Profilers Samplers Flotation

mclanelabs.com

Particle & Phytoplankton Sampler

User Manual

Tel: +1 (508) 495-4000
mclane@mclanelabs.com

Skype: mclane_research
www.mclanelabs.com

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Chapter 1
Introduction

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. Read this manual and keep a copy as a reference if you plan on using a PPS. McLane user manuals are updated frequently and the latest version can always be downloaded from our website.

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:

- Serial number is printed on a label attached to the controller housing, on the Contact McLane screen and also on the Main Menu screen.
- A description of the problem.
- Any relevant capture files (deployment setup, offload data, pumping data stream and so on – capturing all your communications is critical for successful technical support).

Instrument Training

McLane also offers a 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.

Chapter 2
System Description

System Overview

The McLane Particle and Phytoplankton Sampler (PPS) is an autonomous particulate sampler that filters up to 24 individual water samples in time-series with user-defined events. Particulate is collected onto user-supplied 47mm polycarbonate or glass fiber filters (0.65 micron and greater).

Filter pore size is highly dependent on deployment depth and environmental conditions.

Sample contamination by the pump is eliminated because the pump is downstream of the filter. The maximum volume per sample is 10 liters. Recorded deployment data is offloaded from the PPS after deployment and used for sample analysis.

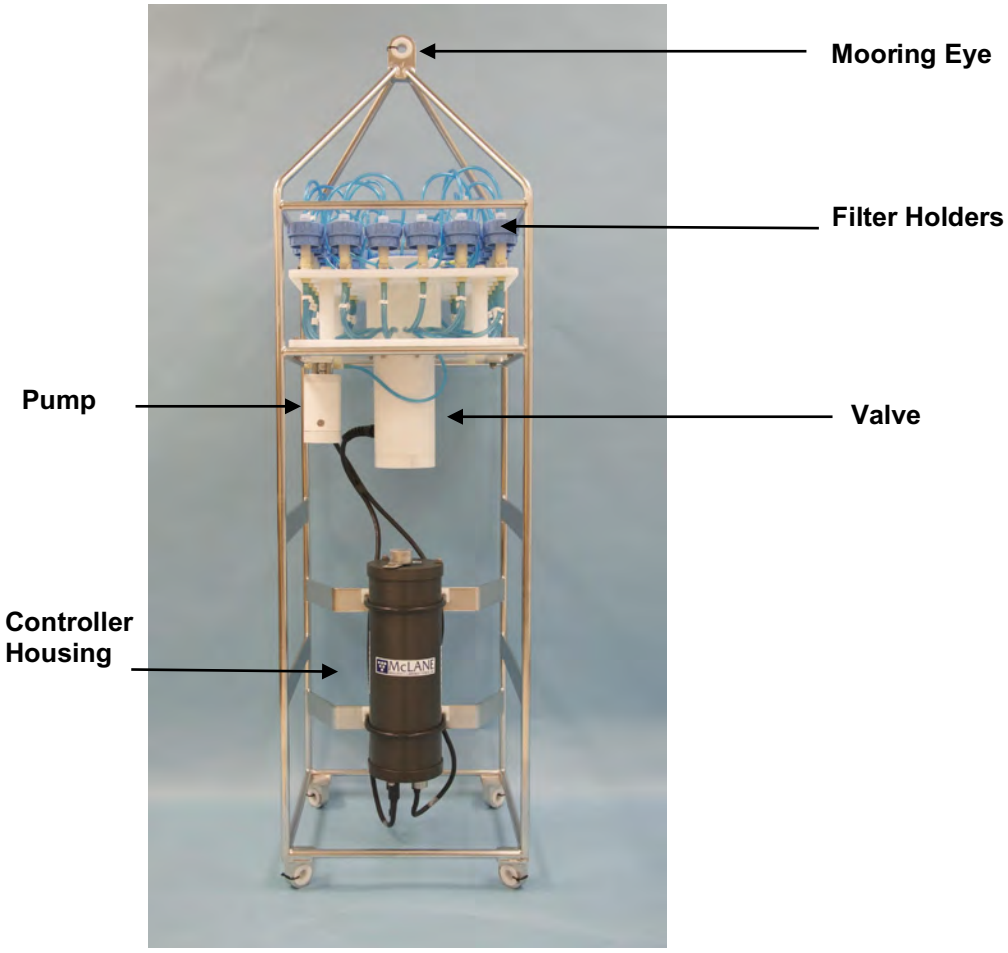


Figure 2-1: PPS Full View

System Components

System Components include the frame, controller housing, end caps, 25-port valve and pump. These components are explained in more detail in the section that follows.

Frame

Components are protected in an electro-polished 316 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 an anodized aluminum alloy cylinder, rated to a depth of 5,500m. The housing holds the battery and electronics. 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 2-2: Controller Housing

End Caps and O-Rings

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

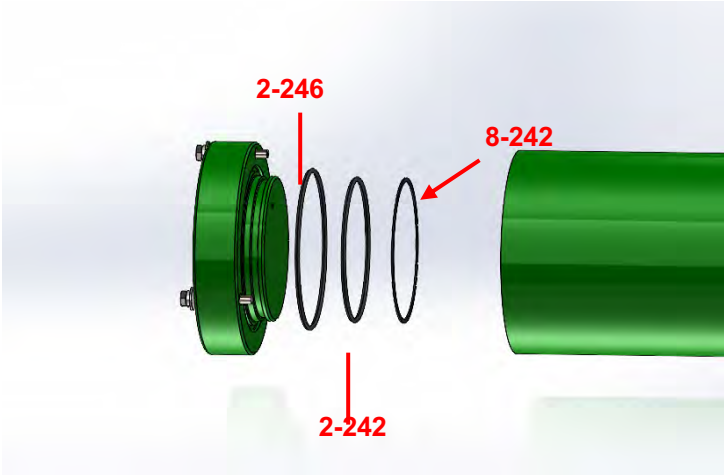


Figure 2-3: Sampler O-Ring Installation – Correct Placement is Critical

End Cap Bulkhead Connectors

The end cap has bulkhead connectors for the Communications connector, Pump, and Valve (Figure 2-4). 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.

Do not overtighten the end cap bolts and do not replace the stainless steel hardware with any other hardware. The Toolkit includes spare hardware, or contact mclane@mclanelabs.com.

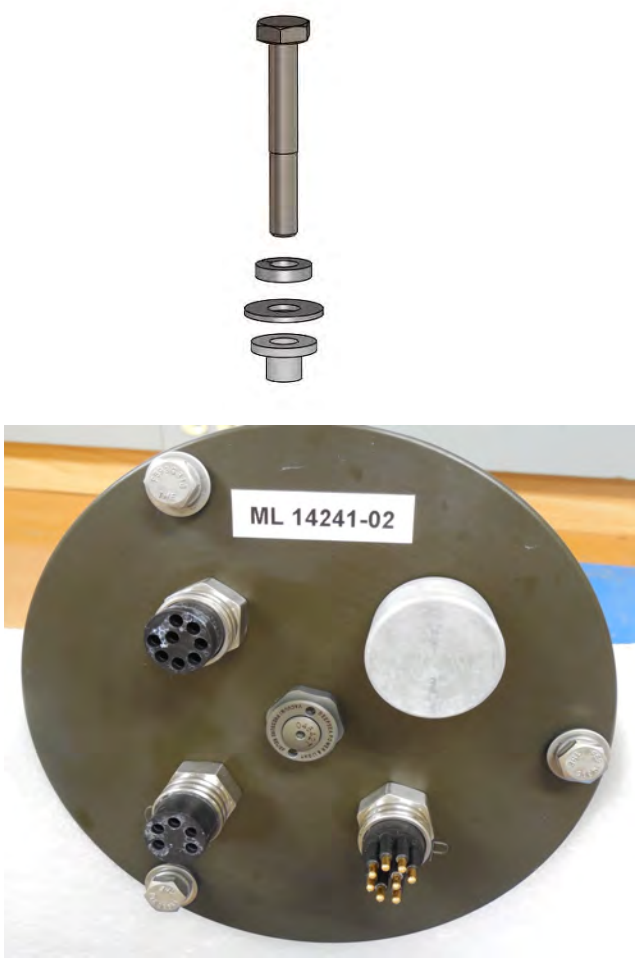


Figure 2-4: Controller Housing End Cap Bulkhead Connectors

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 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. 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 internal 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 PMX-200 (20cSt.) silicone fluid. 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.

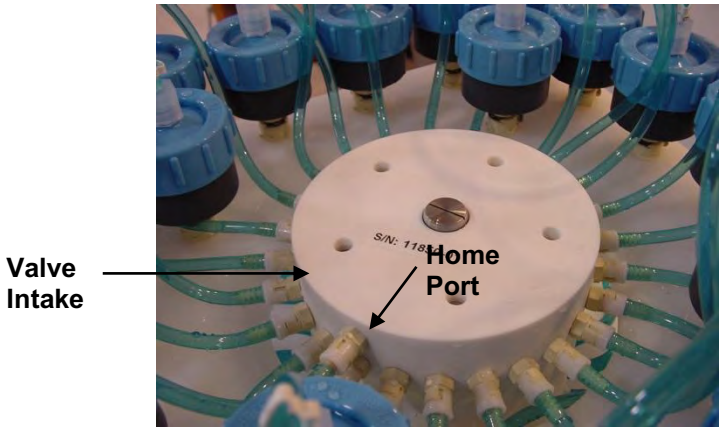


Figure 2-5: Valve

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.

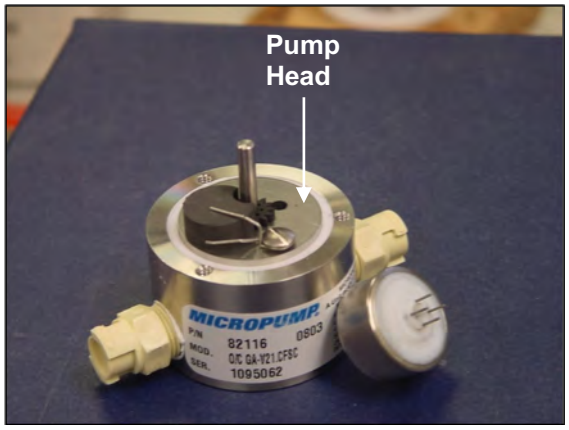


Figure 2-6: Pump Head Gear and Replaceable Magnet

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. Filter holders use standard 70A Durumeter silicone o-rings.

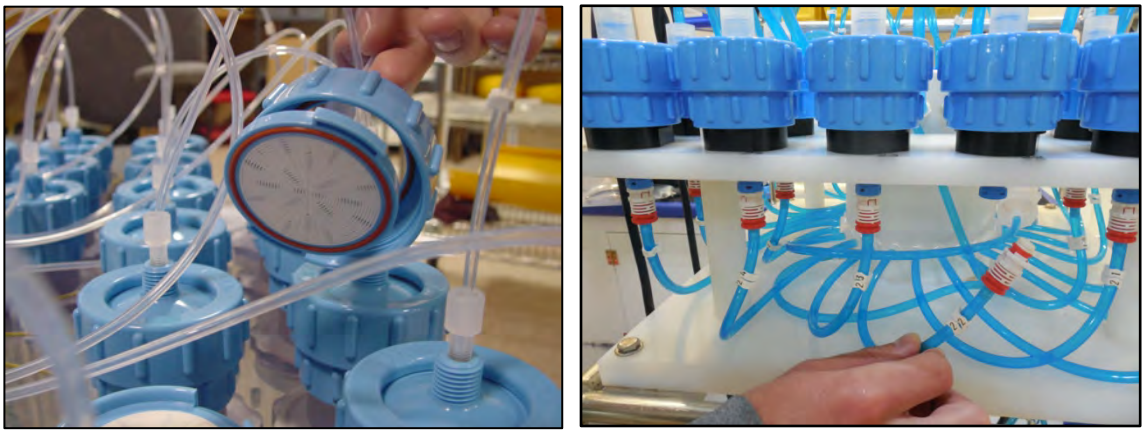


Figure 2-7: Filter Holders

Home Port Flush Filter

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.

Water Flush Filter Holder (Port 0)

Figure 2-8: Water Flush Filter Holder

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. The exhaust bag must be the same size as the intake bag, or larger.

Figure 2-9: PPS Toolkit

The PPS toolkit in Figure 2-9 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

The PPS firmware runs on the Persistor CF2 microcontroller. Older PPS systems use the TattleTale 8 (TT8) microcontroller which is discontinued. Most of this User Manual can apply to both current and older McLane instruments. However, 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.

The PPS electronics communicate using RS-232 serial communications and a terminal emulator, McLaneTerm. See Chapter 4 in this User Manual. "Getting Started" for more information about McLaneTerm which is provided with the system and must be installed on the computer that will connect to the PPS. 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.

Figure 2-10: USB Communications

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 2-11 or a battery pack as shown in Figure 2-12.

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 2-11: Drop-in Battery Holder for ‘D’ Cell Batteries

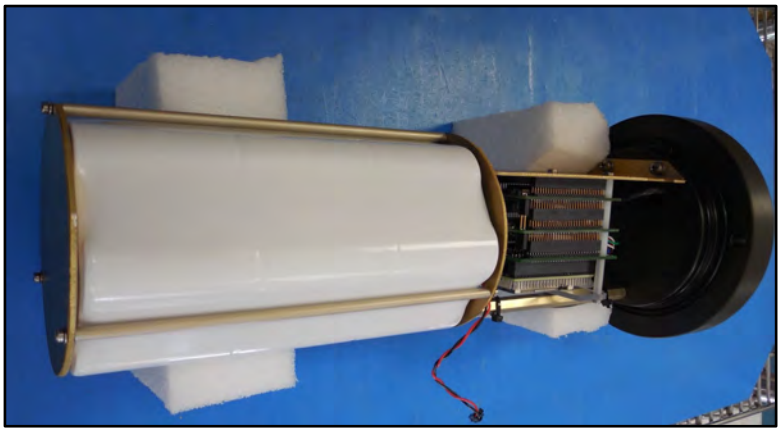


Figure 2-12: A21-1000 Battery Pack

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.

Check your system for backup batteries, if they are installed be sure to replace them before each deployment. On the TT8 microcontroller based devices, the backup battery is a 9 volt battery mounted beside the electronics. On the Persistor CF2 microcontroller based devices, the backup battery is a plastic case with two AAA batteries mounted near the electronics.

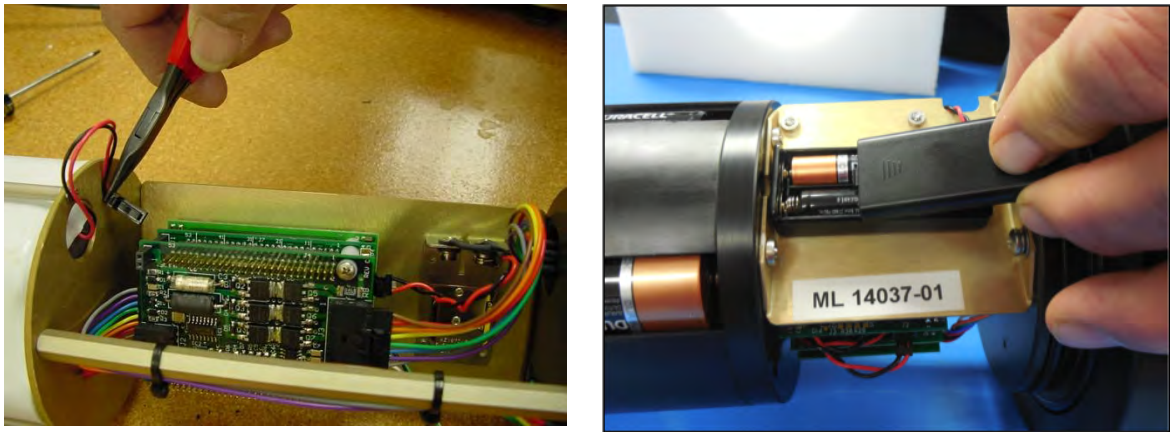


Figure 2-13: Backup Battery 9V and AAA Styles (Older Model PPS systems)

Optional PPS Features

Optional PPS features include:

- Fixative Valve
- Antifouling Solution Reservoir

Optional Fixative Valve

The optional fixative valve is a pair of three-way isolation solenoid valves that allow the PPS to switch the system intake and exhaust between the environment and a fixative solution. When the fixative valve is installed on a PPS a post-sample fixative flush can be programmed to flood the filter holder with a fixative solution immediately after a sample is taken.

PPS systems with the fixative valve option have a 2 liter fixative bag and a 2 liter exhaust collection bag installed inside of a fixative box. Different fixative bag sizes can be configured in the firmware, although the exhaust bag must be the same size as the intake bag, or larger.

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

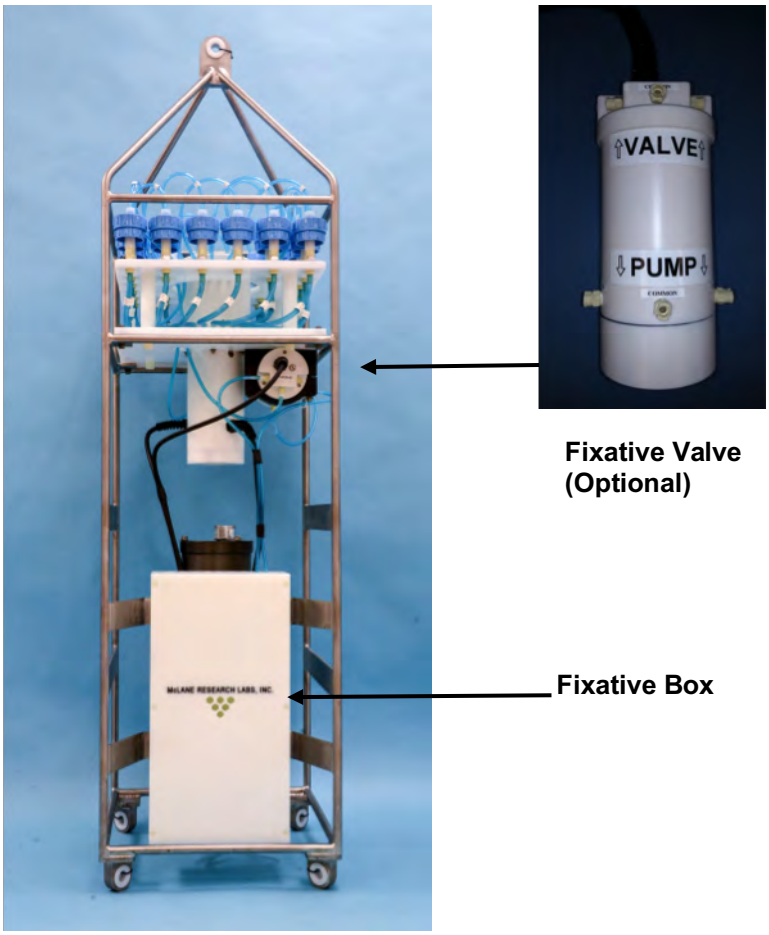


Figure 2-14: PPS with Optional Fixative Valve Box

PPS System Hydraulics with Fixative Valve during a Sample

During a sample, the Fixative Valve is de-energized and in the water position. Ambient 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.

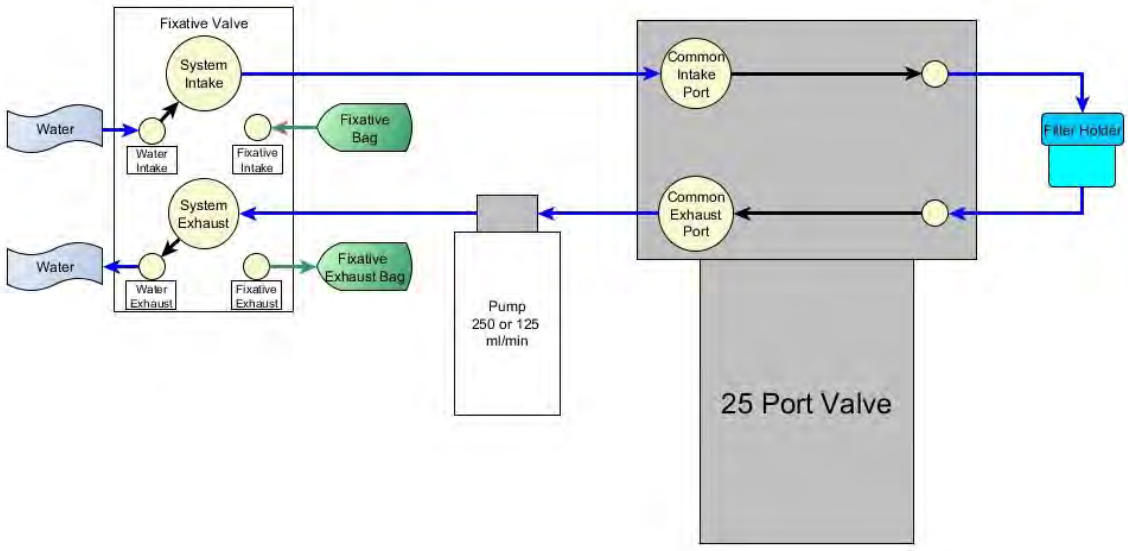


Figure 2-15: Pumping Operation Schematic – Fixative Valve

PPS System Hydraulics with Fixative Valve 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.

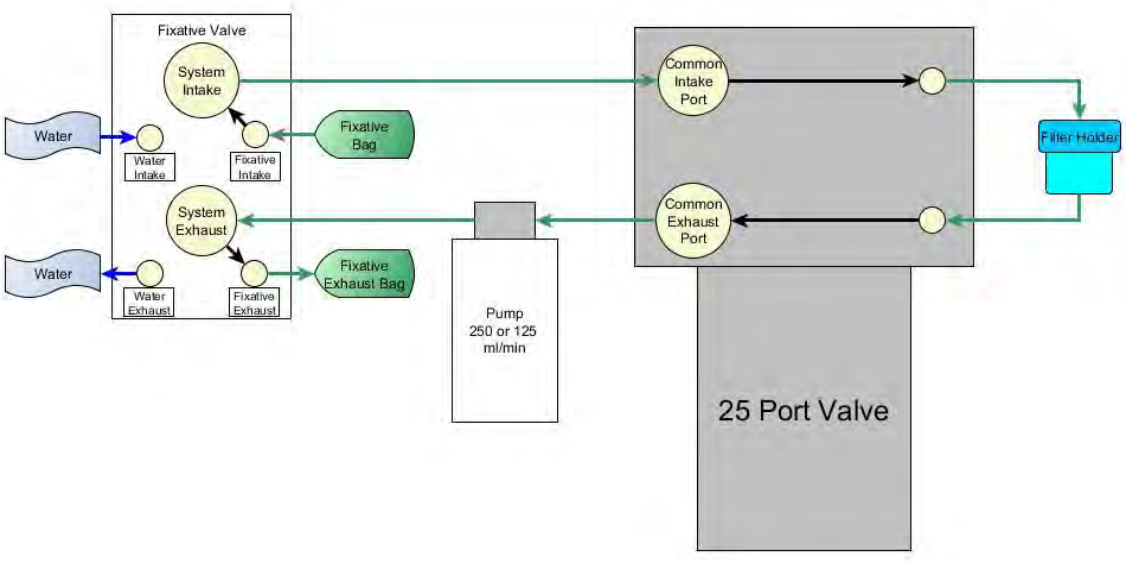


Figure 2-16: Pumping Operation Schematic – Fixative Valve Post-Sample Flush

Optional Antifouling Solution Reservoir

An 800 ml antifouling solution reservoir can be plumbed to port 24 of the 25 port valve, and used to perform a post-sample antifouling flushes. When an antifouling solution reservoir is installed on a PPS, a deployment is reduced to 23 events.

Notes

Chapter 3
PPS Deployment Description

Topics Covered:

- Deployment Overview.
- Water Flush.
- Sample.
- Fixative Flush.
- Antifouling Flush.

Deployment Overview

A PPS deployment is made up of 24 scheduled events, and each event is made up of one or more of the procedures described in this section. Each procedure in a deployment event can have a unique set of user-defined pumping instructions. Every event contains at least a Sample, but can also include a water flush, a fixative flush, and an antifouling flush.

Procedure Parameters

Volume	Volume to be pumped during the procedure.
Flow Rate	The target flow rate of the procedure.
Min. Flow Rate	If filter loading has slowed the flow rate to the minimum flow rate, the procedure is terminated.
Time Limit	If the time limit is reached the procedure is terminated. The time limit is defaulted to the volume / minimum flow rate + 1 minute.

Water Flush

The Home Port (Port 0) can be used to flush standing water from the valve intake tube and common plumbing before each sample is collected. This water flush prevents sample contamination and reduces accumulated bio-fouling.

Parameter	**125 ml / min pump**	**250 ml / min pump**
Flow Rate	100 ml/min	200 ml/min
Volume	0-1000 ml	0-1000 ml

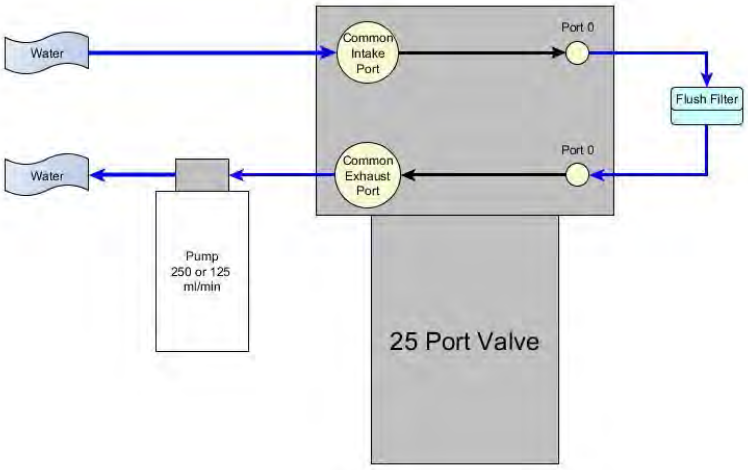


Figure 3-1: Water Flush

Sample

After the water flush the PPS aligns the 25 port valve to the event number filter position and pumps according to the user-defined pumping parameters.

Parameter	**125 ml / min pump**	**250 ml / min pump**
Flow Rate	50 -125 ml / min.	100-250 ml / min.
Minimum Flow Rate	40 - (flow rate - 10) ml / min	75 - (flow rate - 10) ml / min
Volume	10-10,000 ml	10-25,000

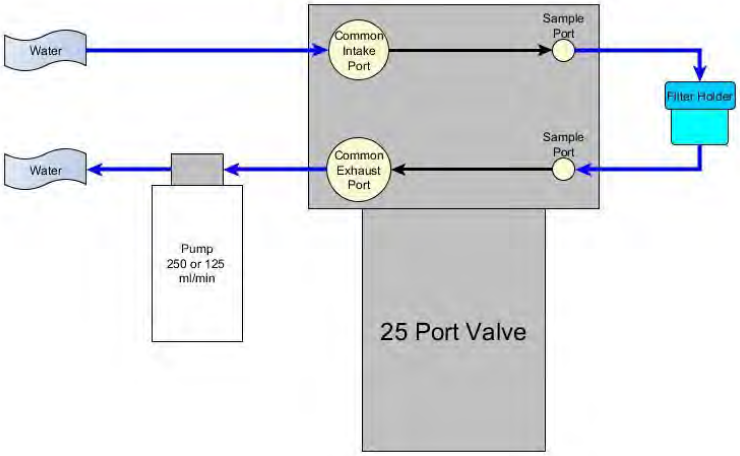


Figure 3-2: Sample

Fixative Flush

If the PPS has the optional fixative valve installed, it can perform a fixative flush immediately after the sample to flood the filter with a fixative solution. Once a sample finishes pumping, the fixative valve is energized and it switches from it's water position to it's fixative position. The pump now draws from the fixative bag, and exhausts into the fixative exhaust collection bag.

Parameter	**125 ml / min pump**	**250 ml / min pump**
Flow Rate	50 -125 ml / min	100 -250 ml / min
Minimum Flow Rate	40 - (flow rate - 10) ml / min	100 - (flow rate - 10) ml / min
Volume	0 – (total fixative / # of events)	0 – (total fixative / # of events)

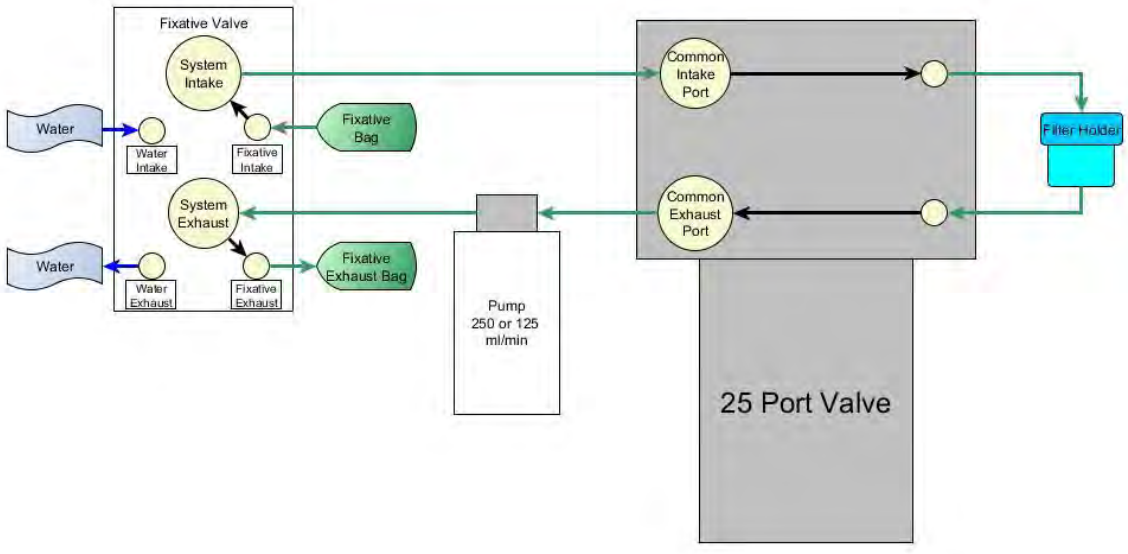


Figure 3-3: Fixative Flush

Antifouling Flush

If the PPS has the optional antifouling reservoir it can finish an event with an antifouling flush. During an antifouling flush the PPS aligns the 25 port valve to port 24 and pumps in reverse into the antifouling reservoir. The water pumped into the reservoir squeezes a bag of antifouling solution, and an equal amount of cleaning solution is pushed through the PPS common plumbing. The cleaning solution remains in all common lines and prevents bio-fouling until the next scheduled event when it is flushed away during the pre-sample water flush.

Parameter	**125 ml / min pump**	**250 ml / min pump**
Flow Rate	50 -125 ml / min.	100 -250 ml / min.
Minimum Flow Rate	40 - (flow rate - 10) ml / min	75 - (flow rate - 10) ml / min
Volume	0 – total antifouling solution / # of events	0 - total antifouling solution / # of events

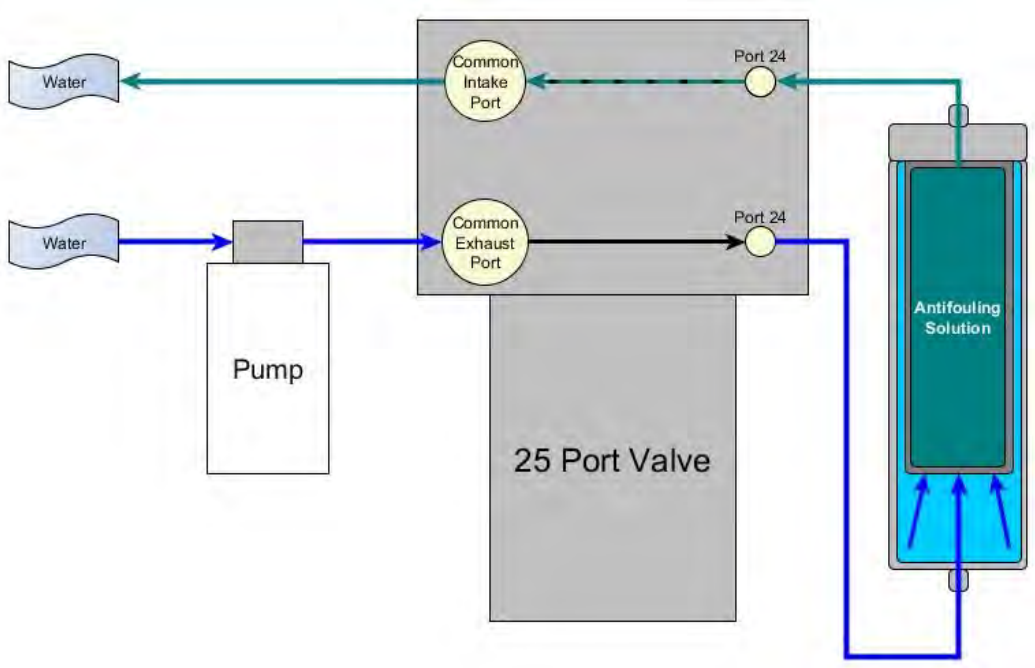


Figure 3-4: Antifouling Flush

Chapter 4
Getting Started

Topics Covered:

- Connecting to a computer.
- Installing and configuring terminal emulation software on a computer.
- Powering up a McLane Sampler.
- Communicating with a McLane Sampler.
- Waking a McLane Sampler from low power sleep mode.

Connecting the Sampler to a Computer

Communicating with your instrument requires connecting the communications cable to a computer running terminal emulation, and configuring the terminal emulation software.

Connecting a Computer

Connect to the instrument by plugging the communications cable from the communications bulkhead on the end cap to a computer RS-232 serial port (the toolkit includes a USB to RS-232 adapter for computers without the built-in RS-232 port). Plug the adapter into the USB port, wait for the drivers to install, and then check the computer's Device Manager for the new USB Serial Port. Windows typically downloads and installs the necessary drivers automatically when the USB to RS-232 adapter is plugged into a USB port.

Figure 4-1: Communications Cable

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

Installing and Configuring McLaneTerm

McLaneTerm is a terminal emulation program for Microsoft Windows used to communicate with serial McLane instruments. With McLaneTerm, you can interact with your McLane instrument's text based interface while it is connected to a serial port on your computer. McLaneTerm replaces the terminal emulation tools MotoCross (for CF2) and CrossCut (for TT8).

Creating capture files of all commands and responses with your McLane instrument is a customer best pratice that is critical for successful technical support.

To follow this section, you will need the McLaneTerm software and McLaneTerm User Manual that was included on the instrument's USB drive. McLaneTerm software and the User Manual can also be downloaded at our website www.mclanelabs.com.

- McLaneTerm uses the standard Windows automatic installation programs. Follow the McLaneTerm User Manual if you need instructions to install McLaneTerm on a computer.
- In the McLaneTerm User Manual, follow the sections "Settings" and "Using Commands" to properly setup McLaneTerm software.
- When communication with your McLane instrument is established, proceed to the section that follows next in this User Manual "Powering up the Sampler".

McLaneTerm system requirements: Windows® 7 or higher.

Powering up 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

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.

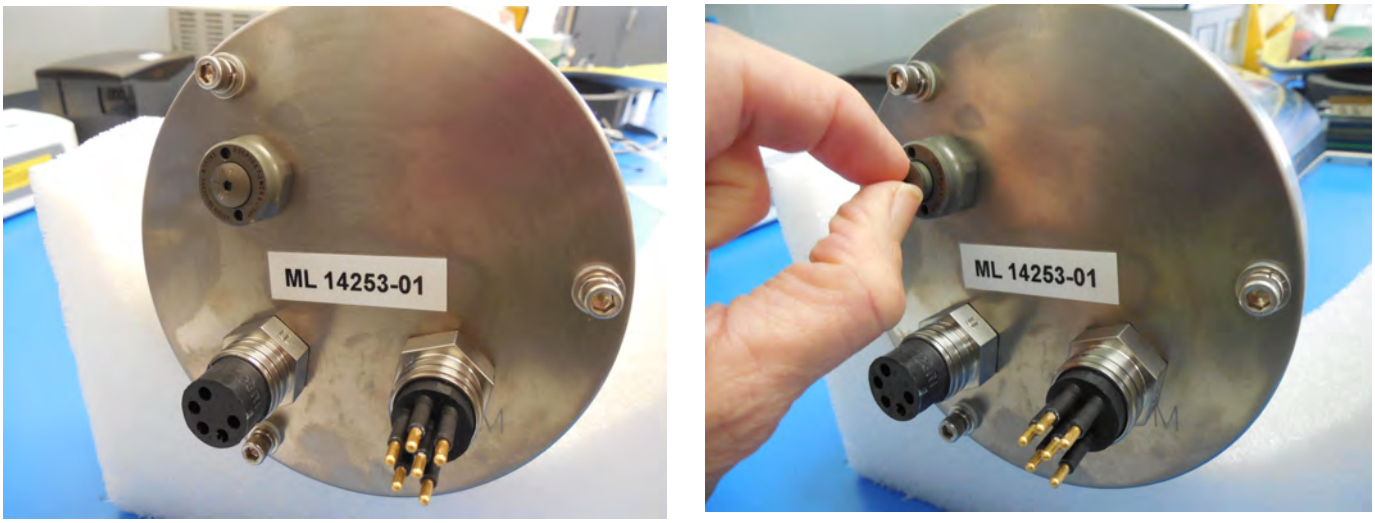


Figure 4-2: Releasing Pressure Relief Valve (Flat Style)

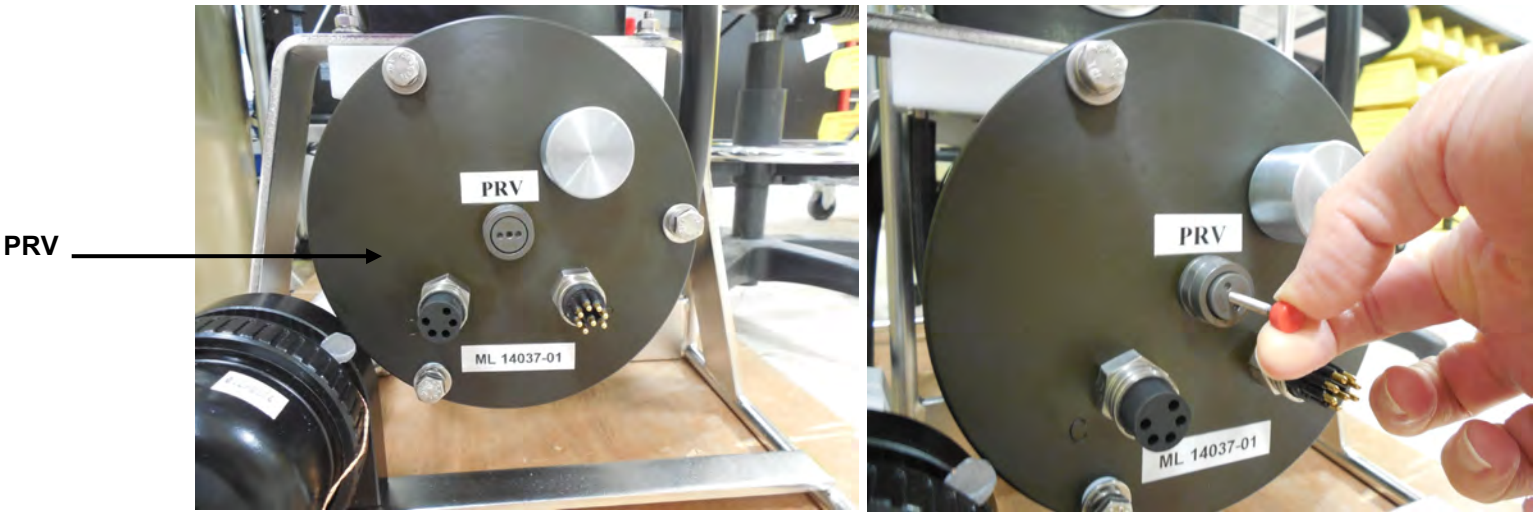


Figure 4-3 Releasing Pressure Relief Valve (Style with Release Tool)

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

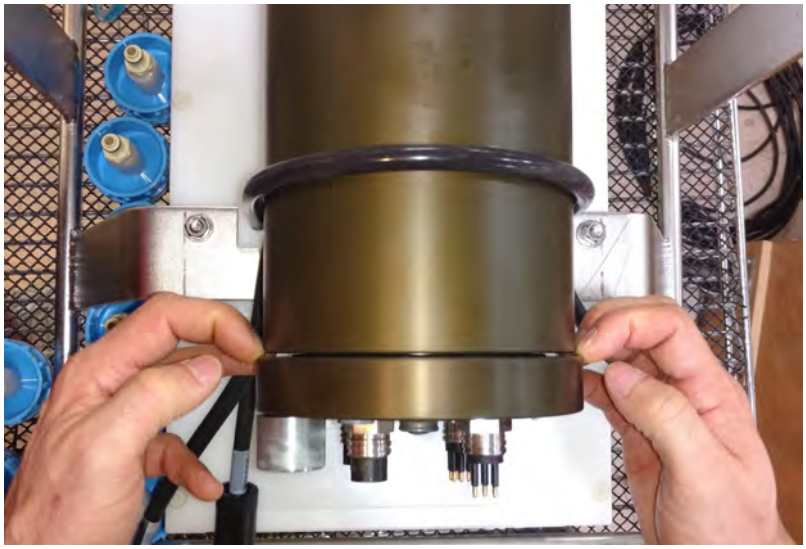


Figure 4-4: *Separating the Housing and End Cap*

Connecting the Batteries

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 4-5: *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 elminated. If deploying a PPS that still has a backup battery, install a fresh battery before every deployment.

Establishing Communication with the Firmware

1. Find the communication cable provided in the toolkit.
2. Connect the communications cable to the computer serial communication port before connecting to the communications connector on the controller end cap.

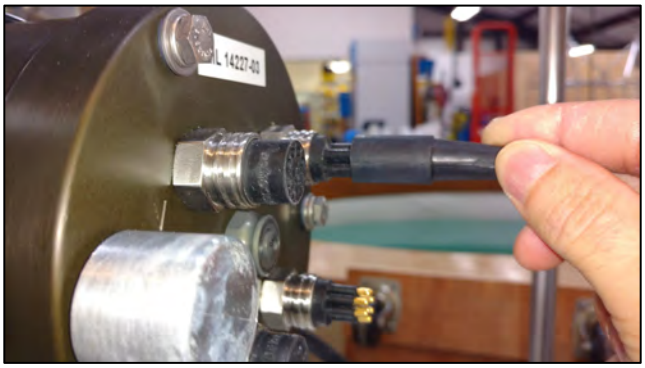


Figure 4-6: Connecting the COM Cable

3. Align the bulkhead connection pins, and push the bulkhead in place on the controller end cap.
4. On the computer, open a properly configured McLaneTerm window.
5. Connect the DB9 end of the communication cable to the computer communication port configured in McLaneTerm.
6. Enter [CTRL]-[C] in McLaneTerm. 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.

Waking the Sampler from Low Power Sleep Mode

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 4-7).

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> Contact McLane
```

Figure 4-7: Main Menu

Notes

Chapter 5
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.

Topics covered:

- PPS Menu System.
- System Configuration.
- Setting the System Time.
- System Diagnostics.
- Manual Operations.

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.

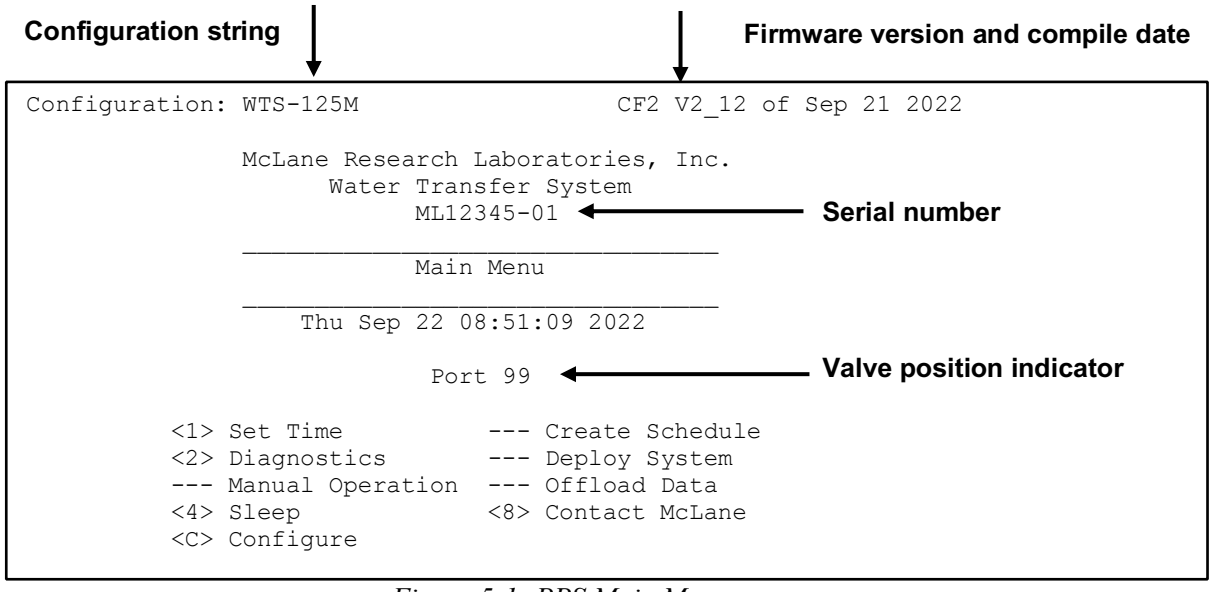


Figure 5-1: PPS Main Menu

- **Configuration String**: The configuration string indicates the current instrument configuration. The configuration string in Figure 5-1 indicates the PPS is part of the WTS (Water Transfer System) family, and has a 125 ml/minute Maxon Pump.
- **Firmware Version**: 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.

<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.

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 09/22/2022 08:52:12

Format is mm/dd/[yyyy or yy] hh:mm:ss

Enter correct time [09/22/2022 08:52:13] ? 09/22/2022 08:52:18

Clock reads 09/22/2022 08:52:18.  Change [N] ?
```

Figure 5-2: Set Time

The Date/Time can be pasted using McLaneTerm. See the section 'Using Commands' in the McLaneTerm User Manual for more information.

<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. Diagnostics data printed to the screen can be paused and resumed by entering any key into by entering any key into McLaneTerm (terminal emulation). Exit and return to the main menu by entering [CTRL]-[C].

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

09/22/2022 08:52:23  33.7 Vb  24°C
09/22/2022 08:52:24  33.7 Vb  24°C
09/22/2022 08:52:25  33.7 Vb  24°C
09/22/2022 08:52:26  33.7 Vb  24°C
```

Figure 5-3: Diagnostics

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 reminding the user to offload data.

<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. The pump can be stopped at any time by pressing [CTRL]-[C]. Forward and reverse directions pump 100mL of water at 75ml/min.
- **Manual Fixative Valve Operation**: If the PPS has a Fixative Valve installed, Option 8 of the PPS Manual Operation Menu switches between the OFF (Water sample) and ON (Fixative) positions.
- System Flush: If the PPS has a Fixative Valve installed, Option 9 on the PPS Manual Operation Menu clears the fixative valve plumbing. The fixative flush can be set from 10 - 300 seconds, with a default of 60 seconds.

```
Configuration: WTS-125M-FV-AF            CF2 V2_12 of Sep 21 2022

                  Manual Operation
                  Thu Sep 22 08:51:54 2022

                           Port 99

          <1> Find port : home
          <2> Find port :
          <3> Next port : advance
          <4> Next port : retreat
          <5> Run pump forward (100 ml @ 75 ml/min)
          <6> Run pump reverse (100 ml @ 75 ml/min)
          <7> Run pump programmable
          <8> Fixative Valve: OFF
          <9> System flush
          <M> Main Menu

          Selection [1] ? 9
```

Figure 5-4: Manual Operation Menu

```
9

How long do you want to flush each port for (10-300 seconds) (10-300) [60] ?

Flush fixative valve plumbing [Y] ?

Continue with system flush? [Y] ?

Flushing fixative valve.

Fixative valve position: FIXATIVE

  Pump   | Hall       | Average   |  Volume    |    Flow      |  Elapsed   |  Batt.  |  Pump   |
  Drive  | Hz         | Hall Hz   |  Pumped    |    Rate      |  Seconds   | Voltage | Current |

   1600 h    104 I_Hz     26 A_Hz       0.7 ml   43.5 ml/min        1 sec    30.0 V    100 mA
   1990 h    242 I_Hz     86 A_Hz       2.4 ml  101.2 ml/min        2 sec    30.2 V     93 mA

Result:             Stopped by user
Elapsed Seconds:    3
Volume:             3 ml
Lowest Flow Rate:   125.0 ml
Lowest Battery:     30.0 V

Fixative valve position: WATER
```

Figure 5-5: Fixative System Flush

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

<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 <4> Sleep option of the Main Menu. 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. To wake the system and return to the Main Menu, hold down [CTRL]-[C] until the system wakes up.

```
           Selection [] ? 4

10/24/16 10:10:51 Suspended ...
```

Figure 5-6: Suspend/Sleep Mode

<5> Create Schedule

The Create Schedule menu option allows users to define a deployment schedule without deploying the system immediately after. Defining a deployment schedule is described in more detail in Chapter 6, “Deployment Preparation”.

<6> Deploy System

The Deploy System menu option will check that deployment schedule was defined. If a deployment schedule is not defined, it will prompt the user to define a schedule and deployment parameters. Once a schedule and deployment parameters have been defined the system will perform pre-deployment system checks, and put the sampler into low power sleep mode until the first programmed deployment event time. System deployment is described in more detail in Chapter 6, “Deployment Preparation”.

<7> Offload Data

The Offload Data menu option will print the data gathered during a deployment to the screen. Users can capture this data by setting up a capture file in McLaneTerm. Offloading data is described in more detail in Chapter 6, “Deployment Preparation”.

<8> Contacting McLane

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

```
Selection [] ? 8
                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: WTS-125M-FV-AF
                   Software version: WTS-2_12
                       Source file: CF2-C
                  Electronics S/N: ML12345-01
                  Compiled: Sep 21 2022 10:53

Press any key to continue.
```

Figure 5-7: McLane Contact Information

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-125M                  CF2 V2_12 of Sep 21 2022

                  ____________________________________
                          Configuration Menu
                  ____________________________________
                      Thu Sep 22 08:51:15 2022


          <A> Pump                            [Maxon 125ml]
          <B> Fixative  valve                 [No]
          <C> RBR CodaT temperature sensor    [No]
          <D> Antifouling fluid reservoir     [No]
          <E> Max Sample Volume Per Sample    [10000]

          <X> Save & Exit
          <^C> Cancel & Exit
          Selection [ ] ?
```

Figure 5-8: Configuration Menu

Configuring the System

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 30 liters.

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 30 liters. If different bag sizes are used, the intake and exhaust bags must be the same size.

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>.

Chapter 6
Deployment Preparation

Topics covered:

- Closing and sealing the controller housing
- Priming the PPS filter holders and plumbing.
- Installing the water flush filter.
- Preparing the optional fixative valve for a deployment.
- Preparing the optional antifouling flush reservoir.
- Programming deployment parameters
- Starting a deployment.

Closing and Sealing the Controller Housing

Before priming, the controller housing end cap should be closed and sealed. Always inspect o-rings for signs of wear and the presence of any foreign material (which can cause leaks). Look for small cracks and feel for grit, sand, or hair. Clean o-rings with alcohol and lubricate with a thin coating of o-ring grease as necessary.

See Chapter 2, "System Description", for details about the end cap and o-rings. Position the larger o-ring in the axial groove to seal against the face end of the pressure housing. Fit the smaller o-ring and the backup ring in the radial groove. Position the backup ring on the low pressure side of the radial groove (toward the interior of the controller housing). The backup ring concave side faces toward the round o-ring. The accompanying o-ring is seated on the concave side (high pressure side) of the backup ring.

Checking the Zinc Anodes

Inspect, and if necessary, replace the zinc anodes attached to the controller housing top and bottom end caps. When installing new zinc anodes, use 316 stainless steel hardware and include the o-ring. Spare zincs can be ordered from McLane.

Priming the PPS

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. These required tools are included in the tool kit:

- 7/16 hand driver (to open and close the enclosure)
- Hose-A
- Hose-B
- Hose-C
- Hose-G
- Luer lock water syringe
- Water container filled with neutral water.
    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).

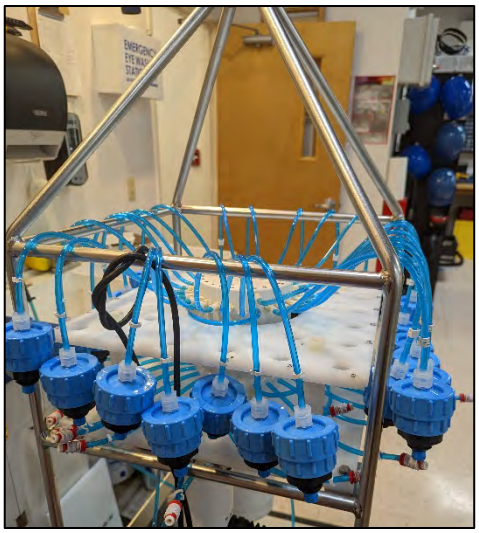
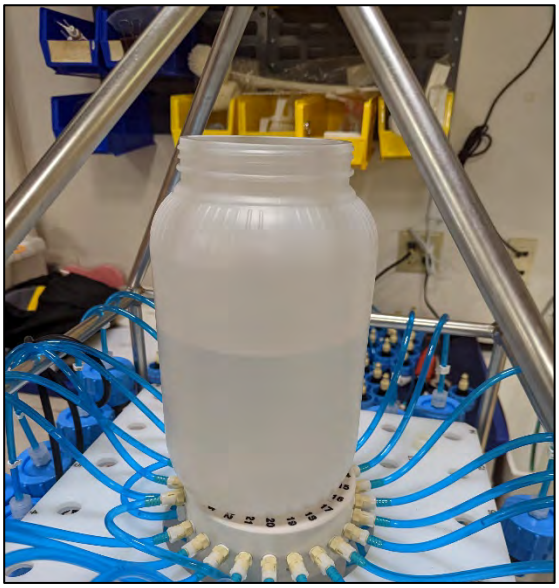


Figure 6-1: Priming Setup

5. Disconnect bottom tubing from all of the filter bodies.
6. Disconnect Filter bodies from the filter base plate, but keep the tops of the filter bodies connected to the 25 port valve.
7. Place a container of neutral water on top of the 25 port valve.



6-2: Priming container

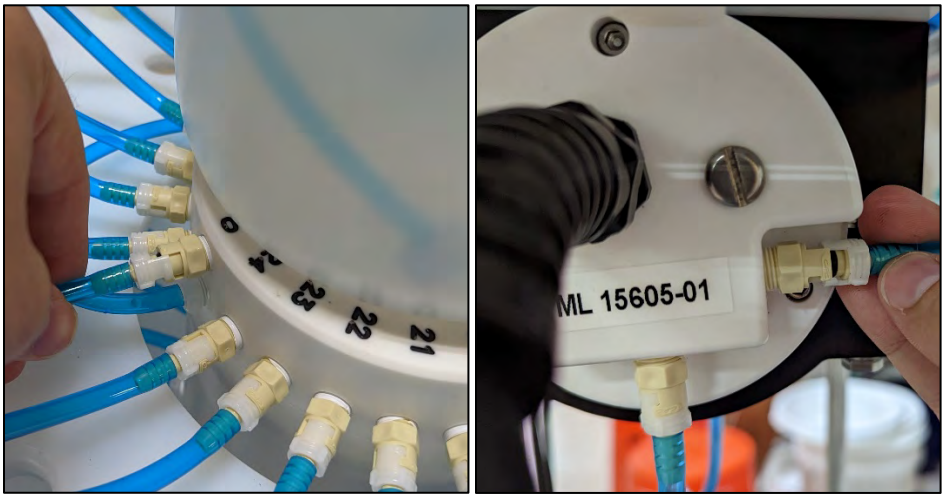


Figure 6-3:Hose-A connection without (left) and with (right) fixative option

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.
9. Place the opposite end of Hose-A in the water container.

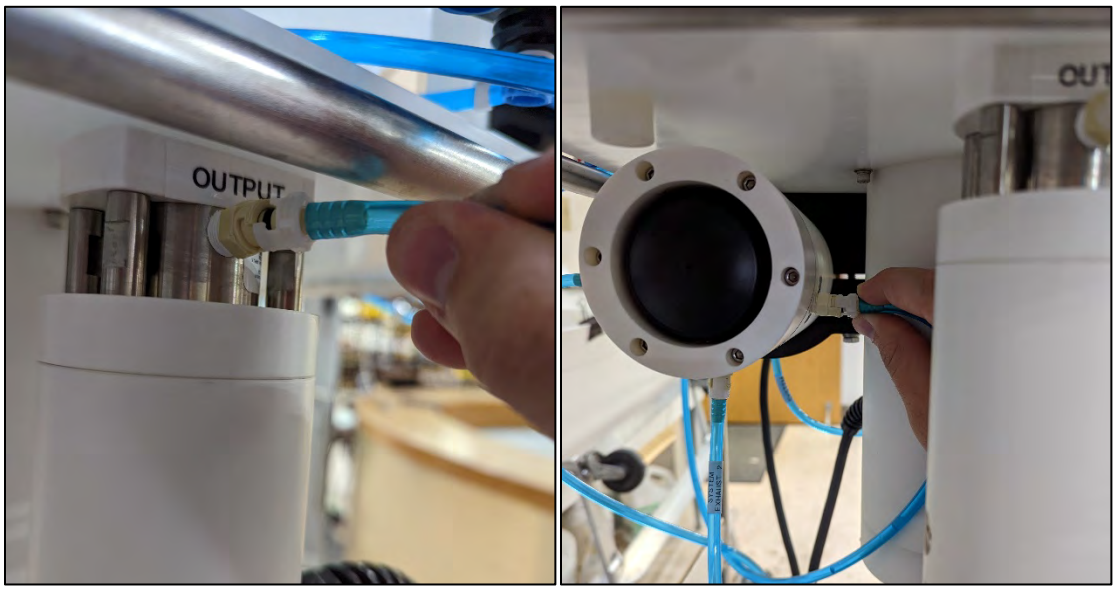


Figure 6-4: Hose-B connection without (left) and with (right) fixative option

10. Connect Hose-B to the exhaust port of the micro-pump. If the fixative valve is installed, connect Hose-B to the exhaust port of the fixative valve instead. Place the opposite end of Hose-B in the water container.
11. Connect Hose-C to the syringe, fill the syringe with water, and remove air from the syringe.
12. Select option 3 of the Manual Operation Menu to advance to the next port (Port 1).
13. 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 6-5: Open Filter Holder 1

14. 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 6-6: Injecting Water with Syringe

15. 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.
16. 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 6-7: Reattaching Top and Bottom of Filter

17. 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.
18. 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.

19. When all air has been purged from the filter position plumbing, disconnect the syringe from the filter body.
20. Connect Hose-G to port 1 bottom tubing, and place the other side of the hose in the water container

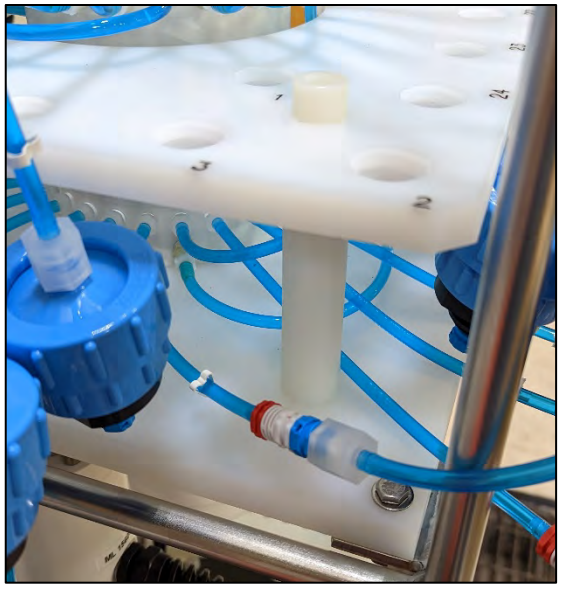


Figure 6-8: Connecting Hose-G

21. 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].

22. Select option 3 of the Manual Operation Menu to advance to the next port.
23. Disconnect Hose-G and reattach the filter body to port 1 of the filter base plate.
24. Attach bottom tubing for port 1 to filter body.
25. Repeat steps 11 – 23 for all filter positions.
26. Once priming is complete, disconnect Hose-A and Hose-B from the system, remove the water container from the top of the 25 Port Valve and move on to the next step, Installing the Water Flush Filter.
27. Once all of the sample positions have been primed, return the valve to the home port using Manual Operations menu option <1>.

Preparing the Fixative Valve for a Deployment

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.

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

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

Priming the Fixative Valve Plumbing

Required tools:

- 7/16 hand driver (to open and close the controller housing)
- Hose-A
- Hose-B
- Hose-E
- Hose-F
- Luer lock water syringe
- Water container filled with neutral water.

Figure 6-9: Fixative Box

1. Open the Fixative Box by removing the six nylon ¼-20 fasteners on the cover of the box.
2. Remove the fixative bag and fixative exhaust collection bag from the fixative box.
3. Place a container of water on the floor near the PPS.

4. Select option <8> of the Manual Operation Menu to toggle the Fixative Valve to the ON (fixative) position.
5. Check the 25 Port Valve position indicator in the Manual Operation Menu to ensure it is aligned to port 0.
6. Connect Hose-A to the Fixative Exhaust-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.
7. Connect Hose-E to the Fixative Syringe, and fill the syringe with Fixative.
8. Connect the Fixative Syringe and Hose-E to Fixative Intake-2 Hose inside the Fixative Box.

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.

9. 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.
10. Disconnect Hose-A, and the Fixative Syringe from the fixative intake and exhaust plumbing.
11. Empty any remaining fixative out of the syringe and Hose-A.
12. Connect Hose-A to the water intake port of the fixative valve.
13. Connect Hose-B to the water exhaust port of the fixative valve.
14. Make sure the fixative valve is in the OFF position.
15. Use Manual Operations menu option <7> to pump 100 ml forward at 100 ml / minute to flush fixative from the common plumbing.
16. Disconnect Hose-A and Hose-B.

Filling the Fixative Bags

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 6-10: 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 6-11: Place Hose-F into Fixative Container

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

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 6-12: 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.

Filling the Fixative Exhaust 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. The exhaust bag doesn'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 6-13: 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 ¼ -20 fasteners. Keep the hose connections facing downward, and the Fixative Exhaust bag in front of the Fixative Intake bag.

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.

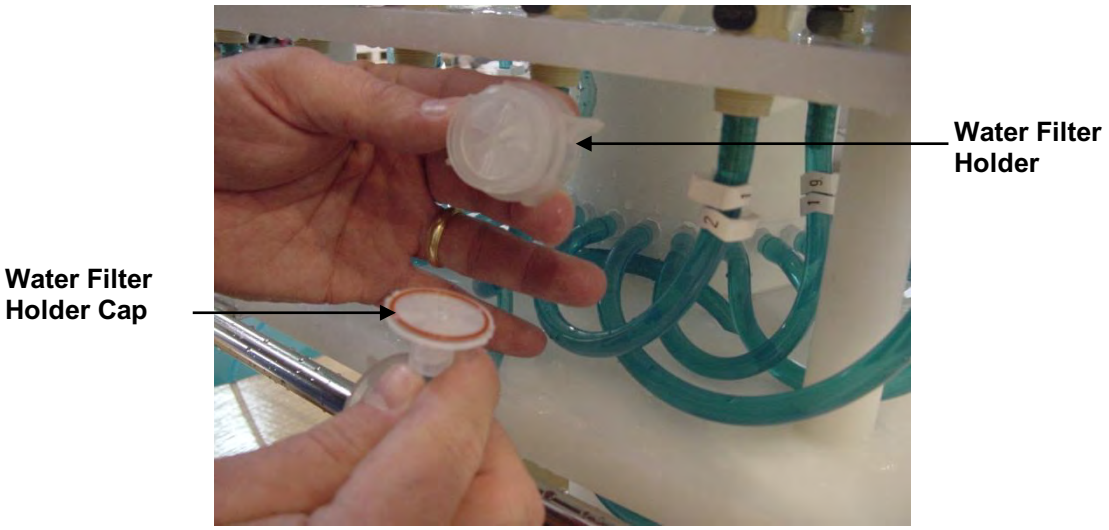


Figure 6-14: Disassembling Water Flush Filter

Required tools:

- Hose-A
- Hose-B
- Hose-E
- Luer lock water syringe
- Water container filled with neutral water.
- 5-10 micron 25 mm filter

1. From the Manual Operation Menu select option <1> to align the 25 port valve to the home port.
2. Check option 8 of the Manual Operations Menu to make sure the Fixative Valve is OFF (the water position) if the fixative option is installed.
3. Connect Hose-E to the syringe, fill the syringe with water, and remove any air from the syringe.
4. 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. Connect the other end to Hose-E and the syringe.
5. 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.
6. Find the 25 mm home port flush filter holder, install a 25 mm filter.
7. Slowly inject with the syringe until air bubble stop coming out of Hose-A.

Preparing Antifouling Reservoir for a Deployment

If this is the last time the PPS pump and valve are used, there will be antifouling solution in the common plumbing until the next event.

Required tools:

- 7/16 hand driver (to open and close the enclosure)
- Hose-A
- Hose-B
- Hose-E
- Hose-F
- Luer lock water syringe
- Water container filled with neutral water.

1. Use Manual Operation Menu Option <1> to align the 25 port valve to the home port.
2. Attach Hose-A to Water Intake port of the fixative valve.
3. Attach Hose-B to Water Exhaust port of fixative valve.
4. Put the opposite ends of both Hose-A and Hose-B in a container full of water placed on top of the 25 port valve.
5. Detach the Antifoul-1 hose from the port 24 filter position quick disconnect on the filter baseplate.
6. Attach Hose-C to the Antifoul-1 hose and place the opposite end of Hose-C in the water container.

Figure 6-15: Attaching Hose-E

7. Attach Hose-E to the Water Syringe.
8. Detach Antifoul-2 Hose from the luer lock fitting on the tube cap.
9. Remove the Antifouling Tube Cap and the connected bag from the Tube.
10. Attach Hose-F to the tube cap.
11. Attach the syringe to the tube cap by connecting Hose-E and Hose-F together.
12. Use the syringe to remove air and or fluid from the antifouling bag.
13. Pinch Hose-F using the small piece of black tubing included in the toolkit to prevent air from entering back into the bag.

Figure 6-16: Fill Antifouling Tube

14. Disconnect Hose-E from Hose-F and fill the syringe with 140 ml of cleaning solution.
15. Fill the antifouling tube to the brim with water.
16. Insert the bag into the tube and secure the cap.
17. Connect the syringe of cleaning solution to the antifouling bag by reconnecting Hose-E and Hose-F.
18. Remove the small piece of black tubing used to pinch Hose-F.
19. Slowly inject the cleaning solution into the antifouling bag with the syringe. This will fill the bag, which will displace water from the tube and out Antifoul-1 hose, through Hose-C, into the water container.
20. Repeat steps 13-19 until 800 ml of cleaning solution have been injected into the antifouling bag. Make sure to inject the final 140 ml slowly.
21. Reconnect the Antifoul-1 hose back to the filter 24 position on the filter baseplate.
22. Reconnect the Antifoul-2 hose back to the tube cap luer lock connector.
23. Use Manual Operation Menu option 2 to align the 25 port valve to port 24.

24. Use Manual Operation Menu option 7 to pump 20 ml of cleaning solution at 100 ml / minute. This will prime the antifouling plumbing with cleaning solution.

25. If these instructions were followed, you should have 800 ml of antifouling solution after pumping 20 ml. Remember this, because you will need to know how much cleaning solution there is during deployment setup.

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.

Program a Deployment Schedule

1. Establish communications with the PPS, and start a capture file named "DEPLOYMENT_PREP_[DATE_AND_TIME]".
2. Select Main menu option <5> to create a schedule. There will be system warnings if there are previous deployment records in memory, if the system hasn't been rebooted since the last deployment event completed, or if battery voltages have dropped below the system warning voltage. Dealing with these warnings should be self-explanatory, just follow the prompts.
3. Confirm that the system clock is correct (McLane firmware uses a 0-24 military time convention).
4. Enter the number of events in the deployment.
5. 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-FV-AF            CF2 V2_12 of Sep 21 2022

                    Schedule Menu

                Thu Sep 22 08:59:53 2022

                 <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 [09/22/2022 08:59:57] ? 09 23 29022
Enter START date and time [09/23/2022 08:59:57] ? 09 23 2022 12 00 00

Enter interval

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

Figure 6-17: Schedule Menu

Schedule menu options:

<1> Enter each event time: This option allows the user to enter event start times individually (month, day, year, hour, minute, and second). The events do not have to be entered in chronological order and will be automatically sorted.

<2> Enter start date & interval: This option allows the user to enter a start date and a desired interval between the event start times. The interval is entered in units of days, hours and minutes.

<3> Enter start date & end date: This option allows the user to enter a start and end date, and the system automatically calculates the intervals between events.

Scheduling properly accounts for leap years.

6. After defining a schedule, individual event times can be modified later in the deployment programming process.

Programming Event Parameters

Immediately after defining a schedule the user must define global event parameters for the deployment. The parameters defined at this point will be applied to all events in the deployment. After the global event parameters are defined the user has the opportunity to modify individual event parameters later on in the deployment programming process. Depending on the optional features installed on the PPS, different procedures will be available for programming. Programming event parameters should be fairly self-explanatory, refer to the Deployment Event Description for details on each procedure.

```
_____________________________________________________________________

                        Event Parameters
_____________________________________________________________________


    Header 1| 12345-03 System test
           2| 05/16/2019
           3| JRG

     Water A| Flushing volume          =            100  [ml]

    Sample B| Sample volume            =           1000  [ml]
           C| Sample flow rate         =            100  [ml/min]
           D| Sample min. flow rate    =             50  [ml/min]
           E| Sample time limit        =             21  [min]

  Fixative F| Fixative Flush           =                 Disabled
     Flush G| Total fixative volume    =                 NA
           H| Fixative flush volume    =                 NA

    Timing P| Pump data period         =             15  [sec]

           V| Verify and continue.
```

Figure 6-18: Event Parameters

Sample Pump Data Period

While pumping a sample the PPS logs pumping diagnostic data to memory at a set interval. This interval is defaulted to one minute, and can be programmed using Event Parameter menu option <P>.

Fixative Flush Programming

If a fixative valve is installed on the PPS an option for a fixative flush will be displayed in the Event Parameters menu. The Fixative Flush is disabled by default, use Event Parameters menu option <F> to enable the fixative flush.

Immediately after enabling the fixative flush the system will ask you to program the available fixative volume. The last known total fixative volume is displayed, and the user has the opportunity to update the volume. Once the total fixative volume is confirmed the user can assign fixative flush pumping parameters. These fixative flush parameters will be applied to every event in the deployment, but the user will have the opportunity to change fixative flush parameters for individual events later in the deployment programming process.

```
_____________________________________________________________________

                        Event Parameters
_____________________________________________________________________

    Header 1| 12345-03 System test
           2| 05/16/2019
           3| JRG

     Water A| Flushing volume          =            100  [ml]

    Sample B| Sample volume            =           1000  [ml]
           C| Sample flow rate         =            100  [ml/min]
           D| Sample min. flow rate    =             50  [ml/min]
           E| Sample time limit        =             21  [min]

  Fixative F| Fixative Flush           =                 Disabled
     Flush G| Total fixative volume    =                 NA
           H| Fixative flush volume    =                 NA

    Timing P| Pump data period         =             15  [sec]

           V| Verify and continue.

              Selection [] ? f

Enable fixative flush [Y] ? y

Total fixative available: 1258.5
Is this correct? [Y] ? n
```

Figure 6-19: Enable Fixative Flush

Program Optional Antifouling Flush

If an antifouling reservoir is installed on the PPS an option for an antifouling flush will be displayed in the Event Parameters menu. The antifouling flush is disabled by default, use Event Parameters menu option <P> to enable the fixative flush.

```
                    Event Parameters

Header       A| Header 1 Example
             B| Header 2 Example
             C| Header 3 Example

Water        D| Flushing volume              =    120 [ml]
Flush         | Flushing time limit           =      4 [min]

Sample       E| Sample volume                 =   5000 [ml]
             F| Pumping flow rate             =    110 [ml/min]
             G| Minimum flow rate             =     51 [ml/min]
             H| Pumping time limit            =     99 [min]

Data         I| Sample pump data period       =      1 [min]

Fixative     J| Enabled
Flush        K| Total fixative volume         =   2000 [ml]
             L| Fixative flush volume         =     70 [ml]
             M| Pumping flow rate             =     75 [ml/min]
             N| Minimum flow rate             =     45 [ml/min]
             O| Pumping time limit            =      2 [min]

Antifouling  P| Disabled
Flush        Q| Total antifouling available  =      0 [ml]
             R| Antifouling volume            =      0 [ml]
             S| Pumping flow rate             =      0 [ml/min]
             T| Minimum flow rate             =      0 [ml/min]
             U| Pumping time limit            =      0 [min]

             V| Verify and continue.

             Selection [] ? P

 Enable antifouling flush [Y] ?

Total antifouling fluid available:   41.0
Is this correct? [Y] ? N
Enter the available antifouling fluid volume (ml) (0.0 to 1000.0) [41.0] ? 800
```

Figure 6-20: Enable Antifouling Flush

Immediately after enabling the antifouling flush the system will ask you to program the total available antifouling solution volume. The last known total antifouling solution volume is displayed, and the user has the opportunity to update the volume. Once the total antifouling solution volume is confirmed the user can assign antifouling flush pumping parameters. These antifouling flush parameters will be applied to every event in the deployment, but the user will have the opportunity to change antifouling flush parameters for individual events later in the deployment programming process.

Verifying Deployment Parameters and Modifying Individual Events

After a schedule and global event parameters have been defined for a deployment, the start times and parameters for each event are printed to the screen. The system analyzes the deployment parameters and will prompt the user with a warning if the estimated time to complete an event could possibly overlap into the scheduled time of another event. At this point the user has the opportunity to edit individual event parameters.

To modify individual event parameters:

1. When asked to modify an event at the Schedule Verification, answer yes and specify an event number when prompted to do so.

```
Schedule Verification

                          |Flush  Time  |Sample Flow  Min   Time  |Fixative Flow  Min   Time  |Antifoul Flow  Min   Time
                          |Vol    Limit |Vol    Rate  Rate  Limit |Vol      Rate  Rate  Limit |Vol      Rate  Rate  Limit

Event  1: 08/30/17 12:00:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event  2: 08/31/17 12:04:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event  3: 09/01/17 12:08:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event  4: 09/02/17 12:12:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event  5: 09/03/17 12:16:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event  6: 09/04/17 12:20:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event  7: 09/05/17 12:24:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event  8: 09/06/17 12:28:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event  9: 09/07/17 12:32:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 10: 09/08/17 12:36:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 11: 09/09/17 12:40:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 12: 09/10/17 12:44:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 13: 09/11/17 12:48:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 14: 09/12/17 12:52:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 15: 09/13/17 12:56:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 16: 09/14/17 13:00:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 17: 09/15/17 13:04:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 18: 09/16/17 13:08:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 19: 09/17/17 13:12:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 20: 09/18/17 13:16:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 21: 09/19/17 13:20:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 22: 09/20/17 13:24:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1
Event 23: 09/21/17 13:28:00 |120    4     |5000   110   51    99    |70       75    45    2     |30       100   50    1

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

Enter the event number (1-23) [1] ? 1
```

Figure 6-21: Schedule Verification

2. After changing parameters for the specified event, enter menu option <V> to verify the new deployment event parameters.

```
                Event 1 Parameters


Header      A| Header 1 Example
            B| Header 2 Example
            C| Header 3 Example

Water       D| Flushing volume              =     50 [ml]
Flush        | Flushing time limit          =      2 [min]

Sample      E| Sample volume                =   1000 [ml]
            F| Pumping flow rate            =    110 [ml/min]
            G| Minimum flow rate            =     51 [ml/min]
            H| Pumping time limit           =     20 [min]

Data        I| Sample pump data period      =      1 [min]

Fixative    J| Enabled
Flush       K| Total fixative volume        =   2000 [ml]
            L| Fixative flush volume        =     50 [ml]
            M| Pumping flow rate            =     75 [ml/min]
            N| Minimum flow rate            =     45 [ml/min]
            O| Pumping time limit           =      2 [min]

Antifouling P| Enabled
Flush       Q| Total antifouling available =    800 [ml]
            R| Antifouling volume           =     28 [ml]
            S| Pumping flow rate            =    100 [ml/min]
            T| Minimum flow rate            =     50 [ml/min]
            U| Pumping time limit           =      1 [min]

            V| Verify and continue.

            Selection [] ? v
```

Figure 6-22: Changing Event Parameters

Make sure the changes were made to the event parameters when the schedule verification is printed to the screen.

Schedule Verification

	Flush Vol	Time Limit	Sample Vol	Flow Rate	Min Rate	Time Limit	Fixative Vol	Flow Rate	Min Rate	Time Limit	Antifoul Vol	Flow Rate	Min Rate	Time Limit
Event 1: 08/30/17 12:00:00	50	2	1000	110	51	20	50	75	45	2	28	100	50	1
Event 2: 08/31/17 12:04:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 3: 09/01/17 12:08:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 4: 09/02/17 12:12:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 5: 09/03/17 12:16:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 6: 09/04/17 12:20:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 7: 09/05/17 12:24:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 8: 09/06/17 12:28:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 9: 09/07/17 12:32:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 10: 09/08/17 12:36:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 11: 09/09/17 12:40:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 12: 09/10/17 12:44:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 13: 09/11/17 12:48:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 14: 09/12/17 12:52:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 15: 09/13/17 12:56:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 16: 09/14/17 13:00:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 17: 09/15/17 13:04:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 18: 09/16/17 13:08:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 19: 09/17/17 13:12:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 20: 09/18/17 13:16:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 21: 09/19/17 13:20:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 22: 09/20/17 13:24:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1
Event 23: 09/21/17 13:28:00	120	4	5000	110	51	99	70	75	45	2	30	100	50	1

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

Figure 6-23: Schedule Verification

3. When finished modifying individual event parameters, answer "N" to the "Modify an event?" prompt, and the system will return to the Main Menu.

4. At this point the system is prepared for a deployment and can be put to sleep until the time comes to deploy the system.

Instrument Current Consumption

The PPS has a +36VDC, drop-in D-cell battery pack with a total capacity of 10,000 mAh. Battery capacity for a planned deployment can be estimated using the Instrument Current Consumption tables in this section. In addition to these typical current consumption numbers, battery drain is affected by flow rate, pump speed and types of filters used in the filter holders. Higher pump speeds and filters that have collected more material will draw additional battery capacity and can make battery endurance estimation more difficult. The PPS may also have a Dual Fixative Solenoid Valve for fixative (Intake) and collection (Exhaust) paths.

Instrument Current Consumption	
Controller electronics ON	9.0 mA
Controller electronics LOW POWER SLEEP	0.22 mA
Moving Valve	340 mA
Forward/Reverse Pumping	160 mA
Pump Water Flush (@ 125 mL / min)	180 mA
Fixative Solenoid Valve (ON)	250 mA
Fixative Solenoid Valve (ON) and Pumping	415 mA

Instrument ON Consumption	
Moving Valve (24 port deployment)	0.451 h = 1,624 s
Moving Valve (single port advance)	0.0022 h = 8 s
Pump Water Flush (100 mL @ 125 mL / min)	0.0134 h = 48 s
Pump Sample (10 L @ 100 mL / min)	1.667 h = 100 min
Fixative Flush (50 mL @ 100 mL / min)	0.0084 h = 30 s

System Deployment /Event Parameters for this example	
Number of Events	24
Length of Deployment	1-Year
Flushing Volume	100 mL
Flushing Time Limit	3 min
Sample Volume	10,000 mL
Pumping Flow Rate	100 mL / min
Minimum Flow Rate	50 mL / min

System Deployment /Event Parameters for this example	
Pumping Time Limit	41 min
Sample Pump Data Period	1 min
Fixative Flush	Enabled
Total Fixative Volume	1400 mL
Fixative Flush Volume	50 mL
Pumping Flow Rate	100 mL / min
Minimum Flow Rate	50 mL / min
Pumping Time Limit	2 min

Example of Estimating Battery Life for One Year Deployment

Pre-deployment (system prep)	
Controller Electronics (ON) – 3 hours	3 h x 9.0 mA = 27.0 mAh
Moving Valve (25 ports, single port advance)	25 ports x 0.0022 h x 340 mA = 18.7 mAh
Pumping – 0.5 hours	0.5 h x 160 mA = 80.0 mAh
	Subtotal = 125.7 mAh
Deployment	
Controller Electronics (Low Power Sleep) – 1 year	8760 h x 0.22 mA = 1927.2 mAh
Moving Valve (24 port deployment)	0.451 h x 340 mA = 153.4 mAh
Pump Water Flush (24 ports)	24 ports x 0.0134 h x 180 mA = 57.9 mAh
Pump Sample (24 ports)	24 ports x 1.667 h x 160 mA = 6401.3 mAh
Fixative Flush (24 ports)	24 ports x 0.0084 h x 415 mA = 83.7 mAh
	Subtotal = 8,623.5 mAh
Recovery (offload data, remove samples)	
Controller Electronics (ON) – 2 hours	2 h x 9.0 mA = 18.0 mAh
Moving Valve (25 ports, single port advance, once around)	25 ports x 0.0022 h x 340 mA = 18.7 mAh
	Subtotal = 36.7 mAh
Total Battery Consumption	**125.7 + 8623.5 + 36.7 = 8786 mAh**

In this example, the total energy consumed is less than the 10,000 mAh capacity of the battery and the proposed deployment plan will have sufficient battery life.

Starting the Deployment

After a deployment schedule and event parameters have been defined, the PPS deployment can be started.

Start a deployment:

1. Select Main Menu option <6> Deploy System.
2. Confirm the system time.
3. If data from a previous deployment exists in memory or EEPROM, a system warning will warn that is going to be deleted before continuing with the deployment. Answer "Y" to continue.
4. When asked to define a new schedule, answer no to use a predefined schedule and deployment parameters. Answer "N" to redefine the schedule and deployment parameters.

```
Configuration: WTS-125M-SV-AF          CF2 V2_09 of Aug 28 2017

               McLane Research Laboratories, Inc.
                     Water Transfer System
                           ML14374-01
                _____________________________________
                           Main Menu
                _____________________________________
                    Tue Aug 29 11:21:41 2017

                              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

          Selection [] ? 6

Seeking home port.. located. Aligning... Confirmed.


Clock reads 08/29/17 11:22:26.  Change [N] ?

Existing deployment data file will be erased. Continue [N] ? y

Enter new deployment schedule [N] ? n
```

Figure 6-24: Start a Deployment

5. Verify the schedule and parameters, and modify any event that needs modification.
6. If the fixative valve is installed, a warning about filling the exhaust bag with a volume of water will appear. Press any key to continue.
7. The system will perform a six second a low-power sleep mode test to verify that backup power is functioning properly.
8. A warning about deleting previous deployment data stored inside of EEPROM, go ahead and answer "Y" if previous deployment data has already been offloaded.
9. The system then prompts the user to disconnect communications and connect the dummy plug onto the communications bulkhead connector before entering low-power sleep mode until the start time of the first deployment event.

```
WARNING -- In order to avoid possible damage to the solenoid valve,
           make sure that all air was purged from the fixative bags.
           If a fixative exhaust bag is being used, it is critical
           that it was purged of air and filled with 100.0 ml of water.

          Press any key to continue.

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

System status: 08/29/17 11:23:06  32.3Vb  24°C  Port 00

 CAUTION -- Deployment will erase all EEPROM data backup entries.

Proceed with the deployment Yes|No [N] ? y

Erasing EEPROM entries ........................

Remove communication cable and attach dummy plug.

System is ready to deploy.

08/29/17 11:23:15 Waiting for event 1 of 23 @ 08/30/17 12:00:00
08/29/17 11:23:16 Suspended until 08/30/17 12:00:00 ...
```

Figure 6-25: System Ready to Deploy

Waking the sampler after this point will cancel the deployment. If the user is curious whether the system is still working DO NOT wake the device. Instead connect to the device, and press any key. The system will print the system time and “Suspended until” the start time of the next scheduled event.

Final steps before Deployment

Deploying the PPS requires the following (in order):

- Connect to a computer, install and configure terminal emulation and powering up the sampler (see chapter 4 “Getting Started” for details about the end cap and connectors).
- Confirm firmware deployment settings, prime the filter holders, prepare optional fixative valve and optional antifouling reservoir (if installed) and start the deployment (see chapter 6 “Deployment Preparation” for details about programming the deployment).
- Disconnect the communications cable and attach the dummy plug.
- Attach the PPS to the mooring.

Notes

Chapter 7
Deployment Recovery, and System Maintenance

Recovery Procedure

After the deployment is completed, the required steps are:

- Retrieve the filters for sample analysis.
- Offload the deployment data.
- Clean PPS fluid paths, filter holders, fixative valve, and plumbing.

Retrieving Filters for Sample Analysis

After a deployment is complete and the system has been recovered, the filter holders can be removed for sample analysis. The quick disconnect connector on the bottom of the 47 mm filter holder is a valved connection and should do a good job of containing the contents of the filter holder. Hose-C and a syringe can be used to remove the liquid contents of a filter holder. The details of processing the sample contained in a filter holder will vary from deployment to deployment, and will ultimately need to be decided by the scientist. If fixative was used during the deployment, make sure to follow all safety procedures while handling the filter holders.

Offloading Deployment Data

Deployment event data and pumping data is stored to volatile memory and non-volatile EEPROM during a deployment. After a system is recovered this data can be offloaded and captured to a text file for future analysis.

```
Configuration: WTS-125M- RBR_T           CF2 V2_10 of May  6 2019
               ____________________________________
                   Offload/Display Data File
               ____________________________________

                   Fri May 17 12:04:12 2019

          <1> Display ALL data
          <2> Display event summary data
          <3> Display pump data
          <4> EEPROM data backup cache
          <5> Display temperature data

          <M> Main Menu
```

Figure 7-1: Offload/Display Data File Menu

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

The computer should be on and McLaneTerm running before connecting to the PPS electronics. Do not disconnect the battery (which erases the data) until checking the capture files to confirm that the data offload was successful.

Offload menu options:

<1> Display ALL data: Displays all event summary and pumping data stored in volatile RAM memory. If power is removed, this data is lost.

<2> Display event summary data: Displays only event summary data.

<3> Display pump data: Displays only the pumping data recorded and the pump data interval programmed while setting up the deployment.

<4> EEPROM data backup cache: Displays EEPROM event data summary. While the data is limited, it will remain in memory after power is cycled.

<5> Display Temperature data: If RBRCodaT is installed, displays temperature data.

To offload deployment data:

1. Establish communication with the PPS and start a capture file named "PPS_OFFLOAD_[DATE & TIME].txt".
2. Select Main Menu option <7> to offload data.
3. Select Offload menu option <1> to display all data. After all the data has been printed to the screen press any key to return to the offload menu.
4. Select Offload menu option <4> to display the backup deployment data summary to the screen. Press any key to return to the offload menu.
5. Stop logging to file.
6. Select Offload menu option <M> to return to the main menu, and put the device to sleep.

The screens that follow show an exampling of selecting Option <1> ‘Display ALL 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

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.C
 Compiled:          May  6 2019 10:37:40
 Electronics S/N:   ML14730-03
```

Figure 7-2: Offload/Display Data File – Display All (1 of 3)

```
_______
HEADER
_______

 14730-03 System test
 05/16/2019

 JRG


___________________
EVENT PARAMETERS
___________________

                                |Flush  |Sample Time  |Fixative
                                |Vol    |Vol    Limit |Vol

 Event  1: 05/16/2019 17:30:00  |100    |1000   21    |50
 Event  2: 05/16/2019 18:07:49  |100    |1000   21    |50
 Event  3: 05/16/2019 18:45:38  |100    |1000   21    |50
. . .
 Event 23: 05/17/2019 07:21:58  |100    |1000   21    |50
 Event 24: 05/17/2019 08:10:00  |100    |1500   31    |60


Pump data period: 15 seconds

Available fixative at start of deployment: 1400.0



_________________
DEPLOYMENT DATA
_________________

Event   |                        |Start               |Internal |Battery |Volume     |        |Procedure
Number  |Procedure               |Time                |Temp.    |Voltage |Pumped     |Duration|Result

        |                        |                    |         |        |           |        |
       1|Water Flush             |  05/16/2019 17:30:02|     21.9|    35.5|        100|      61| Volume reached
       1|Sample                  |  05/16/2019 17:31:15|     22.0|    35.1|       1000|     601| Volume reached
       1|Fixative Flush          |  05/16/2019 17:41:55|     26.6|    33.8|         50|      42| Volume reached

        |                        |                    |         |        |           |        |
       2|Water Flush             |  05/16/2019 18:07:51|     18.9|    35.2|        100|      61| Volume reached
       2|Sample                  |  05/16/2019 18:09:09|     19.3|    34.8|       1000|     602| Volume reached
       2|Fixative Flush          |  05/16/2019 18:19:49|     25.4|    33.6|         50|      41| Volume reached
. . .
      23|Water Flush             |  05/17/2019 07:22:00|     18.4|    32.8|        100|      61| Volume reached
      23|Sample                  |  05/17/2019 07:23:19|     18.9|    32.4|       1000|     601| Volume reached
      23|Fixative Flush          |  05/17/2019 07:33:58|     24.6|    30.6|         50|      42| Volume reached

        |                        |                    |         |        |           |        |
      24|Water Flush             |  05/17/2019 08:10:02|     17.6|    32.9|        100|      61| Volume reached
      24|Sample                  |  05/17/2019 08:11:16|     18.1|    32.3|       1500|     902| Volume reached
      24|Fixative Flush          |  05/17/2019 08:26:56|     25.2|    30.4|         60|      50| Volume reached
```

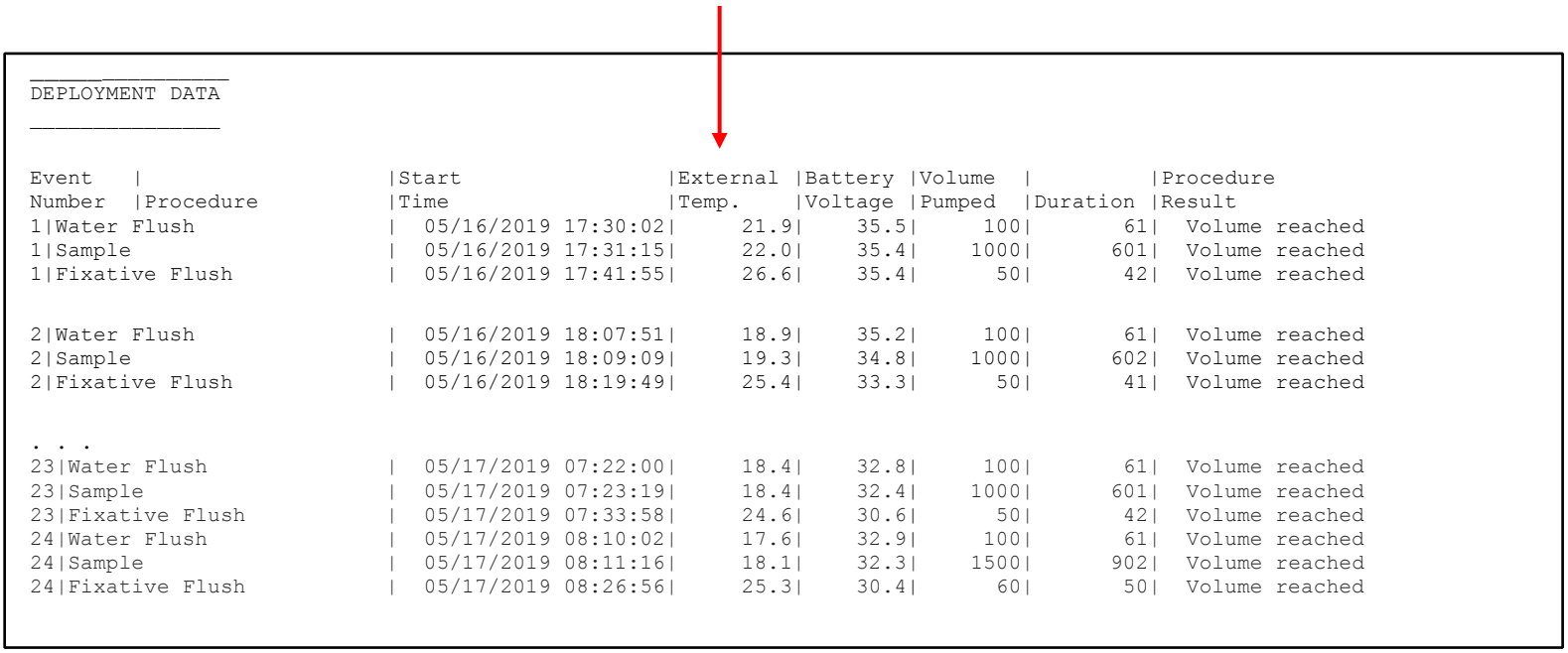
Figure 7-3: Offload/Display Data File – Display All (2 of 3)

```
___________
PUMPING DATA

____________
Pump data period = 15 seconds
  [event#]  [ml/min]    [ml]     [Vbat]    [Av. Cur]    [High Cur]
     1       99.9       23.9      35.4          89           89
     1      100.3       48.9      35.4          87           87
     1       99.9       73.9      35.4          87           87
     1       99.9       98.9      35.3          87           87
     1       99.9      123.9      35.4          87           87
     1      100.3      148.9      35.3          87           87
     1       99.9      173.9      35.4          87           87
     1       99.9      198.9      35.4          87           87
     1      100.3      223.9      35.4          87           87
     1       99.9      248.9      35.3          87           87
     1       99.9      274.0      35.3          86           86
     1      100.3      299.0      35.3          87           87
     1      100.3      324.0      35.3          87           87
     1       99.9      349.0      35.3          87           87
     1       99.9      374.0      35.2          87           87
     1      100.3      399.0      35.2          87           87
     1       99.9      424.0      35.3          87           87
     1      100.3      449.0      35.3          87           87
     1      100.3      474.0      35.2          88           88
     1       99.9      499.0      35.2          88           88
     1       99.9      524.0      35.2          87           87
     1       99.9      549.0      35.3          87           87
     1       99.9      574.0      35.2          87           87
     1      100.3      599.0      35.2          88           88
     1       99.9      624.0      35.2          88           88
     1       99.9      649.0      35.2          87           87
     1      100.3      674.1      35.1          87           87
     1       99.9      699.1      35.2          88           88
     1       99.9      724.1      35.1          88           88
     1       99.9      749.1      35.1          88           88
     1       99.9      774.1      35.2          88           88
     1       99.9      799.1      35.1          88           88
     1      100.3      824.1      35.2          88           88
     1       99.9      849.1      35.2          88           88
     1       99.9      874.1      35.1          88           88
     1       99.9      899.1      35.1          88           88
     1       99.9      924.1      35.2          88           88
     1      100.3      949.1      35.1          88           88
     1      100.3      974.1      35.1          88           88
     1      100.3      999.1      35.1          89           89
     1      100.3      999.1      35.1          89           89
. . .

 End of instrument data file.

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

Figure 7-4: Offload/Display Data File – Display All (3 of 3)

Data Offload with RBRCodaT Installed

The Figure 7-5 shows an exampling of the Data Offload when the optional RBRCodaT is installed.



DEPLOYMENT DATA

Event Number	Procedure	Start Time	External Temp.	Battery Voltage	Volume Pumped	Duration	Procedure Result
1	Water Flush	05/16/2019 17:30:02	21.9	35.5	100	61	Volume reached
1	Sample	05/16/2019 17:31:15	22.0	35.4	1000	601	Volume reached
1	Fixative Flush	05/16/2019 17:41:55	26.6	35.4	50	42	Volume reached
2	Water Flush	05/16/2019 18:07:51	18.9	35.2	100	61	Volume reached
2	Sample	05/16/2019 18:09:09	19.3	34.8	1000	602	Volume reached
2	Fixative Flush	05/16/2019 18:19:49	25.4	33.3	50	41	Volume reached
. . .							
23	Water Flush	05/17/2019 07:22:00	18.4	32.8	100	61	Volume reached
23	Sample	05/17/2019 07:23:19	18.4	32.4	1000	601	Volume reached
23	Fixative Flush	05/17/2019 07:33:58	24.6	30.6	50	42	Volume reached
24	Water Flush	05/17/2019 08:10:02	17.6	32.9	100	61	Volume reached
24	Sample	05/17/2019 08:11:16	18.1	32.3	1500	902	Volume reached
24	Fixative Flush	05/17/2019 08:26:56	25.3	30.4	60	50	Volume reached

Figure 7-5: Deployment Data Offload with RBRCoda External Temperature Data)

System Maintenance

It is important to properly maintain your sampler to ensure optimal performance and to prevent damage to the system. Perform the following system checks and maintenance procedures after every deployment.

Cleaning the PPS Fluid Paths and Filter Holders

Allowing the buildup of biofouling and salt is detrimental to system performance and will shorten sampler life. Flushing the PPS is very important. Any firmware version after 2.09 has an automatic system flush in the Manual Operations menu. The system flush can be used to pump a cleaning solution through each port for a user-specified amount of time between 10 – 120 seconds at a flow rate of 75 ml / minute. 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 or a 1:10 bleach water mixture.

Cleaning the PPS System Plumbing

To clean the PPS system plumbing:

1. Establish communication with the PPS.
2. After removing all filters from the filter holders (including the port 0 flush filter), reassemble and reinstall the filter holders.
3. Place a container of neutral water or a cleaning solution on top of the 25 port valve.
4. Connect Hose-A to the common system intake port on the top half of the 25 port valve. If the fixative valve is installed on the PPS attach Hose-A to the water intake port of the fixative valve.
5. To avoid making a mess, Connect Hose-B to the exhaust port of the pump, and place the opposite end in a container to collect the system exhaust. If the fixative valve is installed on the PPS, connect Hose-B to the water exhaust port of the fixative valve instead of the pump exhaust port.

6. If the antifouling reservoir is installed on the PPS you will need to bypass the reservoir by disconnecting the Antifoul-1 and Antifoul-2 hoses from the tube, and connecting them both to Hose-E. This will allow you to clean the port 24 plumbing.

7. Select option <F> from the Manual Operations menu, and specify how many seconds (within a range of 10 to 120) to run each port flush.

8. Keep an eye on the water container, and make sure not to let it run dry, the system will automatically pump through every filter position.

If a cleaning solution is used to flush the system, make sure to perform another flush with water to rinse the cleaning solution from the system.

Cleaning the Fixative Valve Plumbing

If the fixative valve is installed, perform the following steps to clean the fixative from the system plumbing.

1. Establish communication with the PPS.
2. Use Manual Operation menu option <1> to align the 25 port valve to the home port (port 0).
3. Remove the fixative bag and fixative exhaust bag from the system. Hose-D can be used to seal each bag until the fixative can be disposed of properly.
4. Connect Hose-A to the Fixative Intake hose in the fixative box and place the opposite end in a container of neutral water.
5. Connect Hose-B to the Fixative Exhaust hose in the fixative box and place the opposite end in a container of neutral water.
6. Use Manual Operation menu option <8> to switch the fixative valve to the ON (fixative) position.
7. Use Manual Operation menu option <7> to pump 300 ml at 125 ml/minute. This will flush all of the fixative plumbing.

8. Use Manual Operation menu option <8> to switch the fixative valve to the OFF (fixative) position.

Cleaning and Inspecting the 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. Make sure each filter holder has all three O-rings properly installed.

Rinsing the System

It is very important to clean and rinse the entire system after a deployment with fresh water. Storing a dirty system until the next deployment can lead to serious problems that void the warranty and prevent the PPS from functioning correctly.

Inspecting the Pump

Checking pump performance after a deployment can avoid a last minute emergency pump service before the next deployment.

Volume Test

To perform a volume test:

1. Establish communication with the PPS.
2. Connect Hose-A to the pump intake and place the opposite end in a container of neutral water.
3. Connect Hose-B to the pump exhaust and place the opposite end in a graduated cylinder.
4. Use Manual Operation menu option <7> to pump 100 ml at 125 ml / minute.
5. A healthy pump should pump slightly over the requested volume.

Pump Gear Inspection

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.

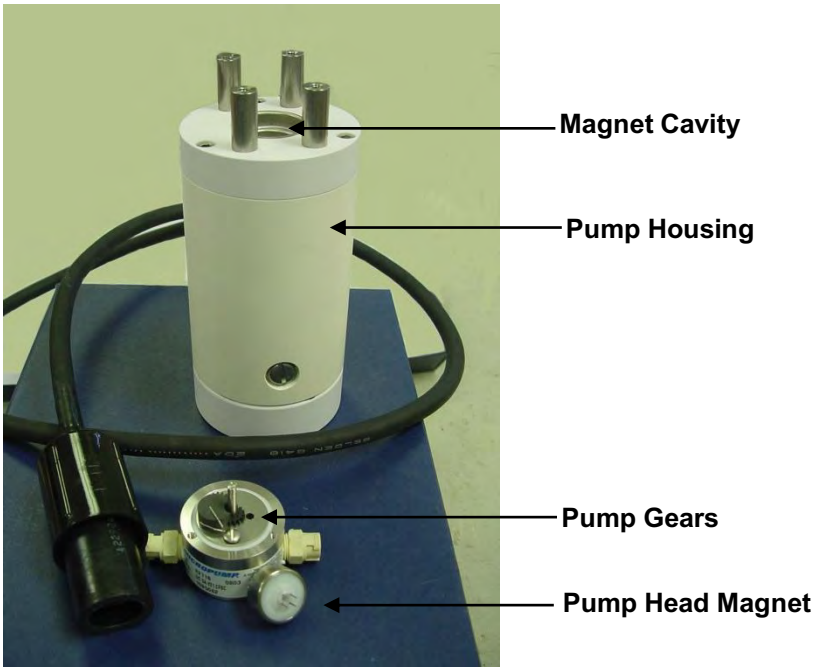


Figure 7-6: Pump Housing, Gears, and Pump Head Magnet

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

3. Inspect the gears and suction shoe for damage.

Storage

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

Avoid excessive vibration and extreme temperatures for prolonged periods of time to protect instrument from damage during transport or storage.

Before storing a PPS:

- Offload all data from memory.
- Rinse all instrument components with fresh water.
- Flush the valve with fresh water.
- Always disconnect and remove batteries. For user replaceable “D” cell alkaline batteries, dispose of the batteries. If using an older system with a battery pack, cover the connector with insulation tape and 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.
- Inspect, and if necessary, replace the zinc anodes attached to the controller housing end caps. When installing new zinc anodes, use 316 stainless steel hardware and include the o-ring.

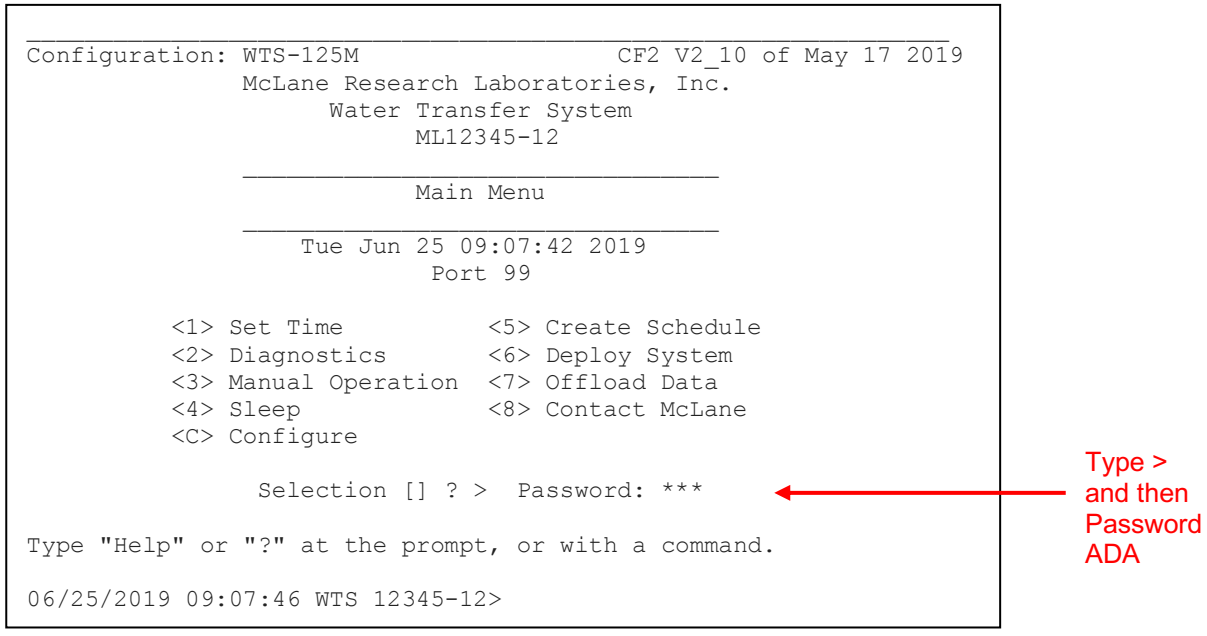
Appendix A
Adaptive PPS Command Reference

Adaptive Commands

WTS Firmware version 2.10 added a command-line interface to standard menu driven PPS firmware. Users can switch between menu-driven and command-line interface (adaptive sampling) modes.

Adaptive firmware gives users access to system functionality through a command-line interface. Some basics before we get started:

- You must be in menu-driven mode to use the Configuration menu.
- The command-line interface can be accessed from the Main menu by typing the menu option ">" and entering the password "ADA".



- The system enters a low-power sleep mode after standing idle for 20 minutes.
- In order to wake from low-power sleep mode enter three [CTRL-C] characters with about a second between each. Alternatively, you can just hold down [CTRL-C] for a few seconds.

- [CTRL-C] is also used as a "cancel" or "back" button. If you are in the middle of something that you need to cancel or escape from, just enter [CTRL-C].

- Command arguments are separated by spaces.

- If you ever need help with a command and you don't have this document, just enter "[the command name] ?" to access the command documentation.

Help:

Description: Displays the command set. Enter a command name at the prompt for a command description. Alternatively, the user can get command help by entering the command name followed by a space and a question mark.

Syntax: HELP or [COMMAND] ?

Example:

```
>help



_________

COMMANDS:
_________


BATTERY
CLOCK
COPYRIGHT
EXIT
FORWARD
HELP
HOME
ID
MCLANE
PORT
QUIT
RESULT
REVERSE
SLEEP
VERBOSE
VERSION
?
SAMPLE_RESULT
START_DEPLOY
RESUME_DEPLOY
STOP_DEPLOY
SAMPLE
SET
OFFLOAD
OFFLOAD_EEP
PRINT_PARAMS
SYSTEM_FLUSH
REBOOT
TEMPERATURE
TEMPERATURE_INTERVAL
TEMPERATURE_SLEEP
TEMPERATURE_DATA
APPLY_FIXATIVE
FIXATIVE_VALVE
FIXATIVE_AVAILABLE
MAIN_MENU


Which command do you want help with?   [^C] to return to prompt.
```

SYSTEM COMMANDS:

MAIN_MENU:

Description: Return to menu based programming
Syntax: MAIN_MENU
Example:

```
>main_menu



_____________________________________________________________
Configuration: WTS-125M-FV              CF2 V2_10 of Jul 25 2019

               McLane Research Laboratories, Inc.
                     Water Transfer System
                           ML12345-01
               _____________________________
                           Main Menu
               _____________________________
                   Wed Apr 15 14:18:36 2020

                            Port 99

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

                Selection [] ?
```

BATTERY:

Description: Display the system battery voltage
Syntax: BATTERY
Example:

```
>battery


Battery: 36.1V [Alkaline, 18V minimum]
```

CLOCK:

Description: Display or set the date and time
Syntax: CLOCK
CLOCK [MONTH] [DAY] [YEAR] [HOUR] [MINUNTE] [SECOND]
CLOCK [MM/DD/YYYY] [HH:MM:SS]
Example:

```
>clock

04/14/2020 16:20:42
```

COPYRIGHT:
Description: Display the firmware copyright notice
Syntax: COPYRIGHT
Example:

```
>copyright


_____________________________________________________________________

CF2-WTS-2.10  WTS-125M-FV-RBR_T  S/N ML12345-01  Water Transfer System

 © 1996-2019 McLane Research Laboratories. All rights reserved.
_____________________________________________________________________
```

ID:
Description: Display the system identification information
Syntax: ID
Example:

```
>id

Identity: CF2-WTS.C ML12345-01
```

MCLANE:
Description: Display McLane contact information
Syntax: MCLANE
Example:

```
>mclane



               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: WTS-125M-FV-RBR_T
                      Source file: CF2-C
                  Electronics S/N: ML12345-01
                  Compiled: Jul 25 2019 16:04



Press any key to continue.
```

SLEEP:
Description: Invoke low-power sleep
Syntax: SLEEP
Example:

```
>sleep

       04/14/2020 17:03:53 Suspended ...
```

VERBOSE:
Description: Displays or enables and disables reporting detailed information while executing commands. Default setting is ON.
Syntax: VERBOSE [on|off]
Example:

```
>verbose off

Verbose: OFF
```

VERSION:
Description: Display version information
Syntax: VERSION
Example:

```
>version

Version:
 WTS 12345-01 V2.10
```

EXIT:
Description: Exit the program
Syntax: EXIT password
Password: MCLANE
Example:

```
>exit mclane


------------------------------------------------------------------
  Persistor CF21M   SN 16479    PicoDOS V4.03r1      PBM V4.03
  (C) 1998-2007 Persistor Instruments Inc. - www.persistor.com
------------------------------------------------------------------

CompactFlash card missing, most features disabled

CF2>
```

QUIT:
Description: Exit the program
Syntax: QUIT [password]
Password: MCLANE
Example:

```
>quit mclane

       ------------------------------------------------------------

  Persistor CF21M   SN 16479    PicoDOS V4.03r1      PBM V4.03
```

```
  (C) 1998-2007 Persistor Instruments Inc. - www.persistor.com
------------------------------------------------------------

CompactFlash card missing, most features disabled

CF2>
```

REBOOT:

Description: Reboots the system. WARNING: rebooting will return to the menu driven command line. Re-enter the adaptive command line using ">" password: ada.

Syntax: REBOOT

Example:

```
>reboot

Resetting...


_____________________________________________________________

CF2-WTS-2.10  WTS-125M-FV  S/N ML12345-01  Water Transfer System

 © 1996-2019 McLane Research Laboratories. All rights reserved.
_____________________________________________________________

Clock reads 04/15/2020 14:14:00.  Change [N] ?

_____________________________________________________________
Configuration: WTS-125M-FV              CF2 V2_10 of Jul 25 2019

               McLane Research Laboratories, Inc.
                     Water Transfer System
                           ML12345-01
               _____________________________
                           Main Menu
               _____________________________
                   Wed Apr 15 14:14:36 2020

                            Port 99

          <1> Set Time          <5> Create Schedule
          <2> Diagnostics       <6> Deploy System
          <3> Manual Operation  <7> Offload Data
          <4> Sleep             <8> Contact McLane
          <C> Configure
                Selection [] ?
```

PUMP COMMANDS:

FORWARD:

Description: Executes a manual pumping operation in the forward direction using the provided pumping parameter arguments.

Syntax: FORWARD [volume] [flowrate] [minflow] [timelimit]

Example:

```
>forward 100 100 50 0
```

```
  Pump    | Hall       | Average    |  Volume     |     Flow      |  Elapsed    |  Batt.  |  Pump    |
  Drive   | Hz         | Hall Hz    |  Pumped     |     Rate      |  Seconds    | Voltage | Current  |
   1600 h      51 I_Hz      12 A_Hz       0.4 ml   21.3 ml/min         1 sec    36.0 V      68 mA
   1976 h     122 I_Hz      43 A_Hz       1.2 ml   51.0 ml/min         2 sec    36.0 V      78 mA
   2211 h     163 I_Hz      84 A_Hz       2.3 ml   68.2 ml/min         3 sec    36.0 V      73 mA
    . . . . . . . . . . . . . . . . . . . . Shortened . . . . . . . . . . . . . . . . . . . .
   2370 h     190 I_Hz     192 A_Hz      96.1 ml   79.4 ml/min        65 sec    36.0 V      69 mA
   2363 h     190 I_Hz     191 A_Hz      97.4 ml   79.4 ml/min        66 sec    36.0 V      68 mA
   2356 h     189 I_Hz     190 A_Hz      98.7 ml   79.0 ml/min        67 sec    36.0 V      63 mA


Result:             Volume reached
Elapsed Seconds:    69
Volume:             100 ml
Lowest Flow Rate:   79.0 ml
Average Current:    73.0 mA
Highest Current:    84.0 mA
Lowest Battery:     35.9 V
```

REVERSE:

Description: Executes a manual pumping operation in the reverse direction using the provided pumping parameter arguments.

Syntax: REVERSE [volume] [flowrate] [minflow] [timelimit]

Example:

```
>reverse 100 100 50 0


  Pump    | Hall       | Average    |  Volume     |     Flow      |  Elapsed    |  Batt.  |  Pump    |
  Drive   | Hz         | Hall Hz    |  Pumped     |     Rate      |  Seconds    | Voltage | Current  |
   1600 h      52 I_Hz      13 A_Hz       0.4 ml   21.7 ml/min         1 sec    36.0 V      67 mA
   1974 h     123 I_Hz      43 A_Hz       1.2 ml   51.4 ml/min         2 sec    36.0 V      81 mA
   2207 h     165 I_Hz      85 A_Hz       2.4 ml   69.0 ml/min         3 sec    36.0 V      78 mA
    . . . . . . . . . . . . . . . . . . . . Shortened . . . . . . . . . . . . . . . . . . . .
   2337 h     190 I_Hz     192 A_Hz      96.2 ml   79.4 ml/min        65 sec    36.0 V      70 mA
   2330 h     189 I_Hz     191 A_Hz      97.5 ml   79.0 ml/min        66 sec    36.0 V      67 mA
   2326 h     189 I_Hz     190 A_Hz      98.9 ml   79.0 ml/min        67 sec    36.0 V      63 mA


Result:             Volume reached
Elapsed Seconds:    69
Volume:             100 ml
Lowest Flow Rate:   79.0 ml
Average Current:    71.0 mA
Highest Current:    81.0 mA
Lowest Battery:     35.9 V
```

RESULT:

Description: Displays the results for manual pumping operation

Syntax: RESULT

Example:

```
>result


Result:             Volume reached
Elapsed Seconds:    69
Volume:             100 ml
Lowest Flow Rate:   79.0 ml


Average Current:    73.0 mA
Highest Current:    84.0 mA
Lowest Battery:     35.9 V
```

VALVE COMMANDS:

HOME:

Description: The 25 port valve uses port 0 as the home reference port of the valve. The HOME command locates, and then sets the port position to the home port.

Syntax: HOME

Example:

```
>home


Already aligned to home port.
```

PORT:

Description: Display or set the valve position

Syntax: PORT
PORT [port]

Example:

```
>port 2


Seeking port 02.. located. Aligning... Confirmed.
```

DEPLOYMENT PREPARATIONS:

SET:

Description: The SET command defines deployment event procedure parameters. During a deployment event, each procedure will be executed according to these parameters. The procedure parameters can be changed at any point during an adaptive deployment.

Note: allow the system to automatically calculate time limits by entering a value of zero. Disable acid, water or fixative by entering procedure name followed by a zero.

Syntax:

PRE-SAMPLE ACID FLUSH:

Syntax: SET PREACID [Volume] [Exposure Time]

Example: SET PREACID 10 1

PRE-SAMPLE WATER FLUSH:

Syntax: SET WATER [Volume]

Example: SET WATER 100

SAMPLE:

Syntax: SET SAMPLE [volume] [flowrate] [minflow] [timelimit]

Example: SET SAMPLE 100 95 50 0

POST-SAMPLE ACID FLUSH:

Syntax: SET POSTACID [Volume]

Example: SET POSTACID 10

FIXATIVE:

Syntax: SET FIXATIVE [Volume]

Example: SET FIXATIVE 50

Example:

```
>set water 50


 Water Flush:
 Volume          [ml]      = 50
 Flow rate       [ml/min]  = 100
 Min. flow rate  [ml/min]  = 50
 Time limit      [minutes] = 2

>set sample 100 75 50 0


 Sample:
 Volume          [ml]      = 100
 Flow rate       [ml/min]  = 75
 Min. flow rate  [ml/min]  = 50
 Time limit      [minutes] = 3
```

PRINT_PARAMS:

Description: Displays the predefined procedure parameters from the SET command

Syntax: PRINT_PARAMS

Example:

```
>print_params



_________________

Event Parameters
_________________


 Water Flush:
 Volume           [ml]      = 50
 Flow rate        [ml/min]  = 100
 Min. flow rate   [ml/min]  = 50
 Time limit       [minutes] = 2


 Sample:
 Volume           [ml]      = 100
 Flow rate        [ml/min]  = 75
 Min. flow rate   [ml/min]  = 50
 Time limit       [minutes] = 3
```

ADAPTIVE DEPLOYMENT COMMANDS:

Adaptive firmware has the ability to execute an adaptive deployment made up of automated deployment events. This feature dramatically decreases the amount of commands required to execute a deployment using adaptive firmware. The commands in this section allow the user to:

- Predefine deployment event parameters.
- Start an adaptive deployment.
- Trigger the automated deployment events using the SAMPLE command.
- Offload deployment event data stored in data.
- Stop and resume a deployment.

An **Adaptive Deployment** is made up of 24 individual which are made up of one to four **Procedures.**

Procedures in the order they would be executed in an adaptive deployment event:

- **Pre-Sample Acid Flush** – If the PPS is equipped with an acid tube, and pre-sample acid flush parameters are defined, the system pumps through port 24 in reverse to push antifouling solution through shared intake plumbing.

- **Water Flush** – Flushes standing fluid from shared intake plumbing prior to a sample.

- **Sample** – Mandatory event procedure that takes a sample through the next available valve position in the adaptive deployment.

- **Post-Sample Acid Flush** – If the PPS is equipped with acid tube, and a post-sample acid flush is defined, the system pumps through port 24 in reverse to push antifouling solution through common plumbing.

  The program keeps track of what valve position it sampled last in non-volatile memory. If power is removed for one reason or another, after the PPS is powered back on, the user can restart the deployment that it was running by entering the RESUME_DEPLOY command. It will continue where it left off before the power interruption.

  Deployment event data is stored to RAM and non-volatile memory during the deployment, and can be viewed at any point during the deployment using the OFFLOAD and OFFLOADEEP commands. Certain commands are disabled or enabled during an adaptive deployment. This can be bypassed by stopping the deployment, executing the disabled command, then resuming the deployment, but that is not recommended and should only be done if absolutely necessary. The system does not keep track of where manual operations are pumping into. Pretend for a moment that port five is next in line in an adaptive deployment. If the user stops the deployment to manually pump into port five, the system does not record where manual pumping operations are pumping into. If the deployment is resumed after the manual pumping operation, the next event will also pump

into port five. The commands that are disabled during a deployment were disabled because they could possibly cause problems during the deployment, so use them at your own risk.

START_DEPLOY:
Description: Start an adaptive deployment. Once an adaptive deployment is started, predefined deployment event procedures can be executed by simply entering the SAMPLE command.
Syntax: START_DEPLOY
Example:

```
>start_deploy


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

Erasing EEPROM entries ......................



Command-line deployment started.
```

RESUME_DEPLOY:
Description: Resume an adaptive deployment from where it left off
Syntax: RESUME_DEPLOY
Example:

```
1>resume_deploy


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


Resuming command-line deployment from event 20.
```

STOP_DEPLOY:
Description: Stop an adaptive deployment Certain deployment commands will become unavailable, and some basic commands will become available again.
Syntax: STOP_DEPLOY
Example:

```
>stop_deploy


Command-line deployment ended.
```

SAMPLE:

Description: If the system is in an adaptive deployment, execute the next predefined deployment event in the deployment. Use the SET command to change sample paramaters

Syntax: SAMPLE

Example:

```
>sample

04/15/2020 10:36:09 Event 6

 Water Flush:
 Volume          [ml]      = 50
 Flow rate       [ml/min]  = 100
 Min. flow rate  [ml/min]  = 50
 Time limit      [minutes] = 2



_____________________

FLUSHING INTAKE PORT
_____________________


  Pump   | Hall      | Average   |  Volume    |    Flow     |  Elapsed   |  Batt.  |  Pump   |
  Drive  | Hz        | Hall Hz   |  Pumped    |    Rate     |  Seconds   | Voltage | Current |
   1600 h     51 I_Hz     12 A_Hz       0.4 ml   21.3 ml/min        1 sec    36.0 V     72 mA
   1976 h    124 I_Hz     43 A_Hz       1.2 ml   51.8 ml/min        2 sec    36.0 V     81 mA
   2207 h    165 I_Hz     85 A_Hz       2.4 ml   69.0 ml/min        3 sec    36.0 V     79 mA
    . . . . . . . . . . . . . . . . . . . . . Shortened . . . . . . . . . . . . . . . . . . . . .
   2791 h    230 I_Hz    230 A_Hz      46.7 ml   96.2 ml/min       31 sec    36.0 V     74 mA
   2762 h    227 I_Hz    229 A_Hz      48.3 ml   94.9 ml/min       32 sec    36.0 V     80 mA
   2739 h    226 I_Hz    228 A_Hz      49.8 ml   94.5 ml/min       33 sec    36.0 V     78 mA


Result:             Volume reached
Elapsed Seconds:    34

Volume:             50 ml
Lowest Flow Rate:   94.5 ml
Average Current:    80.0 mA
Highest Current:    87.0 mA
Lowest Battery:     35.9 V


Seeking port 06..... located. Aligning... Confirmed.


 Sample:
 Volume          [ml]      = 1000
 Flow rate       [ml/min]  = 75
 Min. flow rate  [ml/min]  = 25
 Time limit      [minutes] = 41



_______________

PUMPING SAMPLE
_______________
```

```
  Pump   | Hall      | Average   |  Volume    |    Flow     |  Elapsed   |  Batt.  |  Pump   |
  Drive  | Hz        | Hall Hz   |  Pumped    |    Rate     |  Seconds   | Voltage | Current |
   1600 h     51 I_Hz     12 A_Hz       0.4 ml   21.3 ml/min        1 sec    36.0 V     59 mA
   1857 h    103 I_Hz     38 A_Hz       1.1 ml   43.1 ml/min        2 sec    36.0 V     60 mA
   2010 h    135 I_Hz     72 A_Hz       2.0 ml   56.4 ml/min        3 sec    36.0 V     66 mA
    . . . . . . . . . . . . . . . . . . . . Shortened . . . . . . . . . . . . . . . . . . . .
   1633 h     62 I_Hz     62 A_Hz     180.9 ml   25.9 ml/min      229 sec    36.0 V     38 mA
   1634 h     63 I_Hz     62 A_Hz     181.3 ml   26.3 ml/min      230 sec    36.0 V     37 mA
   1632 h     62 I_Hz     62 A_Hz     181.7 ml   25.9 ml/min      231 sec    36.0 V     41 mA


Result:             Min flow reached
Elapsed Seconds:    232
Volume:             182 ml
Lowest Flow Rate:   25.9 ml
Average Current:    42.0 mA
Highest Current:    71.0 mA
Lowest Battery:     36.0 V


30 second pause to reduce pressure differential.
04/15/2020 10:41:14 Suspended until 04/15/2020 10:41:44 ...  Awake

Seeking port 01..... located. Aligning... Confirmed.

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

Event 6 completed.



04/15/2020 10:42:25 Suspended ...
```

SAMPLE_RESULT:

Description: Display the event data of the last sample completed

Syntax: SAMPLE_RESULT

Example:

```
>sample_result

Event # |Procedure   |Start Time           |Temp. On |Temp. Off|Battery |Volume
       |Duration|Procedure Result
        |            |                     |         |         |                |
        |
       8|Water Flush |  04/15/2020 10:50:14|     31.2|     36.0|              51|
        34| Volume reached
       8|Sample      |  04/15/2020 10:51:37|     32.3|     35.9|             150|
        111| Volume reached
```

OFFLOAD AND RECOVERY:

OFFLOAD:

Description: Display all deployment data in memory

Syntax: OFFLOAD

Example:

```
>offload

 Software version:  WTS.C
 Compiled:          Jul 25 2019 16:04:06
 Electronics S/N:   ML12345-01

 Data start:        04/14/2020 17:33:29
 Data stop:         04/15/2020 13:37:37


______

HEADER
______


...
...
...


_________________

EVENT PARAMETERS
_________________


                                |Flush  |Sample Time
                                |Vol    |Vol    Limit


 Event  1: 04/14/2020 17:33:41  |50     |100    3     |NA
 Event  2: 04/14/2020 17:40:42  |50     |100    3     |NA
 Event  3: 04/15/2020 09:56:57  |50     |100    3     |NA
 Event  4: 04/15/2020 10:23:52  |50     |100    3     |NA
 Event  5: 04/15/2020 10:30:07  |50     |100    3     |NA
 Event  6: 04/15/2020 10:36:09  |50     |1000   41    |NA
 Event  7: 04/15/2020 10:44:16  |50     |150    7     |NA
 Event  8: 04/15/2020 10:48:14  |50     |150    7     |NA
 Event  9: 04/15/2020 11:06:31  |50     |150    7     |NA
 Event 10: 04/15/2020 11:11:50  |50     |150    7     |NA
 Event 11: 04/15/2020 11:18:14  |50     |150    7     |NA
 Event 12: 04/15/2020 11:26:37  |50     |150    7     |NA
 Event 13: 04/15/2020 11:39:50  |50     |150    7     |NA
 Event 14: 04/15/2020 11:46:47  |50     |150    7     |NA
 Event 15: 04/15/2020 11:52:29  |50     |150    7     |NA
 Event 16: 04/15/2020 12:07:17  |50     |150    7     |NA
 Event 17: 04/15/2020 12:13:58  |50     |150    7     |NA
 Event 18: 04/15/2020 12:20:07  |50     |150    7     |NA
 Event 19: 04/15/2020 12:25:24  |50     |150    7     |NA
 Event 20: 04/15/2020 12:30:58  |50     |150    7     |NA
 Event 21: 04/15/2020 12:35:36  |50     |150    7     |NA
 Event 22: 04/15/2020 12:40:30  |50     |150    7     |NA
 Event 23: 04/15/2020 13:18:52  |50     |150    7     |NA
 Event 24: 04/15/2020 13:28:53  |50     |150    7     |NA
```

Pump data period: 15 seconds
Available fixative at start of deployment: 197.5

DEPLOYMENT DATA

Event Number	Procedure	Procedure Duration	Result	Start Time	Internal Temp.	Battery Voltage	Volume Pumped
1	Water Flush	34	Volume reached	04/14/2020 17:33:41	26.9	36.0	51
1	Sample	92	Min flow reached	04/14/2020 17:34:28	26.9	36.0	96
2	Water Flush	34	Volume reached	04/14/2020 17:40:43	26.8	36.0	51
2	Sample	92	Min flow reached	04/14/2020 17:41:35	26.8	36.0	97
. . . . . **Shortened**							
23	Water Flush	33	Volume reached	04/15/2020 13:18:52	21.9	36.0	50
23	Sample	111	Volume reached	04/15/2020 13:19:44	22.1	36.0	150
24	Water Flush	34	Volume reached	04/15/2020 13:28:54	23.5	36.0	50
24	Sample	111	Volume reached	04/15/2020 13:29:40	23.5	36.0	150

PUMPING DATA

Pump data period = 15 seconds

[event#]	[ml/min]	[ml]	[Vbat]	[Av. Cur]	[High Cur]
1	74.8	16.5	36.0	69	69
1	71.5	34.8	36.0	69	69
1	64.8	51.7	36.0	68	68
1	61.0	67.4	36.0	66	66
1	55.6	81.9	36.0	65	65
1	52.3	95.3	36.0	63	63
. . . . . **Shortened**					
24	97.4	20.9	36.1	75	75
24	96.2	45.3	36.0	75	75
24	88.6	68.3	36.0	74	74
24	82.4	89.6	36.0	73	73
24	75.3	109.3	36.1	72	72
24	69.8	127.4	36.0	70	70
24	64.8	144.2	36.1	69	69

OFFLOAD_EEP:

Description: During a deployment, a summarized version (sample procedure results only) of the deployment event data is stored to non-volatile EEPROM in case of power cycle before offload. OFFLOAD_EEP displays this data.

Syntax: OFFLOAD_EEP

Example:

```
>offload_eep



_____________

Event Summary
_____________



Event:               1
Result:              Min flow reached
Start time:          04/14/2020 17:33:41
Volume pumped:       96 ml
Duration:            92 sec
Lowest battery:      36.0 mA
Average current:     63.0 mA
Highest current:     77.0 mA
Duration:            92
. . . . . . . . . . . . . . . Shortened . . . . . . . . . . . . . . .
Event:               24
Result:              Volume reached
Start time:          04/15/2020 13:28:53
Volume pumped:       150 ml
Duration:            111 sec
Lowest battery:      36.0 mA
Average current:     67.0 mA
Highest current:     82.0 mA
Duration:            111

End of EEPROM event backup cache.

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

SYSTEM_FLUSH:

Description: Automatically flush lines of the PPS. Follow system flush procedure in the manual.

Syntax: SYSTEMFLUSH [Time (2 - 120 seconds)]

Example:

```
>system flush 20


Already aligned to home port.

Flushing port 0

  Pump    | Hall       | Average    |  Volume     |     Flow      |  Elapsed    |  Batt.  |  Pump    |
  Drive   | Hz         | Hall Hz    |  Pumped     |     Rate      |  Seconds    | Voltage | Current |
   1600 h      53 I_Hz      13 A_Hz       0.4 ml   22.2 ml/min         1 sec     36.0 V      80 mA
   2092 h     147 I_Hz      50 A_Hz       1.4 ml   61.5 ml/min         2 sec     36.0 V      85 mA
   2396 h     194 I_Hz      98 A_Hz       2.7 ml   81.1 ml/min         3 sec     36.0 V      83 mA
   2607 h     217 I_Hz     152 A_Hz       4.3 ml   90.7 ml/min         4 sec     36.0 V      77 mA
   2771 h     231 I_Hz     197 A_Hz       5.9 ml   96.6 ml/min         5 sec     36.0 V      84 mA
   2908 h     241 I_Hz     220 A_Hz       7.5 ml  100.8 ml/min         6 sec     36.1 V      80 mA
   3024 h     249 I_Hz     234 A_Hz       9.3 ml  104.1 ml/min         7 sec     36.0 V      84 mA
   3125 h     252 I_Hz     243 A_Hz      11.0 ml  105.4 ml/min         8 sec     36.2 V      83 mA
   3219 h     259 I_Hz     250 A_Hz      12.8 ml  108.3 ml/min         9 sec     36.2 V      86 mA
   3300 h     270 I_Hz     257 A_Hz      14.7 ml  112.9 ml/min        10 sec     36.0 V      78 mA
   3358 h     272 I_Hz     263 A_Hz      16.6 ml  113.7 ml/min        11 sec     36.4 V      86 mA
   3413 h     273 I_Hz     268 A_Hz      18.5 ml  114.1 ml/min        12 sec     36.4 V      88 mA
   3466 h     273 I_Hz     272 A_Hz      20.4 ml  114.1 ml/min        13 sec     35.7 V      92 mA
   3519 h     272 I_Hz     272 A_Hz      22.3 ml  113.7 ml/min        14 sec     36.3 V      88 mA
   3573 h     273 I_Hz     272 A_Hz      24.2 ml  114.1 ml/min        15 sec     35.7 V      91 mA
   3626 h     273 I_Hz     272 A_Hz      26.1 ml  114.1 ml/min        16 sec     35.6 V      88 mA
   3679 h     272 I_Hz     272 A_Hz      28.0 ml  113.7 ml/min        17 sec     36.1 V      84 mA
   3734 h     273 I_Hz     272 A_Hz      29.9 ml  114.1 ml/min        18 sec     36.6 V      85 mA
   3786 h     273 I_Hz     272 A_Hz      31.8 ml  114.1 ml/min        19 sec     36.6 V      89 mA
   3839 h     272 I_Hz     272 A_Hz      33.7 ml  113.7 ml/min        20 sec     35.7 V      77 mA


Result:             Time limit reached
Elapsed Seconds:    21
Volume:             34 ml
Lowest Flow Rate:   113.7 ml
Average Current:    84.0 mA
Highest Current:    92.0 mA
Lowest Battery:     35.6 V


Seeking port 01. located. Aligning... Confirmed.
```

FIXATIVE COMMANDS

APPLY_FIXATIVE:

Description: Execute a fixative flush on the specified port. Use SET to specify volume.

Syntax: APPLY_FIXATIVE [port]

Example:

```
>apply_fixative 2


Seeking port 02. located. Aligning... Confirmed.


Fixative valve position: FIXATIVE


_________________

APPLYING FIXATIVE
_________________


  Pump    | Hall       | Average    |  Volume     |     Flow      |  Elapsed    |  Batt.  |  Pump    |
  Drive   | Hz         | Hall Hz    |  Pumped     |     Rate      |  Seconds    | Voltage | Current  |
   1600 h      54 I_Hz      13 A_Hz        0.4 ml    22.6 ml/min         1 sec     36.0 V      52 mA
   1851 h     107 I_Hz      40 A_Hz        1.1 ml    44.7 ml/min         2 sec     36.0 V      58 mA
   1996 h     139 I_Hz      75 A_Hz        2.1 ml    58.1 ml/min         3 sec     36.0 V      63 mA
    . . . . . . . . . . . . . . . . . . . . Shortened . . . . . . . . . . . . . . . . . . . . .
   2087 h     161 I_Hz     160 A_Hz       47.5 ml    67.3 ml/min        41 sec     36.0 V      58 mA
   2071 h     158 I_Hz     160 A_Hz       48.6 ml    66.1 ml/min        42 sec     36.0 V      61 mA
   2062 h     156 I_Hz     159 A_Hz       49.6 ml    65.2 ml/min        43 sec     36.0 V      50 mA


Result:             Volume reached
Elapsed Seconds:    44
Volume:             50 ml
Lowest Flow Rate:   65.2 ml
Average Current:    57.0 mA
Highest Current:    64.0 mA
Lowest Battery:     35.9 V


30 second pause to reduce pressure differential.

Fixative valve position: WATER
```

FIXATIVE_VALVE:

Description: Change fixative valve position from water [OFF] to fixative position [ON]

Syntax: FIXATIVE_VALVE [ON|OFF]

Example:

```
>fixative_valve on


Fixative valve position: FIXATIVE
```

FIXATIVE_AVAILABLE:

Description: Show or adjust the available amount of fixative.

Syntax: FIXATIVE_AVAILABLE [Volume]

Example:

```
>fixative_available


Fixative Available = 97.35
```

BACKUP SAMPLING, STATUS, TEMPERATURE INTERVAL (RBR Sensor) (Firmware Version 2_11 and Greater)

Firmware version WTS-2_11 and later includes commands for a Backup_interval alarm to wake the system up and cause a sample to be taken automatically using whatever parameters were last set for sampling (Set Sample command, etc).

This alarm time will be calculated/recalculated at the following times:

- If enabled, the system will calculate the first alarm time when "Start_Deploy" is entered.
- Any time the feature state goes from disabled to enabled, a new alarm time is calculated.
- Any time the command Backup_Interval Extend is entered.
- Any time a sample command is entered.

BACKUP SAMPLING COMMANDS:

Backup_Interval (with no arguments)

Description: Echo back the current state of the backup interval feature.

Syntax: BACKUP_INTERVAL

Example:

```
11/23/2020 10:31:51 WTS 12345-67>backup_interval

Status: Disabled
Backup_Interval:  15 Days  0 Hours  0 Minutes
Backup_Interval Alarm Time: 00/00/0000 00:00:00
Time Until Backup Interval Alarm: 000 Days 00 Hours 00 Minutes
```

Notice that if the feature is disabled, the Backup_Interval Alarm Time and Time Until Backup Interval Alarm fields are set to all zeroes. The default backup interval is currently set to 15 days, but is fully configurable from the command line, from a maximum of 365 days to a minimum of 1 hour.

Backup_Interval Enable

Description: Enables the feature if currently disabled. Backup_Interval Alarm Time will be calculated as Now + The Backup_Interval. If the feature was previously enabled, this command will have no effect.

Syntax: BACKUP_INTERVAL ENABLE

Example:

```
11/23/2020 10:37:49 WTS 12345-67>backup_interval enable

Status: Enabled
Backup_Interval:  15 Days  0 Hours  0 Minutes
Backup_Interval Alarm Time: 12/08/2020 10:37:54
Time Until Backup Interval Alarm:  15 Days  0 Hours  0 Minutes
```

Backup_Interval Disable

Description: Turns the backup_interval feature off.

Syntax: BACKUP_INTERVAL DISABLE

Example:

```
11/23/2020 10:40:01 WTS 12345-67>backup_interval disable

Status: Disabled
Backup_Interval:  15 Days  0 Hours  0 Minutes
Backup_Interval Alarm Time: 00/00/0000 00:00:00
Time Until Backup Interval Alarm: 000 Days 00 Hours 00 Minutes
```

Set Backup_Interval [Days] [Hours] [Minutes]

Description: Sets the backup interval period. It does not enable or disable the feature. It does not update the alarm time for the backup interval alarm.

Days - Whole number 0 - 364

Hours - Whole number 0 - 24

Minutes - Whole number 0 - 60

All 3 arguments are required.

Syntax: SET BACKUP_INTERVAL [DAYS] [HOURS] [MINUTES]

Example:

```
11/23/2020 10:50:59 WTS 12345-67>set backup_interval 7 0 0

Status: Disabled
Backup_Interval:   7 Days  0 Hours  0 Minutes
Backup_Interval Alarm Time: 00/00/0000 00:00:00
Time Until Backup Interval Alarm: 000 Days 00 Hours 00 Minutes
```

Backup_Interval Extend (No arguments)

Description: Calculates a new alarm time for the backup interval feature as Now + The stored backup_interval period. This command will not enable or disable the feature.

Syntax: BACKUP_INTERVAL EXTEND

Example:

```
11/23/2020 10:53:54 WTS 12345-67>backup_interval extend

Status: Enabled
Backup_Interval:   7 Days  0 Hours  0 Minutes
Backup_Interval Alarm Time: 11/30/2020 10:54:00
Time Until Backup Interval Alarm:   6 Days 23 Hours 59 Minutes
```

Backup_Interval Extend [Days] [Hours] [Minutes]

Description: Calculates a new alarm time for the backup interval feature as Now + the period passed in the command line arguments. This command will not enable or disable the feature.

The arguments passed in the command line will NOT be stored. This command enables a on off alarm time update without affecting the stored backup_interval period.

Days - Whole number 0 - 364

Hours - Whole number 0 - 24

Minutes - Whole number 0 - 60

All 3 arguments are required.

Syntax: BACKUP_INTERVAL EXTEND [DAYS] [HOURS] [MINUTES]

Example:

```
11/23/2020 10:57:45 WTS 12345-67>backup_interval extend 45 0 0

Status: Enabled
Backup_Interval:   7 Days  0 Hours  0 Minutes
Backup_Interval Alarm Time: 01/07/2021 10:57:59
Time Until Backup Interval Alarm:  45 Days  0 Hours  0 Minutes
```

.

STATUS_DEPLOY

Indicates whether or not the system is in deployment. If the system is deployed, the last event number and the max event numbers will be displayed.

Syntax: STATUS_DEPLOY

Example:

```
>status_deploy
Deployment: ACTIVE
Last Event: 1
Max Events: 24
```

TEMPERATURE_INTERVAL (for RBR sensor)

Sets maximum and minimum sampling intervals for RBR temperature samples. Maximum is 365 days, minimum is 1 minute. The default RBR temperature recording interval is 6 hours.

Setting an interval of 0 0 0 turns off RBR temperature logging when the firmware is asleep.

Syntax: TEMPERATURE_INTERVAL [DAYS] [HOURS] [MINUTES]

Example:

```
12/08/2020 16:36:40 WTS 12345-67>temperature_interval 0 0 0
Temperature interval:
Days:    0
Hours:   0
Minutes: 0
12/08/2020 16:36:55 WTS 12345-67>temperature_interval 999 999 999
Temperature interval:
Days:    365
Hours:   0
Minutes: 0
```

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 Fixative Valve and Antifouling option, and how to predefine Fixative and Antifouling Parameters.

Fixative Valve Option

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

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

Solenoid fixative valve ENABLED
```

Figure A-1: 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-2: 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-3: 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-4: 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-5: 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-6: Setting the Antifouling Parameters

Adaptive Deployment with Fixative Valve and Antifouling

Figure A-7 and A-8 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 mmddyy hhmmss   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 mmddyy hhmmss   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-7: Adaptive Deployment, Fixative, Antifouling (Screen 1 of 2)

```
Solenoid valve FIXATIVE

__________________
APPLYING FIXATIVE
__________________

          | --- command --- | ------------------------- result -------------------------- |
     port   vol flo min  tl     vol flowr minfl sec mmddyy hhmmss   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.


__________________

ANTIFOULING FLUSH


__________________

          | --- command --- | ------------------------- result -------------------------- |

     port   vol flo min  tl     vol flowr minfl sec mmddyy hhmmss   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-8: Adaptive Deployment, Fixative, Antifouling (Screen 2 of 2)

Using On-Demand Fixative and Antifouling Commands

Figure A-9 and A-10 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 hhmmss   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-9: Applying Fixative

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

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

__________________
ANTIFOULING FLUSH
__________________

          | --- command --- | ------------------------- result -------------------------- |
     port   vol flo min  tl     vol flowr minfl sec mmddyy 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-10: Applying Antifouling

Notes

Appendix B
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 O-Rings	The instructional video "Replacing O-Rings" provides the steps to clean and install o-rings. See the instrument User Manual for details of o-ring specifications.
Battery Replacement with Drop-in Battery Holder	Explains the correct orientation for replacing batteries using a drop-in battery holder.