OPERATING MANUAL

manostat®
CompuLab™ 3
MODULAR DISPENSING SYSTEM

Model Nos.
72-777-100
72-666-100
72-767-000

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SAFETY

Safety Terms Used in This Manual
Safe practices and precautions for operation and maintenance of the dispensing system are provided in the following paragraphs. Failure to follow these safety practices and precautions can lead to serious injury. Performing procedures improperly can be hazardous and could result in serious injury or death. Improper installation, operation, or maintenance can shorten the life of this equipment. This manual contains statements regarding safety precautions, which are categorized as follows:

DANGER: This word is used in safety messages for hazards that are immediately accessible and capable of causing severe personal injury or death.

WARNING: This word is used in safety messages for hazards that are not immediately accessible, but that present a probability of serious injury if the hazard is not avoided. These safety messages describe precautions that must be taken to avoid the hazard.

CAUTION: This word is used for precautions that must be taken to avoid actions that could damage the equipment.

NOTE: This word is used for information that the operator or technician may use to make the procedure easier to perform.

CAUTION: Product Use Limitation
This product is not designed for, nor intended for use in, patient-connected applications, including, but not limited to, medical and dental use, and accordingly has not been submitted for FDA approval.

Safety Precautions
This equipment uses AC and DC power to operate. AC and DC power can cause serious injury and even death. All of the maintenance and repair procedures in this manual must be performed with the equipment disconnected from the power source. Allow ten minutes for energy-storing components to discharge fully before removing the cover for service.
WARNING: Observe safety precautions at all times. Pay special attention when pumping dangerous liquids. Protect yourself, the work area, and the dispensing system from accidental spillage of the liquid.

CAUTION: To avoid damaging your pump drive, ensure that the voltage selection switch is set to match the AC power source at your location.

WARNING: Turn off the system before removing or installing tubing. Disconnect the pump drive from the AC source to prevent accidental starting of the drive mechanism. Fingers or loose clothing can be caught in the pump mechanism, causing serious injury.

WARNING: Tubing breakage can result in fluid being sprayed from the pump. Take appropriate measures to protect operator and equipment.

WARNING: The dispensing system must be plugged into a grounded power source only. An ungrounded power source presents a serious shock hazard.

WARNING: Never remove the cover from the pump drive when power is present. AC power in the pump drive can cause serious injury or death. Ensure that the pump drive is disconnected from the power source, and allow ten minutes for energy-storing components to discharge fully before removing the cover for service.
INTRODUCTION

General
The VARISTALTIC® COMPULAB™ 3 Modular Dispensing System, as shown in Figure 1, consists of a control console (catalog number 72-767-000) and up to four pump drives. The pump drives may be any combination of MANOSTAT COMPULAB RD-1 (catalog number 72-777-100) and RD-2 drives (catalog number 72-666-100). The control console connects to each of the pump drives with a 3-1/2 ft. (1.1 m) RJ-12 cable (catalog number 77095-02). Each pump drive is identified by the control console with a unique number from 1 to 4, depending on which port on the console the pump drive is connected.

Figure 1. VARISTALTIC COMPULAB 3 Modular Dispensing System
The COMPULAB 3 is a microprocessor-controlled, programmable peristaltic pump system designed to meet liquid-handling needs. The system can be programmed to operate as a dispenser, diluter/dispenser, and an all-purpose pump.

The operator designs programs that contain operational parameters. The programs can be run manually with a dispenser handle or by using the optional footswitch, semiautomatically in cycle, or automatically by specifying the exact number of cycles to be completed.

The control console can control each pump independently, or pumps can be linked and controlled simultaneously.

Operation can be varied to suit specific applications by dispensing cumulative volume, flow in mL/min, and/or by cycle count. The dispenser can communicate with a variety of balances in order to dispense liquid by weight. A built-in RS-232 interface allows the dispenser to be controlled by a personal computer.

Scope of the Manual
This manual contains step-by-step instructions for installing, setting up, programming, operating, and maintaining the dispensing system. It is intended for use by technicians and operators as well as maintenance personnel.

TROUBLESHOOTING on page 39 contains a list of possible problems, their probable causes, and actions to take to remedy each problem.

Instructions for replacing user-serviceable parts and a list of parts that can be ordered are included. ACCESSORIES on page 48 lists all the available accessories for the COMPULAB 3. SPECIFICATIONS on page 45 lists pertinent characteristics of the COMPULAB 3.

APPENDIX A — BALANCE CONNECTION on page 50 provides pinout and signal information for connecting a balance to the dispenser.

APPENDIX B — PC CONNECTION AND SOFTWARE INSTALLATION on page 51 provides details to connect the COMPULAB 3 to a personal computer.

APPENDIX C — OUTPUT RELAY CONNECTIONS on page 52 provides pinout and signal information for connecting external apparatus to be controlled by the pump drives.

APPENDIX D — MENU FLOWCHARTS on page 53 illustrates the menu structure and may be used as an aid when creating or modifying a program or during operation.

The INDEX on page 61 provides an easy way to find information in the manual.
DESCRIPTION

Functional Description
The COMPULAB 3 control console provides the interface for the operator for programming and control of the dispensing system. As many as four MANOSTAT COMPULAB RD-1 or RD-2 VARISTALTIC pump drives connect to the control console and provide the pumping action.

The operator programs and operates the system by using the 20 membrane keys and menus shown on the 80-character, alphanumeric, LCD display. The microprocessor scans the keypad, communicates to the display, and communicates with the attached pump drives. The control console communicates with each of the pump drives through a serial interface. Connection is made with a shielded RJ-12 cable. One of the attached pumps supplies power to the control console.

Programmed information is stored indefinitely in an EEPROM. Each program contains specific parameters for controlling the pump drives. Up to 30 programs can be stored at one time. The stored programs can be any combination of pump, dispense, and dilute programs.

Each pump drive has a POWER switch and seven-segment LED on the front, and an RJ-12 port and a DB-9 connector on the back. The RJ-12 port provides communication and power to the console. The DB-9 connector is used for remote start/stop contact closure input and two contact closure outputs. The pumps are driven by permanent-magnet DC brush motors using optical tachometer feedback for accurate speed control. A slide switch on the back of the unit selects the operating voltage (115 or 230 VAC).

Physical Description
COMPULAB 3 consists of a control console and at least one pump drive. The control console is 8.9 in. (22.6 cm) wide, 6.5 in. (16.5 cm) deep, and 2.7 in. (6.9 cm) in height; and weighs approximately 3 lbs. (1.5 kg).

Each MANOSTAT COMPULAB RD-1 pump drive is 9.1 in. (23.1 cm) wide, 13.3 in. (33.8 cm) deep, and 5.7 in. (14.5 cm) in height; and weighs approximately 19 lbs (8.5 kg).

Each MANOSTAT COMPULAB RD-2 pump drive is 10.1 in. (25.7 cm) wide, 11.9 in. (30.2 cm) deep, and 6.75 in. (17.1 cm) in height; and weighs approximately 20.5 lbs (9.3 kg).

Units are protected against vertically falling water and incidental splashes.
Controls, Indicators, and Connectors

All the controls, connectors, and indicators on the control console are shown in Figure 2. All connectors are located on the back panel.

The operator controls and indicators are:

Display: An 80-character, two-line LCD that displays all menus needed for programming and operating the system.

Selection arrow keys: Used to select menu items shown on the second line of the display.

Numeric keypad: Used for numeric entry.

BACK: Takes user to previous menu line in menu structure. Acts as a backspace key during numeric input.

SPEED/VOLUME: Changes speed or volume of the pump during operation.

ENTER: Used to confirm data entry or to continue during programming.
CANCEL/STOP: Used to stop the currently selected pump immediately and to clear the entry during programming.

STOP ALL: Immediately stops all pumps.

PUMP#: Changes selected pump.

Figure 3 illustrates a pump drive, showing the power switch and display on the front, and the connectors on the back.

Figure 3. Pump Drive Controls, Connectors, and Indicators
INSTALLATION

Site Requirements
The COMPULAB 3 Dispensing System is designed to operate in most workplace conditions. Ensure that the work area temperature range is 0°C to 40°C (32° to 104°F) and that the relative humidity remains between 10% and 90%. The dispensing system should be located so that it is not exposed to running water and is protected from dangerous chemicals and excessive or conductive dust.

Power Requirements
The COMPULAB 3 Dispensing System requires 115 (90–130) VAC or 230 (180–260) VAC, 50/60 Hz incoming power. Each pump drive draws 1.7 A at 115 V or 0.8 A at 230 V.

Interconnection
Each pump drive is connected to the control console with a 3-1/2 ft. (1.1 m) RJ-12 cable. Longer cables are available as an option, but are not recommended for use in areas where interference may be high. Use as short a cable as is practical. Use only cables supplied by Barnant Company.

Refer to Figure 4, and connect the components of the Dispensing System. Ensure that the plugs snap firmly into the connectors on the back of the control console and on the back of each pump drive.

Power Connection
Each pump drive requires AC power to operate. The power for the control console is supplied by one of the pump drives.

WARNING: The dispensing system must be plugged into a grounded power source only. An ungrounded power source presents a serious shock hazard.

CAUTION: Ensure that the 115/230 voltage switch on the back of each pump drive is set to the appropriate voltage before connecting the pumps to the source voltage. Selecting the incorrect voltage can cause damage to the dispenser.

If the voltage selection switch is set to the incorrect voltage, refer to Figure 5 and set the switch to match the voltage of your AC source. Slide the switch so the correct voltage is displayed.
Ensure that the AC outlet is grounded and meets all local and national codes. The use of ground fault interrupted AC power is recommended because of liquid handling. Use the supplied power cord for each pump in the system. Refer to Figure 4, and attach the female plug to the connector on the back of the pump drive. Plug the male connector into a properly grounded AC outlet.

Figure 4. Interconnecting Components
Balance Connection

In order to operate the dispense program with a balance, a compatible balance must be connected to the control console. The COMPULAB 3 provides communication to the balance through a nine-pin male RS-232 DTE port on the back of the control console. Refer to APPENDIX A — BALANCE CONNECTION on page 50 for a list of compatible balances and a description of the RS-232 connections.

CAUTION: Ensure that all pump drives and the balance are disconnected from the power source.

1. Make sure that all power is disconnected.

2. Ensure that the balance is compatible with the dispenser and that the cable is constructed so that pin connections are in accordance with Figure 12 in APPENDIX A — BALANCE CONNECTION on page 50.

3. Refer to Figure 4, and connect the balance to the connector labeled BALANCE on the back of the control console.

4. Tighten the two screws on the connector.
Personal Computer Connection

The COMPULAB 3 may be controlled by a personal computer, using software shipped with the system. A serial port on the computer connects to the RS-232 DCE port on the back of the control console. Refer to APPENDIX B — PC CONNECTION AND SOFTWARE INSTALLATION on page 51 for pin connections and signals.

Footswitch or Dispenser Handle Connection

In order to run a program with a footswitch or dispenser handle, the accessory must be connected. 

CAUTION: Ensure that the pump drive is disconnected from the power source.

1. Make sure that all power is disconnected.
2. Refer to Figure 4, and connect the DB-9 connector from the footswitch or dispenser handle to the nine-pin connector on the back of the pump drive.
3. Tighten the two screws on the connector.

Relay Outputs

Each COMPULAB pump drive provides control to external apparatus through two drive relays. Normally open contacts are open when the relay is off and closed when the relay turns on. Normally closed contacts are closed when the relay is off and open when the relay turns on. Table 1 provides the three possible states for the relays for each type of program. Connections are made to the relays at the DB-9 connector on the back of the pump drive. Refer to APPENDIX C — OUTPUT RELAY CONNECTIONS on page 52 for pin connections and signals.

Table 1. Relay Outputs

<table>
<thead>
<tr>
<th>Pump Program</th>
<th>Dispense Program</th>
<th>Dilute Program</th>
<th>Relay 1</th>
<th>Relay 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not running</td>
<td>Not running or program complete</td>
<td>Not running or program complete</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>Pumping</td>
<td>Dispensing or dispensing paused</td>
<td>Pumping, hold delay, or paused</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>Pumping paused</td>
<td>Delay between cycles</td>
<td>Delay between cycles</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>Calibrating, priming, purging</td>
<td>Calibrating, priming, purging</td>
<td>Calibrating, priming, purging</td>
<td>OFF</td>
<td>OFF</td>
</tr>
</tbody>
</table>
SETUP

Tubing Selection

Flow rate is determined by the size of the tubing in the pump head. For greatest accuracy and repeatability, the use of tubing links is recommended. When tubing links are used, best performance will be achieved when input and output tubing connected to the link are the same ID as the link. All tubing inside the pump head must use surface-printed MANOSTAT precision tolerance tubing.

NOTE: When using multiple pumps, best accuracy is achieved when all tubing lengths are the same for each pump setup.

For best results, select a tubing size with a mid-range at the desired flow rate to be pumped. Table 2 provides an average of flow rates using silicone tubing measured with water at standard pressure at 20°C (68°F) for each pump type. No lift or discharge pressure is represented. Higher flow can be achieved by using PHARMED® or NORPRENE® tubings.

Table 2. Flow Rate Table

<table>
<thead>
<tr>
<th>TUBING SIZE</th>
<th>INSIDE DIAMETER</th>
<th>VOLUME/REV 7.2 rpm (mL/rev)</th>
<th>MINIMUM FLOW 720 rpm (mL/min)</th>
<th>MAXIMUM FLOW 720 rpm (mL/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MANOSTAT COMPULAB RD-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>1/32 in.</td>
<td>0.06</td>
<td>0.40</td>
<td>40</td>
</tr>
<tr>
<td>14</td>
<td>1/16 in.</td>
<td>0.28</td>
<td>2.00</td>
<td>200</td>
</tr>
<tr>
<td>16</td>
<td>1/8 in.</td>
<td>1.04</td>
<td>7.50</td>
<td>750</td>
</tr>
<tr>
<td>25</td>
<td>3/16 in.</td>
<td>3.16</td>
<td>17.00</td>
<td>1700</td>
</tr>
<tr>
<td>17</td>
<td>1/4 in.</td>
<td>3.68</td>
<td>26.50</td>
<td>2650</td>
</tr>
<tr>
<td>18</td>
<td>5/16 in.</td>
<td>4.79</td>
<td>34.50</td>
<td>3450</td>
</tr>
<tr>
<td>MANOSTAT COMPULAB RD-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>1/32 in.</td>
<td>0.07</td>
<td>0.50</td>
<td>50</td>
</tr>
<tr>
<td>14</td>
<td>1/16 in.</td>
<td>0.42</td>
<td>3.00</td>
<td>300</td>
</tr>
<tr>
<td>16</td>
<td>1/8 in.</td>
<td>1.67</td>
<td>12.00</td>
<td>1200</td>
</tr>
<tr>
<td>25</td>
<td>3/16 in.</td>
<td>3.61</td>
<td>26.00</td>
<td>2600</td>
</tr>
<tr>
<td>17</td>
<td>1/4 in.</td>
<td>5.83</td>
<td>42.00</td>
<td>4200</td>
</tr>
<tr>
<td>18</td>
<td>5/16 in.</td>
<td>6.94</td>
<td>50.00</td>
<td>5000</td>
</tr>
</tbody>
</table>

The best type of tubing for a particular application is based on the relative importance of the following factors: chemical compatibility, temperature, pressure, tubing life, purity, clarity, gas permeability, and sterilizability. VITON® fluoroelastomer is excellent with many oils, solvents, and corrosives. Silicone and VITON are the most heat resistant. PHARMED and NORPRENE have the highest pressure ratings and the longest tubing life. Silicone is the least contaminating material, with platinum-cured silicone having fewer potential leachable additives than peroxide-cured silicone. TYGON® is transparent; silicone
is translucent; and other formulations are opaque. TYGON, NORPRENE, and PHARMED allow the least amount of air to permeate through the tubing. All tubing is sterilizable except TYGON.

Installing Tubing
Refer to Figure 6 for the RD-1 or Figure 7 for the RD-2, and use the following procedure to install the tubing.

1. Ensure that you have selected the correct tubing size for the application.

**WARNING:** Turn off the system before removing or installing tubing. Disconnect the pump drive from the AC source to prevent accidental starting of the drive mechanism. Fingers or loose clothing can be caught in the pump mechanism, causing serious injury.

2. Make sure that the power switch is turned off and the pump drive is disconnected from the power source.

3. For the RD-1: Loosen the two knurled nuts holding the clear plastic cover, and slide the cover off the pump head.

![Figure 6. Installing Tubing on the RD-1 Pump](image)
For the RD-2: Remove and retain the four knurled nuts holding the clear plastic cover, and remove the cover from the pump head. Remove and retain the two thumbscrews that secure the tubing clamp, and remove the clamp.

Figure 7. Installing Tubing on the RD-2 Pump

4. FOR TUBING LINKS:

NOTE: The smaller size tubing links for the RD-2 come with spacers that need to be inserted around the tubing just inside the flange. The spacers ensure a snug fit in the tubing clamp.

NOTE: Tubing links are not available for number 18 (5/16 in. ID) tubing.

a. Refer to the instruction sheet that came with the tubing link. Refer to Figure 8, and align the tubing link to its path through the pump head, ensuring that the tie wraps or the flanges of the link are as close as possible to the outside of the pump head.
NOTE: The male connectors on the tubing links are removable. Rotate each a half turn counterclockwise to remove the connector, and a half turn clockwise to reinstall the connector.

b. Attach input and output ends of the transfer tubing to the connectors of the tubing link.

c. Manually rotate the roller assembly while guiding the tubing between the rollers and the pump head wall. Make sure the tubing is in the center of the channel.

5. FOR TUBING:

a. Insert tubing between the rollers and the pump head housing in the center of the channel, midway between the clear plastic pump head cover and the pump head housing bottom. This ensures that the rollers depress the entire width of the tubing as they turn.

b. Feed the tubing in, and manually rotate the roller assembly. Guide the tubing between the rollers and the pump head wall.

NOTE: There should be a small but visible gap between the tubing and the pump head housing for about 1/3 to 1/2 of the contact surface at any time.

c. Pull gently on the input and output sides of the tubing to create a gap between the tubing and the curved pump head housing wall.
NOTE: The clear plastic pump head cover is reversible on the RD-1 models. It has different size tubing retainers on each face. If the tubing is smaller than 3/16 in. ID, place the cover so that the larger tubing retainers hold the tubing. If the tubing is 3/16 in. ID or larger, reverse the cover.

6. For the RD-1: Slide the clear plastic cover over the pump head and tighten the knurled nuts to secure the tubing.

7. For the RD-2: Reinstall the tubing clamp and secure with the two thumbscrews so that the clamp holds the tubing in place but does not pinch the tubing.

Tubing life can be extended by periodically shutting down the pump and moving the tubing so that a different segment is in the pump head. This way, excessive tubing wear at any specific point is avoided.

When using tubing links, the tubing in the link may bunch up at the output end over an extended period of use. Replace the link, or gently pull on the output side of the tubing link to eliminate the bunch. Pulling the tubing too much will change the flow rate and adversely affect accuracy.

Power On

After the control console and all the pump drives are properly connected and the drives are plugged into an AC source, the system may be powered up. Refer to Figure 3, and place the POWER switch on one of the pump drives in the On (I) position. The pump number appears on the LED display. The welcome screen appears on the control console.

Place the POWER switch on the remaining pump drives in the On (I) position.

If the system does not power up, place the POWER switch in the Off (O) position. Check that all interconnection wiring is secure. Make sure that the voltage selection switch on the back of the pump drive(s) are set to the correct voltage. Ensure that the pump drive(s) are plugged into a live, grounded AC source.

If the system powers up but the pump number displayed is 0 (zero), the pump drive is not properly connected to the control console. Place the POWER switch in the Off (O) position, check all the interconnections, and place the POWER switch in the On (I) position.
Initial Operation
When power is applied from any of the attached pumps, the control console displays the welcome screen:

After three seconds, the Program Menu appears:

The number displayed in the upper right corner represents a pump number. The first time the dispenser is powered, #1 is displayed. Pressing PUMP# on the control keypad changes the pump number. When the dispenser is shut down, it remembers the pump number last displayed, and that pump number appears the next time the dispenser is powered.

From this menu, the user can create a new program, edit a program previously saved under a known number, load a program previously saved, or link pumps. The first time the system is started, there are no saved programs, and pressing any arrow key other than the one under NEW or LINK results in an error message. Refer to OPERATION on page 18 for instructions to create new programs, to load programs, to save programs, and to link pumps.

Adjusting the Display Contrast
If you wish to adjust the contrast of the display, press and hold the arrow key under CONTRAST within three seconds after power is applied until the following display appears:

To adjust the contrast of the display, repeatedly press the arrow key under DECREASE or INCREASE until the display is adjusted to your preference. Press ENTER to accept the adjustment.
OPERATION

This equipment should not be operated on a “learn as you go” basis. Be familiar with and practice all safety procedures presented in the SAFETY section before operating the dispensing system.

Description of Programming

Up to 30 programs can be saved in the COMPULAB 3. The saved programs may be of any combination of pump, dispense, and dilute programs. Table 3 lists all the required and optional parameters in each of the three types of programs.

<table>
<thead>
<tr>
<th>Type of Parameter</th>
<th>Required</th>
<th>Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tube size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate</td>
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<tr>
<td>Pump direction</td>
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<td>Delivery</td>
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<td>Pump direction</td>
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<td>Delivery</td>
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<tr>
<td>Pump direction</td>
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</tbody>
</table>

Table 3. Program Parameters

<table>
<thead>
<tr>
<th>Type of Parameter</th>
<th>Program</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Pump</td>
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<tr>
<td>Required</td>
<td>Pump type</td>
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<td></td>
<td>Tube size</td>
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<td></td>
<td>Rate</td>
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<tr>
<td>Optional</td>
<td>Acceleration time</td>
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<td></td>
<td>Deceleration time</td>
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<tr>
<td></td>
<td>Anti-drip</td>
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<td></td>
<td>Pump direction</td>
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</tbody>
</table>

General

Programs may be designed and saved, or may be run immediately without saving. After the program is run, the user can modify the program, try it again, and when satisfied, save it. A designed program that is not saved will be lost if power to the dispenser is removed. After the program is saved, it may be run, modified, and saved under the same or another number.
Settings for optional parameters such as acceleration ramping, deceleration ramping, and anti-drip are usually determined through trial and error. Acceleration and deceleration are programmed separately. Acceleration is the amount of time in seconds it will take the pump to reach the programmed speed. A setting of 0.0 (zero) instructs the pump to reach the programmed speed as quickly as possible. Deceleration is the amount of time in seconds it will take the pump to slow to zero from the programmed speed. A setting of 0.0 (zero) instructs the pump to stop as quickly as possible. Use acceleration/deceleration to minimize splash of dangerous materials or to improve accuracy when dispensing viscous materials.

An anti-drip value instructs the pump to reverse direction before stopping, preventing fluid in the tubing from dripping after the pump has stopped. The best anti-drip setting is dependent upon tube size, rate, physical setup, and viscosity of the fluid being pumped. Anti-drip can be set from 0 (zero) to 10, where 10 equals one pump revolution.

Creating a New Pump Program

To create a new pump program, ensure that the console displays the PROGRAM MENU. If any other menu appears, press the BACK key until the PROGRAM MENU is displayed.

1. Press the arrow key under NEW. The following display appears:

2. Press the arrow key under PUMP. The first screen of the pump program menus appears.

3. Press the arrow key under DRIVE to toggle the pump type between RD-1 and RD-2. Ensure that the selected pump matches the actual pump drive.
NOTE: When the arrow key is pressed under any parameter that requires a numeric input, the cursor appears over the furthest right digit of the value. The cursor moves one digit to the left as each number is entered. The BACK key acts as a backspace when entering a numeric value. CANCEL/STOP clears the entry.

4. Press the arrow key under TUBE and, using the keypad, enter the tube size (13, 14, 16, 17, 18, or 25).

5. Press the arrow key under RATE, and enter the desired rate in mL per minute.

NOTE: If the pump has never been calibrated, the default range for the selected tubing size is displayed. If the pump has been calibrated, the valid range for the tubing size is calculated based on the results of the calibration. The dispensing system stores the calibration for each tubing size for each pump number (1–4).

6. If you wish to enter an acceleration or deceleration rate, an anti-drip value, or change the direction of the pump, press the arrow key under OPT and the following display appears. If your program does not require this screen, press ENTER and proceed to step 11.

7. Press the arrow key under ACCEL and/or DECEL and enter the desired value (0 to 9.9s).

8. Press the arrow key under NO-DRIP and enter the desired anti-drip value (0 to 10, where 10 equals one pump revolution).

9. The default setting for pump direction is CW (clockwise). If you want to change the direction of the pump, press the arrow key under DIR. The pump direction changes from CW (clockwise) to CCW (counterclockwise). Press the arrow key again to change the direction back to CW.

10. Press ENTER to complete the pump program.

11. The following display appears:

To save the program, refer to Saving a Program on page 27.

NOTE: The program may be run without saving it first. In case of a power failure, however, all program parameters will be lost.

To run the program without saving, press ENTER without assigning a number, and refer to Running a Pump Program on page 30.
Creating a New Dispense Program

To create a new dispense program, ensure that the console displays the PROGRAM MENU. If any other menu appears, press the BACK key until the PROGRAM MENU is displayed.

1. Press the arrow key under NEW. The following display appears:

   **PROGRAM MENU**  **LINKED:** NONE  **NEW**  **EDIT:**##  **LOAD**  **LINK**

2. Press the arrow key under DISPENSE. The first screen of the dispense program menus appears:

   **DISPENSE MENU**  **ENTER CONTINUES##**  **DRIVE:**RD2  **TUBE:**0  **RATE:** 0.0mL/MIN  **MORE**

**NOTE:** Rate, tube size, and volume must be specified. Pressing ENTER to continue before RATE, TUBE size, or VOL are entered results in an error message.

3. Press the arrow key under DRIVE to toggle the pump type between RD-1 and RD-2.

   **NOTE:** When the arrow key is pressed under any parameter that requires a numeric input, the cursor appears over the furthest right digit of the value. The cursor moves one digit to the left as each number is entered. The BACK key acts as a backspace when entering a numeric value. CANCEL/STOP clears the entry.

4. Press the arrow key under TUBE and, using the keypad, enter the tube size (13, 14, 16, 17, 18, or 25).

5. Press the arrow key under RATE, and enter the desired rate in mL per minute.

   **NOTE:** If the pump has never been calibrated, the default range for the selected tubing size is displayed. If the pump has been calibrated, the valid range for the tubing size is calculated based on the results of the calibration. The dispensing system stores the calibration for each tubing size for each pump number (1–4).
6. Press the arrow key under MORE. The following display appears:

```
PUMP
DISPENSE MENU CONT. ENTER CONTINUES #1
VOL: 0.0mL DIR: CW OPTIONS
```

7. The default setting for pump direction is CW (clockwise). If you want to change the direction of the pump, press the arrow key under DIR. The pump direction changes from CW (clockwise) to CCW (counterclockwise). Press the arrow key again to change the direction back to CW.

8. Press the arrow key under VOL and enter the desired volume to be dispensed, and press ENTER. The following display appears:

```
PUMP
UNITS MENU
MILLILITER LITER GRAM KILOGRAM
```

**NOTE:** A dispense program may be designed to operate with a balance. When a balance is connected, it monitors the weight of each dispense and communicates that weight to the controller. The controller displays the actual weight at the end of the dispense and adjusts the calibration, if necessary, for the following dispense. Selecting grams or kilograms for unit of measure requires the use of a balance.

9. Press the arrow key under the unit of measure you wish to use.

10. After a unit of measure is selected, you are returned to the following screen:

```
PUMP
DISPENSE MENU CONT. ENTER CONTINUES #1
VOL: 0.0mL DIR: CW OPTIONS
```

11. If you wish to enter an acceleration or deceleration rate, a cycle value, a beep signal time, or an anti-drip value, press the arrow key under OPTIONS and the following display appears. If your program does not require this screen, press ENTER and proceed to step 21.

```
PUMP
DISPENSE OPTIONS ENTER CONTINUES #1
ACCEL: 0.0s DECEL: 0.0s CYCLE MORE OPTS
```

12. Press the arrow key under ACCEL and/or DECEL and enter the desired value (0 to 9.9s).
13. Press the arrow key under CYCLE to enter the information about cycling the pump. The following display appears:

<table>
<thead>
<tr>
<th>CYCLE SETTINGS</th>
<th>ENTER CONTINUES</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>CYCLES: 1 MAN/auto</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Cycle is the number of times the pump repeats the dispensing action before it stops. Entering a cycle value of 0 (zero) instructs the pump to repeat the dispense indefinitely.

14. Press the arrow key under CYCLES and enter the number of times you want the pump to dispense.

**NOTE:** The pump can dispense in either AUTObomatic or MANual mode. In AUTObomatic mode, the program runs to completion of all cycles. In MANual mode, the operator starts each cycle manually.

15. If the pump is to dispense manually with the keypad, a footswitch, or a handle, and does not need to signal the operator, press ENTER and proceed to step 21. If the pump is to dispense automatically or needs to signal the operator, press the arrow key under MAN/auto to see the following display:

<table>
<thead>
<tr>
<th>CYCLE SETTINGS</th>
<th>ENTER CONTINUES</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>CYCLES: 1 AUTO/m</td>
<td>DELAY: 0.0s</td>
<td></td>
</tr>
</tbody>
</table>

16. Press the arrow key under DELAY and enter the time the pump waits between cycles in seconds (0 to 999.9).

17. Press ENTER to go back to the CYCLE SETTINGS menu. Press ENTER again to return to DISPENSE OPTIONS. Press the arrow key under MORE OPTS for beep and anti-drip options. If your program does not require this screen, press ENTER and proceed to step 20.

<table>
<thead>
<tr>
<th>MORE DISPENSE OPTIONS</th>
<th>ENTER CONTINUES</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEEP: 0.0s</td>
<td>NO-DRIP: 0</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** The dispenser provides an audible signal when the BEEP parameter is set longer than zero. In AUTObatic mode, it signals the completion of all the programmed cycles. In MANual mode, it signals for the user to begin the next dispense.

18. Press the arrow key under BEEP and enter the length of time in seconds you want the dispenser to sound a signal. A setting of 0.0 results in no audible signal.

19. Press the arrow key under NO-DRIP and enter the desired anti-drip value (0 to 10, where 10 equals one revolution).
20. Press ENTER to complete the dispense program.
21. The following display appears:

```
SAVE PROGRAM ENTER CONTINUES 1
PROGRAM NUMBER: 0  0 = NOT SAVED
```

To save the program, refer to Saving a Program on page 27.

**NOTE:** The program may be run without saving it first. In case of a power failure, however, all program parameters will be lost.

To run the program without saving, press ENTER without assigning a number, and refer to Running a Dispense Program on page 31.

### Creating a New Dilute Program

For use as a diluter, the pump is first primed with the diluent. Then, a dilute cycle consists of two separate actions, sample and delivery. For the sample action, the outlet end of the tubing is placed in the container holding the sample. The pump runs opposite the programmed direction to draw the sample volume into the tube. For the delivery action, the outlet end of the tubing is moved to the receiving container, and after the hold time, the delivery volume is pumped out of the pump. The sample volume plus the diluent volume equals the delivery volume.

To create a new dilute program, ensure that the console displays the PROGRAM MENU. If any other menu appears, press the BACK key until the PROGRAM MENU is displayed.

```
PUMP
PROGRAM MENU LINKED: NONE
NEW EDIT: # LOAD LINK
```

1. Press the arrow key under NEW. The following display appears.

```
PUMP
NEW PROGRAM CHOOSE MODE
PUMP DISPENSE DILUTE LOAD
```

2. Press the arrow key under DILUTE. The first screen of the dilute program menus appears.

```
PUMP
DILUTE MENU ENTER CONTINUES 1
DRIVE: RD2 TUBE: 0 RATE: 0.0mL/MIN MORE
```

**NOTE:** Rate, tube size, sample volume, and delivery volume must be specified. Pressing ENTER to continue before RATE, TUBE size, SMP (sample volume), or DLV (delivery volume) are entered results in an error message.
3. Press the arrow key under DRIVE to toggle the pump type between RD-1 and RD-2.

**NOTE:** When the arrow key is pressed under any parameter that requires a numeric input, the cursor appears over the furthest right digit of the value. The cursor moves one digit to the left as each number is entered. The BACK key acts as a backspace when entering a numeric value.

4. Press the arrow key under TUBE and, using the keypad, enter the tube size (13, 14, 16, 17, 18, or 25).

5. Press the arrow key under RATE, and enter the desired rate in mL per minute.

**NOTE:** If the pump has never been calibrated, the default range for the selected tubing size is displayed. If the pump has been calibrated, the valid range for the tubing size is calculated based on the results of the calibration. The dispensing system stores the calibration for each tubing size for each pump number (1–4).

6. Press the arrow key under MORE. The following display appears:

```
PUMP
DILUTE MENU CONT. ENTER CONTINUES II
SMP: 0.0mL DLV: 0.0mL DIR: CW OPTIONS
```

**NOTE:** The pump direction is set for delivery dispense. The pump runs in the opposite direction for sample take-up.

7. The default setting for pump direction is CW (clockwise). If you want to change the direction of the pump, press the arrow key under DIR. The pump direction changes from CW (clockwise) to CCW (counterclockwise). Press the arrow key again to change the direction back to CW.

8. Press the arrow key under SMP and enter the sample volume in mL.

9. Press the arrow key under DLV and enter the delivery volume. After the value for delivery is entered, you must select the unit of measure. The following display appears:

```
PUMP
UNITS MENU
MILLILITER LITER
```

10. Press the arrow key under the type of measure you wish to use.

11. After a unit of measure is selected, you are returned to the following screen:
NOTE: Hold is the amount of time in seconds that the pump waits between the sample take-up and the delivery. Entering a value of 0.0 (zero) instructs the pump to hold until the user manually begins the dispense by pressing RUN or by using a footswitch or handle.

12. If you wish to enter an acceleration or deceleration rate, a hold time, a cycle value, a beep signal time, or an anti-drip value, press the arrow key under OPTIONS and the following display appears. If your program does not require this screen, press ENTER and proceed to step 23.

13. Press the arrow key under ACCEL and/or DECEL and enter the desired value (0 to 9.9s).

14. Press the arrow key under HOLD and enter the wait time between the sample take-up and the delivery.

15. Press the arrow key under MORE for beep, anti-drip, and cycle options. If those options are not necessary, press ENTER to complete the dilute program and proceed to step 23.

16. Press the arrow key under BEEP and enter the length of time in seconds you want the dispenser to sound a signal. A setting of 0.0 results in no audible signal.

17. Press the arrow key under NO-DRIP and enter the desired anti-drip value (0 to 10, where 10 equals one revolution).

NOTE: Cycle is the number of times the pump repeats the dilute before it stops. Entering a cycle value of 0 (zero) instructs the pump to repeat the dilute indefinitely.

18. Press the arrow key under CYCLE to enter the information about cycling the pump. The following display appears:

NOTE: The pump can dispense in either AUTOMATIC or MANuual mode. In AUTOMATIC mode, the program runs to completion of all cycles. In MANuual mode, the operator starts each cycle.
manually. Pressing the arrow key under MAN/auto (MANual mode) toggles the setting to AUTO/man (AUTOmatic mode). Pressing the arrow key again toggles the setting back to MANual.

19. Press the arrow key under CYCLES and enter the number of times you want the pump to cycle through a dilute.

20. If the pump is to dispense manually with a footswitch or handle, press ENTER and proceed to step 23. If the pump is to dispense automatically, press the arrow key under MAN/auto to see the following display:

```
PUMP
CYCLE SETTINGS ENTER CONTINUES #1
CYCLES: 1 AUTO/man DELAY: 0.0s
```

21. Press the arrow key under DELAY and enter the time the pump waits between running a dilute cycle in seconds (0 to 999.9). Press ENTER to continue.

22. Press ENTER to complete the dilute program.

23. The following display appears:

```
PUMP
SAVE PROGRAM ENTER CONTINUES #1
PROGRAM NUMBER: 0 0 = NOT SAVED
```

To save the program, refer to **Saving a Program** following.

**NOTE:** The program may be run without saving it first. In case of a power failure, however, all program parameters will be lost.

To run the program without saving, press ENTER without assigning a number, and refer to **Running a Dilute Program** on page 34.

**Saving a Program**

After all the required parameters are entered, you should save the program. Up to 30 programs can be stored at one time. The stored programs can be any combination of pump, dispense, and dilute programs. If the SAVE MENU is not shown, go to the PROGRAM MENU, edit the program you want to save, and press ENTER until the following display appears:

```
PUMP
SAVE PROGRAM ENTER CONTINUES #1
PROGRAM NUMBER: 0 0 = NOT SAVED
```
1. Enter a number between 1 and 30 and press ENTER to save the program. If there is a program saved under the number entered, the following display appears:

   ![Program is in use. Overwrite?]

2. Press the arrow key under YES to overwrite the saved program with the current one, or press the arrow key under NO to go back to the SAVE MENU and to give the program a different number.

**Loading a Program**

To load an existing program, ensure that the console displays the PROGRAM MENU. If any other menu appears, press the BACK key and then the arrow key under PROGRAM so the PROGRAM MENU is displayed.

![Program menu linked: none]

Ensure that the pump number shown in the upper right of the display is the pump that will run the loaded program. If it is not the correct pump, press PUMP# on the control keypad until the correct pump number is displayed.

**NOTE:** If you do not know the number of the program you want to load, press the arrow key under LOAD, and proceed to step 4. If you know the number of the program to load, continue with step 1.

1. Press the arrow key under LOAD, input the program number, and press ENTER. The program loads into memory. Refer to Operating Procedures on page 29 to run the program.

2. If there is no program saved under that number, the following display appears:

   ![No program at this location. Enter continues.]

3. Press ENTER to return to the LOAD menu.
4. To scroll through the saved programs, press the arrow key under DECREMENT or INCREMENT until the desired program is located. Press the ENTER key to load the program. The program loads into memory. Refer to Operating Procedures following to run the program.

Operating Procedures
Before performing any of the procedures in this section, be sure that the correct size tubing is properly loaded. Refer to SETUP on page 12 to install the tubing.

You may run the same program to four pumps, or different programs for each pump.

A program designed for an RD-1 pump will not run on an RD-2 pump. A program designed for an RD-2 pump will not run on an RD-1 pump.

Linking Pumps
For pumping or dispensing operations, two or more pump drives may be linked so that they operate and are controlled simultaneously. All linked drives start with a single key press or by one external signal. All linked drives must be set up to run the same type of program.

NOTE: Dilute programs cannot be linked.

For pump programs, all linked pump drives begin when the RUN arrow key is pressed or the external start/stop contact closure is closed for any linked pump. The pumps continue running until the CANCEL/STOP or STOP ALL key is pressed or until the external start/stop contact closure is opened for any linked pump. All pumps pause simultaneously. All pumps start over or resume simultaneously when the appropriate arrow key is pressed. An external signal resumes all pumps.

For dispense programs, all linked pump drives begin when the RUN arrow key is pressed or the external start/stop contact is momentarily closed for any linked pump. The pumps continue running until the CANCEL/STOP or STOP ALL key is pressed or until the external start/stop contact signal is momentarily closed. All pumps pause simultaneously. All pumps start over or resume simultaneously when the appropriate arrow key is pressed. Momentarily closing the external start/stop contact also resumes all pumps. If not interrupted, each pump continues to run until the programmed volume is dispensed. For programs with multiple cycles, each pump must complete a cycle, then a new cycle simultaneously starts all linked pump drives.
Use the following procedure to link pump drives. Ensure that the PROGRAM MENU is displayed. If it is not, press BACK until the following display is shown:

1. Press the arrow key under LINK. The following display appears:

2. Press the arrow key under the pump you wish to link. The selected pump number appears on the top line.

3. Select the additional pumps to be linked. Their numbers appear on the top line.

**NOTE:** To deselect a pump, press the arrow key under the pump, and its number is removed from the linked pumps.

4. Press ENTER to accept the linked pumps.

**Running a Pump Program**

**NOTE:** Before continuing, be sure that the tubing is properly loaded and routed to the correct locations.

If the pump number shown in the upper right corner of the display is not the pump that is going to run the program, you will have to reload the program to run it on that pump. The program stays in memory, assigned to the active pump when loaded. Change the pump number by pressing PUMP# on the control keypad. When the correct pump number is displayed, refer to **Loading a Program** on page 28, press the arrow key under PROGRAM, and load the desired program.

After creating or loading a previously saved pump program, the following display appears:

**NOTE:** You must prime the pump to purge the air from the tubing before calibrating, dispensing or diluting. Air in the tubing will also cause an inaccurate volume display while a pump program is run. To ensure that the tubing is properly set in the pump head, prime the pump for approximately three minutes.
1. To prime the pump, press the arrow key under PRIME and refer to Priming or Purging the Pump on page 36. To perform a calibration, press the arrow key under CALIBRATE and refer to Performing a Calibration on page 36. Press the arrow key under RUN to run the program. The following display appears and the pump runs:

```
PUMPING AT ***.mL/MIN CANCEL STOPS #1
***.mL
```

2. At any time, you may press CANCEL/STOP to stop the pump. The following display appears showing the total amount pumped:

```
PROG:## PAUSED AMT PUMPED ***.mL #1
RESUME START OVER END
```

3. Press the arrow key under RESUME to restart the pump and to continue totaling the volume pumped from the displayed amount. Press the arrow key under START OVER to reset the amount pumped to zero and to restart the pump. Press the arrow key under END to quit the program.

4. To increase or decrease the pump speed while the pump is running, press SPEED/VOLUME on the control keypad. The following display appears:

```
RATE:###.mL/MIN ENTER CONTINUES #1
FASTER SLOWER
```

5. Press and hold the arrow key under FASTER to increase pump speed or press and hold the arrow key under SLOWER to decrease pump speed. Release the key when the rate is satisfactory. Press the ENTER key to return to the pump status display.

```
PUMPING AT ***.mL/MIN CANCEL STOPS #1
***.mL
```

6. When the desired amount has been pumped, press CANCEL/STOP. Press the arrow key under END to quit the program.

Running a Dispense Program

**NOTE:** Before continuing, be sure that the correct size tubing is properly loaded. If measurement units are in grams, make sure that the balance is connected and turned on. If the program is to cycle by means of a footswitch or handle, ensure that the footswitch or handle is connected.
If the pump number shown in the upper right corner of the display is not the pump that is going to run the program, you will have to reload the program to run it on that pump. The program stays in memory, assigned to the active pump when loaded. Change the pump number by pressing PUMP# on the control keypad. The pump number in the upper right of the display sequences through pump numbers. When the correct pump number is displayed, refer to Loading a Program on page 28, press the arrow key under PROGRAM, and load the desired program.

After creating or loading a previously saved dispense program, the following display appears.

```
  PUMP

| PROGRAM | ## LINKED: NONE | #1 |
| PRIME   | CALIBRATE      | PROGRAM RUN |
```

**NOTE:** You must prime the pump to purge the air from the tubing before calibrating, dispensing or diluting. Air in the tubing will also cause an inaccurate volume display while a pump program is run.

1. To prime the pump, press the arrow key under PRIME. Refer to Priming or Purging the Pump on page 36. To perform a calibration, press the arrow key under CALIBRATE. Refer to Performing a Calibration on page 36. Press the arrow key under RUN to run the program. The following display appears and the pump runs:

```
  PUMP

| DISP AT #.##mL OF # CANCEL STOPS | #1 |
| [---------------------------------] | #.##mL |
```

2. At any time during the dispense cycle, you may press CANCEL/STOP to stop the pump. The following display appears, showing the total amount pumped:

```
  PUMP

| PROG:## PAUSED ## OF ## COMPLETED | #1 |
| RESUME START OVER END |
```

3. Press the arrow key under END if you want to quit the program. Press the arrow key under RESUME to restart the pump and to continue totaling the cycles from the displayed amount. Press the arrow key under START OVER to reset the cycle number to zero and to restart the pump.
NOTE: If a balance is being used, the actual weight of the dispense is communicated to the controller. The controller displays the weight and adjusts the calibration, if necessary, for the following dispense.

4. For AUTOMATIC dispenses: The pump dispenses until the programmed parameters for one cycle is complete. If CYCLE SETTING is any number except 1, another dispense begins at the end of the DELAY parameter. The dispense is repeated for the programmed number of CYCLES. If BEEP was set to any value other than 0 (zero), the console audibly indicates that all cycles are complete. If CYCLES was set to 0 (zero), the dispense is repeated until canceled and terminated by the operator.

For MANUAL dispenses: The pump dispenses until the programmed parameters for one cycle is complete. If BEEP was set to any value other than 0 (zero), the console audibly indicates that the cycle is complete. If CYCLE SETTING is any number except 1, the pump waits for the operator to press the arrow key under RUN, depress the footswitch, or use the handle to dispense. The dispense is repeated for the programmed number of CYCLES. If CYCLES was set to 0 (zero), the dispense is repeated until canceled and terminated by the operator.

NOTE: The volume setting can be adjusted while the program is being run. The pump must be between dispenses or paused.

5. To change the volume, press SPEED/VOLUME on the control keypad when the pump is between dispenses or paused. The following display appears:

```
VOLUME:####.#### ENTER CONTINUES ## MORE LESS
```

6. Press and hold the arrow key under MORE to increase volume or press and hold the arrow key under LESS to decrease volume. Release the key when the volume is satisfactory. Press the ENTER key to return to the pump status display.

NOTE: The new value for volume is not automatically saved. To use the new setting the next time the program is loaded, press the BACK key twice and then the ENTER key to display the SAVE PROGRAM menu. Save the program.
Running a Dilute Program

NOTE: Before continuing, be sure that the correct size tubing is properly loaded. If the program is to cycle manually, ensure that the footswitch or handle is connected.

If the pump number shown in the upper right corner of the display is not the pump that is going to run the program, you will have to reload the program to run it on that pump. The program stays in memory, assigned to the active pump when loaded. Change the pump number by pressing PUMP# on the control keypad. The pump number in the upper right of the display sequences through connected pumps. When the correct pump number is displayed, refer to Loading a Program on page 28, press the arrow key under PROGRAM, and load the desired program.

After creating or loading a previously saved dispense program, the following display appears:

NOTE: You must prime the pump to purge the air from the tubing before calibrating, dispensing or diluting. Air in the tubing will also cause an inaccurate volume display while a pump program is run.

1. To prime the pump, press the arrow key under PRIME. Refer to Priming or Purging the Pump on page 36. To perform a calibration, press the arrow key under CALIBRATE. Refer to Performing a Calibration on page 36. Press the arrow key under RUN to run the program. The following display appears and the pump runs:

2. After the sample is taken up, the pump stops for the duration of the HOLD setting and the following display appears:

NOTE: If the programmed hold time is zero, the dispenser waits for the operator to press the arrow key under RUN, depress the footswitch, or use the handle.
3. After the hold time, the pump dispenses and the following display appears:

4. At any time during the cycle, you may press CANCEL/STOP to stop the pump. The following display appears, showing the total number of cycles completed:

5. Press the arrow key under RESUME to restart the pump and to continue totaling the cycles from the displayed amount. Press the arrow key under START OVER to reset the cycle number to zero and to restart the pump. Press the arrow key under END to quit the program.

NOTE: The sample or delivery volume setting can be adjusted while the program is being run. The pump must be between dispenses or paused.

6. To change the volume, press SPEED/VOLUME on the control keypad when the pump is between dispenses or paused. The following display appears:

7. Press and hold the arrow key under MORE to increase volume or press and hold the arrow key under LESS to decrease volume. Release the key when the volume is satisfactory. Press the ENTER key to return to the pump status display.

NOTE: The new value for volume is not automatically saved. To use the new setting the next time the program is loaded, press the BACK key twice and then the ENTER key to display the SAVE PROGRAM menu. Save the program.
Priming or Purging the Pump
If there is not fluid all the way through the tubing or if it is the first
dispense of the day, the pump should be primed. If there is unwanted
fluid in the tubing, it can be removed by purging the pump. In order to
prime or purge the pump, a program must be loaded or just saved. The
following display appears when a program is loaded or just saved.

1. Press the arrow key under PRIME and the following display appears:

   ![Display](image)

   NOTE: To ensure that the tubing is properly set in the pump head,
   prime the pump for approximately three minutes.

2. To prime the pump, press the arrow key under PRIME. The pump
   runs in the direction (clockwise or counterclockwise) of the program.
   The display updates to show the progress of the pump action. Press
   CANCEL/STOP when the priming time has elapsed to stop the
   pump.

3. To purge the pump, press the arrow key under PURGE. The pump
   runs in the opposite direction (clockwise or counterclockwise) of the
   program. Press CANCEL/STOP when the tubing is purged of fluid.

4. Press ENTER to continue.

Performing a Calibration
You must prime the pump to purge the air from the tubing before
calibrating, dispensing or diluting. Air in the tubing will also cause an
inaccurate volume display while a pump program is run.

NOTE: If the pump has never been calibrated, the default range for the
selected tubing size is displayed. If the pump has been
 calibrated, the valid range for the tubing size is calculated based
on the results of the calibration. The dispensing system stores
the calibration for each tubing size for each pump number (1–4).

NOTE: Before continuing, ensure that the tubing is properly loaded and
the pump is primed.
The COMPULAB 3 can be calibrated anytime a program is loaded. After creating a new program or loading a previously created program, the following display appears:

1. Press the arrow key under CALIBRATE. The following display appears:

NOTE: CLEAR CAL appears only if the tube was previously calibrated. Press the arrow key under CLEAR CAL to delete a calibration and restore the factory calibration.

2. Press the arrow key under VOLUME, and enter the amount you want the pump to dispense for calibration. Press the arrow key under RUN CAL to start pumping action. The following display shows the dispense interactively:

3. When the pump stops, the following display appears:

4. Measure the actual volume that the pump dispensed. If the actual volume and displayed volume are the same press CANCEL. If the amounts are different, press the arrow key under VOL and enter the actual volume. Press ENTER to continue.

After performing step 4, you may want to run the entire procedure again to confirm the calibration.

After the calibration is completed, the actual flow rates for the selected tubing size for the pump are calculated. The calculated rates are displayed when creating or modifying a program.
Locking the Keypad

The COMPULAB 3 keypad may be locked to ensure that running programs are not inadvertently terminated or to restrict access to the system. To lock the keypad, perform the following procedure:

1. Ensure that the control console is not waiting for a numerical input such as tube size, volume, or flow rate.
2. Enter 727637 on the numeric keypad.
3. The following display appears for approximately three seconds. The display reappears any time a non-numeric key is pressed.

   KEYPAD IS LOCKED

4. To unlock the keypad, enter the same code. The following display appears:

   KEYPAD IS UNLOCKED
TROUBLESHOOTING

Use the Troubleshooting Chart as a guide to determine the cause of an observed problem. If a particular problem is not listed in the chart, or if the listed remedies do not solve the problem, contact Barnant Company for assistance in determining the cause of the malfunction.

Table 4. Troubleshooting Chart

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display reads &quot;PUMP DRIVE TURNED OFF OR NOT CONNECTED&quot;</td>
<td>Pump drive not turned on</td>
<td>Place POWER switch in the On (I) position.</td>
</tr>
<tr>
<td></td>
<td>Pump drive not plugged in</td>
<td>Plug pump into a live AC source.</td>
</tr>
<tr>
<td></td>
<td>Pump drive not connected to control console</td>
<td>Connect pump drive to control console.</td>
</tr>
<tr>
<td></td>
<td>Defective cable</td>
<td>Reconnect pump to control console with new cable.</td>
</tr>
<tr>
<td>Display reads &quot;COMMUNICATION ERROR #&quot;</td>
<td>Defective drive or controller</td>
<td>Return to dealer for service.</td>
</tr>
<tr>
<td>Pump drive number displayed is 0 (zero)</td>
<td>Pump drive not connected to control console</td>
<td>Connect pump drive to control console.</td>
</tr>
<tr>
<td></td>
<td>Defective cable</td>
<td>Reconnect pump to control console with new cable.</td>
</tr>
<tr>
<td></td>
<td>Defective drive or controller</td>
<td>Return to dealer for service.</td>
</tr>
<tr>
<td>Everything appears to work properly, but pump does not turn</td>
<td>Broken belt</td>
<td>Refer to Belt Replacement on page 41, and replace the belt.</td>
</tr>
</tbody>
</table>
MAINTENANCE

Safety
The procedures in this section must be performed with power removed from the dispensing system. Attempting to perform the procedure without power removed can result in serious injury or death. If you are unsure of the status of electrical power, DO NOT perform the procedure. The capacitors in the power supply section of the pump drive maintain high-voltage for up to ten minutes after power is removed. Allow sufficient time for the capacitors to discharge before removing the cover for servicing.

Refer to USER REPLACEABLE PARTS on page 47 for the part numbers of all the user replacement parts.

Cleaning
WARNING: Disconnect the dispenser from the AC source before cleaning. A shock hazard exists when using water on powered equipment.

The dispenser enclosures may be cleaned by using a mild detergent and water solution. Never immerse the unit in water nor use excessive fluid when cleaning the dispenser. Dry the dispenser before restoring power.

Fuse Replacement
If you suspect that the fuse has blown, use the following procedure to remove, check, and replace the fuse.

CAUTION: Always replace the fuse with the same type and rating as the blown fuse. Using a fuse of a different type or with a different rating can cause damage to the pump drive.

1. Unplug the power cord from the AC source.
2. Ensure that the power switch is in the Off (O) position, and remove the power cord from the back of the pump drive.
3. Refer to Figure 9, and use a small screwdriver to pull out the fuse tray.
4. Slide the defective fuse out of the fuseholder.
5. Remove the spare fuse and slide it into the fuseholder in place of the defective fuse.
NOTE: Replace the spare fuse as soon as is practical.

6. Push the fuse tray in until it snaps into place.

7. Make sure that the voltage selection switch matches the AC power source.

8. Reconnect the power cord to the connector on the back of the pump drive.

9. Plug the power cord into the AC source.

10. Place the power switch in the On (I) position.

NOTE: If the fuse blows repeatedly, there is a problem with the pump drive. Contact your distributor or Barnant Company Technical Support for help.

Belt Replacement

If the dispenser powers up properly and appears to be operating correctly at the control console, but the pump does not turn, it is possible that the belt has broken. Use the following procedure to inspect and, if necessary, replace the belt.

DANGER: Never remove the cover from the pump drive when power is present. AC and DC power in the pump drive can cause serious injury or death. Ensure that the pump drive is disconnected from the power source before removing the cover for maintenance. Allow ten minutes for the capacitors in the power supply to discharge before proceeding.
1. Remove and retain the four screws from each side of the pump drive cover.

2. Remove the cover by sliding it straight up.

**NOTE:** Inspect the belt to see if it is broken or has missing teeth. If it is broken or worn, it needs to be replaced.

3. Refer to Figure 10 and loosen, but do not remove, the two nuts that secure the motor to the top of the motor mounting brackets.

4. Pivot the motor toward the pump, and remove the belt from around the motor pulley.

5. Remove the belt from around the pump pulley.

6. Install the replacement belt around the pump pulley and around the motor pulley.

**Figure 10. Replacing the Belt**

**NOTE:** Be careful when working near the fan end of the motor. The fan blades are sharp.
7. Pivot the motor so the belt is taut, and secure the motor in position by tightening the nuts loosened in step 3 just enough to hold the motor.

8. Test belt tension by pressing on the belt midway between the pulley. The belt should flex approximately 1/8 in. (3 mm).

9. If belt tension is correct, tighten the nuts securely. If tension is not correct, loosen the nuts and repeat step 7 and step 8.

10. Reinstall cover and secure with eight screws.

**Brush Replacement**

Exact motor brush and commutator life will depend on duty cycle and motor operating speed. Inspect the brushes every six months or after 2000 hours of operation, whichever occurs first. Replace brushes if they are less than 0.30 in. (7.6 mm) long. Inspect the commutator when the brushes are replaced, and clean if necessary.

**DANGER:** Never remove the cover from the pump drive when power is present. AC and DC power in the pump drive can cause serious injury or death. Ensure that the pump drive is disconnected from the power source before removing the cover for maintenance. Allow ten minutes for the capacitors in the power supply to discharge before proceeding.

1. Refer to **Belt Replacement** on page 41, remove the cover, and remove the belt from the pulley on the drive motor.

2. Pivot the motor away from the pump to gain access to the brush on the pump side of the motor.

3. Refer to Figure 11, and remove the brush caps.

4. Rotate each brush retainer so it lines up with the groove in the brush holder. Remove the brushes.

5. Measure the length of the brushes. If either brush is less than 0.30 in. (7.6 mm) long, they both need to be replaced. Always replace them in pairs.

**CAUTION:** Excessive commutator wear or “bridging” between commutator segments can cause excessive current through the controller circuit and damage to the dispenser.

6. Inspect the commutator for wear and dirt. If the commutator segments are worn, replace the motor. If there are dark tracks where the brushes contact the commutator, clean with isopropyl alcohol.
7. Install the brushes into the brush holders and rotate the retainer to secure the brushes. Reinstall the brush caps.

8. When the motor has been reassembled, refer to step 7 of Belt Replacement on page 41 to reassemble the pump drive.
SPECIFICATIONS

Output:

Speed:
- RD-1: 7.2 to 720 rpm
- RD-2: 7.2 to 720 rpm

Maximum torque output:
- RD-1: 10 kg•cm (140 oz-in)
- RD-2: 10 kg•cm (140 oz-in)

Speed regulation (all conditions):
- ±0.3% of full speed

Remote contact closures:
- 28 VDC, 1 A
- 28 VAC, 1 A

Dispense volume:
- RD1: 0.1 mL to 5000 L
- RD2: 0.1 mL to 7000 L

Dilute volume:
- Sample: 0.1 mL to 100.0 mL
- RD1: Delivery: 0.1 mL to 5000 L
- RD2: Delivery: 0.1 mL to 7000 L

Input:

Supply voltage limits:
- 115 VAC: 90 V AC to 130 V AC, 48 Hz to 63 Hz
- 230 VAC: 180 V AC to 260 V AC, 48 Hz to 63 Hz

Nominal current:
- 115 VAC: 1.5 A
- 230 VAC: 0.7 A

Installation category: Category II per IEC 664 (Local level — appliances, portable equipment, etc.)

Remote input: START/STOP +5 VDC, 5 mA

Display: 40-character x 2-line backlit LCD

Construction:

Control console dimensions: 22.6 cm (8.9 in) wide
- 16.5 cm (6.5 in) deep
- 2.3 cm (0.9 in) front, 6.9 cm (2.7 in) back in height

Control console weight: 1.5 kg (3.2 lbs)

RD-1 dimensions: 23.1 cm (9.1 in) wide
- 33.8 cm (13.3 in) deep
- 14.5 cm (5.7 in) high

RD-1 weight: 8.5 kg (18.8 lbs)

RD-2 dimensions: 25.7 cm (10.1 in) wide
- 30.2 cm (11.9 in) deep
- 17.15 cm (6.75 in) high

RD-2 weight: 9.3 kg (20.5 lbs)
Environment:

Operating temperature: 0° to 40°C (32° to 104°F)
Storage temperature: −25° to 65°C (−13° to 149°F)
Humidity (non-condensing): 10% to 90%
Altitude: Less than 2000 m (6500 ft)
Pollution degree: Pollution degree 2 per IEC 664
(Indoor use — lab, office)
Chemical resistance: All materials withstand standard cleaning solvents.
Materials used in the construction are: a polyester label, a combined aluminum motor and paint-loc steel controller enclosure, and an epoxy-based, non-chip paint finish.
Environmental protection: Withstands general spills and light sprays (IEC-529 IP22).

Compliance: Meets UL 508;
CSA C22.2 No. 14-M91; and
CE EN61010-1/A2: 1995 (Safety),
EN50081-1: 1992 (EMC Emissions), and
EN50082-1: 1992 (EMC Immunity)
<table>
<thead>
<tr>
<th>USER REPLACEABLE PARTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump head cover, RD-1</td>
<td>91-055-070</td>
</tr>
<tr>
<td>Pump head cover, RD-2</td>
<td>91-065-110</td>
</tr>
<tr>
<td>Tube clamp, RD-2</td>
<td>91-065-130</td>
</tr>
<tr>
<td>Line cord</td>
<td></td>
</tr>
<tr>
<td>115V</td>
<td>B-3115</td>
</tr>
<tr>
<td>230V</td>
<td>B-2938</td>
</tr>
<tr>
<td>3-1/2 ft (1.1 m) RJ-12 cable</td>
<td>77095-02</td>
</tr>
<tr>
<td>Motor brushes (2)</td>
<td>B-1238-0056</td>
</tr>
<tr>
<td>Fuse</td>
<td>B-1115-0043</td>
</tr>
<tr>
<td>Rubber foot</td>
<td>A-1390-0004</td>
</tr>
<tr>
<td>Brush cap (1)</td>
<td>A-3190-CR</td>
</tr>
<tr>
<td>Belt</td>
<td>A-1341-0006</td>
</tr>
<tr>
<td>Knurled nut (pump cover)</td>
<td>B-1083-0063</td>
</tr>
</tbody>
</table>
# ACCESSORIES

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 ft (3 m) RJ-12 cable</td>
<td>77095-03</td>
</tr>
<tr>
<td>15 ft (4.6 m) RJ-12 cable</td>
<td>77095-04</td>
</tr>
<tr>
<td>Dispenser handle for 1 to 4 pumps</td>
<td>73-055-590</td>
</tr>
<tr>
<td>Dispenser handle holder</td>
<td>08024-55, 56</td>
</tr>
<tr>
<td>Chrome plated dispensing tip w/Luer lock for 1/16 in. and 1/8 in. ID tubing</td>
<td>72-648-010</td>
</tr>
<tr>
<td>PTFE sinkers — keep intake tube at bottom of reservoir (set of 2) for 1/16 in. – 5/16 in. ID tubing</td>
<td>75-250-100</td>
</tr>
<tr>
<td>Footswitch (115V or 230V)</td>
<td>73-750-000</td>
</tr>
<tr>
<td>Autoclavable dispensing tips:</td>
<td></td>
</tr>
<tr>
<td>Glass tip with Luer lock for 3/16 in. ID (size 25) and 1/4 in. ID (size 17) tubing</td>
<td>72-648-000</td>
</tr>
<tr>
<td>Polypropylene tip with Luer lock for 1/16 in. ID (size 14) and 1/8 in. ID (size 16) tubing</td>
<td>72-648-020</td>
</tr>
<tr>
<td>Autoclavable stainless steel cannulae for use with Luer lock dispensing tip:</td>
<td></td>
</tr>
<tr>
<td>Cannula 16 Gauge</td>
<td>91-015-210</td>
</tr>
<tr>
<td>Cannula 13 Gauge</td>
<td>91-015-220</td>
</tr>
<tr>
<td>Silicone tubing links</td>
<td></td>
</tr>
<tr>
<td>Tubing link 1/32 in. ID (size 13)</td>
<td>RD-1</td>
</tr>
<tr>
<td>Tubing link 1/16 in. ID (size 14)</td>
<td>72-300-135</td>
</tr>
<tr>
<td>Tubing link 1/8 in. ID (size 16)</td>
<td>72-300-145</td>
</tr>
<tr>
<td>Tubing link 3/16 in. ID (size 25)</td>
<td>72-300-155</td>
</tr>
<tr>
<td>Tubing link 1/4 in. ID (size 17)</td>
<td>72-300-165</td>
</tr>
<tr>
<td>Tubing link 1/32 in. ID (size 13)</td>
<td>RD-2</td>
</tr>
<tr>
<td>Tubing link 1/16 in. ID (size 14)</td>
<td>75-300-135</td>
</tr>
<tr>
<td>Tubing link 1/8 in. ID (size 16)</td>
<td>75-300-145</td>
</tr>
<tr>
<td>Tubing link 3/16 in. ID (size 25)</td>
<td>75-300-155</td>
</tr>
<tr>
<td>Tubing link 1/4 in. ID (size 17)</td>
<td>75-300-165</td>
</tr>
<tr>
<td>NORPRENE tubing links</td>
<td></td>
</tr>
<tr>
<td>Tubing link 1/32 in. ID (size 13)</td>
<td>72-305-135</td>
</tr>
<tr>
<td>Tubing link 1/16 in. ID (size 14)</td>
<td>72-305-145</td>
</tr>
<tr>
<td>Tubing link 1/8 in. ID (size 16)</td>
<td>72-305-155</td>
</tr>
<tr>
<td>Tubing link 3/16 in. ID (size 25)</td>
<td>72-305-165</td>
</tr>
<tr>
<td>Tubing link 1/4 in. ID (size 17)</td>
<td>72-305-175</td>
</tr>
<tr>
<td>PHARMED tubing links</td>
<td></td>
</tr>
<tr>
<td>Tubing link 1/32 in. ID (size 13)</td>
<td>72-301-135</td>
</tr>
<tr>
<td>Tubing link 1/16 in. ID (size 14)</td>
<td>72-301-145</td>
</tr>
<tr>
<td>Tubing link 1/8 in. ID (size 16)</td>
<td>72-301-155</td>
</tr>
<tr>
<td>Tubing link 3/16 in. ID (size 25)</td>
<td>72-301-165</td>
</tr>
<tr>
<td>Tubing link 1/4 in. ID (size 17)</td>
<td>72-301-175</td>
</tr>
<tr>
<td>Tygon tubing links</td>
<td></td>
</tr>
<tr>
<td>Tubing link 1/32 in. ID (size 13)</td>
<td>72-310-135</td>
</tr>
<tr>
<td>Tubing link 1/16 in. ID (size 14)</td>
<td>72-310-145</td>
</tr>
<tr>
<td>Tubing link 1/8 in. ID (size 16)</td>
<td>72-310-155</td>
</tr>
<tr>
<td>Tubing link 3/16 in. ID (size 25)</td>
<td>72-310-165</td>
</tr>
<tr>
<td>Tubing link 1/4 in. ID (size 17)</td>
<td>72-310-175</td>
</tr>
</tbody>
</table>
WARRANTY

The manufacturer warrants this product to be free from significant deviations from published specifications. If repair or adjustment is necessary within the warranty period, the problem will be corrected at no charge if it is not due to misuse or abuse on your part, as determined by the manufacturer. Repair costs outside the warranty period, or those resulting from product misuse or abuse, may be invoiced to you.

*The warranty period for this product is noted on the Warranty Card.*

PRODUCT RETURN

To limit charges and delays, contact the seller or manufacturer for authorization and shipping instructions before returning the product, either within or outside of the warranty period. When returning the product, please state the reason for the return. For your protection, pack the product carefully and insure it against possible damage or loss. Any damages resulting from improper packaging are your responsibility.

*NOTE: Items returned must be free of hazardous or toxic materials.*

TECHNICAL ASSISTANCE

If you have any questions about the use of this product, contact the manufacturer or authorized seller.

We reserve the right to make improvements in design, construction, and appearance of our products without notice.
APPENDIX A — BALANCE CONNECTION

The following balances have been confirmed as compatible with the COMPULAB 3. Other balances may work with the dispenser, but have not been tested by Barnant Company.

OHAUS® VOYAGER® Model V1D120  
SARTORIUS® Masterpro Model LP4200

The COMPULAB 3 provides communication to the balance through a nine-pin male RS-232 DTE port on the back of the control console. The COMPULAB 3 communicates at 9600 baud, 7 databits, 2 stop bits, odd parity. The balance must be set up to communicate at that protocol and must be set up to measure in grams. Figure 12 shows pin connections and signals necessary for the dispenser to communicate with the compatible balances.

<table>
<thead>
<tr>
<th>CONTROLLER</th>
<th>BALANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT USED 1</td>
<td>1</td>
</tr>
<tr>
<td>RXD 2</td>
<td>2</td>
</tr>
<tr>
<td>TXD 3</td>
<td>3</td>
</tr>
<tr>
<td>NOT USED 4</td>
<td>4</td>
</tr>
<tr>
<td>GND 5</td>
<td>5</td>
</tr>
<tr>
<td>NOT USED 6</td>
<td>6</td>
</tr>
<tr>
<td>RTS OUTPUT 7</td>
<td>7</td>
</tr>
<tr>
<td>CTS INPUT 8</td>
<td>8</td>
</tr>
<tr>
<td>NOT USED 9</td>
<td>9</td>
</tr>
</tbody>
</table>

RS-232 CONNECTOR ON CONTROL CONSOLE

NOTES:
1. 9-PIN BALANCE CONNECTOR IS SHOWN. PIN NUMBERS ARE THE SAME FOR THE 25-PIN CONNECTOR ON THE SARTORIUS BALANCE.  
2. FOR OHAUS VOYAGER BALANCE, MODEL V1D120, PINS 5 AND 6 ON BALANCE CONNECTOR MUST BE JUMPERED.

Figure 12. RS-232 Pin Assignments for the Balance Connection
APPENDIX B — PC CONNECTION AND SOFTWARE INSTALLATION

The COMPULAB 3 provides communication to a personal computer through a nine-pin female RS-232 DCE port on the back of the control console. The COMPULAB 3 communicates with software provided with the system to provide an alternative user interface to access all the capabilities of the system. Figure 13 shows pin connections and signals necessary for the dispenser to communicate with the computer.

A complete description of the serial communication protocol can be found on the distribution CD.

Use the following procedure to install the COMPULAB 3 Control Software:

1. Insert the COMPULAB 3 Control Software CD in the CD-ROM drive.
2. Run the installation program, setup.exe in the root directory.
3. Accept the default directory, or specify an alternate location for the software.
4. Follow the instructions on the screen during the setup procedure.
5. When installation is complete, the COMPULAB 3 Control Software can be used for remote control of the pump controller.

Figure 13. RS-232 Pin Assignments for PC Connection
APPENDIX C — OUTPUT RELAY CONNECTIONS

The DB-9 connector on the back of the pump drive provides the interface for the footswitch, dispensing handle, or other remote start/stop device, as well as relay connections for the pump drive to control other equipment. Pins 6 and 9 of the connector are used for remote start/stop, and pins 1, 2, 3, 4, 5, and 8 are the relay connections. Refer to Table 5 and Figure 14 for the proper connections.

**Table 5. DB-9 Pinout Signals**

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Relay 1 normally open</td>
</tr>
<tr>
<td>2</td>
<td>Relay 1 normally closed</td>
</tr>
<tr>
<td>3</td>
<td>Relay 1 common</td>
</tr>
<tr>
<td>4</td>
<td>Relay 2 normally open</td>
</tr>
<tr>
<td>5</td>
<td>Relay 2 normally closed</td>
</tr>
<tr>
<td>6</td>
<td>Remote Start/Stop</td>
</tr>
<tr>
<td>7</td>
<td>Remote ground return</td>
</tr>
<tr>
<td>8</td>
<td>Relay 2 common</td>
</tr>
<tr>
<td>9</td>
<td>Remote Start/Stop</td>
</tr>
</tbody>
</table>

**Figure 14. Relay Connections**

NOTE: Either remote start/stop pin (6 or 9) can be used. Both pins are connected to the same point internally.
APPENDIX D — MENU FLOWCHARTS

Main Menu

```
MINOSTAT COMPULAB 3 V#.# PRESS ENTER TO BEGIN CONTRAST
PRESS AND HOLD WITHIN THREE SECONDS TO ADJUST CONTRAST

ADJUST CONTRAST DECREASE ENTER CONTINUES INCREASE

PROGRAM MENU
NEW EDIT:## LOAD LINK

CREATE A NEW PROGRAM
SEARCH FOR A PROGRAM TO LOAD

LINKED PUMPS:NONE
PUMP1 PUMP2 PUMP3 PUMP4

PUMP #### AT ####.#mL/MIN
LOAD:## DECREMENT INCREMENT

PROCEED TO FLOWCHARTS FOR RUNNING OR TO CREATE OR EDIT A PROGRAM

NEW PROGRAM
PUMP DISPENSE DILUTE LOAD

TO CREATE OR EDIT A PUMP PROGRAM FLOWCHART
TO CREATE OR EDIT A DISPENSE PROGRAM FLOWCHART
TO CREATE OR EDIT A DILUTE PROGRAM FLOWCHART
```
Create or Edit a Pump Program

![Diagram showing the steps to create or edit a pump program]

1. **PUMP MENU**
   - **DRIVE:** RD2
   - **TUBE:** 0
   - **RATE:** 0.0 mL/Min

2. **PUMP OPTIONS MENU**
   - **ACCEL:** 0.0s
   - **DECEL:** 0.0s
   - **NO-DRIP:** 0
   - **DIR:** CW

3. **SAVE PROGRAM**
   - **PROGRAM NUMBER:** 0
   - 0 = NOT SAVED

---

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Create or Edit a Dispense Program

- Dispense Menu
- Dispense Menu Cont.
- Units Menu
- Dispense Options
- Cycle Settings
- More Dispense Options
- Save Program

Example: Drive: RD2 Tube: 0 Rate: 0.0 mL/min

Example: Dispense Menu Continues

Example: Units Menu

Example: Dispense Options

Example: Cycle Settings

Example: More Dispense Options

Example: Save Program

Example: Program Number: 0 0 = Not Saved
Create or Edit a Dilute Program
Running a Pump Program

PERFORM PRIME AND CALIBRATE PROCEDURES BEFORE RUNNING THE PROGRAM
Running a Dispense Program

PROGRAM ## LINKED:NONE ##
PRIME CALIBRATE PROGRAM RUN

TO PROGRAM MENU
ON MAIN MENU
FLOWCHART

PRIME ENTER CONTINUES #1
PRIME PURGE

CALIBRATE CANCEL STOPS #1
CAL VOLUME: 10.0mL

ENTER VOLUME DISPENSED IN mL:##

DISP ##.mL ## OF ### CANCEL STOPS #1
[ ] ##.mL

MANUAL DELAY AUTO DELAY

DISP ##.mL ## OF ### CANCEL STOPS #1
TIME LEFT ##.## OF ##.## SECONDS

PRESS SPEED/VOLUME TO CHANGE VOLUME

PRESS RUN OR USE FOOTSWITCH OR HANDLE IN MANUAL MODE
Cycles repeat automatically in AUTO MODE

VOLUME:##.mL ENTER CONTINUES #1 MORE

PERFORM PRIME AND CALIBRATE PROCEDURES BEFORE RUNNING THE PROGRAM
CANCEL/STOP FUNCTIONS ARE NOT SHOWN TO SIMPLIFY FLOWCHARTS
Running a Dilute Program

NOTES:
1. PERFORM PRIME AND CALIBRATE PROCEDURES BEFORE RUNNING THE PROGRAM.
2. CANCEL/STOP FUNCTIONS ARE NOT SHOWN IN ORDER TO SIMPLIFY FLOWCHART.
3. PRESS SPEED/VOLUME DURING HOLD OR PAUSED TO CHANGE VOLUME OF SAMPLE.
4. PRESS SPEED/VOLUME DURING A DELAY OR PAUSED TO CHANGE VOLUME OF DELIVERY.

FLOWCHART:
- PRESS RUN OR USE FOOTSWITCH OR HANDLE TO REPEAT CYCLE.
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