ChemTec II

Programmable Metering Pump

Installation, Operating & Maintenance Instructions

Parker

ENGINEERING YOUR SUCCESS.

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Table of Contents

Revision History:

Revision:	Description:	Author:
A	Initial Release	Arthur Dawson
B	Formatting Changes	Arthur Dawson

Precautions

READ this manual BEFORE operating or servicing this equipment.
FOLLOW these instructions carefully.
SAVE this manual for future reference.
DO NOT allow untrained personnel to operate, clean, inspect, service or tamper with this equipment.
ALWAYS DISCONNECT this equipment from the power source before cleaning or performing maintenance.
CALL Parker Customer Service for parts, information and service.

	⚠ WARNING
	DISCONNECT ALL POWER TO THIS UNIT BEFORE INSTALLING, SERVICING, CLEANING OR REMOVING THE FUSE. FAILURE TO DO SO COULD RESULT IN BODILY HARM AND/OR PROPERTY DAMAGE.
	⚠ CAUTION
	OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES.
	⚠ WARNING
	ONLY PERMIT QUALIFIED PERSONNEL TO SERVICE THIS EQUIPMENT. EXERCISE CARE WHEN MAKING CHECKS, TEST AND ADJUSTMENTS THAT MUST BE MADE WITH POWER ON. FAILING TO OBSERVE THESE PRECAUTIONS CAN RESULT IN BODILY HARM.
	⚠ WARNING
	FOR CONTINUED PROTECTION AGAINST SHOCK HAZARD, CONNECT TO PROPERLY GROUNDED OUTLET ONLY. DO NOT REMOVE THE GROUND PRONG.

If the power cord is lost or damaged, contact Customer Service to obtain a new one. Do not replace it on your own.

Précautions

LISEZ ce manuel AVANT de faire fonctionner ou d'entretenir cet équipement.
SUIVEZ attentivement ces instructions.
CONSERVEZ ce manuel pour future référence.
NE LAISSEZ PAS du personnel non qualifié utiliser, nettoyer, inspecter, entretenir, réparer ou manipuler cet équipement.
DÉBRANCHEZ TOUJOURS cet équipement de la source de courant avant de nettoyer ou d'exécuter l'entretien.
APPELEZ PARKER pour pièces détachées, renseignements et entretien.

	⚠ ATTENTION DÉBRANCHEZ TOUT COURANT DE CETTE UNITÉ AVANT DE FAIRE L'INSTALLATION, D'EFFECTUER L'ENTRETIEN, LE NETTOYAGE OU AVANT DE RETIRER LE FUSIBLE. NE PAS OBSERVER CES PRÉCAUTIONS RISQUERAIT DE CAUSER DES BLESSURES CORPORELLES OU/ET D'ENDOMMAGER L'ÉQUIPEMENT.
	⚠ PRUDENCE SOYEZ PRUDENT LORSQUE VOUS MANIPULEZ DES APPAREILS SENSIBLES À L'ÉLECTROSTATIQUE.
	⚠ ATTENTION AUTORISEZ SEULEMENT LE PERSONNEL QUALIFIÉ À ENTRETENIR CET ÉQUIPEMENT. SOYEZ PRUDENT LROSQUE DES VÉRIFICATIONS, TESTS ET AJUSTEMENTS DOIVENT ÊTRE EFFECTUÉS SOUS TENSIONS. NE PAS OBSERVER CES PRÉCAUTIONS RISQUERAIT DE CAUSER DES BLESSURES CORPORELLES.
	⚠ ATTENTION POUR ASSURER UNE PROTECTION CONTINUE CONTRE UNE DÉCHARGE ÉLECTRIQUE, BRANCHEZ UNIQUEMENT SUR UNE PRISE CORRECTEMENT RELIÉE Á LA TERRE. NE RETIREZ PAS LA FICHE DE TERRE.

SI le cordon d'alimentation est perdu ou endommagé, contactez le service clientèle pour en obtenir un nouveau. Ne le remplacez pas par vous-même.

Installation & Start-Up

Installation of the ChemTec II must be carried out only by trained personnel in accordance with the relevant regulations and this operations manual.

Make sure that the technical specifications and input ratings of the ChemTec II are observed. See “ChemTec II Specifications”.

The protection provided by this equipment may be impaired if the ChemTec II is used in a manner inconsistent with this manual or for purposes not specified by the manufacturer.

Maintenance & Cleaning

The ChemTec II is minimal maintenance. The Tandem peristaltic pump head should periodically have tubing debris cleaned from it, but requires no lubrication.

To remove dust, dirt and stains, the outer surfaces of the ChemTec II may be wiped down using a soft, non-fluffing cloth moistened with water. If required, you may also use a mild detergent or Isopropanol.

The SciPres II disposable sensors used with the system come pre-calibrated from the factory and require no maintenance. The SciPres II disposable sensors may be sanitized with 0.1 Molar NaOH, or Isopropanol. They may be autoclaved once.

Introduction

You will find the ChemTec II easy to setup and use for your metering and pH control needs. The state-of-the-art hardware and software design of the ChemTec II allows you to control measure and document your metering processes. With proper maintenance, the ChemTec II will provide many years of excellent service and performance.

Please read the following instructions carefully!

Inspections: Remove the products carefully from the shipping container. Check the contents against the purchase order to verify that all parts are included and undamaged.

Please do the inspection upon receipt of the product, even if you don't intend to use it immediately. Many carriers must receive damage claims within 7 days of delivery. Please retain all packing material so unit may be shipped safely, if necessary.
If assistance is required, please contact us at:

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Bioscience Filtration
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Oxnard, California, USA 93030
toll free: 877 784 2234
phone: +1 805 604 3400
fax: +1 805 604 3401
bwf.oxn.support@support.parker.com
www.parker.com/bioscience

Parker Hannifin Manufacturing Ltd
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Durham Road
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DH3 2SF, England
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fax +44 (0)191 4105312
befe.birtley.support@support.parker.com
www.parker.com/bioscience

Parker customer service will be able to serve you more efficiently if you have the following information:

- Serial number and model name of the equipment
- Installation procedure being used
- Concise list of symptoms
- List of operating procedures and conditions in use when problem arose

Warranty

Country specific information can be found at: www.parker.com/termsandconditions.

ChemTec II Maintenance

Factory based preventative maintenance is recommended on an annual basis.

Contact your local Parker Sales Representative or Parker Technical Support to obtain a quote for this process or go to https://solutions.parker.com/service and fill out the online form.

ChemTec II Specifications

MECHANICAL

- Dimensions: Width: 9.5 in. (24.1cm); Height: 11.5 in. (29.2cm); Depth: 13.4 in. (34cm)
- Weight: 16.2 lbs. (7.34kg)
- Enclosure: Aluminum / Steel; Corrosion Resistant
- Accommodates a range of motor / pump heads combinations, including:
  - Peristaltic pump heads, TANDEM model 1081 and 1082, either with 8, 160, or 600 RPM motors.
  - Piston pump heads, FMI model RH1, RH0 or RH00, either with 160, 600 or 3400 RPM motors.
  - Magnetic gear pump heads, Micropump models 040, 120, 184, 187, 200 & 201, with 3400 RPM motors.
- Pressure Sensors: Accommodates three SciPres II Disposable pressure sensors using the P1, P2 and P3 ports. Pressure is used for monitoring and alarms. Pressure Displayed with a resolution of 0.1 psi; choice of psi, bar, kpa.
- Pressure Range: The default pressure range of the sensors is 0-60psi. Most peristaltic pumps generate pressures up to 30 psi. If you have need for higher pressures, contact Parker Technical Support (bioscienceNA.TS@parker.com) for assistance.

ELECTRICAL

- Power: 100-240 V~, 50/60 Hz, 150 VA, Class 2 switching power supply; fuse: 3.15A-T20, 250V
- Battery: CR1632, used to support the internal clock only, not user serviceable.
- Motor: Choice of four motors: 8, 160, 600 and 3400 RPM at 24V ⎓, 3.8 Amperes, Variable Pump Speed optically encoded, servo-controlled motors.
- Encoder: 100 lines/rev. for 600-RPM motor. 120 lines per/rev. for all other motors.
- I/O Ports:
  - “Printer”, Female DB9 connector for data collection with Printer or PC.
  - “S1”, “S2”, “S3”, Male DB9 connectors for RS-232 connection to an electronic scale.
  - “P1, P2, P3”, Amphenol connectors for SciPres II disposable Pressure Sensors.
  - “ANALOG”, Female DB25 for up to 8 Analog (4-20 mA) inputs and 4 Analog outputs.
  - “DIGITAL”, Female DB25 for 8 TTL Digital Outputs and 8 TTL Digital Inputs.
  - “PROFIBUS” Female DB9 for Profibus communication. Disabled
  - “CAN IN” Male DB9 for CAN communication input. Disabled
  - “CAN OUT” Male DB9 for CAN communication output. Disabled
  - “USB1, USB2, USB3”, USB connectors, used for storage and retrieval of recipes.
  - “Ethernet”, RJ-45 connector. Disabled
  - “RELAY1”, “RELAY2” Six 250 V, 8A NO relays, three on each connector.

ENVIRONMENTAL

- Temperature range: 4 to 40° C.
- Altitude: up to 2000 Meters
- Indoor, dry environments only, clean-up is wipe down only. (IP 20)
- Relative humidity: 0-95%
- Voltage fluctuations +/- 10%
- Pollution degree: 2

ChemTec II Software

The ChemTec II is recipe driven. You can create recipes for the following processes:

- Volume Flow: Programmable volumetric metering.
- Mass Flow: Programmable gravimetric metering, which requires an electronic balance.
- Diafiltration: Maintains weight of monitored vessel and requires an electronic balance. Can be additive or subtractive.
- pH Control: Provides control of pH Maintenance and/or End Point Titration via connection to pH meter with 4-20 ma output.

The ChemTec II can be controlled also in Manual Mode by % of motor speed. The end user can configure Pump settings and Alarms.

Installation of the USB Driver

Upon connecting the ChemTec II to the PC via the provided RS232 to USB adapter cable on the Printer Port of the ChemTec II, open Control Panel, then Device Manager on your PC.

The listing for the cable will have a yellow triangle on it indicating that the driver was not properly loaded. You must have Administrative rights to your computer to fix this, as one must double-click on that listing and then choose “Update Driver”. Allow the computer to search the internet for the driver and it will successfully find and install it.

Once this is done, disconnect the cable from the computer and reinstall it. This will refresh Device Manager, and it will now be listed as a “USB Serial Port” with an assigned COM Port.

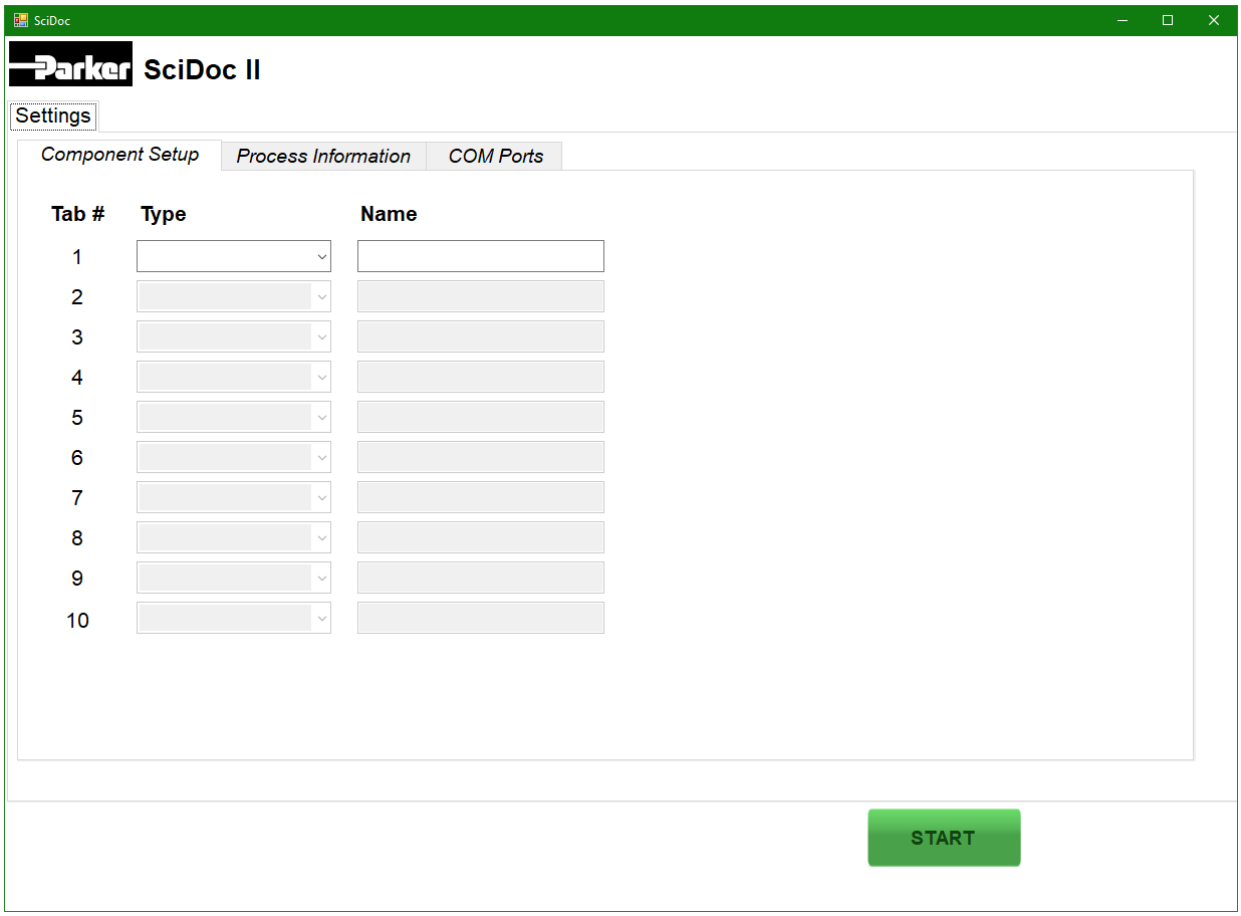
If you provide your own adapter, follow its instructions for installation.

Installation of Documentation Software (SciDoc II) for PC

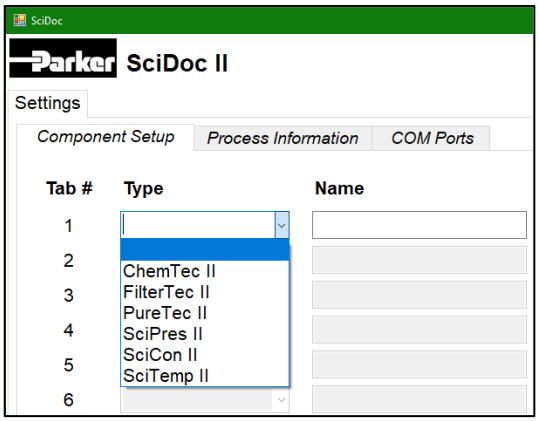
SciDoc II Software Package provides complete process analysis with graphing of data, and real-time verification and documentation of process parameters.

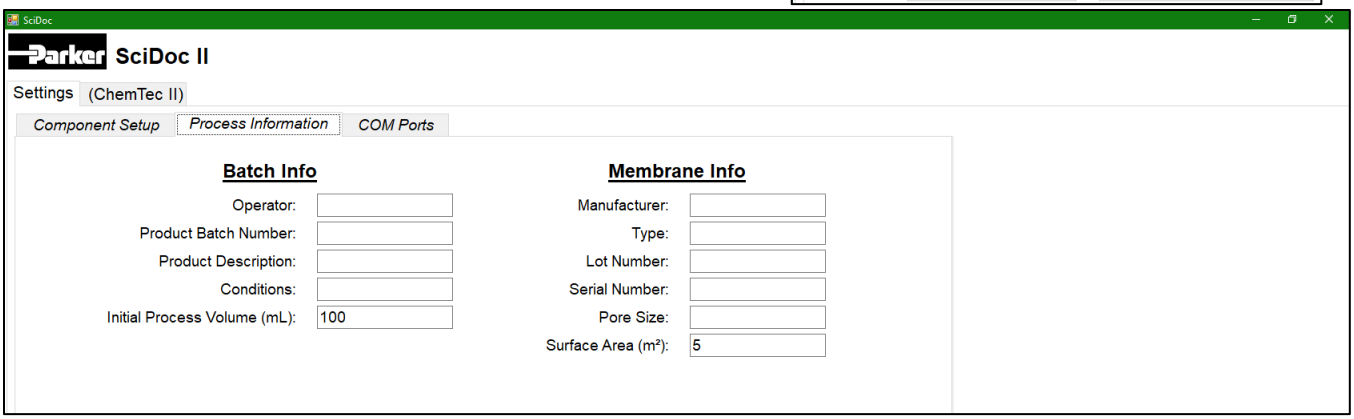
SciDoc II Software Installation

- Go to https://discover.parker.com/lab-system-support and download the SciDoc II file
- Extract the files to your chosen location and run Setup.exe to install it.
- Plug in the pump and connect the USB cable to the PC.
- Go to START – All programs
- In the SciDoc folder on your PC, click on SciDoc to launch the program
- The following screen is displayed for the initial configuration of the data collection.

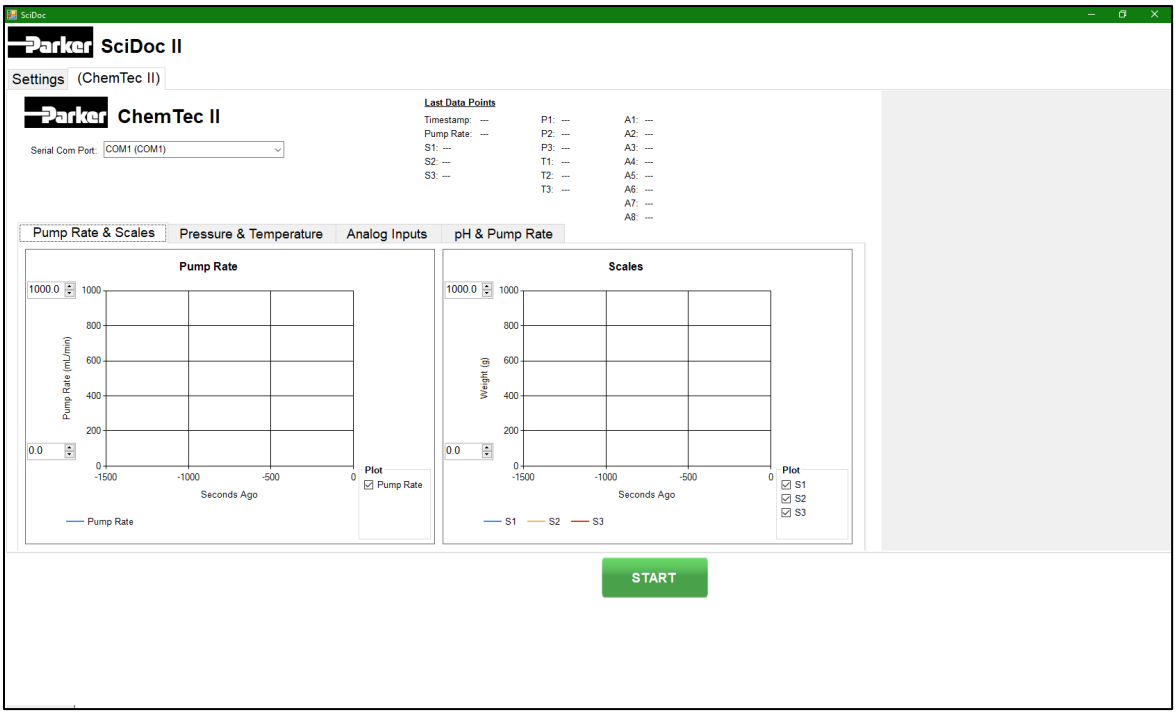


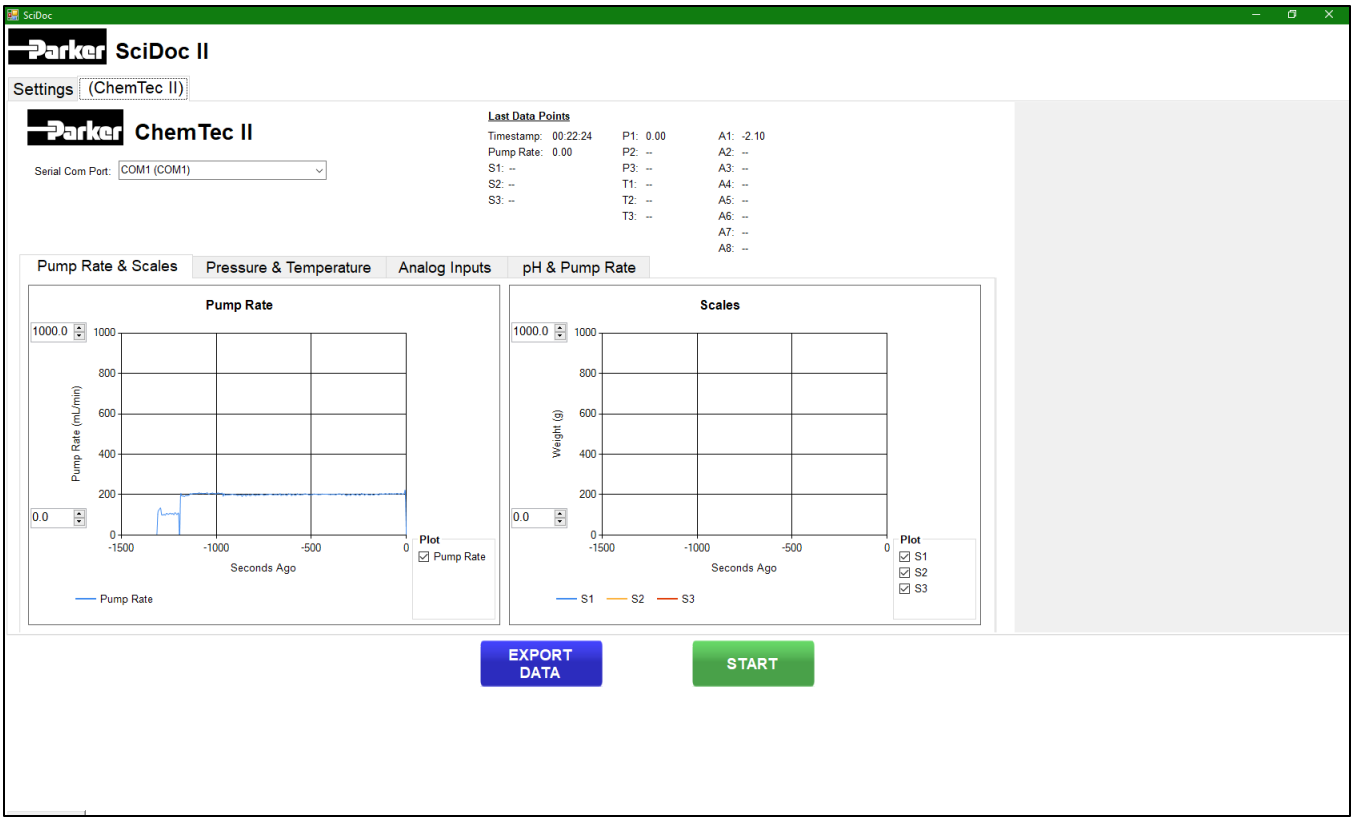
- Choose the Type of equipment from the list you are gathering data from (up to 10 may be collected from at the same time on one computer)
- Give each one an alternate name if you wish.
- Click on the **ADD** button to create a tab for each.
- Click on the Process Information tab and fill this form out as desired.
- Click on the Com Ports tab to provide alternate names to them as desired for ease of identification.



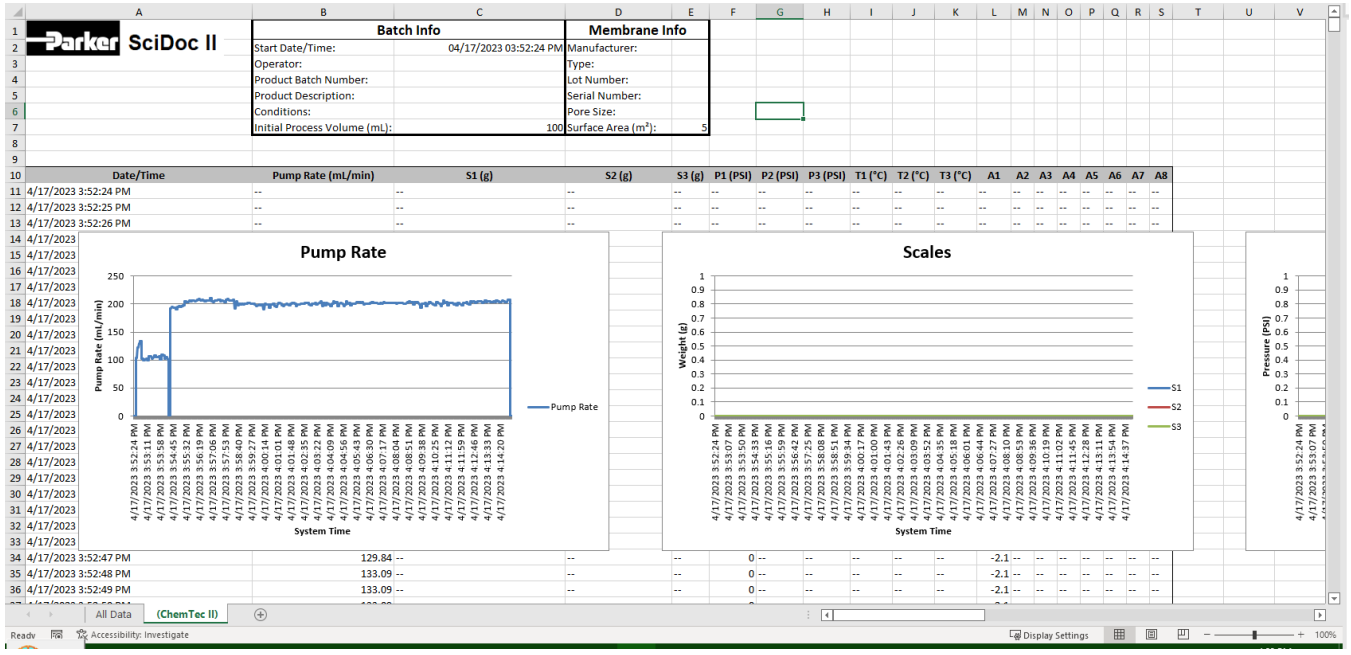


Click on the ChemTec II tab and choose the detected / assigned COM Port. Click on Start on the software, then the ChemTec II will automatically start sending data to SciDoc when any recipe is executed and ran. After pressing START, a red STOP button appears for use when your run is complete.





Once complete, press the EXPORT DATA button. This will generate a 21CFR11 compliant spreadsheet for your use. A browse window will allow you to choose where the file is stored, and a default file name based on current date and time is assumed unless you change it. The file will look similar to this:



Start-up: Volume Flow Metering into a Bioreactor

EQUIPMENT
The following items are needed to get started:

Parker P/N	Description	Quantity
CHEM2-21	ChemTec II, CP-120 w/ 1081 Tandem Peristaltic Head, 160rpm Motor	1 pc
400-116	Silicone Tubing, Platinum Cured, #16	25 ft (1 pkg)
080-USB	RS232 to USB Cable	1 pc
	SciDoc II Data Collection Software	Included
N/A	Appropriate Media Reservoir	1 pc
N/A	Appropriate Bioreactor or Fermentor	1 pc

Hardware Setup

1. Unpack all the components, visually identify and inspect for damage.
2. At the bench, place the Media reservoir to the far left. To the right of the bench, position ChemTec II, and then the Bioreactor or Fermentor. Leave space between these items to allow for cables and tubing.
3. Connect the RS232 to USB cable between the PC and the “Printer” connector on the rear of the ChemTec II. This cable may need a driver installed from the internet, contact your IT person if help is needed.
4. Plug in and power-up all the equipment.
5. Install SciDoc II software from https://discover.parker.com/lab-system-support. Choose the ChemTec II from the menu, select the appropriate COM Port, and it will be ready to receive data from the pump.
6. If the ChemTec II and scale were purchased together from Parker, both will be configured to communicate with each other. If purchased separately, contact Parker support for assistance.
7. Cut an appropriate length of the #16 tubing and connect it to the Media reservoir. Route the tubing from the reservoir to the ChemTec II, open the head by rotating the lever 180 degrees counterclockwise, and place the tubing over the upper set of rollers. Confirm that the tubing is under the centering springs and close the head by rotating the lever back to its original position. Connect the remaining end to the Bioreactor.

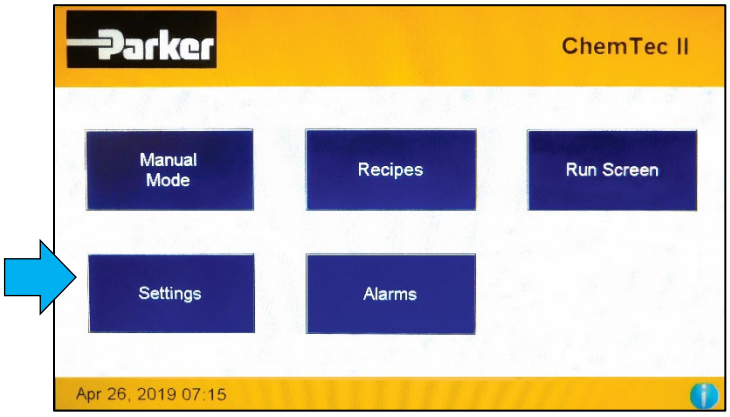
This completes the hardware and tubing configuration.

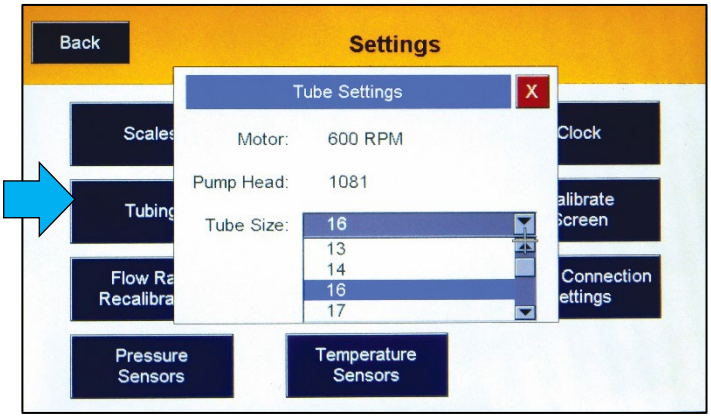
PROGRAM EDITING AND EXECUTION
At this point, please consider the parameters of the reaction being fed and determine the type of metering needed. This can be done at a constant rate, a linear rate, or an exponential rate by using several short linear ramps. A selection of user-definable alarms may be utilized to monitor the process, solution, or reactor weights if balances are connected to monitor them and the measured pressure for one to three of the connected pressures. All the alarms may be disabled or enabled and set to interlock and even provide an audible alarm.

Volume Flow Programming

From the main screen:

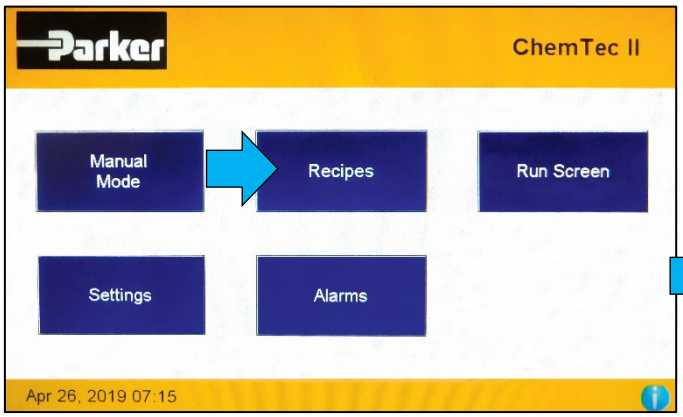
- Choose SETTINGS
- Select TUBING
- Confirm Motor RPM and head in the Tube Settings
- Select the TUBE SIZE from the drop down, press SET

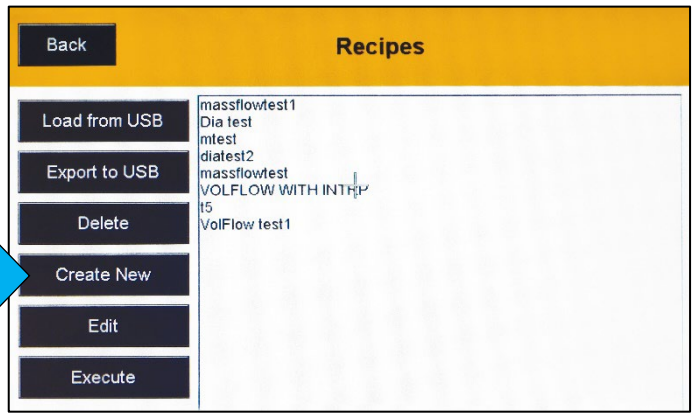


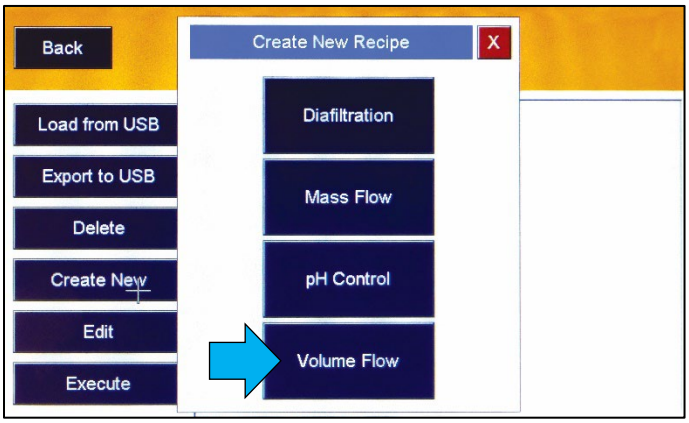


Steps to enter a Volume Flow Recipe:

- Return to the main screen
- Select the RECIPES button
- Choose an existing recipe, or click on CREATE NEW (For this Quick Start, click on CREATE NEW)
- Click VOLUME FLOW



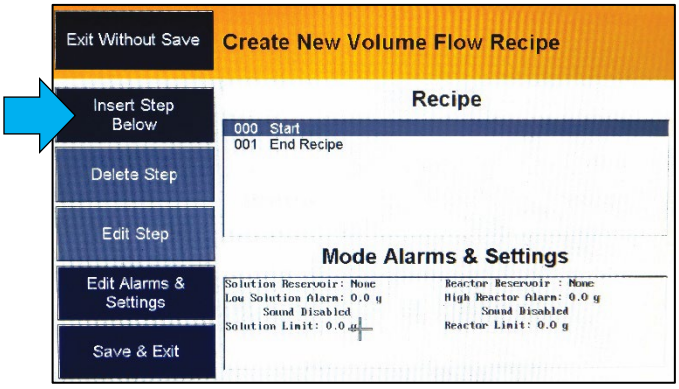


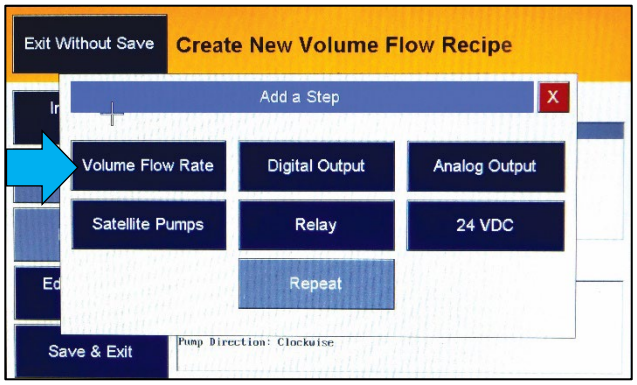


New Volume Flow Recipe screen:

This screen allows you to add new steps and/or edit and delete existing steps; access process alarms for editing and settings; Exit without a save or save and exit for prompts to save the recipe name. (The recipe name is limited to upper- and lower-case letters, numbers and dashes).

- Select INSERT STEP BELOW to get started
- Press VOLUME FLOW RATE

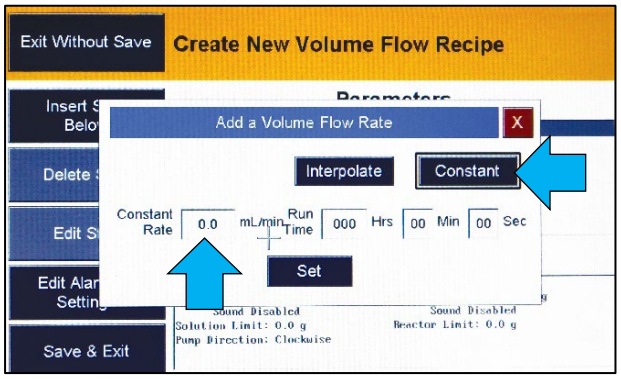


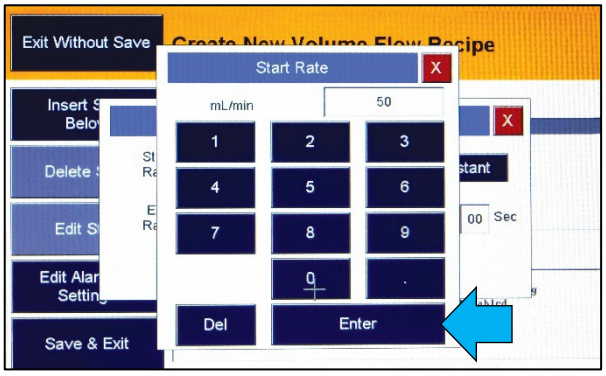


NOTE: 'Start' and 'End' parameters are always listed and cannot be edited or deleted. Steps cannot be inserted below 'End'.

<u>Configure a Volume Flow Rate & Time Step:</u>

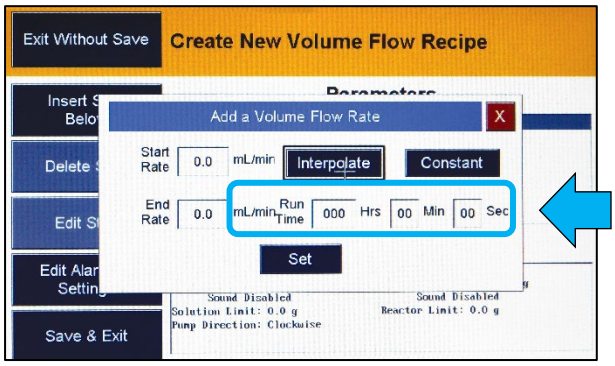
- Choose CONSTANT or INTERPOLATE
  (An interpolated rate will ramp up from an initial rate to the new rate over the set time interval)
- Select the RATE field, enter desired flow rate, and ENTER

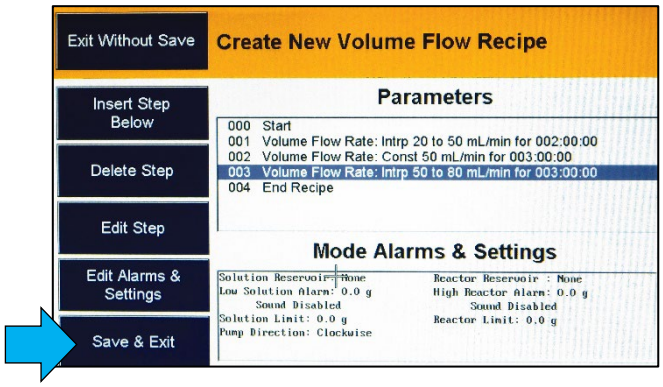




Set a time for the step:

- Click in the RUN TIME field, then enter time in hours, minutes and seconds
- Select SET to add your new Volume Flow Rate Step to the recipe
- Click SAVE AND EXIT

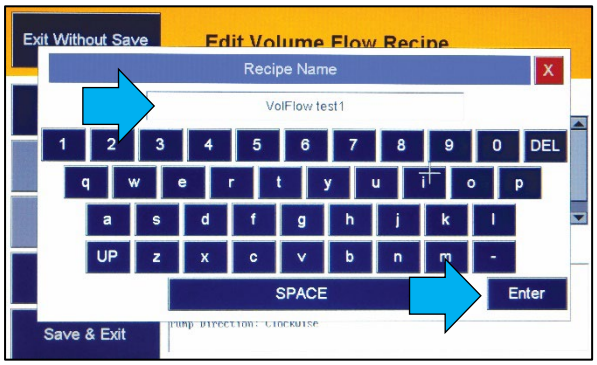


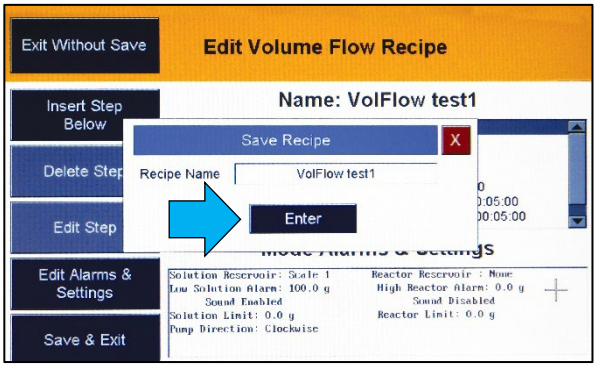


NOTE: The above recipe is incorrect as it does not start with a step flow rate. Highlight any of the steps and edit or delete as needed.

Name recipe:

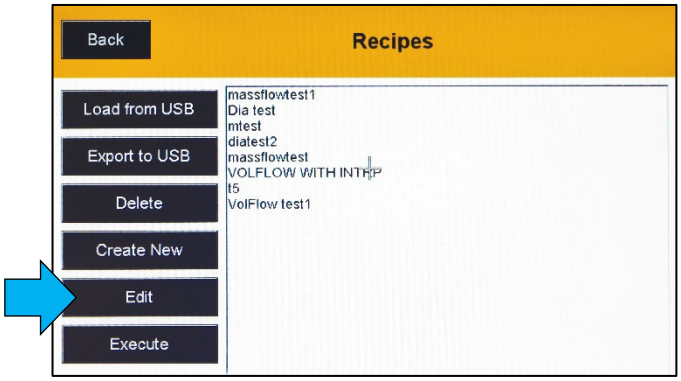
- Select SAVE RECIPE, place cursor in text field
- From the keyboard, type the recipe name & ENTER
- Hit ENTER again to save the recipe and have it added to the recipe list

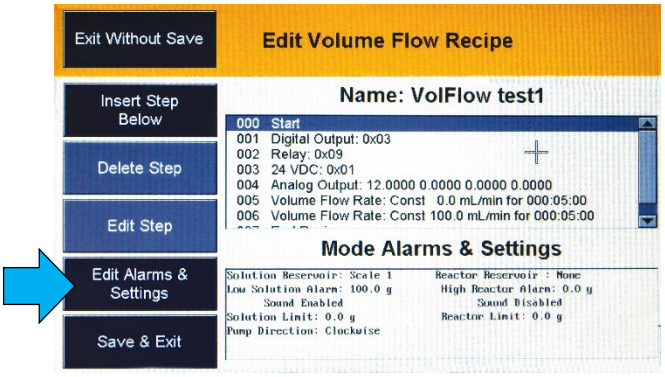




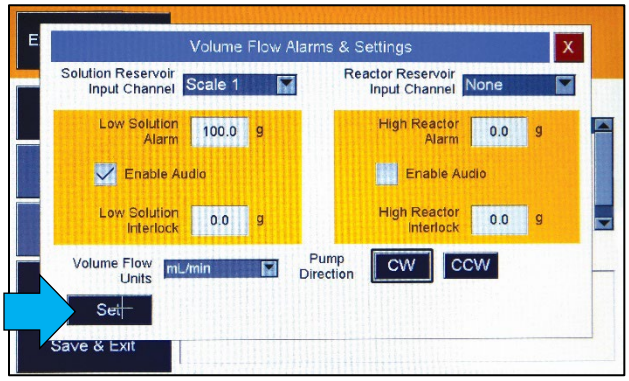
Configure Recipe Alarms:

- Highlight the recipe and hit EDIT
- Select EDIT ALARMS & SETTINGS



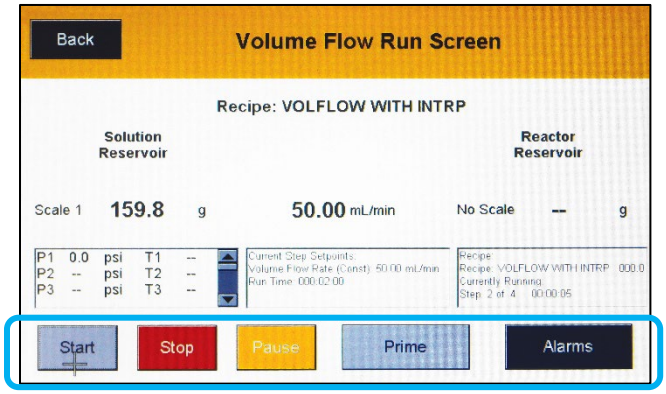


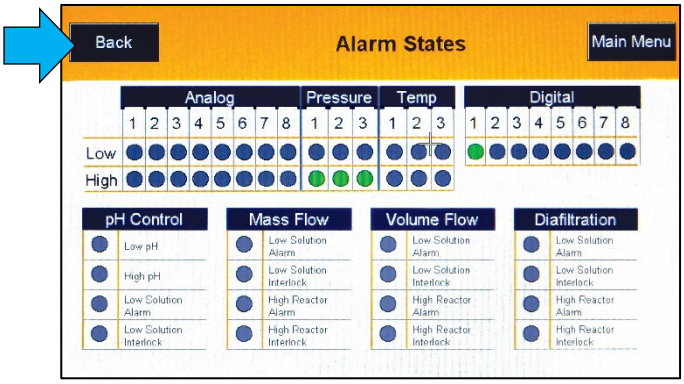
The following screen illustrates the setting of low and high Solution (pumping from) and Reactor (pumping to) weight alarms and interlocks if scales are connected to monitor them. The choice of flow rate units is also configured here, either mL/min (default) or L/min. If not used, disregard this screen.



- Select SET when alarms are complete
- Hit SAVE to keep recipe
- Return to recipe list, select recipe to run
- Choose EXECUTE

The following screens are now available:





The Volume Flow Run Screen shows the ongoing process.

- Hit PRIME to prime tubing lines, and select again to stop priming
- Select START to begin the process
- Once the process starts, you can select PAUSE to interrupt the process
  (once Pause is activated it will switch to RESUME, select again to resume the process)
- Select STOP to end the process

If ALARMS is selected from this screen, the Alarm States window will appear. Select BACK to return to the Run screen.

While this process is actively running, data is being sent and can be captured on SciDoc II software.

Refer to APPENDIX A for tubing dimensions chart and available flow rates based on tubing and motor size.

Start-up: Mass Flow Metering into a Bioreactor

EQUIPMENT

You will need the following items to get started:

Parker P/N	Description	Quantity
CHEM2-21	ChemTec II, CP-120 w/ 1081 Tandem Peristaltic Head, 160rpm Motor	1 pc
100-VIPER6	Mettler Toledo ICS425 Scale, 6000gm x.1gm	1 pc
400-116	Silicone Tubing, Platinum Cured, #16	25 ft (1 pkg)
080-072ICS	Cable, Interfaces ChemTec II and Mettler Scale	1pc
080-USB	RS232 to USB Adapter Cable	1 kit
N/A	Appropriate Media Reservoir	1 pc
N/A	Appropriate Bioreactor or Fermentor	1 pc

Hardware Setup

1. Unpack all the components, visually identify and inspect for damage.
2. At the bench, place the scale with the media reservoir to the far left. To the right of the bench, position the ChemTec II and Bioreactor. Leave space between these items to allow for cables and tubing.
3. Connect the interface cable between the ChemTec II and the scale, connecting it to the “S1” connector on the rear panel of the ChemTec II.
4. Connect the RS232 to USB cable between the PC and the “Printer” connector on the rear of the ChemTec II. This cable may require a driver installation from the internet, and assistance from your internal IT department to download.
5. Plug in to power equipment.
6. Install SciDoc II software from https://discover.parker.com/pump-support-gen2. Choose ChemTec II from the menu, select the appropriate COM Port, and it will be ready to receive data from the pump.
7. If the ChemTec II and scale were purchased together from Parker, both will be configured to communicate with each other. If purchased separately, contact Parker Technical Support (bioscienceNA.TS@parker.com) for assistance.
8. Cut an appropriate length of #16 tubing and connect it to the Media reservoir. Route the tubing from the reservoir to the ChemTec II, open the head by rotating the lever 180 degrees counter-clockwise, and place the tubing over the upper set of rollers. Confirm that the tubing is under the centering springs and close the head by rotating the lever back to its original position. Connect the remaining end to the Bioreactor.

This completes the hardware and tubing configuration.

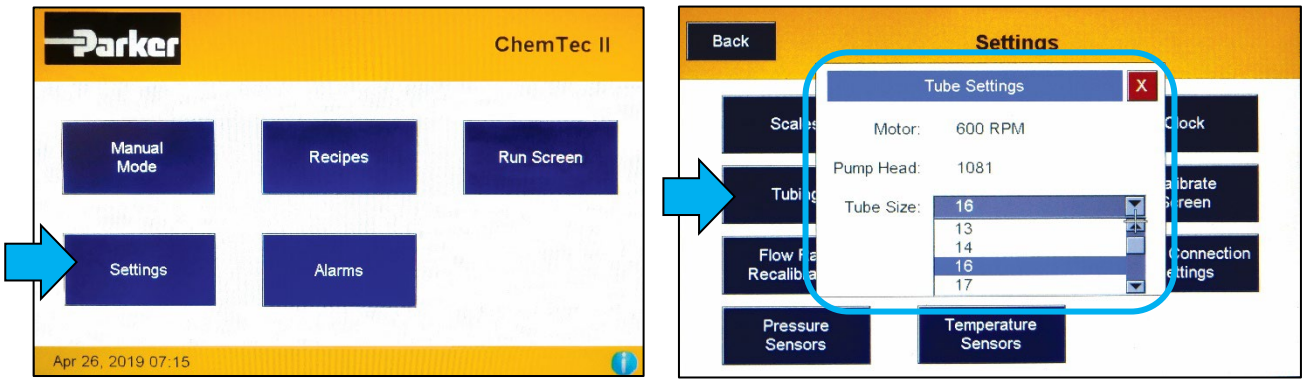
PROGRAM EDITING AND EXECUTION

At this point, consider the parameters of the reaction being fed and determine the type of metering needed. This can be done at a constant rate, a linear rate, or an exponential rate by using several short linear ramps. Several user-definable alarms may be utilized to monitor the process; solution or reactor weights if balances are connected to monitor them and the measured pressure for one to three of the connected pressures. All the alarms may be disabled or enabled and set to interlock and provide and audible alarm.

Mass Flow Programming

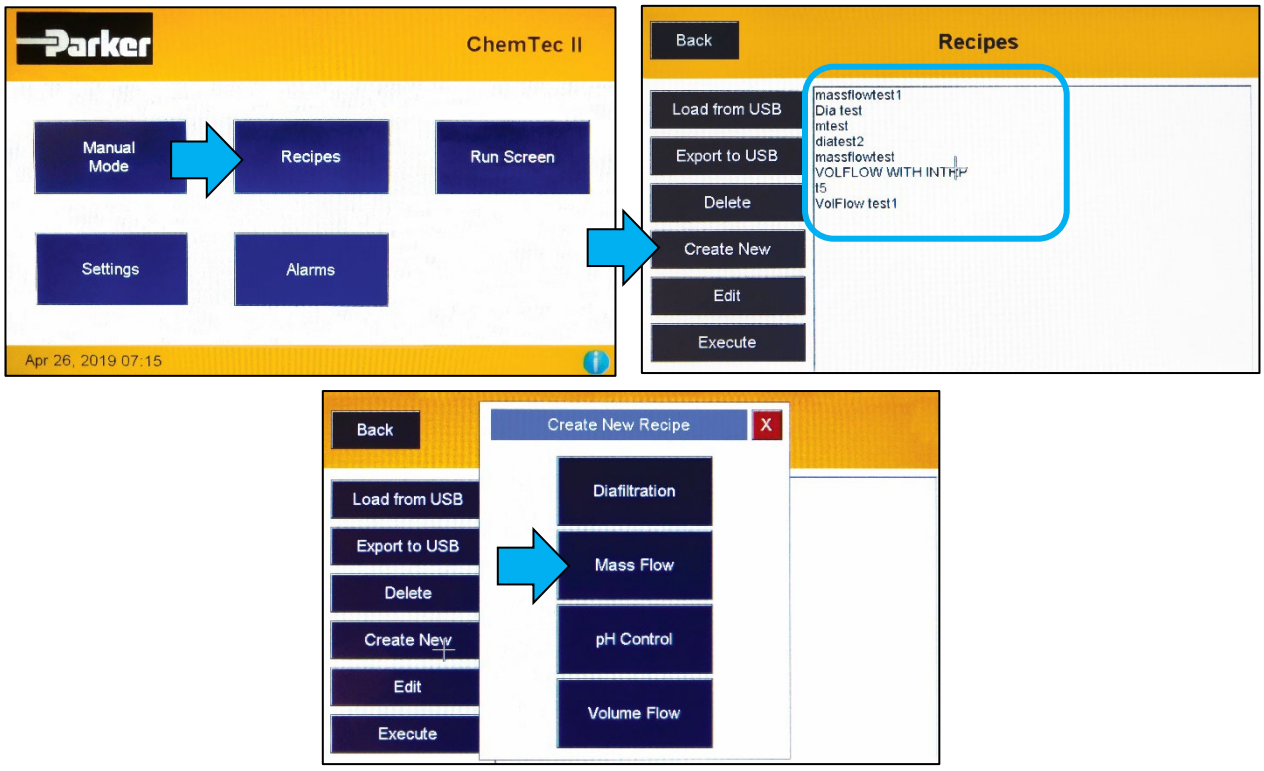
From the main screen:

- Choose SETTINGS
- Select TUBING
- Confirm Motor RPM and head in the Tube Settings
- Select the TUBE SIZE from the drop down, press SET



Steps to enter a Mass Flow Recipe:

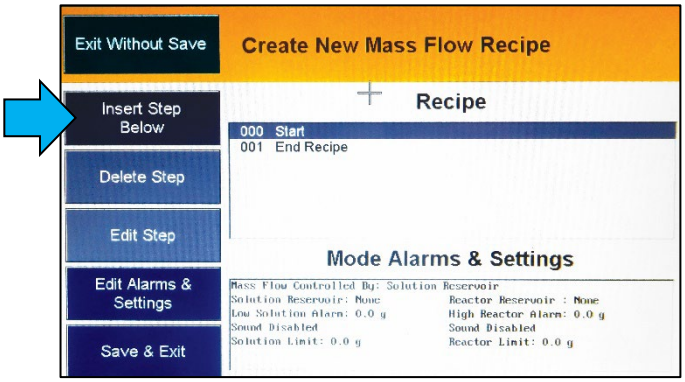
- Return to the main screen
- Select the RECIPES button
- Choose an existing recipe, or click on CREATE NEW (For this Quick Start, click on CREATE NEW)
- Click MASS FLOW

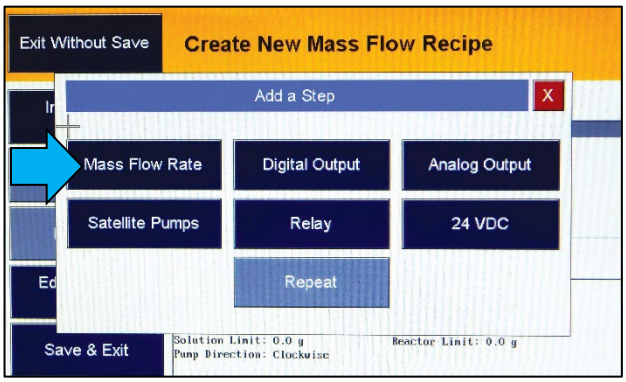


New Mass Flow Recipe screen:

This screen allows you to add new steps and/or edit and delete existing steps; access process alarms for editing and settings; exit without a save or save and exit for prompts to save the recipe name. The recipe name is limited to upper- and lower-case letters, numbers and dashes.

- Select INSERT STEP BELOW to get started
- Press MASS FLOW RATE

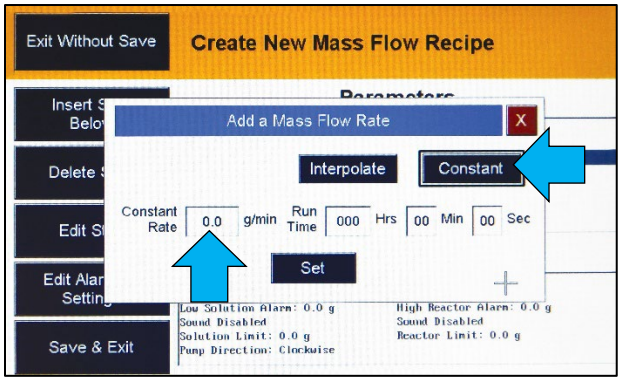


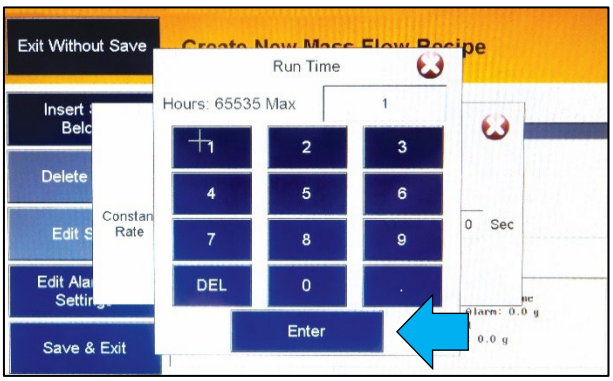


NOTE: 'Start' and 'End' parameters are always listed and cannot be edited or deleted. Steps cannot be inserted below 'End'.

Configuring a Mass Flow Rate and Time Step:

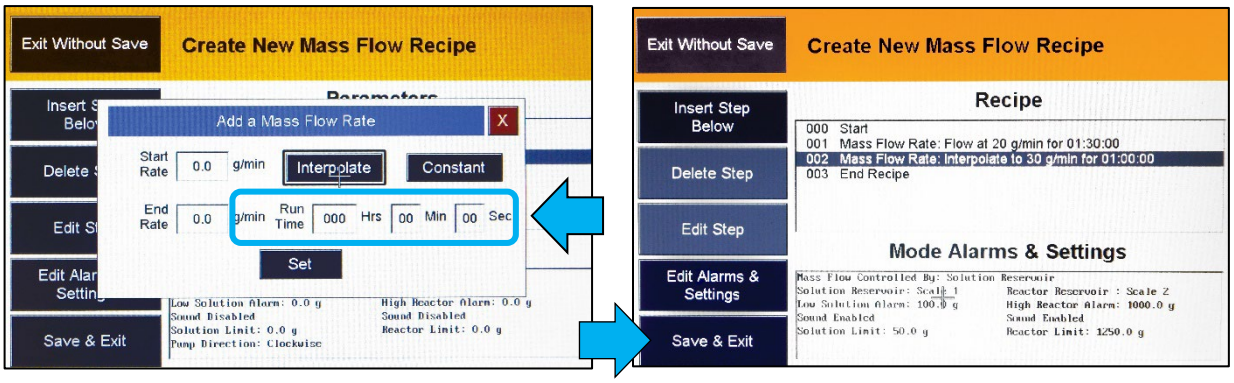
- Choose CONSTANT or INTERPOLATE
  (An interpolated rate will ramp up from an initial rate to the new rate over the set time interval)
- Select the RATE field, enter desired flow rate, and ENTER





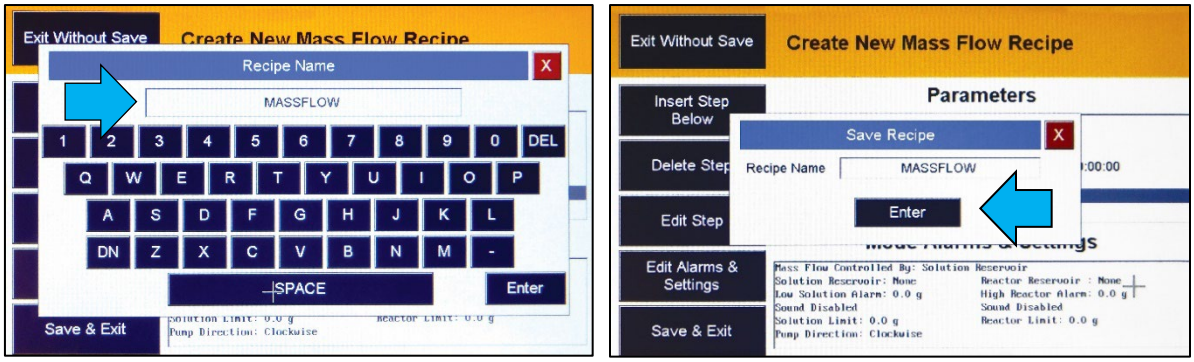
Set a time for the step:

- Click in the RUN TIME field, then enter time in hours, minutes and seconds
- Select SET to add your new Mass Flow Rate Step to the recipe
- Highlight any step to edit & delete as needed
- Click SAVE AND EXIT



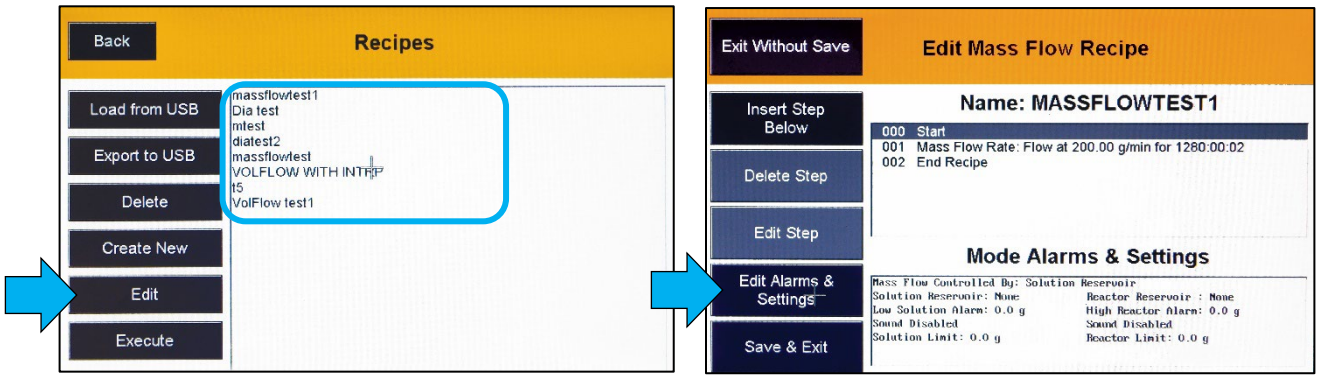
Name recipe:

- Select SAVE RECIPE, place cursor in text field
- From the keyboard, type the recipe name & ENTER
- Hit ENTER again to save the recipe and have it added to the recipe list

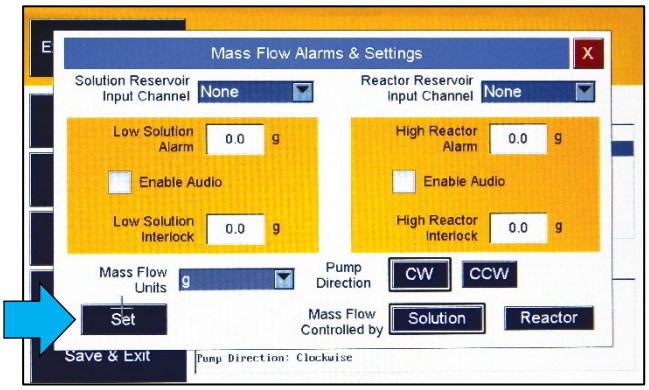


Configure Recipe Alarms

- Highlight the recipe and hit EDIT
- Select EDIT ALARMS & SETTINGS

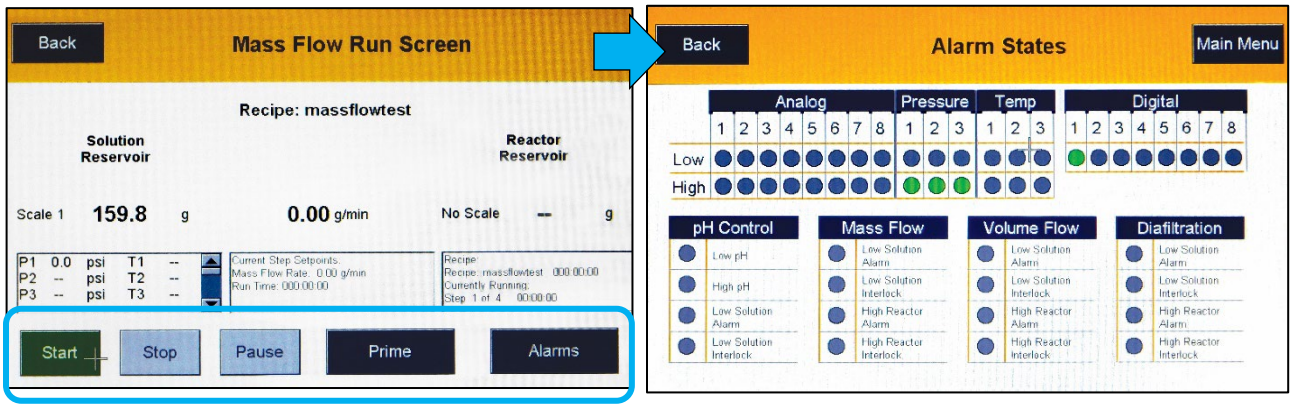


The following screen allows the setting of low and high Solution (pumping from) and Reactor (pumping to) weight alarms and interlocks if scales are connected to monitor both. The choice of flow rate units is also configured here, either gm/min (default), Kg/min or oz/min.



- Select SET when alarms are complete
- Hit SAVE to keep recipe
- Return to recipe list, and select a recipe to run
- Choose EXECUTE

The following screens are now available:



The Mass Flow Run Screen shows the ongoing process.

- Hit PRIME to prime tubing lines, and select again to stop priming
- Select START to begin the process
- Once the process starts, you can select PAUSE to interrupt the process
  (once Pause is activated it will switch to RESUME, select again to resume the process)
- Select STOP to end the process

If ALARMS is selected from this screen, the Alarm States window will appear. Select BACK to return to the Run screen. While this process is actively running, data is being sent and can be captured on SciDoc II software. The setting of pressure alarms and limits as well as analog and digital inputs are explained later in the manual.

Refer to APPENDIX A for tubing dimensions chart and available flow rates based on tubing and motor size.

Start-up: Diafiltration, or Maintenance of Vessel Weight

EQUIPMENT

You will need the following items to get started:

Parker P/N	Description	Quantity
CHEM2-21	ChemTec II, CP-120 w/ 1081 Tandem Peristaltic Head, 160rpm Motor	1 pc
400-116	Silicone Tubing, Platinum Cured, #16	25 ft (1 pkg)
080-USB	RS232 to USB Cable	1 pc
100-VIPER6	Mettler Toledo ICS425 Scale, 6000gm x.1gm	1 pc
080-072ICS	Cable, Interfaces ChemTec II and Mettler Scale	1pc
	SciDoc II Data Collection Software	Included
N/A	Appropriate buffer Reservoir	1 pc
N/A	Appropriate Retentate vessel	1 pc

Hardware Setup

1. Unpack all the components, visually identify and inspect for damage.
2. At the bench, place the buffer reservoir to the far left. To the right on the bench, position ChemTec II, and the scale with Retentate Vessel on it. Leave space between these items to allow for cables and tubing.
3. Connect the interface cable between the ChemTec II and the scale, connecting it to the “S1” connector on the rear panel of the ChemTec II.
4. Connect the RS232 to USB cable between the PC and the “Printer” connector on the rear of the ChemTec II. This cable may need a driver installed from the internet, contact your IT person if help is needed.
5. Plug in and power-up all the equipment.
6. Install SciDoc II software from https://discover.parker.com/pump-support-gen2. Choose ChemTec II from the menu, select the appropriate COM Port, and it will be ready to receive data from the pump.
7. If the ChemTec II and scale were purchased together from Parker, both will be configured to communicate with each other. If purchased separately, contact Parker Technical Support (bioscienceNA.TS@parker.com) for assistance.
8. Cut an appropriate length of #16 tubing and connect it to the Buffer reservoir. Route the tubing from the reservoir to the ChemTec II, open the head by rotating the lever 180 degrees counter-clockwise, and place the tubing over the upper set of rollers. Confirm that the tubing is under the centering springs and close the head by rotating the lever back to its original position. Connect the remaining end to the retentate vessel.

This completes the hardware and tubing configuration.

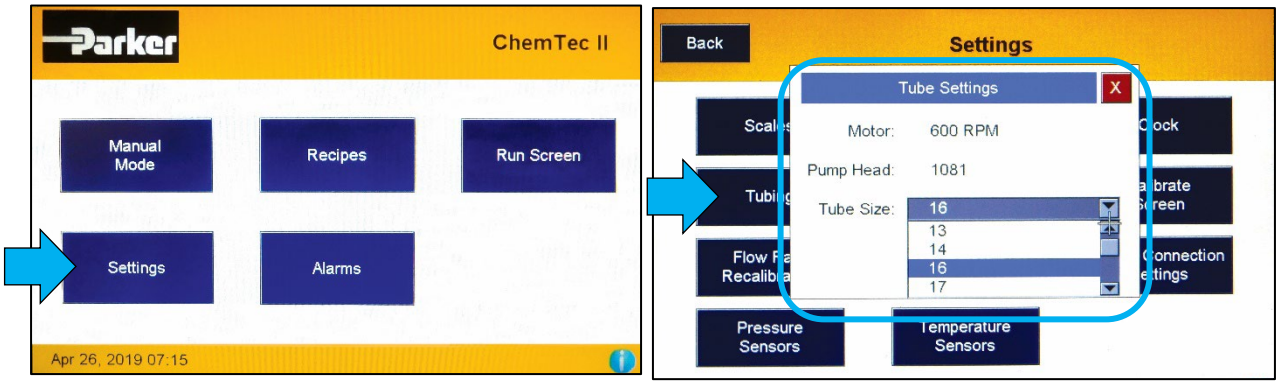
PROGRAM EDITING AND EXECUTION

At this point consider the parameters of the process such as the permeate rate if this is TFF, or the rate at which material is being removed from the vessel. Assure that the motor and tubing combination has sufficient flow capability with some excess above the expected rate. There are user-definable alarms may be utilized to monitor the process; solution or vessel weights if balances are connected to monitor them and the measured pressure for one to three of the connected pressures. All the alarms may be disabled or enabled and set to interlock and/or provide an audible alarm.

Diafiltration programming

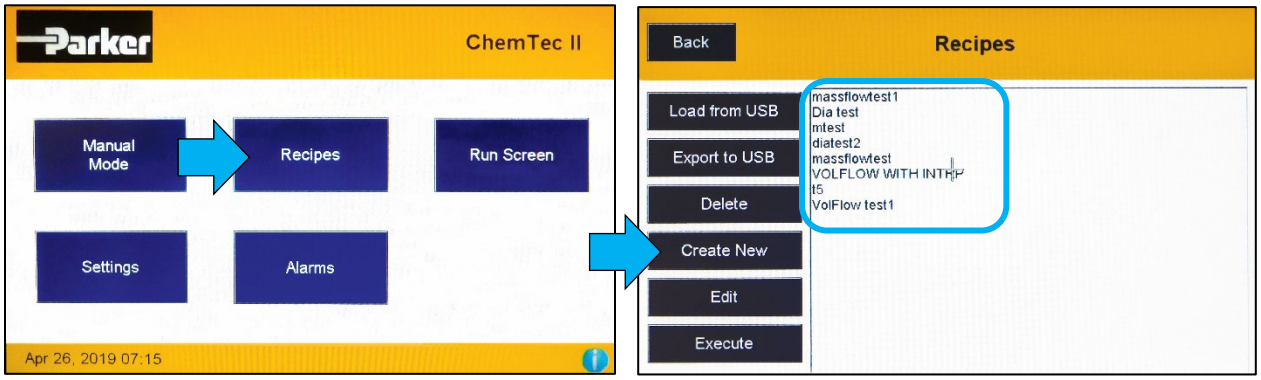
From the main screen:

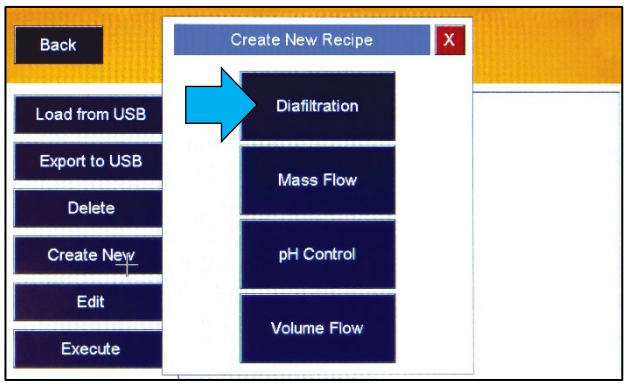
- Choose SETTINGS
- Select TUBING
- Confirm Motor RPM and head in the Tube Settings
- Select the TUBE SIZE from the drop down, press SET



Steps to enter a Diafiltration Recipe:

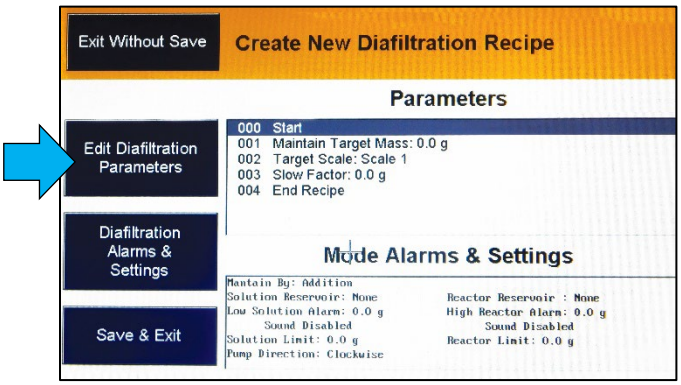
- Return to the main screen
- Select the RECIPES button
- Choose an existing recipe, or click on CREATE NEW (For this Quick Start, click on CREATE NEW)
- Click DIAFILTRATION

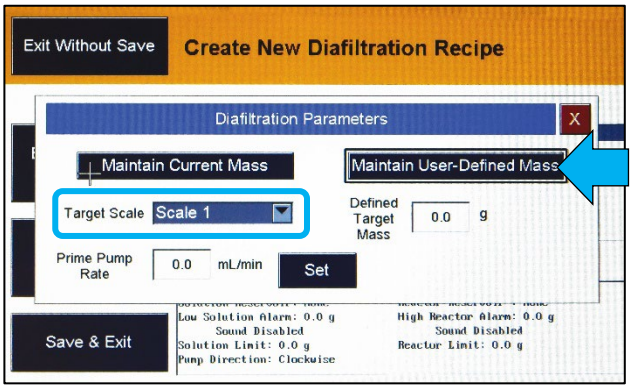




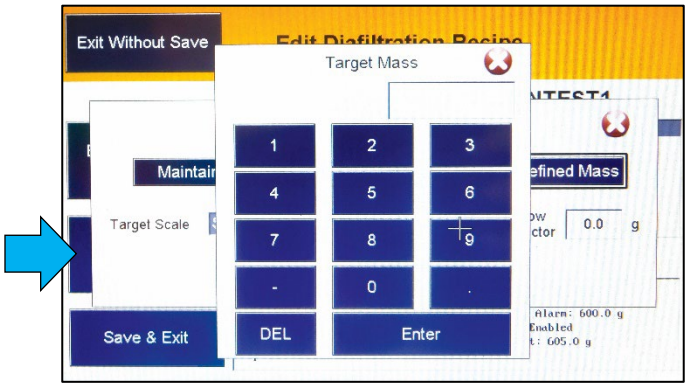
New Diafiltration Recipe Screen:

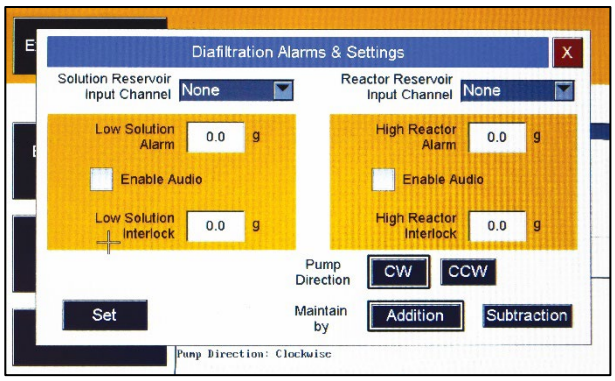
- Select EDIT DIAFILTRATION PARAMETERS
- Choose the TARGET SCALE from the drop down





- If MAINTAIN CURRENT MASS is chosen, the value on the scale is displayed, and that value will be the target maintained.
- Choose MAINTAIN USER-DEFINED MASS if starting with an empty vessel that will be filled to that value, and maintained
- Select DIAFILTRATION ALARMS & SETTINGS to display the following screen





The DIAFILTRATION ALARMS & SETTINGS screen provides the following options:

- Low Solution Alarm
- High Reactor Alarm
- Balance identification
- Pump direction (CW or CCW)
- Addition (default) or Subtraction methods

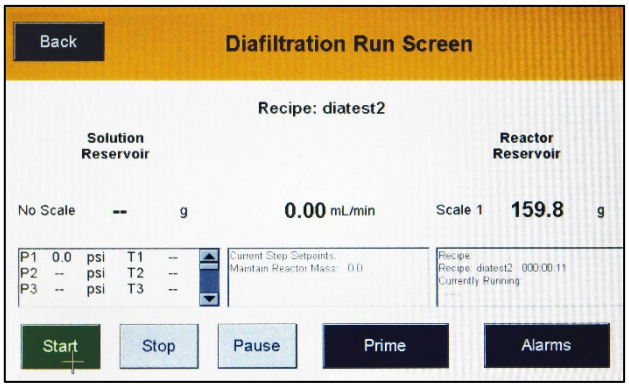
Once all settings are entered

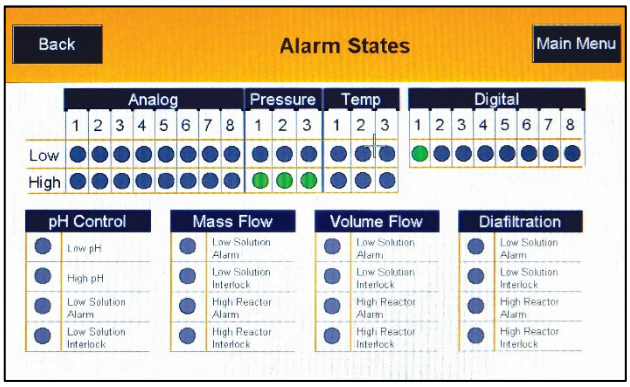
- Choose SET to accept the settings
- Select SAVE to name the Recipe

NOTE: By setting both input channels to the same scale, one may set a Low Solution Alarm to trigger as a Low Reactor Alarm if desired using just one scale.

To initiate the process:

- Select the Recipe from the list
- Choose EXECUTE to initiate the Run Screen





The Diafiltration Run Screen shows the ongoing process. The PRIME button can be used to prime lines, once to start, and again to stop. To control the process:

- Select START to begin the process
- Once the process starts, select PAUSE (once Pause is activated it will switch to RESUME)
- Select RESUME to begin the process again from where it was first paused
- Select STOP to end the process

If ALARMS is selected from this screen, the Alarm States will appear to indicate that while this process is actively running, data is being sent and can be captured on SciDoc II software.

Refer to APPENDIX A for tubing dimensions chart and available flow rates based on tubing and motor size.

Start-up: Simple pH Maintenance of a “Base” reaction

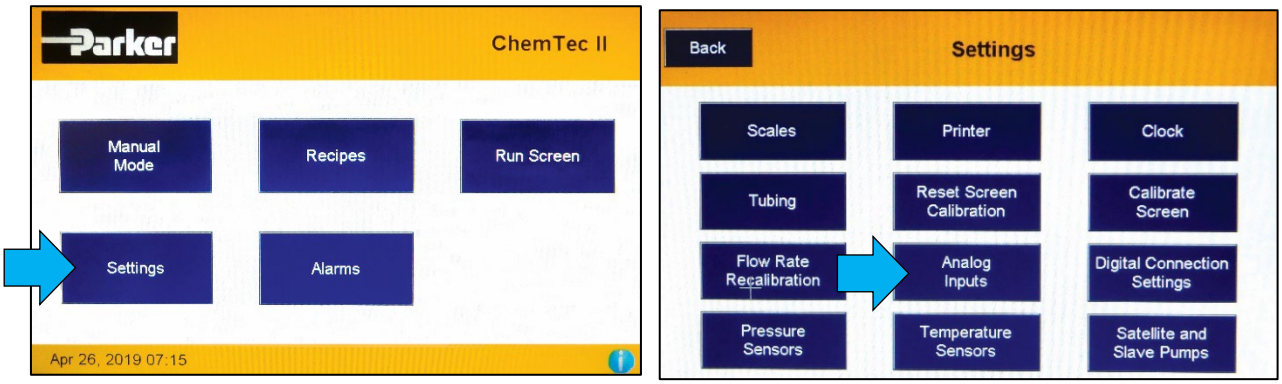
EQUIPMENT

You will need the following items to get started:

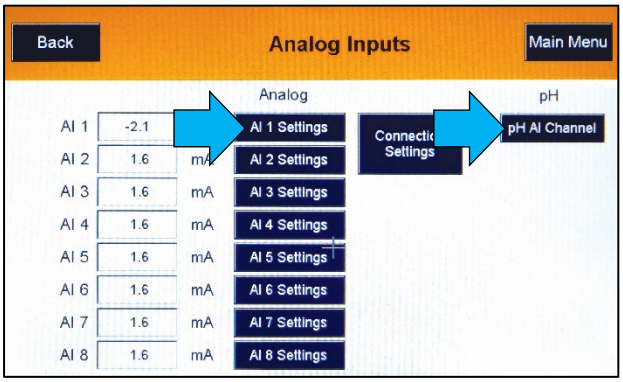
Parker P/N	Description	Quantity
CHEM2-21	ChemTec II, CP-120 w/ 1081 Tandem Peristaltic Head, 160rpm Motor	1 pc
400-116	Silicone Tubing, Platinum Cured, #16	25 ft (1 pkg)
N/A	pH Meter & Probe with 4-20ma output and interface cable	1 pc
N/A	Appropriate Acid Solution Reservoir	1 pc
N/A	Appropriate Reaction Vessel w/ stirrer	1 pc

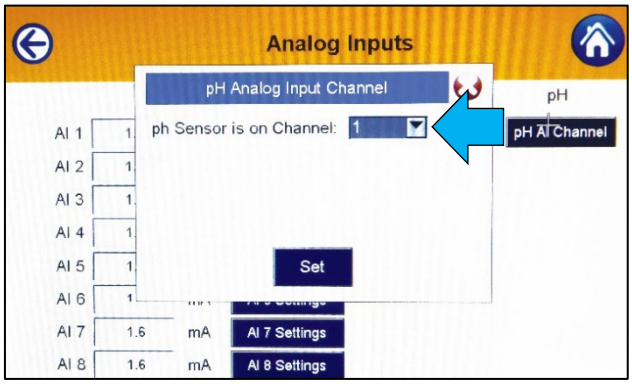
Hardware Setup

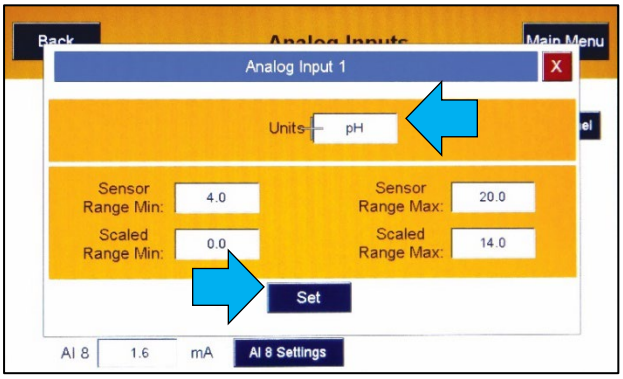
1. Unpack all the components, visually identify and inspect for damage.
2. At the pH bench, place the reagent reservoir to the far left. To the right of the bench, position ChemTec II, the reaction vessel, and pH meter with probe. Leave space between these items to allow for cables and tubing.
3. Connect the pH / ChemTec II interface cable to the output of the pH Meter, and the Analog connector on the rear of the ChemTec II.
4. Connect the RS232 to USB cable between the PC and the “Printer” connector on the rear of the ChemTec II. This cable may need a driver installed from the internet, contact your internal IT department if help is needed.
5. Plug in to power the equipment.
6. Install SciDoc II software from https://discover.parker.com/pump-support-gen2. Choose ChemTec II from the menu, select the appropriate COM Port, and it will be ready to receive data from the pump.
7. If the ChemTec II and scale were purchased together from Parker, both will be configured to communicate with each other. If purchased separately, contact Parker Technical Support (bioscienceNA.TS@parker.com) for assistance.
8. Proceed to the Main Screen:
   - Select SETTINGS, and then ANALOG INPUTS



- Select the pH AI CHANNEL to set the input channel, Channel 1 is the default
- After setting Channel 1, select the AI 1 SETTINGS
- Set the units to pH, the Sensor Range Min/Max to 4 and 20 mA (typical) and the Scaled Range Min/Max to match the pH output of the pH Analyzer in use (0 and 14 are typical)
- Choose SET







9. Cut approx. 6-8 ft. of #16 tubing and connect it to the reagent reservoir. Route the tubing from the reservoir to the ChemTec II, open the head by rotating the lever 180 degrees counter-clockwise, and place the tubing over the upper set of rollers. Confirm that the tubing is under the centering springs and close the head by rotating the lever back to its original position. Connect the remaining end to the reaction vessel.

This completes the hardware and tubing configuration.

PROGRAM EDITING AND EXECUTION

At this point, consider the parameters of the titration/maintenance process and determine how close the pH Setpoint must be maintained and the max flow rate desired for reagent addition as the pH increases. Several user-definable alarms may be utilized to monitor upper and lower pH limits, and reagent volume. Alarms and Limits may also be set for Pressure in the submenu for those items in Setup Mode if those sensors are used.

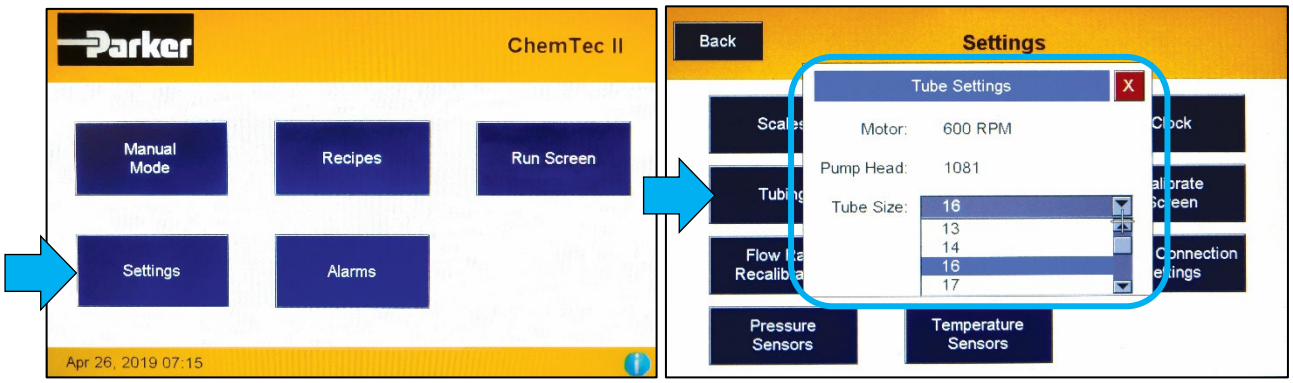
If all is working as expected for an “Acid” reaction, acid is the reagent being added to bring the solution back to a neutral Setpoint of 7.0 pH, when the pH exceeds 7.10 (Tolerance = 0.1) the ChemTec II will begin to slowly dispense the Acid Reagent. This speed will increase linearly to the maximum Pump Rate that was set as the Delta value is approached. It will automatically slow down as the pH returns toward 7.1 and stop when it drops below that value. With an Endpoint Delay of 0.0, this will continue for as long as desired.

Refer to APPENDIX A for tubing dimensions chart and available flow rates based on tubing and motor size.

pH Control programming

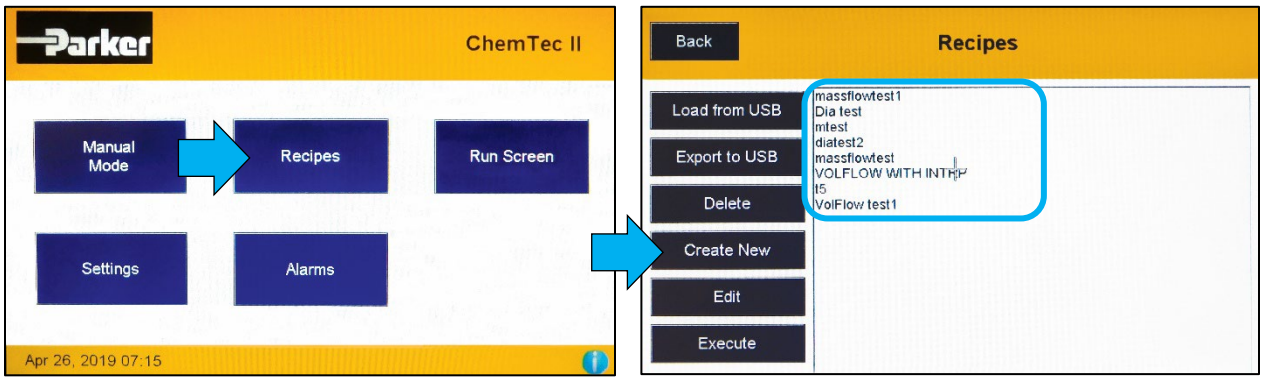
From the main screen:

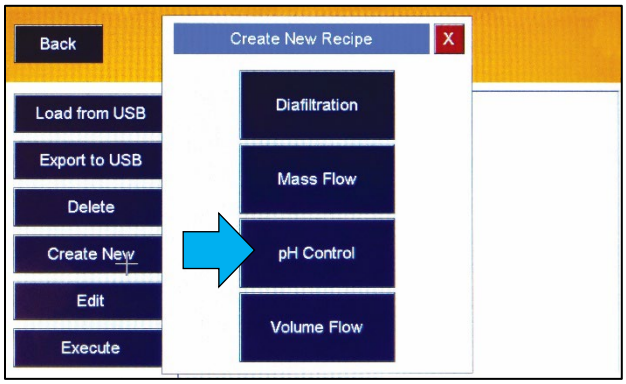
- Choose SETTINGS
- Select TUBING
- Confirm Motor RPM and head
- Choose the TUBE SIZE from the drop down, press SET



Steps to enter a pH Control Recipe:

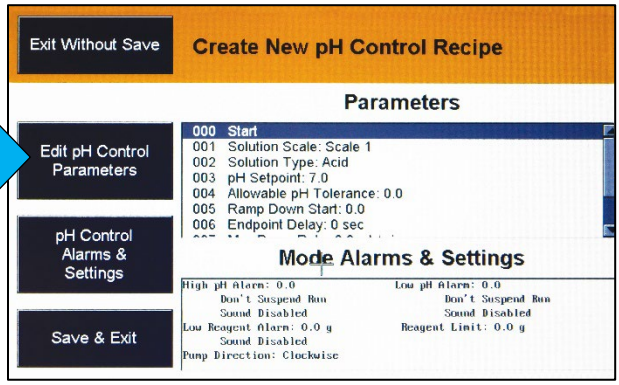
- Return to the main screen
- Choose RECIPES
- Select an existing recipe or click on CREATE NEW. (For this Quick Start, click on CREATE NEW)
- Choose pH CONTROL

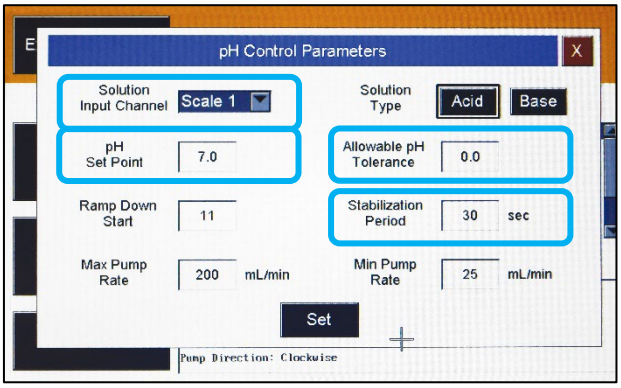




New pH Control Recipe screen:

- Choose EDIT pH CONTROL PARAMETERS and the next screen is displayed.





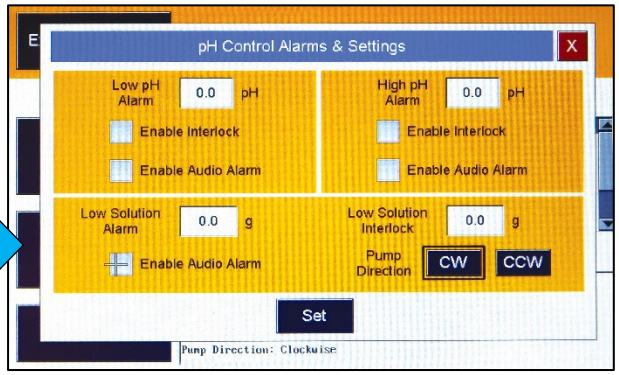
- Under Solution Input Channel, select the SCALE from the drop down for the reagent solution (if applicable). This scale will be monitored on the run screen and an alarm can be set if desired.
- Choose ACID or BASE as applicable
- Select pH SET POINT and set the target value
- Select STABILIZATION PERIOD, and set time in seconds to wait for the solution to be homogeneous
- Select ALLOWABLE pH TOLERANCE and set the allowed “dead band” value
  (Once inside this value, the pump will stop the process for the length of the set Stabilization Period. If outside the allowed tolerance, more reagent will be added. This process will repeat until the solution is stable for longer than the set stabilization period)

For this process to occur once and stop, as in an Endpoint Titration, set the Stabilization Period to a non-zero value in seconds. (Maximum = 999 seconds) As long as the pH stays within the bandwidth setting for the length of the Stabilization Period, the process is considered complete when the timer expires.

If more addition occurs during this stabilization period, i.e. the solution, once homogenous is back outside the pH Tolerance setting, the stabilization period timer is reset.

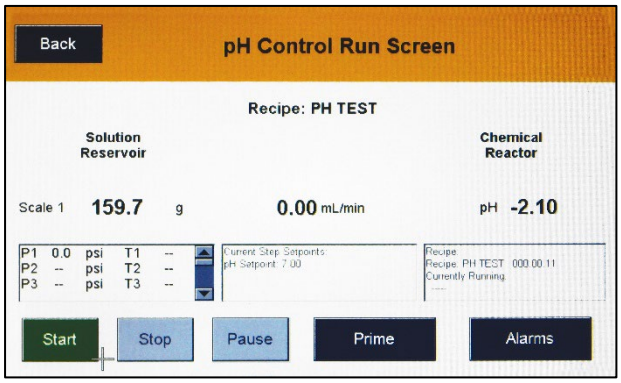
If the Endpoint Delay is set to 0 seconds, this is considered Maintenance mode, and the unit will respond indefinitely as the pH changes without considering the process complete until you stop the unit.

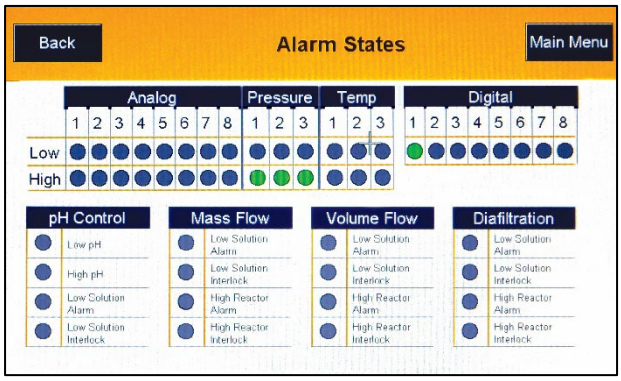
Select the pH CONTROL ALARMS & SETTINGS to display the following.



Choose LOW AND HIGH pH ALARMS to enable Interlocks and Audio Alarms. Low Solution alarms and interlocks may also be configured, as well as the direction of the motor. (Clockwise (CW) is the default and preferred setting.) SAVE the Recipe to the list.
To start the process:

Select recipe from list, press EXECUTE.





The pH Control Run Screen shows the ongoing process. The PRIME button can be used to prime lines, once to start, and again to stop. To control the process:

- Select START to begin the process
- Once the process starts, select PAUSE (once Pause is activated it will switch to RESUME)
- Select RESUME to begin the process again from where it was first paused
- Select STOP to end the process

If ALARMS is selected from this screen, the Alarm States will appear to indicate that while this process is actively running, data is being sent and can be captured on SciDoc II software.

Refer to APPENDIX A for tubing dimensions chart and available flow rates based on tubing and motor size.

Front Display & Back Panel Interface

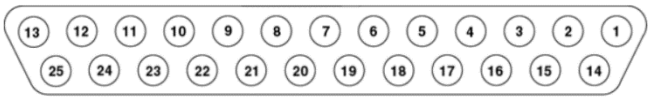
ChemTec II front panel display

A 7" resistive, touch screen color LCD which responds to use with standard disposable lab gloves and/or a stylus. All modes, settings, and recipes are displayed on this screen. The image shown is the default screen when initially connected to power.

ChemTec II back panel interfacing ports

- Printer: ChemTec II can be connected to a PC for data collection or to a Parker purchased Printer via the female DB9 RS-232 port labeled "Printer" with the included RS-232 to USB Adapter. Alternatively, the Printer Kit (PN 080-095A) can be connected here.
- Electronic Balance: Male DB9, labeled "S1", "S2" and "S3".
- CAN In/Out: Male DB9 for CAN communication cables (not enabled).
- Profibus: Female DB9 for Profibus communication cable (not enabled).
- SciPres II Single-Use Pressure Sensors: Three (3) Amphenol connectors labeled "P1, P2, P3", one for each pressure sensor.
- Scales: Male DB9 connectors labeled "S1", "S2" and "S3" are RS-232 ports for electronic scales.
- Analog: Female DB25 for Analog Input or Output. 8 inputs and 4 outputs exist.
- Digital: Female DB25 for Digital Input or Output. 8 inputs and 8 outputs exist.
- USB: Three USB "B" connectors for loading / saving of recipe files.
- Ethernet: Used for connection to the ChemTec II via a LAN. (not enabled.)
- Relay 1 and 2: Three Output relays for control of other devices on each as well as 24 VDC Outputs.
- T1, T2, and T3: These ports are unassigned at this time and not enabled.

Analog Connector Pin Out



1	2	3	4	5	6	7	8	9	10	11	12	13
AI8-	AI7-	AI6-	AI5-	GND	AI4+	AI3+	AI2+	AI1+	AO4	AO3	AO2	AO1
14	15	16	17	18	19	20	21	22	23	24	25	
AI8+	AI7+	AI6+	AI5+	AI4-	AI3-	AI2-	AI1-	GND	GND	GND	GND	

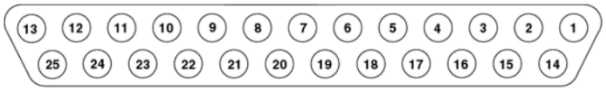
ANALOG INPUTS AND OUTPUTS

Analog Inputs must be loop powered from the connected source. Input Channel 1 is typically used for pH Input connection.

Analog Outputs are provided with 12 vdc loop power.

Input Channel	+ Pin	- Pin	Input Channel	+ Pin	- Pin		Output Channel	+ Pin	- Pin
1	9	21	5	17	4		1	13	25
2	8	20	6	16	3		2	12	24
3	7	19	7	15	2		3	11	23
4	6	18	8	14	1		4	10	22

Digital Connector Pin Out

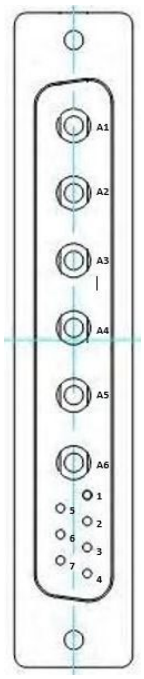


1	2	3	4	5	6	7	8	9	10	11	12	13
DO5	GND	DO4	DO3	GND	DO2	DO1	NC	DI4	DI3	GND	DI2	DI1
14	15	16	17	18	19	20	21	22	23	24	25	
GND	DO8	GND	DO7	DO6	GND	DI8	DI7	GND	DI6	DI5	GND	

DIGITAL INPUTS AND OUTPUTS

These are TTL inputs and outputs. This means simple contact closure all that is needed on the inputs, and the outputs provide 5 vdc with minimal current. They may be used to trip solid state relays with trigger voltages of 3-5 vdc., or with other systems with similar inputs.

Input Channel	+ Pin	GND		Output Channel	+ Pin	GND
1	13	25		1	7	19
2	12	25		2	6	19
3	10	22		3	4	16
4	9	22		4	3	16
5	24	11		5	1	14
6	23	11		6	18	5
7	21	22		7	17	5
8	20	22		8	15	2



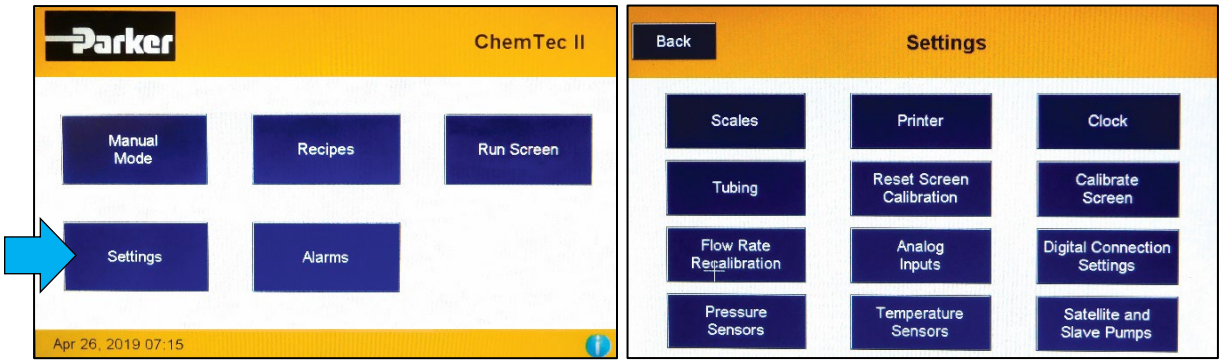
RELAY CONNECTOR PIN OUT

These provide upper connections for Relays 1 – 3, and lower connections for Relays 4 – 6. These are 250 V, 8 Amp max, Normally Open relays. The relays may be closed programmatically and in Manual Mode.

There are also connections for 24 VDC on the 7 small pins at the bottom of each connector that can be turned on and off programmatically and in Manual Mode.

Relay#				24 VDC1 / 2	
Upper Connector					
1	A1	A2		1, 2, 3	+
2	A3	A4		4	N/C
3	A5	A6		5, 6. 7	GND
Lower Connector					
4	A1	A2		1, 2, 3	+
5	A3	A4		4	N/C
6	A5	A6		5, 6. 7	GND

Settings



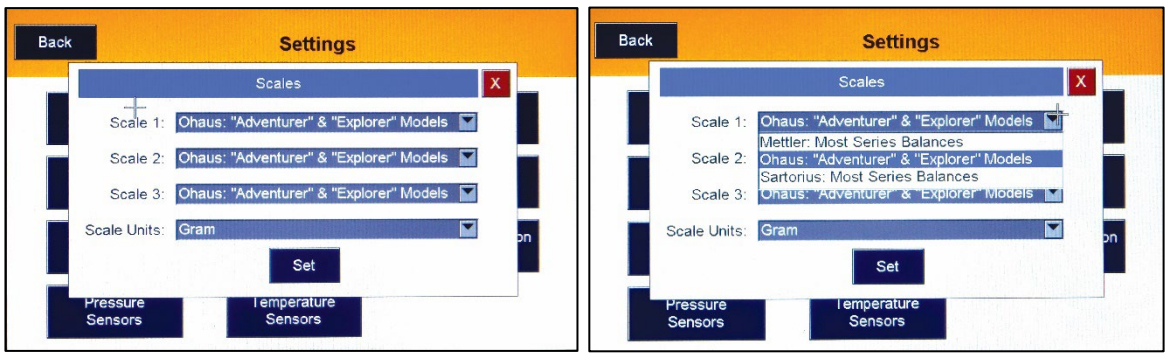
By selecting SETTINGS from the main screen, the Settings menu appears listing the configuration options:

- Scales
- Printer
- Clock
- Tubing
- Reset Screen Calibration
- Calibrate Screen
- Flow Rate Calibration
- Analog Inputs
- Digital Connection Settings
- Pressure Sensors
- Satellite and Slave Pumps

NOTE: The Temperature Sensor option is not supported.

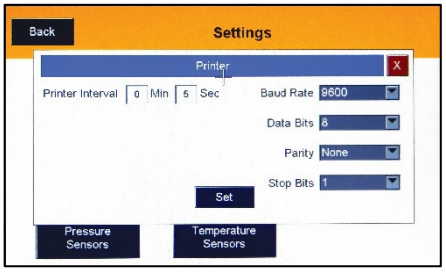
<u>The following outlines the options for each of the settings.</u>

SCALES



Select SCALES and set the type of scale to be used for Scale 1, 2 or 3. Most modes on the ChemTec II will use only one or two scales. Choose between Ohaus, Mettler or Sartorius Scales.

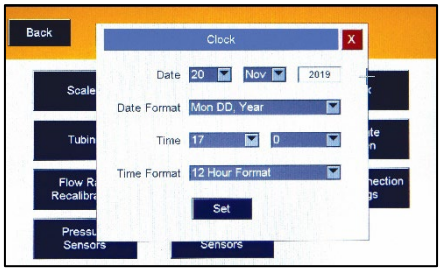
If you purchased the scale from Parker, it will be properly configured for use right out of the box. If using your own, contact Parker Technical Support at 877-784-2234 or bioscienceNA.TS@parker.com for assistance.



PRINTER

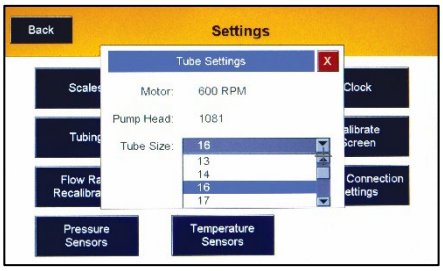
The communication settings for the printer are preset to the defaults of the Thermal Printer sold by Parker, and for use with a PC. These should not be modified under normal conditions.

Set the Printer interval to the desired value with a maximum of 60 minutes, 59 seconds.



CLOCK

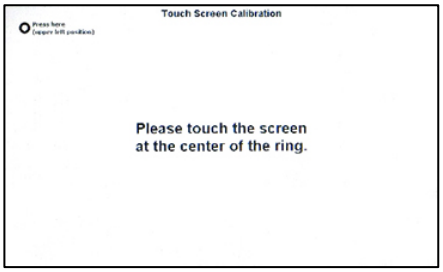
Set the date and time as needed for your location.
Several date formats may be chosen, and a choice between 12 hour and 24-hour time format is available.



TUBING

From the drop down list select the tubing size used in the pump head.
1081 pump head tubing sizes: 13, 14, 16, 25, 17 or 18
1082 pump head tubing sizes: 15, 24, or 35

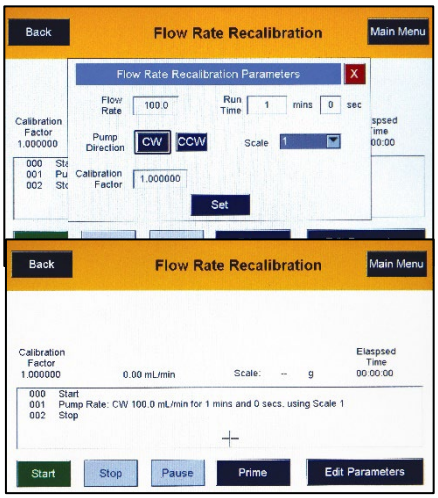
If using a head capable of using #36. set this to 35 and calibrate the flow rate.



TOUCH SCREEN CALIBRATION

Select CALIBRATE SCREEN and follow the on-screen instructions to adjust the calibration to be responsive to your touch.

Choose “RESET SCREEN CALIBRATION” to reset to the default.

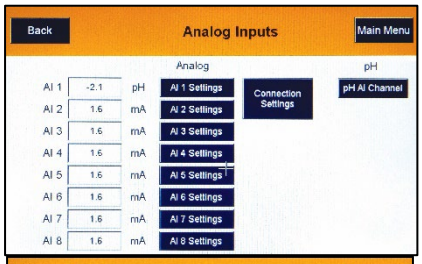


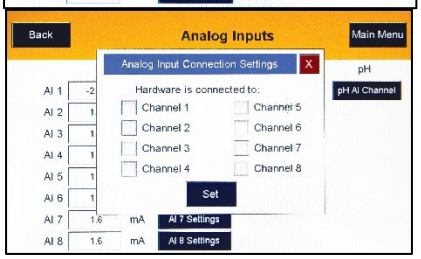
FLOW RATE CALIBRATION

This is used to fine tune the volumetric flow rates if the built-in curves don’t meet your needs. Click EDIT PARAMETERS and enter desired flow rate, direction, and a strongly suggested minimum run of 5 minutes. (10 is better if practical) A scale can be used if available, a prompt for the collected volume or weight will occur at the end of the run.

The calibration factor shown is the calculated single point adjustment to the internal curves based on motor and tubing settings.

Set the parameters, use the PRIME button if needed to charge the lines, and press START. The calibration will run on its own, and prompt for acceptance.

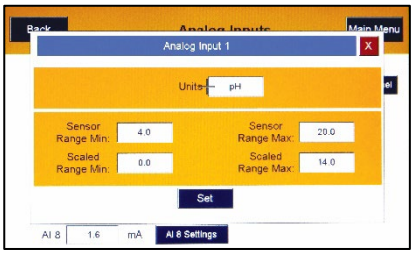




ANALOG INPUTS

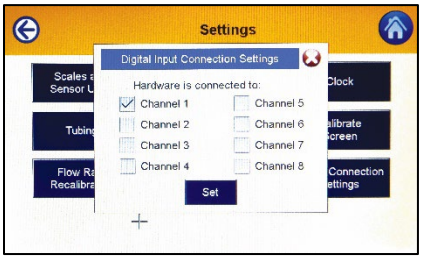
The ChemTec II is equipped with up to 8 Analog Input channels. Channel 1 is typically reserved for pH input but can be changed by pressing the button in the upper right and choosing a different one.

Connection settings is used to allow specification of where hardware is attached, please check the appropriate box(s) and tap Set.



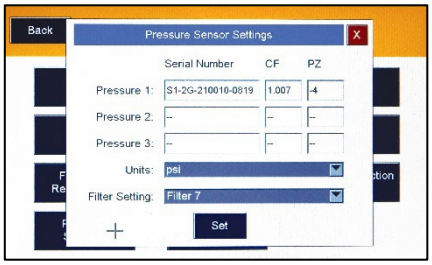
ANALOG INPUT SETTINGS

Press on AI1 (or any option) and enter the settings for the input device. The settings shown are for a pH analyzer that outputs 4-20 mA over a range of 0-14 pH units. Sensor Range Min and Max will typically be 4 and 20, and for this example, the Scaled Range Min and Max are 0 and 14. If this was OD values from a UV detector, the Min and Max Scaled range would be based on the output of that detector, i.e. 0 and 2 would be typical.



DIGITAL CONNECTION SETTINGS

This is to indicate which Digital Input Connections are being used, if any. The states of these inputs can be monitored in Manual Mode, and are either High (default) or Low (when pulled to ground by a connected device, switch or relay.

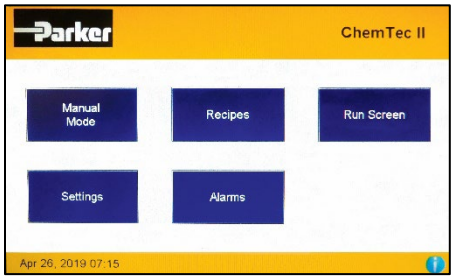


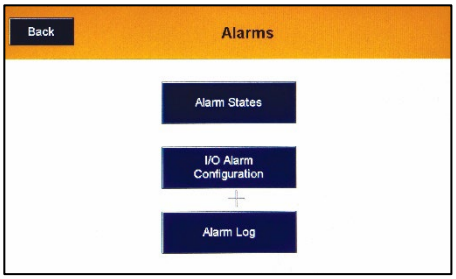
PRESSURE SENSOR SETTINGS

Select PRESSURE SENSOR SETTINGS and it will display any SciPres II sensor attached to the unit with Serial Number and Calibration information. Pressure units default to PSI (KPA and Bar may also be chosen).

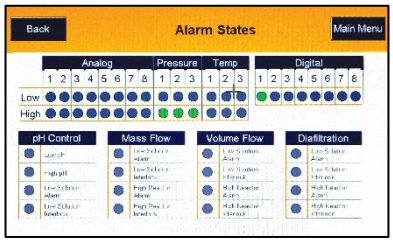
The Filter Setting is used to smooth out the pressure displayed, especially due to pulsation caused by a peristaltic pump. Settings range from 1 to 9, with 1 being live data, and 9 being a boxcar average of 4 seconds. A setting of 4 is typical (250 mS).

ALARMS



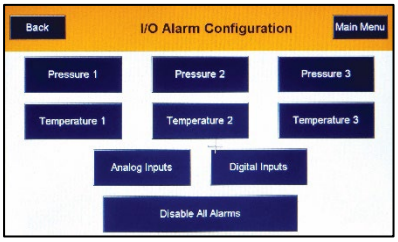


Selecting the ALARMS button brings up the Alarms page and allows you to access the I/O Alarm Configuration pages, the Alarm States screen, and the Alarm Log screen.



Alarm States

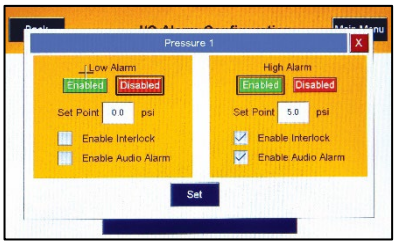
Displays the state of all alarms, both global and Mode based alarms. Green is enabled and normal, red is triggered.



I/O Alarm Configuration

Allows configuration of all global alarms on the unit. All three pressures, Analog Inputs, and Digital Inputs.

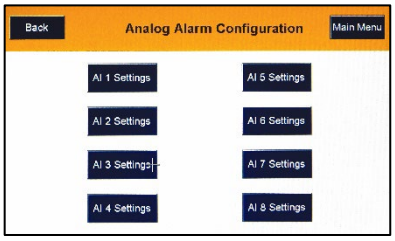
Temperature Sensors are not supported so may be ignored. You may also disable all alarms at once.



Pressure 1, Pressure 2, Pressure 3

Configure both High- and Low-pressure alarms. Enable, Disable and set points, as well as choose audible alarms and/or interlocks.

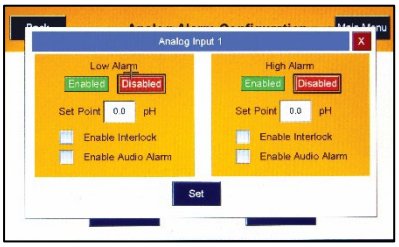
This process is the same for all three sensors and must be set individually.

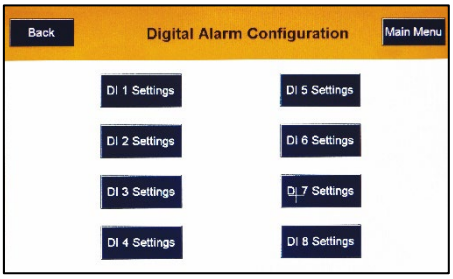


Analog Alarms

If attached, alarms may be set for Analog Inputs.

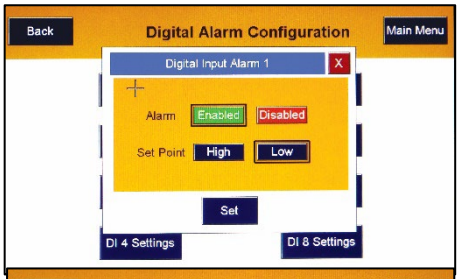
Analog 1 is shown, others are similar. As with the Pressure alarm, choose High and Low set points, audible alarms and interlocks, and Enable or Disable settings.





Digital Alarm Configuration

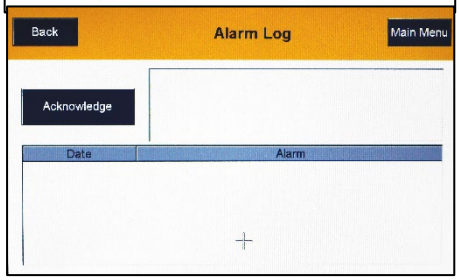
Alarms may be configured for the Digital Inputs if connected.



Digital Alarm 1

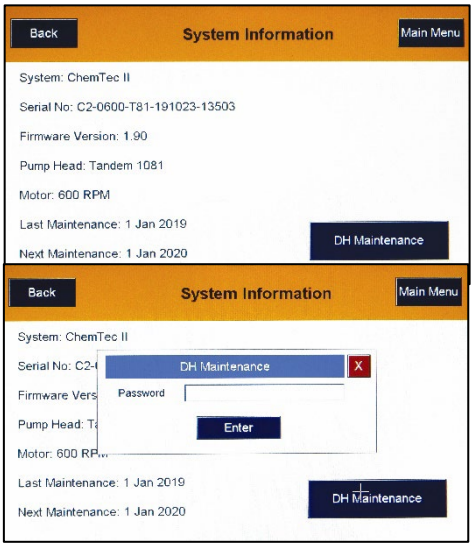
This alarm may be enabled or disabled and set to trigger if low or high.

These inputs default to a high input and will trigger immediately if set to high, enabled, and not pulled low by the attached device.



Alarm Log

All alarms are logged in red text while the unit is powered. Once acknowledged, they will be listed in the history list below the alarm list. This data is not exportable at this time.



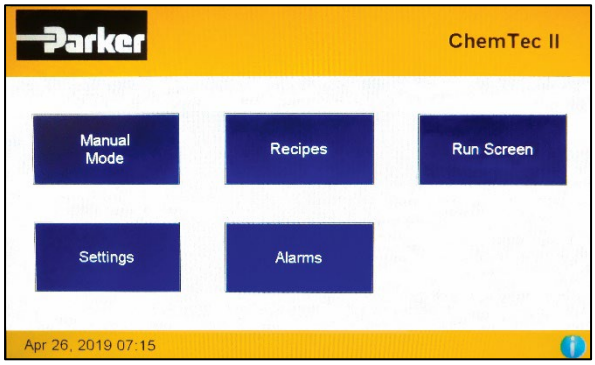
System Information

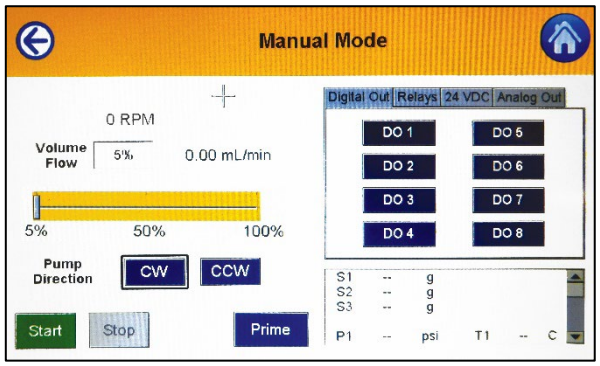
From the main screen, tap on the Sys Info button in the lower left corner to see this screen display:

- System (Model)
- Serial Number
- Firmware Version
- Pump Head installed
- Motor installed
- Last Maintenance date
- Next Maintenance date

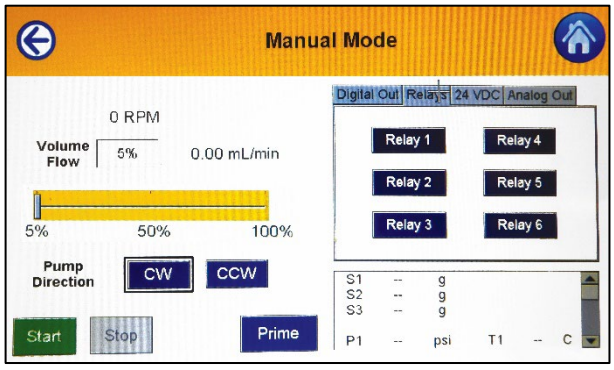
Selecting DH MAINTENANCE will bring up a password screen used by the Service Department to update this information.

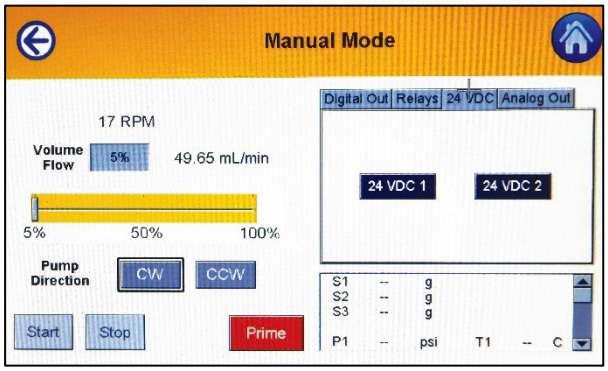
ChemTec II Manual Mode



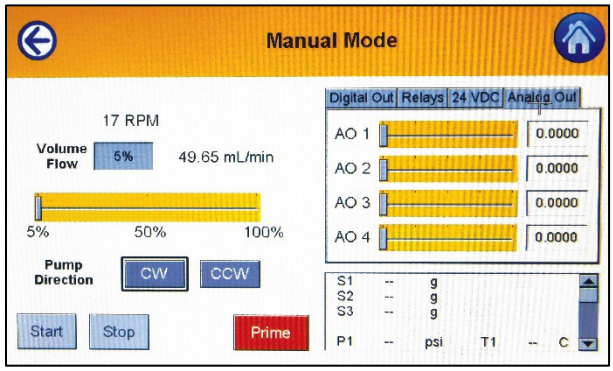


Manual Mode allows you to run the pump manually based on % of motor speed. You can change that by using the slider or tapping on the box and entering the desired value. The Prime button is a toggle, tap it to start, and again to stop, it will run at the set rate. The Start and Stop buttons work as expected. The Digital Output buttons allow one to toggle the 8 TTL outputs for testing purposes. These are 5 VDC outputs that carry a minimal current.





The Relay screen allows the Relays to be tested, there are three on each connector on the rear of the unit. They are 250 V 5 Amp relays. The 24 VDC screen allows one to toggle the 24 VDC outputs that share the connector with the relays on the back panel.



The Analog Output screen allows testing the 4 analog outputs on the Analog connector on the rear panel. These can be used for Satellite pumps.

See the Settings section on the pin outs for all of these connections.

The values for the Pressure Sensors, Scales, Analog and Digital Inputs may also be monitored in Manual Mode by scrolling down on the lower right quadrant of the display.

ChemTec II Metering Applications

Bioreactor Feed Application - General Information

Linear and exponential feeding strategies are very useful in many bioreactor applications. The ChemTec II allows the user to readily implement such nutrient metering strategies. The following examples outline some general approaches; however, the specific pump rates and feeding intervals must be experimentally determined and are dependent on the specifics of the process, i.e. type of organism, rate of bio-mass growth, bioreactor size, etc. Once the optimal feeding rate and feeding interval have been determined, the appropriate feeding strategy can be readily automated with the ChemTec II, utilizing either a volumetric or a mass-flow metering program.

Volumetric metering is recommended for applications in which the feeding intervals are relatively short. Here, the pump tube wear of the peristaltic pump is the main limitation to metering accuracy. Thus, longer feeding intervals may require frequent pump re-calibrations, which are not only inconvenient but also affect overall metering accuracy. The actual pump rate prior to re-calibration can be off by as much as 5%, depending on the extent of pump tube wear and the time between re-calibrations.

In contrast, mass-flow metering has several advantages. The most important one lies in the high precision and high accuracy levels (RSD < 0.2%) that can be achieved with mass-flow metering without the need for pump re-calibrations. This advantage is further magnified when dealing with feeding intervals that stretch over many hours, days or even weeks. However, to achieve these long-term, superior precision and accuracy levels, the ChemTec II requires hook-up of an electronic, top-loading balance.

In the Mass-Flow Mode, the ChemTec II metering rate is constantly monitored and, if required, adjusted based upon feedback from an electronic balance or scale. The nutrient reservoir is located on the balance; the pump rate is calculated and maintained based upon the reservoir weight decrease which is being monitored on a continual basis.

Effective control of the mass-flow rate is limited primarily by the resolution of the electronic balance. For high-performance electronic balances, e. g Mettler ICS Monoblock style, the resolution is +/- 0.01 grams. Thus, the lowest mass-flow rate achievable with high performance balances is 0.03 to 0.04 grams per minute. To implement such low mass-flow rates, a ChemTec II equipped with an 8 RPM pump motor and a 1081 TANDEM pump head using #13 PharMed tubing is recommended.

Linear, Volumetric Bioreactor Feed

A Parker customer provided the following data: A ChemTec II was used to automate nutrient feed into a bioreactor. During the initial growth phase, a linear nutrient ramp was implemented that lasted four hours, followed by a very slow ramp during the remaining eleven hours:

Time, *hrs.*	Rate, *ml/min*
0.0	35.60
0.5	43.21
1.0	50.66
1.5	57.83
2.0	66.04
2.5	73.65
3.0	81.26
3.5	88.87
4.0	96.48
4.5	96.55

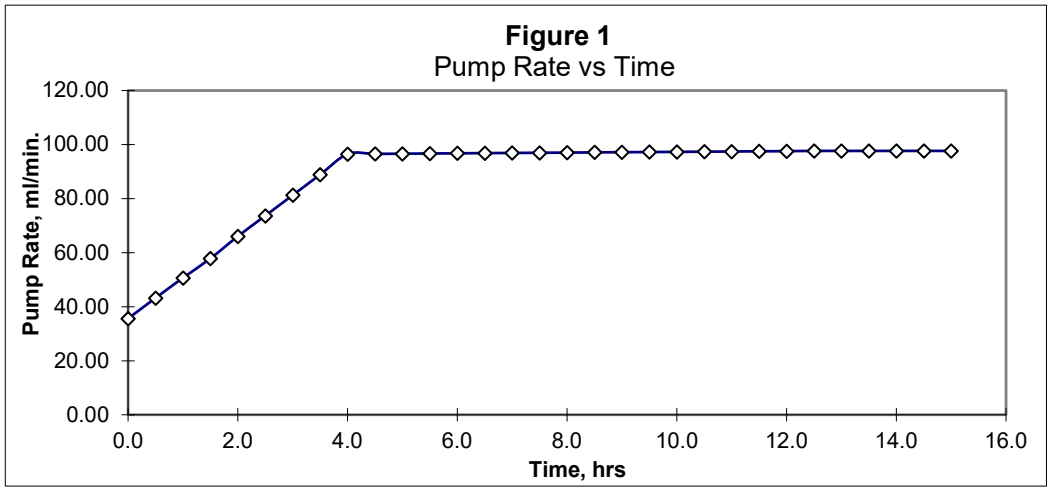
Time, *hrs.*	Rate, *ml/min*
5.0	96.62
5.5	96.69
6.0	96.75
6.5	96.83
7.0	96.89
7.5	96.96
8.0	97.02
9.0	97.16
9.5	97.23
10.0	97.29

Time, *hrs.*	Rate, *ml/min*
10.5	97.37
11.0	97.43
11.5	97.50
12.0	97.56
12.5	97.65
13.0	97.65
13.5	97.65
14.0	97.65
14.5	97.65
15.0	97.65

A ChemTec II CP-120 with a TANDEM 1081 peristaltic pump head (160 RPM pump motor) was used for this feed application. PharMed pump tubing #16 was chosen since it can generate flow rates from 4.6 ml/min. to 120 ml/min.

The following Recipe was entered into the Volu Flow mode:

START
Interpolate from 35.6 ml/min to 96.48 ml/min over 4 hours
Interpolate from 96.48 ml/min to 97.65 ml/min over 11 hours
END



When executing the above VOLU FLOW program, the ChemTec II will generate an initial pump rate of 35.60 ml/min, which is ramped up to 96.48 ml/min. over a four-hour period. This initial ramp is followed by an almost constant pump rate, when actually; the pump rate of 96.48 ml/min. is increased to 97.65 ml/min. over an 11-hour period. During the entire 15-hour operation of the ChemTec II, no human intervention or supervision was required. The ChemTec II performance data was printed out at 15-minute intervals.

Exponential Feed - Mass Flow, Example

A biotechnology company generated the following 75-hour, exponential feed. Utilizing a utility pump hooked up to a process control device, 150 data points were required to define the exponential feed strategy over this 75-hour period.

Parker offered a simpler, alternative approach by generating an exponential feed based on six, linear segments, each segment being 12.5 hours long. This approach reduced the required number of data points from 150 to 7 without adversely affecting the feeding accuracy. The following data set, which was derived from the original 150-point data set, was used to define the six, linear feeding segments:

A ChemTec II CP-8 with a TANDEM 1081 peristaltic pump head
(8 RPM pump motor) was used for this feed application. PharMed pump tubing #16 since it can generate pump rates from 0.4 ml/min. to 6.4 ml/min.

Time, hrs.	Mass Flow Rate, gr/min.
0.0	0.37
12.5	0.50
25.0	0.69
37.5	0.94
50.0	1.28
62.5	1.75
75.0	2.39

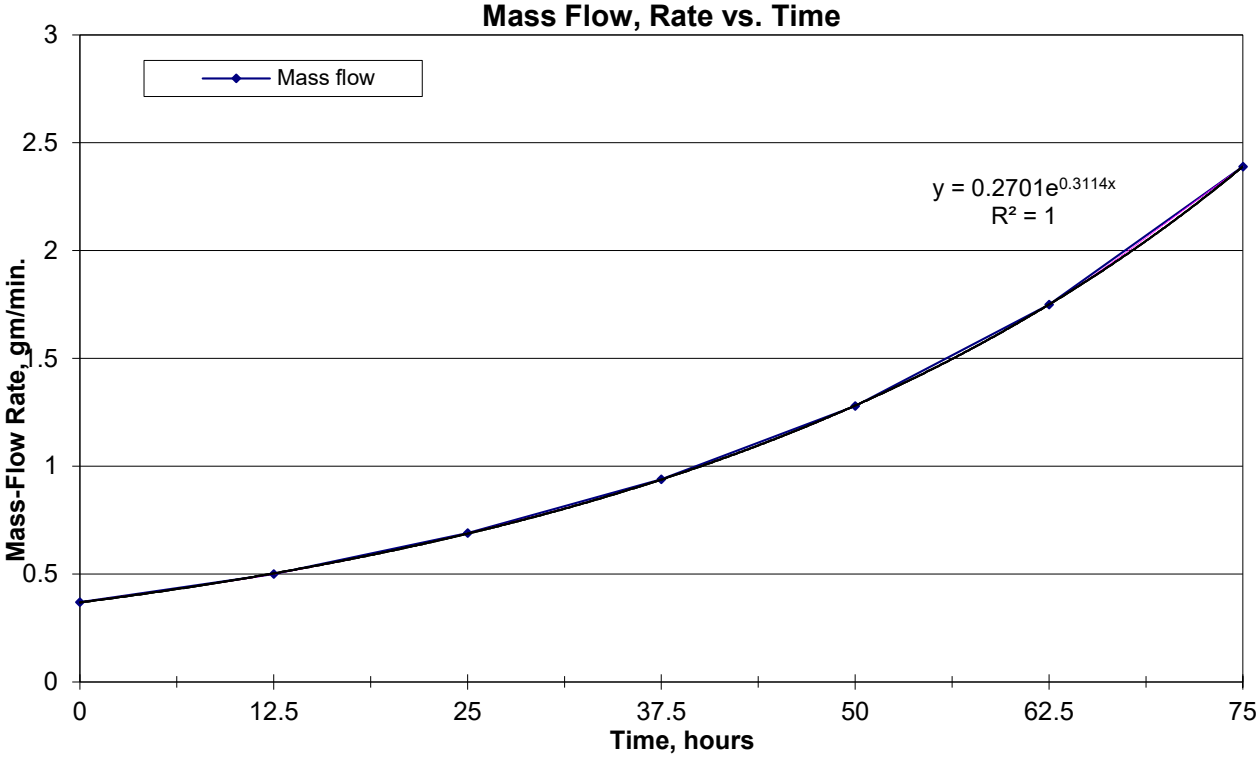
The following recipe was entered into the Mass Flow mode:

START
Interpolate from 0.37 gm/min to 0.50 gm/min over 12 hours, 30 minutes
Interpolate from 0.50 gm/min to 0.94 gm/min over 12 hours, 30 minutes
Interpolate from 0.94 gm/min to 1.28 gm/min over 12 hours, 30 minutes
Interpolate from 1.28 gm/min to 1.75 gm/min over 12 hours, 30 minutes
Interpolate from 1.75 gm/min to 2.39 gm/min over 12 hours, 30 minutes
END

When executing the above program, the ChemTec II will generate an initial pump rate of 0.37 g/m, which is ramped up to 0.50 g/m during the first 12.5-hour segment. As shown in Figure 2, the six linear segments provide an excellent fit. The largest deviation (error) from the original, exponential feed rate is found in the last segment, which starts at 62.5 hours and ends at 75.0 hours. If necessary, the error associated with the last segment can be substantially reduced by generating two segments each 6.25 hours long in its place:

SEGMENTS
Interpolate from 1.75 gm/min to 2.05 gm/min over 6 hours, 15 minutes
Interpolate from 2.05 gm/min to 2.39 gm/min over 6 hours, 15 minutes

Figure 2
Mass Flow, Rate vs. Time



Appendix A.

Tubing Chart

MasterFlex Tubing		13	14	16	25	17	18	15	24	35
Tubing ID*: in		0.030	0.060	0.125	0.190	0.250	0.310	0.190	0.250	0.310
Tubing OD*: in		0.157	0.189	0.251	0.314	0.376	0.439	0.376	0.439	0.500
Tubing Wall*: in		0.063	0.063	0.063	0.063	0.063	0.063	0.093	0.093	0.093
Pump Rate Range*:		ml/min	ml/min	ml/min	ml/min	ml/min	ml/min	ml/min	ml/min	ml/min
CP-8	8RPM	0.03 - 0.45	0.10 –1.63	0.43-6.38	0.9 - 12.6	1.14 -18.3	1.7 - 24.3	0.45 – 13	0.65 – 20	0.8 - 32
CP-120	160RPM	0.5 - 10	1.7 - 35.2	6.3 - 129	12.5 - 283	18.5 - 405	24.7 - 554	9 – 260	13 – 435	16 – 650
CP-200	600RPM	2 - 34	8.6- 132	29 - 533	49 -974	70 - 1048	103 - 1515	59-993	85-1348	111 - 2258
* Nominal Values										
Pump Head Model:		TANDEM 1081						TANDEM 1082		

Tandem Pump Head Installation and Maintenance

TANDEM Dual Channel Peristaltic Pump Head

The TANDEM peristaltic pump head is specifically designed for use with the ChemTec II system. The TANDEM pump heads (models 1082 & 1081) will provide you with rugged reliability as long as common-sense maintenance and good quality pump tubing are used.

For continuous, heavy duty metering applications, the TANDEM 1082 (P/N: 080-1082) together with either #24 or #15 (thick-walled, 0.093” tube wall-thickness) Silicone or PharMed pump tubing is recommended.

The TANDEM pump head is driven by either an 8 RPM, 160 RPM, or 600 RPM high-torque motor. The ChemTec II pump motor is optically encoded and servo-controlled, thus the TANDEM pump head will maintain a constant output over a wide range of metering conditions.

TANDEM Pump Head Installation

1. Identify the front and back of the TANDEM. Two 8-32 mounting cap screws, as well as the pump shaft tang extend from the back of the TANDEM pump head.
2. Facing the front of the TANDEM, open the pump head by moving the black loading lever 180° to the left. The upper and lower pump shoe will move in opposite directions, thereby exposing the inside of the upper and lower pump shoe channels.
3. With the TANDEM pump head completely opened, locate the mounting holes for the two 8-32 cap screws inside the lower pump channel.
4. On the front panel of the ChemTec II, locate the mounting holes and the slotted pump head coupler.
5. Before fastening the TANDEM, align the two mounting screws and pump shaft tang of the TANDEM with the holes and slotted coupler of the ChemTec II front panel mounting plate.
6. Make sure the TANDEM pump shaft tang is properly seated in the mating slot of the pump head coupler, before fastening the TANDEM to the front panel of the ChemTec II.

TANDEM Pump Tube Installation

Open the TANDEM pump head by moving the black loading lever 180° to the left. If using the upper pump channel, slip the tubing into the upper channel; this is over the pump roller cage. If the lower pump channel is used, feed the tubing through the lower channel; this is under the pump roller cage. Do NOT mount or dismount the pump tubing while the ChemTec II is running.

NOTE: When using both upper and lower pump channels simultaneously, the same type of tubing should be used in each channel.

Lock the tubing in place by pushing the loading lever 180° to the right. The tube retainer spring will automatically place the correct tension on the pump tubing to prevent tube "walking".
With the TANDEM pump head closed, lightly pull the two ends of the tubing in opposite directions and away from the pump head. This pulling action insures that the pump tubing is taut and within the pump channel.

TANDEM Pump Tube Replacement

The pump tubing section located in the TANDEM pump head should be advanced at regular time intervals if the ChemTec II is heavily used. Only use high-quality Parker or Masterflex™ pump tubing.

NOTE: When advancing pump tubing, the used pump tube section must be moved to the pump discharge side, i.e. dispensing side. The used pump tube section is weakened and tends to collapse when placed on the suction side of TANDEM pump head.

Appendix B.

RH Series Pump Head Installation and Maintenance

RH Series Piston Pump Heads - General Information

The ChemTec II FM-120, FM-200 and FM-520 systems use rotating, reciprocating piston pump heads of various sizes. In a reciprocating pump, the rotating piston moves back and forth inside the cylinder, sucking in fluid at the inlet while compressing and releasing fluid at the outlet. Flow rates for these pumps are varied by changing either the motor speed or the stroke length. The RH series of piston heads are excellent for precise fluid metering.

These ChemTec II systems provide true positive displacement metering. They can handle pressures up to 100 psi. This style of pump head is appropriate for pumping of suspensions, as well as corrosive / non-aqueous liquids and slurries, emulsions, thin solvents, aqueous solutions and non-abrasive semi-solids. They are also capable of easily handling viscous fluids up to 2000 centipoises. You may pump fluids up to 10,000 cps by applying feed reservoir/line pressure to avoid cavitation.

NOTE: Piston pumps are not recommended for metering of biological fluids, or liquids containing biological cells or cellular components. High local shear is generated in the fluid along with strong mechanical agitation, which may destroy cells and fragment large molecular weight components such as DNA or large protein molecules.

Materials of Construction

RH series pump heads have cylinder bodies and fittings made of either Kynar or Tefzel. The piston and cylinder liner are ceramic, except for the RH00 models, which use a stainless steel piston with a sintered carbon cylinder liner. An “LF” designation refers to a “Low Flow, low dead volume” pump connection, that utilizes ¼-28 HPLC nuts and ferrules with 1/8” or 1/16” tubing instead of compression fittings designed for 1/4” OD tubing.

Installation

The following are directions for dismounting and installing a new pump head on a ChemTec II. The ChemTec II will come with the head already installed and ready to use.

1. Disconnect the power from the ChemTec II.
2. Remove the two screws (6-32 x ½ RH) from underneath the ChemTec II between and just behind the front feet.
3. Remove the four screws (6-32 x 3/8” FH) from the face plate at the front of the ChemTec II.
4. Carefully remove the pump/motor subassembly from the ChemTec II. Disconnect the motor cable from the pc board making note of how it was connected before completely removing it from the chassis.
5. Loosen the set screws on the head side of the coupler.
6. Using an offset screwdriver (It has a tip bent at right angles to the shaft), remove the head mounting screws (8-32 x ½”) from the rear of the face plate, allowing the head to be removed.
7. Reassemble the new head by reversing this process.
8. Test the ChemTec II with the new head installed after making fluid connections to both ports of the pump head. Do not let the pump head run dry without fluid for prolonged periods.

Stroke Volume Adjustment

The knurled Adjustment Ring on the RH series piston head controls the stroke length and thus the output per motor revolution. This Adjustment Ring is factory set to “200”.

By turning the ring clockwise, the stroke length is reduced, and consequently by turning it counterclockwise, the stroke length is increased.

Please do not turn the head clockwise further than a setting of “50” or counterclockwise further than “450”.

Turning the Adjustment Ring past the 450 mark will eventually result in the ring falling off the pump head.

Chemical Compatibility

The RH series of pump heads are well known for their robustness and overall chemical compatibility with many process fluids. The materials used in manufacturing are inert to most chemicals, however the following exceptions must be observed:

- In the model number of the head, the “T” in CTC refers to Tefzel, and the “K” in CKC refers to Kynar.
- For applications involving fluids above 90°F do not use heads with Tefzel cylinder body material. Please use either Kynar, or consult with Parker about the availability of stainless steel heads for your application.
- While Kynar has good chemical resistance to most fluids, Kynar heads must not be used with Acetone, Ketones, or Esters.
- When pumping Acetone, Toluene, Methylethylketone, Methanol, Ethanol, Hexyl Alcohol, Isobutyl Alcohol, or Isopropyl Alcohol, pump heads with Tefzel cylinder bodies must be used.

Viscosity Effects

When pumping high viscosity liquids, you should always use large bore tubing (1/4” OD), slow pump rates, and large stroke volumes. Set the knurled Adjustment Ring to the “400-450” range.

The ChemTec II FM-200 together with either a RH0 or RH1 can handle fluid viscosities up to 2000 cps. Viscosities of up to 10,000 cps can be pumped when the fluid reservoir and /or feed line connected to the pump inlet port are pressurized to avoid cavitation.

H431-02

INSTRUCTIONS FOR ALL "H" MODEL PUMPS

MODELS RH, RHB, RHSY, RHV, PIP

LAB PUMP JR.

CONGRATULATIONS! YOU ARE WORKING WITH ONE OF THE FINEST METERING PUMPS IN THE WORLD - THE FMI LAB PUMP JR., MODEL RH - A RUGGED LITTLE PACKAGE OF EXCEPTIONAL PUMP PERFORMANCE! ITS FLUID PATH IS MADE OF CERAMIC AND FLUOROCARBON TO GIVE IT OUTSTANDING RESISTANCE TO LABORATORY CHEMICALS; ITS INTERNAL DIMENSIONS ARE MEASURED IN MICROINCHES TO PRODUCE MICROLITER RESULTS. USE IT WISELY AND IT WILL GIVE MANY YEARS OF TROUBLE FREE SERVICE.

SAFETY INSTRUCTIONS

Before using any Fluid Metering, Inc. product read the following safety instructions as well as specific product specifications and operating instructions.

Warning! Fire, electrical shock or explosion may occur if used near combustibles, explosive atmosphere, corrosive air, wet environment or submerged in fluid.

- Turn off the electrical power before checking pump for any problems.
- Connect motor, speed controllers, or any other electrical devices based on Fluid Metering Inc. specifications. Any unauthorized work performed on the product by the purchaser or by third parties can impair product functionality and thereby relieves Fluid Metering, Inc. of all warranty claims or liability for any misuse that will cause damage to product and /or injury to the individual.
- Power cables and leads should not be bent, pulled or inserted by excessive force. Otherwise there is a threat of electrical shock or fire.
- Replace any in-line fuses only with fuse rating as specified by Fluid Metering, Inc.
- When pump/drive is under operation, never point discharge tubing into face or touch any rotating components of pump.
- In a power down thermal overload cut-in condition, unplug or turn off power to pump. Always allow a cool down period before restarting: otherwise, injury or damage may occur.
- For 30 seconds after power is removed from pump/drive: do not touch any output terminals. Electrical shock may occur because of residual voltage.

Caution! Fire, electrical shock, injury and damage may occur if not used in accordance with Fluid Metering, Inc. specifications and operation instructions.

- Do not put wet fingers into power outlet of unit.
- Do not operate with wet hands
- Do not operate drive assemblies that require a hard mount (to be bolted down) unless they are mounted per Fluid Metering, Inc. specifications, if not injury may occur and/or damage to unit.
- Do not touch any rotating pump or motor components: injury may occur.
- Do not run pump dry, unless designed for that service.
- Running dry is harmful to the pump, and will cause excessive heating due to internal friction.
- Check pump rotation and inlet/outlet pump port orientation before connecting power to pump. If not injury may occur.
- When pulling out cords from outlets do not pull cord, grasp plug to prevent plug damage or electrical shock.
- Fluid Metering, Inc. Drive Motors become **HOT** and can cause a burn. **DO NOT TOUCH**!

INSTALLATION & OPERATING TIPS

1. CLEAN FLUIDS. Abrasives in the pumped fluid may damage cylinder and piston surfaces and should therefore be avoided.

2. COMPATIBLE FLUIDS. Pump only fluids compatible with materials of construction of your pump.

3. WET OPERATION. The pumped fluid provides surface cooling and lubrication to the piston and cylinder of your FMI PUMP. Therefore avoid dry operation (except pumps specifically designated "gas pump").

4. PRESSURE. Do not operate pump against pressures in excess of design specification. Drive pin on piston may bend or break under overload and other irreparable damage may be suffered. Avoid dead heading. **Check your fluid circuit before applying power to the pump!**

5. CLEANING YOUR PUMP. Routine flushing with solvent before shut-down will suffice for most applications. Set pump for maximum stroke and operate until solvent appears clear at discharge port.

CAUTION! Ceramic piston/cylinder sets are sensitive to neglect and may "freeze if allowed to dry out without adequate cleansing. Fill a loop of flexible tubing with fluid that will thin or neutralize the last fluid pumped. Then connect one end of the tube to the pump suction port, the other to the discharge port. With this loop positioned above the pump head, the ceramic surfaces and seal areas stay moist and mobile for extended idle periods. If, however, a piston does freeze in the cylinder, DO NOT TRY TO FORCE IT FREE! Be gentle. Try to remove the pump head (refer to para. 20) from the base assembly so the whole pump head can be soaked in a suitable solvent. If the head is not conveniently removable, the tube loop discussed in the prior paragraph may permit solvent to dissolve the "frozen" residue in reasonable time. If all else fails, pack it all up and ship it back to the factory with a note telling us what you think might be left inside - sometimes we're lucky. New pump heads are expensive and realigning pump drive components is tedious work, so avoid freeze-ups or, if you feel you must have them, try to correct them gently!

6. ADAPTING RH PUMP HEADS TO STANDARD Q PUMP DRIVE MODULES. (refer to figs. 1,7c) The RH/Q Kit adapts the RH pump heads to standard Q Pump Drive Modules. Assemble as follows:

a) Assemble Kit parts to RH pump head as shown (fig. 1) with "shoe" of part H481-1 down. Slip COUPLING H482 fully onto pump shaft, with its slot away from pump head and SET SCREW 110288-4 contacting the flat on the pump shaft.

b) Insert DRIVE PIN 110301 of Kit into SPHERICAL BEARING 110292 as shown.

c) Orientate coupling slot to accept P/N 110301. On Q drives the shoe is slipped between the base Q402 and Q616 assembly.

FLUID METERING, INC.
5 AERIAL WAY, SUITE 500, SYOSSET, NY 11791
(800) 223-3388 • (516) 922-6050 • FAX (516) 624-8261 • http://www.fmipump.com

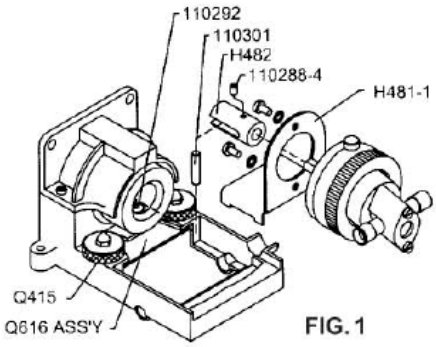


FIG. 1

d) Tighten thumb NUTS and operate motor. If noisy, alter position of BRACKET under RETAINER PLATE slightly while operating until minimal noise position is found. Retighten thumb NUTS.

7. MOUNTING RH PUMP. For maximum pump performance, mount RH pump with motor at 12 O'Clock and pump head at 6 O'Clock position. This orientation will allow air bubbles that enter the pumping chamber to directly exit through buoyant assist. Discharge lines should be inclined upward from pump head.

7.1. PANEL MOUNTING OF RH PUMP HEADS. Two threaded holes (#8-32) are provided on the back side of each RH pump head for panel mounting purposes. A bearing adjustment access hole is also required. Each panel mount layout should, therefore, provide the three holes as shown in fig. 2. below.

It will be noted that the center line of the pump ports is displaced 90° from the center line of the pump mounting holes. Thus, a vertical hole pattern in the mounting panel will result in horizontal port alignment of the pump; a horizontal hole pattern will give vertical port alignment.

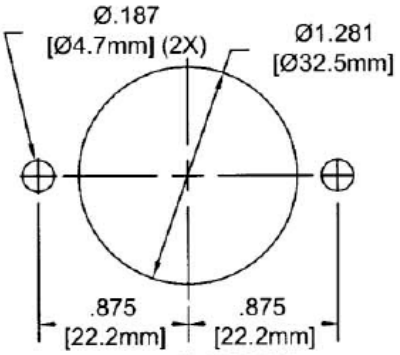


FIG. 2

RHSY

8. RHSY Series pumps are powered by belt-coupled synchronous motors (refer to figs. 4 & 7c). To service this type of pump, **un-plug power cord**, loosen THUMB SCREW 110437 on rear of CASE ASSEMBLY HSY-109 from COVER ASSEMBLY HSY-113. It will then be noted that a machine SCREW 110230-6 and a STAND-OFF 110439 serve to lock the RH pump head assembly and the SY motor assembly to the COVER ASSEMBLY HSY-113. Removal of the machine screw and stand-off permits removal of pump head and/or motor bracket assembly. Loosening the two machine SCREWS 110132-3 holding the MOTOR ASSEMBLY HSY-110- permits adjustment of the drive belt tension (relocates motor position).

Pulley grooves on motor and pump must be in alignment as shown in fig. 4. SET SCREWS 110288-2 in parts HSY-102 and HSY-105 may be loosened as necessary to achieve such alignment. **Tighten screws** after any service adjustment and **replace CASE ASSEMBLY HSY-109** before plugging electric cord into outlet.

Belt tension should be adjusted to taut condition (no arc in belt between pulleys) but should not excessively stretch the belt. Pump stroke rate is controlled by the groove position in which the belt has been placed. Thus in fig. 4, with belt in central position as shown, the pump operates at 300 strokes per minute; with belt on the small-**motor**-pulley and large-**pump**-pulley, (fig. 4) it operates at 150 strokes per minute and with the belt on the large-motor-pulley/small-pump-pulley the pump operates at 600 strokes per minute.

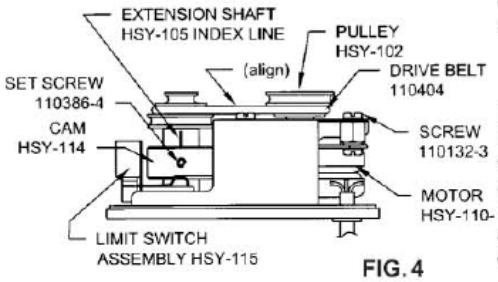


FIG. 4

"PiP" micro π-petter®

9. The FMI micro π-petter® "PiP" has three switches to control its functions: 1) A PENDANT (squeeze button) switch at the end of a 6' long remote operating cord. This switch starts and stops each operating cycle. It is sealed and can be actuated by hand, foot or other remote pressure means. 2) A "MODE" switch face-mounted on the PiP. In the down or SINGLES position this switch permits only one dispense or aspirate pulse per squeeze of the PENDANT and the up or REPEAT position permits the PiP to operate continuously as a pump, when pendant is squeezed operation is temporarily disabled. A center OFF position on this switch provides system-off facility. 3) A DIRECTION switch controls and indicates the direction of fluid flow through the PiP pump head. Pushing the direction switch to the FWD or up position will cause flow in that direction. Push switch down to the REV position to reverse flow direction.

RH PUMP HEAD CALIBRATION

10. HOOK-UP. The pump ports of the FMI RH Pump Head are designed to accept 1/4" outside diameter (O.D.) tubing and/or tubing adapters. (see fig. 7a) The lower port is normally for suction, the upper port for discharge. Suction tubing should be soft and flexible with largest possible inside diameter, shortest practical length. Discharge tube may have smaller inside diameter than suction tube and may incorporate dispense tip or other partial flow restrictors.

11. BUBBLE -CLEARING. After tubing has been securely installed in each of the pump head fittings and the suction line is in the supply fluid, plug electric cord into outlet and operate pump in forward mode until apparent bubbles are cleared from fluid lines. Then, while pump is still operating, pinch-close the suction line for 10 to 15 seconds to cavitate residual bubbles from pump head. Continue to operate until all bubbles are cleared from discharge tube.

12. PUMP STROKE ADJUSTMENT. The knurled ADJUSTMENT NUT on the pump head controls stroke to stroke piston displacement. Turning it clockwise to zero stops displacement. Turning the ADJUSTMENT NUT counterclockwise four and one half turns from zero (450 on scale) (fig. 5) causes maximum pump reciprocation, e.g., 50 µl per stroke for the H-0 or 100 µl for the H-1 unit. Thus each 1-1/8 turn (112.5 on scale) of the ADJUSTMENT NUT represents 25 of maximum (12.5 µl for H-0 and 25 µl for H-1) and each graduation on the ring represents an **adjustment** of 1/450th of maximum (0.111 µl for H-0, 0.222 µl for H-1).

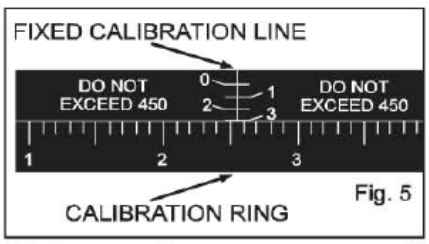


Fig. 5

Hanging the pump vertically with motor at 12 noon and pump head at 6 pm will allow bubbles that enter the pump head to pass directly through with buoyant assist. Discharge lines should be inclined upward from pump head and bubble traps should be purged as often as necessary to assure liquid flow continuity.

19. SYSTEM PRECISION FACTORS. Several interrelated factors are involved in the exceptional operating precision possible in systems using FMI LAB PUMPS. Of primary concern are the following:

a) FMI LAB PUMP DISPLACEMENT precision is based on a simplified positive stroke mechanism which has no secondary linkages to produce stroke to stroke mechanical errors and has no gravity actuated or spring loaded valves to introduce random valve seating errors. The single mechanical linkage components between the LAB PUMP piston and its drive elements is a precision spherical bearing which transforms circular drive motion into elliptical thrust motion (reciprocation). The total mechanical clearance of this linkage is less than 0.1 of the maximum pump stroke length or, approximately 0.0003". Thus it may be said that LAB PUMP **displacement precision** (stroke to stroke) is in the order of the mechanical linkage clearance; that is to say, stroke to stroke displacement is reproducible to less than 0.5 within the rated capacity of a given pump model.

b) FMI LAB PUMP VALVING is performed by a slot in the piston which is mechanically aligned with one cylinder port during the suction portion of each stroke and with the other cylinder port during the discharge portion of each stroke. The slot alignment is controlled by the single drive bearing discussed in the preceding sentences. The valve action is therefore mechanically precise, and free of random closure variations.

c) FLUID SLIP, a term commonly used to describe the migration of fluid around the internal moving parts of gear, lobe and vane pumps, is the volumetric difference between physical component displacement and fluid through-put of a pump system. In the FMI LAB PUMP, slip loss refers to the fluid which passes through the clearance space (approx. .0002") between the piston and the cylinder wall. Since this clearance represents a restrictive passage of essentially constant dimension, it will be readily seen that the slip rate is determined by viscosity, pressure and time: e.g. assuming constant fluid viscosity and pressure, slip will be a smaller factor in a high repetition rate pump (short time per stroke) than in a low repetition rate pump. As viscosity increases and pressure decreases, time (or repetition rate) becomes less a significant contributor to slip loss.

d) STROKE REPETITION RATE is directly related to drive motor speed which in turn is influenced by work load and electrical supply voltage, i.e. motor speed decreases when work load increases and when electrical supply voltage (115 Volts AC) decreases. This motor speed variation may amount to as much as 15 for work load variations between zero discharge pressure and maximum rated discharge pressure. A 10 voltage drop may result in as much as 20 motor speed reduction when the pump is operating against a significant head pressure.

e) THE FLOW STABILITY (precision) of an FMI LAB PUMP is therefore principally related to consistency in fluid slip rate and stroke repetition rate and these functions in turn are related to external system load factors such as viscosity, differential pressure and electric line voltage; i.e., when load factors remain essentially constant, slip rate and repetition rate remain essentially constant; when viscosity increases, fluid slip rate and stroke repetition rate both decrease; when differential pressure increases fluid slip rate increases and stroke repetition rate decreases.

In short, FMI LAB PUMP PRECISION is influenced by fluctuations of fluid differential pressures, fluid viscosity and electric line voltage. When these factors are controlled predictably reproducible pumping precision better than 0.5 may be expected.

MAINTENANCE & REPAIR INSTRUCTIONS

20. REMOVING PISTON/CYLINDER GROUP ASSEMBLY. (refer, Fig 8.) remove two 110655-20 screws and while holding cylinder ports in place, slip part H435 off of CYLINDER ASSEMBLY H422. Tilt the assemly as shown in **figure 8.** This will permit removal of PISTON DRIVE PIN 110366 from SPHERICAL BEARING H477 **without fully withdrawing piston from liner.**

21. SERVICING OF PISTON/CYLINDER GROUP ASSEMBLY. If teardown for detail cleaning or seal replacement is required, remove parts with care to avoid damage to piston, cylinder and seals. For piston/cylinder sets with scavenger slots. Carefully remove all solid matter that may have collected in the scavenger slot - the groove inside the cylinder liner that extends from the left hand port to the seal reservoir. This tiny groove serves the dual purposes of minimizing seal wear and seal weepage by maintaining near atmospheric pressure on the inside seal surfaces. KEEP IT CLEAN! Wipe all parts with lintless oil-saturated cloth. The H408 SEALS that keep your LAB PUMP piston dry are not "just ordinary plastic discs." They are precisely cut and formed from sheets of chemically inert fluorocarbon, specifically formulated for resistance to wear, abrasion, heat and chemical attack.

Each H408 SEAL possesses an exceptional mechanical memory which allows it to maintain a relatively constant wiping pressure on the piston, compensating for seal wear as it occurs. Properly maintained in cleaned condition, the original SEALS on an FMI LAB PUMP may be expected to last the life of the pump. If they are removed for any reason, they should be carefully cleansed of all foreign particles prior to reassembly. Seal seats must also be free of particles.

When H408 SEALS are replaced, the following procedure should be followed: (please see fig. 7a)

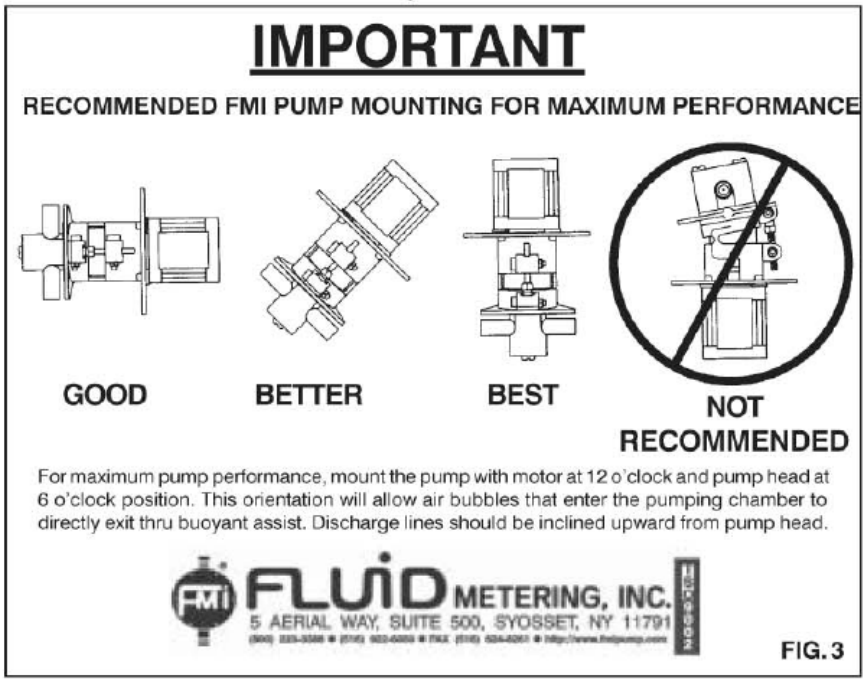


FIG. 3

a) Place GLAND NUT H406 and GLAND WASHER H409 on PISTON ASSEMBLY H423.
b) First "form" lip of LIP SEAL around piston by gently placing a LIP SEAL H408 on piston, **lip side last.** Carefully rotate the seal on the piston to avoid damage to the lip while passing over the flat to the piston neck. *Then remove seal and reverse lip direction.*
c) Gently place one "formed LIP SEAL H408 on piston, **lip side first,** carefully rotating the seal on the piston until it is past the flat and on the piston neck.
d) Gently place two LIP SEALS H408 on piston, **lip side last**. Carefully rotate the seals on the piston to avoid damage to the lip while passing over the flat to the piston neck.
e) Insert piston into CYLINDER ASS'Y H422 and tighten GLAND NUT H406.
f) Rotate piston by hand after reassembly to assure free movement in cylinders and seals.

22. PISTON/CYLINDER GROUP ASSEMBLY REPLACEMENT. (refer, figs. 8 & 9) Install "O" RING 110036 over GLAND NUT H406. Note in fig. 8 that PISTON DRIVE PIN 110366 must be guided into SPHERICAL BEARING H477-1 while the piston and cylinder remain assembled. This for the purpose of avoiding assembly damage to the seals. When PIN is in bearing, seat GLAND NUT with "O" RING in SUPPORT H433 as shown in fig. 9. **OPERATE PUMP MANUALLY FOR SEVERAL STROKES BEFORE APPLYING POWER.**

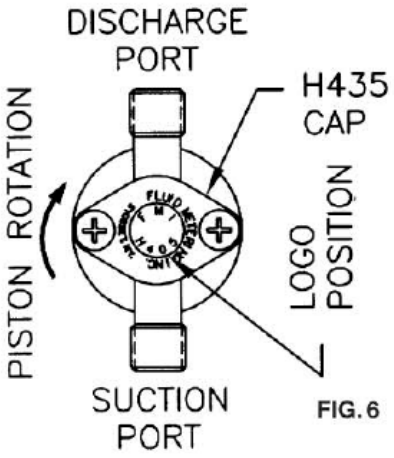


FIG. 6

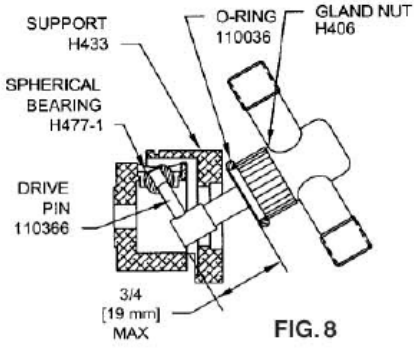


FIG. 8

NOTE THAT PISTON IS VISIBLE IMMEDIATELY BEHIND "LOGO" DURING AT LEAST PART OF EACH REVOLUTION OF PUMP SHAFT - WITHOUT ACTUALLY CONTACTING BACK OF "LOGO"

23. ADJUSTING PISTON/CYLINDER RELATIONSHIP. (refer, figs. 7a, b) If piston is not visible behind "LOGO" or if it contacts "LOGO" during operation, H485 BEARING ASSEMBLY should be adjusted. This situation may occur when PISTON ASSEMBLY H423 has been replaced. To make this correction (see fig. 7a).
a) Loosen THUMB SCREW 110387 and remove CALIBRATION RING H472 then loosen SET SCREW 110288-2 in BASE ASSEMBLY H470.
b) Turn BEARING ASSEMBLY H485 with FMI supplied spanner wrench counterclockwise 1 full turn.
c) Turn ADJUSTMENT NUT H434 clockwise until its threads are completely seated on BASE H432.
d) Rotate BEARING ASS'Y H485 clockwise until PISTON ASS'Y H423 just touches back of logo (as described above) when rotated 360°.
e) Once properly adjusted rotate H485 counterclockwise 1/4 turn and tighten SET SCREW 110288-2. Replace CALIBRATION RING H472.
f) Turn ADJUSTMENT NUT back to its normal operating range and run pump.

23.1 RHB & RHV PISTON/CYLINDER RELATIONSHIP. To correct piston position on RHB & RHV pumps:
a) Loosen THUMB SCREW 110387 on CALIBRATION RING H472-1, rotate until 1/4" hole lines up with piston adjustment hole on BASE H432-1 (fig. 7b).
b) Looking into piston adjustment hole, rotate motor shaft until SET SCREW 110386-4 is visible, loosen set screw.
c) Turn ADJUSTMENT NUT H434 clockwise until threads are completely seated on BASE H432-1.
d) Position SPINDLE H424-1 forward until PISTON ASS'Y H423 is visible at back of logo as described above. Tighten set screw.
e) Check for smooth shaft rotation by turning motor shaft by hand. Repeat step (d) if required. To recalibrate see sec. 12.

24. PISTON SEAL SETTING. After installing new LIP SEALS H408 in pump head it is recommended that the SEALS be set (formed in place) by fluid pressures generated by pump action. To accomplish this:
a) Operate the pump spindle clockwise for 10 or 20 strokes at maximum setting, handling water (left to right mode facing the pump head with suction line blocked or pinched off). This will create a vacuum in the pump head, permitting atmospheric pressure to shape the outer seal member tightly around the piston.
b) Reverse the pumping direction (spindle direction reversed "CCW" on RH pumps) and partially block the suction line. This will generate pressure in the seal area of the pump head, causing the inner seals to form intimately around the piston.

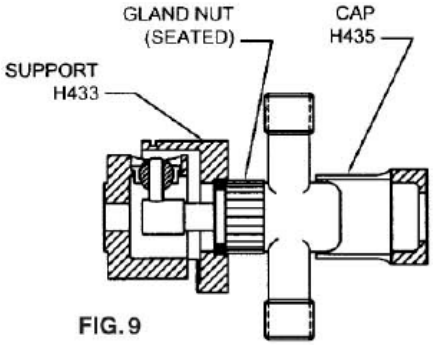


FIG. 9

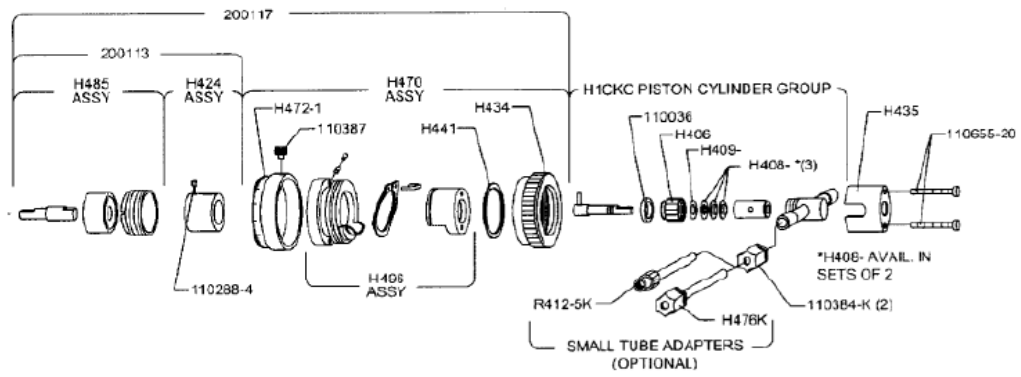


FIG 7c **MODELS RH00CKC, RHOCKC, RH1CKC** FIG. 7a

PARTS PRICE LIST - RH PUMP MODELS

PART NO.	DESCRIPTION
H406	GLAND NUT
H408-0A	LIP SEAL, RULON A, 3/16" PISTON (RH0)
H408-1A	LIP SEAL, RULON A, 1/4" PISTON (RH1)
H408-OOJ	LIP SEAL, RULON J, 1/8" PISTON (RH00)
H409-0	GLAND WASHER, TEFLON 3/16" PISTON (RH0)
H409-1	GLAND WASHER, TEFLON 1/4" PISTON (RH1)
H409-00	GLAND WASHER, TEFLON 1/8" PISTON (RH00)
H424	SPINDLE ASS'Y (RH)
H424-1	SPINDLE ASS'Y (RHB) (RHV)
H434	ADJUSTMENT NUT WITH DECAL
H435	CYLINDER CAP WITH DECAL
H441	SUPPORT RING
H470	BASE ASS'Y
H470-1	BASE ASS'Y (RHB) (RHV)
H472	CALIBRATION RING WITH DECAL
H472-1	CALIBRATION RING WITH DECAL (RHB) (RHV)
H474	ADAPTER PLATE, (MASTERFLEX)
H481-1	BRACKET, ADAPTER (Q)
H482	COUPLING
H482-1	COUPLING, DRIVE - (MASTERFLEX)
H485	BEARING ASS'Y
H496	CYLINDER SUPPORT ASSY (H470)
H498	CYLINDER SUPPORT ASSY (H470-1)

PART NO.	DESCRIPTION
110036	"O" RING
110049	WASHER, #8 INT LOCK
110132-3	SCREW, #8-32 x 3/16" PAN HEAD
110132-8	SCREW, #8-32 x 1/2" PAN HEAD
110132-18	SCREW, #8-32 x 1 1/8" PAN HEAD
110132-54	SCREW, #8-32 x 3 3/8" PAN HEAD
110230-6	SCREW, #8-32 x 3/8" PAN HEAD
110288-2	SET SCREW, #8-32 x 1/8" LONG
110288-4	SET SCREW, #8-32 x 1/4" LONG
110301	DRIVE PIN
110366	PISTON DRIVE PIN
110372	RETAINER, SPRING-RING
110384-K	FERRULE NUT, 1/4" O.D.
110384-T	FERRULE NUT, TEFLON

Please contact SciLog for Pricing and availability.

RH style heads in normal use should have their seals replaced on an annual basis. This is a service SciLog would prefer to do for you, allowing us to keep you informed as to the performance of the head, and when total replacement of the head may be needed. Please note the Maintenance form at the beginning of this manual.

Appendix C.

Magnetic Gear Pump Head Installation and Maintenance

Magnetic Gear Pump Heads- General Information

The ChemTec II MP-320 is equipped with a Magnetic Gear pump head and is recommended for metering applications requiring pulse-free flow. These are external gear type heads in which the spur gears rotate and intermesh inside the chamber, thereby creating a pressure differential between the inlet and outlet ports of the pump.

An inline check valve (Parker p/n 400-536 or equivalent) must be installed on the discharge side of the pump head to avoid back-siphoning of solution between metering or dispensing cycles. The check valve must be above the solution reservoir level.

Only clean fluids, without particulates or abrasives, should be dispensed or pumping capacity will decrease quickly. A gear replacement (Service) kit is available from Parker.
The rotating gears of a magnetic gear pump head generate significant shear, thus shear-sensitive solutions should not be metered/dispensed with this head. Use the Tandem Peristaltic pump head instead.

Magnetic decoupling of the head can occur when the torque limit of the driving magnet has been exceeded. Once this occurs, the driving magnet (the one attached to the motor shaft) turns by itself while the driven magnet (inside the pump head) remains motionless. Magnetic coupling can be restored by simply stopping the pump. The magnets will automatically re-align and re-couple. Decoupling is an inherent feature of magnetic couplings, do NOT indicate a pump failure, and should only occur when the magnet coupling torque limit has been exceeded. It often acts as a safety feature, preventing inadvertent pump / motor overloads.

Avoid metering of liquids of a viscosity greater than 500 cps as this will cause the de-coupling mentioned above. You will need to reduce the pump speed when metering fluids above 300 cps.

MICROPUMP

INSTALLATION, OPERATION AND WARRANTY INFORMATION

- 180 SERIES
- 120 SERIES
- 200 SERIES
- 220 SERIES
- 1330/1350
- 1601
- 5000

IDEX CORPORATION

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Magnetic gear heads have self-priming capabilities when they are new. The ability to self-prime is dependent on the fluid being pumped, your operating system conditions, and the pump model being used, and how long the pump has been in service. If the pump self-priming capability of the magnetic gear pump heads in use has diminished or stopped due to wear, flooding the head will get the fluid moving again as this capability is greatly increased when the gears are wet.

EC DECLARATION OF INCORPORATION

(In accordance with Annex II B of the Machinery Directive 89/392/EEC)

I, the undersigned Scott Hollister, of
MICROPUMP INC.
A Unit of IDEX Corporation
1402 NE 136th Avenue
Vancouver, WA 98684-0818
U.S.A.

CE

Declare that the pumps described in this document comply with the following EU directives:

EN809, EN 292 Part 1, EN 292 Part 2

and within the limits specified for the machinery, is in conformity with the essential health and safety requirements of the Machinery Directive 89/392/EEC and subsequent amending directives.

The machinery described in this certificate must not be put into service until the machinery in which it is incorporated has been declared in conformity with the provisions of the Machinery Directive and its amendments.

MANUFACTURER: Scott Hollister

(Signature)

IMPORTER IN COUNTRY OF USE:

(Signature)

DOC No: 7046 10/00

PUBLISHED BY

MICROPUMP INC.
A Unit of IDEX Corporation
Fifth Edition October 2000

Every effort has been made to ensure that the information contained in this manual is accurate prior to printing. However, the products described in this manual are subject to continuous development and improvement and Micropump shall not be liable for any errors contained herein or for incidental or consequential damages in connection with the furnishing, performance or use of this manual.

LIMITED WARRANTY

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The products manufactured by Micropump Incorporated are warranted to be free from defects in workmanship and material at the time of shipment from the place of manufacture. Micropump will repair or replace, at its option any part of our product which fails to conform to this warranty for a period of one year from the date of manufacture, plus six months warehouse and transit period, or for a period of one year from the date of purchase by the first user of the product, whichever period expires first. In no event shall this period exceed 18 months from date of original invoice. Micropump's obligation under this warranty is limited to the repairs or replacement of defective equipment returned to us on an F.O.B. basis, providing that our examination discloses that such part or parts were defective at the time of sale.

The warranty described above is the exclusive Micropump warranty and is in lieu of all other warranties, expressed or implied, including any warranty of merchantability or fitness for a particular purpose or any warranty previously issued. We neither assume nor authorise any other person to assume for us any other liability in connection with the sale or use of our equipment.

No warranty of any kind is made or shall be imposed with respect to any pump or parts (1) which have not been properly installed and tested in operation, (2) which have been subject to misuse, negligence, acts of God or the elements, or any other form of casualty, or (3) which have been repaired or altered outside of Micropump's plant so as, in our judgment, to affect performance or reliability.

The parties agree that the buyer's sole and exclusive remedy against Micropump shall be for the repair or replacement of defective parts under the conditions stated above. The buyer agrees that no other remedy, including but not limited to incidental or consequential damages for lost profits, lost sales, loss of use, injury to person or property, or any other incidental or consequential loss shall be available to it.

This warranty shall not apply to prototype pumps, experimental pumps, special pumps, or brush-type electric motors. Our warranty position of the aforementioned equipment is available on request.

The adjustment or replacement of defective parts made under this warranty will not extend the original warranty period.

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4

INTRODUCTION

Your Micropump Pump....

represents years of fluid handling experience and we feel it is the finest product available of its type.

The pump you have purchased was designed and constructed to handle compatible, clean fluids within designated limits and conditions. Staying within performance limits and following the guidelines given in this manual will result in excellent performance and maximum pump life.

Should you have a question or a problem, technical assistance is available both in the USA and Europe. Micropump products are designed for easy field servicing with service kits and technical support available for all products.

The Purpose of this Guide....

is to provide information to enable suitably qualified technicians and fitters to install, operate and maintain the Micropump range of gear pumps and gear pump/motor combinations.

How to Use the Guide

You will have purchased a gear pump or gear pump/motor combination. This guide contains specific information for gear pumps and additional general information for gear pump/motor combinations. When installing or operating gear pump/motor combinations the instructions given in this guide should be read in conjuction with the instructions provided with the motor.

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Contents

List of Abbreviations

The following abbreviations are used in this guide:

316SS	316 AISI Stainless Steel	PEEK	Polyetheretherketone
CG	Carbon Graphite	PPS	Polyphenylenesulfide
EPDM	Ethylene Propylene	PTFE	Polytetrafluoroethylene
NPSH	Net Positive Suction Head		

GENERAL

5

Safety

The following are used throughout this guide to indicate procedures that, if not followed correctly, may result in injury to personnel or damage to equipment.

Warnings are used to alert the reader to a procedure or practice, which if not followed correctly, could result in personal injury.

Cautions are used to alert the reader to a procedure or practice, which if not followed correctly, could result in damage to the gear pump or ancillary equipment.

Notes are used to highlight important information that may assist the reader in carrying out a procedure or in understanding the text.

6

LIMITS OF USE

Limits of Use

To achieve optimum performance and safe operation Micropump gear pumps must be operated within the limits given for each model in the Technical Specification tables. Operation outside these limits is not recommended and may result in damage to the gear pump and/or ancillary equipment.

Temperature. Operating the pump beyond the maximum operating temperature given in the technical specification is not recommended and may result in damage to the pump.

Dust and Airborne Contamination. Pump performance is not affected providing the installation instructions given are followed. Reference should always be made to the installation and operating instructions for the motor under such conditions.

Corrosive Liquids. Corrosive liquids may eventually produce leak paths around the sealing surfaces of the pump. The pump should be inspected for leaks on a regular basis.

Flooding and Water Immersion. The pumps covered by this guide are not designed to operate immersed in water. Reference should always be made to the installation and operating instructions for the motor under such conditions.

High Humidity. When pumping cold liquids ensure that condensation does not present a safety hazard. Condensation on the external surfaces of the magnet cup may result in motor seizure. Reference should always be made to the installation and operating instructions for the motor under such conditions.

High Pressure Fluid Ejection. Providing the pump is operated within its technical specification the sealing system will prevent high pressure fluid ejection.

Unpacking and Storage

Before installing the gear pump ensure all transit packaging has been removed. Remove the blanks from the inlet and outlet ports. If the gear pump is to be stored prior to installation re-pack the gear pump in its original packing, refit the blanks to the ports and store in a dry, covered environment.

TECHNICAL SPECIFICATION 180 SERIES

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MODEL No.	180	181	182	183	184	185	186	187	188	1800	1830	1840
FLOW RATE @ 3450rpm (ml/min)	145	145	290	290	145	290	60	60	320	320	320	320
MAX. SPEED (rpm)	8000	8000	8000	8000	8000	8000	8000	8000	8000	10000	10000	10000
MAX. SYSTEM PRESSURE (bar)	20	20	20	20	20	20	20	20	20	20	20	20
MAX. DIFFERENTIAL PRESSURE FOR CONTINUOUS DUTY (bar)	2.75	2.75	2.75	2.75	2.75	2.75	1.4	1.4	1.4	3.4	3.4	3.4
MAX. DIFFERENTIAL PRESSURE FOR INTERMITTENT DUTY (bar)	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	5.5	5.5	5.5
MAX. DIFFERENTIAL PRESSURE (bar) See Note 1	9.7	24.8	4.5	20.7	24.8	20.7	27.6	27.6	11	4.5	20.7	20.7
DE-COUPLING TORQUE (mN/m)	21	78	21	78	78	78	78	78	21	21	78	78
VISCOSITY RANGE (Centipoise)	Up to 100	Up to 100	Up to 100	Up to 100	Up to 100	Up to 100	Up to 100	Up to 100	Up to 100	Up to 100	Up to 100	Up to 100
TEMPERATURE RANGE	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 122°C
WETTED MATERIALS												
Pump Body:	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS
Gears/Bushings:	CG	CG	CG	CG	CG	CG	CG	CG	CG	PPS	PPS	PPS
Seals:	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE
Shafts:	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS
Driven Magnet:	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PPS	316SS & PPS	316SS & PPS
BYPASS VALVE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
NOISE LEVEL dB(A)	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70

Note 1: These pressures are the maximum the pump will generate if the pump outlet becomes blocked.

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TECHNICAL SPECIFICATION 120 SERIES

MODEL No.	114	020	120	122	030	130	132	040	140	142	050	150	152
FLOW RATE @ 3450rpm (ml/min)	9500	1100	2240	3300	1100	2240	3300	1100	2240	3300	1100	2240	3300
MAX. SPEED (rpm)	4000	10000	10000	8000	10000	10000	8000	10000	10000	8000	10000	10000	8000
MAX. SYSTEM PRESSURE (bar)	20 or 92 (See Note 2)	20	20	20	20	20	20	20	20	20	20	20	20
MAX. DIFFERENTIAL PRESSURE FOR CONTINUOUS DUTY (bar)	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
MAX. DIFFERENTIAL PRESSURE FOR INTERMITTENT DUTY (bar)	4.1	6	6	5.5	6	6	5.5	7.5	7.5	5.5	7.5	7.5	5.5
MAX. DIFFERENTIAL PRESSURE (bar) See Note 1	5.9	6.2	6.2	6.2	6.2	6.2	6.2	19.3	9.8	7.2	19.3	9.8	7.2
DE-COUPLING TORQUE (mN/m)	706	134	134	134	134	134	134	78	134	134	134	134	134
VISCOSITY RANGE (Centipoise)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
TEMPERATURE RANGE See Note 3	-46 to 54°C	-46 to 54°C	-46 to 54°C	-46 to 54°C	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 54°C	-46 to 54°C	-46 to 54°C	-46 to 122°C	-46 to 122°C	-46 to 122°C
WETTED MATERIALS													
Pump Body:	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS
Gears/Bushings:	PTFE	PTFE	PTFE	PTFE	PPS	PPS	PPS	PTFE	PTFE	PTFE	PPS	PPS	PPS
Seals:	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE
Shafts:	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS	316SS
Driven Magnet:	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE	316SS & PTFE
BYPASS VALVE	NO	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
NOISE LEVEL dB(A)	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70	<70

Note 1: These pressures are the maximum the pump will generate if the pump outlet becomes blocked.

Note 2: This model is supplied in two configurations. Each configuration has a different maximum system pressure. Models with part number 80943 have a maximum system pressure of 20 bar. Models with part numbers 81427 and 81744 have a maximum system pressure of 92 bar.

Note 3: For pumps with PTFE gears a temperature of 54°C is the maximum temperature with standard seals. Alternative seals can be fitted which will give a maximum temperature of 98°C with the exception of the 114 which has a maximum temperature of 54°C. Consult Micropump or an authorised distributor.

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TECHNICAL SPECIFICATION 200 AND 220 SERIES

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MODEL No.	200.15	200.35	201	219	220	221	223
FLOW RATE @ 3450rpm (ml/min)	900	2050	3950	3000	6400	11000	11000
MAX. SPEED (rpm)	10000	10000	8000	8000	6000	4000	4000
MAX. SYSTEM PRESSURE (bar)	20	20	20	103	68	68	103
MAX. DIFFERENTIAL PRESSURE FOR CONTINUOUS DUTY (bar)	5	5	3.5	4.1	4.1	4.1	4.1
MAX. DIFFERENTIAL PRESSURE FOR INTERMITTENT DUTY (bar)	5.5	5.5	3.5	10.3	8.3	4.5	4.5
MAX. DIFFERENTIAL PRESSURE (bar) See Note 1	11	7.5	4.5	11	10.3	5.2	7
DE-COUPLING TORQUE (mN/m)	162	162	162	388	692	692	692
VISCOSITY RANGE (Centipoise)	100	100	100	1500	1500	1500	1500
TEMPERATURE RANGE	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 122°C	-46 to 122°C
WETTED MATERIALS							
Pump Body:	316SS	316SS	316SS	316SS	316SS	316SS	316SS
Gears/Bushings:	PPS	PPS	PPS	PPS	PPS	PPS	PPS
Seals:	VITON®	VITON® or EDPM	VITON®	VITON®	VITON®	VITON®	NEOPRENE
Shafts:	316SS	316SS	316SS	316SS	316SS	316SS	316SS
Driven Magnet:	316SS & PPS	316SS & PPS	316SS & PPS	316SS & PPS	316SS & PPS	316SS & PPS	316SS & PPS
BYPASS VALVE	OPTIONAL	OPTIONAL	OPTIONAL	NO	NO	NO	NO
NOISE LEVEL dB(A)	<70	<70	<70	<70	<70	<70	<70

Note 1: These pressures are the maximum the pump will generate if the pump outlet becomes blocked.

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TECHNICAL SPECIFICATION 1330/1350/1601/5000

MODEL No.	1330	1350	1601	5000
FLOW RATE @ 3450rpm (ml/min)	2300	2300	360	20000
MAX. SPEED (rpm)	5000	5000	8000	4000
MAX. SYSTEM PRESSURE (bar)	13.8	13.8	5.2	20
MAX. DIFFERENTIAL PRESSURE FOR CONTINUOUS DUTY (bar)	3.5	3.5	2.75	2
MAX. DIFFERENTIAL PRESSURE FOR INTERMITTENT DUTY (bar)	3.5	3.5	2.75	3
MAX. DIFFERENTIAL PRESSURE (bar) See Note 1	5.5	5.5	4.5	3.5
DE-COUPLING TORQUE (mN/m)	134	134	21	680
VISCOSITY RANGE (Centipoise)	100	100	100	1500
TEMPERATURE RANGE	-45 to 65°C	-45 to 65°C	-45 to 65°C	-46 to 122°C
WETTED MATERIALS				
Pump Body:	316SS & PPS	316SS & PPS	PPS	316SS
Gears:	PPS	PPS	PPS	PTFE or PEEK
Bushings:	PPS	PPS	PPS	RULON® or PEEK
Seals:	VITON®	VITON®	EPDM	PTFE or VITON®
Shafts:	316SS	316SS	316SS	316SS
Driven Magnet:	316SS & PPS	316SS & PPS	316SS & PPS	316SS & PPS
BYPASS VALVE	YES	NO	NO	NO
NOISE LEVEL dB(A)	<70	<70	<70	<70

Note 1: These pressures are the maximum the pump will generate if the pump outlet becomes blocked.

DOC No: 7048 10/00

DESCRIPTION

11

Description

The pump comprises a sealed unit containing the pumping parts which are connected to a driven magnet. The magnetic cup separates the pumped liquid from the atmosphere and is attached to the pump body. Elastomer seals prevent leakage. The driving magnet, which is attached to a motor shaft, encircles the magnetic cup.

180 Series Pumps are suction shoe gear pumps. Each pump is manufactured from 316 stainless steel and is fitted with PTFE seals and carbon graphite gears and suction shoes. 1800, 1830 and 1840 pumps are fitted with PPS gears and suction shoes.

200 Series Pumps are suction shoe gear pumps. Each pump is manufactured from 316 stainless steel and is fitted with Viton® seals and PPS gears and suction shoes.

120 Series Pumps are conventional cavity style gear pumps. Each pump is manufactured from 316 stainless steel and is fitted with PTFE seals and gears. Model 130 and 150 pumps are fitted with PPS gears.

1330/1350/1601 Pumps are conventional cavity style gear pumps. Each pump is manufactured from PPS and is fitted with PPS gears. 1330/1350 models are fitted with Viton® seals. 1601 models are fitted with EPDM seals.

5000 Pumps are conventional cavity gear pumps. Each pump is manufactured from 316 stainless steel and is fitted with either PTFE seals and gears or PEEK gears and Viton® seals.

Function

The driven magnet is connected to the pumping parts and is sealed in the magnet cup. The driving magnet, which is connected to the motor, encircles this cup. The magnets align pole-to-pole and rotate together with no slippage until the decoupling limit is exceeded. Rotation of the pumping elements produces flow.

Magnet Decoupling

Magnetic decoupling occurs when the load on the pump exceeds the coupling torque between the magnets. The magnets are forced out of pole-to-pole alignment and are decoupled. When decoupling occurs, the driving magnet speed increases to motor no-load speed while the driven magnet and pumping parts remain motionless. To recouple the magnets the motor must be stopped, allowing the magnets to re-align and then restarted.

NOTE

Decoupling is an inherent feature of magnetic couplings and DOES NOT indicate a pump failure. Decoupling should only occur when the magnet decoupling torque has been exceeded. Decoupling can be a safety feature, preventing inadvertent pump/motor overloads.

The decoupling torque can vary with different fluids, temperatures, system conditions and width of driving magnet. The decoupling torques given in the Technical Specification tables are for pumping clean water at 21°C.

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INSTALLATION

Installation

Pump Location. The following should be observed when selecting the pump location:

- The pump should be located with the inlet below or as close as possible to the fluid level of the fluid supply. The pump can be mounted in any position.
- Ensure that there is adequate space for operation, inspection and maintenance.
- The foundation must be capable of supporting the combined weight of the pump and motor and provide a rigid support.

Installation in Explosive and Fire Danger Zones.

WARNING

Ensure the motor is suitable for area classification.

WARNING

Ensure that the pumphead does not exceed flash point temperature of area if pumping hot liquids.

WARNING

Ensure that the pump does not run dry for extended periods.

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Space Requirements. Refer to the illustrations on pages 21-22 for overall dimensions and weights of the pumps covered by this guide.

Pipework. The following should be observed when connecting pipework.

- Pipes connected to the pump should be level or slope down towards the pump.
- Ensure that no part of the pipe extends below the level of the pump suction port.
- Ensure all pipes and fittings are of the correct size for the pump being installed. Refer to the following table.

NOTE

Restrictions in the inlet and discharge lines may cause a loss of pump performance. A restriction can be a valve, small bore tubing, long lengths of tubing or sharp turns/elbows in the line. Limit these restrictions wherever possible.

PUMP MODEL No.	PORT SIZE	MIN. RECOMMENDED TUBING I.D.
180 Series	1/8" NPT	6.5mm (1/4")
040, 120, 130, 122	1/8" NPT	6.5mm (1/4")
114	1/4" NPT	10mm (3/8")
200, 201	1/8" NPT	6.5mm (1/4")
220, 221	3/8" NPT	12.5mm (1/2")
1330/1350	1/8" NPT	6.5mm (1/4")
1601	1/4" UNF	6.5mm (1/4")
5000	1/2" NPT	12.5mm (1/2")

INSTALLATION

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Filtration.

The pump can be damaged if the fluid being pumped has suspended solids that are abrasive. Always install a suitable filter or strainer when these fluids are being pumped.

For open systems the filter must be installed on the inlet side of the pump. For closed loop systems the filter can be installed on the inlet or discharge side.

Recommended filter specifications for the pumps covered by this guide are given below.

All strainers and filters should have large surface areas to prevent excessive pressure drop.

PUMP SERIES	FILTER TYPE/SIZE
180/1601	5 MICRON, [<0.14 bar (2 psi) pressure drop] CANNISTER or FINE MESH style
120 1330/1350/5000	40 MICRON, soft particles [<0.27 bar (4 psi) pressure drop] 5 MICRON, hard particles [<0.27 bar (4 psi) bar pressure drop] CANNISTER style
200/210/220	40 MICRON, soft particles [<0.14 bar (2 psi) bar pressure drop] 5 MICRON, hard particles [<0.14 bar (2 psi) pressure drop] CANNISTER style

Mounting Plates and Adapters

If you have purchased a pump/motor combination this will be assembled ready for installation.

If you have purchased a pump without a motor you may require an NEMA 56C or IEC/ISO adapter. IEC/ISO adapters are supplied in frame sizes 56, 63 and 71.

Models 114, 219, 220, 221, 223 and 5000 are supplied in ready to mount form in either 56C or IEC/ISO format (frame size 63 and 71).

Models 020, 030, 040, 050, 120, 122, 130, 132, 140, 142, 150, 152, 1840, 184, 185, 187, 200 and 201 couple directly to Micropump 56C or IEC/ISO adapters. Refer to the instructions supplied with the adapter kit for installation details.

Models 180, 181, 182, 183, 186, 188, 1800, 1830, 1300/1350 and 1601 are designed for use with small motors and do not accept 56C or IEC/ISO motors. These models are supplied with a suitable motor mounting bracket. Refer to the instructions supplied with the motor mounting bracket for installation details.

If a non-Micropump mount/adapter is used it must comply with the requirements of EN 809.

Mounting screws are provided with Micropump supplied motors. Mounting screws are not provided with gear pumps.

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INSTALLATION

Fitting the Pump/Motor to the Installation. It is recommended that the pipe fittings are connected to the pump before the pump/motor is fitted into the installation. The following should be observed when connecting pipe fittings:

- Pipe sealing compound or PTFE tape should be applied to the threads to prevent leakage.
- Apply sealant or tape sparingly to prevent a build up of excess material which may dislodge and clog the pump. Two wraps of PTFE tape are usually sufficient.
- Secure the pump in a vice (use pads to protect the pump body) and support the motor when installing fittings.

Do not overtighten fittings. Refer to the manufacturers installation instructions for torque values .

Ensure all piping is clean and flushed out prior to connection to the pump. Do not force piping into position as this will place unnecessary strain on the pump.

Ensure that inlet and discharge pipes are connected correctly in relation to the direction of flow arrow marked on the pump.

Piping should be installed according to the following guidelines:

- Design piping runs to minimise friction losses. Restrictions in the inlet and discharge lines may cause a loss in performance.
- Piping that handles hot liquid requires installation of expansion loops/joints to prevent misalignment from linear expansion.
- Never size suction piping diameter smaller than the pump suction port.
- Ensure all joints are airtight.
- Separate suction lines are recommended when more than one pump is operating from the same medium source.

If in doubt refer to the guidelines for piping given in the "Hydraulic Institute Standards".

Secure the pump/motor to the installation using suitable fixing bolts. Connect the inlet and discharge pipework to the pump.

INSTALLATION

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Electrical Connection. Refer to the installation instructions supplied with the motor for connection details.

Electrical installation must be carried out by qualified personnel who are conversant with local electricity installation regulations.

Before starting any electrical installation work ensure that the main electrical supply is adequately isolated.

Ensure that the voltage and frequency of the supply are correct for the motor being connected.

When using DC motors they must be connected to a class II power supply.

The pump may be electrically isolated from the motor depending on the mounting configuration. Some installations may need an earthing connection on the pumphead.

Pumping flammable fluids without a proper earthing connection may cause spontaneous ignition.

Compressed Air Connection. Refer to the installation instructions supplied with the motor for connection details.

Compressed air connections must be carried out by qualified personnel who are coversant with the hazards associated with high pressure air supplies.

Ensure that the compressed air supply is suitable for the type of motor being used.

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OPERATION

Operation

Start-up Procedure. Before starting the pump ensure that any valves in the inlet or discharge lines are open and that any inlet filters are clean and free from obstruction.

Starting or running the pump with the discharge valve closed will result in overloading of the drive motor and overpressure in the discharge pipe.

Once started the pump should prime if it has not already been filled with fluid. If the pump fails to prime, stop the pump and fill the pumphead with liquid.

Post Start-up Checks. Once the pump has started carry out the following checks:

Check that the pump is rotating in the correct direction. This should be clockwise when viewing the drive shaft of the drive unit. If the direction of rotation is incorrect check the motor electrical connections.

Flow rate should always be adjusted by the valve fitted in the discharge line. Ensure that overpressure does not occur in the discharge pipe. NEVER throttle flow by the inlet valve.

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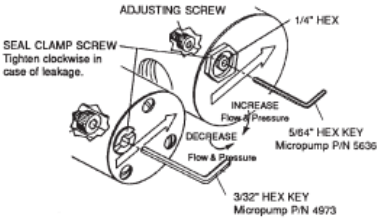
- Check that the pump and motor operate smoothly and are free from vibration.
- Check the inlet and discharge fittings are free from leaks.

Shut-down Procedure. Switch off the drive motor and check that the unit runs down in a steady manner. Close the inlet and discharge valves. Drain the pump if it is to be shut-down for long periods or installed in areas where the liquid may freeze.

OPERATION

Bypass Valve Adjustment. The bypass valve is an internal relief valve that permits recirculation of the working fluid when the pre-set pressure is reached. The bypass can be activated from 0.7 bar (10psi) to the maximum differential pressure of the pump. The bypass can be adjusted in situation while the pump is operating by rotating the adjusting screw with the hexagon key provided. Turn the screw clockwise to increase pump pre-set pressure and anticlockwise to decrease pump pre-set pressure.



CAUTION

The pump internally re-circulates bypass fluid and heat can be produced as a result. Increasing the amount of fluid that is re-circulated through the bypass will increase the heat produced. It is possible that at full bypass the fluid temperature will exceed the operating temperature of the pump. Micropump recommend that pumps are not run continuously at full bypass.

How to Recognise Magnet De-coupling. Magnet decoupling occurs when the load on the pump exceeds the coupling torque between the magnets. The magnets are forced out of pole-to-pole alignment and are decoupled. When decoupling occurs , the driving magnet speed increases to motor no-load speed while the driven magnet and pumping parts remain motionless.

NOTE

Decoupling is an inherent feature of magnetic couplings and DOES NOT indicate a pump failure. Decoupling should only occur when the magnet decoupling torque has been exceeded. Decoupling can be a safety feature, preventing inadvertent pump/motor overloads.

Causes of Magnet De-coupling. Due to the quiet operation of magnetic pumps it is not always possible to detect, without disassembly of the pump, when the magnet coupling and pumping parts are operating incorrectly. It is therefore important to be able to recognise possible causes of magnet de-coupling:

- Blockage or restriction in the discharge side of the system
- Discharge pressure exceeds decouple point
- Fluid viscosity too high
- Foreign particles jamming pumping parts
- Binding or stuck pumping parts - this may occur between pumping cycles as a result of dried residue of the fluid being pumped. Drain and flush the pump to remove the residue.

OPERATION

Magnet Re-coupling. Before re-coupling ensure that the cause of the de-coupling has been identified and rectified. To recouple the magnets the motor must be stopped, allowing the magnets to re-align, and then restarted.

Draining. The pump should only require draining prior to disassembly for service, changing the type of liquid being pumped or to prevent frozen liquid damage to the pump

WARNING

The pump cannot be drained completely, a certain amount of liquid will remain in the magnet cup area. Ensure that the pump is either flushed with a suitable flushing agent or precautions are taken against the effect of any remaining liquid during servicing. When the pump has been handling flammable, toxic or hazardous fluid, the pump internals must be properly decontaminated by suitably qualified personnel. The Material Safety Data Sheet for the pumped liquid must be referred to for correct procedures and precautions to be followed when handling the liquid.

Dry Running. Dry running for short intervals (i.e. when dry lifting to prime the pump) may not affect pump performance.

CAUTION

Extended periods of dry running may result in permanent damage to the pump.

Mixed Phase. Micropump gear pumps can handle mixed phase (gas/fluid) pumping.

Reverse Pressure. Pressure loaded suction shoe pumps (Series 180, 200, 220) cannot operate conventionally under reverse pressure conditions. This occurs when the fluid pressure coming into the pump is greater than the fluid on the discharge side. Contact your Micropump distributor for information on reverse pressure installations.

MAINTENANCE AND FAULT ISOLATION

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Maintenance

Micropump magnetic drive gear pumps are designed to be maintenance free and, apart from bypass models, require no adjustments. To ensure the pump retains optimum performance maintain the fluid circuit to keep filters clean and prevent abrasive solids from passing through the pump.

Like all pumps Micropump gear pumps contain components that will wear over a period of time. This will be noticeable by a gradual deterioration in performance and you should contact your Micropump distributor for a service kit. Each service kit contains full fitting and service instructions.

Fault Isolation.

If the pump does not meet its design performance or fails to operate correctly refer to the following tables for assistance in identifying the cause and remedy:

PUMP PRODUCES NO LIQUID AT START UP	
CAUSE	REMEDY
Suction valve closed. Discharge valve closed.	Open suction valve. Open discharge valve.
Pump does not come up to speed, magnets de-couple.	Shut off the motor. Check the motor is running. Ensure inlet and outlet valves are open.

PUMP DOES NOT SUCTION LIFT OR SELF PRIME	
CAUSE	REMEDY
Suction pipe is not properly sealed and the pump is pulling in air.	Check suction pipe and fittings are airtight.
Viscosity of liquid is too high or too thin causing loss of self-priming capability.	Install foot valve at the bottom of the suction line, fill suction line and pump with liquid before restart. Modify pipe layout.

PUMP SEIZES IMMEDIATELY AFTER START-UP	
CAUSE	REMEDY
Solids are present in the pump.	Clean tank and piping system. Replace any damaged parts before reassembly

PUMP IS NOISY AND VIBRATES AFTER START-UP	
CAUSE	REMEDY
Magnet coupling out of alignment. Signs of rubbing may be present on magnet cup.	Check alignment. Ensure adapter/mount is of the correct type and is not damaged or distorted. Use only Micropump adapter/mounts.
Mounting base not rigid.	Ensure the base is adequately supported, particularly in the area of the motor attaching points. Ensure attachment bolts are of the correct size and tightened sufficiently.
Pump cavitates; NPSH available < NPSH required.	Increase NPSH available.

MAINTENANCE AND FAULT ISOLATION

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PUMP DOES NOT OBTAIN RATED FLOW OR PRESSURE AT START UP	
CAUSE	REMEDY
Suction line valve is not fully open.	Open suction valve.
Suction line strainer or filter is blocked.	Clean.
Pump rotates in wrong direction.	Check motor electrical connections (refer to connection details supplied with motor).
Suction pipe is not properly sealed and the pump is pulling in air.	Check suction pipe and fittings are airtight.
Differential head of the system is higher than specified.	If differential head cannot be reduced, a higher pressure pump is required.
Viscosity is higher than pump specification.	Contact your Micropump application engineer.
Pump cavitates; NPSH available < NPSH required.	Increase NPSH available.

MOTOR IS OVERLOADED	
CAUSE	REMEDY
Differential head is higher than specification, discharge valve is fully open. Pump operates with reduced capacity and increased power consumption.	If capacity is more than required, install additional bypass line from discharge to suction. Adjust the capacity and differential head with a throttle valve in the bypass line.
Density or viscosity is higher than pump specification.	Contact your Micropump application engineer.

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WEIGHTS AND DIMENSIONS

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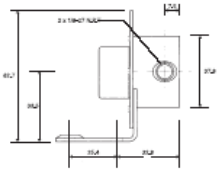
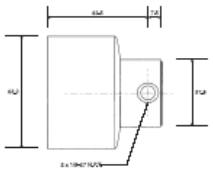
Weights and Dimensions

All dimensions in mm.

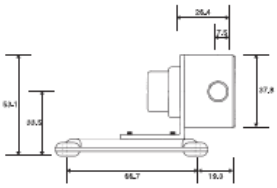


Model 181, 183, 186, 1830
Weight = 0.27kg

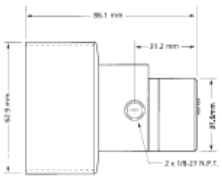
NOTE: Bracket is supplied with some motor assemblies and is shown here for dimensional purposes only.



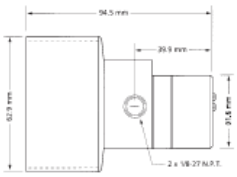
Model 184, 185, 187, 1840
Weight = 0.31kg



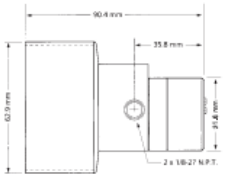
Model 180, 182, 188, 1800
Weight = 0.24kg



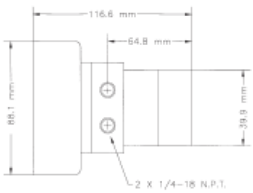
Models 020, 030, 040, 050
Weight = 0.43kg



Models 122, 132, 142, 152
Weight = 0.47kg



Models 120, 130, 140, 150
Weight = 0.46kg



Model 114
Weight = 1.63kg

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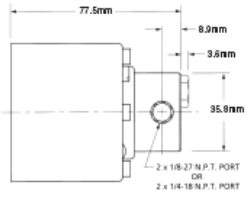
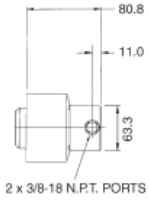
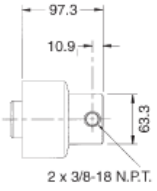
WEIGHTS AND DIMENSIONS



Models 200, 201
Weight = 0.36kg



Model 219
Weight = 1.63kg



Models 220, 221, 223
Weight = 1.63kg

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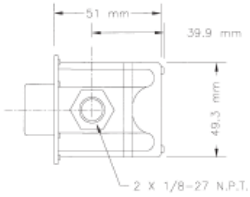
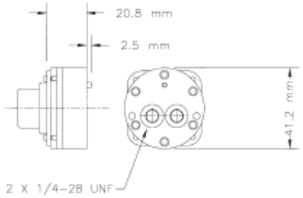
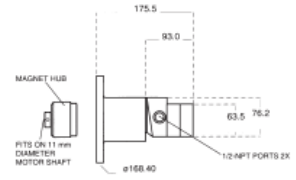


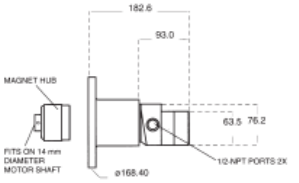
Models 1300/1350
Weight = 0.25kg



Model 1601
Weight = 0.06kg



Model 5000 on IEC/ISO 63 Adapter
Weight = 3.9Kg



Model 5000 on IEC/ISO 71 Adapter
Weight = 3.9Kg

Notes

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