

# Osci-Flow<sup>®</sup>

## Flow Controller

### Users Manual



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## Getting Started

### Introduction

Fluid-induced shear stress occurs in every tissue in the body as a result of interstitial fluid movement. Tissue deformation by compression, tension or shear forces results in the movement of interstitial fluid around cells. Fluid movement acts as a transport vehicle for ions, proteins, carbohydrates and other molecules capable of movement within the matrix. As the fluid moves past cell membranes, a shear stress,  $\tau$ , is generated. If one assumes that laminar flow occurs through a parallel-plate flow chamber, fluid-induced shear stress values can be determined with the following formula:  $\tau = 6\mu Q/bh^2$ , where  $\tau$  is the shear stress in dyne/cm<sup>2</sup>,  $\mu$  is the viscosity of the fluid in dyne.s/cm<sup>2</sup>,  $Q$  is the flow rate in ml/s,  $b$  is the width of the flow channel in cm, and  $h$  is the height of the flow channel in cm. Shear stress in the vascular system may vary from less than 1, to more than 35 dyne/cm<sup>2</sup>. Fluid shear stress in canaliculi of bone may vary from 1 to 20 dyne/cm<sup>2</sup>, while in cartilage it may be in the range of 1 to 5 dyne/cm<sup>2</sup>.

The OsciFlow® is a software-controlled valve-operated device designed to provide oscillatory or start-stop flow patterns to cells cultured in the Streamer™, FlexFlow™ or other perfusion devices. Both the Streamer™ and FlexFlow™ are parallel-plate flow systems designed to apply fluid-induced shear stress to cells grown in a monolayer. The OsciFlow® regulates flow direction by choreographing the closing and opening a collection of pinch valves. This carefully timed action serves to constrict or release tubing thus directing the fluid flow through the desired channels. The OsciFlow® device is able to regulate flow both in an oscillatory (flow reversal) manner and in a pulsatile (square wave) mode, where the flow is stopped and then restarted after a designated period of time. Software control through StreamSoft™ software allows the user to regulate frequency of oscillation or pulsatile patterns, as well as shear stress levels applied to cells. Individual protocols can be designed for flow experiments. The frequency of oscillation or pulsation is specified by programming seconds ON and seconds OFF in the software.

OsciFlow®'s advantage over other flow reversal techniques is that it overcomes inertial lag. Other techniques for flow reversal rely on a change of pump – motor rotation. With this strategy, the inherent inertial effects associated with the deceleration and acceleration creates an unavoidable response lag time. Because the OsciFlow® does not require the pump – motor to change directions, near instantaneous flow reversal can be achieved with less wear and tear on pumps and motors.

### OsciFlow® System Specifications:

- Maximum Frequency of Oscillation: 1Hz (0.5 sec on/ 0.5 sec off)
- Minimum Frequency of Oscillation: No limit
- Maximum Frequency of Pulsation: 1Hz (0.5 sec on/ 0.5 sec off)
- Minimum Frequency of Pulsation: No limit
- Maximum Flow Rate through valves: No Limit
- Pinch Valve Maximum Pressure: 20 psi
- Pinch Valve Maximum Fluid Temperature: 158F (70C)
- Box Dimensions: 13" x 7.5" x 7.5" (33cm x 19.1cm x 19.1cm)
- Box Weight: 14lbs (6.4kg)
- Power Requirements: 120V, 0.15A
- Tubing sizes accepted: MasterFlex L/S 16, L/S 25, L/S 17
- Interface Connection to computer: NI Shielded Ribbon Cable
- Connection Cable Length: 3.3' (1m)

## OsciFlow® Components

- OsciFlow® Device
- DAQ Card DIO-24 with manuals and NI-DAQ software
- Shielded connector cable for connection from OsciFlow® to DAQ card
- OsciFlow® Tubing (includes quick disconnect fittings)
- Additional tubing lengths necessary for connecting to flow system
- StreamSoft™ software V2.2.1
- Dell Inspiron notebook computer (optional)

## OsciFlow® Setup and Assembly

The following instructions are for integrating the OsciFlow® into the Streamer™ and/or FlexFlow™ systems. **When using the OsciFlow® with either system, the box should not be placed in the incubator with the flow device and its other components.** The OsciFlow® should be placed on top or beside the incubator, as near as possible to the port through which the tubing enters the incubator. This will minimize the amount of fluid that is exposed to atmospheric temperatures.

The OsciFlow® is very easily integrated into the Streamer™ and FlexFlow™ systems. A special tubing connector is provided with the OsciFlow® that will connect directly in line with the Streamer™ or FlexFlow™ system, with the addition of two more tubing lengths provided with the OsciFlow®.

1. Connect the OsciFlow® tubing connector to the front of the OsciFlow® as shown below. Push the tubing all the way into the pinch valves so that each piece is fully inserted and pinched between the valve body and pinching mechanism. The connector must be inserted as shown below, such that the each of the four pieces of tubing is connected to their respective valve.
2. Find a location for your OsciFlow® that is as near as possible to the port hole on the back or top of your incubator. Place the OsciFlow® such that the tubing connector quick disconnects are in close proximity to the port hole.
3. Disconnect the male quick disconnect that is currently connected to the inlet of your Streamer™ or FlexFlow™ device and connect it to the bottom left female quick disconnect (refer to Figure 1) of the OsciFlow® tubing connector.
4. Disconnect the male quick disconnect that is currently connected to the outlet of your Streamer™ or FlexFlow™ device and connect it to the top left female quick disconnect (refer to Figure 1) of the OsciFlow® tubing connector.
5. Use one of the tubing lengths provided with the OsciFlow® to connect the top right female quick disconnect (refer to Figure 1) on the OsciFlow® tubing connector to the inlet of your Streamer™ or FlexFlow™ device.
6. Use the other tubing length provided with the OsciFlow® to connect the bottom right female quick disconnect (refer to Figure 1) on the OsciFlow® tubing connector to the outlet of your Streamer™ or FlexFlow™ device.



*Figure 1: OsciFlow® front with tubing connector in place*

### **Connecting the OsciFlow® to your laptop computer:**

7. Follow the software installation instructions on page 6 to install the StreamSoft™ and NI-DAQ software.
8. Insert the NI-DAQ card into one of the PCMCIA slots on the side of your laptop computer.
9. Using the black shielded cable provided with the OsciFlow®, connect the exposed side of the NI-DAQ card to the vertical 50-pin grey connector on the back of the OsciFlow®.
10. Plug the OsciFlow® in and turn the power on.
11. Once the system is fully connected, clean it by pumping deionized water through all components.

*\*Note: Any of the tubing lengths above can be shorted or extended according to your setup needs.*

## StreamSoft™ v2.2.1 Software

### Installation Instructions

#### NI-DAQ Software (must be installed for proper functionality of StreamSoft V2.2.1):

- 1) Insert the NI-DAQ for Windows V6.9.3 CD into the CD-ROM on your computer.
- 2) Installation process will begin automatically.
- 3) When the “Feature Tree” window appears during installation, go to the block beside *LabView 6.0 Support* and click it with your left mouse button to pull down the menu. Select *Install this feature to a local drive*.
- 4) Check to be sure that the *NI-DAQ 6.9.3 Device Driver* and the *Ni-DAQ OPC Server* are already selected in the same manner.
- 5) Proceed with installation by clicking *Next*.
- 6) Once installation is complete, reboot your computer.
- 7) Once rebooted, NI-DAQ will offer to install further information on the computer that is not necessary for StreamSoft functionality. Click *Cancel*.
- 8) Insert the NI-DAQ card into one of the PCMCIA slots on the side of your laptop. The laptop should make a sound, recognizing that the card has been installed.

#### Installation of StreamSoft™ V2.2.1:

- 1) Insert the StreamSoft™ V2.2.1 CD into the CD-ROM on your computer.
- 2) Click on the *Start* menu at the bottom left corner of your screen and select *Run*.
- 3) Click on the *Browse* button in the *Run* window.
- 4) Locate your CD-ROM and open the folder entitled “Streamer (rev 2-2-1) Installation Disks”.
- 5) Click on the file “Setup.exe” and then click *Open*.
- 6) Click *OK* in the *Run* window and follow installation instructions. Setup will first install the StreamSoft™ V2.2.1 software, followed by LabVIEW™ files to support the software.
- 7) StreamSoft™ V2.2.1 installation is now complete.

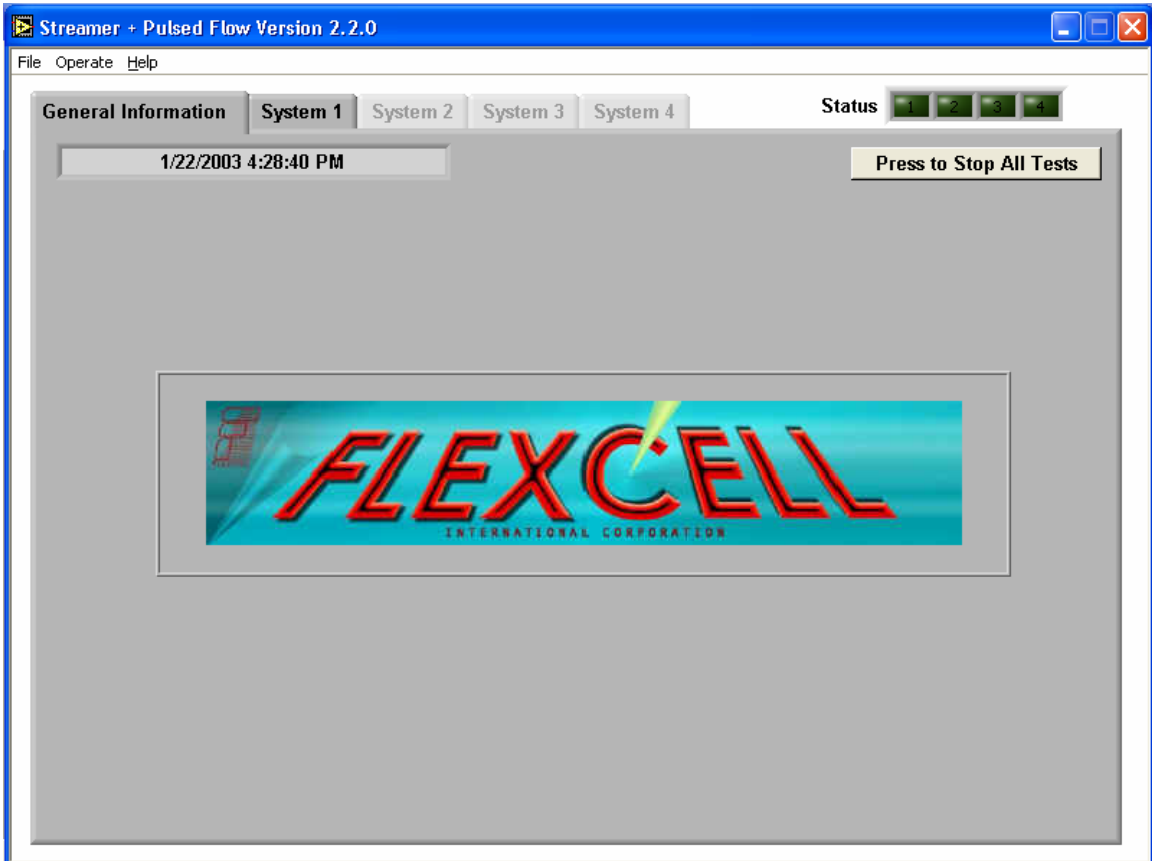
#### Setting up parameters in StreamSoft™ V2.2.1:

Specific parameters will need to be set up in StreamSoft™ V2.2.1 to customize it for your particular device and system. **Setting up these parameters is extremely important to insure accurate flow results with your system.** For instructions on setting up these parameters, see pages 18 and 19 (*Configure Testing Apparatus*), and page 20 (*Configure System Variables*). Complete this setup before proceeding with any experiments.

## Main Panel

### General Information Tab

**Function:** The default main panel allows the user to verify that the system is running and to stop the tests at any time.

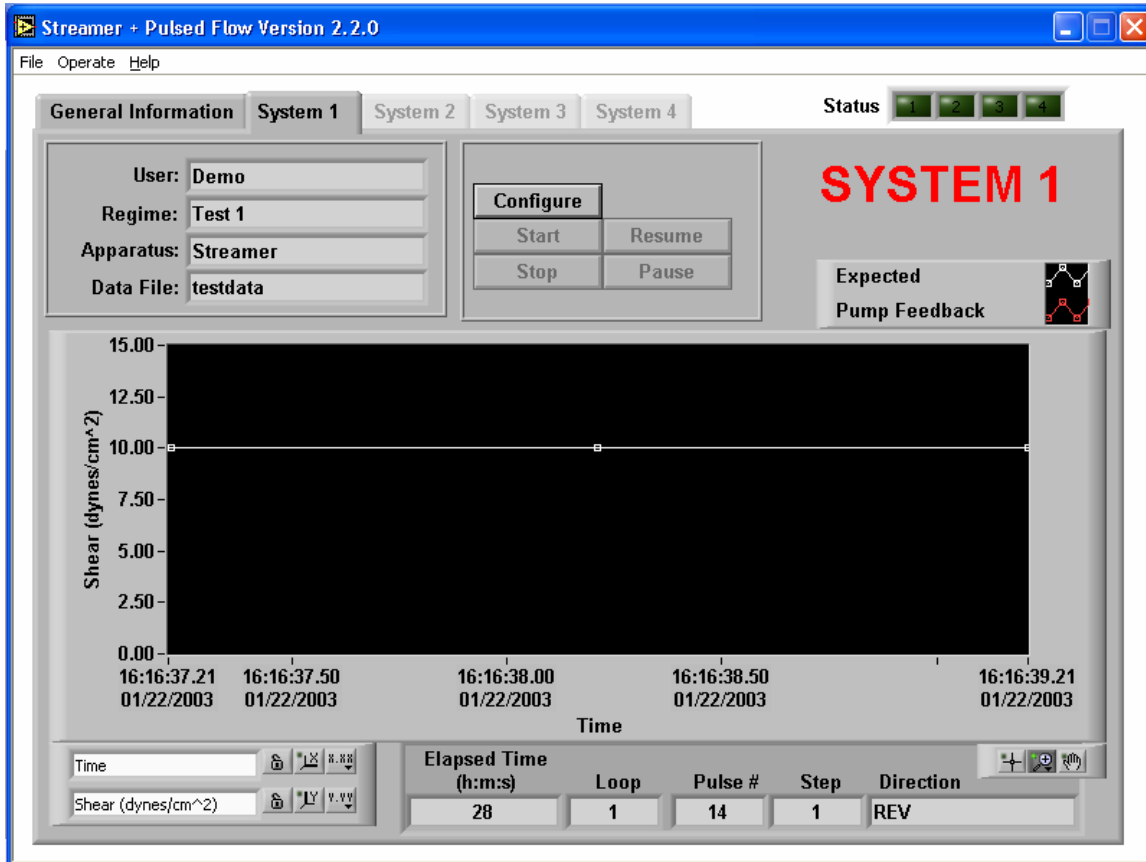


### **Buttons and Fields**

Status buttons	Number is bright green when an experiment is running
System 1,2,3,4	These tabs will automatically become highlighted according to the number of pumps connected to the computer (1-4).
Date and Time	Current date and time values
'Press to Stop All Tests'	Abort the current regime.

## System Tab

**Function:** This panel is used to run the experiments. Each of the other ‘system’ tabs are identical to this one.



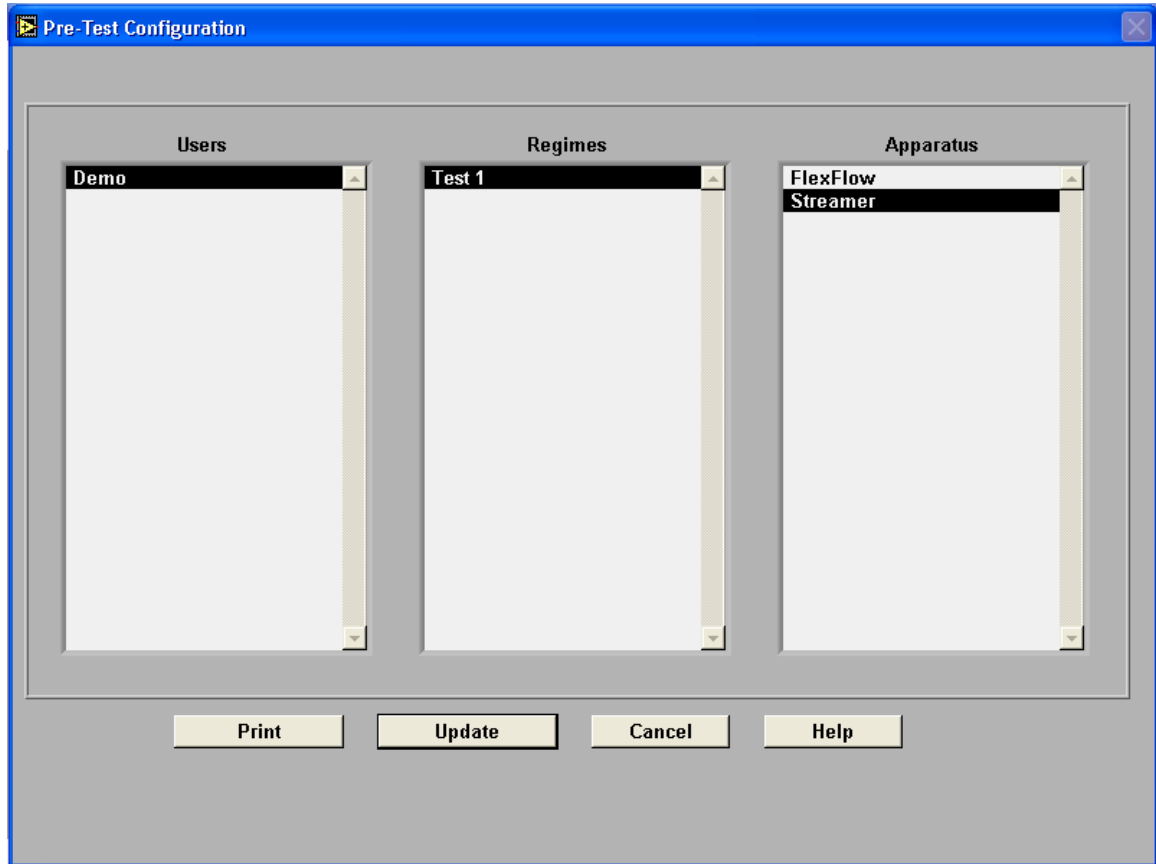
## Buttons and Fields

User	Current user in currently configured regime
Regime	Regime currently configured
Apparatus	Device being used with software (Streamer™ or FlexFlow™)
Data File	Name of file to which data is being saved (if appropriate)
Configure	Configure (load) the experiment; the <i>Pre-Test Configuration</i> window will appear.
Start	Start the experiment.
Stop	Terminate the experiment. This button is only active when an experiment is running.
Pause	Suspend the experiment; the pump will stop, but the test regimen is kept in memory.
Resume	Resume a paused experiment.
Graph	This graph shows the expected and actual shear stresses during the experiment.

Elapsed Time (h:m:s)	Elapsed time in the current experiment
Loop	Current loop in the current step or series of steps
Pulse #	Total number of pulsations (square wave) or oscillations (FWD/REV) produced by the valves in this regime
Step	Current (active) step in regime
Direction	Current flow direction (FWD/REV)

## Pre-Test Configuration

**Function:** This panel allows the user to configure the parameters of an experiment. It appears when the user presses the *Configure* button on the System panel. The information selected here is transferred to the *User*, *Regime* and *Apparatus* fields on the *System* panel.



### Buttons and Fields

Users	List of all users; select users with the mouse.
Regimes	List of regimes created by the previously selected user. Select from list by using the mouse to highlight the desired regime.
Apparatus	List of configured flow devices; select the device that you will be using for the experiment. <b>Important: Be sure that all parameters have been properly set for your device in the <i>Configure Testing Apparatus</i> window. See pages 18 and 19.</b>
Print	Print the current panel to a printer or HTML file.
Update	Use the current selections to run the experiment.
Cancel	Cancel any new selections and use the previously configured setup for the experiment.
Help	Online help (not yet available)

## Pull-down Menus

This section summarizes the function of each item in the three pull-down menus.

<i>File</i>	<i>Operate</i>	<i>Help</i>
-Print -Exit	-Manual Mode -View Data -Users -Configure Regime -Configure Apparatus -Configure System -Reinitialize Hardware	-Help -About LabVIEW

### File

*Print* – Allows user to print a copy of the current panel. This system is configured such that printing sends a copy of the panel being viewed to a printer or to an html file. If there is no printer connected to the computer, an error message from the Windows default printer queue will appear when the user tries to print.

*Exit* – Allows user to close the program. If the pump is operating at the time of exit, it will continue running. The keyboard short-cut is **Ctrl-Q**.

### Operate

*Manual Mode* – Allows the user to manually control the pump without setting up an experimental regimen.

*View Data* – Allows the user to view shear stress data from a previous experiment.

*Users* – Allows user names to be added and removed.

*Configure Regime* – Allows the user to create an experimental protocol.

*Configure Apparatus* – Allows the user to configure parameters of the flow device so that the software can assign the flow rates corresponding to the desired shear stress. **These parameters must be set correctly to insure that the proper shear stress values are shown on your screen. See the manual for your device for the appropriate values.**

*Configure System* – Allows the user to configure system level parameters such as data saving, the Com port used, and the presence or absence of valves in the system.

*Reinitialize Hardware* – This will reinitialize the software connect to the pump and OsciFlow® (if present) in the event that a wire is disconnected or the pump is turned off.

Help

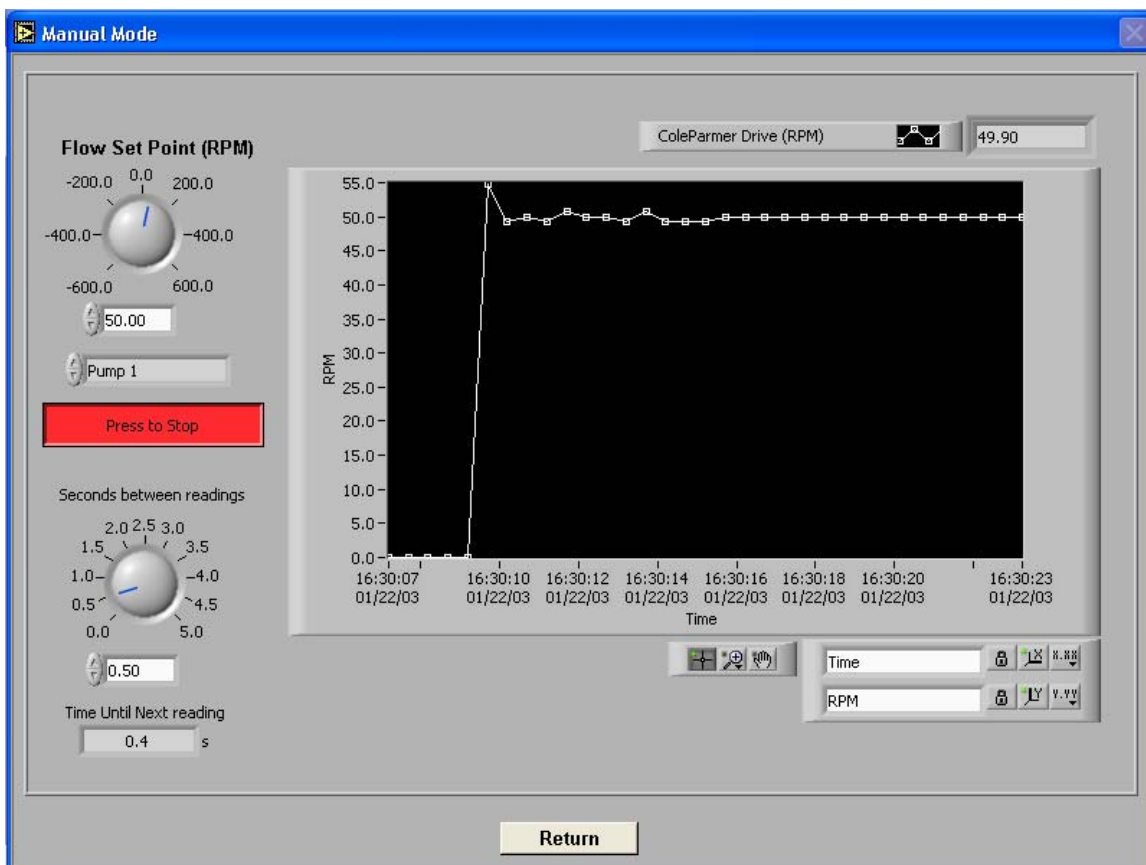
*Help* – Online help (not yet available)

*About LabVIEW* – Software version information

## Operate Menu

### Manual Mode

**Function:** This panel allows the user to manually control the pump. The actual flow rate and speed of the pump (RPM) are shown on the graph when the pump is working. Manual mode may be used to troubleshoot the pump operation. The shear stress value is not shown on this panel since it will depend on the tubing size and flow chamber used.

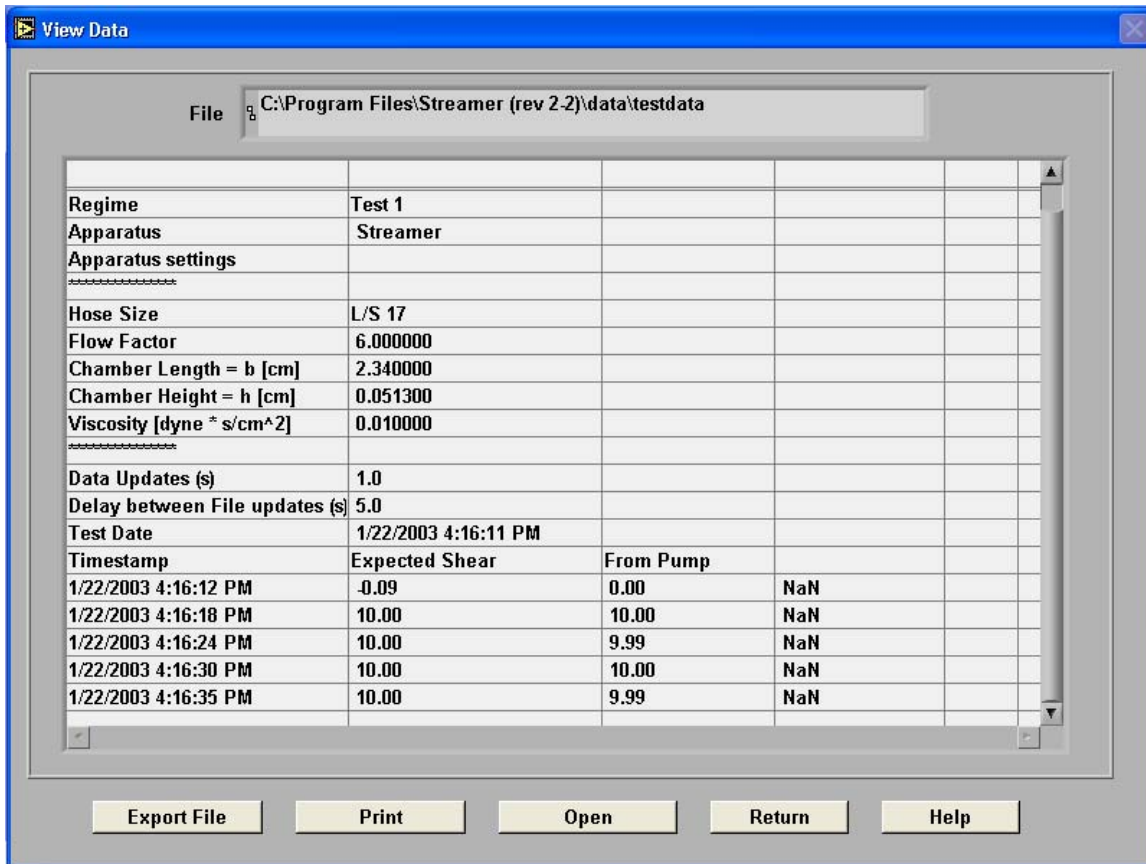


### **Instructions**

1. Enter the flow set point (pump speed) either by entering a number in the box or using the mouse to drag the dial to the desired level.
2. Adjust the seconds between readings to a number between 0 and 5. This is the time between each update of the pump data on the graph.
3. Click on *Press to Start*.
4. Click on *Press to Stop* when ready to stop.
5. Click on *Return* when done.

**View Data**

**Function:** This panel allows the user to view previously collected experimental data in a table format.

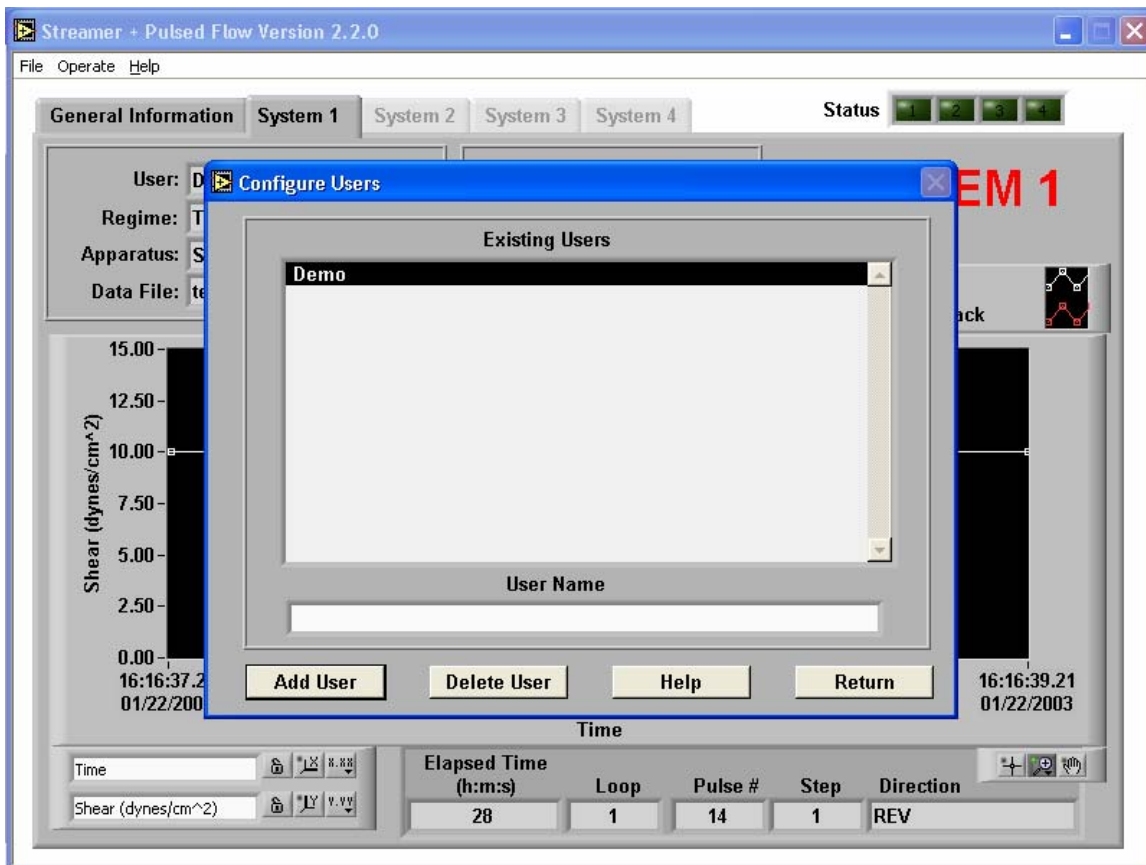


**Buttons and Fields**

File	The complete file path to the data file being viewed
Table	Contents of the experimental data log file
Export File	Export data to a spreadsheet-compatible format
Print	Print a copy of this panel to the Windows default printer or write a copy to an HTML file.
Open	Open a data file.
Return	Close this panel and return to the Main panel.
Help	Online help (not yet available)

## Configure Users

**Function:** This panel allows the user to create or delete users.



### Buttons and Fields

Existing Users	Lists all current users of the system
User Name	Field used to enter new users
Add User	Add new users to the system.
Delete User	Delete users from the system.
Help	Online help (not yet available)
Return	Exit this panel and return to the Main panel.

### Instructions

To add a user:

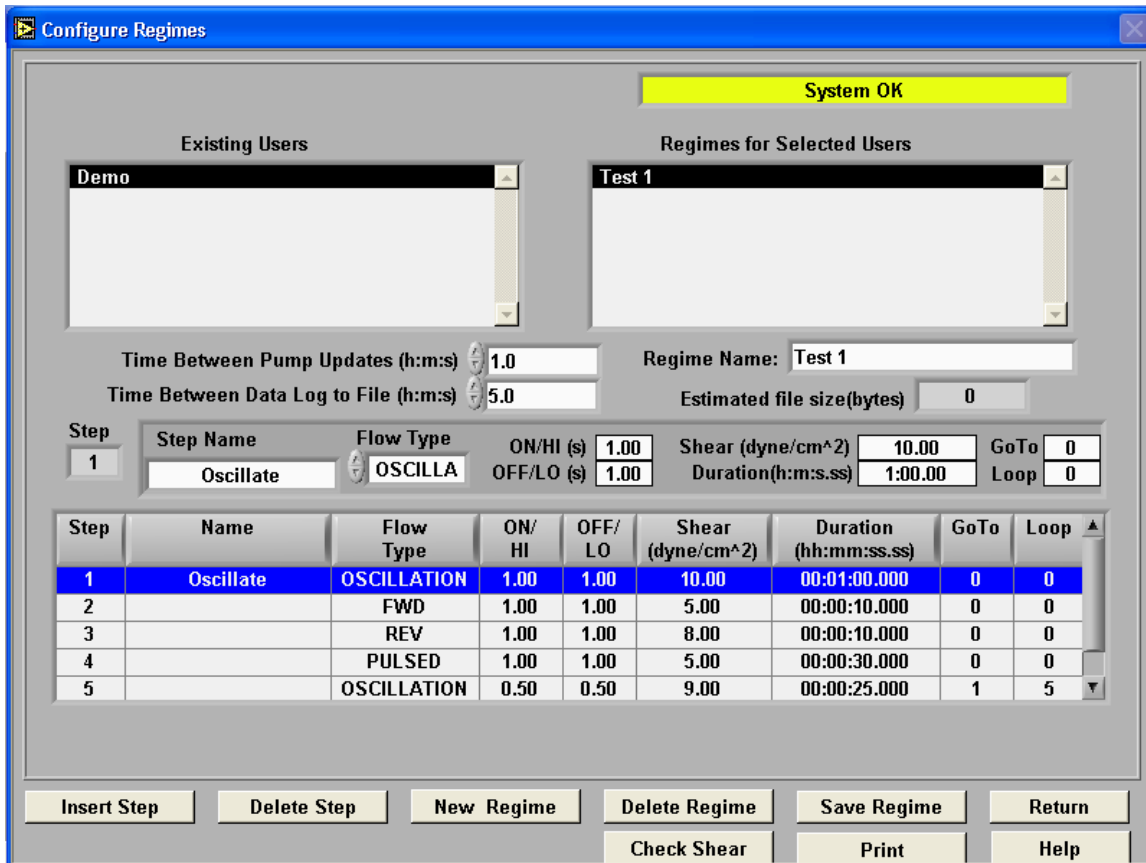
- 1) Type the name into the *User Name* field.
- 2) Press the *Add User* button.

To delete a user:

- 1) Using the mouse, select the user from the list of *Existing Users*.
- 2) Press the *Delete User* button. If the user has any stored regimes and data sets, the operator will be prompted to confirm the deletion.

**Configure Regimes: Setup Parameters**

**Function:** This panel allows the user to configure (create) a regime.



**Buttons and Fields**

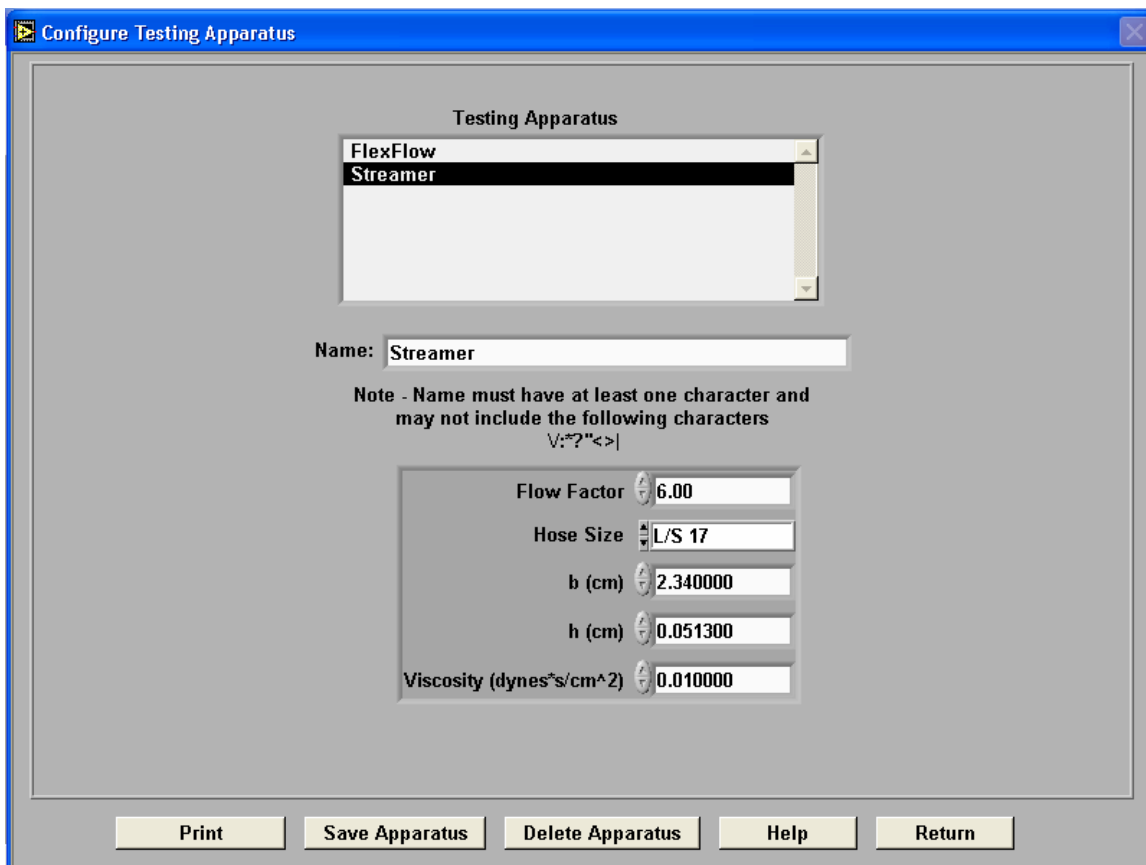
Existing Users	List of all users; select a user from the list using the mouse.
Regimes for Selected Users	List of regimens created by the current user. Selecting from this list will load that regimen and allow the user to view and/or modify that regime.
Regime Name	Name of the current regimen; if creating a new regimen, enter a name in this field.
Time Between Pump Updates	Time elapsed between computer updates of the pump parameters; default is 1 second.
Time Between Data Log to File	Time interval between each computer sampling of the experimental flow data. Default value is 10 seconds. For an extremely long test, increase this interval to reduce the size of the data file. Note: this function only applies when the data saving option is selected in the <i>Configure System Variables</i> window. See page 20.
Estimated file size	This is an estimate of how large the data file would be given the total test length and the time between data. Note: this function only applies when the data saving option is selected in the <i>Configure System</i>

	<i>Variables</i> window. See page 20.
Step	Current step number selected or being modified
Step Name	Name of the currently selected step
Flow Type	Specifies the direction or type of flow for this step (forward, reverse, pulsed (square wave), oscillation)
ON/HI (s)	When using pulsed (square wave) or oscillatory flow, specifies how long the valves remain in a position to allow the fluid flow to continue unhindered or flow in the forward direction, respectively. For normal forward or reverse (unidirectional) flow, this value remains at 1.00.
OFF/LO (s)	When using pulsed (square wave) or oscillatory flow, specifies how long the valves remain in a position to stop the fluid flow to the device or cause it to flow in the reverse direction, respectively. For normal forward or reverse (unidirectional) flow, this value remains at 1.00.
Shear (dyne/cm <sup>2</sup> )	The value of shear stress to be applied to the cells in this step.
Duration (h:m:s.ss)	Time to spend in this step (hours:minutes:seconds.milliseconds)
GoTo	To create a loop, indicate which step to go back to. The <i>GoTo</i> step must always be a step number before the current step.
Loop	Indicates how many times to loop between the <i>GoTo</i> step and the current step.
Summary Table	This table is a listing of the current steps in the regimen. Selecting a row from this table will allow the parameters of the step to be viewed and modified.
Insert Step	Insert a step into the regimen before or after the current step.
Delete Step	Delete the currently selected step.
New Regime	Clear all parameters and start a new regime. Type in a new name under <i>Regime Name</i> and select <i>Insert Step</i> .
Delete Regime	Delete the currently selected regime.
Save Regime	Save a new or modified regime.
Return	Exit this panel and return to the <i>Main Panel</i>
Check Shear	Check the shear stresses entered in your regime to see if they are achievable with the apparatus, pump and tubing size that you are using.
Print	Print the current panel to a printer or an HTML file.
Help	Online help (not yet available)

**\*\* Instructions on how to set all the parameters for an experiment are included in the *Doing an Experiment* section of this manual.**

**Configure Testing Apparatus**

**Function:** This panel allows the user to create, modify or delete a testing apparatus (Streamer™ or FlexFlow™ flow chamber). **Because each Streamer™ and FlexFlow™ device is manufactured to strict dimensional specifications, the values for the height and width of the chambers must be entered into the software for each individual device. These values are measured for *your particular device* and must be correct for accurate shear stress measurement. The values can be found in the appendix of the manual for your device.**



**Buttons and Fields**

Testing Apparatus	List of all flow devices available
Name	When a testing apparatus is selected, this field (and the parameters) will be updated.
Flow Factor	A factor that accounts for any parallel paths in the flow stream. This number is 6 for the Streamer™ and 1 for the FlexFlow™.
Hose Size	Hose size determines how fast the pump must move to achieve the desired flow rate and shear stress level. The sizes listed are standard for Masterflex® tubing. Select the hose size that you are using with your system.

b	Width of the flow area (cm) in a single chamber of the Streamer™ or FlexFlow™ device. This number is found in the back of the manual for your device listed as <i>Flow Area Width (cm)</i> .
h	Height of the flow area (cm) in a single chamber of the Streamer™ or FlexFlow™ device. This number is found in the back of the manual for your device listed as <i>Flow Area Height (cm)</i> .
Viscosity	Viscosity of the perfusate/media used in the experiment. Standard value is 0.01.
Print	Print the current panel to a printer or an HTML file.
Save Apparatus	Save changes to the apparatus listed in <i>Name</i> .
Delete Apparatus	Deletes apparatus listed in <i>Name</i> .
Help	Online help (not yet available)
Return	Exit this panel and return to the <i>Main</i> panel. Any changes that have not been saved will be discarded.

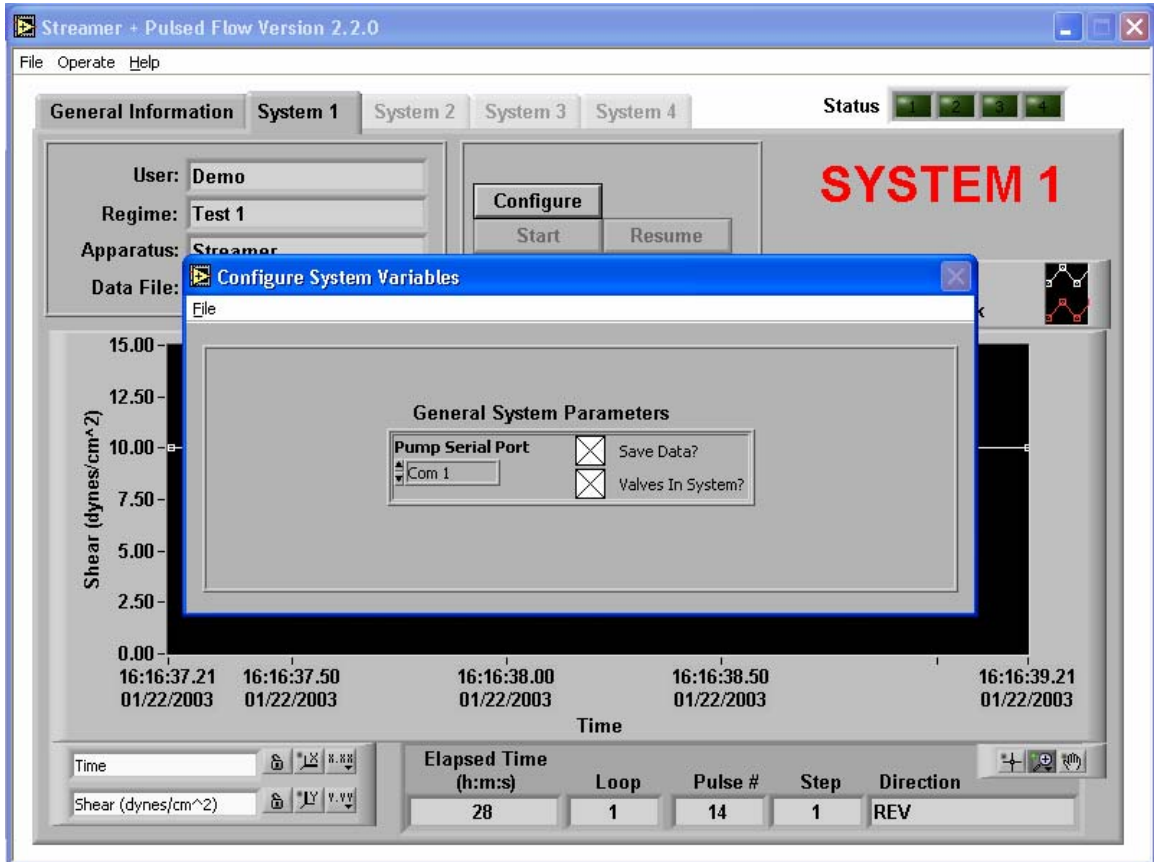
### How to enter the proper values for your device:

**Please check the Appendix of the manual for your device for the proper *b* and *h* values.**

1. Select the *Testing Apparatus* being used for the experiment or enter a name for a new apparatus in the *Name* box.
2. Enter the correct flow factor for your device. This specifies the number of parallel flow chambers in your device.
3. Select the correct *Hose Size* for the type of Masterflex® tubing being used in the experiment.
4. Enter the proper *b* and *h* values for your device.
5. Enter the *Viscosity* of the perfusate fluid used in the experiment. The default value is 0.01 dynes\*s/cm<sup>2</sup>.
6. Click *Save Apparatus* button, then click *Return* to exit this screen.

## Configure System Variables

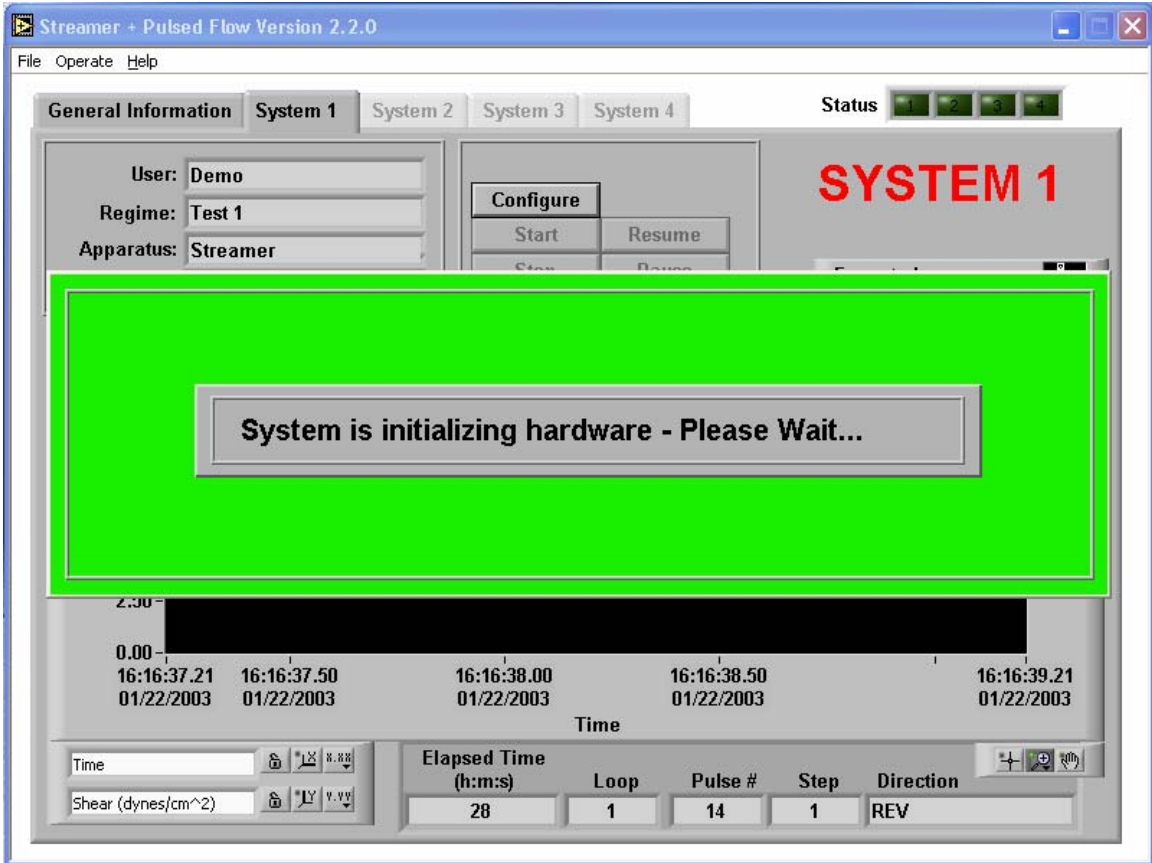
**Function:** This panel is used to select three system parameters – Communications port, data saving, and the presence of valves in the flow system.



Pump Serial Port	Com 1 is the default port. This should be changed only if there is a conflict with this port on your computer.
Save Data?	Select this option if you want to save regime data files.
Valves in System?	Select this option if you are using the OsciFlow® Flow Controller.

**Reinitialize Hardware**

**Function:** This panel will appear when the computer program is first started. It will also appear when the Reinitialize Hardware item is selected in the Operate menu. When the system is properly initiated, the pump will display PO1 and the OsciFlow® valves will click. If power to the pump is cycled during experimentation, or communication is lost, the user should reinitialize the hardware before turning off the program and starting it again.



### StreamSoft V2.2.1 Notes

When running a regime in StreamSoft V2.2.1, do not run other applications on the same computer. The communication timing to the pump and OsciFlow® requires full CPU availability. If another program or operation is running that requires CPU power, it is possible that the pump or valve timing could be interrupted. This effect may be noticeable when using the OsciFlow® at a higher frequency than 2 seconds on, 2 seconds off, or when oscillating the pump speed to create pulsatile flow.

## Doing an experiment

### Creating a regime

1. From the main panel, select the *Configure Regimes* item in the *Operate* menu.
2. Click on an existing user name.
3. To create a new regimen, click on *New Regime*. Enter a name in the *Regime Name* field.
4. Click *Insert Step*; give this step a name in the *Step Name* field.
5. Click on *Save Regime*. The regime name should appear in the *Regimes for Selected Users* field at the top.
6. Specify the Flow Type (FWD, REV, PULSED, OSCILLATION), ON/HI & OFF/LO times (only when using the pulsed or oscillation functions; see page 17 for more details), Shear, and Duration for this step. Click on *Save Regime* to save all information entered up to this point.
7. *Note: If you are using the OSCILLATION function, create a first step in the regime in FWD mode. This step is required to push out the air that remains in the top of the Streamer after the top is opened for slide insertion. The first step will push this air through to the outlet in the medium bottle.*

#### **If you wish to add additional steps:**

8. Click *Insert Step*. You will be queried as to whether this step should be inserted before or after the current step. Click on *before* or *after* according to your preference. Enter the preferred parameters as in #6. If this step was inserted after the step entered in #6, you can also use the GoTo and Loop options to loop through steps 1 and 2. Under GoTo in step 2, enter "1". Under Loop, enter the number of times that you would like to loop through steps 1 and 2.
9. Add additional steps as desired. Once the regime is complete, click on *Save Regime*.
10. **Optional:** Check the shear stress(es) in your regime to be sure that they are achievable with your apparatus, tubing size and pump. Click on *Check Shear* at the bottom of the Configure Regimes window while your regime is selected and in view in the Summary Table (see page 17). The Pre-Test Configuration window will appear (see page 10). Select a user, regime, and apparatus. Click on *Update*. The software will tell you if your shear stresses are achievable with this apparatus and the tubing size and pump assigned to it. Modify shear stresses if necessary.
11. The regime is now ready to run.

### Filling the System to Eliminate Air Bubbles

Before using the OsciFlow® system with cells, all of the tubing must be filled with media and all air bubbles removed. To fill the system, create a regime with two steps, the first in FWD mode and the second in REV mode. Each step should be 2 minutes at a shear stress level  $\frac{1}{2}$  that of which your device is capable. This will give sufficient time for fluid to fill all of the tubing. As you notice air bubbles in the silicone tubing at different locations, shake the tubing to release the air bubbles.

## OsciFlow® Troubleshooting

### When the OsciFlow® valves are not responding

When the OsciFlow® valves do not respond, the following troubleshooting steps should be taken:

- 1) Check to be sure that the OsciFlow® is on. The red light on the front of the box should be illuminated.
- 2) Check all connections to be sure that they are intact: the DAQ Card should be fully inserted into the PCM/CIA slot on the side of the laptop, and the cable should be fully connected from the DAQ card to the back of the OsciFlow®.
- 3) Check to be sure that tubing has been inserted into the OsciFlow® pinch valves. If there is no tubing in the valves, they will not return to their "off" position and the device will appear to be malfunctioning.
- 4) Stop and restart the software. The OsciFlow® valves should click as the software is initializing. If the valves do not click, proceed with the following steps:
- 5) Open the *Operate* menu in the software and select the *Configure System* option. Be sure that the *Valves in System?* option is selected. If not, select this option and click *Return*. If the valves do not click at this point, proceed with the following steps:
- 6) Close the StreamSoft™ software so that nothing is running but the Windows® environment.
- 7) Go to the bottom right corner of the windows screen on the taskbar, and look for a small icon with a green arrow with a pop-up window labeled *Safely Remove Hardware*. Double click on this icon.
- 8) When the *Safely Remove Hardware* window appears, click on *Stop* to stop the hardware activity.
- 9) Click on *OK* to confirm.
- 10) When a pop-up window appears at the bottom right corner of the screen stating, *Safe to Remove Hardware*, push the button on the side of the laptop to remove the DAQ card.
- 11) Close the *Safely Remove Hardware* window.
- 12) Reinsert the DAQ card into the PCM/CIA slot. You should hear a sound from the computer, indicating that the card has been inserted and recognized.
- 13) Turn on the OsciFlow® and connect it to the computer.
- 14) Start the StreamSoft software. The OsciFlow® valves should click as the computer is initializing the hardware. If the valves do not click, proceed with the following steps:

- 15) With the OsciFlow® powered on and with all connections intact, open up the *Measurement & Automation* explorer from the desktop of your computer. There should be an icon for this program on the main screen of the laptop. If not, check in the list of programs under the *Start* menu.
- 16) Click the “+” sign beside the *Devices and Interfaces* folder. *The DAQCard-DIO-24 (Device 1)* should be listed.
- 17) Right click on this device and choose *Test Panel*.
- 18) A warning window will appear. Simply click *Yes* to continue on.
- 19) If a second warning window appears before the *Test Panel* appears, this means that the computer is not recognizing the OsciFlow® card. In this case, go back to step 5 and continue to this point.
- 20) Once the *Test Panel* appears, go down to the *Output Port* and change this to “0”.
- 21) Mouse click in the boxes above numbers 7, 6, 5 and 4, then click *Write Output*. At this point, two of the valves should click.
- 22) Mouse click in the same boxes again so that the check marks disappear, and click *Write Output* to release the valves to their de-energized state.
- 23) If the OsciFlow® does not respond in these conditions, the unit should be returned to Flexcell for repair.

## Warranty Information

1. **FLEXCELL INTERNATIONAL CORPORATION** warrants to the original purchaser/customer all hardware components of the **OsciFlow® System** serial # OFC-1001 for a period of **one year** from the date of delivery to the purchaser/customer to be free from manufacturing defects in workmanship or materials with the following exceptions, terms and conditions:
  - a. **ITEMS EXCLUDED FROM THE WARRANTY ARE:** software, disks, manuals and external peripherals such as printers, mouse or track ball units, imaging devices, vacuum pumps, air tanks, electric voltage converters, compressors, surge suppressers and all other accessory equipment.
  - b. **DURING THE WARRANTY PERIOD,** the purchaser/customer must notify Flexcell of any warranty claim in writing, by telephone, fax transmission or email identifying each defective part or specifically describe the exact problem no later than the last day the warranty is in effect.
  - c. **FLEXCELL AGREES** to correct any defect in workmanship or material and supply new or rebuilt parts in exchange for defective parts upon completion and submission by purchaser/customer of a printed "Parts Return Authorization" form furnished by Flexcell. Parts must be properly packed in original container and shipped to our factory service center or distributor with all shipping costs prepaid if the unit is out of warranty coverage. If the original shipping box is not available, Flexcell will send the required protective shipping container. (Flexcell will recommend the insurance value for parts or equipment to be shipped.) Return carrier shipping costs will be paid by Flexcell from the service center. The purchaser/customer is solely responsible for payment of custom fees, taxes, holding fees or value added taxes.
  - d. **THIS LIMITED WARRANTY** only covers failures due to defects in materials or workmanship which occur during normal use. It does not cover damage which occurs in shipment or failures of original equipment due to products identified as add-ons not manufactured by Flexcell International Corporation or its distributors nor does this limited warranty cover damages or failures which result from accident or disaster such as fire, explosion, flood, wind, lightning, or earthquake or misuse, abuse, neglect, mishandling, misapplication, alteration, faulty installation, modification or service by anyone other than our factory or distributor. This warranty is extended only to the original purchaser/customer unless a transfer of ownership is approved by Flexcell in writing.
  - e. **LIMITED LIABILITY.** Flexcell or its distributor's only liability shall be to remedy any defect to comply with its warranty and return the repaired equipment to function as designed. Under no circumstances shall Flexcell or its distributors be liable for any special incidental or consequential damages based upon breach of warranty or contract or negligence. Such damages include, but are not limited to: loss of profits, revenue, loss of data, down time, customer's material or time.
  - f. **DISCLAIMER OF WARRANTIES:** The Limited Warranty expressed in the foregoing language is the only warranty applicable to this product. Any other warranty, expressed or implied warranty or of merchantability or fitness for a particular purpose are hereby disclaimed. No oral or written information or advice provided by Flexcell, through its agents or employees, in the use and functioning of the equipment shall in any way create a warranty or in anyway increase the scope of this limited warranty.
  - g. **DISCLAIMER: LANGUAGE.** This warranty document, accompanying instruction manual and supplemental applicable laws appear in the English language. In the event of any inconsistency in the meaning of the words and terminology and any foreign language translation, the English language shall prevail.
  
2. **GOVERNING LAW.** The performance of the duties and liabilities of the parties under the terms and conditions of this Limited Warranty shall be governed in all respects by the laws of the Commonwealth of Pennsylvania, the United States of America.
 

APPLICATION OF STATE LAWS: Some states do not allow the exclusion or limitation of consequential damages nor do some states allow limitations on how long an implied warranty lasts, so the above limitations may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.
  
3. **INTERNATIONAL CUSTOMERS.** The full text of the foregoing limited warranty and all disclaimers is applicable to international customers/purchasers except when the purchase was made from an international distributor or reseller, the warranty will be covered through your distributor or reseller.

If technical advisory support service is not available through your distributor or reseller, for service contact warranty headquarters by phone or fax.

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**NOTICE**

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