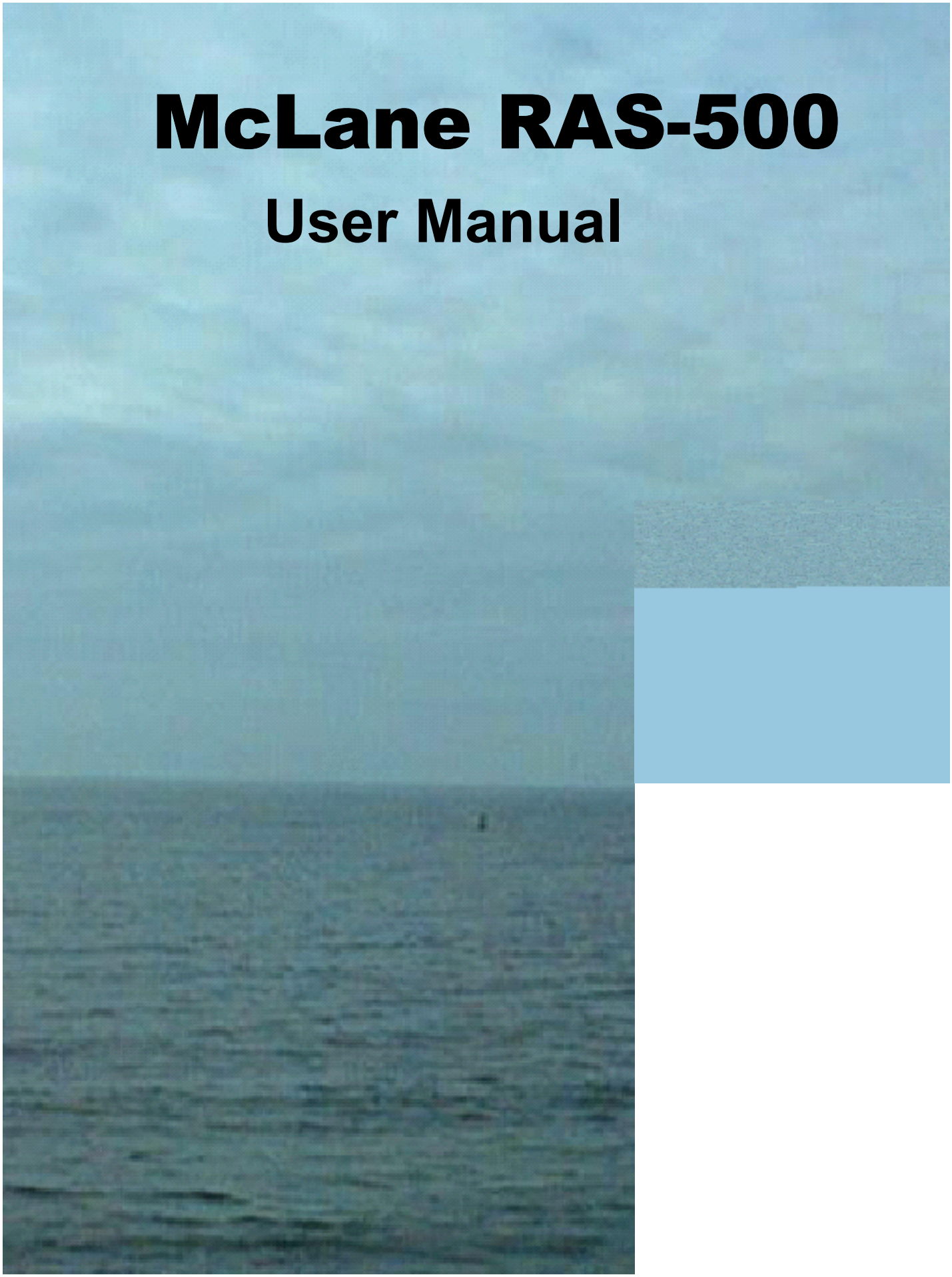

McLane RAS-500

User Manual

NOTE
Attach zinc or steel anodes to the frame when deploying the RAS-500 in a highly corrosive environment.

Controller Housing

The controller housing, which is pressure resistant to 5,500 meters, is a cylindrical pressure housing fastened to the RAS-500 frame by two latex rubber-insulated 316 stainless steel U-bolts. The battery pack, a micro-controller, a 3-phase pump-motor driver and a stepper-motor driver (for the multi-port valve) are contained in the controller housing. Two sacrificial zinc anodes (one attached to each end of the controller housing) provide galvanic protection from corrosion.

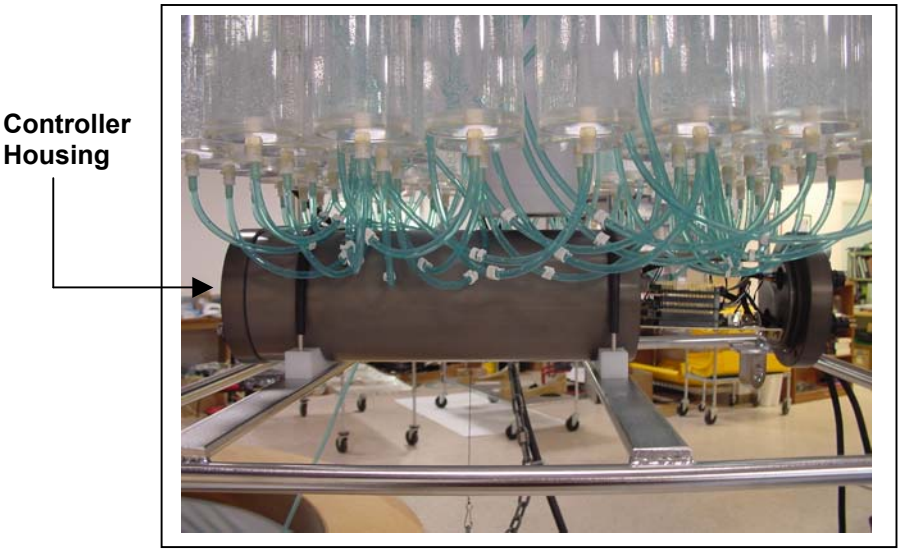

Figure 2-2: Controller Housing

The micro-controller, which starts automatically when the main or backup battery is connected, directs the programmed sampling settings and controls the pump and valve actions. The RAS-500 firmware on the microcontroller allows system testing, entry of deployment schedules and offloading recovered data.

Top and Bottom End Caps

The electronics and battery pack are fastened to the inside of the top end cap (the end cap with bulkhead connectors). Both top and bottom end caps seal the controller housing against water intrusion with a face o-ring and a radial o-ring (with a radial back-up ring).

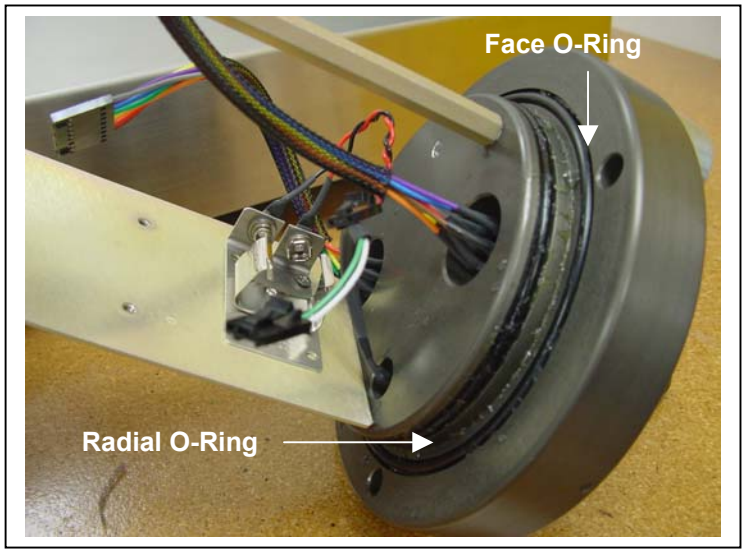

Figure 2-3: Controller Housing Top End Cap with O-Ring Seals

End Cap Bulkhead Connectors

The bulkhead connectors in the RAS-500 end cap have a different number of pins for each connection (Multi-Port Valve, Pump, and Com Port). Additionally, the connectors are labeled 'P' ('Pump'), 'V' ('Multi-Port Valve') and 'C' ('Com Port').

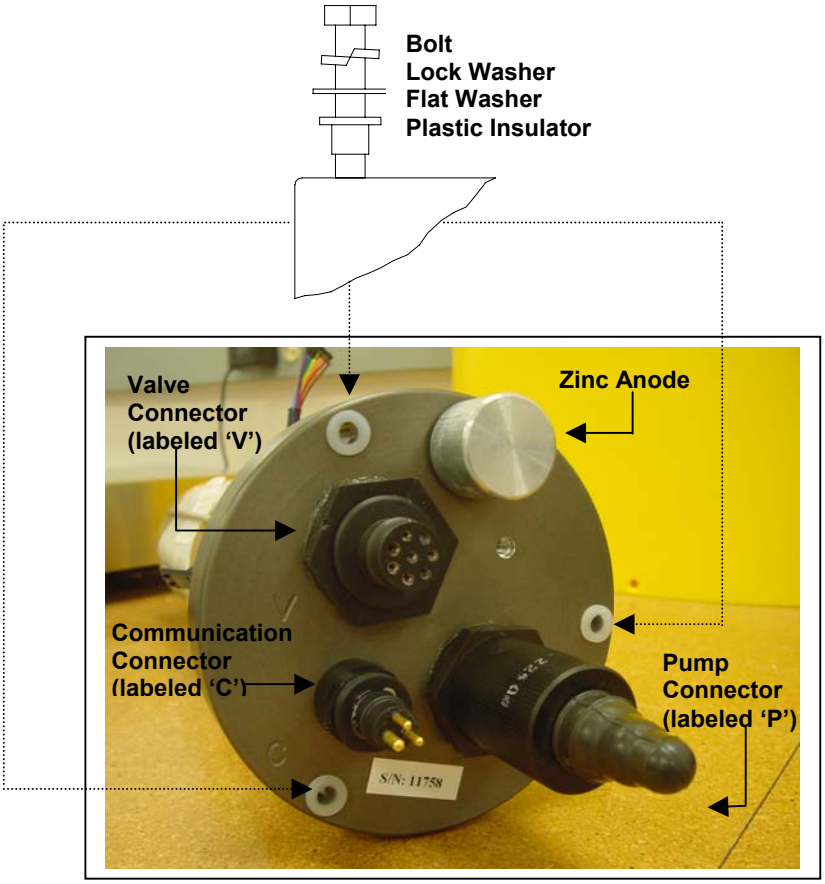

Figure 2-4: Controller Housing End Cap Bulkhead Connectors

IMPORTANT
Do not cross-connect the pump and valve cables. Cross-connected cables will damage the pump, valve and electronics.

The “thumb bump” on the cable connector should always be aligned with the thick pin on the bulkhead connector.

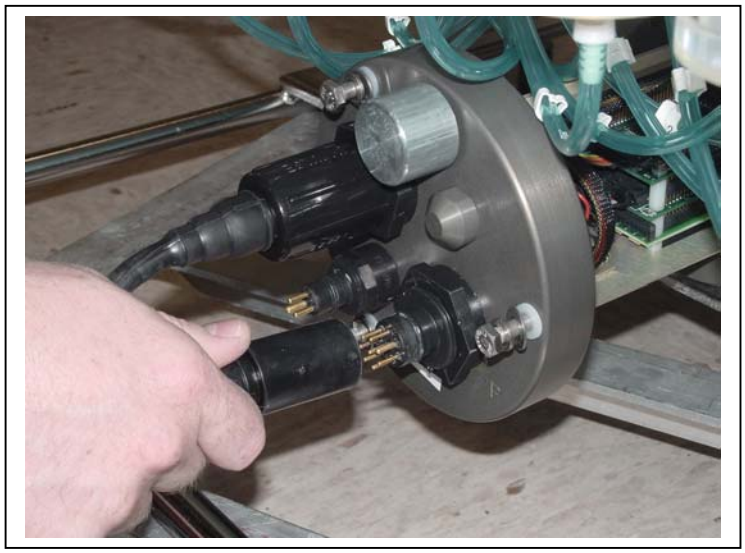

Figure 2-5: Aligning Cable Connectors with Thumb Bump

IMPORTANT
Start the PC and Crosscut before connecting the RAS-500 COM cable to the PC.

End Cap Bolts, Plastic Inserts and Screw Holes

Three bolt/washer assemblies hold the controller housing end cap in place (see Figure 2-4). The bolts should be tightened until the lock washers become flattened (20 in./lb.). A white plastic insert first goes into the screw hole of the controller housing, then a flat washer, spring (lock) washer, and lastly, the bolt. All hardware is stainless-steel-type 316 (do not replace with any other type of material). A 7/16” box wrench is included in the Toolkit.

NOTE
Do not over- tighten the end cap bolts.

Sample Tubes

The RAS-500 frame has 48 individual sample holders, machined from CAST acrylic that can each hold a 500ml bag attached to the third turn polycarbonate cap. A bleed hole in the cap allows air to escape during priming and provides pressure compensation during deployment.

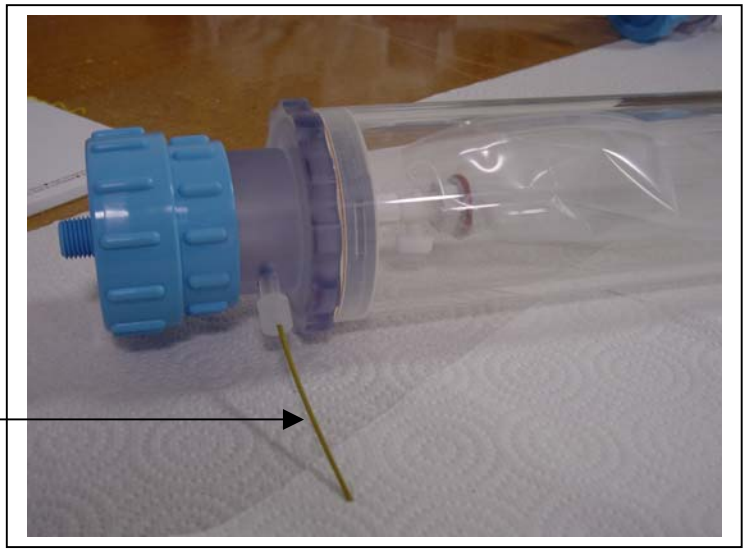

Figure 2-6: Sample Tube with Luer Bag Installed

Each sample holder is connected in series between the intake head (top half of valve) and the exhaust head (lower half of valve). The pump draws water out of the sample holder in which the collapsed sample bag is mounted. This pumping creates a pressure gradient that drives the flow of ambient seawater through the intake and into the sample bag. After each sample is taken, the multi-port valve returns to the Home Port (0) sealing the sample in the bag.

Pumping and Flushing System

The pump heads are a HYDEX plastic stator and a Kynar plastic rotor. The stator is held stationary, while a stepper motor with a 100:1 planetary gear head turns the rotor. An optical sensor and slotted disk determine rotor position. The motor, gear head, and optical sensor are in a pressure compensated PVC plastic housing filled with Dow Corning 200 fluid (20cSt.).

Gear Pump

A positive displacement gear pump creates the pressure gradient for sampling. The pump head is type 316 stainless steel and the motor housing is white PVC plastic. The pump head has user replaceable carbon gears and a replaceable magnet. A brushless DC 3-phase servo-motor is magnetically coupled to the pump head. Hall-effect encoders provide feedback to the controller for shaft speed control.

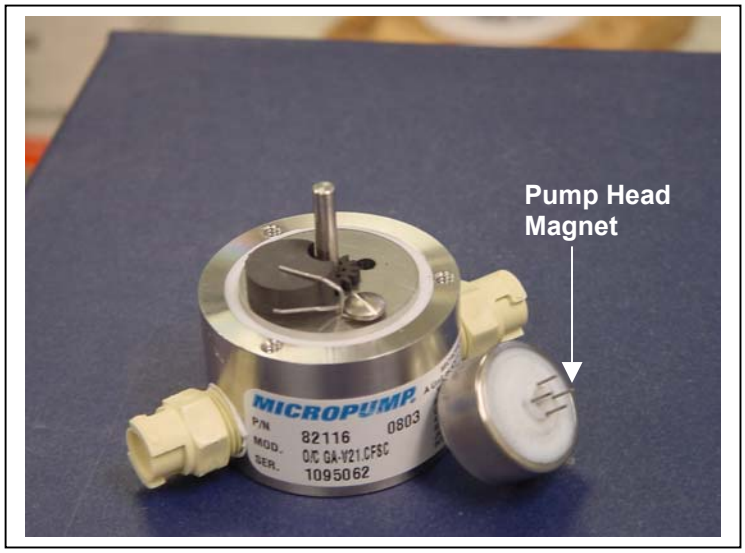

Figure 2-7: Pump Head Gear and Replaceable Magnet

NOTE
After pumping 100 L of seawater, examine the pump head carbon gears and replace if worn.

A dual-head, 50-port rotary valve directs seawater to each sample bag. The top head has a single intake port and 50 exhaust ports; the bottom head has 50 intake ports and a single exhaust port. The valve top shows the port numbers and the tubing is also tagged with numbers to further identify the port and valve connections. The sample containers and water flush option are connected between the two heads of the valve. Only one port is open on each head at one time.

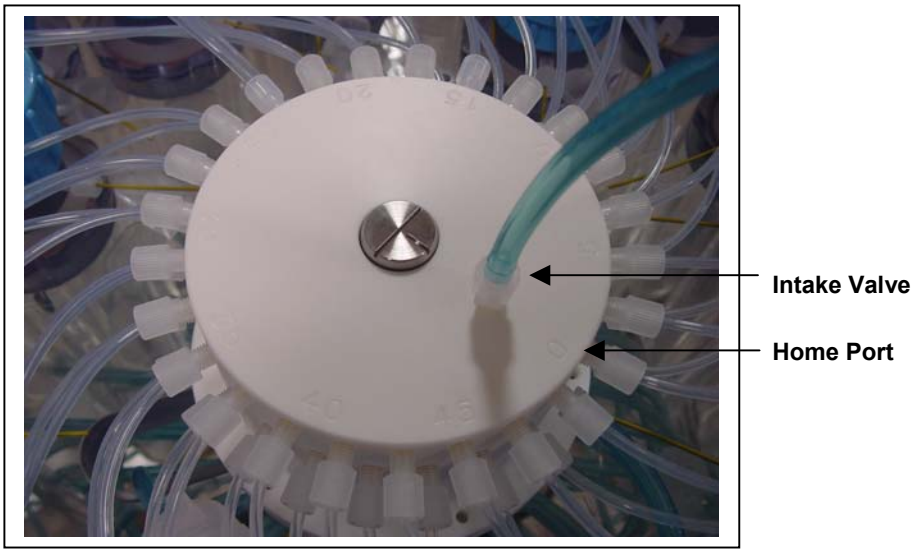

Figure 2-8: Multi-Port Valve

Water Flush Assembly

The water flush assembly consists of a 25mm filter holder (for a filter with pore size between 3 and 20 microns) connected to 'Home' port (Port 0) of the multi-port valve. The filter keeps large suspended particles from entering the pump while the valve is being flushed.

To prevent sample contamination and reduce accumulated bio-fouling, the multi-port valve flushes resident water from the intake tube and valve heads before each sample is collected. A small 25 mm disc filter that holds a filter with a pore size from 3 to 20 microns is placed in-line with the flush port (Port 0) to protect the valve from damage by large particles.

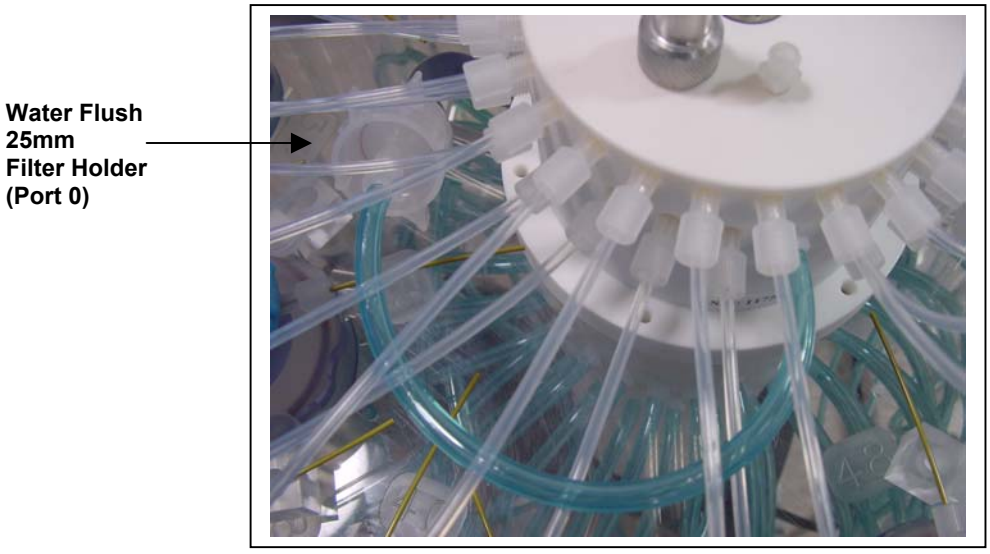

Figure 2-9: Water Flush Filter Holder

The intake tube is further cleaned by a bio-fouling acid flush from Port 49. As illustrated by Figure 2-10, the samples and the pump are isolated from each other.

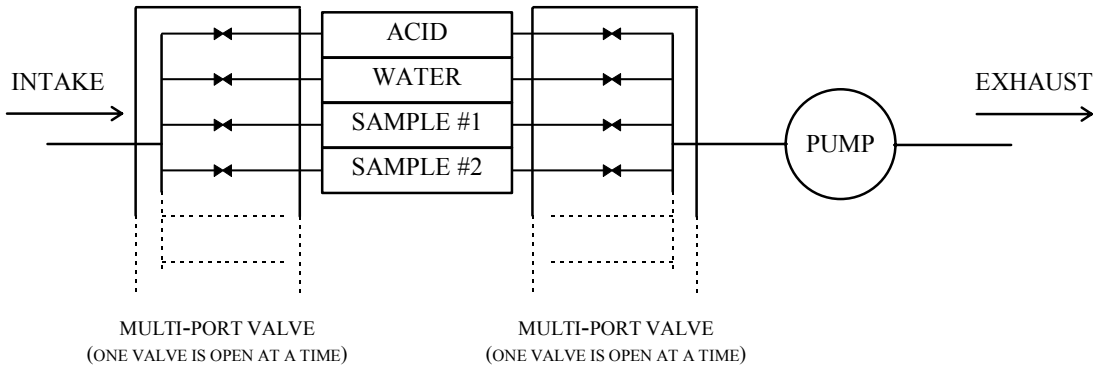

Figure 2-10: Pumping Operation Schematic

The Port/Designation table shown next illustrates how the water flush and acid flush (both pump in reverse) keep the intake path clear of contaminants.

Port #	Designation
0/Home	Water Flush (Reverse Pump)
1	Sample #1
2	Sample #2
. . .	. . .
47	Sample #47
48	Sample #48
49	Acid Flush (Reverse Pump)

Serial Number

The RAS-500 clear acrylic base plate contains a serial number label. The controller housing end cap, pump assembly, valve assembly and system menu also display this information.

Figure 2-11: RAS-500 Serial Number Label

Chapter 3
Electronic Description

Controller Electronics Stack

The RAS-500 controller is a three board stack mounted on the chassis plate between the controller housing end cap and the main battery cage.

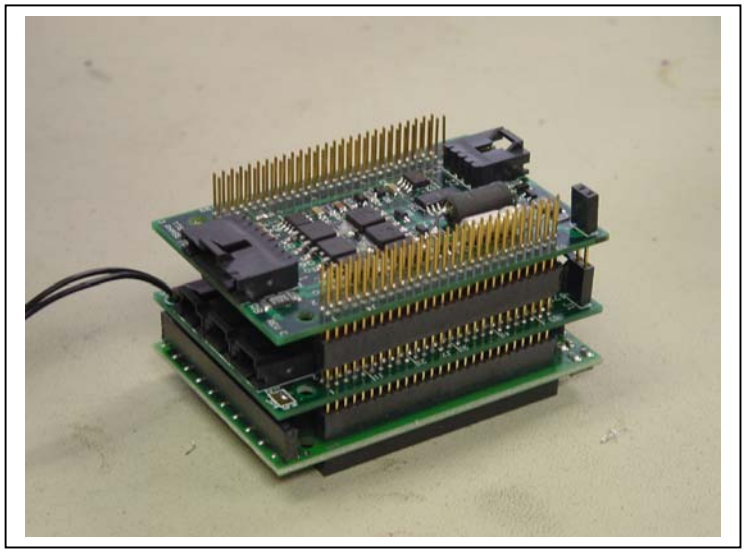

Figure 3-1: RAS-500 Controller Stack

IMPORTANT
McLane recommends that you take standard electrostatic discharge (ESD) precautions when handling the electronics.

The top circuit board in the controller stack is a 3-Phase circuit which accepts a serial control command from the pump software and converts it to an analog control voltage to drive the pump motor. Power to the motor is routed through the chip set from the main battery. The chip set also monitors Hall effect sensors in the motor housing and sends a pulse train to the TT8, to monitor the actual pump speed. The pump software completes a tight Proportional-Intergral (PI) control loop around the pump and tracks the programmed flow rate independent of battery voltage and other environmental forcing. The pumped volume is monitored and limited to the capacity of a sample bag to protect the integrity of each sample.

The middle circuit board contains an AUX circuit and a Stepper circuit. The AUX circuit generates regulated voltages from the main and auxiliary battery inputs and distributes voltages to the rest of the system under the control of the RAS-500 software. The AUX circuit includes access to the RS-232 serial communications port of the TT8 and an on-board thermistor used to monitor temperatures inside the controller pressure housing. Optionally, an external thermistor can be installed to record temperature (see Appendix B "External Temperature Sensor"). The Stepper circuit drives the stepper motor of the multi-port valve under the direction of the system software. The Stepper circuit also monitors an optical switch in the motor housing to determine rotor position and precisely align the valve to each port.

The bottom circuit board is a TattleTale 8 (TT8) version 2 micro-controller manufactured by Onset Computer Corporation (www.onsetcomp.com). The TT8 is a single board computer with large and varied I/O capacity that controls hardware operation including serial communication ports, digital, analog and timing interfaces, a PIC 16C64 microcontroller (serving as a programmable clock), non-volatile flash memory, and RAM storage of the deployment data file with non-volatile EEPROM backup.

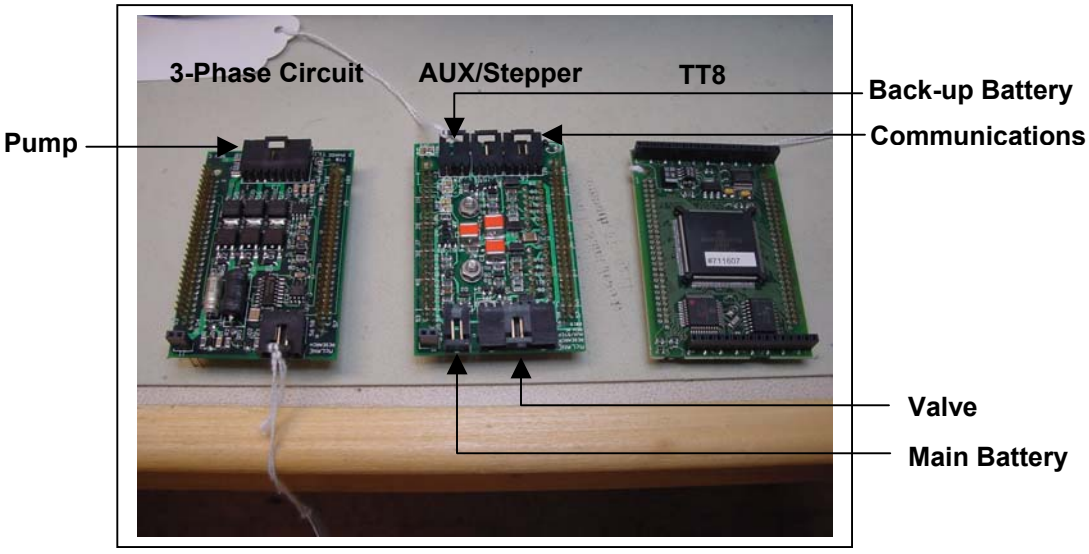

Figure 3-2: Three Boards of Electronics Stack

Battery Connection

Connecting and disconnecting the main battery is the only way to switch the RAS-500 on and off. The main and back-up battery connectors are keyed to prevent misconnection.

NOTE
Disconnect the battery before shipping the RAS-500 to prevent electrical system damage during transit. Before disconnecting power, press [CTRL]-[C] to return to the Main Menu or Sleep.

To connect the main battery, complete the following steps:

1. Boot the operator PC and start the communications software.
2. Open the controller housing and connect the main battery to the 2-pin connector on the middle board of the electronics stack.
3. Install the 9-volt backup battery into the holder.
4. Remove the dummy plug from the communications connector.

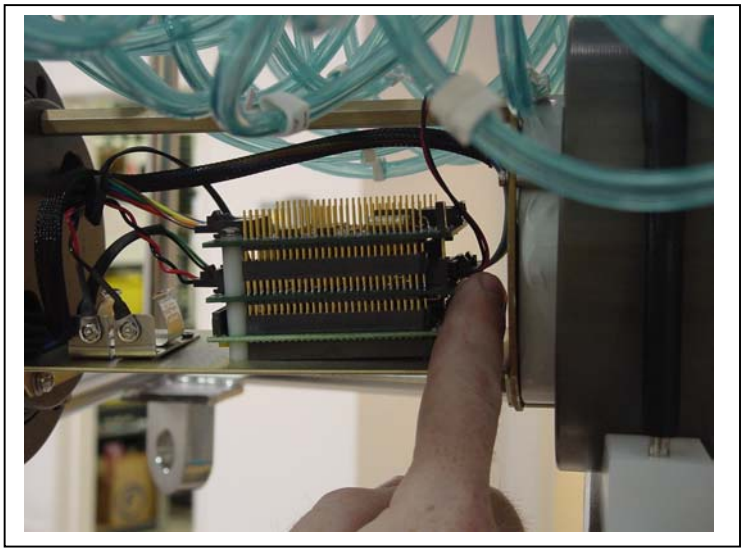

Figure 3-3: Connecting the Battery

5. Attach the supplied communication cable between the main battery communications connector on the controller housing and the PC serial port.

IMPORTANT
Always make and break the COM connection at the RAS-500 bulkhead rather than the PC serial port to avoid crashing the TT8 controller.

Chapter 4
Maintenance and Storage

Several maintenance procedures should be followed before and after each deployment for smooth operation and long instrument life for the RAS-500. Rinsing the entire instrument assembly with clean fresh water after every deployment is important to prevent corrosion. Also clean and flush the valve, tubes, and pump as described in Chapter 5 "Operations". Before and after each deployment inspect the following:

- O-rings
- Pump gears
- Pressure compensation tubes on each sample container
- Bolts
- Fluid lines and sample containers

Cleaning and Inspecting the Controller Housing

Controller Housing

Inspect and, if necessary, replace the zinc anodes prior to each deployment. Ensure that the insulated bushings are installed properly and that all hardware is 316 stainless steel. Keep hard objects such as tools and shackles from coming in contact with the controller housing, as scratches that penetrate the anodized aluminum hard coating will localize galvanic action and can lead to deep crevices or pits.

O-Rings

The RAS-500 ships with a set of o-rings in the end caps at both ends of the controller housing. Each set includes 3 o-rings, 2 round-section o-rings (BN70-2-244/BN70-2-240) and one back up ring (BN90-8-240). O-rings must be installed properly and kept in place at all times.

Positioning the larger o-ring (2-244) in the axial groove provides a seal against the face end of the pressure housing. Fit the smaller o-ring (2-240) and the backup ring (8-240) 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.

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. O-rings should be cleaned with alcohol and lubricated with a thin coating of o-ring grease as necessary.

IMPORTANT
When inserting the end cap into the controller housing, ensure that the face o-ring remains seated in its groove and that the radial o-rings enter the housing uniformly without pinching.

Pump Gears

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

1. Remove the pump from the RAS-500.
2. Remove the four screws that hold the pump head to the pump housing.
3. Lift the pump head up off the pump housing (the gears are mounted on the bottom of the pump head).

IMPORTANT
Never remove the metal magnet cavity from the pump motor housing (the area under the metal cavity is filled with oil).

Pressure Compensation Tubes

The pressure compensation tube assembly in each sample container must be kept clean and clear of obstructions to remain effective. This assembly allows a small exchange of fluid volume between the sample cylinders and the seawater to prevent the sample containers from cracking in deep deployments. The ID of the compensation tube is ~0.18mm which is sufficient for effective pressure compensation without compromising the volume accuracy of the pump.

Battery Maintenance

The capacity of a standard RAS-500 new alkaline battery pack (A21-1000) is 10,000 mAhr. The 31.5 volt battery will last up to 18 months. This is a mildly conservative figure assuming a low temperature environment and standard current drain.

NOTE
It is strongly recommended that fresh Duracell batteries be used for each deployment.

Battery Replacement

Running Option <2>, Diagnostics, from the RAS-500 Main Menu displays battery voltage. A warning message will display after Diagnostics is run and immediately before a deployment commences if the battery voltage is below 28 volts. The battery should be replaced when the voltage falls below 28 volts if a full deployment is planned.

IMPORTANT
Before replacing the battery, offload all data from the RAS-500. Unless a working 9V auxiliary battery is in place, removing the main battery erases all the deployment data stored in memory.

Backup Battery

The backup battery is a 9 volt alkaline battery. The backup battery will sustain the controller memory for approximately 3 months in the event of a main battery failure.

IMPORTANT
Making contact with the battery terminals reversed can seriously damage the controller. Install the backup battery such that the terminals of the battery correctly correspond to the terminals on the holder.

Storage

The RAS-500 shipping crate is a reusable international freight container. The crate is intended for both shipping and storing the RAS-500 and meets the requirements for international transport by ground, ocean, or air freight carriers.

NOTE
To avoid instrument damage, do not leave the RAS-500 sampler in direct sunlight for prolonged periods of time and avoid excessive vibration.

There are several procedures to prepare the RAS-500 for storage longer than a month:

- Offload all data from memory.
- Rinse all instrument components with fresh water.
- Remove both batteries. If the main battery is still usable, first cover the connector with insulation tape and then store the battery in a refrigerator.
- Reassemble the main battery holder and insert the electronics package back into the housing.
- Replace all bolts.
- Apply a small amount of anti-seize to the threads.

Chapter 5
Operations

Prior to deployment, the RAS-500 fluid lines and sample tubes must be cleaned and the sampler must be primed to remove air. Information to determine instrument current consumption (to confirm sufficient battery life for the deployment) is also provided in this chapter.

Cleaning the Fluid Lines and Sample Tubes

Cleaning the RAS-500 fluid lines removes contaminants and air pockets.

To flush the fluid lines with cleaning solution complete the following steps:

1. Remove all bags from the acrylic sample tubes and replace the caps with pressure compensation plugs on the tubes.
2. Place the intake and exhaust hoses into a container of prepared cleaning solution.
3. From the Main Menu select <3>, Manual Operation.

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º        Manual Operation          º
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      Thu Jan  1 00:30:27 1970
              Port = 99

<1> Find port : home
 <2> Find port : J
 <3> Next port : advance
<4> Next port : retreat
<5> Run pump  : forward (100 ml)
 <6> Run pump  : reverse (100 ml)
 <7> Run pump  : programmable
 <M> Main Menu
  Selection  ?
```

Figure 5-1: Manual Operation display

4. From the Manual Operation menu select <1> Find Port: home to move the valve to the Home Port (0). A message displays once the port is located.
5. From the Manual Operation menu select <5> Run Pump: forward to flush cleaning solution through all connecting fluid lines at that port.
6. Run the pump until cleaning solution has been flushed through the line.
7. Press [CTRL]-[C] to stop the pump or wait for the program to finish pumping the specified volume.

8. Select <3> Next Port: advance to move the valve to the next port.
9. Repeat steps 5-8 for each port.
10. After all lines have been flushed with solution, place the intake hose into a large reservoir of distilled water and place the exhaust hose into an empty waste water container/drain.
11. Select <5> Run Pump: forward and rinse each line.

IMPORTANT
Select <5> to run the pump forward (reverse pumping will draw waste water through the lines).

12. After each line is rinsed, stop the pump by pressing [CTRL]-[C]. Select <3> Next port: advance to advance the valve.
13. Repeat steps 11-12 for each sample tube. An optional flush with distilled water (using steps 2-12 above) can also be performed to further rinse each line.
14. After the lines have been cleaned and rinsed, open each acrylic sample tube and clean the threads and o-rings. Inspect o-rings visually and feel them for wear.

Priming the RAS-500

The RAS-500 lines and sample tubes must be clear of trapped air when deployed. Sample tubes can be installed with or without filter holders. The priming steps detailed in this section provide an example of priming with filter holders installed. Information about priming a RAS-500 without filter holders is also provided. Complete these steps in order:

- Step 1 – Preparing to Prime
- Step 2 – Installing the sample bags and optionally adding preservative (also installing the 47mm filters if filter holders are installed)
- Step 3 – Filling the sample tubes with water and reverse pumping on each valve
- Step 4 – Filling the acid flush bag for Port 49
- Step 5 – Installing the water flush filter and priming Home Port

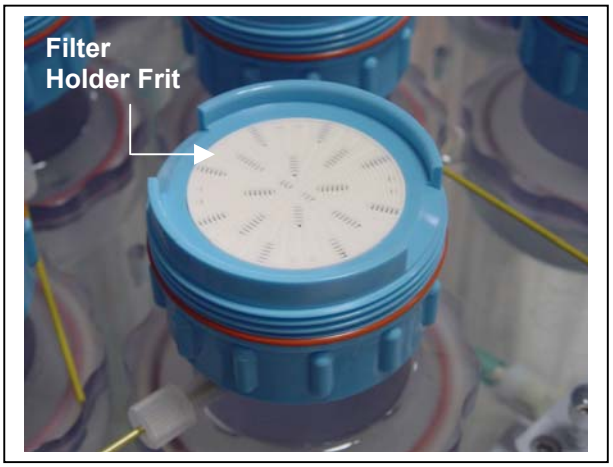

Figure 5-2: Sample Tube with Filter Holder

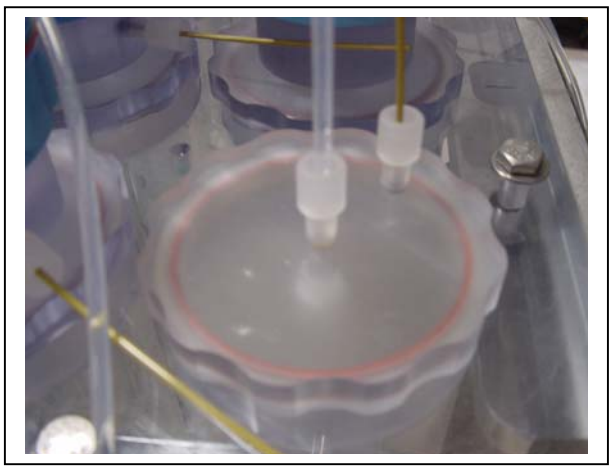

Figure 5-3: Sample Tube without Filter Holder

Step 1 – Preparing to Prime

To prepare for priming, complete the following steps:

1. Power up the PC, start Crosscut, and then plug the RAS-500 COM cable into the PC serial port.
2. Connect the RAS-500 battery (if this is the first use of the RAS-500 since shipment, the battery will be inside the controller housing but not connected).
3. Close and seal the controller housing.

IMPORTANT
Priming is a wet process. Ensure the electronics housing is sealed to protect the electronics.

4. From the RAS-500 Main Menu select <3> Manual Operation.
5. From the Manual Operation menu select <1> Find port: home.
6. Place a large syringe (provided in the Toolkit) full of water on the valve intake.

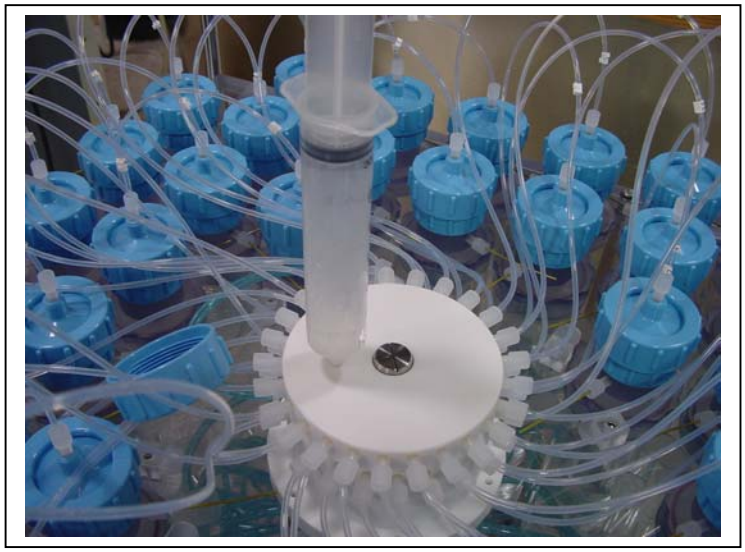

Figure 5-4: Water-Filled Syringe on Valve Intake

7. Unscrew and remove the acrylic bars and loosen the acrylic hold-down clamps that secure the sample tubes in place.

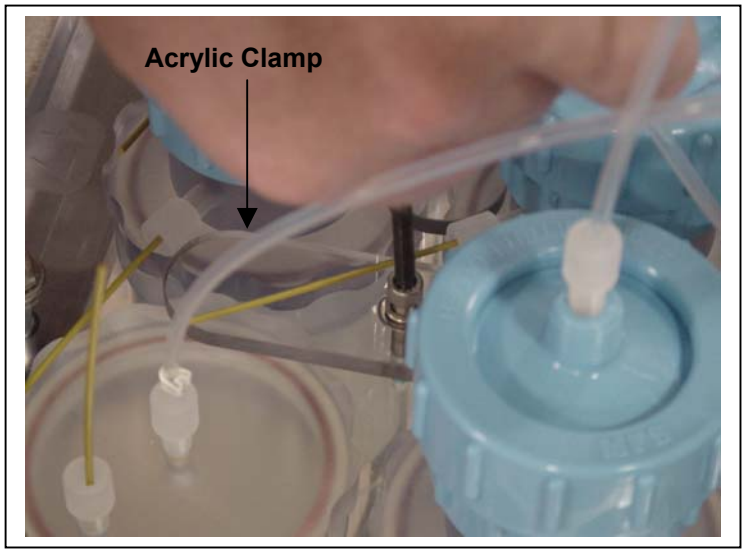

Figure 5-5: Loosening an Acrylic Clamp

8. If using filter holders, remove all filter holder tops.

Figure 5-6: Removing Filter Holder Tops

Step 2 – Installing the Sample Bags and Optionally Adding Preservative

RAS-500 sample bags are available with Luer locking valve fittings or JACO fittings.

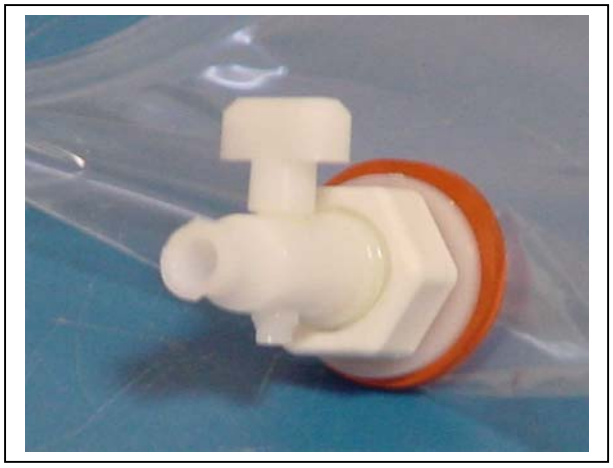

Figure 5-7: Luer Locking Valve

Figure 5-8: JACO Fitting

NOTE
Each standard sample bag is shipped with a JACO fitting, ferrule, short length of tubing and threaded male connector. If the ferrule is missing, place a new ferrule onto the tubing before use. Sample bags with Luer Locking valves do not have a ferrule.

To install the sample bags, complete the following steps:

1. From the Manual Operation menu select <2> Find port: 1.
2. If adding preservative to the sample bags, use a syringe to inject the desired quantity into the bag, otherwise, skip this step. The preservative is drawn into the sample bag prior to the water sample (the approximate volume of the sample tube is 1.0 ml).

NOTE
Before adding preservative, check the "RAS-500 Specifications" section in Chapter 1 of this User Manual to ensure chemical compatibility .

3. Insert a syringe (provided with the Toolkit), into the top of the sample bag and pull the syringe out to extract as much air as possible. For sample bags with Luer lock fittings, close the valve.

Figure 5-9: Attaching Sample Bag to Sample Tube Cap

4. Attach the sample bag to the sample tube cap.

NOTE
If not using filter holders, press down on the syringe in the valve intake to fill the tubing between the valve and the sample tube with water and then attach the sample bag to the sample tube cap.

5. Place the bag inside the sample tube and attach the cap onto the acrylic tube.
6. If optional filter holders are installed, complete the following:
    - Remove the filter holder frit.
    - Fill the bottom reservoir of the filter holder with water.
    - Replace the filter holder frit.
    - Wet the filter and place on top of the frit.
    - Press down on the syringe in the valve intake to fill the tubing and filter holder top with water.

Figure 5-10: Injecting Water into Tubing and Filter Holder

- Push down on filter top to displace air bubbles, and re-secure the filter holder cap.

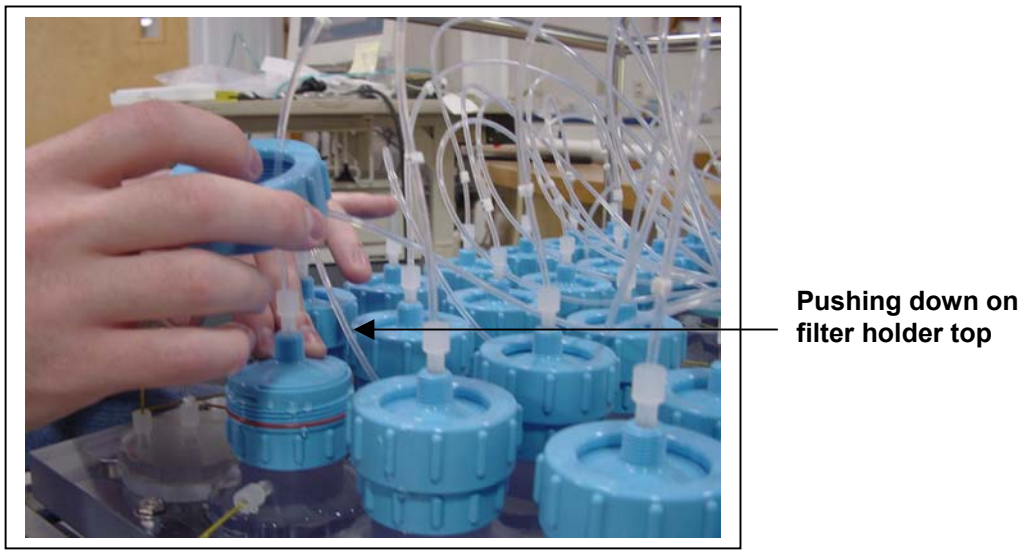

Figure 5-11: Reassembling Filter Holder

7. From the Manual Operation menu, select <3> Next port: advance to move to the next port.
8. Repeat steps 2 – 7 for each sample tube.
9. Remove the syringe from the valve intake and replace with the intake plug (provided in the Toolkit).

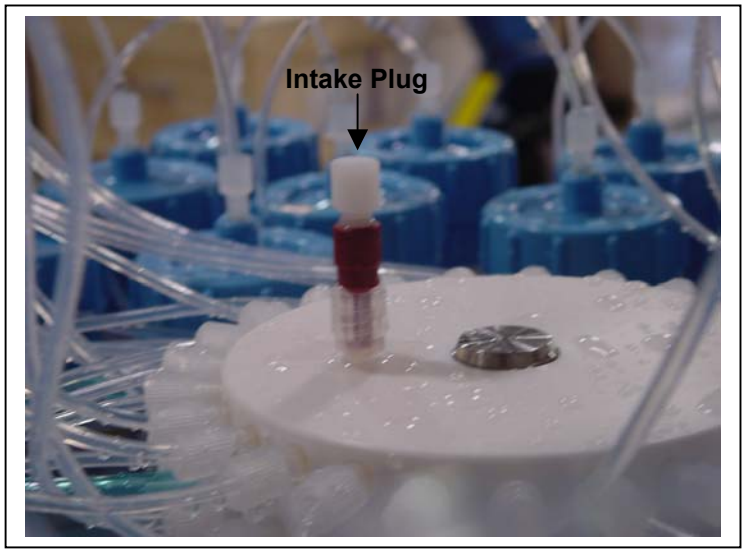

Figure 5-12: Intake Plug

IMPORTANT
Do not forget to remove the intake plug just prior to deploying the RAS-500. If the plug remains in place during the deployment, the RAS-500 cannot pump properly.

Step 3 – Filling Sample Tubes with Water and Reverse Pumping

Filling the sample tubes with neutral water prevents damage and sample contamination from differential pressure while reverse pumping at each Port removes any trapped air.

1. Open a sample tube.

2. Using a hose connected to tap water, fill the sample tube to the top with water.

Figure 5-13: Filling the Tubes with Water

3. Place the top back on the sample tube and re-secure.

IMPORTANT
If using Luer locking valve bags, open the bag valve before re-securing the sample tube cap.

4. Repeat steps 1 – 3 for each sample tube.
5. Connect one end of the exhaust tube (provided in Toolkit) to the pump exhaust.
6. Place the other end of the exhaust tube in a sink or large bucket filled with water and keep the tube submerged throughout the procedure to prevent air bubbles from entering the tubing.
7. From the Manual Operation menu select <2> Find port: 1.
8. From the Manual Operation menu select <6> Run pump: reverse.

9. Run the pump until water drips out of the pressure compensation tube.

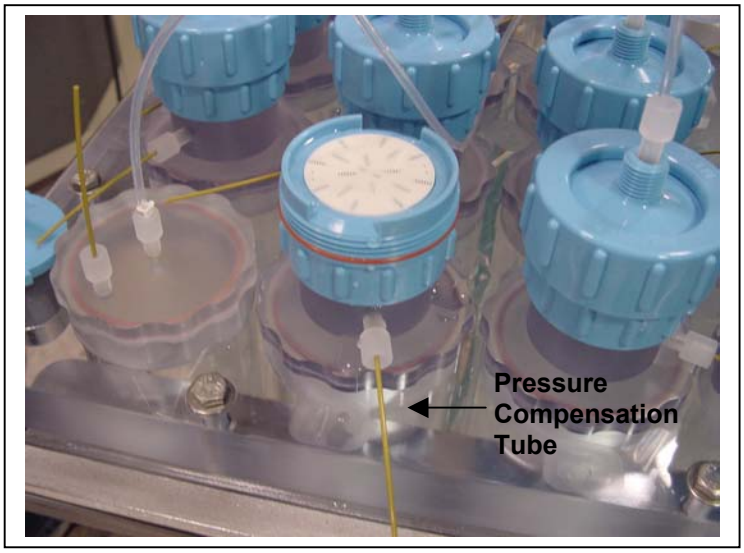

Figure 5-14: Pressure Compensation Tube

10. From the Manual Operation menu select <3> Next port: advance.
11. Repeat steps 7 – 10 for Ports 2 through 48.

Step 4 – Adding Acid Flush to Sample Tube Number 49

Adding acid to Port 49 provides a bio-fouling flush that further cleans the intake tube.

NOTE
When this step is completed, the intake plug should be on the valve intake and the exhaust tubing should still be in a sink or bucket of water, as was setup in Step 3 – Filling Sample Tubes with Water and Reverse Pumping.

To add acid, complete the following steps:

1. Place an Acid Bag in the sample tube. Use a syringe to inject acid into the bag.
2. Attach the sample bag to the sample tube cap and close the sample tube.
3. From the Manual Operation menu select <2> Find port: 49.
4. Select <6> Run pump: reverse until the sample tube for Port 49 fills with water and water drips out of the pressure compensation tube.

Step 5 – Installing the Water Flush Filter

The water flush filter is placed inline to Home Port (Port 0) to hold a 25mm disc filter with a pore size from 3 to 20 microns. The filter protects the valve from damage by large particles. To install the water flush filter, complete the following steps:

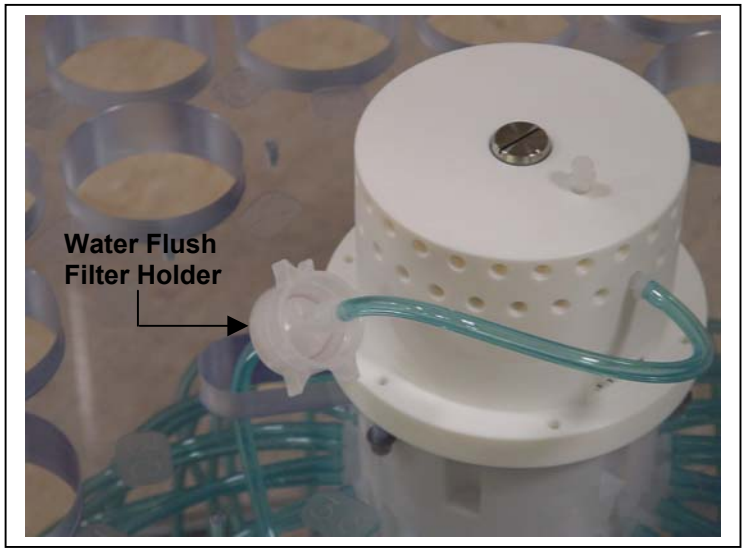

Figure 5-15: Water Flush Filter Holder

1. Place the pump exhaust tube in a bucket of water, if not already in water.
2. Remove the intake plug from the valve intake and place a syringe filled with water in the valve intake.
3. Disassemble the water flush filter by unscrewing the filter cap.
4. From the Manual Operation menu select <1> Find port: home.
5. From the Manual Operation menu select <6> Run pump: reverse.
6. Run the pump until water flows out of the filter holder.
7. Push the syringe to inject water into the tubing until water flows through the filter holder frit.
8. Place the filter in the filter holder (on top of the frit).
9. Reassemble the filter holder.
10. Remove the syringe and place the intake plug on the intake valve.
11. Using Chapter 7, "User Interface", program the deployment and then put the RAS-500 to sleep.

12. Remove the intake plug from the intake valve just prior to launching the RAS-500.

IMPORTANT
Do not forget to remove the intake plug just prior to lauching the RAS-500. If the plug remains in place during the deployment, the RAS-500 cannot pump properly.

Instrument Current Consumption

The values for pumping or moving the valve include the current drain of the controller, which is awake during valve rotation and pumping. Using the instrument current consumption values listed next, the operator can estimate battery life from the proposed deployment schedule. An example of this procedure for a one-year deployment is shown next.

Controller unit	3.0 mA
Controller unit in low power mode	0.30 mA
Pumping	160 mA
Moving the valve from one port to the next	0.23 mAh (2.7 seconds)

Example of Determining Battery Life for One Year Deployment

Pre-deployment (loading sample bags)	
Controller unit (3 hours)	3 h x 3.00 mA = 9.0 mAh
Moving valve (twice around)	100 ports x 0.23 mAh = 23.0 mAh
Running the pump (1.0 hour)	1.0 h x 160 mA = 160.0 mAh
	Subtotal = 192.0 mAh
Deployment	
Controller (1year)	8760 h x 0.30 mA = 2628.0 mAh
Move valve (48 samples)	1300 ports x 0.23 mAh = 299.0 mAh
Pumping (2 minutes per port)	1.6 h x 160 mA = 256.0 mAh
	Subtotal = 3183.0 mAh
Recovery (offload data/remove samples)	
Controller unit (2 hours)	2 h x 3.00 mA = 6.0 mAh
Move valve (once around)	50 ports x 0.23 mAh = 11.5 mAh
	Subtotal = 17.5 mAh
Total Current Consumption	**192 + 3183 + 17.5 = 3392.5 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 not exceed battery life.

Chapter 6
Launch and Recovery

Attaching to a Mooring

The RAS-500 can be deployed on different mooring types for deployment durations of up to 18 months. As a stand-alone mooring, the RAS-500 requires 140 kg of positive flotation. As part of a complex mooring array, the RAS-500 can be used as a bottom tethered or floating "in-line" instrument. For profiling applications in depths less than 5,500m, the RAS-500 can be lowered from a ship by winch.

Simple Mooring

An example of a simple RAS-500 mooring setup is below. Mooring components are listed from top to bottom (sea floor):

Top

- 250 kg of positive flotation (140 kg for the RAS-500 sampler and 110 kg for the other mooring hardware).
- A 3 m piece of 5/8" stainless steel chain attached to the top eye of the RAS-500 frame, with a 3/4" shackle through the white Acetal insert (insulator).
- A four-to-one bridle connection (see Figure 6-1) attached to the bottom mooring eyes of the RAS-500 frame, through the white Acetal inserts (insulators).
- 3 m of 5/8" stainless steel chain.
- An acoustic release.
- A 200 kg weight.

Bottom

NOTE
If possible, do not deploy or recover the RAS-500 through an oil slick (oil can damage the pump and valve). If this condition is unavoidable, pour clean, fresh water over the spot where the RAS-500 will enter or break the water surface through the slick, and rinse the instrument thoroughly after recovery.

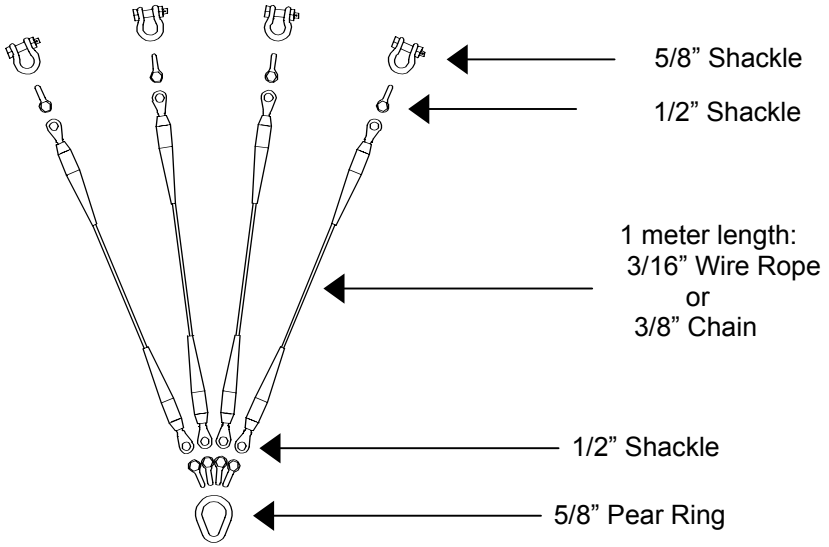

Figure 6-1: Four-to-One Bridle Connection

NOTE
If necessary, the RAS-500 can be removed from its frame and mounted on a special purpose instrument rig or a bottom-lander using longer cables to connect between parts. Contact McLane to use this configuration.

Launch Preparation

Preparing and launching the RAS-500 deployment requires the following (in order of completion):

- Connect the battery.
- Close the end cap.
- Connect the RAS-500 COM cable.
- Program the deployment (as documented in Chapter 7 of this User Manual).
- Disconnect the COM cable and attach the dummy plug.
- Deploy the RAS-500.

IMPORTANT
Do not forget to remove the intake plug that was used during Priming just prior to deploying the RAS-500. If the plug remains in place during the deployment, the RAS-500 will not sample properly.

Recovery Procedure

After the deployment is completed, the required steps are:

- Remove the sample bags for storage and later analysis.
- Offload the deployment data.

Steps for offloading the data are included in Chapter 8, "Data Offload and Processing" in this User Manual.

Removing the Sample Bags

Steps for removing the sample bags are provided below.

1. Remove the bag from Port 1 by twisting the sample tube cap counter-clockwise through one third of a revolution (do not remove the bag by pulling on the cap or the bag's intake tube).

IMPORTANT
Disconnect the tubing at the bottom of the acrylic sample tube to reduce the force required to remove a full sample (pressure on the bag can cause some of the sample to flow back through the intake tube valve, potentially contaminating the sample).

2. Lift the cap gently and firmly grasp the sample bag just below the bag's intake tube using the thumb and index finger.
3. Gently pull the bag out of the sample container by gripping the bag just below the intake tube.
4. Disconnect the sample bag from the cap and install a 1/4-28 threaded female cap on the tubing. Store the sample safely and replace the cap on the acrylic sample tube.
5. Repeat steps 1-4 for all sample bags.

6. Reassemble the RAS-500 and perform any necessary maintenance (see Chapter 4, “Maintenance and Storage” in this User Manual for maintenance procedures).

Chapter 7
RAS-500 User Interface

This chapter describes the RAS-500 firmware menus, commands, and screens.

Power-Up Sequence

Connecting the RAS-500 battery automatically loads the TT8 RAM. A screen prompt displays to set the time and date (press [ENTER] to accept the default time and date).

NOTE
If the time and date screens do not display and the battery has been connected for some time, press [CTRL]-[C] three times to wake the system from Low Power Sleep (LPS). If the screens still do not display, confirm the COM port connection and communication protocol settings (9600 baud, 8 data bits, 1 stop bit, and no parity).

The Main Menu – Operating the RAS-500

The RAS-500 Main Menu provides the user interface to control all system operations. To select an option, type the appropriate alphanumeric character and press [ENTER].

```
 McLane Research Laboratories, USA
       Remote Access Sampler
  Version: ras600_0.c   S/N: 11733-01

ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
º            Main Menu              º
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
      Thu Jan  1 00:05:32 1970
             Port = 99

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

  Selection  ?
```

Figure 7-1: Main Menu display

<1> Set Time

This option sets the real time clock (RTC).

IMPORTANT

McLane recommends that the RTC be set during the power-up sequence. When the RAS-500 is powered on, the clock defaults to January 1,1970, 00:00:00. The operator can set the clock to any date and time in the allowed range and the count will continue from the new value.

```
Clock reads 01/01/70  00:48:21
Change time & date (Yes/No) [N] ? y

(Note: Year 2000=100, 2001=101, etc.)
Enter correct time  [01/01/70 00:48:24] ? 11 15 98 20 30 55

Clock reads 11/15/98  20:30:55
Change time & date (Yes/No) [N] ? n
```

Figure 7-2: Set Time display

<2> Diagnostics

Diagnostics is a scrolling display of system status including date, time, battery voltage (in Vb), temperature (in °Celsius), and valve status. A sample diagnostics display is shown below. Type [X] or [CTRL]-[C] to exit from Diagnostics and return to the Main Menu. Toggle the scrolling on and off without exiting by pressing any other alphanumeric key.

```
 11/15/98  20:50:03   32.1 Vb    25.2 °C  PORT = 00
 11/15/98  20:50:04   32.1 Vb    25.4 °C  PORT = 00
 11/15/98  20:50:05   32.1 Vb    25.4 °C  PORT = 00
 11/15/98  20:50:06   32.1 Vb    25.2 °C  PORT = 00
 11/15/98  20:50:07   32.1 Vb    25.3 °C  PORT = 00
```

Figure 7-3: Diagnostics display

Low battery voltage triggers operator warning messages. If the voltage of the main battery pack is below 28 V, a message displays during the exit from the diagnostic routine, suggesting battery replacement before deployment.

```
Battery voltage is abnormally low.  Check/replace
main battery pack before deploying system.

Press any key to continue.
```

Figure 7-4: Low Battery Voltage display

If the voltage of the main battery pack is below 18 V, only one status line will be printed, the diagnostic routine will terminate, and the program will return to the Main Menu.

```
Main battery is extremely low and should be replaced
before running diagnostics.
```

Figure 7-5: Critically Low Battery Voltage display

If a critically low battery is detected and a data file exists in memory that has not been offloaded, an additional warning will be displayed before returning to the Main Menu.

```
A data set exists in memory that has not been offloaded.
Offload the data now, before replacing battery, or the
data may be lost.
```

Figure 7-6: Critically Low Battery Voltage - Offload Data display

IMPORTANT

The firmware can detect only that the *Offload Data* option was successfully executed from the Main Menu and cannot check the successful data file logging by your terminal emulator. Confirm that offloaded data is accurate before disconnecting the battery.

<3> Manual Operation

The Manual Operation option allows direct control of the valve and pump.

NOTE

Port 99 indicates an unknown valve position. The valve must first find the Home Port.

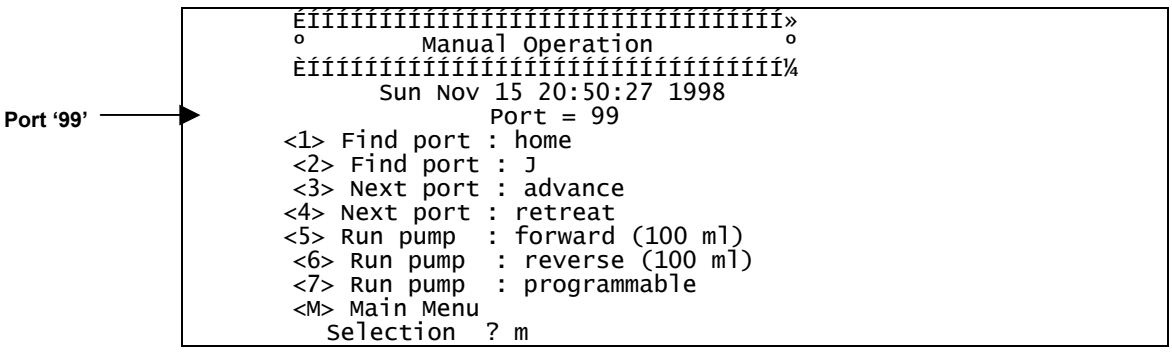

Figure 7-7: Manual Operation Menu display

Option <1> Find Port: home

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

Option <2> Find Port:

This option moves the valve to a specified port.

Option <3> Next port:advance

This option moves the valve forward one port position (for example, from Port 3 to Port 4).

Option <4> Next port:retreat

This option moves the valve backwards one port position (for example, from Port 3 to Port 2).

Option <5> Run pump: forward

This option pumps 100 ml of water at 75 ml/min. in the forward direction. The pump can be stopped at any time before the operation is complete by pressing [CTRL]-[C]. Each row of the display shows the pump speed control value; the instantaneous pump speed in Hertz, the average pump speed in Hertz, the cumulative volume pumped, the instantaneous flow rate in ml/min, and the elapsed time in seconds.

```
1676 h  401 I_Hz  100 A_Hz    1.4 ml  83.8 ml/min     1 secs
1582 h  286 I_Hz  171 A_Hz    2.7 ml  78.8 ml/min     2 secs
1695 h  183 I_Hz  217 A_Hz    4.0 ml  76.3 ml/min     3 secs
```

Figure 7-8: Run Pump Forward display

Option <6> Run pump: reverse

This option pumps 100 ml of water at 75 ml/min. in the reverse direction. The pump can be stopped at any time before the operation is complete by pressing [CTRL]-[C].

Option <7> Run pump: programmable

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

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

<4> Sleep

This option places the RAS-500 in Low Power Sleep (LPS) mode to conserve battery power. When the RAS is not running a schedule, LPS automatically triggers after 20 minutes of inactivity.

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

```
<11/06/98  12:01:24> Sleeping . . .
Enter <CTRL-C> now to wake up?
```

Figure 7-9: Low Power Sleep display

<5> Create Schedule

This option allows creation of a sampling schedule in advance of the actual deployment. The schedule consists of preprogrammed dates and times that will trigger pumping events, and specifies the number of samples to be taken (from 1 through 48). Scheduling is Year 2000 compliant and properly accounts for leap years.

IMPORTANT
Creating a new schedule makes data in memory inaccessible.

NOTE
Confirm that the real time clock and the scheduled events refer to the same time zone, e.g., GMT or local time.

Select <5> 'Create Schedule', and enter the number of desired sampling events. This prompt will be preceded by warnings if previous deployment records (a data file) or a deployment schedule exist.

```
Enter the number of events to program  (0 to 48) ? 48
```

Figure 7-10: Create Schedule display

```
       ÕÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¸
       ³          SCHEDULE MENU             ³
       ÔÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¾
      (Note: Year 2000=100, 2001=101, etc.)
        <1> Enter each event time
        <2> Enter start date & interval
        <3> Enter start date & end date
        <M> Main Menu


            Selection  ? 2
```

Figure 7-11: Schedule Menu display

There are several options for creating a sampling schedule of events.

Option <1> Enter each event time

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

Option <2> Enter start date & interval

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

Option <3> Enter start date & end date

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

<6> Deploy System

This option prepares the RAS-500 for a deployment. Select 'Deploy System' to redisplay Main Menu options and verify your deployment settings. The valve is aligned to Home Port (0), if this has not already been done. Prompts allow the operator to:

- Offload any existing data that has not already been displayed (the warning to offload existing data occurs only if a data file exists and has not been offloaded).
- Check and reset the time.
- Create a new schedule or check (change) an existing schedule.

The next screens show the prompts displayed after selecting 'Deploy System'.

IMPORTANT
McLane recommends using the file capture utility available in Crosscut to log the communication with the RAS-500 (including pre-deployment bench testing). Refer to Appendix A in this User Manual for more information.

Deployment Initialization

The system first confirms that the valve is aligned with Home Port (0).

```
Searching for home port . . . done
```

Figure 7-12: Confirming Home Port Alignment display

If the valve cannot be aligned with Home Port, the warning message shown next is displayed, the deployment is terminated, and the firmware returns to the Main Menu.

```
WARNING -- Unable to find home port!!!
           This problem must be resolved before deploying the system.
           Begin by checking external connections and exercising
           the multiport filter valve using the tools found in the
           "Manual Operation" menu.
```

Figure 7-13: Unable to Locate Home Port display

Once the valve is aligned, the firmware checks to see if a data set that has not been offloaded exists in memory.

```
A data set exists in system memory that has
not been offloaded.  Existing data will be lost
if a deployment schedule is defined.

Continue (Yes/No) [N] ?
```

Figure 7-14: Data Set Exists in Memory display

Select 'Yes' or 'No' as appropriate.

IMPORTANT

The firmware cannot detect whether "Capture to File" (in Crosscut) is active during the offload operation. Confirm that "Capture to File" is ON during offload.

Next, the real time clock date and time display. To change the time, select 'Y'. If the time is correct, select 'N'. Press any key to continue.

```
Clock reads 01/01/70  00:48:21
Change time & date (Yes/No) [N] ? y

(Note: Year 2000=100, 2001=101, etc.)
Enter correct time  [01/01/70 00:48:24] ? 11 15 98 20 50 49
```

Figure 7-15: Real Time Clock display

If there is deployment data still in memory, the message below is displayed. Select 'Y' to delete the deployment data, 'N' to return to the Main Menu.

```
Previous deployment records will be erased.  Continue (Yes/No) [N] ? y
```

Figure 7-16: Previous Deployment Data in Memory display

If a schedule is already in memory, the message below is displayed. Select 'Y' to delete the current schedule or 'N' to keep the schedule.

```
Enter new schedule (Yes/No) [N] ? y
```

Figure 7-17: Enter New Schedule display

Enter the number of events to program.

```
Enter the number of events to program  (0 to 48) ? 48
```

Figure 7-18: Enter Number of Events to Program display

Entering or Changing a Pumping Schedule

The Schedule Menu is displayed next and allows creation or modification of an event schedule. To enter the start data and interval, from the Main Menu select <2>, 'Schedule Menu' and then select <2> 'Enter start date & interval'.

```
       ÕÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¸
       ³          SCHEDULE MENU              ³
       ÔÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¾
      (Note: Year 2000=100, 2001=101, etc.)
       <1> Enter each event time
        <2> Enter start date & interval
        <3> Enter start date & end date
        <M> Main Menu


            Selection  ? 2
```

Figure 7-19: Schedule Menu display

Enter the start date and time for the RAS-500 to begin pumping the first sample. Then, enter the interval between the start time of one sample and the start time of the next sample.

```
Enter START date and time [11/15/98 20:51:23] ? 11/15/98/21/30/0

      Enter interval

                  Days     (0 to 365) ? 0
                  Hours    (0 to 23) ? 0
                  Minutes  (0 to 59) ? 15
```

Figure 7-20: Pumping Start Date & Time display

NOTE
Date and time information can be separated by [SPACE], [/], or entered using the display format [MM/DD/YY HH:MM:SS].

A schedule of the event times will appear on the screen in blocks of 16 events. Verify the dates and times and respond to the 'Modify an event' prompt. To review the next/remaining block, press any key.

```
------------------VERIFICATION--------------------
       Event   1 of  48 = 11/15/98  21:30:00
       Event   2 of  48 = 11/15/98  21:45:00
        ...
       Event  47 of  48 = 11/16/98  09:00:00
       Event  48 of  48 = 11/16/98  09:15:00

       Modify an event  (Yes/No) [N] ?
```

Figure 7-21: Event Verification display

To change an event type 'Y' at the 'Modify an event' prompt. Select the event to change, and enter a new date and time for that event. If the schedule is acceptable, type 'N' or press [ENTER] to proceed with the deployment.

Programming Sampling Parameters

When deployment initialization and scheduling is completed, a menu is displayed for entering the sampling parameters. After entering the parameters described below, select 'D' to continue with the deployment. The parameters are divided by general function into five groups: Header, Acid, Water, Sample, and Timing.

```
Header 1|
       2|
       3|

Acid   4| Flushing volume     =     10 [ml]
       5| Flushing time limit =      1 [min]
       6| Exposure time delay =      1 [min]

Water  7| Flushing volume     =    100 [ml]
       8| Flushing time limit =      5 [min]

Sample 9| Sample volume       =    500 [ml]
       A| Pumping time limit  =     25 [min]

Timing B| Pump data period    =      1 [min]

       D| Done.

        Selection  ? d
```

Figure 7-22: Sampling Parameters display

A Quick Reference overview of each sampling parameter is provided next. More detailed descriptions of the deployment parameters follow the Quick Reference.

RAS-500 Sampling Parameters
Quick Reference

Header: Three lines of text (up to 65 characters per line) entered as a file header and offloaded with the data. The header could be project name, deployment location or instrument number.

Acid Flushing Volume: Amount of acid flushed through the intake to loosen bio-growth so that it can be removed by the water flush before sampling. Maximum volume is determined by the number of samples scheduled and an assumed available acid volume of 480 ml. For example, if 48 samples were scheduled, maximum allowed acid flush volume would be 10 ml.

Acid Flushing Time Limit: Maximum time for the acid flush that occurs before sampling. The minimum and maximum allowed values depend on the flushing volume and the maximum and minimum flow rates (75 ml/min and 20 ml/min). The time limit defaults to its maximum value, but a smaller value can be set by the user to establish time rather than volume control over flushing.

Acid Exposure Time Delay: Time delay during which any bio-fouling growth present in the valve intake will be exposed to the acid. The acid is left standing in the valve intake during this delay, allowing sufficient time to remove growth. The acid is removed by the water flush. The delay cannot be zero and will not be executed if the acid flushing volume is zero. The exposure delay is automatically set to zero when the acid flushing volume is set to zero.

Water Flushing Volume: Amount of water flushed through the water port before sampling.

Water Flushing Time Limit: Maximum time for the system flush prior to sampling. Minimum and maximum allowed values depend on the flushing volume and maximum and minimum flow rates (75 ml/min and 20 ml/min). Time limit defaults to its maximum value, but a smaller value can be set to establish time rather than volume control over flushing.

Sample Volume: Amount of water to be sampled before the pump is turned off. Adjust flow rate with the control system to reduce differential pressure across the sampling apparatus.

Pumping Time Limit: The maximum time limit for each event before pumping is terminated. The minimum and maximum allowed values depend on the selected sample volume and the maximum and minimum flow rates (75 ml/min and 20 ml/min). The time limit defaults to its maximum value, but a smaller value can be set by the user to establish time rather than volume control over sampling.

Pump Data Period: Sampling period of pump flow rates and volumes stored during each event.

Detailed Descriptions of Sampling Parameters

Option <1>, <2>, and <3> Header

Enter a header or a personalized title for each deployment. Each header line may contain up to 65 characters.

Option <4> Acid Flushing Volume

This option specifies the volume of acid (or other bio-fouling fluid) to flush through the valve intake before taking a sample. Acid flushing loosens any bio-fouling growth along the intake path so that it can be removed by the water flush. The maximum volume is the capacity of the nominally 500 ml acid reservoir (the actual volume is assumed to be 480 ml) divided by the number of samples in the schedule.

Option <5> Acid Flushing Time Limit

This option specifies the acid flush time limit. The maximum time limit is determined from the selected flushing volume and the fixed minimum flow rate of 20 ml/min.

Option <6> Acid Exposure Time Delay

This option specifies a time delay during which the acid will be left standing in the valve intake. This allows the acid sufficient time to act upon any growth that may be present. The acid will be removed by the water flush. If the acid flushing volume is zero, the delay cannot be set to a value other than zero and will not be executed. The exposure delay is automatically set to zero when the acid flushing volume is set to zero.

Option <7> Water Flushing Volume

This option specifies the volume of water to flush through the valve before taking a sample. This is done to clear out any debris in the valve and intake hose, and to ensure that the sample is taken entirely from current ambient water.

Option <8> Water Flushing Time Limit

This option specifies the water flush time limit. The maximum time limit is determined from the selected flushing volume and the fixed minimum flow rate of 20 ml/min.

Option <9> Sample Volume

This option specifies the volume of water to be pumped for each sample.

Option <A> Pumping Time Limit

This option specifies the time limit for the samples. The maximum time limit is determined from the selected flushing volume and the fixed minimum flow rate of 20 ml/min.

Option <B> Timing Pump Data Period

This option establishes the instantaneous flow rates and volumes for each sample that are logged in the data file at a user selectable interval.

Option <D> Done

Select this option when finished changing the pumping parameters. Prompts will display to change parameters that are in conflict with other parameters.

Checking for Event Overlap

After a schedule is accepted, the RAS-500 firmware checks for potential problems, such as expired or overlapping events.

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

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

NOTE
The warning message indicates that an overlap could occur, not that it will. Entering a schedule with intentionally short intervals can be a technique to secure rapid, sequential samples. The overlap message is only a reminder and can be ignored if tight scheduling is intended.

```
Start times of events
       2   3   4   5   6   7   8   9  10
  11  12  13  14  15  16  17  18  19  20
  21  22  23  24  25  26  27  28  29  30
  31  32  33  34  35  36  37  38  39  40
  41  42  43  44  45  46  47  48
 occur before the time limits of the previous events expire.
 The listed events may begin later than their scheduled start
 times.  Any events that are actually delayed will take place
 as soon as earlier events are completed.

 Press any key to continue.
```

Figure 7-23: Overlap Reminder display

A message will display as a reminder to offload data written to the EEPROM backup during a previous deployment. Disregard the message if the data has already been recovered. The data offload reminder will be followed by one line of system status information and a prompt to proceed with or terminate the deployment (a final chance to check the settings prior to deployment). Select 'Y' to proceed or 'N' to return to the Main Menu and change settings.

```
Caution:  Deployment will overwrite the
          EEPROM data backup cache.

System status:

 11/15/98  20:52:02   32.1 Vb    25.2 °C  PORT = 00

Proceed with the deployment (Yes/No) [N] ? y
```

Figure 7-24: Data Offload Reminder display

Low battery output voltage triggers operating warning messages.

NOTE
The voltage levels generating the two warning messages are 28 V and 18 V.

If the main battery is below 28 V, a warning message displays the system status information and suggests battery pack replacement before deploying the RAS-500 (see Figure 7-4).

Battery output below 18 V triggers a caution message to replace the battery before running diagnostics. If there is deployment data in system memory that has not been offloaded, a reminder to offload the data before replacing the battery is displayed (see Figures 7-5 and 7-6).

Proceeding with the Deployment

Select 'Y' at the 'Proceed with the Deployment' prompt and the RAS-500 enters a low power sleep (LPS) mode until the time of the first scheduled event.

NOTE
If conducting a bench test, leave the communications cable attached to the RAS-500 electronics to observe the operation of the instrument in the Crosscut window (do not touch the keyboard).

During an actual deployment, disconnect the communications cable from the controller housing. Reconnect the dummy plug to the communications connector on the controller housing and deploy the RAS-500.

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

<11/15/98  20:52:09> Waiting for event 01 of 48 @ 11/15/98  21:30:00
<11/15/98  20:52:09> Sleeping . . .
```

Figure 7-25: Deploy System display

The RAS-500 program enters a monitor mode where no further user entries are allowed (except [CTRL]-[C]).

<7> Offload Data

This option works with the "Capture to file" feature of Crosscut. After recovering the RAS-500, and re-establishing the communications link with the PC, select <7> Offload Data to process the binary data and offload to a disk drive.

IMPORTANT
Offload data before disconnecting the battery, otherwise the data will be lost.

To use the Offload Data option, complete the following steps:

1. Start Crosscut on the PC.

IMPORTANT
The PC should be on and Crosscut running before connecting to the RAS-500 electronics. Failure to observe this caution can crash the program. Only data stored in the EEPROM can be recovered after such a crash.

2. Within Crosscut, specify a "Capture file" for the offloaded data.

3. From the Offload/Display Data File menu select option <1>, <2>, or <3> to display recorded data as a scrolling ASCII text file on the screen (Option 1 shows all the data in a single scrolling display, Options 2 and 3 display the two main portions of the data file separately).

The Offload/Display Data File Menu is shown next.

```
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
º    Offload/Display Data File    º
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
     Mon Nov 16 00:03:59 1998

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

  Selection  ? 1
```

Figure 7-26: Offload/Display Data File display

Option 4 accesses a back-up copy of the most critical data, which is written to non-volatile memory during deployment. In the unlikely event of complete battery failure or a serious system malfunction, the EEPROM backup provides limited data recovery.

An example of Option 4 output is shown below. Note that only the most critical data for sample processing is included.

```
During deployments a backup copy of the most important
information stored in the instrument datafile is also written
to a small EEPROM.  The EEPROM provides non-volatile data
storage, allowing data recovery in the unlikely event the
instrument datafile is no longer resident in active memory.

The EEPROM data cache contains the start and stop time for
each sampling event that occurred, the volume of water pumped
through the filter during the event, and the port number of
the valve.

To copy the EEPROM cache file to a disk file, initiate your
communication program's file logging command now and then press
any key to start the transfer.  The cache file remains resident
in the EEPROM until overwritten during the next deployment.



Start time:      11/15/98  21:33:13
Volume pumped:   500 ml
Elapsed time:    400 sec
Volume reached.
Lowest battery:  31.3 V
Port used:       01
Stop time:       11/15/98  21:39:53

...

Start time:      11/16/98  09:18:11
Volume pumped:   500 ml
Elapsed time:    400 sec
Volume reached.
Lowest battery:  29.5 V
Port used:       48
Stop time:       11/16/98  09:24:51

End of EEPROM data backup cache.
```

Figure 7-27: EEPROM Data Backup Cache display

IMPORTANT
Make backup copies of the capture file.

<8> Contacting McLane

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

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

Tel:    (508) 495-4000
Fax:    (508) 495-3333
Email:  mclane@mclanelabs.com
WWW:    http://www.mclanelabs.com

Software version:  ras500_6.c
Compiled:          Jun 01 2004 20:25:22
Electronics S/N:   11746-01

Press any key to continue
```

Figure 7-28: McLane Contact Information display

Chapter 8
Data Offload and Processing

After the RAS-500 is recovered and rinsed, and the sample bags are removed for storage and analysis, complete these steps to run the Offload Data option and print the data file to the screen (to also create a permanent log file, use the "Capture to file" feature within Crosscut).

IMPORTANT
After running the Offload Data option, confirm that data is successfully offloaded by checking the Crosscut files before disconnecting the battery (data is erased when the battery is disconnected).

To offload the deployment data, complete the following steps:

1. Place the RAS-500 in a dry area, power on the PC and start Crosscut.

IMPORTANT
Powering on the PC and starting Crosscut before connecting the RAS-500 serial cable to the PC prevents a possible crash of the RAS-500 firmware.

2. Remove the dummy plug from the RAS-500 COM connector.
3. Connect the RAS-500 serial cable to the PC.
4. From the Main Menu select <7>, Offload Data.

```
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
º    Offload/Display Data File    º
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
     Mon Nov 16 00:03:59 1998

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

   Selection  ? 1
```

Figure 8-1: Offload/Display Data File Menu display

5. From the Offload/Display Data File menu select <1>, Display ALL Data. The system displays the screen shown next.

```
To copy the instrument data file to a disk file, initiate
your communication program's file logging command now and
then press any key to start the transfer.  The instrument
data file will remain resident and is not erased by this
offload procedure.
```

Figure 8-2: All Data display

6. Start "Capture to file" within Crosscut.

7. Press any key to offload the data and display to the screen (the data is sent to the specified capture file). An example data offload file is shown next.

```
Software version:  ras500_0.c
Compiled:          Nov 15 1998 20:25:22
Electronics S/N:   9655

Data recording start time = 11/15/98  20:52:09
Data recording stop time  = 11/16/98  09::

HEADER
______

SAMPLE PARAMETERS
_________________

Sample volume           [ml]      = 500
Sample time limit       [minutes] = 25
Water flush volume      [ml]      = 100
Water flush time limit  [minutes] = 5
Acid flush volume       [ml]      = 10
Acid flush time limit   [minutes] = 1

SCHEDULE
________

Event  1 of 48 @ 11/15/98  21:35:00
Event  2 of 48 @ 11/15/98  21:45:00
...
Event 47 of 48 @ 11/16/98  05:15:00
Event 48 of 48 @ 11/16/98  05:25:00

DEPLOYMENT DATA
_______________

  1  11/15/98  21:30:00  31.8 Vbat   27 °C  PORT = 00
     Acid flush        10 ml        8 sec  LB 31.3 V   Volume reached.
     Flush port  = 49
     Intake flush     100 ml       80 sec  LB 31.3 V   Volume reached.
     Flush port  = 00
     Sample           500 ml      400 sec  LB 31.3 V   Volume reached.
     Sample port = 01
     11/15/98  21:38:20  31.8 Vbat   27 °C  PORT = 01
```

Figure 8-3: Data Offload File display

```
   2  11/15/98  21:45:00  31.7 Vbat   29 °C  PORT = 00
      Acid flush        10 ml        8 sec  LB 31.3 V   Volume reached.
      Flush port  = 49
      Intake flush     100 ml       80 sec  LB 31.3 V   Volume reached.
      Flush port  = 00
      Sample           500 ml      400 sec  LB 31.2 V   Volume reached.
      Sample port = 02
      11/15/98  21:53:20  31.7 Vbat   29 °C  PORT = 02
...

 47   11/16/98  09:00:00  29.7 Vbat   37 °C  PORT = 00
      Acid flush        10 ml        8 sec  LB 31.3 V   Volume reached.
      Flush port  = 49
      Intake flush     100 ml       80 sec  LB 31.3 V   Volume reached.
      Flush port  = 00
      Sample           500 ml      400 sec  LB 29.4 V   Volume reached.
      Sample port = 48
      11/16/98  09:08:20  29.7 Vbat   29 °C  PORT = 47

  48  11/16/98  09:15:00  29.7 Vbat   38 °C  PORT = 00
      Acid flush        10 ml        8 sec  LB 31.3 V   Volume reached.
      Flush port  = 49
      Intake flush     100 ml       80 sec  LB 31.3 V   Volume reached.
      Flush port  = 00
      Sample           500 ml      400 sec  LB 29.5 V   Volume reached.
      Sample port = 49
      11/16/98  09:23:20  29.7 Vbat   29 °C  PORT = 48

 PUMPING DATA
 ————————————

 Sample interval = 1 [minutes]
  [event#]  [ml/min]    [ml]     [Vbat]

     1          75        75      31.4
     1          75       150      31.4
     1          75       225      31.4
     1          75       300      31.3
...
     2          75        75      31.3
...
    47          75        75      29.7
...
    48          74        74      29.7
...

 End of instrument data file.

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

Figure 8-4: Data Offload File display (continued)

8. After the data is offloaded, stop the Crosscut "Capture to file".

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

Notes

Appendix A
Operating Crosscut and Crosscut for Windows

You can use file logging during all of your interactions with the RAS-500 to create a log of operations, deployment settings, and recovery procedures. There are two standard file capture programs that McLane recommends. Both programs are freely distributed by Onset Computer (www.onsetcomp.com) for TT8 communication. Crosscut is a DOS-based program that runs on a PC, and Crosscut for Win is Windows-based. McLane recommends using file capture for all deployments.

To download compressed archives of Crosscut and Crosscut for Win software, go to:

www.mclanelabs.com/downloads/crosscut.zip

www.mclanelabs.com/downloads/crosscut-win.zip

Using Crosscut

Crosscut is a DOS-based program that runs on a PC. Crosscut will run without modification or difficulty under DOS, Windows (up to Windows 98, 1st edition), and Windows NT (up to Version 4.0, Service Pack 5). Later releases of these operating systems commonly require a change to the PC registry to disable power management of the serial port. Modifications may also be required to enable the mouse. Detailed instructions for the registry change can be found below and at www.mclanelabs.com/laptops_and_crosscut.html. Contact McLane or Onset Computer (www.onsetcomp.com) for additional information.

First Time Crosscut Use

To use Crosscut for the first time, complete the following steps:

1. Place the six Crosscut files from the disk provided in the Toolkit into a directory on the PC (or create a new directory). Alternatively, create a Crosscut directory and place the six Crosscut files there. If you operate Crosscut from the directory that contains the files, changes to the path are unnecessary.
2. Type *crosscut* at the DOS prompt or click on the Crosscut icon to run the program (a short cut can also be created from the desktop). Do not connect the PC to the TT8 yet.

3. Select ‘CommPort’ from the menu bar at the top of the Crosscut window and then select ‘Port setup’ from the submenu (use a mouse or the keyboard combination [ALT]-[P]).

4. Use the mouse or [TAB] and arrow keys to set the COM port being used to 9600 baud, 8 data bits, 1 stop bit, no handshaking, and no parity (9600, 8, N, 1). The copy of Crosscut on the floppy disk should have these values preset.

5. Click ‘OK’ to store these values in the configuration files and they will be used whenever Crosscut is started again.

6. Connect the RAS-500 serial cable to the PC.

Editing the Registry to Enable Crosscut

1. On the desktop of a PC running a recent version of Windows, click START and select RUN from the pop up menu.

2. In the prompt box type *regedit* and click ‘OK’ to start the registry editor window.

3. The editor will display a Windows directory tree in the left half of the window and a folder contents display in the right half of the window. Click through the directory tree following this path:

   HKEY_LOCAL_MACHINE / SYSTEM / CurrentControlSet / Services / VxD / VCOMM

4. Click on the VCOMM folder and its contents will be displayed in the right half of the window.

5. Double-click ‘ENABLE POWER MANAGEMENT’ in the right half of the window and change its value from *01 00 00 00* to *00 00 00 00* using the editing tool that pops up.

6. After the value has been changed, go back through the directory tree and exit the registry editor.

7. Exit all programs, restart the PC, and try Crosscut again.

Capturing Data Files Using Crosscut

Once the steps for first-time Crosscut use are complete, use the steps provided next to capture data files.

1. To start Crosscut type *crosscut* at a DOS prompt or click on the Crosscut icon (the Crosscut directory must be in the directory path for this step).

2. To capture a data file after a deployment, select 'CommPort' from the menu bar and 'Capture to File' from the submenu.

3. Select a directory and a name for the file.

4. The 'Open file' window will appear in the Crosscut window. [ALT]-[Z] brings up the 'Open file' window from the keyboard.

5. Type the path and name of the file in the *Name* field or use the [TAB] and [ENTER] keys to select the directory and enter the name in the *Name* field.

6. Once the capture is started, everything that appears in the Crosscut window, whether from the instrument or the keyboard, is written to the file. Run the offload utility and the data unpacked from the flash card will be captured in the named log file. Note that Crosscut always overwrites the information in an existing log file.

7. Terminate file logging by selecting 'CommPort' and 'Capture to File' again or by typing [ALT]-[Z].

8. To exit Crosscut select 'File' from the menu bar and 'Quit' from the submenu or type [ALT]-[Q].

The format of the captured data file is ASCII text (use the extension .TXT for the file name). ASCII text files can be loaded and edited by all of the common word and text processors.

Crosscut assigns a default file name of CAPTURE.TXT to log files. The operator can, as described above, change the name before logging begins. That name becomes the default during that Crosscut session. Alternatively, the file can be renamed once captured to the hard disk of the PC. In either case, Crosscut does not append (each log file must eventually have a unique name and path or it will be overwritten).

Using Crosscut for Win

Crosscut for Win is a Windows-based program that runs on a PC. Crosscut for Win will run without modification or difficulty under all currently available versions of Windows, including 95, 98, Me, NT, 2000 and XP. Contact McLane or Onset Computer (www.onsetcomp.com) for additional information.

First-Time Crosscut for Win Use

To use Crosscut for Win for the first time, complete the following steps:

1. Create a Crosscut for Win directory and copy into it the two Crosscut for Win files from the disk provided in the Toolkit.
2. Click on the Crosscut for Win icon to run the program (or establish a short cut from the desktop). Do not connect the COM cable to the RAS-500 yet.
3. Select 'CommPort' from the menu bar at the top of the Crosscut for Win window and then 'Setup' from the submenu.
4. Select the COM port and set the port parameters to 9600 baud, 8 data bits, 1 stop bit, and no parity (9600, 8, N, 1).
5. Click 'OK'. The system stores these values and they will be used whenever Crosscut for Win is started in the future.
6. Connect the COM cable from the PC to the RAS-500 serial port.

Capturing Data Files with Crosscut for Win

1. Start Crosscut for Win.
2. To capture a data file after a deployment select 'Terminal' from the menu bar and 'Capture Setup' from the submenu.
3. Enter a *Capture file name* in the box and select *Overwrite* or *Append*. Overwrite replaces any information in an existing log file. Append adds new information to an existing file (select carefully)!
4. Click 'OK'.
5. Start 'File → Capture'. Everything that appears in the Crosscut for Win window is written to the file.
6. Toggle file logging by selecting 'File' and 'Capture' again.
7. To exit Crosscut for Win select 'File' from the menu bar and 'Exit' from the submenu.

The format of the captured data file is ASCII text (you should use the extension .TXT for the file name). ASCII text files can be read by word processors and text editors.

Crosscut for Win requires a name for the log file the first time the capture utility is called during a Crosscut for Win session. That name then becomes the default for the remainder of the session. The file can be renamed after capture on the hard disk of the PC.

Connecting the RAS-500 to a PC

Connecting a DB-9 or DB-25 connector to a PC serial port by rocking the connector back and forth can cause a Com Port Crash in the TT8. If a crash occurs, remove the connector and then restore power to recover control of the RAS-500. The crash is caused by signals or apparent signals on the receive pin of the communications port if they arrive when the TT8 is in low power sleep and if the ground connection between the TT8 and the PC is intermittent.

To connect and disconnect the communications cable complete the following steps:

1. Always boot the PC and start Crosscut before connecting the communications cable to the RAS-500.
2. Connect the communications cable first to the PC and then to the RAS-500.
3. Disconnect the communications cable first from the RAS-500 and then from the PC.
4. Connect to and disconnect from the RAS-500 as smoothly as possible. Try to prevent repeated intermittent contacts.
5. Leave the PC and Crosscut running until the COM cable is disconnected from the RAS-500.

Additional Documentation

A more detailed and complete description of Crosscut operations can be found in the file crosscut.doc, which is included with the Crosscut program. Crosscut for Win also has a help utility which can be viewed by selecting 'Help' from the menu bar.

Notes

Appendix B
External Temperature Sensor

The RAS-500 internal Thermistor temperature sensor can optionally be extended from its standard location on the electronics card to a specially-manufactured aluminum block screwed into the top end cap.

External temperature readings are recorded in RAM and in EEPROM.

Figure B-1: Thermistor External Temperature Sensor

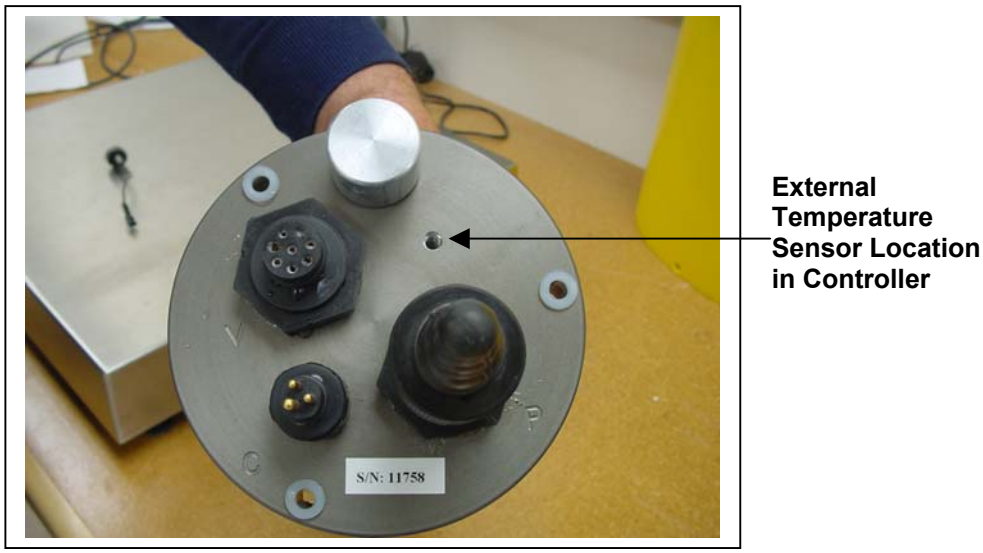

Figure B-2: External Temperature Sensor Installed in Controller Housing