

FlowControl Lab

Programmable Valve System

User's Guide
Revision B



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Bellevue, WA 98005
(425) 641-0944, Fax: (425) 643-0595



Technical Assistance

To obtain technical assistance please contact your local distributor.

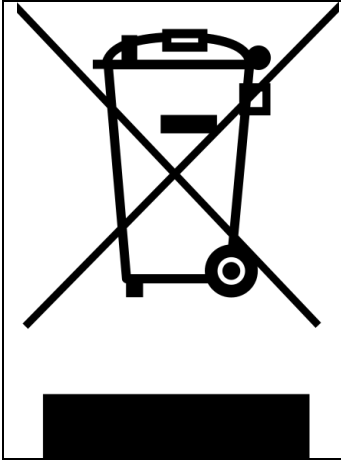
A list can be found at <http://www.SequoiaSci.com/contact/international.aspx?SectionName=contact>
Or, contact Sequoia Scientific, Inc. directly:

Telephone: +1 (425) 641-0944

Email: info@sequoiasci.com or wslade@sequoiasci.com

Please be sure to include the instrument serial number with any correspondence.

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Waste Electrical and Electronic Equipment

Smaltimento di apparecchiature elettriche ed elettroniche da rottamare

Table of Contents

1	OVERVIEW.....	1
2	FEATURES.....	1
3	CONTENTS AND TECHNICAL SPECIFICATIONS	2
	3.1 Specifications	2
	3.2 Controller Unit.....	3
	3.3 Flow Sensor	5
	3.4 Actuated Valve	7
4	FLOWCONTROL OPERATION	8
	4.1 General Description.....	8
	4.2 FlowControl Software	8
	4.3 Data File Format.....	15
5	INSTRUMENT MOUNTING, CARE, AND MAINTENANCE.....	16
6	WARRANTY	17

1 Overview

The FlowControl is a programmable, three-way valve system. The valve is designed around the purpose of switching seawater between two flow paths on a schedule. Typically, the system is configured to routinely divert seawater through a 0.2-micron cartridge filter, allowing calculation of particle properties by differencing temporally adjacent filtered and whole water samples. This approach yields measurements that are independent of drift in instrument calibration and also offers advantages for applications in clear waters where uncertainties in instrument calibration can be a significant part of the measured signal.

For more information on the sort of measurements that can be made using the FlowControl system in ocean optics, see:

Slade, W.H, E. Boss, G. Dall'Olmo, M.R. Langner, J. Loftin, M.J. Behrenfeld, C. Roesler, and T.K. Westberry, 2010. Underway and moored methods for improving accuracy in measurement of spectral particulate absorption and attenuation. *Journal of Atmospheric and Oceanic Technology*, 27:10, 1733-1746.

2 Features

- Auxiliary inputs for volumetric flow sensors (Omega paddlewheel, FPR series) Flexible configuration of valve operation for scheduled or profiling operation, as well as start and stop conditions
- Continuous logging of valve state and flow sensor data to host computer
- Windows software for configuration and control of FlowControl instrument and data logging
- Industrial enclosure for shipboard use

3 Contents and Technical Specifications

- The FlowControl Lab is shipped with the following items:
- FlowControl Lab control unit
- Electrically-actuated three-way ball valve(s)
- Paddlewheel flow sensor(s)
- Valve to controller cable
- USB cable for connecting controller unit to host computer
- AC cable for powering controller unit
- Alternate fittings for three-way valve union connections
- CD-ROM or USB drive containing User's Guide and Windows Software

3.1 Specifications

Mechanical and Environmental

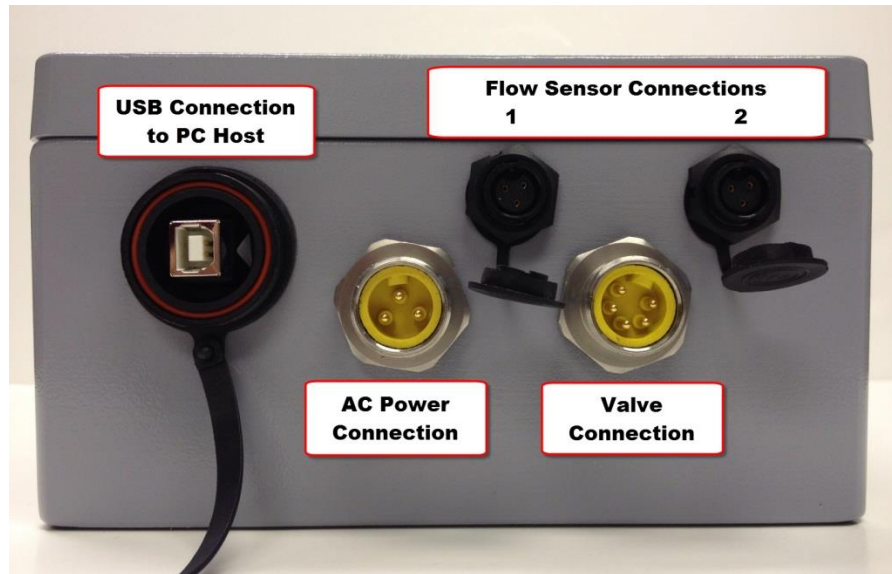
Dimensions	15.625 in (39.7 cm) long, 3.950 in (10.0 cm) diameter (max)
Weight	6.6 lb (3.0 kg) in air, TBD in water
Environmental Rating	Controller Unit: NEMA 4X, Valve: NEMA 4, Connectors and cables: NEMA 6P
Temperature Range	TBD

Electrical and Sampling

Input Power	90 - 264VAC (47 - 400Hz)
Valve Actuating Voltage	24 VDC
Communication Method	USB (HID) connection to PC Host
Sample Rate	1 sample/sec
Valve Switch Time	~ 5 sec
Auxiliary Sensors	Omega FPR301 paddlewheel flow sensor(s)

3.2 Controller Unit

Controller Unit Connections



Connect dust caps to prevent seawater, dirt, or other contaminants from damaging connectors when not in use.

AC Power and Valve bulkhead fittings can be cleaned with a swab and rinsed with clean water. Allow to dry before re-connecting!

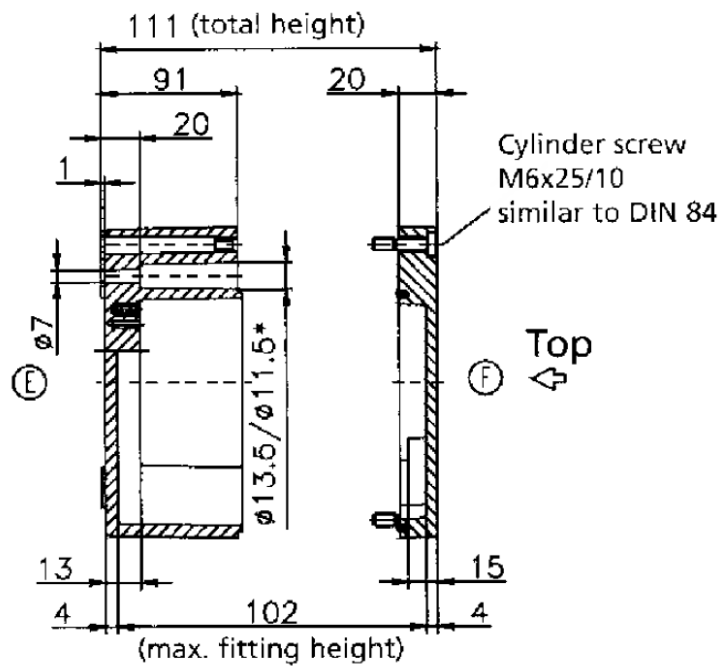
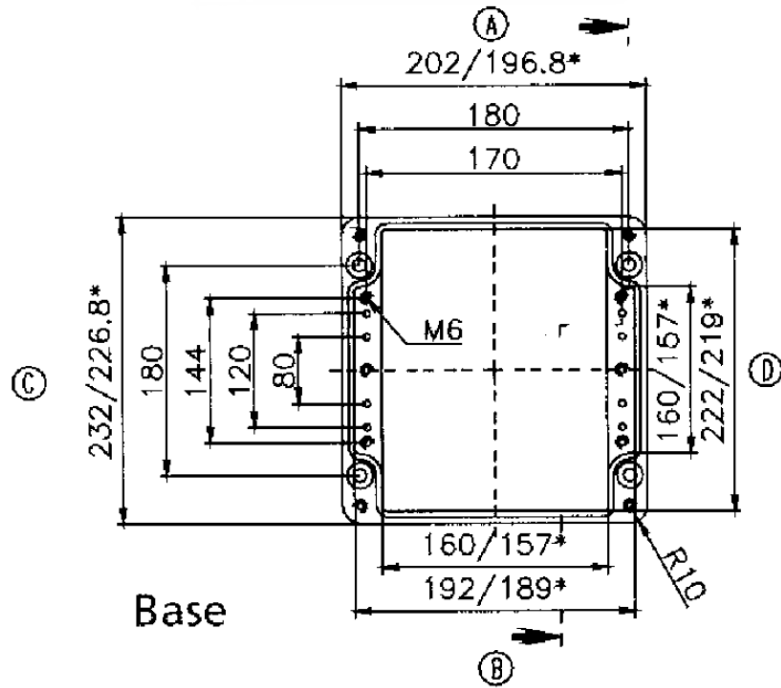
Mounting Case is Rose+Bopla part 01232011 00/85. Mounting holes are accessible by removing the front lid screws. External mounting brackets are available from the manufacturer (part 10052034 00).



**Do not open the front lid when controller unit is connected to AC mains supply. Hazardous voltages are present!
Disconnect AC power before opening controller unit!**

Dimensions in millimeters.

* = Conical form tapering downwards
Free dimensions-tolerance to GTA 13/5 DIN 1688



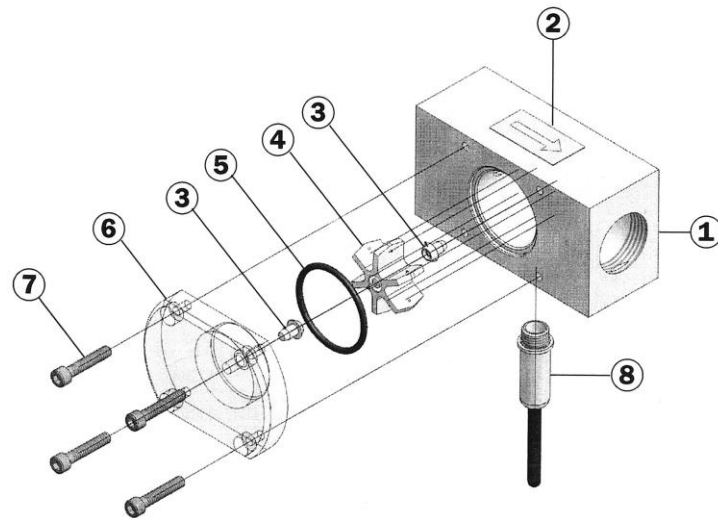
3.3 Flow Sensor

Installation Notes Flow sensors are connected to the controller unit via the small 3-pin connectors.

Plumbing connections to the Omega FPR301 sensors are via 3/8" FNPT fittings. Straight piping of at least five diameters upstream of the sensor is recommended. Vertical, horizontal, or lens down installation positions are acceptable. Flow direction is indicated on the sensor body by an arrow.

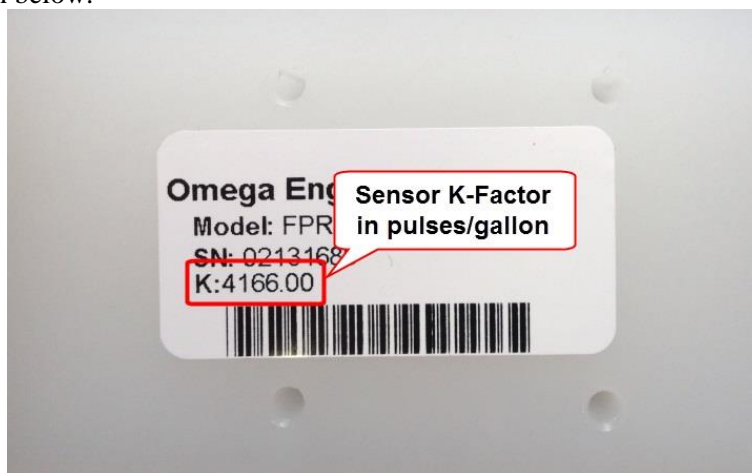
The FPR flow sensor is a sensitive device. Do not test with compressed air as damage to the low-friction bearings can occur!

The sensor can be cleaned using mild soap and clean water. Disassemble if needed for thorough cleaning, but use extreme care when reassembling to ensure that rotor shaft is aligned with ruby bearing and recess in window.



- ① Sensor Body
- ② Flow Direction Indicator
- ③ Bearing (ruby)
- ④ Rotor with Shaft
- ⑤ O-Ring
- ⑥ Clear Acrylic Cover
- ⑦ Cover Screws
- ⑧ Hall Effect Sensor

Flow Sensor Calibration The Omega flow sensors are calibrated by the manufacturer. Calibration K-factors (in pulses per gallon) are printed on the back of the sensor body as shown below.



The calibration sheets provided by Omega are also provided.

User Calibration Contact Sequoia Scientific for an updated protocol.

3.4 Actuated Valve

Application Notes The valve is connected to the controller unit via the rugged yellow 5-pin cable. Ensure connections are secure to avoid contaminant infiltration into the fitting and allow for proper valve operation.

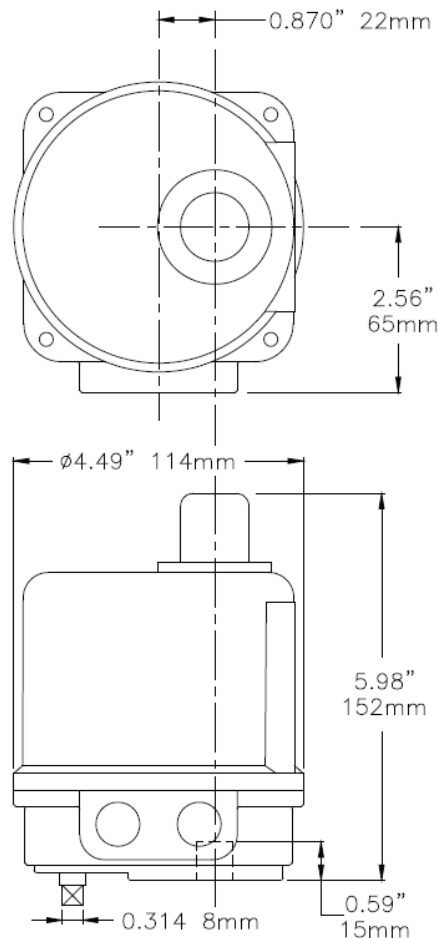
Plumbing connections are made via the ½" NPT PVC unions. Fittings with ½" FNPT and solvent weld fittings are provided.

The valve is factory calibrated. There is no reason to open its case. The actuator contains a heating element to ensure correct operation over a wide range of conditions. It is normal for the actuator housing to be warm to the touch!

Valve bulkhead fittings can be cleaned with a swab and rinsed with clean water. Allow to dry before re-connecting!

DO NOT install the valve actuator in cold or humid environments unless it is connected to the controller unit and the internal heater is functioning. The controller unit must be powered up (connected to AC) in order for the valve actuator heater to be powered.

Mounting



4 FlowControl Operation

4.1 General Description

The FlowControl Lab is a system for autonomous control of one or two three-way ball valve(s). The system can be operated such that the valve switches state on a schedule, such as hourly, half-hourly, or on an interval, such as every 20 minutes.

The FlowControl Lab system connects to a PC running Microsoft Windows via a USB connection. Software on the Windows PC controls the valve state and logs hourly files containing valve state and flow sensor data at approximately 1 Hz.

Connecting the FlowControl Components

1. The controller unit should first be connected to the Windows PC.
2. Flow sensor(s) can then be connected, and will function without AC power (the flow sensors, as well as the internal I/O module, are powered from the USB bus).
3. Connect the valve(s) to the controller using the heavy duty 5-pin cable.
4. Connect AC power cable to the controller unit.
5. Connect the AC power cable to the AC supply.

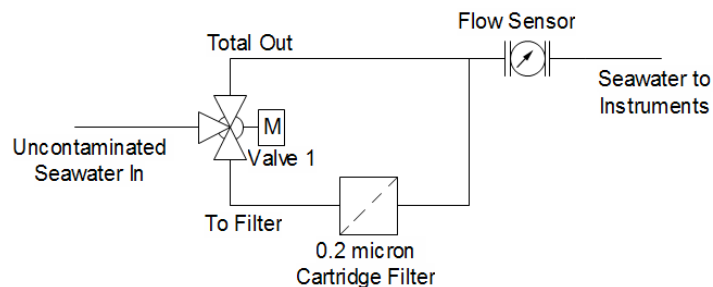


Use extreme care when making AC connections. AC mains voltage is hazardous. Combine AC mains with water – especially seawater – and it is extremely hazardous. Connect cabling as specified above, and only in a dry environment!

4.2 Suggested Setup for Underway Flowthrough Measurements

Single Valve Setup

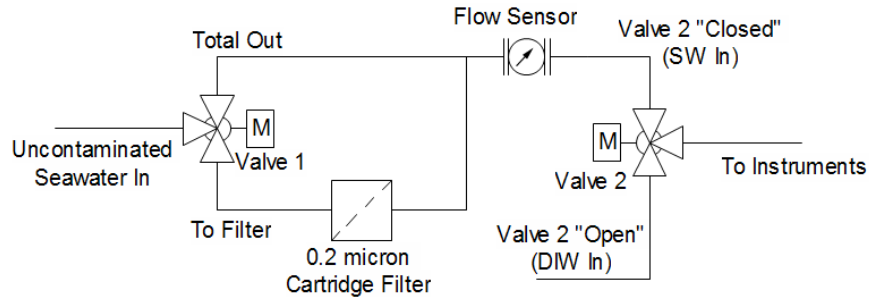
With the FlowControl setup with a single electrically-actuated valve, the valve is plumbed to divert incoming seawater flow periodically through a cartridge filter, as shown below.



Instruments are either arranged to be fed in parallel by a manifold such that flow can be varied independently for each, or the instruments can be arranged

in series. In the latter case, the flow sensor can also be placed after the instruments in the drain line.

Dual Valve Setup Adding a second valve is useful for periodically introducing a cleaning agent into the system or for measuring a calibration liquid, such as de-ionized water (DIW). Plumbing for such a system is shown below.



4.3 FlowControl Software

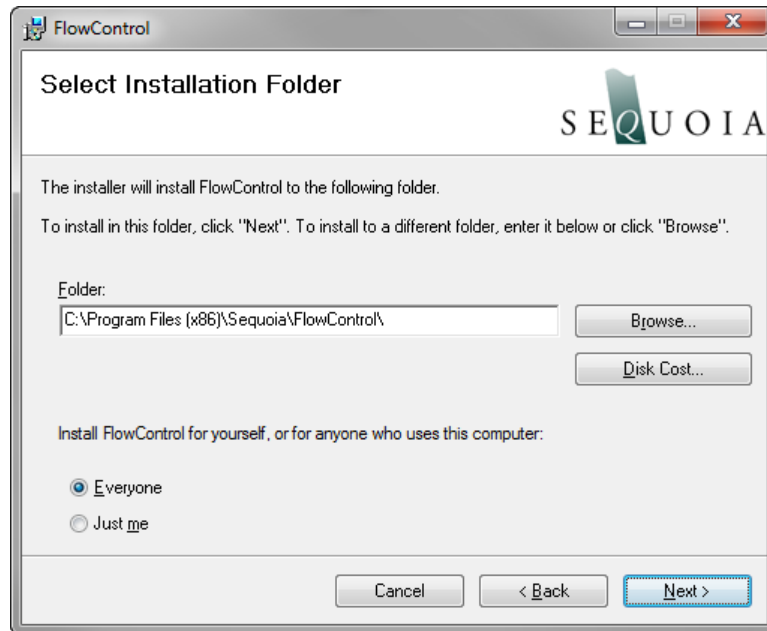
Software Installation A software installer is provided on the ship disk. The software has been tested under Windows 7 and Windows XP SP3. The software uses the .NET framework, which will be downloaded by the installer if needed. The .NET installer is also provided on the Ship Disk.



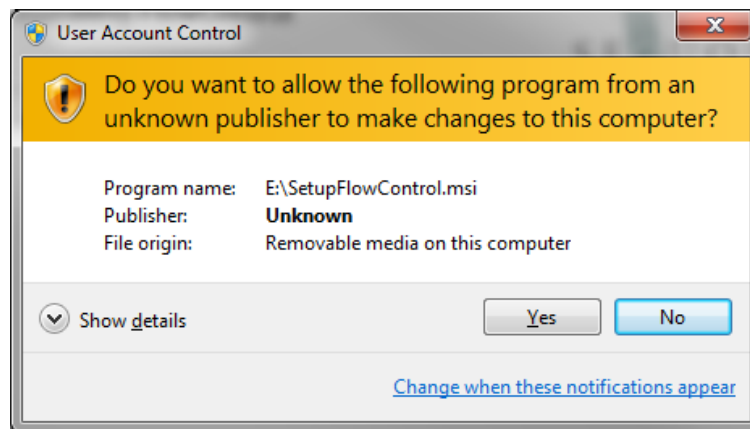
Run the software installer, setup.exe.



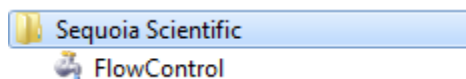
Click Next, and an option for installation location and usage permission is provided. It is recommended to store the application in the default application files directory such as "Program Files" or "Program Files (x86)".



The installer may request permission to make changes to your computer in order to install the FlowControl software. Say Yes.



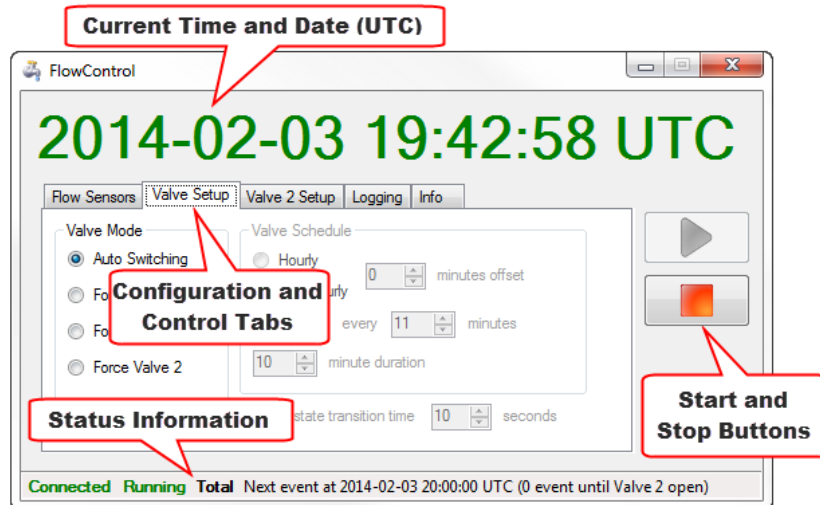
The installer will continue, and when finished, the FlowControl software will be available under the Start Menu, under All Programs → Sequoia Scientific.



Using the FlowControl Software

The FlowControl software is represented by an icon of a faucet.

The software consists of a single main window with a large clock display, several tabs, start and stop buttons, and a status bar.



The large clock is a convenient reference to the current “lab time” for keeping activity logs during a cruise.

Each of the other items is displayed below.

Status Information

The status bar provides the following information to the user:

Not Connected	Indicates the current status of the USB connection between the controller unit and the host PC.
Connected	
Stopped	Indicates whether the automation program is currently running or stopped.
Running	
Total	If the automation program is running, then the current valve state is indicated: total or filtered valve position, or if auxiliary valve (valve 2) is open.
Filter	
Valve2	

Additional information is also provided:

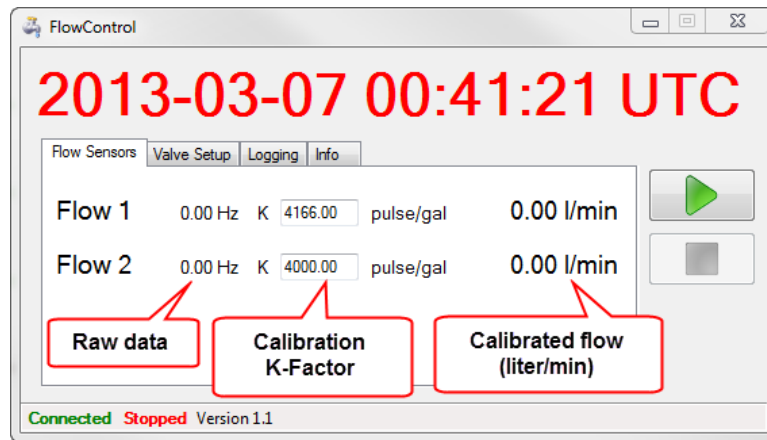
- File I/O errors (such as problems opening or writing to data files)
- Timing of hourly event schedule start (when first event will occur)
- Time that current event started
- Time of next event or end of current event
- Forced total or filtered measurement
- Time that automation program was stopped
- Software version information

Configuration and Control Tabs

The FlowControl is configured using three tabs: Flow Sensors, Valve Setup, and Logging.

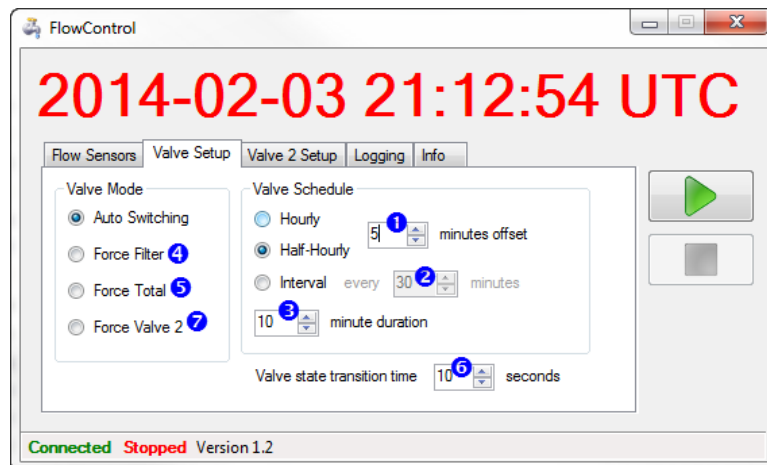
Flow Sensors Tab

The Flow Sensors tab shows the current flow rate calibration and data from up to two flow sensors. The flow sensors contain paddlewheels containing magnets, and Hall effect sensors in the housings output a pulse train with frequency related to the flow rate. The raw data are displayed for each sensor in Hz (pulses per second). If the system is not running, a calibration setting (K-factor) can be entered for each sensor. If the system is in the running state, then the K factors are visible but not editable. Calibrated volumetric flow rates are provided in liters per minute.



Valve Setup Tab

The Valve Setup tab allows configuration of the valve switching schedule.



The switching schedule can be:

Hourly

Valve switches to filtered measurement once per hour at a specified time ① after the hour for a specified duration ③.

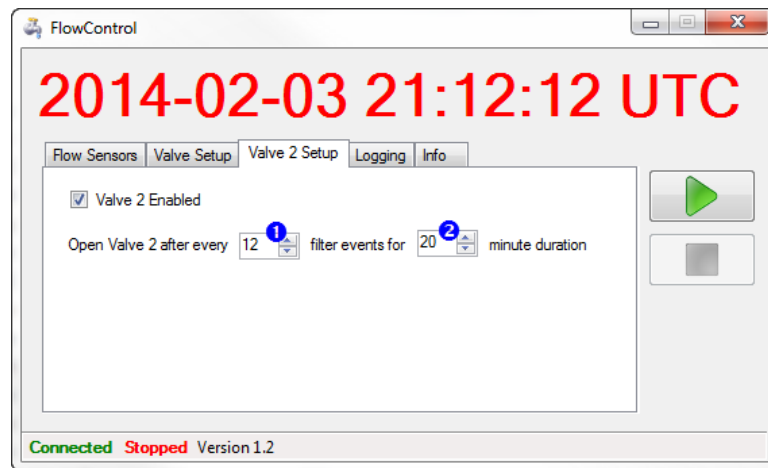
Half-Hourly Valve switches to filtered measurement twice per hour at a specified time ① after the hour or half hour for a specified duration ③.

Interval Valve events are scheduled on an specified time interval in minutes ②, with each event lasting for the specified duration ③.

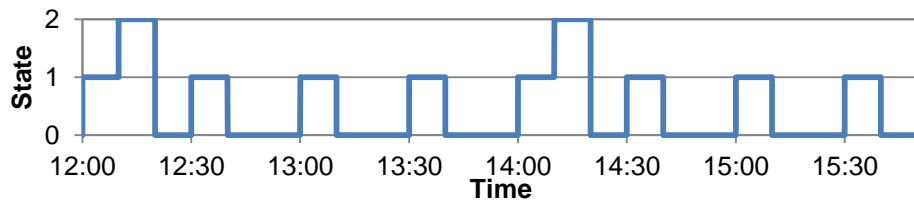
While running, the system can be manually forced to the filtered ④, total ⑤, or valve 2 open ⑦ positions. The scheduled valve events will not resume until Auto Switching is re-selected. Valve state transition time ⑥ is the length of time power will be applied to actuate the valve to switch states. If the valve is not fully transitioning between positions, this value can be increased.

Note that the Valve Mode selections are disabled while the valve is being actuated.

Valve 2 Setup Tab A second electrically-actuated valve can be installed, typically for making occasional clean water measurements. The valve 2 scheduling is tied to the primary valve event schedule.



Valve 2 will open after every specified number ① of filter events, for a specified duration ②. For example, the figure below shows the system state (0=total, 1=filtered, 2=valve2 open) for half-hourly events, 10 minute filtered duration, with 10 minute valve 2 duration every 4 filter events.

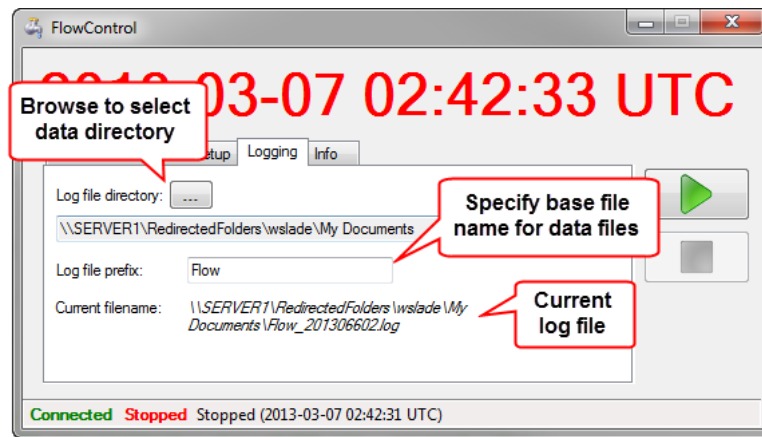


If valve 2 is enabled, then it will open following the first filter event after the system is started.

If the duration of the valve 2 event is within a minute of the time remaining

between the end of the filter event and the next filter event, then valve 2 will remain open until the next filter event starts.

Logging Tab The Logging Tab allows configuration of the directory for saving log files, as well as the base name or prefix for log files.



When the system is running, the current filename is displayed (and options for changing the log file directory and prefix are disabled).

The current filename is the log file prefix appended with a date and time stamp (based on the UTC clock):

`<path>\<prefix>_<yyy><ddd><hh>.log`

- where `<path>` is the log file directory,
- `<prefix>` is the log file prefix (base name),
- `<yyy>` is the current year,
- `<ddd>` is the current year day (1-Jan is year day 001), and
- `<hh>` is the hour number in 24 hour format (00 is midnight).

Starting and Stopping FlowControl

The FlowControl system can be started and stopped using the start and stop buttons.



Start the program with the current Flow Sensor, Valve Control, and Logging settings. If a log file already exists for the current hour, it will be appended to.



Stop the program. The valve will be left in its current state, but the mode will be set to Auto Switching. Data files will be closed.

4.4 Data File Format

Data is stored to files at ~1 Hz in the following format:

```

2013-02-21 19:33:56 UTC    0    0100  0.00  0.00  0.000  0.000
2013-02-21 19:33:57 UTC    0    0100  0.00  0.00  0.000  0.000
2013-02-21 19:33:58 UTC    0    0100  0.00  0.00  0.000  0.000
    
```

Specifically,

```

<current time string> <TAB> <valve state> <TAB> <relay state> <TAB> <flow1 Hz> <TAB>
    <flow2 Hz> <TAB> <flow1 LPM> <TAB> <flow2 LPM> <CRLF>
    
```

where

<i><current time string></i>	is the date and time (UTC) in a format, with date, time, and “UTC” separated by spaces;
<i><valve state></i>	is 0 for total state, 1 for filtered, 2 for valve 2 open;
<i><relay state></i>	is a binary representation of the relay states driving the actuator,
<i><flowX Hz></i>	is the uncalibrated flow sensor data for sensor X; and,
<i><flowX LPM></i>	is the calibrated volume flow rate for sensor X in liters per minute.

Each variable is delimited by a tab character <TAB>, and each record is terminated by a carriage return, line feed pair <CRLF>.

The date/time format is a “universal sortable” format similar to ISO 8601 and DOES NOT depend on the Region and Language control panel settings. The format is:

```

<yyyy>-<MM>-<dd> <hh>:<mm>:<ss> UTC, where <yyyy>, <MM>, <dd>, <hh>, <mm>, and <ss>
    are the four digit year, and two digit month, month day, hour (24 clock), minute, and seconds.
    
```

5 Instrument Mounting, Care, and Maintenance

Mounting the Instrument The controller unit can be laid flat on a bench or mounted to the wall using the mounting holes under the lid (screws not provided).

The valve should be mounted such that it can be easily accessed for cleaning. The actuator housing can be used to secure the valve unit using a custom bracket or spacer and hose clamp.

Mount all components out of direct sunlight and avoid freezing conditions.

Storage and Transport The instrument should be stored and transported in its shipping case for protection.

Insert connector dust plugs when not connected.



Use extreme care when making AC connections. AC mains voltage is hazardous. Combine AC mains with water – especially seawater – and it is extremely hazardous. Connect cabling as specified, and only in a dry environment!

Disconnect AC power before opening controller unit!

6 Warranty

STATEMENT OF LIMITED, EXTENDED WARRANTY

This Statement of Limited Warranty applies to all Sequoia Scientific, Inc. ("SEQUOIA") products ("Products"). Any additional or different terms, including any terms in any purchase order, will be of no effect unless agreed to in writing by an authorized representative of SEQUOIA as reflected in a written SEQUOIA quotation.

1. Limited Warranty

SEQUOIA warrants that upon delivery by SEQUOIA (a) the Products will be free from defects in materials and workmanship, (b) the Products will perform substantially in accordance with SEQUOIA's applicable specifications, and (c) any Products (or components or parts thereof) that are manufactured by SEQUOIA do not infringe any U.S. patent or copyright.

2. Correction of Non-Compliance

If, during the twelve months after delivery (the "Warranty Period"), any Product does not comply with the warranties set forth in 1(a) and 1(b) above, SEQUOIA will, at its option, either (a) repair the Product, (b) replace the Product, or (c) refund the purchase price paid by Customer to SEQUOIA for the Product; provided that Customer gives SEQUOIA written notice of the noncompliance within the Warranty Period and ships the Product to SEQUOIA within one month after the end of the Warranty Period. As to any Product repaired or replaced by SEQUOIA, the Warranty Period will end upon the later of the end of the original Warranty Period or 90 days after SEQUOIA's delivery of the repaired or replacement Product to Customer. Any Product, component, part or other item replaced by SEQUOIA becomes the property of SEQUOIA. SEQUOIA may use refurbished components in the repair of Products supplied hereunder.

SEQUOIA's warranties shall be void and not apply if the Product has been subjected to misuse or alteration or repaired by a party not approved by SEQUOIA or the serial number on a product (if applicable) has been altered or defaced. SEQUOIA shall not be liable for normal wear and tear (such as replacement of consumables), nor for defects or failure caused by maintenance, misuse, negligence or failure resulting from non-compliance with SEQUOIA's specifications, operating or maintenance manuals.

3. Infringement Indemnification

If any Product does not comply with the warranty set forth in 1(c) above, SEQUOIA will defend and indemnify Customer against any third-party claim asserted in any proceeding against Customer based on this noncompliance; provided that Customer gives SEQUOIA prompt written notice of the claim, SEQUOIA has exclusive control over the defense and settlement of the claim, Customer provides such assistance as SEQUOIA may request in connection with the defense and settlement of the claim (in which event SEQUOIA will reimburse the reasonable out-of-pocket costs incurred by Customer to provide such assistance), Customer does not settle the claim without the prior written consent of SEQUOIA and, upon SEQUOIA's request, Customer returns the Non-Complying Product to SEQUOIA for modification, replacement or a refund of the purchase price paid by Customer to SEQUOIA for the Non-Complying Product, less a reasonable allowance for Customer's use prior to return.

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THE WARRANTIES SET FORTH IN PARAGRAPH 1 ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED. SEQUOIA DISCLAIMS ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED (INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AND ANY IMPLIED WARRANTY ARISING FROM COURSE OF PERFORMANCE, COURSE OF DEALING, OR USAGE OF TRADE) OTHER THAN THOSE SPECIFICALLY SET FORTH IN PARAGRAPH 1.

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SEQUOIA will not be liable for any indirect, incidental, special or consequential damages, any cover, or any loss of revenue, profit, data or use.

7. Limitations of Liability

SEQUOIA's liability (whether in contract, tort, or otherwise; and notwithstanding any fault, negligence, strict liability or product liability) with regard to any Product (including, but not limited to, any breach of or default by SEQUOIA) will in no event exceed the purchase price paid by Customer to SEQUOIA for such Product. Further, SEQUOIA will not be liable for, or be in breach of or default on account of, any delay or failure to perform as a result of any cause, condition or circumstance beyond SEQUOIA's reasonable control.

8. Indemnification by Customer

Customer acknowledges that the Products are designed and manufactured for use in non-critical, monitoring situations. If Customer chooses to purchase a Product or Products for use in applications that could result in damages in excess of the price of the Product if the Product does not operate properly or otherwise fails, Customer acknowledges and agrees that it is Customer's responsibility to provide for redundancy and/or other safety or back-up measures sufficient to assure that failure of a Product(s) will not cause such damages. Customer agrees that it will defend and hold SEQUOIA harmless from any and all claims and costs (including but not limited to attorney's fees and other costs of defense against such claims) in excess of the price of the Products arising directly or indirectly from such Customer's use of the Products. Such indemnification is a critical part of the consideration being provided by Customer (over and above the price paid for the Product(s)) for the right to use the Products for such purposes and Customer shall not use a Product or Products for such purposes if it is unwilling or unable to provide such indemnification.

9. Statute of Limitations

Customer will not commence any action based on breach of warranty with respect to any Product more than 18 months after SEQUOIA's delivery of such Product.

10. Software

The Products may include or be delivered with certain computer programs, databases or other software that is proprietary to SEQUOIA. SEQUOIA hereby grants Customer a nonexclusive license to use such software solely for the purpose of operating Products. Customer will not: use any such software for any other purpose; modify, adapt, translate, or create derivative works based on any such software; or disassemble, decompile or reverse engineer any such software. No title to or ownership of any software or intellectual property rights are transferred to Customer.

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12. Controlling Document

In the event of any conflict or inconsistency between any provision of this Statement of Limited Warranty and any other provision of the Order, the provision of this Statement of Limited Warranty will control.

13. Controlling Law

This Statement of Limited Warranty will be governed by the laws of the State of Washington without reference to its rules relating to choice of law for the purpose of applying another jurisdiction's law. The U.N. Convention on Contracts for the International Sale of Goods will not apply.

Document History

Revision	Date	Description	Author
A	2013-02-25	Draft document	WHS
B	2014-02-03	Updated for new version with auxiliary valve	WHS



HAYWARD INDUSTRIAL PRODUCTS

INSTALLATION OPERATION & MAINTENANCE

OF TRUE UNION LATERAL THREE WAY BALL VALVE

PLEASE READ THE FOLLOWING INFORMATION PRIOR TO INSTALLING AND USING HAYWARD VALVES, STRAINERS, FILTERS, AND OTHER ASSOCIATED PRODUCTS. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN SERIOUS INJURY.

1. Hayward guarantees its products against defective material and workmanship only. Hayward assumes no responsibility for damage or injuries resulting from improper installation, misapplication, or abuse of any product.
2. Hayward assumes no responsibility for damage or injury resulting from chemical incompatibility between its products and the process fluids to which they are subjected. Compatibility charts provided in Hayward literature are based on ambient temperatures of 70 °F and are for reference only. Customer should always test to determine application suitability.
3. Consult Hayward literature to determine operating pressure and temperature limitations before installing any Hayward product. Note that the maximum recommended fluid velocity through any Hayward product is eight feet per second. Higher flow rates can result in possible damage due to the water hammer effect. Also note that maximum operating pressure is dependent upon material selection as well as operating temperature.
4. Hayward products are designed primarily for use with non-compressible liquids. They should NEVER be used or tested with compressible fluids such as compressed air or nitrogen.
5. Systems should always be depressurized and drained prior to installing or maintaining Hayward products.
6. Temperature effect on piping systems should always be considered when the systems are initially designed. Piping systems must be designed and supported to prevent excess mechanical loading on Hayward equipment due to system misalignment, weight, shock, vibration, and the effects of thermal expansion and contraction.
7. Because PVC and CPVC plastic products become brittle below 40 °F, Hayward recommends caution in their installation and use below this temperature.
8. Published operating torque requirements are based upon testing of new valves using clean water at 70 °F. Valve torque is affected by many factors including fluid chemistry, viscosity, flow rate, and temperature. These should be considered when sizing electric or pneumatic actuators.
9. Due to differential thermal expansion rates between metal and plastic, transmittal of pipe vibration, and pipe loading forces **DIRECT INSTALLATION OF METAL PIPE INTO PLASTIC CONNECTIONS IS NOT RECOMMENDED.** Wherever installation of plastic valves into metal piping systems is necessary, it is recommended that at least 10 pipe diameter in length of plastic pipe be installed upstream and downstream of the plastic valve to compensate for the factors mentioned above.

SOCKET CONNECTION:

Socket end connections are manufactured to ASTM D2467-94. Solvent cementing of socket end connections to pipe should be performed per ASTM specifications D2855-87. Cut pipe square. Chamfer and deburr pipe. Surfaces must be cleaned and free of dirt, moisture, oil and other foreign material. Remove assembly nuts and end connectors from valve body. Slide assembly nuts, with threads facing valve, onto pipe to which the end connector is to be cemented. Apply primer to inside socket surface of end connector. Never allow primer or cement to contact valve ball or end connector o-ring sealing surfaces, as leaking may result. Use a scrubbing motion. Repeat applications may be necessary to soften the surface of the socket. Next, liberally apply primer to the male end of the pipe to the length of the socket depth. Again apply to the socket, without delay apply cement to the pipe while the surface is still wet with primer. Next apply cement lightly, but uniformly to the inside of the socket. Apply a second coat of cement to the pipe, and assemble the end connector to the pipe, rotating the end connector 1/4 turn in one direction as it is slipped to full depth on to the pipe. The end connector should be held in position for approx. 30 seconds to allow the connection to "set". After assembly wipe off excess cement. Full set time is a minimum of 30 minutes at 60 to 100 °F. Full cure time should be based on the chart below.

JOINT CURE SCHEDULE:

The cure schedules are suggested as guides. They are based on laboratory test data, and should not be taken to be the recommendations of all cement manufacturers. Individual manufacturer's recommendations for their particular cement should be followed.

Temperature Range During Cure Period(B) °F(°C)	Test Pressures for Pipe Sizes 1/2" to 1-1/4"		Test Pressures for Pipe Sizes 1-1/2" to 3"		Test Pressures for Pipe Sizes 4" & 5"		Test Pressures for Pipe Sizes 6" to 8"	
	Up to 180 PSI (1240 kPa)	Above 180 to 370 PSI (1240 to 2550 kPa)	Up to 180 PSI (1240 kPa)	Above 180 to 315 PSI (1240 to 2172 kPa)	Up to 180 PSI (1240 kPa)	Above 180 to 315 PSI (1240 to 2172 kPa)	Up to 180 PSI (1240 kPa)	Above 180 to 315 PSI (1240 to 2172 kPa)
60 to 100 (15 to 40)	1 hour	6 hours	2 hours	12 hours	6 hours	18 hours	8 hours	1 day
40 to 60 (-5 to 15)	2 hours	12 hours	4 hours	1 day	12 hours	36 hours	16 hours	4 days
20 to 40 (-7 to 5)	6 hours	36 hours	12 hours	3 days	36 hours (A)	4 days (A)	3 days (A)	9 days (A)
10 to 20 (-15 to 7)	8 hours	2 days	16 hours	4 days	3 days (A)	8 days (A)	4 days (A)	12 days (A)

Colder than 10 (-15) Extreme care should be exercised on all joints made where pipe, fittings or cement is below 10°F.

A: It is important to note that at temperatures colder than 20°F on sizes that exceed 3 in., test results indicate that many variables exist in the actual cure rate of the joint. The data expressed in these categories represent only estimated averages. In some cases, cure will be achieved in less time, but isolated test results indicate that even longer periods of cure may be required.

B: These cure schedules are based on laboratory test data obtained on Net Fit Joints (NET FIT=in a dry fit the pipe bottoms snugly in the fitting socket without meeting interference).

THREADED CONNECTION:

Threaded end connections are manufactured to ASTM specifications D2464-88. F437-88 and ANSI B2.1. Wrap threads of pipe with Teflon tape of 3 to 3-1/2 mil thickness. The tape should be wrapped in a clockwise direction starting at the first or second full thread. Overlap each wrap by 1/2 the width of the tape. The wrap should be applied with sufficient tension to allow the threads of a single wrapped area to show through without cutting the tape. The wrap should continue for the full effective length of the thread. Pipe sizes 2" and greater will not benefit with more than a second wrap, due to the greater thread depth. To provide a leak proof joint, the pipe should be threaded into the end connection "hand tight". Using a strap wrench only. (Never use a stillson type wrench) tighten the joint an additional 1/2 to 1-1/2 turns past hand tight. Tightening beyond this point may induce excessive stress that could cause failure.

FLANGED CONNECTION:

Flange bolts should be tight enough to slightly compress the gasket and make a good seal, without distorting or putting excessive stress on the flanges. Suitable washers should be used between the bolt head and flange and the nut and flange. Bolts should be tightened in alternating sequence.

RECOMMENDED FLANGE BOLT TORQUE

FLANGE SIZE	BOLT DIA.	TORQUE FT. LBS.	FLANGE SIZE	BOLT DIA.	TORQUE FT. LBS.
1/2	1/2	10-15	2	5/8	15-25
3/4	1/2	10-15	2-1/2	5/8	20-25
1	1/2	10-15	3	5/8	20-25
1-1/4	1/2	10-15	4	5/8	20-25
1-1/2	1/2	10-15	6	3/4	30-40

NOTE: USE WELL LUBRICATED METAL BOLTS AND NUTS. USE SOFT RUBBER GASKETS.

ADJUSTMENT:

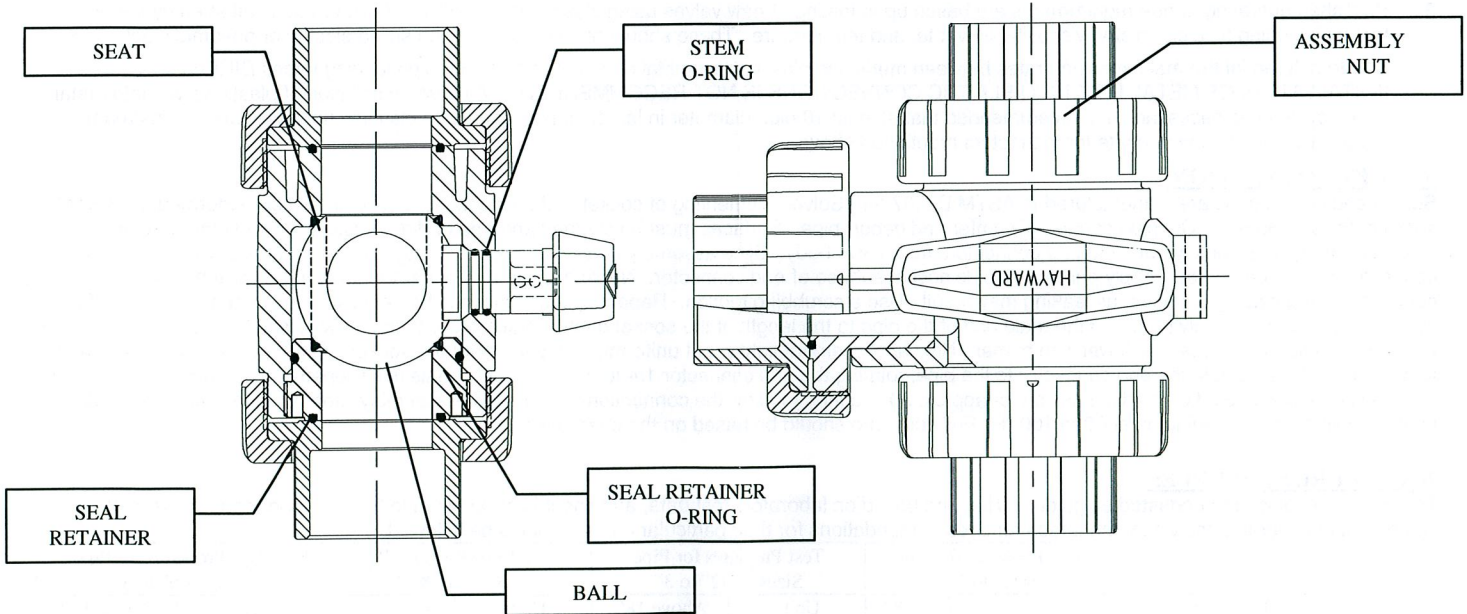
EXTREME CAUTION MUST BE TAKEN WHEN WORKING ON THIS VALVE.

THE PIPING SYSTEM MUST BE DEPRESSURIZED AND DRAINED. PROPER CARE MUST BE TAKEN. CONSULT M.S.D.S. (MATERIAL SAFETY DATA SHEETS) INFORMATION REGARDING YOUR SPECIFIC APPLICATION.

Remove the assembly nut and end connector from the "adjust" end of the body which is always the right port as viewed from the top with the tab up; or the complete valve body from the piping system. The direction of rotation is right hand tightens (clockwise rotation), counterclockwise loosens. The assembly nut should be installed on the valve "hand tight". Using a strap wrench only the joint may be tightened 1/2 to 3/4 of a turn past hand tight.

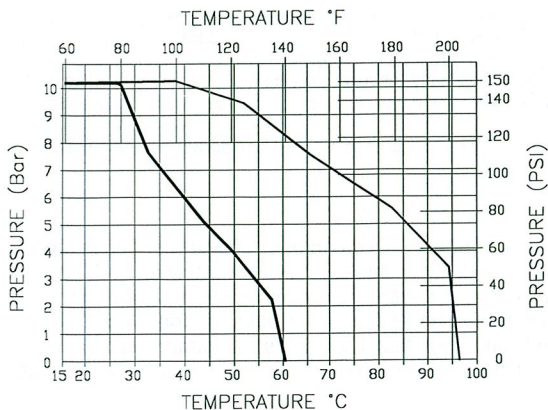
REPAIR:

Follow the adjustment sequence and information above, but rotating the seal retainer completely in the "loosen" direction and remove it from valve body. The o-rings and seals are now accessible for replacement using a "seal" repair kit. Carefully remove the o-rings from their respective locations taking care not to scratch their sealing surfaces. Insert o-rings and re-assemble. See table below.



OPERATION:

The valve flow pattern is in or out one side port and down through the bottom port or straight through the valve. Ball pattern DOES NOT allow both side ports to be blocked at the same time. Valve can be rotated 90° or 180° to change ports.



VALVE SIZE	TORQUE IN*LB
1/2"	40
3/4"	50
1"	60
1 1/2"	70
2"	80
3" & 2 1/2"	140
4" & 6"	170

METER CALIBRATION REPORT

Model SPX038-13

Serial Number 072013002506

Nominal K-Factor 4254

Min Flow Rate (GPM) 0.07

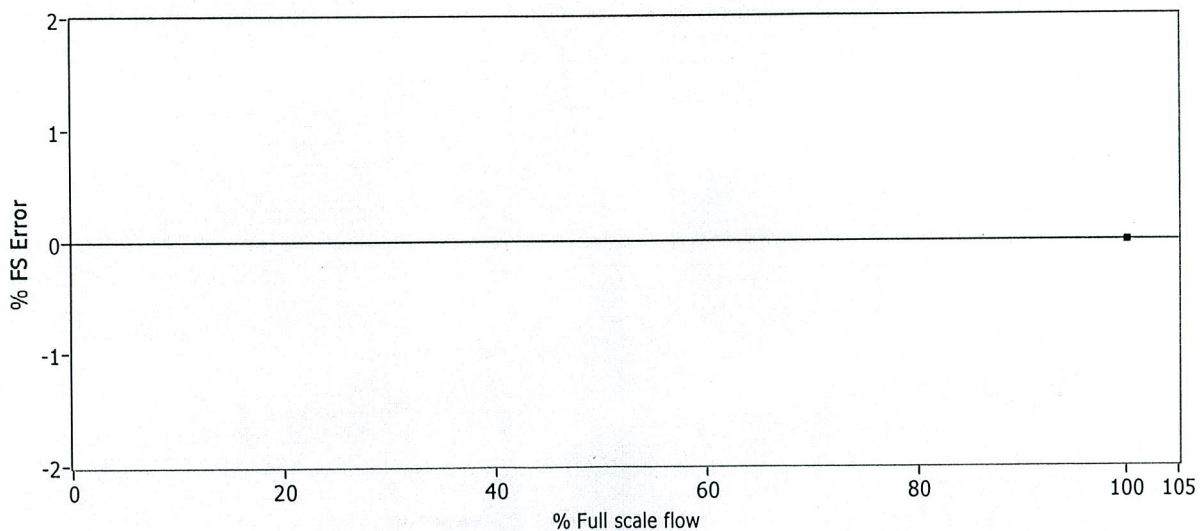
Max Flow Rate (GPM) 5

Calibrated by: Sasha

Date: 7/30/2013

Time: 7:36 AM

Temp (F)	Flow (GPM)	K-factor (PPG)	Type A Uncertainty	Type B Uncertainty	Combined Expanded Uncertainty
72.2	5.00	4254	0	0.035	0
72.2	1.00	3812	10.4	1.86	10.4



- 1) Type A uncertainty was the bias, where bias = (nominal K – measured K) / nominal K * 100. Degrees of freedom was equal to 1.
- 2) Type B uncertainty was the uncertainty of k-factor measurements at the 67% confidence probability. Contact SeaMetrics for documentation regarding measurement uncertainty and the calibration system.
- 3) The combined expanded uncertainty was twice the Root Sum Square (RSS) of the bias and measurement uncertainty. Combined Expanded Uncertainty = 2xRSS(bias, measurement uncertainty). Coverage factor was equal to 2, at 95% confidence probability.
- 4) K-Factor, temperature, and flow rate measurements are traceable to NIST.