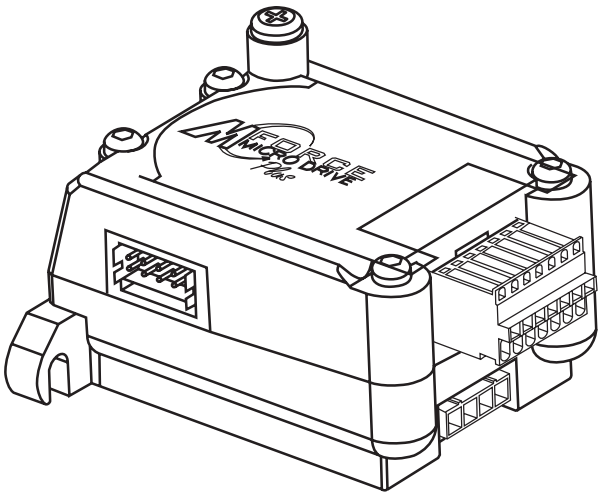
VICI

Valco Instruments Co. Inc.

M Series Pump
Models M6 and M50
Instruction Manual

For units with MForce controller, shipped since September 2016



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VICI does not recommend the use of an M Series pump in life support or applications where it may directly or indirectly threaten life or injury. See the Warranty and Disclaimer statement included in the back of this manual.

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Product Description

The Cheminert® M Series liquid handling pump is a syringe-free pump capable of delivering a bidirectional flow to six orders of magnitude. It is a positive displacement pump, which means that it is self-priming and tolerant of any gas which may find its way into the fluid lines. Since there is no separate fill cycle, the pump can be operated continuously, and volumetric capacity is limited only by time.

RS-422/485 communication protocols are incorporated into the microprocessor-driven controller. USB interface requires an adapter cable, supplied as part of the full pump package.

The M Series pump is recommended for any liquid handling applications requiring accuracy and precision. It is particularly suited for applications with a wide range of volumes (which entail laborious syringe changes with other pumps) and for applications which benefit from the versatility provided when the pump is coupled with the optional multiposition reagent selection valve.

Operating Principle

At the core of the pump is a rotor which houses four pistons. As the microstepper motor turns the rotor, the pistons float on a stationary cam; at any given moment, one piston is filling, one is dispensing, and the other two are in transit between the fill and dispense positions.

Software

The pump comes complete with MSLHS software, which employs standard liquid handling terminology and an integrated valve control package in a familiar Windows format for everyday lab usage. For more advanced control of system parameters, download a programming manual directly from the manufacturer at http://motion.schneider-electric.com/downloads/manuals/MCode.pdf.

Hardware installation (pages 4-6) is the same for all users.

Getting Started

Components of the M Series Pump System

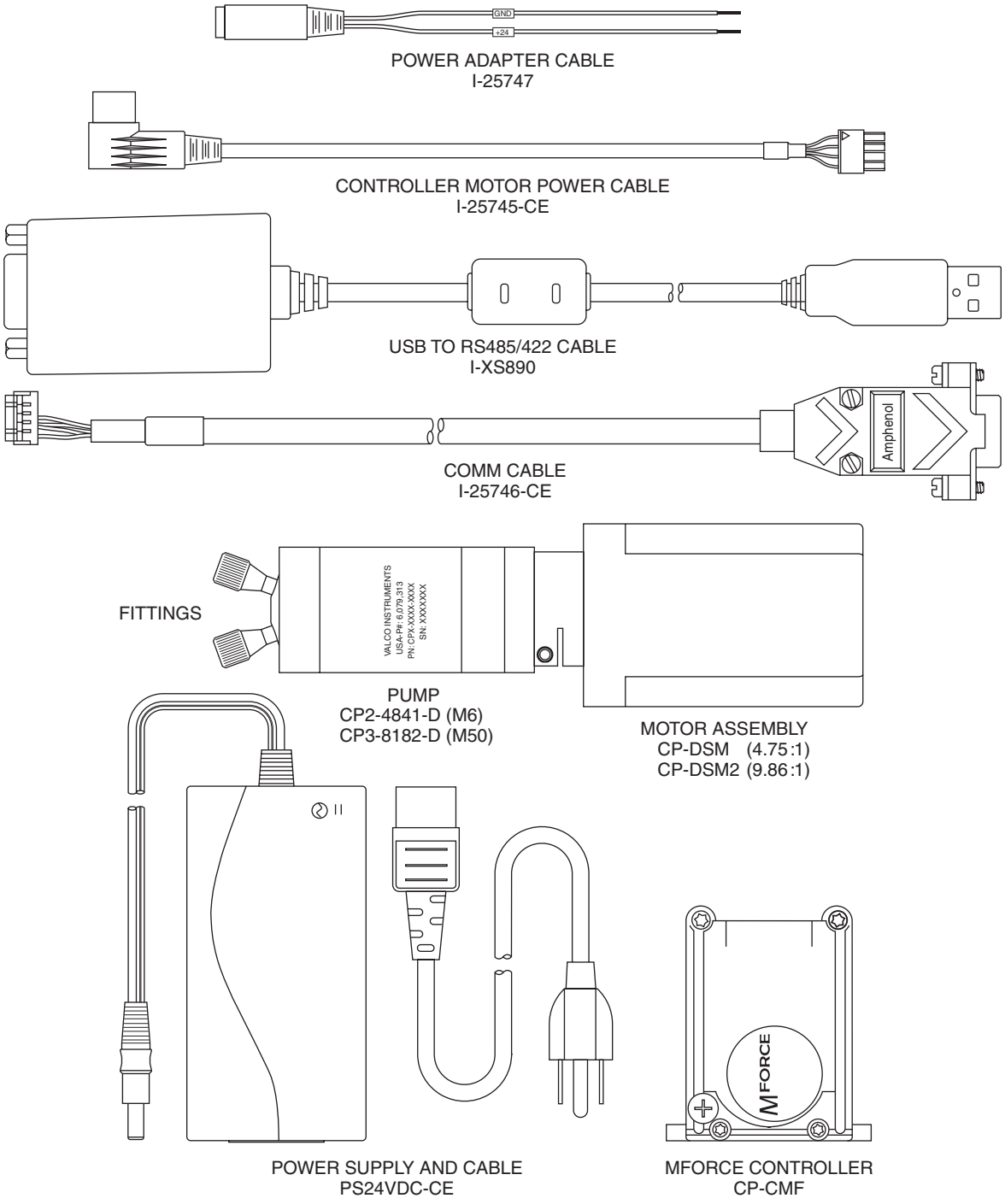
Check the contents of the packages against **Figure 1** to verify that you have received all of the components. Contact the factory if anything is missing or damaged. (NOTE: damaged shipments must remain with the original packaging for freight company inspection.)

Components include:

- Pump
  Model M6: Product number CP2-4841-D
  Model M50: Product number CP3-8182-D
- Motor assembly
  Model M6: Product number CP-DSM
  Model M50: Product number CP-DSM2
- MForce controller: Product number CP-CMF
- Power adapter cable: Product number I-25747
- Controller motor power cable with 5 pin DIN connector:
  Product number I-25745-CE
- Comm cable: Product number I-25746-CE
- RS-422/485 to USB converter cable: Product number I-XS890
- 24 VDC power supply with 110/220 VAC cable:
  Product number PS24VDC-CE
- Fittings (2)
  Model M6: Product numbers ZN1FPK (nut) and ZGF1PK (ferrule)
  Model M50: Product numbers CFL-2BK-S (nut) and
  CFL-CB2KF-S (bushing)
- MSLHS software (flash drive)
- Manual
- Quality control certificate

PC System Requirements

Pentium PC 100 MHz or higher, running Windows 95, 98, ME, NT, 2000, XP, 7, or 10. The pump controller requires a dedicated serial port. If your pump system includes a valve with electric actuator, an additional serial port is required.



System components not shown in illustration:

1. This manual
2. Flash drive with MSLHS software
3. Quality control certificate
4. *Optional* stream selection valve and valve controller (Contact VICI for details)

Figure 1: Components of the M Series pump system

Hardware Installation

Mounting

The mounting points of the pump motor and controller are given in **Figure 2**, along with the external dimensions of each module.

For best results, the M Series pump must be oriented with its ports facing up. If the pump is oriented in any other direction, bubbles may be trapped in the internal chambers of the pump.

The controller should be mounted in such a way to allow adequate cooling.

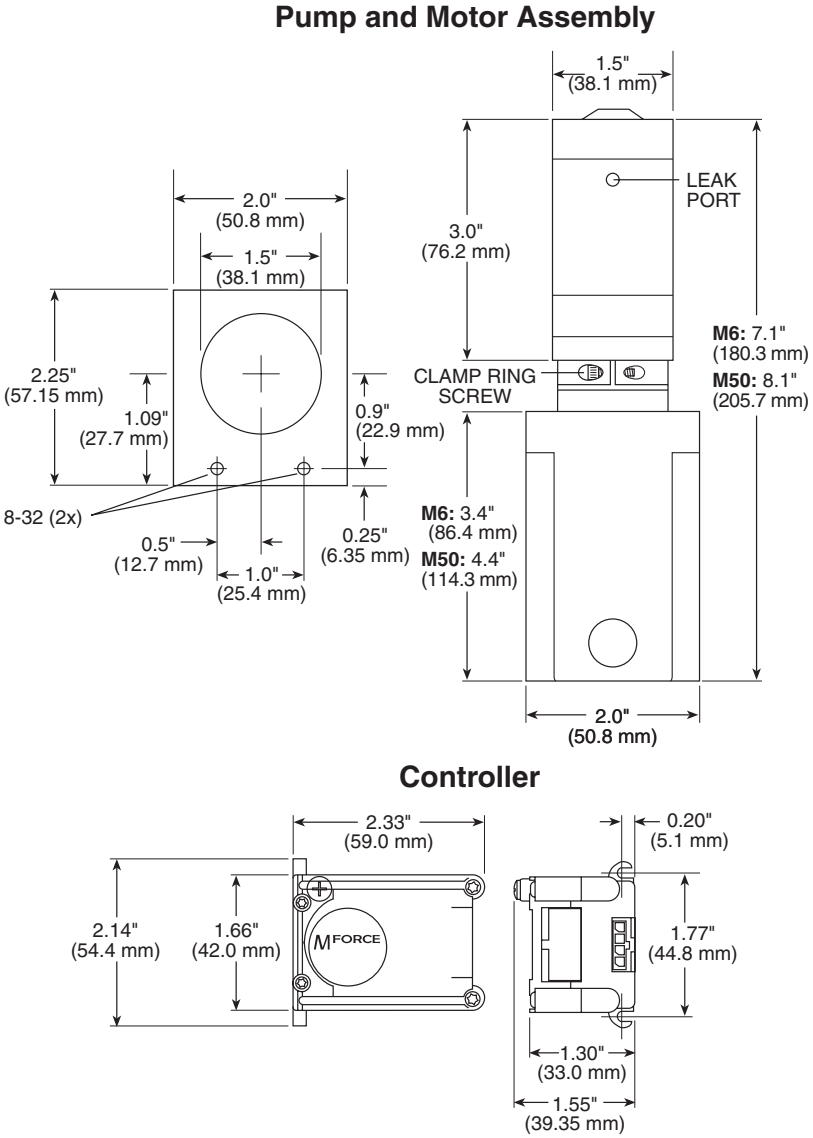


Figure 2: Mounting points and external dimensions for the pump, motor, and controller

Connections

CAUTION: Apply power to the power supply only after all connections have been made. Failure to do so may destroy the controller. Take precautions to avoid static discharges to the controller.

1. Remove the 7-pin connector from the controller and connect the red (+24) and black (GND) wires of the power adapter cable (I-25747) as indicated in **Figure 3**. Then plug the connector back into the controller.
2. Connect the motor power cable (I-25745-CE) to the controller and pump as shown in **Figure 4**.

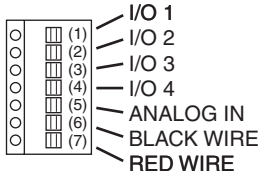


Figure 3: 7-pin connector

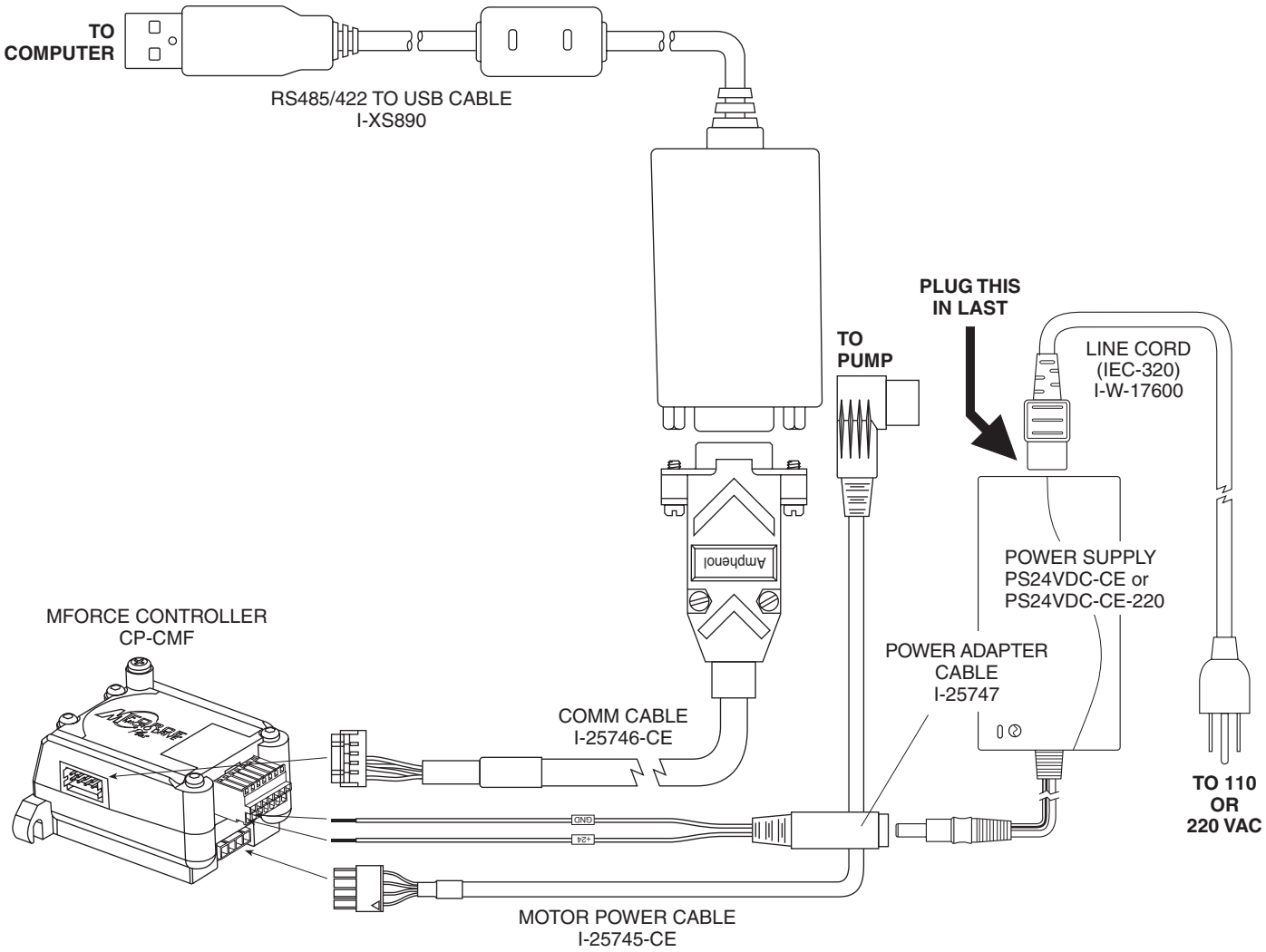


Figure 4: Cable connections

3. Connect the male 9-pin connector of the I-XS890 USB adapter cable to the female 9-pin connector of the comm cable (I-25746-CE), then plug the USB connector into the computer. Or, if you prefer, a custom comm cable can be fabricated using the connector included with the USB adapter cable.
4. Plug the 10-pin female connector of the comm cable (I-25746-CE) into the MForce controller.
5. Plug the power supply into the power adapter cable (I-25747).
6. Plug the line cord (I-W-17600) into a 110 or 220 VAC source.
7. Finally, connect the line cord to the power supply. (This sequence is recommended by the manufacturer of the MForce controller.)
8. If the system includes a valve, plug one end of its RS-232 cable into the valve actuator controller and the other end into a serial port on the computer. If a serial port is not available, an RS-232 to USB adapter is required.

For more advanced hardware and connectivity options, download a Motion Control MForce hardware manual directly from the manufacturer at http://motion.schneider-electric.com/downloads/manuals/MFI.pdf.

Initial Setup

MSLHS Software Installation

Insert the flash drive with the MSLHS software into the PC. If the installation doesn't begin automatically, browse the drive and double click on the file called *setup.exe*. The installer will place an icon for MSLHS on the Windows desktop.

COM Port Assignment

1. Double click the icon on the desktop to start the MSLHS software.
2. On main menu, choose Utility > Setup, as in **Figure 5**.
3. Select the correct COM port for the pump and valve. If no valve is being used, select None. (**Figure 6**)
4. Click Apply, then Close.

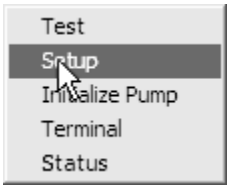


Figure 5: Select "Setup"

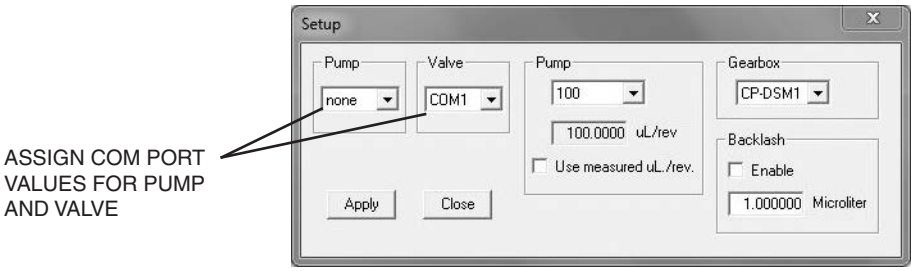


Figure 6: Select COM ports for pump and valve

Initialization

1. On the main menu, choose Utility > Initialize Pump. If initialization is successful, proceed to the next section, "Setting the Backlash and Volume/Revolution Values".
2. If the error message in **Figure 7** appears, close the window, then check to make sure that all the connectors are completely plugged in. Repeat Step 1.
3. If initialization is successful, proceed to the next section, "Setting the Backlash and Volume/Revolution Values".

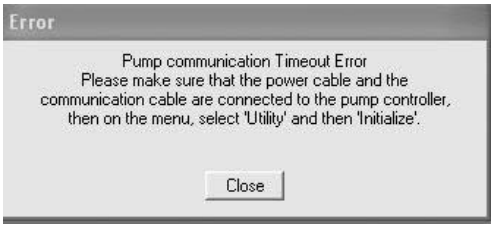


Figure 7: Initialization error message

4. If the error message persists, make sure that the COM port assignments correspond to the ports to which the cables are physically connected. Repeat Step 1.

Selecting Pump and Gearbox Values

In the Gearbox pulldown menu, select CP-DSM1 or CP-DSM2, based on the gearbox type indicated on the motor label. If the label says CP-DSM, select CP-DSM1.

In the Pump pulldown menu, select 100 for Model M6 or 628 for Model M50. (The values 4 and 750 are currently unused.) These values represent nominal µL/revolution for the two models. The next section discusses how these can be overridden for greater accuracy.

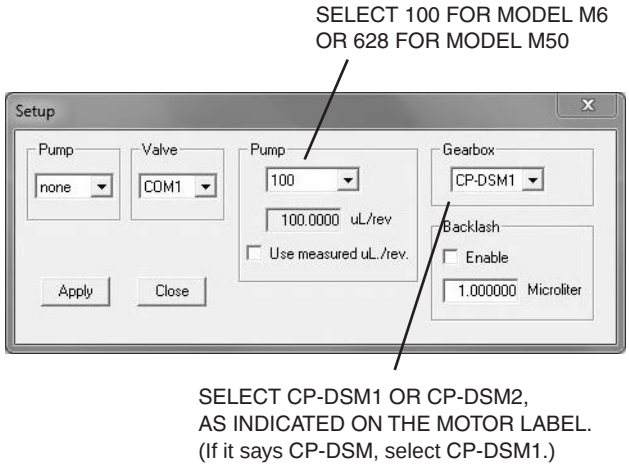


Figure 8: Selecting pump and gearbox values

Setting the Backlash and Volume/Revolution Values

Backlash is defined as the transition from the aspirate function to the dispense function, or vice versa. The MSLHS software observes the factory default settings of 1.5 µL for backlash and 100 µL or 628 µL for volume/revolution (as set above, depending on the pump model).

However, the actual values for each pump are calibrated and recorded on the QC certificate supplied with every unit. For the highest accuracy and precision, these values should be entered manually.

To override the factory default values for backlash and µL/rev:

1. Locate the backlash and µL/rev values on the QC certificate.
2. Click the Enable box under Backlash on the Setup screen, and type in the backlash value, as indicated in **Figure 9** on the page opposite.
3. Click the Use measured uL/rev box under Pump, and type in the volume per revolution.
4. Click Apply, then Close.

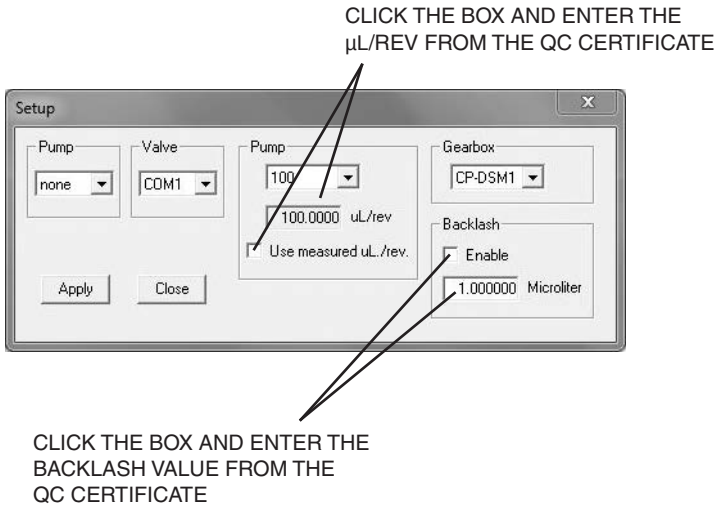


Figure 9: Setting the backlash and volume per revolution values

Priming and Testing the Pump

At this stage, some basic tests will determine that the tubing connections are tight and that the pump is rotating in the proper direction. The tests include an initial priming of the pump to remove all air and unwanted solutions in the tubing.

Use proper safety precautions when pumping flammable liquids. In all applications, make sure you have enough tubing and sufficient quantities of solutions ready for use before beginning a procedure.

Tubing Connections (M6 shown)

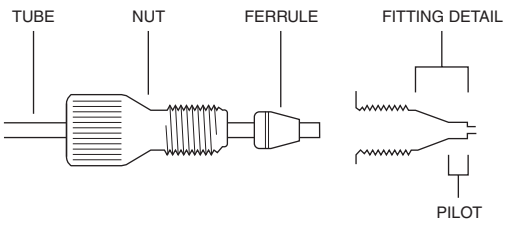
M6 pumps should not be used with tubing ODs smaller than 1/16". For M50 pumps, the minimum OD is 1/8".

Improperly installed fittings can create space for a bubble to become trapped, degrading pump performance. The use of non-VICI fittings can also adversely affect pump function and performance.

1. Connect a length of tubing to the inlet (Port A) and place the other end in a vessel containing isopropyl alcohol.
2. Connect a second length of tubing to the outlet (Port B) and place the other end into a receiver bottle.

Fitting Assembly Instructions

1. Slide the nut and ferrule onto the tubing in the order shown.
2. Insert this assembly into the fitting detail, screwing the nut in two or three turns by hand.



3. Push the tubing all the way forward into the detail so that it seats firmly. *This is essential for a proper zero dead volume connection*.
4. Turn the nut into the detail until it is finger tight.

Initial Priming

In the Test Mode, a mouse click on a button directs the pump to either aspirate or dispense. *(Refer to page 13, No. 7 for a definition, if required.)* When the Enable box in the Fixed Volume area is checked, (see **Figure 8**) the pump will aspirate or dispense the quantity entered in the Fixed Volume field and then stop. If the Enable box is *not* selected, the pump will continue to run at the set Flow Rate until either Stop (stops aspirating or dispensing) or Quit (exits the Test Mode) is selected.

If the pump aspirates a volume larger than the outlet tube volume, sample or reagent could enter the pump and mix with liquid in the reservoir.

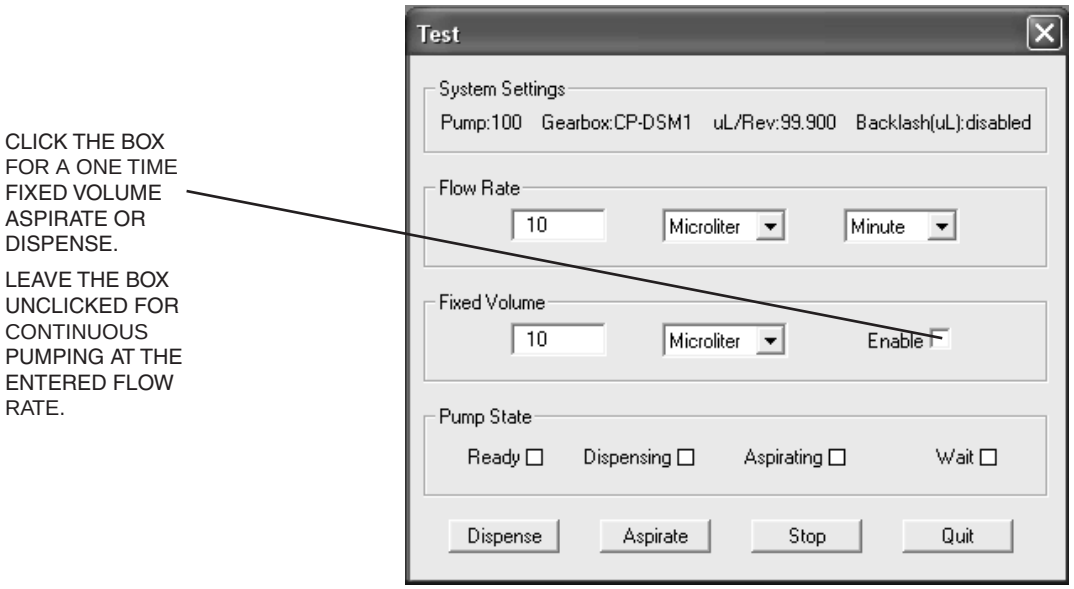


Figure 10: Priming the pump in the Test Mode (M6 values shown)

1. If the screen in **Figure 10** is not already open, go to the main menu, and choose Utility > Test.
2. If the tubing ID is 0.010" or less, enter
   Flow Rate: 200 µL/min
   Fixed Volume: 1000 µL
   Click the Enable box

   If the tubing ID is larger than 0.010", enter
   Flow Rate: 9000 µL/min
   Fixed Volume: 1000 µL
   Click the Enable box

(In the Test Mode, user-entered flow parameters cannot be saved; when you exit the program, these values will revert to defaults.)

NOTE: Smaller ID and longer length tubing can cause excessive restriction. Adjust flow rates accordingly. Maximum backpressure is 100 psi.

3. Click the Dispense button. The designated volume of isopropyl alcohol should move through the tubing and into the receiver bottle, removing any air bubbles and priming the system. If it does, the pump is primed and ready for use.

NOTE: If a buffer will be used, flush all the isopropyl alcohol out of the lines by placing the inlet tube in a vessel of water, changing the fixed volume to 2000 µL, and clicking the Dispense button.

4. *If the pump doesn't seem to draw any isopropyl alcohol into the tubing:*
   (a) Check for leaks around the fittings and make sure the tubing is well seated in the pump head.
   (b) Make sure the end of the tubing is free to draw liquid into the pump. (TIP: Cut the tip end that goes into the isopropyl alcohol reservoir at a 45° angle.)
   (c) Touch the pump to make sure it is on.

If the pump still doesn't seem to function properly, consult the factory.

Programming Application Methods

Method Screen Functions

From the main menu, choose Method > New to open the screen below.

1: Method status
Idle, Active (running), or *Editing*

2: Mode activation buttons
Run: Starts running the method.
Reset: Pauses a method which is underway, allowing a change to the editing mode.
Repeat: If this box is clicked, when the method completes the last action, it goes back to first action in a continuous loop.

3: Function status
Indicates the current activity during a run.

4: Event button
Refer to **No. 11: Event box**.

5: Edit and Close buttons
Edit: When the method is idled, clicking this button changes it into the editing mode.
Close: Closes the method screen.

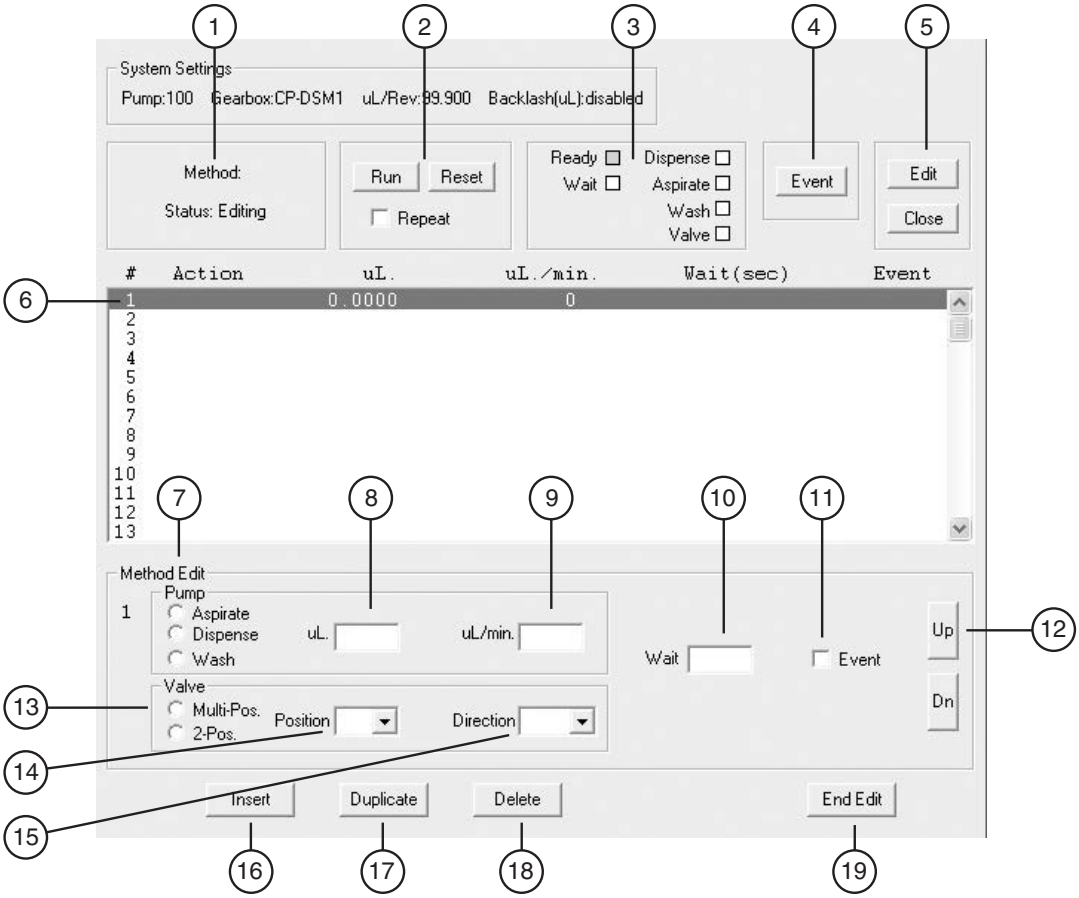


Figure 11: The Method screen

6: Action line
A step in the method sequence, reflecting the values entered by selecting or typing values in the Pump, Valve, and Wait fields. To move to a different line for editing, just click on it or use **No. 12: Up and Dn buttons**.

7: Pump function

Aspirate:	Draw liquid *into* the line connected to the pump *outlet* (Port B).
Dispense:	Force a pre-programmed amount of liquid through the pump.
Wash:	Wash or flush the lines (always in the outward direction, or A to B) with system fluid or a pre-programmed reagent selected.

8: Volume
The amount to be aspirated, dispensed, or sent through as a wash.

9: Flow rate
The rate at which the given volume is aspirated, dispensed, or sent through as a wash.

10: Wait field
If a value is entered in this field for an action line, during a run the program will wait for the designated time (in seconds) after the completion of that action before advancing to the next action. Used after an aspirate or dispense step to allow the liquid to equilibrate in the line or the dispensed liquid to come to equilibrium, as with viscous liquids or very small capillary tubing.

11: Event box
When this box is clicked when programming an action line, the program will stop before that action is executed. The program will remain stopped until **No. 4: Event Button** is clicked. (If the step before the event line has a programmed Wait interval, the Event button will not trigger the action until the Wait interval has elapsed.)

12: Up and D(ow)n buttons
In the Editing mode, these move the line highlighter up and down.

13: Valve type

Multi-Pos:	Multiposition stream selector
2-Pos:	Two position switching valve/injector

14: Valve Position
The position the valve needs to be in to select the proper solvent or reagent.

15: Valve Direction (for Multi-Pos only)
The direction the valve will take to the indicated position – the shortest (used in most cases), clockwise, or counterclockwise.

16: Insert button
Inserts a new action line above the highlighted line.

17: Duplicate button
Duplicates the highlighted line. The new line can then be edited as required.

18: Delete button
Deletes the highlighted line.

19: End Edit button
When editing is complete, click this button to return to the Idle mode, ready to Run.

Example Application Methods

In the Test Mode, user-entered flow parameters cannot be saved; when you exit the software, the values revert to defaults. So creating several simple example methods is a useful way to start learning the M6-LHS software. The methods below utilize flow parameters characteristic of the Model M6, but the same principles apply to programming for the M50.

Example method 1: "Prime System"

1. From the main menu, choose Method > New to open the screen in **Figure 11** on page 12.
2. Action line one will be highlighted. In the pump function field, select Dispense, and enter the volume and flow rate values from Step 2 at the top of page 11. This will dispense the isopropyl alcohol, as in our initial priming done in the Test mode.
3. Click Duplicate to add a new, identical action.
4. While action line 2 is highlighted, check the Event box.
5. Click the End Edit button.
6. On the main menu, choose Method > Save, and call this method "prime system".

Running "prime system"

1. With the inlet tube in a vessel of isopropyl alcohol, click the Run button. The box next to Dispense in the function status area will turn green, indicating that the first action line is underway.

   Since the Event box for action line 2 is checked, the program will pause before executing action line 2.
2. Move the inlet tube to a vessel of water and click on the Event button to start action line 2, which now dispenses water to flush the alcohol from the system.

Example method 2: "Aspirate and Dispense"

1. From the main menu, choose Method > New to open the screen in **Figure 11** on page 12.
2. Action line one will be highlighted. In the pump function field, select Wash, then enter 1000 for the volume and 9000 for the flow rate. For larger tubing, increase the wash volume to equal five times the tubing volume.
3. Click the Duplicate button to make an identical Wash action line.
4. Use the Dn (down) button to highlight the second line, then click the Insert button.
5. For the newly inserted line, select Aspirate in the pump function field, then enter 10 for the volume and 100 for the flow rate.
6. Click the Duplicate button to make an identical Aspirate line.
7. Click on the newly created line to highlight it, then change the volume to 100 and the flow rate to 500, and enter "2" in the Wait box.

8. Use the Dn (down) button to highlight the last line, then click the Insert button.
9. For the newly inserted line, select Dispense in the pump function field, then enter 110 for the volume and 1000 for the flow rate.
10. Click the End Edit button.
11. On the main menu, choose Method > Save, and call this method "aspirate and dispense".

The result should look like **Figure 12**.

TIP
The method in **Figure 12** is written so all functions will be automatically performed when the Run button is clicked.
For manual operation, check the Event box for each action line.
Then each line is performed by clicking the Event button.

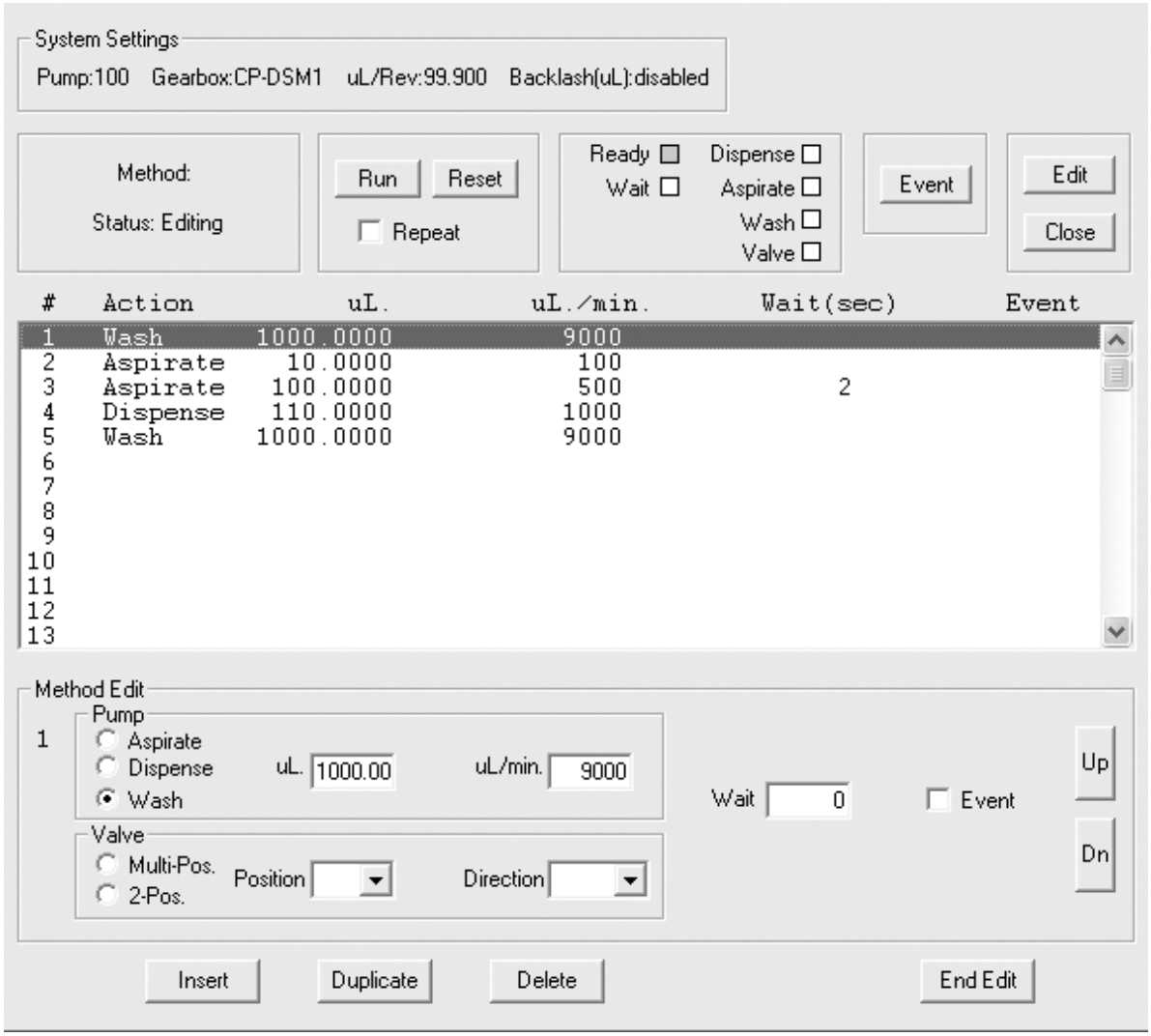


Figure 12: Example "Aspirate and Dispense" method for Model M6

Example method 3: "Dispense Selected Reagents"

This method, which employs an 8-position multiposition valve for selecting multiple reagents to be added to tubes or microplates, is a typical example of the applications possible when a Valco or Cheminert valve is integrated into the pump/M6-LHS system. A wash step (or in this case, a prime step) is incorporated between reagents.

NOTE: Wash is always in the dispense or outward direction of the pump, and can be used for washing with a system fluid, or, as in this case, a reagent.

By now you should know how to enter all the information shown in **Figure 13** to create this method. (Only the first four positions for the 8-position valve are shown.)

TIP
You might find it handy to use the Duplicate button to create all the nearly identical Multi Valve action lines, then go back with the Insert button to create the Wash and Dispense lines.

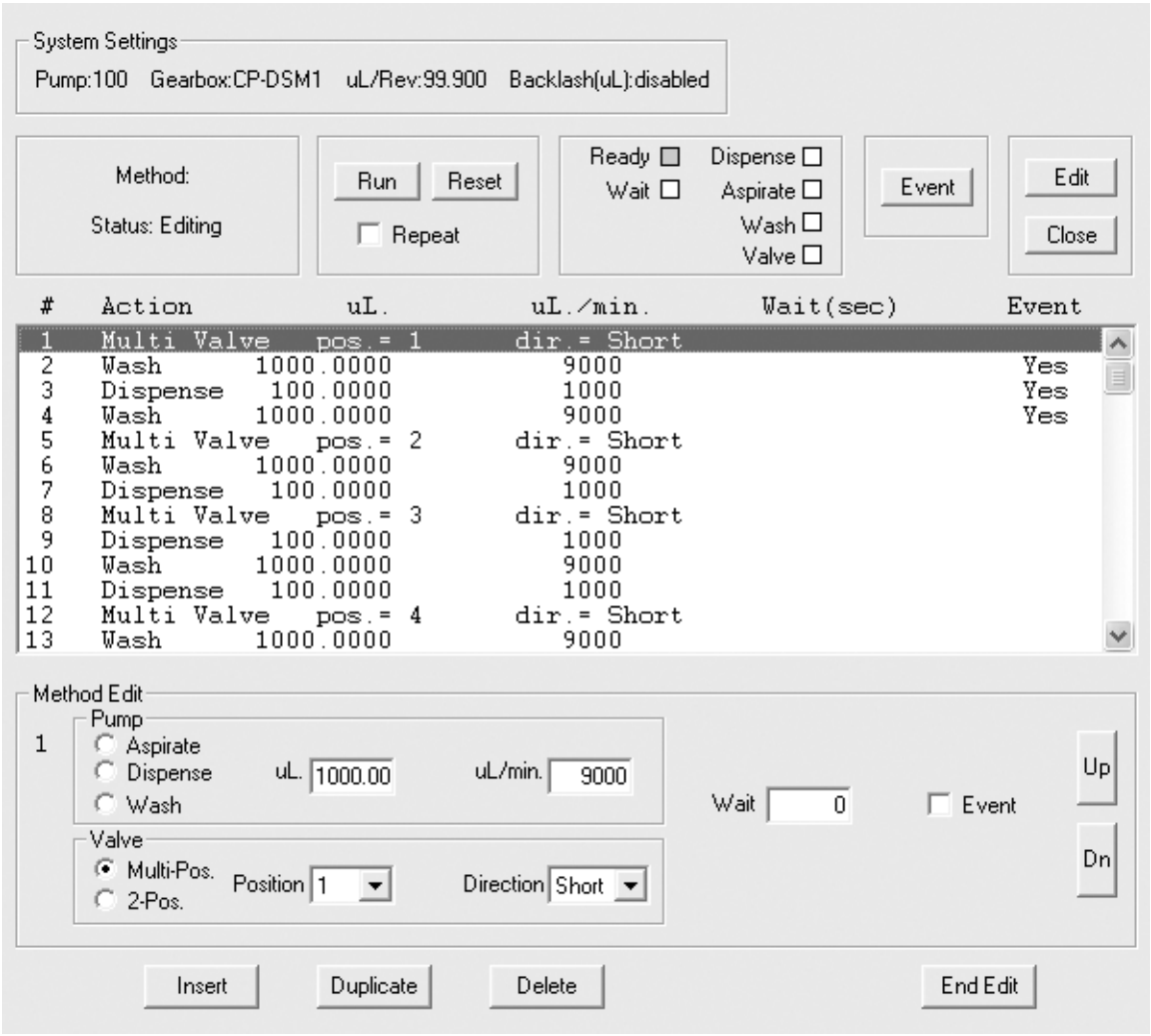


Figure 13: Method screen (partial) for example "Dispense Selected Reagents" method for Model M6

Maintenance

Follow these recommended cleaning and maintenance instructions to obtain optimum performance and maximum life from your pump.

If the pump is not going to be used for at least 24 hours, make sure no solvents are left in the pump. Following this procedure will extend pump lifetime and prevent seizing.

Routine maintenance

- Flush the pump thoroughly with distilled or de-ionized water after each use. ***Store the pump dry.***
- Avoid running the pump dry for extended periods. The pump is self-priming and will dispel entrapped bubbles when orientated vertically.
- Inspect the pump for signs of leakage on a regular basis and correct any problems immediately. Liquid entering the motor housing could damage the motor and gear assembly.

  Leakage from the pump's leak port indicates excessive backpressure and unreliable pumping action. (See **Figure 2** on page 4.)
- Wipe up all spills on and around the pump immediately

Routine cleaning

The high temperatures associated with autoclaving will compromise the pump seals. Therefore, chemical procedures should be employed to ensure sterility. The pump fluid path can be cleaned with any of the following cleaning solutions:

- Dilute detergent wash
- Dilute acid and base wash

  Pump 5 mL of **0.1N NaOH**, followed by
  5 mL (Model M6) *or* 50 mL (Model M50) of **water**, followed by
  5 mL of **0.1N HCl**, followed by
  10 mL (Model M6) *or* 50 mL (Model M50) of **water**
- Dilute bleach wash:

  Pump 5 mL of a **10% bleach** solution followed by
  10 mL (Model M6) *or* 50 mL (Model M50) of **water**

Chemical Compatibility of Wetted Surfaces

To ensure best results, please consider the chemical compatibility of the wetted surfaces with the liquids to be used before putting the pump into service.

Model M6 (standard)

PTFE

The piston tips are made from PTFE. Polytetrafluoroethylene is the generic name for the class of materials such as Teflon®. It offers superior chemical resistance and lends itself to good sealing characteristics. Because it's so easy to handle, it is often used in low pressure situations such as the M6 pump. Compounds of low molecular weight can permeate PTFE.

PAEK

The pump port end cap is made of a PAEK-based composite. Polyaryletherketone is the generic name for the family of polyketone compounds. PAEK includes PEK, PEEK, PEKK, and PEKEKK, which differ in physical properties and, to a lesser degree, in inertness. This composite used in the M6 resists all common HPLC solvents and dilute acids and bases. However, concentrated or prolonged use of halogenated solvents may cause the polymer to swell. Avoid concentrated sulfuric or nitric acids (over 10%) and refer to the guidelines on the next page.

Valcon P

The M6 pump rotor is made from Valcon P. This PTFE/carbon composite is employed as a rotor material in many Valco valves, so it has seen extensive use in many analytical applications. It is routinely used at 1000 psi/75°C, and can also be used at temperatures approaching 200°C with decreased sealing tension.

Sapphire

The M6 piston chambers are made of sapphire and are sealed in place with a Viton® O-ring. Sapphire has a unique set of properties including high strength, hardness, surface smoothness, and excellent chemical compatibility. It is commonly used in applications where a combination of exceptional mechanical and chemical properties is essential.

Viton®

Viton® O-rings are used to seal the sapphire pistons. Besides its excellent mechanical properties, Viton® provides the best proven fluid and chemical resistance of any commercial non-fluorinated elastomer. *NOTE: Viton® is not compatible with THF and acetone. Use of these substances will cause premature O-ring failure, which can lead to additional pump damage.*

Teflon® is a registered trademark of E.I. duPont de Nemours.
Viton® is a registered trademark of DuPont Dow Elastomers.

Model M50 (standard)

Valcon H2

The M50 cap is a carbon fiber-reinforced, PTFE-lubricated inert polymer. This material is routinely used at 5000 psi at temperatures not more than 75°C.

Ceramic

The M50 pump rotor is made of ceramic (ZrO_2), which is resistant to most chemicals.

PTFE

The piston tips are made from PTFE. Polytetrafluoroethylene is the generic name for the class of materials such as Teflon®. It offers superior chemical resistance and lends itself to good sealing characteristics. Because it's so easy to handle, it is often used in low pressure situations such as the M50 pump. Compounds of low molecular weight can permeate PTFE.

Guidelines

Specific reagent combinations should be tested to insure compatibility with pump components. Since the least chemically inert component in these composites is PEEK, for optimum component lifetime the following guidelines* (for PEEK at room temperature) should be followed:

Acids and bases	No stronger than 1 M (exceptions noted below)
Sulfuric acid	Resistant to 10%
Hydrochloric acid	Resistant to 20%
Hydrofluoric acid	Not resistant to 40% (no data on lower conc.)
Nitric acid	Resistant to 10%
Dibutylamine in Toluene	Not rated
Sodium hydroxide	Resistant
Hydrogen sulfide	Resistant
Methyl mercaptan	Not rated
Acetone	Resistant (see Viton® note on previous page)
Methyl ethyl ketone	Resistant
Methyl alcohol	Resistant
Toluene	Resistant
Xylene	Resistant
Chloroform	Resistant
Chlorobenzene	Resistant
Iodine/iodide in water	Not rated
Sodium hypochlorite (household bleach)	Resistant
Permanganate	Resistant
Hexane	Resistant

* Corrosion Resistance Tables, Schweitzer, Marcel Dekker, 1991

Technical Support

Technical support for this product is handled by the VICI facilities in Houston, Texas, USA, and Schenkon, Switzerland.

USA
Telephone: (713) 688-9345
Fax: (713) 688-8106
Email: tech_usa@vici.com

Switzerland
Telephone: int+41 41 925-6200
Fax: int+41 41 925-6201
Email: tech@vici.ch

Firmware updates for the MForce can be downloaded from www.IMSHome.com.

Returning Pumps for Repair

The following procedure must be followed when pumps are returned to VICI for repair:

1. To obtain a Return Merchandise Authorization number (RMA#), go to http://www.vici.com/returns.php. You can navigate there by clicking the Returns/repairs link under the Service pulldown menu.
2. Return the pump and the completed decontamination report (if requested) to:

VICI Valco Instruments Co. Inc.
Repair Department
Attn: RMA#
8300 Waterbury
Houston, TX 77055

or

VICI AG International
Attn: RMA#
Parkstrasse 2
CH-6214 Schenkon, Switzerland

Operational and Technical Specifications

Power requirement	**Both Models (M6 and M50)**	
Rest current draw	50 mA	
Operational current draw	Typical 300 mA (RMS)	
Voltage	Typical 24 VDC, input voltage 12 - 48 VDC	
Communications (COM1 or COM2)		
Type	RS-422/485	
Baud rate	Default 9600 bps, Full range 4.8 -115.2 kbps	
Parity	None	
Data bits per character	8	
Stop bits	1	
Error checking	None	
Mode	ASCII	
Environmental		
Operating Temperature	0 - 50°C	
Operating Humidity	< 90% non-condensing	
Storage Temperature	-20°C – 70°C (dry)	
Motor		
Type	2 Phase Bipolar (1.8° per step)	
Planetary Gear Assembly	**M6**	**M50**
Ratio	4.75:1	9.86:1
Physical Specifications		
Dimensions	See Figure 2	See Figure 2
Weight: pump motor and gear assy. MForce controller power supply	520 g 560 g 80 g 300 g	540 g 650 g 80 g 300 g
Resolution	MSEL=256	MSEL=256
Minimum flow	5 nL/min	1 µL/min
Maximum continuous flow	5 mL/min	25 mL/min
Maximum intermittent flow*	10 mL/min	35 mL/min
Maximum back pressure	100 psi	100 psi
Volume accuracy (%error)	< ±0.5%	< ±0.5%
Volume precision (%CV)	<0.1% at 1.25 mL <0.5% at 125 µL	<0.1% at 8 mL <0.5% at 800 µL
Fittings	1/16" Valco detail (10-32)	1/8" Cheminert (1/4-28)
Fluid contact	PTFE, Sapphire, PAEK, Viton®, and Valcon P	PTFE, Ceramic, Valcon H2

* High speed continuous flow or the use of chemicals incompatible with the wetted surfaces *(refer to page 17)* will reduce pump lifetime.

Appendix A: MForce Terminal Section

Terminal Programming Mode

The Terminal programming mode is for advanced control of the M Series Pump, allowing the user to alter the factory default settings for various parameters. While this may be useful in certain research applications, the main use is for OEM (original equipment manufacturer) customers. **Figures 15** and **16** show the various control settings used for specialized applications, as well as the default settings.

On the main menu, choose Utility > Terminal, as in **Figure 14**. To change any of the parameters, enter the commands in **Figures 15** and **16**.

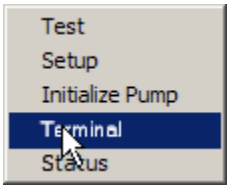


Figure 14: Select "Terminal"

Command	Function	Default
A=n	Set acceleration in steps/sec^2 from 91-1000000000.	1000000
AL	Used with the PR instruction to print the value/state of all variables and flags to the terminal program.	
BD=n	Set communications BAUD rate, in bps: 48=4800 96=9600 19=19200 38=38400 11=115200	96
BY	Busy flag (program executing). 0=no program running, 1=program executing	
CP n	Clear program at the specified address, from 1-767.	
D=n	Set deceleration in steps/sec^2 from 91-1000000000.	1000000
DN=<"ascii character">	Sets the device address for PARTY mode operation: 0-9, A-Z, or a-z.	!
E	Stops the execution of a program. Used in program mode to designate the end of the program.	
EF	Used with the PR instruction to print the state of error flags to the terminal program. 0= no error exists, 1=error condition exists	
EM=n	Sets the full/half duplex configuration of the RS-485 channel. 0=full duplex (all info sent back over comm line) 1=half duplex (only prompts are sent back; info not echoed) 2=only responds to PR and L commands 3=saves echo in print queue, then prints after command is terminated	0
ER	Used with the PR instruction to print the error code for the most recent error that has occurred.	

Figure 15: MForce commands, part A

Command	Function	Default
EX a,n	Execute program at a specified address or label (a) using selected mode (n=0, 1, or 2). 0 (or blank)=normal execution 1=trace mode The program executes continuously until the program E is encountered; the instructions are “traced” to the communications port so the user can see what instructions have been executed. 2=single step mode User can step through the program using the space bar to execute the next line of the program.	
FD	Restore factory defaults.	
HC=n	Set motor holding current (when pump is stationary) as a percentage (0-100) of 4A.	5
HT=n	Time in milliseconds (0-65000) after the motor stops moving before the device shifts to the holding current level.	
IP	Initialize parameters. Returns all of the device variable and flag parameters to their stored values.	
L a	Returns the contents of program space from the specified address or label (a) to the end. If no address is specified, it will list beginning at address 1.	
MA ±n,m	Move to an absolute pump position n in µl. Sign of n indicates direction, with deceleration (m=0) or without (m=1). If parameter omitted, m=0.	
MR ±n,m	Dispense/aspirate volume is volume n in µl. Sign of n indicates direction, with deceleration (m=0) or without (m=1). If parameter omitted, m=0.	
MS=n	Set microstep resolution.	200
MV	Used with the PR instruction to determine if the device is in motion. 0=not moving, 1=moving	
PR	Print selected data and/or text.	
PY=n	Enable(1) or disable(0) Party mode.	
RC=n	Set motor running current (pump is moving) as a percentage (0-100) of 4A.	25
S	Saves all variables and flags currently in working memory (RAM) to non-volatile memory (NVM).	
SL n	Slews the axis at the specified velocity in steps per second, 1-500000.	
UV	Used with the PR instruction to read the value of all user variables.	
V	Used with the PR instruction to read the current velocity of the axis in steps per second.	
VI=n	Set initial velocity for motion commands from 1-5000000 steps/sec.	1000
VM=n	Sets the maximum velocity in steps/counts per second that the axis will reach during a move command. Must be higher than VI.	768000
VR	Used with the PR instruction to read the version of the firmware installed at the factory.	

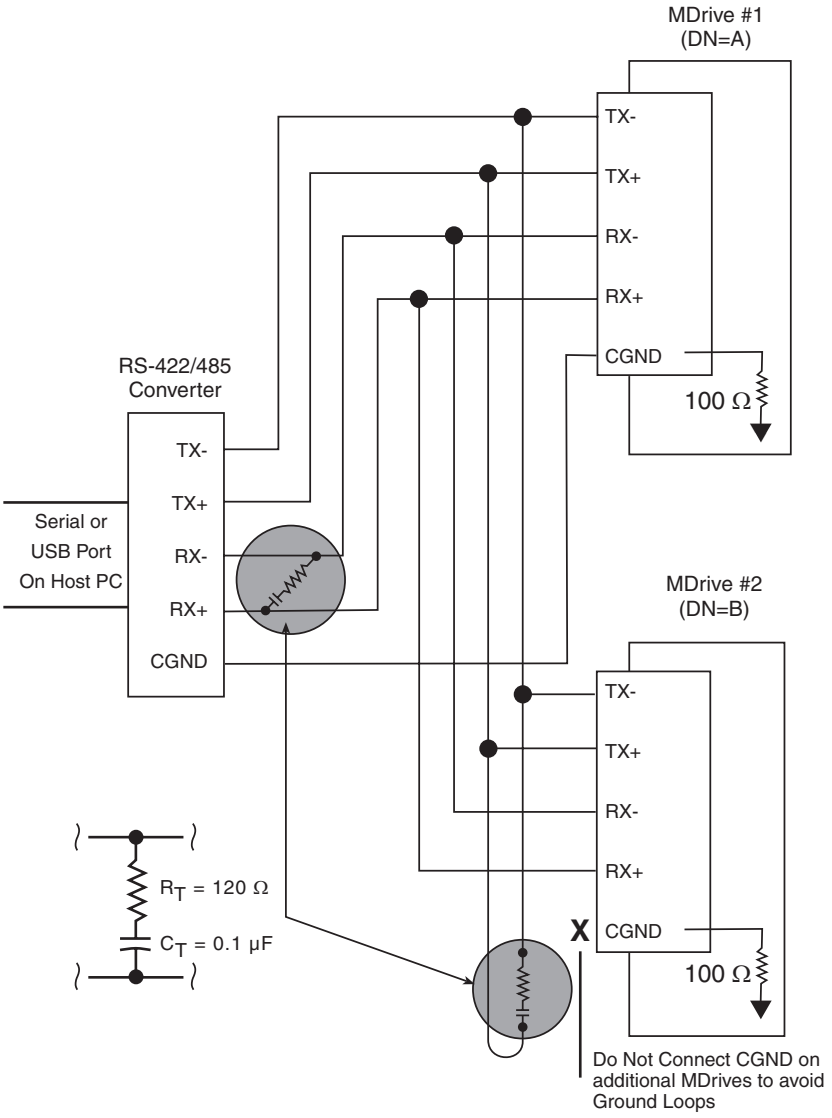
Figure 16: MForce commands, part B

We recommend that you contact VICI technical support before changing any of the factory default values. They are application dependent, and any changes could adversely affect the pump and its performance.

Appendix B: Setup for Multipump Operation

Connections

Figure 17 illustrates the connection schematic for a multidrop communications system. Note that communications ground only connects to the first MForce controller.



Data Cable Termination Resistors

Data cable lengths greater than 15 feet (4.5 meters) are susceptible to signal reflection and/or noise. To avoid this problem, the controller manufacturer recommends 120 ohm temination resistors in series with 0.1 µF capacitors at both ends of the receive lines of the communications cables. Termination resistors are not required with cables 15 feet long or less..

Setting the Address of each MForce Controller

1. Connect the comm to the first MForce controller only.
2. Apply power. You should get the following startup string:
   >Copyright?2010 Schneider Electric Motion USA
3. The address is set with the DN command.
   Input: DN="x" <ENTER>

   The "x" represents the address of your choice, which can be any single ASCII character from a-z, A-Z, or 0-9.

The address must be enclosed with quotes when naming. The quotes are not required when sending commands to the controller.

4. Save the address.
   Input: xS<ENTER>
5. Establish party mode.
   Input: PY=1<ENTER>

   The cursor will not move. The MForce is now in party mode.

In the party mode, all commands must be preceded by the address and terminated with *[Ctrl-J].*

6. Test the setup by sending the command PRINT VER, requesting the version of the firmware. (Remember, "x" is the value assigned above.)
   Input: xPR VR*[Ctrl-J]*

   You should receive the line:
   Output: 3.014
7. Remove power and connect the communications cable to the next MForce.
8. Apply power.

Repeat steps 3-8 for each additional controller.

Notes about party communication

- There is no sign-on message in party mode.
- All communications must be terminated with *[Ctrl-J]*. The Enter key will not work. If Enter is accidentally pressed, the MForce controller will not complete the command until a *[Ctrl-J]* is sent.
- When an individual MForce controller is in party mode, it monitors communications looking for its address. If the first character in a communication does not match its address, that MForce stops "listening" until a *[Ctrl-J]* is detected. All devices "pay attention" after a *[Ctrl-J]*. Therefore if you accidentally type a wrong character and the unit you are trying to communicate with seems to be ignoring you, send a *[Ctrl-J]* to make every MForce controller start monitoring again.

Troubleshooting Party Mode Communications

If you can't communicate with an MForce controller in party mode, first make sure that commands are preceded with the correct address and terminated with *[Ctrl-J]*. Also remember that the unit will stop listening if you send a wrong address. Send a *[Ctrl-J]* and try again. If it still doesn't work, read on.

- *Did you enclose the desired address in quotes (DN="x")?*
  While quotes are not required when sending commands to the controller, during assignment the address must be enclosed within quotes.
- *Did you accidentally set the wrong address?*
  You may have inadvertently set the address to an unintended character or wrong case. Try sending a *[Ctrl-J]*, then try every ASCII character from A-Z, a-z, and 0-9.

If problems still exist, perform the following:

1. Check all cable connections to ensure there are no loose wires or short circuits or incorrect connections.
2. Remove power.
3. Connect the communication cable to the problem MForce controller only.
4. Apply power.
5. Set the MForce to single mode.

   Input: xPY=0 *[Ctrl-J]*

   The MForce is now in single mode and an address is not required.
6. Save the parameter.

   Input: *S*<ENTER>

7. *C*ycle the power by removing power, then reapplying power.

   Output: >Copyright?2010
   Schneider Electronic Motion USA

The MForce should send the sign-on message. At this point, the Party flags have been reset, the address has been reset to ! and no address is required to communicate with this controller.

9. Reset the address according to the procedure on page 25.

Warranty

Certain applications using the M Series pump may involve potential risks of death, personal injury, or severe property or environmental damage. The M Series pump is not designed, authorized, or warranted to be suitable for use in life support devices or systems or other critical applications. Inclusion of VICI products in such applications is understood to be fully at the customer's risk.

This Limited Warranty gives the Buyer specific legal rights, and a Buyer may also have other rights that vary from state to state. For a period of 365 calendar days* from the date of shipment, Valco Instruments Company, Inc. (hereinafter Seller) warrants the goods to be free from defect in material and workmanship to the original purchaser. During the warranty period, Seller agrees to repair or replace defective and/or nonconforming goods or parts without charge for material or labor, or, at the Seller's option, demand return of the goods and tender repayment of the price. Buyer's exclusive remedy is repair or replacement of defective and nonconforming goods, or, at Seller's option, the repayment of the price.

Seller excludes and disclaims any liability for lost profits, personal injury, interruption of service, or for consequential incidental or special damages arising out of, resuiting from, or relating in any manner to these goods

This Limited Warranty does not cover defects, damage, or nonconformity resulting from abuse, misuse, neglect, lack of reasonable care, modification, or the attachment of improper devices to the goods. This Limited Warranty does not cover expendable items. This warranty is VOID when repairs are performed by a nonauthorized service center or representative. For information about authorized service centers or representatives, write Customer Repairs, Valco Instruments Company, Inc, P.O. Box 55603, Houston, Texas 77255, or phone (713) 688-9345. At Seller's option, repairs or replacements will be made on site or at the factory. If repairs or replacements are to be made at the factory, Buyer shall return the goods prepaid and bear all the risks of loss until delivered to the factory. If Seller returns the goods, they will be delivered prepaid and Seller will bear all risks of loss until delivery to Buyer. Buyer and Seller agree that this Limited Warranty shall be governed by and construed in accordance with the laws of the State of Texas.

The warranties contained in this agreement are in lieu of all other warranties expressed or implied, including the warranties of merchantability and fitness for a particular purpose.

This Limited Warranty supercedes all prior proposals or representations oral or written and constitutes the entire understanding regarding the warranties made by Seller to Buyer. This Limited Warranty may not be expanded or modified except in writing signed by the parties hereto.

NOTE: There are NO user-serviceable parts inside the pump. Opening the pump by removing or loosening the hex bolts that hold the pump together will void this limited warranty.

* The warranty period may be shortened or voided altogether by factors such as an extreme duty cycle (*i.e.,* excessive speed of continuous flow or excessive number of revolutions), use of chemicals incompatible with the pump's wetted materials, or too high a fluid temperature.