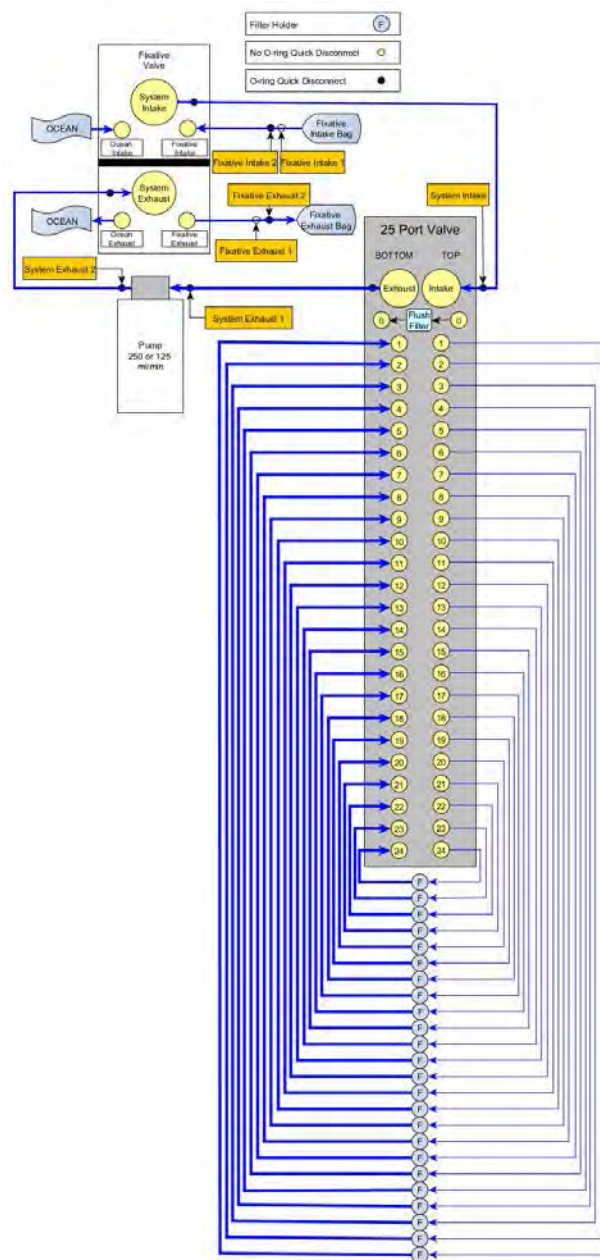


Figure 4.3-2: System Operation

1. Locate Hose E, Hose-A, and the Fixative Syringe.
2. Open the Fixative Box by removing the six nylon $\frac{1}{4}$ -20 fasteners on the cover of the box.

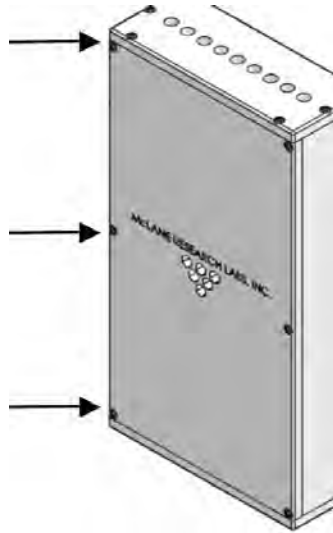


Figure 4.3-3: Opening the Fixative Box

3. Remove the fixative reservoir and fixative collection bags from the fixative box by disconnecting them from their respective hoses.
4. Place a container of water on the floor near the PPS.
5. Select option 8 of the Manual Operation Menu to toggle the Fixative Valve to the ON (fixative) position.
6. Check the 25 Port Valve position indicator in the Manual Operation Menu to ensure it is aligned to port 0.

7. Connect Hose-A to the Fixative Collection-1 Hose inside of the Fixative Box, and place the other end in the water container. Use the nut attached to the hose as a weight to keep it submerged in the water container.
8. Connect Hose-E to the Fixative Syringe, and fill the syringe with Fixative.
9. Connect the Fixative Syringe and Hose-E to Fixative Reservoir-2 Hose inside the Fixative Box.
10. Use the Fixative Syringe to SLOWLY inject fixative through the fixative plumbing. This will cause air to exit Hose-A into the water container. If it is not very easy to push water through the fixative plumbing, stop and check the Manual Operation Menu to make sure that the Fixative is in the ON position, and the 25 Port Valve is aligned to port 0.

```
Configuration: WTS-125M-SV                CF2 V2_05 of May  9 2016
-----
Manual Operation
-----
Mon Oct 24 10:00:33 2016
      Port 00
<1> Find port : home
<2> Find port : J
<3> Next port : advance
<4> Next port : retreat
<5> Run pump  : forward (250 ml @ 100 ml/min)
<6> Run pump  : reverse (250 ml @ 100 ml/min)
<7> Run pump  : programmable
<8> Fixative Valve: ON
<M> Main Menu
```

Figure 4.3-4: Aligned to Home Port, Fixative ON

11. When the air bubbles have stopped, select option 8 of the Manual Operation Menu to switch the Fixative Valve to the OFF (Water) position. This will seal the fixative plumbing, and keep air out.
12. Disconnect Hose-A, and the Fixative Syringe from the fixative intake and exhaust plumbing.

Fill the Fixative Intake Bag

1. Weigh the Fixative Intake Bag, and make a note of the weight.
2. Locate the Fixative Syringe, Hose-F, and the quick disconnect plugs in the toolkit.
3. Fill a container with fixative, place it on a surface with the fixative bags.
4. Connect the Fixative Syringe to Hose-F, and fill the syringe with fixative.

5. Inject the contents of the syringe into Fixative Intake Bag. Repeat this process until the amount of fixative required by the deployment is added to the Fixative Intake Bag.



Figure 4.3-5: Inject Syringe Contents into Fixative Bag

6. When filling is complete, remove Hose-F from the syringe, while leaving Hose-F attached to the Fixative Intake Bag.
7. Place the free end of Hose-F into the fixative container using the nut attached to the hose as a weight to keep the hose submerged.



Figure 4.3-6: Place Hose-F into Fixative Container

8. Squeeze the air out of the fixative intake bag, through the hose, into the container.



Note that removing air from the bag will cause a slight vacuum, allowing the bag to pull more fixative from the container after air is removed.

9. After air is removed, seal the Fixative Intake Bag by folding the end of the hose and pinching it shut. Disconnect Hose-F from the Fixative Intake Bag, and connect the quick disconnect plug.



Figure 4.3-7: Pinch Fixative Bag Hose, Attach to Intake-2 Hose

10. Weigh the Fixative Intake Bag and make a note of the weight. Subtract the filled bag weight from the empty bag weight to determine the total amount of fixative added.
11. Pinch the Fixative Intake Bag hose, disconnect the plug, while continuing to pinch the hose, attach the bag to the Fixative Intake-2 hose inside of the Fixative Box. If done correctly no air should have been introduced.

Fill the Fixative Collection Bag

It is important to fill the collection bag with a volume of water equal to 5% of the bag's rated capacity. Without this water a differential pressure could build across Fixative Valve O-ring seals at ocean depths, potentially damaging the fixative valve.

1. Locate the Fixative Syringe, Hose-E, a water container, and the quick disconnect plugs in the toolkit.
2. Connect Hose-E to the Fixative Syringe.

3. Fill the syringe with neutral water. This is the exhaust bag, and shouldn't require fixative.
4. Inject approximately 5% of the Fixative Exhaust Bag's capacity into the bag.
5. When filling is complete, remove Hose-E from the syringe while leaving it attached to the Fixative Exhaust bag.
6. Place the free end of Hose-E into the container using the nut attached to the hose as a weight to keep the hose submerged.
7. Roll up the Fixative Exhaust Bag to force air from it into the water container.



Figure 4.3-8: Roll Fixative Bag to Release Air

8. Pinch the end of the Fixative Exhaust Bag hose, disconnect Hose-E. While continuing to pinch the hose, attach the bag to the Fixative Exhaust-1 hose inside of the Fixative Box. If done correctly no air should have been introduced.
9. Attach the Fixative Intake Bag and Fixative Exhaust Bag to the fixative box using the nylon $\frac{1}{4}$ -20 fasteners. Keep the hose connections facing downward, and the Fixative Exhaust bag in front of the Fixative Intake bag.

Section 4.4

Preparing the Post Sample Acid Flush Reservoir

Acid provides an optional, programmable post-sample bio-fouling flush that further cleans the intake tube. Port 24 is used as the antifouling acid flush chamber, leaving a maximum of 23 sample events. Use the steps that follow to prepare the acid flush reservoir. Skip to section 4.5 if you are not using this optional feature.



Setting the acid flush and antifouling fluid volume is completed on the Configuration menu. The Antifouling flush must also be enabled on the Event Parameters menu. Individual event settings can be changed from the Schedule Verification display. Contact mclane@mclanelabs.com to upgrade an older PPS system to use the post-sample acid flush feature (the addition of an acid chamber is required).

1. Using option 3 from the Manual Operation menu, advance to Port 24, the position used for acid cleaning.
2. Remove insert an acid bag in the fixative chamber.
3. Gently fold the bag, slide it into the chamber and secure the cap.
4. Install the supplied acid bag fitting.
5. Fill a clean syringe with an acid solution and inject acid into the bag. The acid bag will hold just over 500 ml of acid, so filling will require multiple injections from the syringe. Keep track of the volume of acid injected. Overfilling could cause the bag to burst.
6. Remove the acid bag fitting and reconnect the top tubing.
7. Remove the clean water syringe from the valve intake and replace the intake cap.
8. From the Manual Operation menu, select option 6 Run pump: reverse. Perform a reverse pump to fill the remaining volume of the acid reservoir with clean water.
9. Filling the entire volume may require a few restarts of the pumping routine.

10. Press [CTRL]-[C] to stop the pump manually when water emerges from the bleed hole at the top of the acid cap.
11. Remove the intake cap and attach a syringe of acid solution.
12. Disconnect the top tubing from the acid cap and inject acid into the intake until the top tubing is filled.
13. Reattach the top tubing to the acid reservoir cap.
14. Remove the acid syringe from the intake and replace the intake cap.

Section 4.5

Programming Deployment Parameters

After the system has been inspected and primed, the next step in preparing for a deployment is programming the Deployment Parameters. Follow the steps in this section to program the PPS Deployment Parameters.

Create a Deployment Schedule

The Create Schedule option of the Main Menu allows users to define a deployment event schedule without entering a deployment immediately afterwards. While programming a schedule, use the file capture utility available in Motocross to log all communication with the PPS.

To define a PPS deployment schedule, complete the following steps.

1. Power on the computer and start MotoCross terminal emulation.
1. Remove the dummy plug from the communications connector on the end cap and connect the communications cable to the computer.
2. Connect the communications cable to the computer serial port.
2. Connect the battery.
3. After the firmware powers on, select Main Menu option 5 'Create Schedule'.
4. Confirm that the system clock is correct (McLane firmware uses a 0-24 military time convention).
5. Enter the number of events in the deployment.



Scheduling properly accounts for leap years.

This prompt will be preceded by warnings if previous deployment records (a data file) or a deployment schedule exist. The system requires a reboot to clear EEPROM before saving a new schedule if there is at least one file in memory. If a reboot is needed, a message displays.

```
Selection [] ? 5

Records show that the system requires a post-deployment
reboot before proceeding with deployment setup.

A data set exists in system memory that has
not been offloaded. Existing data will be lost
if the system is rebooted.

Reboot now? [Y] ? y

Resetting...
```

Figure 4.5-1: System Reboot Required

- At the Schedule Menu, deployment event times can be programmed individually, at a set interval, or by defining a deployment start and stop time.

```
Configuration: WTS-125M-SV          CF2 V2_05 of May  9 2016

-----
                Schedule Menu
-----
                Wed Dec  7 16:51:31 2016

                <1> Enter each event time
                <2> Enter start date & interval
                <3> Enter start date & end date

                <M> Main menu

                Selection [2] ? 2

Enter START date and time [12/07/2016 16:51:34] ? 12/10/16 01:00:00

Enter interval

Days      (0-365) [  0] ? 1
Hours     (0- 23) [  0] ? 0
Minutes   (0- 59) [  0] ? 0
```

Figure 4.5-2: Schedule Menu

Option <1> Enter each event time

This option enters events one at a time (month, day, year, hour, minute, and second). The events do not have to be entered in chronological order and will be automatically sorted.

Option <2> Enter start date & interval

This option enters a start date and a desired interval between the event start times. The interval is entered in units of days, hours and minutes.

```
Selection [2] ? 2
Enter START date and time [03/18/2015 10:25:45] ? 03 18 15 10 45 00
Enter interval
Days      (0-365) [ 0] ?
Hours     (0- 23) [ 0] ?
Minutes   (0- 59) [ 0] ? 20

Schedule Verification

Event 1 of 48 at 03/18/15 10:45:00
Event 2 of 48 at 03/18/15 11:05:00
Event 3 of 48 at 03/18/15 11:25:00
Event 4 of 48 at 03/18/15 11:45:00
. . . ← Display shortened to save space
Event 47 of 48 at 03/19/15 02:05:00
Event 48 of 48 at 03/19/15 02:25:00

Modify an event [N] ?
```

Figure 4.5-3: Schedule – Option 2

Option <3> Enter start date & end date

This option schedules events at regular intervals between the entered start and end dates.

```
Selection [2] ? 3
Enter START date and time [03/17/2015 13:15:14] ? 03/17/2015 13:21:00
Enter END date and time   [03/17/2015 13:15:31] ? 03/18/2015 07:48:00
Schedule Verification
Event  1 of 48 at 03/17/15 13:21:00
Event  2 of 48 at 03/17/15 13:44:33
Event  3 of 48 at 03/17/15 14:08:06
Event  4 of 48 at 03/17/15 14:31:39
. . .
Event 47 of 48 at 03/18/15 07:24:18
Event 48 of 48 at 03/18/15 07:47:51
Modify an event [N] ?
```

Figure 4.5-4: Schedule – Option 3

7. Review to confirm correct dates and times (press any key to scroll the display forward).

```
Schedule Verification
Event  1 of 48 at 03/17/15 13:21:00
Event  2 of 48 at 03/17/15 13:44:33
Event  3 of 48 at 03/17/15 14:08:06
Event  4 of 48 at 03/17/15 14:31:39...
. . . ←————— Display shortened to save space
Event 47 of 48 at 03/18/15 07:24:18
Event 48 of 48 at 03/18/15 07:47:51
Modify an event [N] ?
```

Figure 4.5-5: Schedule Verification

8. Type *Y* to change an event date or time.

Event Parameters Menu

After a schedule is defined, the user is brought to the Event Parameters Menu. The parameters defined here will be applied globally to all events in the deployment.

Event Parameters	
Header	A B C
Water	D Flushing volume = 100 [ml]
Flush	Flushing time limit = 2 [min]
Sample	E Sample volume = 20000 [ml]
	F Pumping flow rate = 200 [ml/min]
	G Minimum flow rate = 75 [ml/min]
	H Pumping time limit = 267 [min]
Fixative	J Enabled
Flush	K Fixative volume = 25 [ml]
	L Pumping flow rate = 150 [ml/min]
	M Minimum flow rate = 100 [ml/min]
	N Pumping time limit = 1 [min]
Antifouling	O Enabled
Flush	P Antifouling volume = 20 [ml]
	Q Pumping flow rate = 150 [ml/min]
	R Minimum flow rate = 100 [ml/min]
	S Pumping time limit = 1 [min]
Data	I Pump data period = 1 [min]
	V Verify and continue.

Figure 4.5-6: Event Parameters Menu

- **Headers:** Options A, B, and C of the Event Parameters Menu allow the user to define three headers to describe the deployment.
- **Water Flush:** To prevent sample contamination and reduce accumulated bio-fouling, the Home Port (Port 0) can be used to flush standing water from the 25 port valve intake tube and valve heads before each sample is collected. Users can program the flush volume here. The flush flow rate will always be the maximum flow rate the pump is capable of, and the time limit is automatically calculated by the system.

- **Sample:** Sample volume, flow rate, minimum flow rate, and pumping time limits are user-programmable, and acceptable values are determined by the system configuration.
- **Data:** Pump data is stored to memory at a set interval while pumping a sample. This interval is user-programmable, and applied to all deployment events.
- **Fixative Flush:** If the PPS is configured with the optional Fixative Valve, the Fixative Flush must be enabled in the Event Parameters Menu. The Fixative Flush is disabled by default, after enabling the Fixative Flush using menu option J, program the available fixative volume. Once these initial steps are completed, global Fixative Flush parameters are defined in the Event Parameters menu. However, specific parameters can also be created for each event.
- **Post-Sample Antifouling Flush (optional):** The PPS can perform an acid flush after sample events if the optional anti foul chamber option is installed. This option uses Port 24 as an antifouling flush chamber, leaving a maximum of 23 sample events. The antifouling flush can be changed for individual samples later in the deployment setup.

Optional Post-Sample Antifouling Flush

This option is enabled on the Configuration menu. The maximum recommended antifouling flush volume for a sample event is the total available volume less 10 divided by the number of events in the deployment.

```
-----  
Configuration: WTS-250M-SV                CF2 V2_05 of Apr  8 2016  
  
-----  
Configuration  
-----  
Fri Apr  8 13:32:57 2016  
  
<1>      50ml pump: No  
<2>     125ml pump: No  
<3>     250ml pump: Yes  
<M>      Maxon motor: Yes  
<P>      Pittman motor: No  
<S>      Fixative valve: Yes  
          Volume: 1000.0 ml  
<A> Antifouling fluid: Yes  
  
<X> Save & Exit    <^C> Cancel & Exit  
  
Selection [] ? a  
  
Is there an Antifouling fluid installed? [N] ? y  
Enter the available antifouling fluid volume (ml) (0.0 to 500.0) [500.0] ? 500
```

Figure 4.5-7: Configuration Menu



Contact mclane@mclanelabs.com to upgrade an older PPS to the antifoul flush option.

Schedule Verification and Modifying Individual Event Parameters

Once the global event parameters are defined and accepted, the next step is the schedule verification.

- All events and their individual parameters are printed to the screen, and the system asks if the user wants to modify any events.
- At this point users can modify individual event parameters by answering 'Y', and specifying which event to modify.

In the example below the user modified the Fixative Flush volume and flow rate of Event 1. Notice in the schedule verification that Event 1 will now only pump a 50 ml fixative flush at 100 ml/min. If no event parameters need modifying, respond 'N' to this question. All data will be saved, and the PPS will return to the Main Menu.

Event 1 Parameters	
Header	A Descriptive Header One B Descriptive Header Two C Descriptive Header Three
Water Flush	D Flushing volume = 100 [ml] Flushing time limit = 3 [min]
Sample	E Sample volume = 10000 [ml] F Pumping flow rate = 100 [ml/min] G Minimum flow rate = 50 [ml/min] H Pumping time limit = 201 [min]
Data	I Sample pump data period = 1 [min]
Fixative Flush	J Enabled K Total fixative volume = 2000 [ml] L Fixative flush volume = 50 [ml] M Pumping flow rate = 100 [ml/min] N Minimum flow rate = 50 [ml/min] O Pumping time limit = 2 [min]
	V Verify and continue.
	Selection [] ? v

Figure 4.5-8: Event 1 Parameters

Schedule Verification											
		Flush	Time	Sample	Flow	Min	Time	Fixative	Flow	Min	Time
		Vol	Limit	Vol	Rate	Rate	Limit	Vol	Rate	Rate	Limit
Event 1:	12/10/16 01:00:00	100	3	10000	100	50	201	75	100	50	2
Event 2:	12/11/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 3:	12/12/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 4:	12/13/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 5:	12/14/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 6:	12/15/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 7:	12/16/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 8:	12/17/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 9:	12/18/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 10:	12/19/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 11:	12/20/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 12:	12/21/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 13:	12/22/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 14:	12/23/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 15:	12/24/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 16:	12/25/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 17:	12/26/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 18:	12/27/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 19:	12/28/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 20:	12/29/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 21:	12/30/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 22:	12/31/16 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 23:	01/01/17 01:00:00	100	3	10000	100	50	201	75	75	50	2
Event 24:	01/02/17 01:00:00	100	3	10000	100	50	201	75	75	50	2

Pump data period: 1 minute
Modify an event [N] ? n

Figure 4.5-9: Schedule Verification

Checking for Event Overlap

After a schedule is accepted, the PPS firmware checks for potential problems, such as expired or overlapping events.

If an overlap occurs during deployment, the start of the next event is delayed until the current event is completed (an overlap condition does not terminate the deployment).

Event overlap is calculated after the sampling parameters have been entered and is based on the acid exposure delay and the duration of the combined flushing and sample volumes at their minimum flow rates. The system compares the time limit of each event to the scheduled start time of each subsequent event.



The warning message indicates that an overlap could occur, not that it will.

Entering a schedule with intentionally short intervals can be a technique to secure rapid, sequential samples. The overlap message is only a reminder and can be ignored if tight scheduling is intended.

```
The following event(s) overlap previous event(s):  
  
    2   3   4   5  
  
The listed events may begin later than their scheduled start.  
Any events that are actually delayed will start as soon as  
earlier events are completed.  
  
Press any key to continue.
```

Figure 4.5-10: Overlap Reminder

One line of system status information displays followed by a message reminder to offload data written to the EEPROM backup during a previous deployment. Disregard the message if the data has already been recovered.



The pre-deployment process checks to confirm that backup batteries are correctly installed. If backup batteries are not detected, the firmware will not accept the ‘Y’ entry to start the deployment.

The data offload reminder and low power sleep check will be followed by a prompt to proceed with or terminate the deployment (a final chance to check the settings prior to deployment). The deployment will not start if the low power sleep test fails.

```
Performing 6 second low-power sleep mode test...

System status: 05/02/16 15:40:08 35.9Vb 27°C Port 00

Caution: Deployment will erase all EEPROM data backup entries.
Proceed with the deployment Yes|No [N] ?
```

Figure 4.5-11: Deploy System

If the main battery voltage is too low to support the deployment, warnings will display.

Proceeding with the Deployment

After the status line (and battery warnings if any), a final prompt displays. Type *Y* to commit to the deployment (or *N* to cancel and return to the Main Menu). Prior to submerging the sampler, disconnect the communications cable from the controller housing. Reconnect the dummy plug to the communications connector on the controller housing and deploy the PPS.

```
Proceed with the deployment [N] ? y

Erasing EEPROM entries .....

>>> Remove communication cable and attach dummy plug. <<<
>>> System is ready to deploy. <<<

03/17/15 13:18:38 Waiting for event 01 of 48 @ 03/17/15 13:21:00

03/17/15 13:18:38 Suspended until 03/17/15 13:21:00 ...
```

Figure 4.5-12: Proceed with Deployment

The PPS enters a low power sleep mode until the time of the first scheduled event. The PPS automatically wakes up and begins sampling at the scheduled time of the first pumping event.

```
>>> Remove communication cable and attach dummy plug. <<<

>>> System is ready to deploy. <<<

03/06/15 10:38:46 Waiting for event 01 of 05 @ 03/06/15 11:30:00
03/06/15 10:38:46 Suspended until 03/06/15 11:30:00 ....
```

Figure 4.5-13: Deploy System

For a bench test, leave the communications cable attached to the PPS electronics to observe the operation of the instrument in the MotoCross window.



Pumping begins whether or not the PPS is on station. Reconnecting the COM cable and typing [CTRL]-[C] will terminate the deployment.

Chapter 5

Deployment and Recovery

Attaching to a Mooring

The PPS can be deployed on different mooring types. Once sampling is complete, the recovery process includes removing the filters and offloading deployment data.

Deployment Preparation

After the Operations steps are completed, deploying the PPS requires the following (in order):

- Connect the battery and close the end cap (see chapter 2 for details about the end cap and connectors).
- Connect the communications cable and confirm firmware deployment settings (see chapter 4 for details about programming the deployment).
- Disconnect the communications cable and attach the dummy plug.
- Attach the PPS to the mooring.

Recovery Procedure

After the deployment is completed, the required steps are:

- Remove the water from the top of the filters.
- Remove the filters for storage and later analysis.
- Offload the deployment data.

Steps for offloading the data are included in this User Manual.

Emptying Water and Removing the Filters

This procedure clears the water above the filters in the filter holders.



Do not open the filter holders until these steps are completed and water is removed from above the filters.

1. Remove the filter holder in tact.
2. Connect the syringe and the 1/8" ID tubing (provided in the toolkit) with the male quick disconnect fitting to the bottom of the filter holder.

3. Using the syringe, create a vacuum on the filter holder to draw the water through the filter. Continue until water is no longer flowing into the syringe.
4. Open the filter holder, carefully remove the filter and store it for analysis.
5. Repeat steps 1-4 for each filter holder.
6. Perform necessary maintenance on the PPS after all filter holders are removed.

Offloading Data

Once the steps are completed to recover the PPS, data can be offloaded. This section contains instructions for running the data offload. The deployment data will display on screen and a log file can be created for use in analysis.

This procedure can be repeated because deployment data remains in memory until a new deployment schedule is created or the batteries are drained and/or removed.



Do not disconnect the battery (which erases the data) until checking the capture files to confirm that the data offload was successful.

1. Start Motocross on the host computer (see Chapter 2 in this User Manual for Terminal emulation details).
2. Within MotoCross, specify a “Capture file” for the offloaded data.
3. If necessary, turn the capture On.

4. Connect the communications cable to a computer and then connect the communications cable to the PPS.



The computer should be on and MotoCross running before connecting to the PPS electronics.

5. From the Offload/Display Data File Menu select option <1>, <2>, <3>, or <4> to display recorded data.

```
Configuration: WTS-125M-SV                CF2 V2_05 of May  9 2016

-----
Offload/Display Data File
-----

Mon Oct 24 13:04:49 2016

<1> Display ALL data
<2> Display event summary data
<3> Display pump data
<4> EEPROM data backup cache

<M> Main Menu

Selection [] ? 1
```

Figure 5-1: Offload/Display Data File Menu

The screens that follow show Option <1> ‘Display ALL Data’.

6. Press any key to offload the data and display to the screen (the data is saved to the Capture filename specified in Step 2). An example data offload file is shown next.

Configuration: WTS-125M-SV CF2 V2_05 of May 9 2016

Offload/Display Data File

Mon Oct 24 13:04:49 2016

- <1> Display ALL data
- <2> Display event summary data
- <3> Display pump data
- <4> EEPROM data backup cache

<M> Main Menu

Selection [] ? 1

Start the capture file now.

Then, press any key to start the transfer. The data file will remain in memory and is not erased by this offload procedure.

Software version: WTS-2.05.c

Compiled: May 9 2016 14:09:28
Electronics S/N: ML12345-03

Data start: 10/24/16 10:57:20
Data stop: 10/24/16 13:04:37

Figure 5-2: Display All Data

HEADER

Bench Test, 10-24-2016

s/n 12345-03

FJH

EVENT PARAMETERS

			Flush Vol	Time Limit	Sample Vol	Flow Rate	Min Rate	Time Limit	Fixative Vol	Flow Rate	Min Rate	Time Limit
Event 1:	10/24/16	11:00:00	100	3	150	100	50	4	25	100	50	1
Event 2:	10/24/16	11:13:20	100	3	150	100	50	4	25	100	50	1
Event 3:	10/24/16	11:26:40	100	3	150	100	50	4	25	100	50	1
. . .												
Event 9:	10/24/16	12:46:40	100	3	150	100	50	4	25	100	50	1
Event 10:	10/24/16	13:00:00	100	3	150	100	50	4	25	100	50	1

Pump data period: 1 minute

DEPLOYMENT DATA

1	10/24/16	11:00:01	25°C	31.7 Vb	Port 00							
Intake flush		100 ml		49 sec	LB 31.7 V	Average I	83 mA	Highest I	90 mA	Port 00	Volume reached	
Sample		151 ml		91 sec	LB 31.7 V	Average I	65 mA	Highest I	72 mA	Port 01	Volume reached	
Fixative flush		26 ml		16 sec	LB 31.7 V	Average I	60 mA	Highest I	63 mA	Port 01	Volume reached	
10/24/16	11:03:22		26°C	31.7 Vb	Port 00							
2	10/24/16	11:13:22	24°C	31.7 Vb	Port 00							
Intake flush		100 ml		49 sec	LB 31.7 V	Average I	89 mA	Highest I	95 mA	Port 00	Volume reached	
Sample		151 ml		91 sec	LB 31.7 V	Average I	68 mA	Highest I	78 mA	Port 02	Volume reached	
Fixative flush		26 ml		15 sec	LB 31.7 V	Average I	65 mA	Highest I	70 mA	Port 02	Volume reached	
. . .												
10	10/24/16	13:00:01	26°C	31.7 Vb	Port 00							
Intake flush		100 ml		49 sec	LB 31.7 V	Average I	87 mA	Highest I	95 mA	Port 00	Volume reached	
Sample		151 ml		90 sec	LB 31.7 V	Average I	61 mA	Highest I	71 mA	Port 10	Volume reached	
Fixative flush		26 ml		16 sec	LB 31.6 V	Average I	67 mA	Highest I	73 mA	Port 10	Volume reached	
10/24/16	13:04:36		28°C	31.7 Vb	Port 00							

Figure 5-3: Offload/Display Data File – Display All (2 of 3)

PUMPING DATA

Pump data period = 1 minute

[event#]	[ml/min]	[ml]	[Vbat]	[Av. Cur]	[High Cur]
1	100	100	31.7	65.0	72.0
2	100	100	31.7	68.0	78.0
3	100	100	31.7	67.0	75.0
4	100	100	31.7	65.0	73.0
5	100	100	31.7	63.0	71.0
6	100	100	31.7	67.0	74.0
7	100	100	31.7	70.0	78.0
8	100	100	31.7	65.0	71.0
9	100	100	31.7	66.0	72.0
10	100	100	31.7	62.0	71.0

End of instrument data file.

Terminate file logging operation now
and press any key to continue.

Figure 5-4: Offload/Display Data File – Display All (3 of 3)

7. After the data is offloaded, stop the Motocross file capture.



The Offload option can be repeated if necessary (the data file remains in memory until a new deployment schedule is created or the batteries are disconnected).

8. From the Main Menu, select <4> Sleep to put the firmware into Suspend mode.
9. Disconnect the COM cable from the controller and reinstall the dummy plug.

Chapter 6

Maintenance and Storage

Several maintenance procedures before and after each deployment provide smooth operation and long instrument life for the PPS. Rinsing the entire instrument assembly with clean fresh water after every deployment is critical to prevent corrosion. Other maintenance recommendations are included in this chapter.

Cleaning the PPS Fluid Paths and Filter Holders

Allowing the buildup of biofouling and salt is detrimental to system performance and will shorten the life of the PPS. Follow the steps in this section to clean the fluid pathways of the PPS after every deployment.



The recommended cleaning solution is a 1:10 hydrochloric acid water mixture.

Preparing To Clean:

1. Follow the steps in Chapter 2 ‘Getting Started with your McLane Sampler’ to establish communications with the PPS.
2. Enter the Manual Operation Menu and select option 1 to align the 25 Port Valve to the home port.
3. Check option 8 of the Manual Operations Menu to make sure the optional Fixative Valve is OFF (the water sample position).
4. Prepare 3 liters of cleaning solution, a container to collect system exhaust, and 9 liters of reverse osmosis or distilled water in separate containers.
5. Find Hose-A, Hose-B, Hose-F, the water container, and the Water Syringe in the PPS toolkit.
6. Fill the container with cleaning solution and place it on top of the 25 port valve.
7. Remove the water flush filter holder (if used).
8. Connect Hose-A to the Water Intake port of the Fixative Valve.

9. Connect Hose-B to the Water Exhaust port of the Fixative Valve, and place the opposite end in the exhaust container.
10. Attach Hose-F to the Water syringe, and fill the syringe with water.
11. Attach the opposite end of Hose-F to Hose-A, and SLOWLY inject water through the pump to prime the pump plumbing.

Pump Cleaning Solution Each Port:

1. Select option 3 of the Manual Operation Menu to advance to port 1.
2. Remove the syringe and Hose-F from Hose-A, and place Hose-A in cleaning solution.
3. Select option 7 of the Manual Operation Menu to pump 100 ml of cleaning solution forward at the 125 ml/minute.
4. When this pumping operation completes, advance to the next port to seal the cleaning solution in the port plumbing.
5. Repeat this process for ports 2-24.

Rinse Each Port:

6. Remove Hose-A from the cleaning solution and place it in a container of neutral water.
7. Select option 7 of the Manual Operation Menu to pump 300 ml of water forward at the 125 ml/minute through port 1.
8. Repeat this process for all ports.
9. After all ports have been cleaned, return to port 0.

Cleaning the Optional Fixative Plumbing

1. Disconnect the Fixative Intake and Fixative Exhaust from their respective bags.
2. Connect Hose-A to the Fixative Intake Hose in the Fixative Box, and place the other end of Hose-A in the cleaning solution.
3. Connect Hose-B to the Fixative Exhaust Hose in the Fixative Box, and place the other end of Hose-B into the exhaust container.
4. Select option 8 of the Manual Operation Menu to switch the Fixative Valve to the ON position.

5. Select option 7 of the Manual Operation Menu to pump 100 ml of cleaning solution forward at the 125 ml/minute.
6. To seal the cleaning solution in the fixative plumbing select option 8 of the Manual Operation Menu to switch the Fixative Valve to the OFF position.
7. Place Hose-A in neutral water, and let the cleaning solution soak for about 10 minutes.
8. After the cleaning solution has soaked for 10 minutes in the fixative plumbing, select option 8 of the Manual Operation Menu to switch the Fixative Valve to the ON position.
9. Select option 7 of the Manual Operation Menu to pump 300 ml of water forward at the 125 ml/min through the fixative plumbing.
10. To seal the cleaning solution in the fixative plumbing select option 8 of the Manual Operation Menu to switch the Fixative Valve to the OFF position.

Final Flush

1. Connect Hose-A to the Water sample Intake port of the Fixative Valve and the other end in the water container.
2. Connect Hose-B to the Water sample Exhaust port of the Fixative Valve, and place the opposite end in the exhaust container
3. Select option 7 of the Manual Operation Menu to pump 300 ml of water forward at 125 ml/minute through port 0.

Clean and Inspect Filter Holders

After the lines have been cleaned and rinsed, open the filter holders and clean the threads and O-rings with alcohol and a lint-free wipe. Inspect the O-rings visually and feel them for wear.

Pump Gears

Periodically examine the graphite pump gears and replace them if there are any visible signs of wear or cracks. To inspect the gears, complete the following steps:

1. Remove the pump from the PPS and remove the four screws that hold the pump head to the pump housing.
2. Carefully remove the pump head from the pump housing (the gears are mounted on the bottom of the pump head). Invert the pump housing for easier removal.

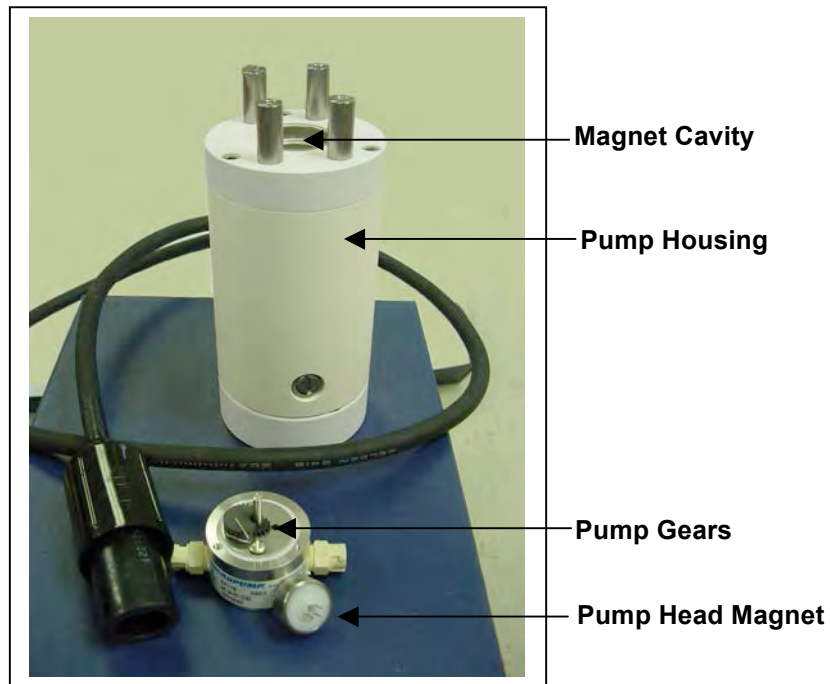


Figure 6-1: Pump Housing, Gears, and Pump Head Magnet



Do not remove the magnet cavity from the pump motor housing (the area under the metal cavity is filled with oil).

Storage

The shipping crate is a reusable international freight container that is ISPM-15 compliant for international transport.



To prevent instrument damage during transport or storage, crate should remain upright. Avoid excessive vibration and extreme temperatures for prolonged periods of time.

There are several procedures to complete before packing the PPS in the crate for storage longer than one month:

- Offload all data from memory.
- Rinse all instrument components with fresh water.
- Flush the valve with fresh water.
- Always disconnect and remove batteries. For a battery pack that is still usable, first cover the connector with insulation tape and then store the battery in a refrigerator.
- Reassemble the main battery holder and insert the electronics package back into the controller housing.
- Replace all bolts and apply a small amount of anti-seize to the threads.

Notes

Appendix A

Adaptive Sampling Firmware

Adaptive sampling firmware provides the user with command-line control over the PPS. By issuing commands from a provided command set, the user has full control over the system and can execute valve movements, pumping operations, and other system functions.



The Adaptive Sampling option requires a continuous RS-232 connection from the PPS to a computer or other microcontroller.

PPS Adaptive Sampling firmware AWT-2_05 and higher includes Antifouling and Solenoid Valve commands, and an Adaptive Deployment option. Adaptive deployment automates many of the necessary steps required to perform a deployment from the command-line interface.

- The Antifouling option replaces Sample 24 with an antifouling reservoir bag and sample container.
- The Fixative Valve option is used to administer a fixative onto the sample filter after the water sample has been taken. See the User Manual for more detailed information.

Adaptive Deployment

An Adaptive Deployment is a deployment that is pre-programmed to perform the same functions as a standard (time-series) deployment, except that a serial command sent to the controller triggers each sample collection. In standard deployment mode, a date and time trigger sample collection.

Adaptive deployment provides a single command that automates many deployment steps, or users can perform on-demand actions by using commands that function the same as the Manual Operations menu in the standard PPS firmware.

Command Prompt

In Adaptive Deployment mode, there is no menu as in the standard firmware. A Command Prompt is displayed as shown below.

```
07/20/2016 09:57:10 AWT ML12345-67>
```

The command prompt is formatted with the current date (mm/dd/yyyy format), current time (hh:mm:ss format), firmware family name, and instrument serial number followed by the “>” symbol.

```

CF2-AWT-2.05 R3 L2.3 | ADEV2.05.c compiled Apr 1 2016 at 14:58
WTS-125M S/N ML12345-67 Adaptive Water Transfer System
© 2010-2016 McLane Research Laboratories. All rights reserved.

Seeking home port ...
Seeking home port...
Port 00
Port 01

Home port located. Aligning... Confirmed
McLane Research Laboratories, Inc.
CF2 Adaptive Remote Sampler
Version 3.04 of Mar 13 2015 08:55
Pump type: Maxon 125ml
Bag capacity: 100

Type "Help" or "?" at the prompt, or with a command.
03/16/15 10:54:00 Suspended ... ? ← Command Prompt
Enter ^C now to wake up ... [^C]
03/20/15 09:57:10 AWT ML12345-67>

```

Figure A-1: Adaptive Deployment Mode

Waking the Instrument from the Command Prompt

Adaptive firmware will automatically enter low-power sleep mode to conserve power after 20 minutes of inactivity. In order to wake the device, enter <CTRL>-C three times with a one second pause between each <CTRL>-C.

Command to Controller	Response from Controller
<CTRL>-C	?
<CTRL>-C	Enter ^C now to wake up ...
<CTRL>-C	03/16/15 11:06:50 AWT ML12345-67> Sampler is now ready to receive commands

AWT Commands (Adaptive PPS Sampling)

The section that follows lists AWT commands included in firmware AWT-2_05 and higher. Some parameters are password protected to prevent accidental configuration changes. Where passwords are required, the entry is *mclane*. Commands are listed in alphabetical order.

Command Help

Command help is displayed by entering “Help” at the command line, or by entering a question mark after a specific command (Figure A-2).

```

07/15/16 10:19:21 AWT ML12345-67>applyfixative ?
-----
APPLYFIXATIVE
-----
Description:
-----
Apply fixative using the provided parameters.
Example: APPLYFIXATIVE 10 100 50 0 1
Syntax:
-----
APPLYFIXATIVE |volume|flow rate|min. flow|time limit|port
  
```

Type command ? for Help

Command description

Command example

Command syntax

Figure A-2: Command Help

Command: ANTIFOUL
Syntax: ANTIFOUL ENABLE or DISABLE
Description: Enables or disables antifoul operations.
Example: 03/20/15 09:57:10 AWT ML12345-67>ANTIFOUL ENABLE 03/20/15 09:57:10 AWT ML12345-67>ANTIFOUL DISABLE

Command: ANTIFOULFLUSH
Syntax: ANTIFOULFLUSH volume flow rate min. flow rate time limit
Description: Performs an Antifouling Flush using the specified parameters.
Example: 03/20/15 09:57:10 AWT ML12345-67>ANTIFOULFLUSH 20 80 50 0

Command: APPLYFIXATIVE
Syntax: APPLYFIXATIVE volume flow rate min. flow rate time limit port
Description: Performs a Fixative Flush using the specified parameters.
Example: 03/20/15 09:57:10 AWT ML12345-67>APPLYFIXATIVE 20 80 50 0 1 Applies 20 ml of fixative to port 1 at 80 ml / min with a min. rate of 50 and an automatically calculated time limit.

Command: BATTERY
Syntax: BATTERY
Description: Displays the battery voltage.
Example: 03/20/15 09:57:10 AWT ML12345-67>battery Battery: 32.1V [Alkaline, 18V minimum]

Command: CLOCK
Syntax: CLOCK mm/dd/yy hh:mm:ss
Description: Sets the date and time.
Example: 03/20/15 10:02:45 AWT ML12345-67>clock 03/20/2015 10:04:06 Clock: 03/20/15 10:04:06

Command: CODES
Syntax: CODES
Description: Displays the pumping termination code table. Pumping codes are displayed in the RESULT command.
Example: 03/20/15 10:04:06 AWT ML12345-67>codes Termination Codes: # description 0 = Pumping in progress 1 = Volume reached 2 = Time limit reached 3 = Min flow reached 4 = Low battery 5 = Stopped by user 6 = Pump would not start

Command: COPYRIGHT
Syntax: COPYRIGHT
Description: Displays the firmware copyright notice.
Example: 03/20/15 10:04:06 AWT ML12345-67>copyright _____ CF2-AWT-2.05 R3 L2.3 ADEV2.05.c compiled Apr 1 2016 at 14:58 WTS-125M S/N ML12345-67 Adaptive Water Transfer System © 2010-2016 McLane Research Laboratories. All rights reserved. _____

Command: DATE
Syntax: DATE mm/dd/yy
Description: Sets the date.
Example: 03/20/15 10:46:20 AWT ML12345-67>date 03/20/15 Clock: 03/20/15 10:47:04

Command: EXIT password required
Syntax: EXIT [<i>password</i>]
Description: Exits the program to the operating system. Restart the program by typing <i>app</i> at the prompt.
Example: 03/20/15 10:47:04 AWT ML12345-67>exit mclane

Command: FORWARD
Syntax: FORWARD volume flow rate min. flow rate time limit
Description: Starts a forward pump operation. If zero is entered for time limit, time limit will automatically be calculated based on the volume and the minimum allowable flow rate.
Example: 03/20/15 10:41:10 AWT ML12345-67>forward 50 100 50 0
<pre> --- command --- ----- result ----- port vol flo min tl vol flowr minfl sec mddyy hhmmss batt V pump cur. code Status 00 50 100 50 2 1.1 69.0 0.0 1 040116 111220 29.8 V 91 mA 0 Status 00 50 100 50 2 2.7 92.0 0.0 2 040116 111221 29.8 V 87 mA 0 Status 00 50 100 50 2 4.3 99.9 0.0 3 040116 111222 29.8 V 80 mA 0 Status 00 50 100 50 2 6.0 100.3 0.0 4 040116 111223 29.8 V 90 mA 0 Status 00 50 100 50 2 7.7 100.3 0.0 5 040116 111224 29.8 V 88 mA 0 Status 00 50 100 50 2 9.4 99.9 0.0 6 040116 111225 29.8 V 89 mA 0 Status 00 50 100 50 2 11.0 99.9 0.0 7 040116 111226 29.8 V 85 mA 0 Status 00 50 100 50 2 12.7 100.3 0.0 8 040116 111227 29.8 V 88 mA 0 </pre>

Command: HELP
Syntax: [<i>command</i>] ?
Description: Displays the help text including syntax.
Example: 07/15/16 10:19:21 AWT ML12345-67>applyfixative ? _____ APPLYFIXATIVE _____ _____ Description: _____ Apply fixative using the provided parameters. Example: APPLYFIXATIVE 10 100 50 0 1 _____ Syntax: _____ APPLYFIXATIVE volume flow rate min. flow time limit port

Command: HISTORY
Syntax: HISTORY
Description: Displays the command history list.
Example: 07/15/16 10:19:21 AWT ML12345-67>HISTORY -1: COPYRIGHT -2: VERSION -3: SERIAL -4: CODES -5: CLOCK 11/11/11 11:11:11 -6: DATE 11/11/11 -7: TIME 11:11:11 -8: TIME -9: BATTERY -10: ID -11: REVERSE 50 100 50 0 -12: PUMPTYPE mclane maxon 125 -13: PUMPTYPE

Command: HOME
Syntax: HOME
Description: Sets the valve to the home position
Example: 07/15/16 10:19:21 AWT ML12345-67>HOME Seeking port 24... Located. Aligning... Confirmed. Seeking home port... Located. Aligning... Confirmed. Port: 00

Command: ID
Syntax: ID
Description: Displays identification information.
Example: 07/15/16 10:19:21 AWT ML12345-67>ID Identity: CF2-ADEV2.05 ML12345-67

Command: MCLANE
Syntax: MCLANE
Description: Displays McLane contact information.

Command: OFFLOAD
Syntax: OFFLOAD ALL
Description: Offloads deployment data.
Example: 03/20/15 10:41:10 AWT ML12345-67> OFFLOAD ALL

Command: OFFLOADEEP
Syntax: OFFLOADEEP
Description: Offloads EEPROM deployment data
Example: Example: 03/20/15 10:41:10 AWT ML12345-67> OFFLOADEEP
<pre> EVENT SUMMARY ----- Event: 1 Start time: 04/01/16 11:26:34 Volume pumped: 101 ml Elapsed time: 61 sec Lowest battery: 29.8 V Average current: 87.0 mA Highest current: 93.0 mA Port used: 00 Stop time: 04/01/16 11:29:41 Status: Volume reached End of EEPROM event backup cache. Terminate file logging operation now and press any key to continue. End of EEPROM data. </pre>

Command: PAUSEDEPLOY
Syntax: PAUSEDEPLOY
Description: Pauses an adaptive deployment. This command is built in because certain commands cannot be executed while there is an active deployment. It is not suggested to enter these commands mid-deployment, but this command makes it possible.

Command: PORT
Syntax: PORT [port]
Description: Displays or sets the valve position.
Example: 03/20/15 10:51:20 AWT ML12345-67>port 1

Command: PRINTPARMS
Syntax: PRINTPARAMS
Description: Print the programmed event parameters.
Example: 03/20/15 10:51:20 AWT ML12345-67>PRINTPARAMS SAMPLE PARAMETERS 04/01/16 11:12:55 Water Flush: Volume [ml] = 100 Flow rate [ml/min] = 100 Min. flow rate [ml/min] = 50 Time limit [minutes] = 3 Sample: Volume [ml] = 101 Flow rate [ml/min] = 101 Min. flow rate [ml/min] = 51 Time limit [minutes] = 3 Fixative Flush: Volume [ml] = 25 Flow rate [ml/min] = 70 Min. flow rate [ml/min] = 50 Time limit [minutes] = 1

Command: PUMPTYPE <i>password required</i>
Syntax: Set pump type: PUMPTYPE password Maxon or Pittman 125 or 250 Display pump type: PUMPTYPE
Description: Displays or sets the pump type.
Example: 03/20/15 10:52:39 AWT ML12345-67>pumptype mclane maxon 250 Configuration successfully stored Pump type: Maxon 250ml

Command: QUIT <i>password required</i>
Syntax: QUIT [<i>password</i>]
Description: Quits the program.
Example: 03/20/15 10:52:39 AWT ML12345-67>quit mclane

Command: REBOOT
Syntax: REBOOT
Description: Reboots system, after confirming the command.
Example: 03/20/15 10:52:39 AWT ML12345-67>REBOOT Reboot the system? [N] ?

Command: REBOOTNOW
Syntax: REBOOTNOW
Description: Reboots system immediately.

Command: RESULT
Syntax: RESULT
Description: Report results for last PUMPING operation. Format: Result port vol flow minf tlim vol flow minf secs date-time batt code
Example:

Command: RESUMEDEPLOY
Syntax: RESUMEDEPLOY
Description: Resumes an adaptive deployment.
Example:

Command: REVERSE
Syntax: REVERSE volume flowrate minflow timelimit
Description: Start a reverse pump operation. If zero is entered for time limit, time limit will automatically be calculated based on the volume and the minimum allowable flow rate.
Example: 03/20/15 10:41:10 AWT ML12345-67>reverse 50 100 50 0 <pre> --- command --- ----- result ----- port vol flo min tl vol flowr minfl sec mmddyy hhmmss batt V pump cur. code Status 00 50 100 50 2 1.1 65.2 0.0 1 040116 111148 29.8 V 89 mA 0 Status 00 50 100 50 2 2.6 88.6 0.0 2 040116 111149 29.8 V 99 mA 0 Status 00 50 100 50 2 4.2 97.4 0.0 3 040116 111150 29.8 V 98 mA 0 Status 00 50 100 50 2 5.8 99.5 0.0 4 040116 111151 29.8 V 98 mA 0 Status 00 50 100 50 2 7.5 99.9 0.0 5 040116 111152 29.8 V 97 mA 0 Status 00 50 100 50 2 9.2 99.9 0.0 6 040116 111153 29.8 V 97 mA 0 </pre>

Command: SAMPLE
Syntax: SAMPLE
Description: Sample next position in an adaptive deployment using the predefined parameters programmed with the set command. The system must be in an active deployment.
Example: See Figure E-3 in this Appendix

Command: SAMPLERESULT
Syntax: SAMPLERESULT
Description: Displays results of last sample.
Example: 03/20/15 10:41:10 AWT ML12345-67>SAMPLERESULT 1 Start: 04/01/16 11:26:34 29.8 Vbat 25.2 °C PORT = 00 Intake Flush PORT 00 100 ml 61 sec LB 29.8 V Average I 83.0 mA Highest I 89.0 mA Volume reached Sample PORT 01 101 ml 61 sec LB 29.8 V Average I 87.0 mA Highest I 93.0 mA Volume reached Fixative Flush PORT 01 25 ml 22 sec LB 29.8 V Average I 57.0 mA Highest I 64.0 mA Volume reached End: 04/01/16 11:29:42 29.8 Vbat 26.0 °C PORT = 00

Command: SERIAL
Syntax: SERIAL
Description: Displays the sampler serial number.
Example: Serial: ML12345-67

Command: SET
Syntax: SET procedure name Procedure parameters (see examples)
Description: Sets event parameters for an adaptive deployment.
Example: Auto calculate time limits by entering zero for time limit value. Example: SET WATER 100 200 50 0 To turn flush off just enter: SET WATER 0 PRE-SAMPLE FLUSH PARAMETERS: SET WATER VOLUME FLOW RATE MINIMUM FLOW RATE TIME LIMIT (Minutes) Example: SET WATER 100 200 50 0 SAMPLE PARAMETERS: SET SAMPLE VOLUME FLOW RATE MINIMUM FLOW RATE TIME LIMIT (Minutes) Example: SET SAMPLE 500 200 50 0 FIXATIVE PARAMETERS (if solenoid valve is installed and enabled): SET FIXATIVE VOLUME FLOW RATE MINIMUM FLOW RATE TIME LIMIT (Minutes) Example: SET FIXATIVE 30 75 50 0 ANTIFOULING FLUSH PARAMETERS (If antifouling is installed and enabled): SET ANTIFOUL VOLUME FLOW RATE MINIMUM FLOW RATE TIME LIMIT (Minutes) Example: 03/20/15 10:41:10 AWT ML12345-67> SET ANTIFOUL 30 75 50 0

Command: SLEEP
Syntax: SLEEP
Description: Invokes low-power sleep.

Command: STARTDEPLOY
Syntax: STARTDEPLOY
Description: Starts an adaptive deployment. Allows user to perform samples using parameters defined with the SET command. The system automatically selects the next port in the deployment and will stop when there are no available ports left to sample.
Example: See Figure E-8 in this Appendix.

Command: STOPDEPLOY
Syntax: STOPDEPLOY
Description: Stops an adaptive deployment.

Command: SV
Syntax: SV ENABLE or DISABLE SV ON or OFF SV FIXATIVE or OCEAN
Description: The SV command has arguments that will enable or disable the solenoid valve, and switch the solenoid valve position. ON is the alternate fluid source (typically a fixative) and off is the resting position, which is plumbed to the primary fluid source (the environment) you can use either the ON/OFF arguments or the OCEAN/FIXATIVE arguments to switch the valve position.
Example: 03/20/15 10:41:10 AWT ML12345-67>SV ENABLE - Configures system with a solenoid valve. 03/20/15 10:41:10 AWT ML12345-67>SV DISABLE - Configures system without a solenoid valve. 03/20/15 10:41:10 AWT ML12345-67>SV ON - Energizes solenoid valve, switches to alternate fluid position. 03/20/15 10:41:10 AWT ML12345-67>SV FIXATIVE Energizes solenoid valve, switches to alternate fluid position.. 03/20/15 10:41:10 AWT ML12345-67>SV OFF - De-energizes solenoid valve, moves to resting position (default fluid position). 03/20/15 10:41:10 AWT ML12345-67>SV OCEAN - De-energizes solenoid valve, moves to resting position (default fluid position).

Command: TIME
Syntax: TIME hh:mm:ss
Description: Sets the time.
Example: 03/20/15 10:41:10 AWT ML12345-67>TIME 11:11:11 Clock: 04/01/16 11:11:11

Command: VERSION
Syntax: VERSION
Description: Displays version information
Example: 03/20/15 10:41:10 AWT ML12345-67>VERSION Version: McLane Research Laboratories, Inc. CF2 Adaptive Water Transfer System Version 2.05 of Apr 1 2016 14:58 Pump type: Maxon 125ml

Command: VOLUME
Syntax: VOLUME ANTIFOUL or FIXATIVE
Description: Sets the available fixative or antifouling fluid volume.
Example: 03/20/15 10:41:10 AWT ML12345-67>VOLUME FIXATIVE 100 03/20/15 10:41:10 AWT ML12345-67>VOLUME ANTIFOULING 100

Using Automated Adaptive Commands

To perform an adaptive deployment, use the SET, STARTDEPLOY and SAMPLE commands. Use the OFFLOAD DATA command to offload the deployment data.

SET Command

With the SET command, the user can predefine water flush, sample parameters, fixative flush, and antifouling flush parameters.

```
03/13/15 10:43:48 AWT ML12345-67>set water 100 100 50 0
Water Flush:
Volume          [ml]          = 100
Flow rate       [ml/min]      = 100
Min. flow rate  [ml/min]      = 50
Time limit      [minutes]     = 3
```

Figure A-3: SET Command

Deploy Commands

The commands STARTDEPLOY and ENDEPLOY start and stop the automated deployment. After the sample event parameters have been predefined, entering STARTDEPLOY starts the deployment. The system clears stored data from the previous deployment, then goes to sleep until the user enters the SAMPLE command to wake the system.

```
03/13/15 10:54:03 AWT ML12345-67>startdeploy
Erasing previous deployment data .....
Deployment started.

04/01/16 11:12:58 Suspended ...
04/01/16 11:20:01 Suspended ...

SAMPLE

04/01/16 11:26:34 Event 1 starting
```

Figure A-4: STARTDEPLOY Command

Sample Command

When the SAMPLE command is entered the system automatically selects the next available port, executes the predefined sample parameters, and records event data. The system locates the next port, confirms alignment and remains in suspend mode until the next sample is automatically triggered (Figure A-5).

The SET command can be run during the deployment to change the sample volume, flow rates and time limits, for the remaining samples.

```

12/10/15 16:14:58 AWT ML12935-01>sample ← Collect Sample
12/10/15 16:15:01 Event 1 starting

FLUSHING INTAKE PORT

-----
| --- command --- | ----- result ----- |
port  vol flo min  tl    vol flowr minfl  sec  mmddyy hhhmss  batt V  pump cur. code
Status 00 | 50 125 100  1 | 0.6 36.4 0.0  1 121015 161503 | 22.5 V  105 mA  0
Status 00 | 50 125 100  1 | 2.0 81.1 0.0  2 121015 161504 | 22.5 V  129 mA  0
. . . ← Shortened to save space
Status 00 | 50 125 100  1 | 47.1 125.0 125.0 24 121015 161526 | 22.5 V  151 mA  0
Status 00 | 50 125 100  1 | 49.2 125.0 125.0 25 121015 161527 | 22.5 V  140 mA  0

Volume reached

Total volume pumped      = 50 ml
Elapsed time of event    = 26 sec
Lowest battery detected  = 22.5 V
Average pump current     = 142 mA
Highest pump current     = 151 mA

Seeking port 01...
Located.
Aligning...
Confirmed.

PUMPING SAMPLE

-----
| --- command --- | ----- result ----- |
port  vol flo min  tl    vol flowr minfl  sec  mmddyy hhhmss  batt V  pump cur. code
Status 01 | 255 125 50  6 | 0.6 36.4 0.0  1 121015 161540 | 22.5 V  108 mA  0
Status 01 | 255 125 50  6 | 2.0 81.5 0.0  2 121015 161541 | 22.5 V  133 mA  0
. . . ← Shortened to save space
Status 01 | 255 125 50  6 | 251.4 125.0 124.6 122 121015 161741 | 22.5 V  150 mA  0
Status 01 | 255 125 50  6 | 253.5 125.0 124.6 123 121015 161742 | 22.5 V  147 mA  0

Volume reached

Total volume pumped      = 255 ml
Elapsed time of event    = 124 sec
Lowest battery detected  = 22.5 V
Average pump current     = 149 mA
Highest pump current     = 153 mA

Seeking port 02...
Located.
Aligning...
Confirmed.

12/10/15 16:18:48 AWT ML12935-01>set sample 200 75 50 0 ← Set Sample Parameters
Sample:
Volume          [ml]      = 200
Flow rate       [ml/min]  = 75
Min. flow rate  [ml/min]  = 50
Time limit      [minutes] = 5
12/10/15 16:19:01 AWT ML12935-01>sample
12/10/15 16:19:04 Event 2 starting ← Collect Sample

FLUSHING INTAKE PORT

-----
| --- command --- | ----- result ----- |
port  vol flo min  tl    vol flowr minfl  sec  mmddyy hhhmss  batt V  pump cur. code
Status 00 | 100 75 50  3 | 0.6 36.8 0.0  1 121015 161906 | 22.5 V  75 mA  0
Status 00 | 100 75 50  3 | 1.6 57.3 0.0  2 121015 161907 | 22.5 V  84 mA  0
← Shortened to save space

```

Figure A-5: SAMPLE and SET Commands

Ending the Deployment

The deployment automatically ends when all available ports have been sampled.

Alternatively, the user can end the deployment at any point using the STOPDEPLOY command.

Once STOPDEPLOY is entered, the automated deployment cannot be restarted.

```
. . . .
Status 01 | 101 101 51 3 | 97.0 100.8 100.8 58 040116 112845 | 29.8 V 90 mA 0
Status 01 | 101 101 51 3 | 98.7 101.2 100.8 59 040116 112846 | 29.8 V 88 mA 0
Status 01 | 101 101 51 3 | 100.4 100.8 100.8 60 040116 112847 | 29.8 V 84 mA 0

Volume reached

Total volume pumped = 101 ml
Elapsed time of event = 61 sec
Lowest battery detected = 29.8 V
Average pump current = 87 mA
Highest pump current = 93 mA

Seeking port 24...
Located.

Aligning...
Confirmed.

Seeking home port...
Located.

Aligning...
Confirmed.

Sample completed. Normal shutdown now in effect.
04/01/16 16:18:10 Suspended ...
```

Figure A-6: Deployment Ends After Last Sample

```
Seeking port 01... Located. Aligning... Confirmed.  
. . . .
```

PUMPING SAMPLE

```
-----  
| --- command --- | ----- result ----- |  
port  vol flo min  tl   vol flowr minfl  sec  mmddyy hhmss  batt V  pump cur. code  
Status 01 | 101 101 51 3 | 1.2 69.8 0.0 1 040116 112748 | 29.8 V 90 mA 0  
Status 01 | 101 101 51 3 | 2.7 92.8 0.0 2 040116 112749 | 29.8 V 88 mA 0  
Status 01 | 101 101 51 3 | 4.4 100.3 0.0 3 040116 112750 | 29.8 V 88 mA 0  
Status 01 | 101 101 51 3 | 6.1 101.2 0.0 4 040116 112751 | 29.8 V 88 mA 0
```

. . . ← Shortened to save space

```
Status 01 | 101 101 51 3 | 97.0 100.8 100.8 58 040116 112845 | 29.8 V 90 mA 0  
Status 01 | 101 101 51 3 | 98.7 101.2 100.8 59 040116 112846 | 29.8 V 88 mA 0  
Status 01 | 101 101 51 3 | 100.4 100.8 100.8 60 040116 112847 | 29.8 V 84 mA 0
```

Volume reached

```
Total volume pumped      = 101 ml  
Elapsed time of event     = 61 sec  
Lowest battery detected   = 29.8 V  
Average pump current      = 87 mA  
Highest pump current      = 93 mA
```

```
04/01/16 11:26:34 AWT ML12345-67> STOPDEPLOY
```

Figure A-7: End Deployment Using STOPDEPLOY

Offload Command

The OFFLOAD command is used any time during the deployment to offload data. This command is available if you use adaptive deployment rather than Manual Operations commands such as PUMP FORWARD.

```

12/10/15 16:27:27 AWT ML12935-01>offload

Software version:  AWT-2.05.c
Compiled:          Dec 10 2015 16:04:04
Electronics S/N:  ML12345-01

Data start:       12/10/15 16:14:53
Data stop:        12/10/15 16:23:53

-----
HEADER
-----
...
...
...

-----
SAMPLE PARAMETERS
-----

```

Event	Flush Vol	Flush Time Lim.	Sample Vol	Flow Rate	Min Flow	Sample Time Lim.	Pump Data Increment
1	50	1	255	125	50	6	Set at
12/10/15 16:14:32							
2	100	3	200	75	50	5	Set at
12/10/15 16:19:01							

```

-----
DEPLOYMENT DATA
-----

1 Start: 12/10/15 16:15:01 22.6 Vbat 23.7 øC PORT = 00
  Intake Flush PORT 00 50 ml 26 sec LB 22.5 V Average I 142.0 mA Highest I 151.0 mA
  Volume reached
  Sample PORT 01 255 ml 124 sec LB 22.5 V Average I 149.0 mA Highest I 153.0 mA
  Volume reached
  End: 12/10/15 16:18:10 22.6 Vbat 23.7 øC PORT = 01

2 Start: 12/10/15 16:19:04 22.6 Vbat 23.8 øC PORT = 00
  Intake Flush PORT 00 100 ml 81 sec LB 22.5 V Average I 88.0 mA Highest I 95.0 mA
  Volume reached
  Sample PORT 02 200 ml 162 sec LB 22.5 V Average I 87.0 mA Highest I 95.0 mA
  Volume reached
  End: 12/10/15 16:23:53 22.6 Vbat 24.0 øC PORT = 02

-----
PUMPING DATA
-----
Pump data period = 1 minute
[event#] [ml/min] [ml] [Vbat] [Av. Cur] [High Cur]
1 125 122 22.5 147.0 152.0
1 125 247 22.5 149.0 153.0
2 75 74 22.5 87.0 94.0
2 75 149 22.5 88.0 95.0

```

Figure A-8: OFFLOAD Command

Using Manual Commands

To perform adaptive sampling with manual commands for each step, use the PORT, FORWARD, and REVERSE commands. Using manual commands do not have a data offload. These commands are equal to using the Manual Operations menu in the standard firmware.

Figure A-9 shows manually commanding the move to Port 1. Manually commanding forward pumping is also shown.

```
12/10/15 15:09:39 AWT ML12935-01>port 1 ← Port 1
Seeking port 01...
Located.
Aligning...
Confirmed.
Port: 01
12/10/15 15:01:10 AWT ML12935-01>forward 100 250 100 0 ← Forward
| --- command --- | ----- result ----- |
port  vol flo min  t1    vol flowr minfl  sec  mmddyy  hhmmss  batt V  pump cur.  code
Status 00 | 100 250 100  2 |  1.0  72.8  0.0  1 121015 150150 | 22.5 V  108 mA  0
Status 00 | 100 250 100  2 |  3.5 160.6  0.0  2 121015 150151 | 22.5 V  132 mA  0
Status 00 | 100 250 100  2 |  6.7 207.4  0.0  3 121015 150152 | 22.5 V  139 mA  0
Status 00 | 100 250 100  2 | 10.3 227.5  0.0  4 121015 150153 | 22.5 V  144 mA  0
```

Figure A-9: Manually Commanding Pumping

Configuring the Fixative Valve and Antifouling Options

If the Fixative Valve or Antifouling options are installed, these options must be enabled in the firmware, and the volume of available fixative or antifouling solution must be defined. Fixative and Antifouling Flush parameters can be predefined and automatically executed in an Adaptive Deployment, or executed manually using the FIXATIVEFLUSH and ANTIFOULFLUSH commands. The following examples explain how to configure a system with the Solenoid Valve and Antifouling option, and how to predefine Fixative and Antifouling Parameters.

Fixative Valve Option

1. Type SV ENABLE to enable the solenoid valve option.

```
07/15/16 10:03:20 PPS ML12345-67>sv enable
Solenoid fixative valve ENABLED
```

Figure A-10: Enabling the Fixative Valve Option

2. Define the available fixative volume.

```
07/15/16 10:03:25 AWT ML12345-67>volume fixative 1000
Available fixative: 1000.0 ml
```

Figure A-11: Defining the Available Fixative

3. Type SET FIXATIVE to define the Fixative Flush parameters.

```
07/15/16 10:04:08 AWT ML12345-67>set fixative 20 100 50 0
Fixative Flush:
Volume           [ml]           = 20
Flow rate        [ml/min]        = 100
Min. flow rate   [ml/min]        = 50
Time limit       [minutes]       = 1
```

Figure A-12: Setting the Fixative Parameters

Antifouling Flush Option

1. Type ANTIFOUL ENABLE to enable the Antifouling Option.

```
07/15/16 10:03:32 AWT ML12345-67>antifoul enable
```

```
Antifouling ENABLED
```

Figure A-13: Enabling the Antifouling Option

2. Define the available antifouling solution volume.

```
07/15/16 10:03:39 AWT ML12345-67>volume antifoul 1000
```

```
Available antifouling solution: 1000.0 ml
```

Figure A-14: Defining the Available Antifouling Solution

3. Type SET ANTIFOUL to define the Antifouling Flush parameters.

```
07/15/16 10:04:17 AWT ML12345-67>set antifoul 20 100 50 0
```

```
Antifouling Flush:  
Volume           [ml]           = 20  
Flow rate        [ml/min]        = 100  
Min. flow rate   [ml/min]        = 50  
Time limit       [minutes]       = 1  
Fixative Flush:  
Volume           [ml]           = 25  
Flow rate        [ml/min]        = 70  
Min. flow rate   [ml/min]        = 50  
Time limit       [minutes]       = 1
```

Figure A-15: Setting the Antifouling Parameters

Adaptive Deployment with Solenoid Fixative and Antifouling

Figure A-16 and A-17 show a deployment with Fixative Valve and Antifouling options enabled.

```

07/15/16 10:04:23 AWT ML12345-67>startdeploy
Erasing previous deployment data .....
Deployment started.
07/15/16 10:04:31 Suspended ...  [^C]
07/15/16 10:05:01 AWT ML12345-67>sample
Seeking home port...  Located. Aligning...  Confirmed.
07/15/16 10:05:23 Event 1 starting

```

```

FLUSHING INTAKE PORT

```

command		result											
port	vol flo min tl	vol flowr minfl sec	mmddy hhhmss	batt V	pump cur.	code							
Status 00	20 100 50 1	0.4 22.2 0.0 1	010136 000225	23.9 V	25 mA	0							
Status 00	20 100 50 1	1.1 41.8 0.0 2	010136 000226	23.9 V	32 mA	0							
. . .													
Status 00	20 100 50 1	18.0 97.8 93.7 14	010136 000238	23.8 V	86 mA	0							
Status 00	20 100 50 1	19.6 98.3 93.7 15	010136 000239	24.2 V	83 mA	0							

```

Volume reached
Total volume pumped      = 20 ml
Elapsed time of event    = 16 sec
Lowest battery detected  = 23.5 V
Average pump current     = 499 mA
Highest pump current     = 868 mA

```

```

Seeking port 01...  Located. Aligning...  Confirmed.

```

```

PUMPING SAMPLE

```

command		result											
port	vol flo min tl	vol flowr minfl sec	mmddy hhhmss	batt V	pump cur.	code							
Status 01	20 100 50 1	0.0 0.0 0.0 1	010136 000252	23.9 V	21 mA	0							
Status 01	20 100 50 1	17.8 98.7 98.3 12	010136 000308	23.7 V	81 mA	0							
Status 01	20 100 50 1	19.5 98.3 98.3 13	010136 000309	24.0 V	84 mA	0							

```

Volume reached
Total volume pumped      = 20 ml
Elapsed time of event    = 14 sec
Lowest battery detected  = 23.7 V
Average pump current     = 0 mA
Highest pump current     = 859 mA

```

Figure A-16: Adaptive Deployment, Solenoid Fixative and Antifouling Enabled (Screen 1 of 2)

Solenoid valve FIXATIVE

APPLYING FIXATIVE

```
| --- command --- | ----- result ----- |
port  vol flo min  tl    vol flowr minfl sec mddyy hhmss  batt V  pump cur. code
Status 01 | 20 100 50  1 | 0.0  0.0  0.0  1 010136 000313 | 24.0 V  11 mA  0
Status 01 | 20 100 50  1 | 17.9 98.7 96.2 13 010136 000327 | 23.8 V  85 mA  0
Status 01 | 20 100 50  1 | 19.6 98.3 96.2 14 010136 000328 | 23.9 V  79 mA  0
```

Volume reached
Total volume pumped = 20 ml
Elapsed time of event = 15 sec
Lowest battery detected = 23.5 V
Average pump current = 0 mA
Highest pump current = 852 mA

Solenoid valve OCEAN

Seeking port 24... Located. Aligning... Confirmed.

ANTI FOULING FLUSH

```
| --- command --- | ----- result ----- |
port  vol flo min  tl    vol flowr minfl sec mddyy hhmss  batt V  pump cur. code
Status 24 | 20 100 50  1 | 0.0  1.7  0.0  1 010136 000350 | 23.7 V  660 mA  0
Status 24 | 20 100 50  1 | 17.9 98.7 98.7 12 010136 000406 | 23.5 V  81 mA  0
Status 24 | 20 100 50  1 | 19.5 98.7 98.7 13 010136 000407 | 23.5 V  81 mA  0
```

Volume reached
Total volume pumped = 20 ml
Elapsed time of event = 14 sec
Lowest battery detected = 22.7 V
Average pump current = 0 mA
Highest pump current = 819 mA

Seeking home port... Located. Aligning... Confirmed.
Sample completed. Normal shutdown now in effect.

Figure A-17: Adaptive Deployment, Solenoid Fixative and Antifouling Enabled (Screen 2 of 2)

Using On-Demand Fixative and Antifouling Commands

Figure A-18 and A-19 shows the commands that allow the user to perform fixative and antifouling on-demand.

```

07/15/16 10:19:24 PPS ML12345-67>applyfixative 10 75 50 0 1

Solenoid valve FIXATIVE

Seeking port 01... Located. Aligning...   Confirmed.

-----
APPLYING FIXATIVE
-----

      | --- command --- | ----- result ----- |
port  vol flo min  tl |  vol flowr minfl sec  mmddyy hhmms  batt V  pump cur. code
Status 01 | 10 75 0 1 | 0.4 25.1 0.0 1 010136 002019 | 23.9 V  19 mA  0
Status 01 | 10 75 0 1 | 1.1 38.0 0.0 2 010136 002020 | 23.8 V  24 mA  0
. . .
Status 01 | 10 75 0 1 | 8.2 69.4 0.0 9 010136 002027 | 23.8 V  39 mA  0
Status 01 | 10 75 0 1 | 9.4 70.7 0.0 10 010136 002028 | 23.9 V  41 mA  0

Volume reached
Total volume pumped      = 10 ml
Elapsed time of event    = 11 sec
Lowest battery detected  = 23.8 V
Average pump current     = 329 mA
Highest pump current     = 415 mA

Solenoid valve OCEAN

Seeking port 24... Located. Aligning...   Confirmed.
Seeking home port... Located. Aligning...  Confirmed.

Port: 00

```

Figure A-18: Applying Fixative

```
07/15/16 10:15:44 PPS ML12345-67>antifoulflush 10 75 50 0
```

```
Seeking port 24... Located. Aligning... Confirmed.
```

```
-----  
ANTIFOULING FLUSH  
-----
```

port	vol	flo	min	tl	vol	flowr	minfl	sec	mmddy	hhmmss	batt V	pump cur.	code
Status 24	10	75	50	1	0.4	22.6	0.0	1	010136	001611	23.9 V	18 mA	0
Status 24	10	75	50	1	1.0	35.5	0.0	2	010136	001612	23.8 V	26 mA	0
Status 24	10	75	50	1	1.7	44.7	0.0	3	010136	001613	23.9 V	31 mA	0
. . .													
Status 24	10	75	50	1	8.0	69.4	0.0	9	010136	001619	23.8 V	45 mA	0
Status 24	10	75	50	1	9.1	71.1	0.0	10	010136	001620	23.7 V	43 mA	0

```
Volume reached  
Total volume pumped      = 10 ml  
Elapsed time of event    = 11 sec  
Lowest battery detected  = 23.7 V  
Average pump current     = 358 mA  
Highest pump current     = 438 mA
```

```
Seeking home port... Located. Aligning... Confirmed.
```

Figure A-19: Applying Antifouling

Appendix B

External Power and RS-422 Communication

The PPS endcap has an 8-pin connector when optional external power and RS-422 communications are installed.



Figure B-1: Endcap with External Power and RS-422 Option

Electronics

The PPS electronics contain an additional circuit board with RS-422 and RS-232 sockets. A jumper controls which communication protocol is active.

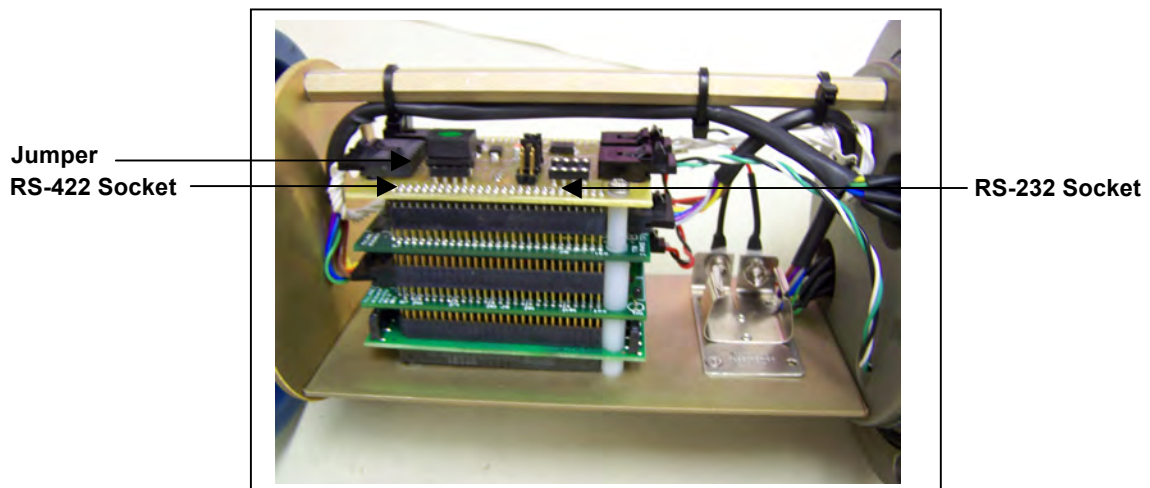


Figure B-2: Electronics with External Power/RS-422 Circuit Board



The PPS runs only one communication protocol at a time (do not connect both COM cables simultaneously). The connected COM cable must match the jumper setting.

Figure B-3 shows the wiring diagram for the External Communication/RS-422 cable.

REV	ECO	DESCRIPTION	DATE	APVD
A		Initial Release	07/07/08	MWB

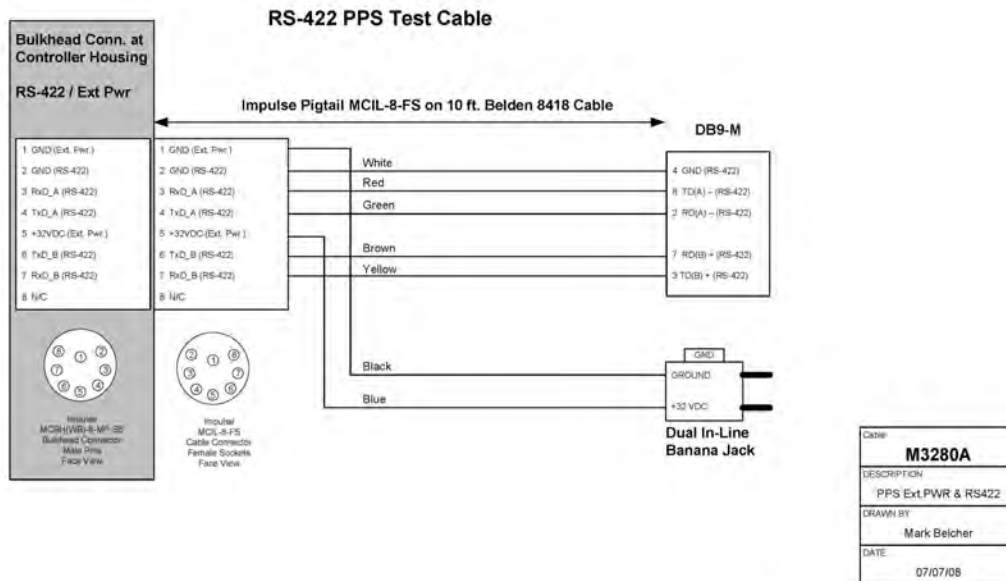


Figure B-3: RS-422 Cable Drawing

Power Requirements

The external power specification is 32 to 36 Volts DC. RS-422 communication is designed for use with external power. Using RS-422 communication with battery power is not recommended because the energy draw is 2.7 mA during lower power sleep. This draw is not an issue under external power, but places a significant drain on battery power (RS-232 communication draws .30 mA from the battery in low power sleep).

Estimated Battery Endurance Calculation with RS-422 Communication

The section that follows provides values and an estimated battery endurance calculation with RS-422 communication. This example uses a one-year deployment. The values for pumping or moving the valve include the current drain of the controller, which is awake during valve rotation and pumping.

Controller unit	3.0 mA
Controller unit in low power sleep (LPS) mode	2.7 mA
Pumping	160 mA
Moving the valve from one port to the next	0.23 mAh (2.7 seconds)

Example of Determining Battery Life for One Year Deployment

Pre-deployment (loading filters)	
Controller unit (3 hours)	$3 \text{ h} \times 3.00 \text{ mA} = 9.0 \text{ mAh}$
Moving valve (25 ports twice around)	$50 \text{ ports} \times 0.23 \text{ mAh} = 11.5 \text{ mAh}$
Reverse pumping (0.5 hour)	$0.5 \text{ h} \times 160 \text{ mA} = 80.0 \text{ mAh}$
	Subtotal = 100.5 mAh
Deployment	
Controller (1 year)	$8760 \text{ h} \times 2.7 \text{ mA} = 23,652.0 \text{ mAh}$
Move valve (24 samples)	$340 \text{ ports} \times 0.23 \text{ mAh} = 78.2 \text{ mAh}$
Pumping (60 minutes per port)	$24 \text{ h} \times 160 \text{ mA} = 3840.0 \text{ mAh}$
	Subtotal = 27,570.2 mAh
Recovery (offload data/remove samples)	
Controller unit (2 hours)	$2 \text{ h} \times 3.00 \text{ mA} = 6.0 \text{ mAh}$
Move valve (once around)	$25 \text{ ports} \times 0.23 \text{ mAh} = 5.8 \text{ mAh}$
	Subtotal = 11.8 mAh
Total Battery Consumption	$100.5 + 27,570.2 + 11.8 = 27,682.5 \text{ mAh}$

In this example, the total energy consumed exceeds the 10,000 mAh capacity of the battery. If using RS-422 communication with battery power, the proposed deployment would not have battery capacity for a one year deployment.

Changing the Communication Protocol

To switch between communication protocols, complete the following steps:

1. Unscrew the bolt/washer assemblies and remove the endcap.
2. Gently slide the electronics out and place on an electrostatically safe surface.
3. Using the circuit tool extractor (provided in the toolkit), gently lift the jumper from the current socket on the External Power/RS-422 circuit board (the RS-422 and RS-232 circuits are labeled, see Figure B-4).

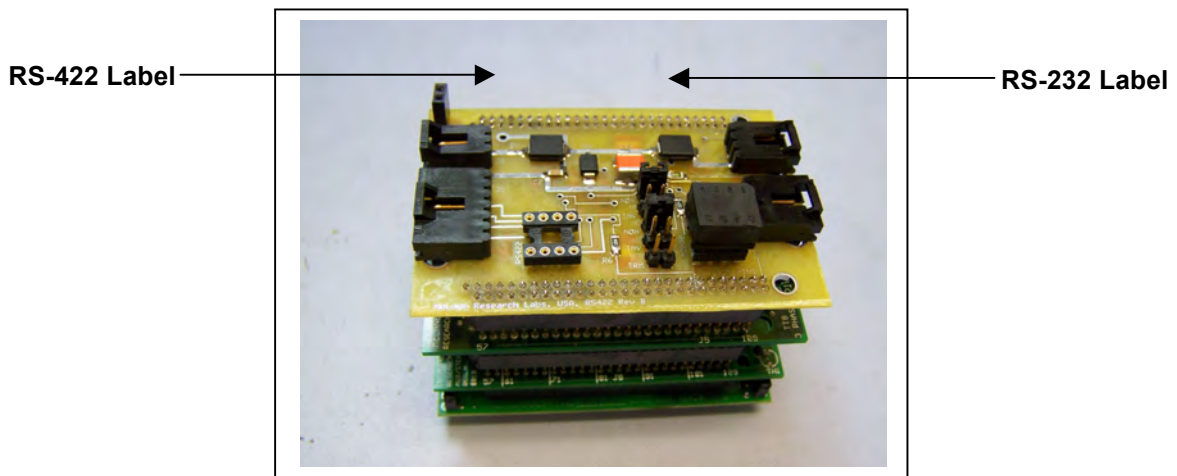


Figure B-4: RS-422 and RS-232 Labels on Circuit Board

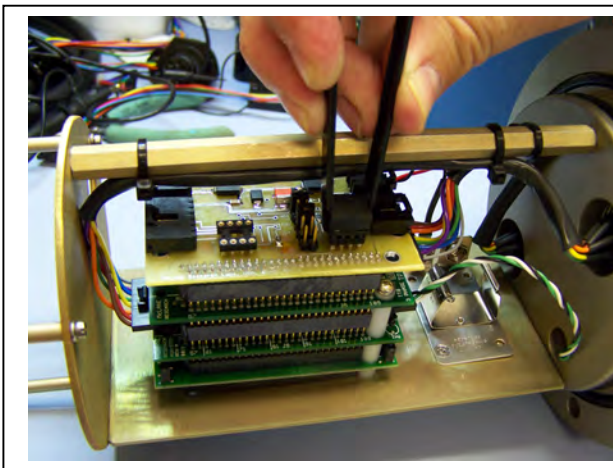


Figure B-5: Gently Grasp Jumper with Extractor

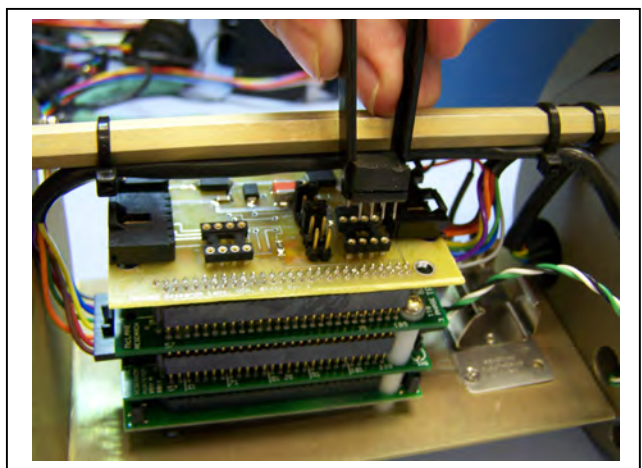


Figure B-6: Lift Jumper Out of Socket

4. Place the jumper in the other socket and press down firmly to secure in place.

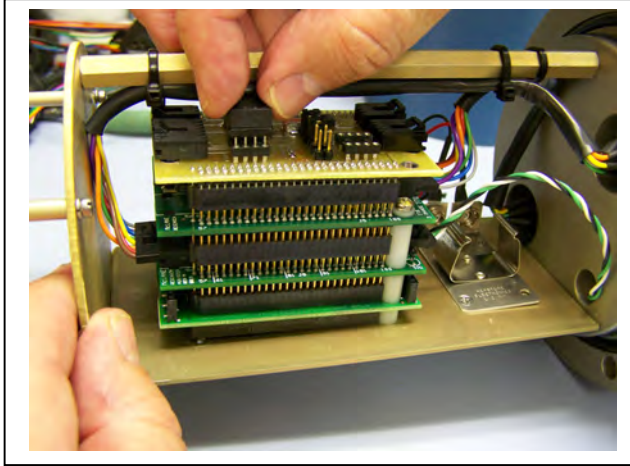


Figure B-7: Place the Jumper in Socket

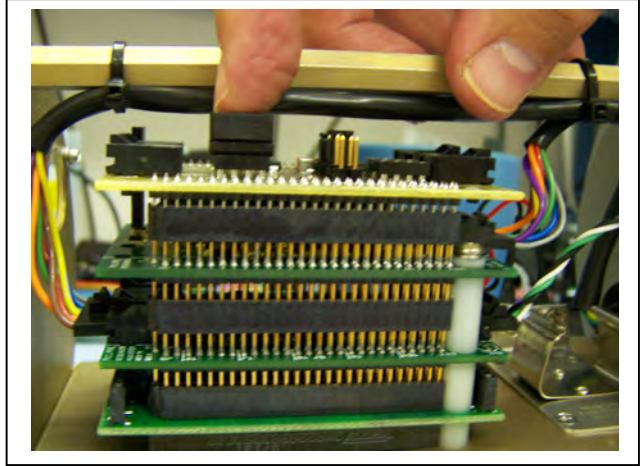


Figure B-8: Press to Secure Jumper

5. Slide the electronics chassis back into the controller housing and secure the endcap.

Appendix C

Training Videos

There is a priming and a battery replacement training video available for the PPS. These videos are included on the media that ships with a new sampler and can also be downloaded from the McLane website at:

<http://mclanelabs.com/phytoplankton-sampler/pps-videos/>.

A description of each video and content is provided below for reference.

Video	Content
Priming the PPS	Illustrates a sample of the PPS priming step that clears lines and valve ports of trapped air. For the complete and most up to date priming procedure, refer to the PPS User Manual.
Replacing the Batteries in the Drop-in Holder	Explains the correct orientation for replacing batteries using a drop-in battery holder.

Appendix D

System Overview with Fixative Valve

The diagram in this Appendix can be used as a reference during priming a PPS with the Fixative Valve option

