SCAL Program Guide

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Program Overview

The SCAL Program is designed to be a versatile program capable of controlling a large variety of experiments. This document is meant to help new users learn how to navigate, setup, and control the SCAL Program easily. Many of the controls and indicators in the program have descriptions and tips associated with them. If you are ever unsure of what a control does or what a setting should be, hover the mouse over it for a few seconds to see its tip. You can also right click the control or indicator to access a more detailed description.

Capabilities Include:

- Recording data from up to 5 transducers or flow meters
- Recording data from up to ISCO pumps
- Sending commands to pumps from the GUI
- Automatically maintaining a desired net stress
- Automatically executing predefined stress changes
- Calculating permeability/fracture conductivity in real-time

Program Setup

Start setting up the program by clicking the "Settings" menu on the menu bar.
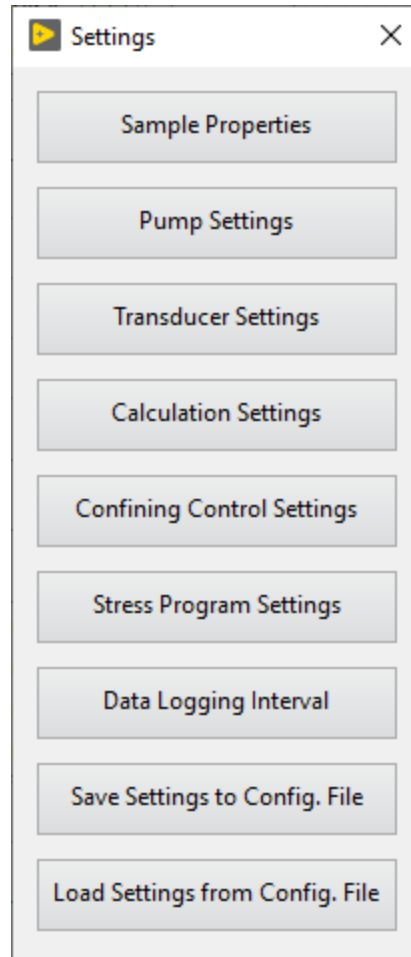
The settings menu is broken up into seven sections. If this is the first time the SCAL Program has been setup on this computer or if you are setting up a new type of experiment with a different configuration, open each settings menu and adjust the settings accordingly.

Sample Properties

The sample properties menu is where you will enter experiment and sample specific information. This information will be stored as a header in the top of the data log. The length, diameter, and viscosity are also used by the program to calculate permeability or fracture conductivity.

Pump Settings

The pump settings menu allows you to configure communication settings for up to four ISCO pumps.

Assign each pump a specific name such as "Flow pump" or "Confining pump". This name will be used in the headers of the data log and for graphing purposes. If you are using a pump to control confining pressure, it must be set up as pump 4 to have access to the additional confining control and stress program features.

Select "Single" for the pump type for single ISCO pumps and "Dual" if you are using a dual continuous flow delivery system. The pump ID can be left as pump A for single pumps unless it is plugged into a different port on the controller. If you are using a continuous flow delivery system and you want to be able to record both the continuous volume and flow rate while also recording the volumes and rates for the individual pumps, you can use the same serial port for multiple settings clusters and change the pump type and pump ID accordingly (see example below).

Change the serial port value to match the COM port the pump is currently using. You can determine this by opening the computers device manager and selecting Ports (COM &LPT). COM 1 and COM 3 are typically already used by the computer. The Baud Rate and Controller ID won't usually need to be changed and can be left as their default values (9600 and 6).

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Transducer Settings

The transducer settings menu allows you to configure communication settings for up to five transducers.
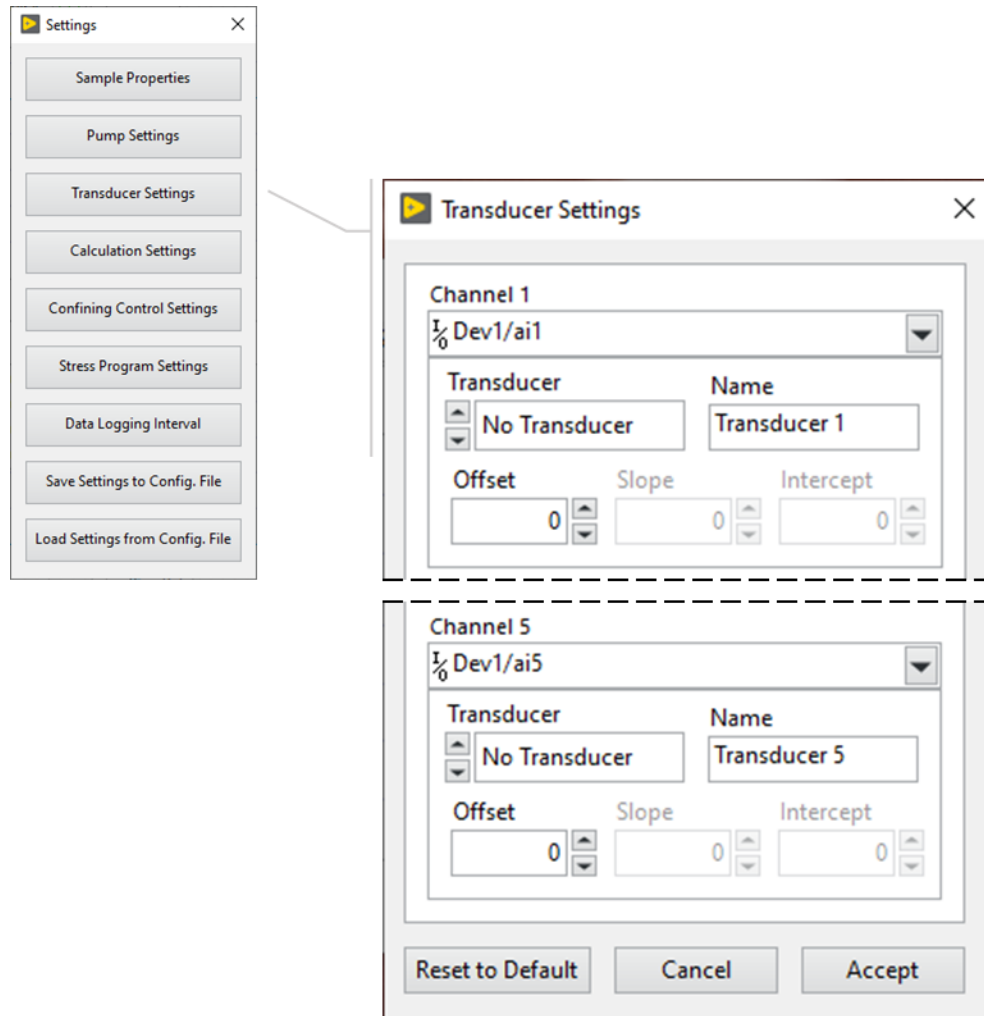
Before adjusting the transducer settings, it is important to make sure the transducers are properly connected to the DAQ and computer. You can easily connect and disconnect transducers using one of SCAL's DAQs (provided you have the correct cable). Most National Instruments DAQ will also work with the SCAL Program.

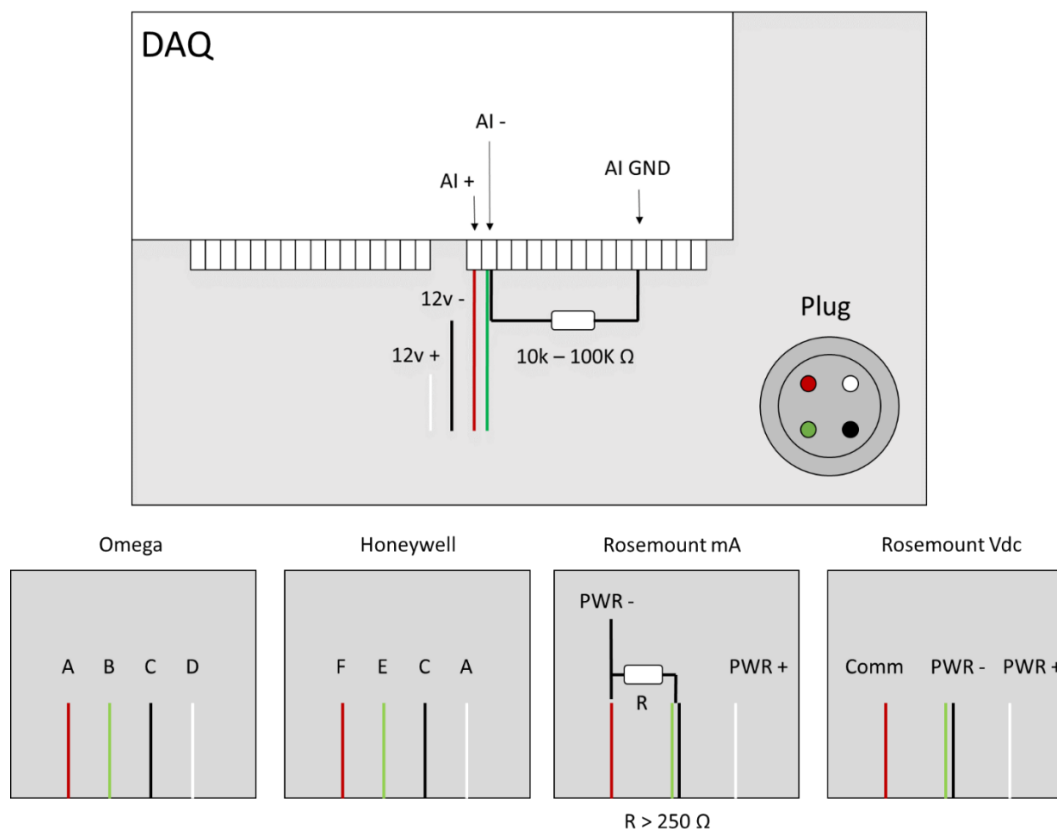If the transducer you are using does not have a cable, follow the schematic below to create one.

Once the transducers are connected to the DAQ, plug the DAQ into the computer. The computer will automatically recognized the device and you will be able to select the device channels in the channel dropdown menu. It is important to note that transducers cannot share a channel. Even if a channel is going unused, it must be set to a different channel than the rest. If this is the first time using this DAQ, all channels must be changed to reflect the new device number or else the communication will fail to initialize. From left to right on the SCAL DAQ, channels are ordered from channel 1 to channel 5.

Click the transducer dropdown to select the transducer serial number. The calibrations for most SCAL transducers are preprogrammed into the SCAL program. If you are using a transducer that does not appear on the list, select the unlisted transducer that corresponds with the channel. This will then allow you to enter your own slope and intercept for the transducer. Gas flow meters can also be connected to the DAQ and selected as flow meters in the dropdown.

During setup, the offset can be left as zero. During experimental setup, you may find that your transducers do not read exactly zero when they should. This is when you can return to the transducer settings menu and adjust the offest to compensate for any drift.

Calculation Settings

The calculation settings menu is designed to allow you to configure the SCAL Program to calculate either permeability or fracture conductivity in real time based on the experimental setup. This calculation will be stored in the data log and available for plotting.
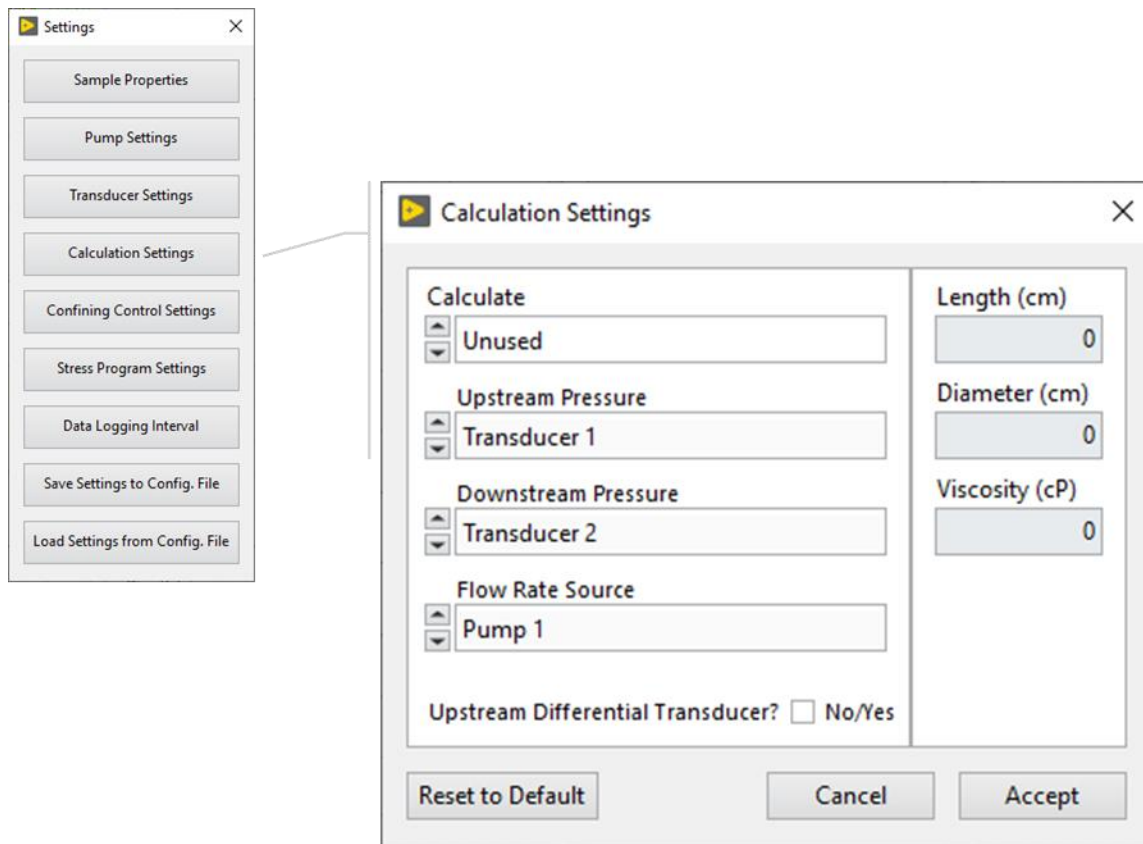
From the drop down menus, select which parameter you want to calculate, what transducer or pump you want to use as the upstream source, downstream source, and flow source, and check the checkbox if you are using a differential transducer as an upstream source. The indicators on the right will display the length, diameter, and viscosity entered into the sample properties menu that will be used in the calculation.

Confining Control Settings

The confining control settings menu allows the user to specify how the confining pump should calculate and maintain the desired net stress while active.
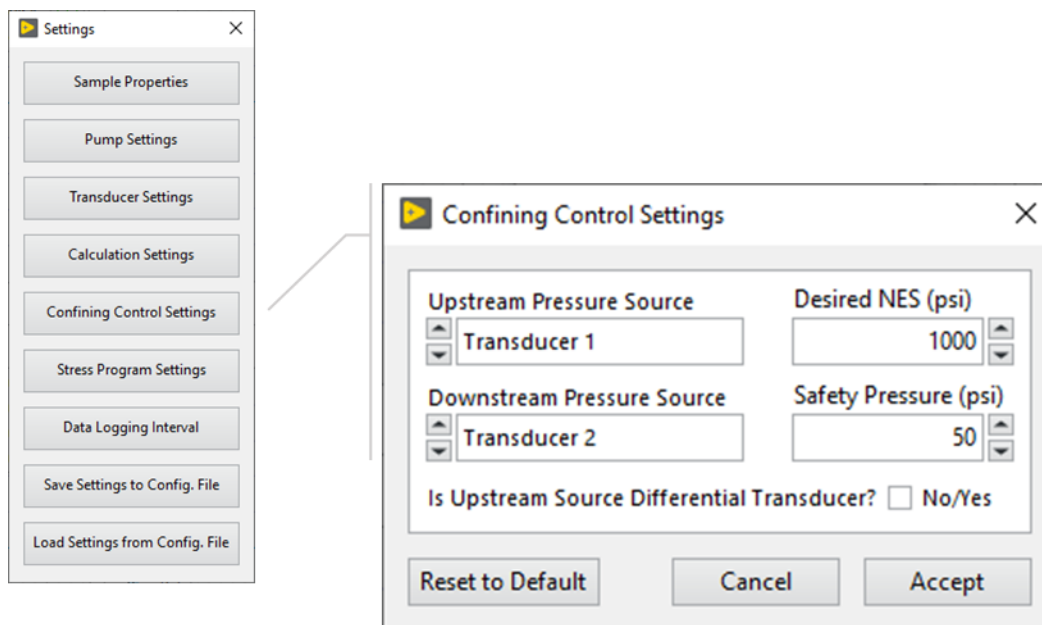

Choose which transducer or pump you want to use for upstream and downstream pressure sources from the dropdown menus. Check the checkbox if the upstream pressure source is a differential transducer. Enter the net effective stress you want the program to maintain in the "Desired NES" control. The safety pressure is how much pressure the program is allowed to drop in one second before the program overrides the confining control calculation and maintains its current pressure. This feature is designed to prevent the program from rapidly decreasing the confining pressure if a leak occurs in the system or a pressure source malfunctions. The default safety pressure is 50 psi and usually won't need to be adjusted.

NOTE: These settings will only be applied to pump 4 and is why pump 4 data cannot be used in the calculations.

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Stress Program Settings

The stress program settings menu is where an automated confining stress program can be created for pump 4.
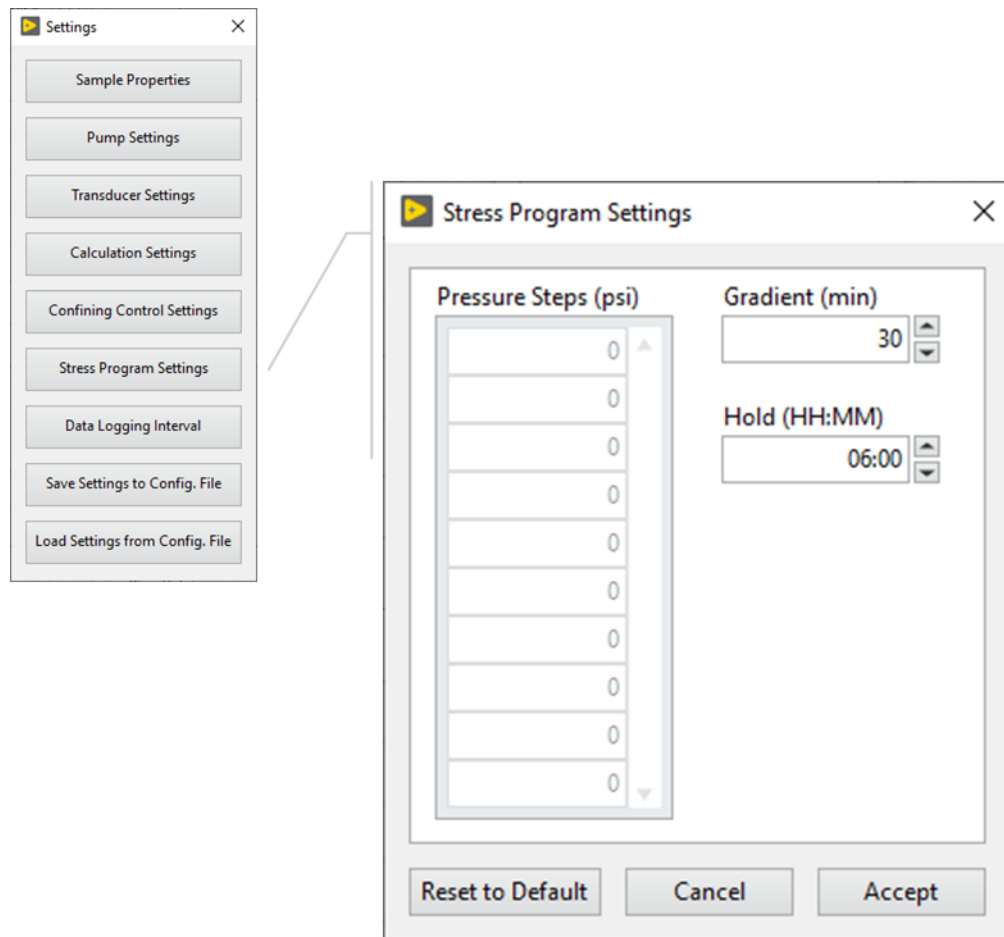
Enter the pressures you want the program to generate in the "Pressure Steps" control and the time you want to hold at that pressure into the "Hold" control. The gradient time is the time you want the program to take to go from one pressure step to the next (longer times result in more gradual transitions).

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Data Logging Interval

The menu allows you to set the frequency that the program will add data to the log (in seconds).

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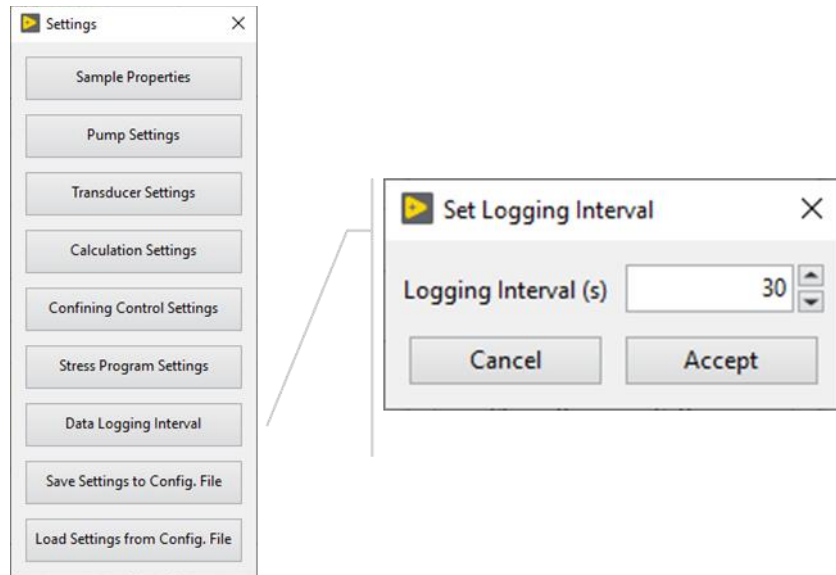
Save/Load Settings

When the SCAL Program is closed and reopened, it will automatically revert to its default settings, so it is important to always save your settings before closing the program. Once all the settings have been entered, click the "Save Settings to Config. File" in the settings menu. This will store all program settings on the computer as an XML file. Next time you open the program, you can click the "Load Settings from Config. File" button to immediately load your saved settings from the configuration file.

Activating Communications

Once setup is complete and your settings have been saved, it is time to activate the communications between the program and the instruments. Click on "Active Data Sources" and select the instrument you want to begin communicating with. Once you have selected the source, provided no errors occur, data will begin to appear in the graphs and indicators. A check mark will also appear next to the data source to show that the program is currently communicating. If an error has occurred and no data is being displayed, deactivate the data stream and check your settings again.

Data Logging

       Once the program is setup and you are ready to start logging data, click the "Data Logging" menu and select "Start Logging Data". The program will prompt you to choose where you would like to store the data log and then begin logging. When you would like to view the logged data, select "View Logged Data" from the "Data Logging" menu. A new window will appear, and you can load any data log by clicking "Load Data" and selecting the file you would like to view. If you would like to add comments to the log during an experiment, select the "Add Comment to Data Log" option from the "Data Logging" menu. The comment will be added as a single line entry the next time the program logs a line of data.

Pump Controls

Click the "Pump Controls" menu to send commands to any ISCO pump.
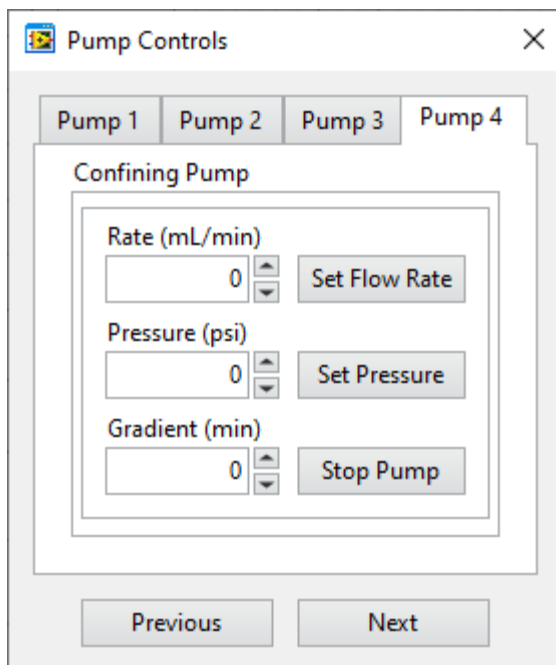
The pump commands have the following behavior:

Set Flow Rate: This command briefly stops the pump, tells the pump to switch to constant flow mode, sets the flow rate to the value in the Rate control, and then begins running the pump at that rate.

Set Pressure: If Gradient is set to 0 minutes, this command briefly stops the pump, tells the pump to switch to constant pressure mode, sets the pressure to the value in the Pressure control, and the begins running the pump at that pressure.

If Gradient is set to anything greater than 0 minutes, this command briefly stops the pump, tells the pump to switch to constant pressure mode, calculates increments that will take the pump pressure from the current pressure to the value in the pressure control over the time specified in the Gradient control, and then begins running the pump at the first pressure increment (updating the pressure each second).

Stop Pump: This command stops the pump.

Pump 4 has additional controls because it is designated to use as a confining pump. Click the Next or Previous Button to cycle through the controls.
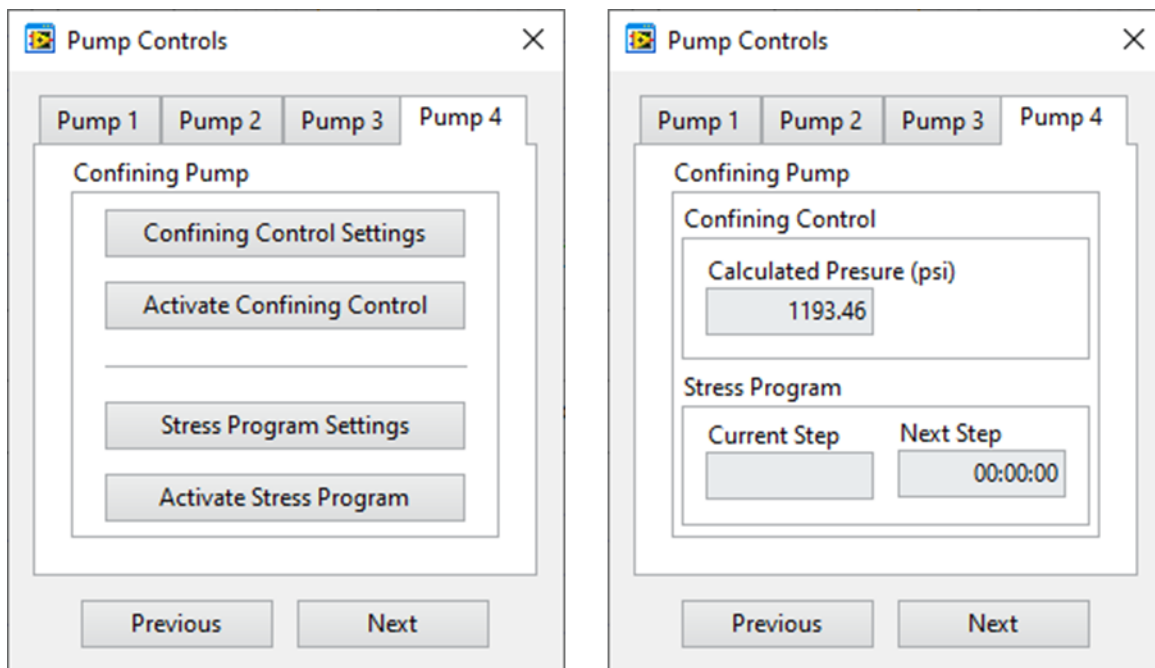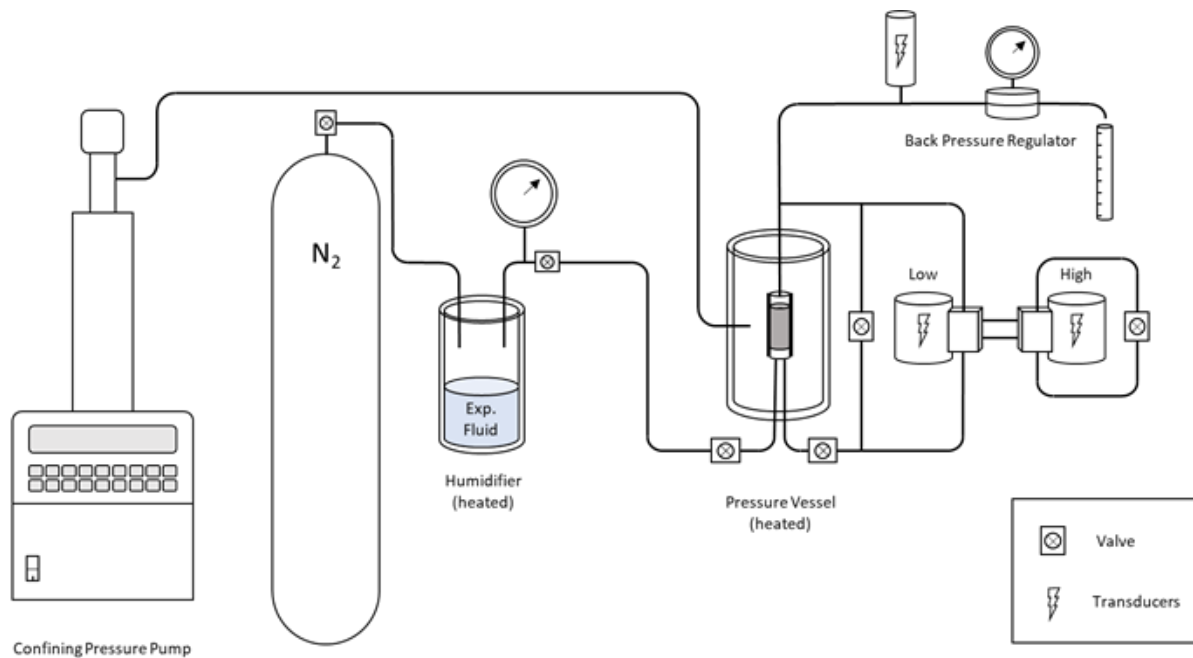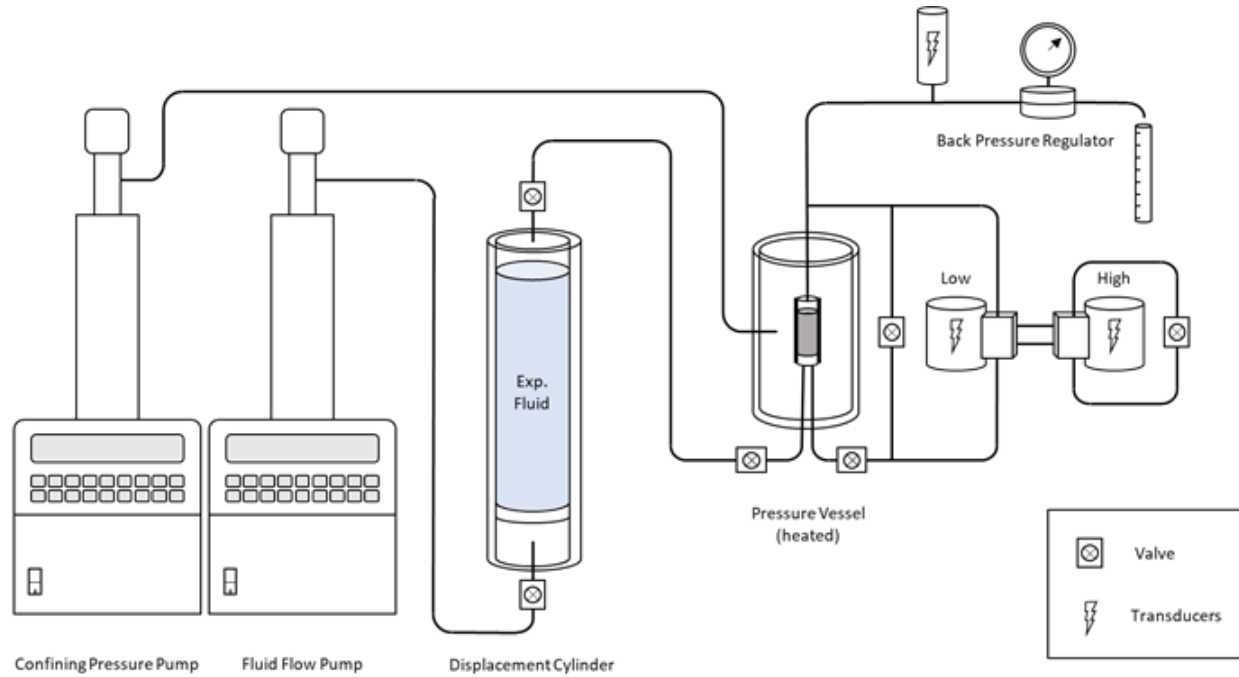

You can access the confining control and stress program settings from the pump 4 controls window. On the indicator page, you can view the calculated confining control value that will be applied once activated. It's always a good idea to check your settings and indicators before activating the confining control as the pressure will be applied instantly with no gradient. The indicator page also includes indicators to show how many steps are left in the stress program and how long until the next step.
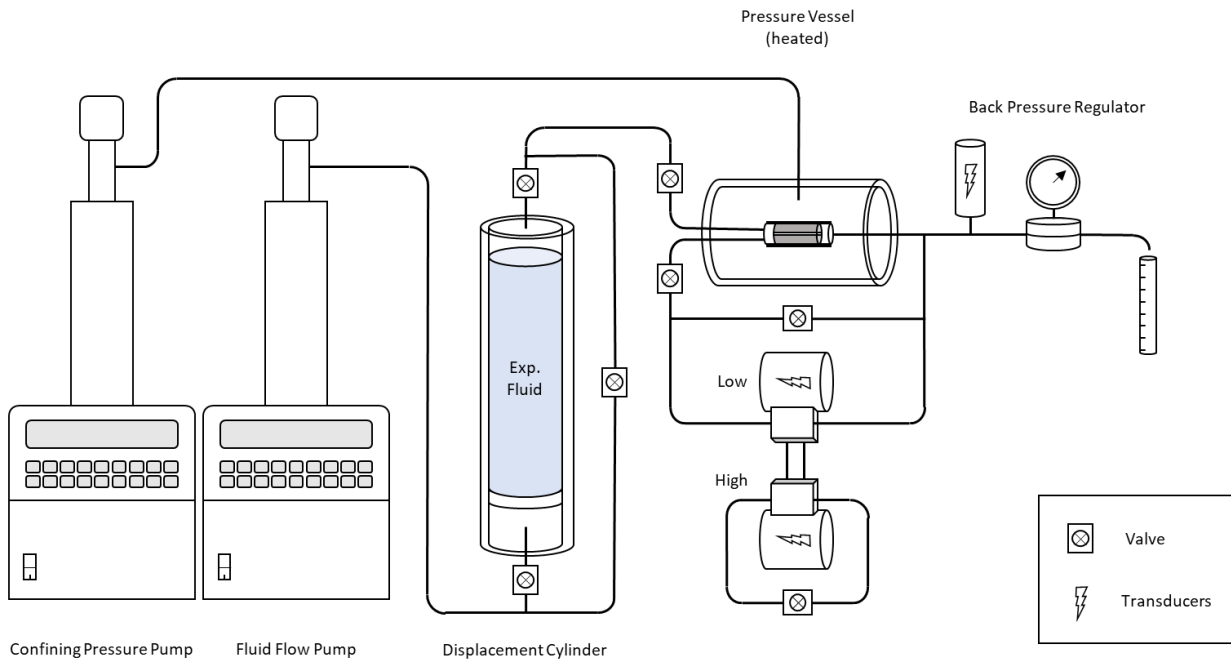
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Schematics

These schematics are meant to serve as examples and are not the definitive guide to setting up experiments.

Relative Permeability

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Fracture Conductivity