USERS GUIDE

SOLVENT
DELIVERY SYSTEM

Tianzhao Chromatography Technology Co.,Ltd
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Gradient System

The gradient system consists of one pump that acts as the master controller, and another or M500 pump that becomes the slave. It is equipped with a mixing tee that is designed to combine the flow output of the slave and master pumps, and eliminate mixing baseline noise.

SET-UP:

1. After unpacking the instruments, check the contents with the packing slip to verify that the shipment is complete. Inspect all items for damage. Any damage should be reported immediately to the shipping carrier and the distributor. If any items are damaged, save the shipping container for claims purposes.

2. Place pumps on level bench top with sufficient space for detectors and other ancillary equipment. It is best to place the pump away from direct sunlight and from areas that are subject to wide temperature fluctuations such as air vents. The pumps may either be placed side by side, or one on top of the other. (See paragraph 6 below.)

3. Install the solvent intake line to pump inlet. Always use a 10 micron or finer solvent filter to protect the check valves and system hydraulics. Solvent bottles should be placed at approximately the same level as the pump or higher. The solvent reservoir may also be located below the pump intake, but not more than 36" below the pump intake, as loss of pump performance may result.

   Note: In order to maintain flow accuracy, it is essential to degas the solvent. The most efficient method of degassing is vacuum with sonication for 5 minutes.

4. If the seal wash option was purchased, then install the inlet and outlet lines to the manifold. We recommend using de-ionized water as the wash solvent.

5. Install the waste line to the purge valve (1/4 – 28 finger tight fitting), with the outlet placed in a suitable solvent waste container.

6. Install the connector tube between the Slave pump output and the port at the top of the hydraulics module. (The must be on the top, for proper fit of this tube.)

7. Install the RS232 cable to the rear of each pump. The male end of the connector should be inserted into the right hand port at the rear of the controller pump (pump A). The label should read "RS232 out." The female end of the connector goes to the left hand port at the rear of the slave pump (pump B). This connector is labeled "RS232 in."

   Note: The may be run in the manual mode without the RS 232 cables connected. It is only necessary to install the RS 232 when one pump is used to control another.

8. Plug in the power cord. Note that the and 501 will accept any voltage from 85 to 264 VAC, but it is essential to use the proper size fuse for the available line voltage.

Nominal voltage (VAC)	Fuse (Amp)
100	.75
115	.75
220/240	.375

9. Turn the power on with the main switch at the rear left side of chassis. The red LED lamp located on the right side of the key pad should come on, indicating that the pump is now ready for operation.

10. Confirm head type. At startup, the pump will automatically detect the head type and then ask for confirmation. If the head type installed agrees with the detected head, then press ***enter***.

OPERATION: RUNNING THE MODEL500G/500 IN MANUAL MODE

Setting flow rates

1.0 Press the ***flow*** key and enter the numerical value for flow rate, in ml/ min.
2.0 Press ***enter***, and then ***run***. Subsequent changes in flow rate require only entering the numerical value and pressing ***enter***. Changes in flow may also be made by using the up/down scroll keys.

Priming the pump

1.0 Open purge valve 1/2 turn
2.0 Press ***purge*** function
3.0 The pump will draw solvent through the inlet lines and expel air out the purge valve to waste. When no more air is present in the intake lines and cannot be seen coming out of the purge valve waste port, then the pump is primed.

Setting over-pressure limit (P max)

1.0 Press ***P max***
2.0 Enter numerical value for maximum desired over-pressure limit, then press ***enter***. The pump will shut off when this pressure is exceeded. See table below for allowable values.

Head Type	Default limit	Maximum limit
Micro head:	9,000 psi	10,000 psi min.
Analytical head:	5,400 psi	6,000 psi
Semi Prep head:	2,500 psi	2,775 psi
Prep head:	1,200 psi	1,300 psi

At start-up, the pump automatically detects the head type and sets the maximum pressure limit to 90% of the maximum specified upper pressure limit for that head type. When this pressure is exceeded, the pump will automatically stop pumping and ask if the user wishes to reset P max. In order to resume operation, press the ***enter*** key and then press ***run*** to continue or press ***P max*** and enter a new Pmax value.

Setting under pressure limit (P min)

1.0 Press ***P min***
2.0 Enter numerical value for P min, then press ***enter***. The pump will shut off when the pressure drops below this value.

Solvent compressibility compensation

The contains a library of solvents and solvent compressibilty factors that you may select from. When the solvent being used for the mobile phase is selected, the pump will automatically compensate for solvent compressibility and pressure. The names of the solvents have been abbreviated, as shown is the solvent library list below.

Relying on the factory default value for solvent compressibility will result in +/- 2.5% accuracy for most solvents and pressures. Selecting the specific solvent to be run will result in a +/- 1% accuracy or better for all pressures and HPLC solvents. **Note:** It is essential to degas the mobile phase to achieve maximum accuracy.

Solvent library

Abbreviation	Solvent Name	Compressibility Factor
H2O	Water	100
IPA	2 - Propanol	167
Aceto	Acetone	195
MeOH	Methonol	185
THF	Tetrahydrofuran	160
STD	Factory default	125
PPNL2	2 – Propanol	167
AGN	(not assigned)	not assigned
NHPTN	Heptane	not assigned
BTNL2	Butanol - 2	not assigned
ISBTL	Isobutyl Alcohol	not assigned
BTNL1	Butanol – 1	not assigned
BTLAC	n – Butyl Acetate	not assigned
DMTNS	Dimethyl Sulfoxide	not assigned
ACN	Acetonitrile	180
S16 – S29	User selectable	See appendix

To select a solvent:

1. Press ***P max*** to access the pump parameter screen.
2. Press the right scroll key once to get to the solvent selection key.
3. Scroll up or down until the solvent appears that the pump will be using.
4. Press ***enter.***
5. The pump will automatically compensate for the compressibility of the selected solvent. For solvents that are not listed in the menu, additional compressibility values can be assigned to any of the labels S15 to S29. Refer to appendix to learn how to determine compressibility values for solvents that are not in the pump library.

Programming the for Gradient Operation

Edit mode:

Pressing the “edit” key on the lower right side of the key pad will access the Edit screen. Four command selections will be displayed as follows:

Modify Method 00
Copy Method 00 to 00
Delete Method 00
Clear All Methods

Use the right or left arrow keys to scroll up or down. The method number can be input by either keying in a method (0 though 59), or by using the up/down arrows to increment or decrement. Press ***enter*** after inputting the desired method number or numbers.

To modify a method:

1. Press ***edit***.
2. Key in the number of the method to be edited, press ***enter***.
3. Right scroll to the parameter that needs to be edited.
4. Key in a new value, press ***enter***.
   (Always press ***enter*** after each parameter revision.)

To copy a method:

1. Press ***edit***.
2. Press the right scroll key once to get to the copy field.
3. Use the up/down scroll key to input the number of the method that is to be copied. (Do not press ***enter*** yet.)
4. Press the right hand scroll key once.
5. Key in the number of the method that will be written over.
6. Press ***enter***.
7. The display will ask you to confirm by pressing ***enter*** again. Once the copy is completed, the display will return to the main operating menu.

To delete a method:

1. Press ***edit***.
2. Press the right hand cursor three times to get to the delete method field.
3. Key in the number of the method to be deleted and press ***enter***. The up/down scroll keys can also be used to input the number.
4. The display will ask you to confirm by pressing ***enter*** again. Once the method is deleted, the display will return to the Edit menu.

To delete all methods:

1. Press ***edit.***
2. Use the right scroll key to get to the ***Clear All Methods*** field
3. Press ***enter***.
4. The display will ask you to confirm by pressing ***enter*** again. Once the methods are deleted, the display will return to the Edit menu.

Creating A Method:

Select method number

- Press Edit
- Scroll to the *Modify Method* field. (The cursor should be in this field after pressing ***edit***).
- Key in the desired method number, 1 through 59, and press ***enter***. The method number can also be selected by using the up/down scroll key, followed by the ***enter*** key.

Input step size

- Use the right hand scroll key to move the cursor to the *Step* field.
- Key in the step size and press ***enter***. The up/down keys may also be used to change the step size. For a linear gradient, enter 0. For a step gradient, enter the desired percent step size. The step size that you enter will be equal to a percentage of the total flow rate of both pumps. For instance, if the flow rate is 1.00 ml/min and a step size of 10 is selected, then the step sizes will consist of 10 micro-liter per min flow rate increments.

Input Link number

- Use the right hand scroll key to move the cursor to the *Link* field.
- Key in the desired link number and press ***enter***. When the pump has finished executing the last line of the current method, the pump will begin to execute the first line of the method number that was entered into the link field. The up/down scroll keys may also be used to change the link value.

Input flow rate

- Use the right hand scroll key to move the cursor to the *Flow* field.
- Key in the desired flow rate and press ***enter***. This flow rate is equal to the combined flow of both pumps, and will remain constant throughout the method run.

Select mobile phase

- Use the right hand scroll key to move the cursor to the *Solvent A* field.
- Scroll up or down to the desired mobile phase. See page 3 for list of mobile phase abbreviations.
- Use the right hand scroll key to move the cursor to the *Solvent B* field.
- Scroll up or down to the desired mobile phase. See page 3 for list of mobile phase abbreviations.

  Note: Solvent “A” refers to the master pump. Solvent “B” refers to the slave pump.

Time programming

There are 20 time slots per method, labeled T00 through T19. Each time label can be assigned a time, percent A, and percent B solvent composition. The sum of percent A and percent B must add up to 100%. When a value for percent A is entered, the pump will automatically calculate and display the value for B (equal to 100 – A).

Use the right hand scroll key to move the cursor to the T00 field.

1. Press the right scroll key again and key in a value for time (0 to 999 minutes), then press ***enter***. Note: It is not necessary to enter decimal points in the time field. (10 equal 1.0 minutes.)
2. Press the right scroll key again to get to the Solvent A field, and enter a value for solvent "A" at time T00, and press ***enter***. The value for solvent "B" does not need to be entered.
3. Scroll to the left to the T00 field again and then scroll with up arrow key to go to time T1.
4. Repeat steps 2, 3, and 4 until the program is complete. If additional time program steps are required, then use the Link feature. When the existing method has executed the last step, the program will automatically begin executing the first step of the Linked method.

Running A Method

1. Press ***activate***.
2. Enter the number of the method that you wish to run (00 – 59).
3. Press ***enter***.
4. Press ***run*** to begin executing the method.

Note: If the slave pump is not connected, a warning will be displayed that says:

********Warning********
Slave not connected
Hit enter to confirm

Make sure the RS232 cables are both installed properly between the master and slave pumps. You can override this warning by pressing ***enter***. The master pump will operate by itself with a flow gradient that matches the solvent gradient for the pump A.

Programming Examples

Example A: Create a method that will generate the following solvent compositions.

100% MeOH for 10 minutes
100% MeOH to 100% water in 20 minutes, linear gradient.
100% water for 11.5 minutes.

Flow Rate:	1.0 ml/min
Solvent A:	Water
Solvent B:	MeOH
Method name	01

1. Press ***edit***.
2. Key in ***1*** and press ***enter***
3. Scroll to the ***Step*** field, key in 0 and press ***enter***.
4. Scroll to the ***Link*** field, key in 0 and press ***enter***.
5. Scroll to the ***Flow*** field, key in 1.0 and press ***enter***.
6. Scroll to the ***Solvent A*** field, scroll up (if necessary) to ***H2O*** and press ***enter***.
7. Scroll to the ***Solvent B*** field, scroll down to ***MeOH*** and press ***enter***.
8. Scroll to the ***Time*** field corresponding to ***T00***, key in ***0*** and press ***enter***.
9. Scroll to the right one space and key in ***0*** for Solvent A; press ***enter***.
10. Scroll left to ***T00*** and use the up arrow to scroll to the ***T01*** field.
11. Scroll to the right one space and key in ***100***; press ***enter***.
    Note: it is not necessary to enter a decimal to input time. (the field reads 10.0 minutes.)
12. Scroll to the right one space and key in ***0*** for solvent A; press ***enter***.
13. Scroll left to ***T01*** and use the up arrow to scroll to the ***T02*** field.
14. Scroll to the right one space and key in ***300***; press ***enter***. (300 = 30.0 minutes.)
15. Scroll to the right one space and key in ***100*** for Solvent A; press ***enter***.
16. Scroll left to ***T02*** and use the up arrow to scroll to the ***T03*** field.
17. Scroll to the right one space and key in ***415***; press ***enter***. (Total run time is 41.5 min.)
18. Scroll to the right one space and key in ***100*** for solvent A; press ***enter***.

The above method is run by pressing ***Activate, enter, Run***. Make sure that the correct method number has been selected before pressing the ***Run*** key. If no slave pump is connected, the display will ask for confirmation. Press ***enter***. As the method starts to run, the time will be counted in .1 minute intervals on the display screen.

Example B: Relay Control of External Valves or Other Devices Rev B (9/6/01)

Description of External Events Option:

If the has the External Events Control Option (EECO) installed, the user may provide output voltages from the upper 10 pin cable connector on the rear panel. The EECO includes four internally mounted solid state relays. When any one or any combination of the four relays is closed, a switching signal voltage will be provided to one or more external devices. Various pulse widths are available, along with steady state power. The output voltage level is determined by (and is the same as) the input voltage supplied from an external power supply provided by the user. This input voltage may range from 5 volts to 28 volts DC, as required by the external device to be controlled, and is applied to the top two contacts on the rear panel cable connectors. The positive voltage is applied to the second contact (pin 2) down from the top, and the ground is applied to the top contact (pin 1). See the accompanying diagram, Figure 1, which defines all electrical connections, both input and output.

Note that there are two vertically aligned connectors on the rear panel of the . The upper 10 contact connector handles input power and delivers the output signal to the four relays. The lower 6 contact connector is provided for the user who will want to apply a start/stop signal to the pump, and provide for external device control from some external source such as a Logic Controller. To start (or stop) the Pump, apply 5 volts to the upper contact (pin 11) of this connector and the ground to the second contact down. (Contact usage defined on panel.)

Note: There will be a 5VDC signal required for the ***start*** command which is used to start a programmed method while the pump is in "Run". This Power Supply must be provided by the user and does not need to have a range to 28VDC. See the following sections of this manual.

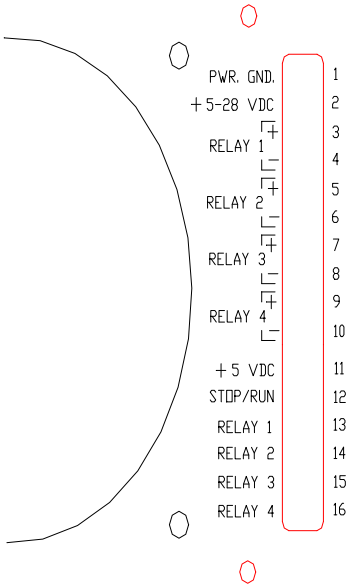

Figure 1

Example of External Event Relay Control

In the previous example of gradient programming, the time fields starting with **T00** (Method Start) were used to establish run time starts for solvent composition changes. At the far right hand end of each time line, (**T00**, **T01,** etc.) on the display, the user will see the letter **V**. The line will appear, for example, as:

T00 000.0 A000 B000 V

When the cursor is scrolled to the "**V**", and ***"enter"*** is pressed, the line will change to:

V1:00 2:00 3:00 4:00

These four fields may be modified to control the state of the four relays described above. All four relays may be controlled from this display line, or if only one event is to be controlled, the user sets codes for **V1** only. There are twenty Time Lines which may be coded, as the user may scroll through lines **T00** to **T19**.

When first coding a Time Line, say **T00,** the Time Field must be set. As described in the gradient programming example above, time is counted in .1 minute intervals, and displayed as such.

For example: **001.0** represents 1 minute
000.5 = .5 minute or 30 seconds

Reminder: When coding time fields, do not input a decimal point, i.e. input **100** for a timed event which is to occur at **10.0** minutes.

Review the following list of relay timing codes as well as the diagram below, which describes a simple relay timing program. When setting **V1:00** to a desired working code (other than **00**), place the cursor on the first **0** and increment or decrement until the appropriate code is set. Press ***"enter"*** Move the cursor to the second **0** and set the desired code. Press *"enter*" The following codes are available to provide short or longer term relay closures, including a permanently "ON" or "OFF" state.

On States

00 "ON" until otherwise commanded
01 "ON" for 50 m second
02 "ON" for 100 m second
03 "ON" for 500 m second
04 "ON" for 1 second

Off States

10 "OFF" until otherwise commanded
11 "OFF" for 50 m second
12 "OFF" for 100 m second
13 "OFF" for 500 m second
14 "OFF" for 1 second

Although relay timing may be established on Time Lines involving other events in the method, the example below defines simple ""ON"/"OFF" control with no other parameters involved.

Building a Training Method for Event Timing:

The following method is complex. TIANZHAO recommends that the user try a simple single relay first.

Create a Method that will control Relays 1 and 2. Start the method with the relays programmed in the "OFF" state, turn the two relays "ON" at .3 minute, turn them "OFF" at .5 minute, "ON" again at .8 minute and "OFF at 1.0 minute, which will be the end of this method. Use a 5 volt power supply connected across pins 1 and 2 of the External Event connector on the rear panel of the . If an actual external device, such as a switching valve is to be activated, the voltage may be set as high as 28 VDC, if required by your device, and if the user supplied power supply covers that range.

1. Turn the pump on. (The red "Stop" light is on.)
2. Turn on the external power supply, and set to the desired voltage.
3. Press the "Edit" key. The top line of the display will read: **MODIFY METHOD 00**
4. Press "***2***" and ***"enter"***.
   The top line of the 4 line display will now read: **MTHD 02 STEP 00 LINK 00**
5. Scroll through **STEP 00 AND LINK 00**

   To the **FLOW** field. Set **FLOW** to equal the desired flow rate (a **FLOW** must be established to create a viable method).

6. Right scroll to **SLVNT A**. A solvent will be designated. This solvent may be selected or revised by pressing the Down Arrow which will bring up the next solvent of the built in list. Right Scroll to **SLVNT B**. Select a solvent, using the Down Arrow.
7. Right scroll once from the Solvent B field to the line that appears as: **T00 000.0 A000 B000 V** The cursor is on the second **0** in the **T00** field.
8. Right scroll once, press **3** to set time at **.3** minute.
9. Right scroll through **A000** and **B000** to **V**. (The cursor is now on the **V**.)
10. Press ***"enter."***
11. Right scroll one time to place the cursor on the first **0** in **V1:00**, press the Down Arrow which will set the **0** to a **1**.
12. Right scroll twice to place the cursor on the first **0** of the **2:00** field, press the Down Arrow to change the **0** to a **1**.
13. Right scroll (6) times to change the display to:

Mthd 02 Step 00 Link 00
T00 000.3 A000 B000 V
T01 000.0 A000 B000 V
T02 000.0 A000 B000 V

14. The cursor is now in the Time Field of **T01**. Key in **5, "enter"** and the line appears as:
T01 000.5 A000 B000 V
15. Right scroll 3 times to place the cursor on the **V**, press ***"enter"***. The following line appears:
V1:00 2:00 3:00 4:00

Note that the **V1:00 and 2:00** are already set at **0** in both the first and second relay coding positions. This is the correct setting for "ON" until commanded "OFF" for these two relays. The relays associated with Time Line **T01** are therefore set to "ON".

16. Right scroll through all cursor positions (9) to bring up lines starting with **T01, T02, T03**. The cursor is now in the Time Field **T02**.
17. Press **8 "*enter"***. The line appears as: **T02 000.8 A000 B000 V**
18. Right scroll 3 times to again place the cursor on the **V** and press ***"enter"***. The line appears as:
V1:00 2:00 3:00 4:00
19. Move the cursor to the first **0** in the field **V1:00**, press the Down Arrow to set this first **0** to **1**.
20. Right scroll 2 times to place the cursor on the first **0** of the **2:00** field and press the Down Arrow to set this **0** to **1**. The relays are now properly coded for the time Line **T02**.
21. Right scroll 6 times to bring up Line **T03**. Enter **10** in the Time Field and press ***"enter"***. The Time Field for line **T03** is now set to: **1.0** minute.
22. Right scroll 3 times to place the cursor on the **V**, and press ***"enter"***.

The cursor is again on the **V1:00** field corresponding to Time Line **T03**. Note that **V1:00** and **2:00** are again correctly set to: **0's** which are the proper codes to turn the relays "OFF" until commanded otherwise. The status of relays 1 and 2 are now set to:

Close at .3 minute
Open at .5 minute
Close at .8 minute
Open at 1.0 minute (end of Method)

The relays are always de-energized at the end of a Method.

Executing the Method Just Programmed:

1. Press: ***"Edit"*** The top line of the display will now read: **Modify Method 02**
2. Press: ***"Activate", "enter", "Run."*** The display now reads:

********Warning********
Slave not connected
Hit enter to confirm

Note: If a slave pump is connected via the serial cable, this message will NOT be displayed. Press ***"enter"***. The bottom line shown on the display will first start with **T000.0** which will change to **T000.1, T000.2, T000.3**, indicating that the timer is counting in .1 minute intervals. At **T000.3,** the relays 1 and 2 will close.

After reaching time **T03** and the end of the Method, the relays are reset to their normal or default states of "OFF". Please review the following diagram, (Figure 2) which pictorially defines the previous example.

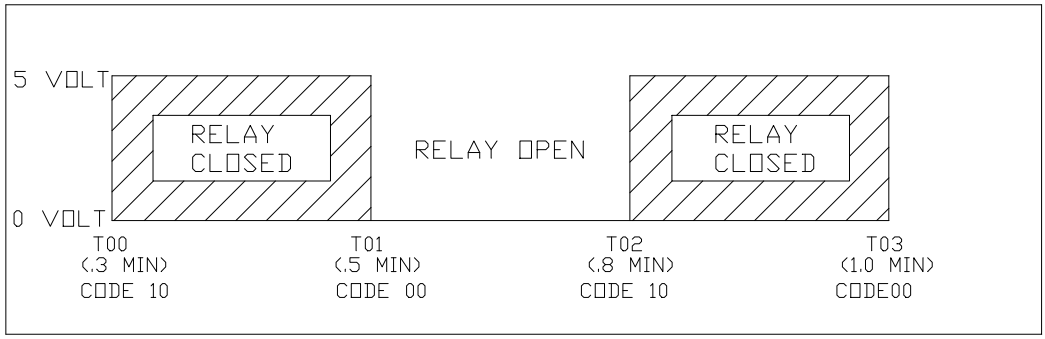

Figure 2

Note that at .3 minute, (**T00**) the relays HAD BEEN OPEN between the Method start and .3 minute. The relays were then closed between .3 and .5 minute. Setting code **10** (OFF) which closes a relay, implies that the relay was open in the prior time period.

SAMPLE DISPLAY SCREENS:

Start by building two methods. The first, Method 1, will be your 20 minute method which starts at the compositions of 80%A and 20%B. The next three screens will show all the lines required in the method.

Building Method 1:

Mthd 01	**Step 00**		**Link 02**	First Screen
Flow	**01.000**		**ml/min**	Gradient Controller Pump
Slvnt	**A H2O**		**B IPA**	NOTE LINK 02
T00	**000.0**	**A080**	**B 020**	
Mthd 01	**Step 00**		**Link 02**	Second Screen
T00	**000.0**	**A080**	**B020**	Gradient Controller Pump
T01	**005.0**	**A080**	**B020**	
T02	**015.0**	**A080**	**B020**	
Mthd 01	**Step 00**		**Link 02**	Third Screen
T03	**018.0**	**A050**	**B050**	Gradient Controller Pump
T04	**020.0**	**A080**	**B020**	
T05	**000.0**	**A000**	**B000**	
				Method ends at T 04

Building Method 2 (a steady composition state method):

Mthd 02	**Step 00**		**Link 01**	First Screen
Flow	**01.000**		**ml/min**	Gradient Controller Pump
Solvent	**AH2O**		**B IPA**	NOTE LINK 01
T00	**000.0**	**A080**	**B 020**	
Mthd 02	**Step 00**		**Link 01**	Second Screen
T00	**000.0**	**A080**	**B020**	Gradient Controller Pump
T01	**060.0**	**A080**	**B020**	
T02	**000.0**	**A000**	**B000**	
				Method ends at T 01

After the two methods are built, it is a good idea to press “EDIT” which brings up a screen where you set the “MODIFY METHOD” line to: MODIFY METHOD 01. This method will then appear first in a screen where you start the method.

When using an injector valve to start a method, it is necessary to have the pumps both running in “Flow” mode. The injection is made during the time the two pump system is in “Flow” mode.

Press “FLOW” on the Gradient Controller Pump. The screen shown below appears on the display of the Controller Pump. This pump is now in “Flow” mode.

Pressure		**XXXX psi**	First Screen
Flow	**00.800 ml/min**		Slave Pump
P Min	**0000**	**P Max 5400**	

100 Solvent	**H20**	

Press “FLOW” on the Slave Pump, usually a Model 501. The following screen appears in the display window of the Slave Pump. This pump is now in “Flow” mode.

Slave Mode		**XXXX psi**	Second Screen
Flow	**00.200 ml/min**		Slave Pump
P Min	**0000**	**P Max 5400**	
100 Solvent		**H2O**	

At this time you are ready to start the system and ready to run the gradient.

Press “ACTIVATE” on the Gradient Controller Pump and then press “ENTER” and the first screen of Method 01 will appear in the display, as shown below.

Mthd 01		**Step 00**	**Link 02**	First Screen
Flow		**01.000 ml/min**		Ready to start M01
Solvent		**A H20**	**B IPA**	Gradient Controller Pump
T00	**000.0**	**A080**	**B020**	

The system is now ready to start the method 01, which is already activated. The method will start when the Rheodyne 7725 I injector Valve is turned in the clockwise direction to the “Inject” position, and then turned counter-clockwise back to the “Load” position.

Turn the valve to “Inject” and back to “Load”. The gradient method 01 will start to run. The screen below shows that the method has started and has progressed to time = .3 minutes.

Pressure			**XXXXpsi**	First Screen
Flow	**01.000**	**ml/min**		M01 is started
Mthd 01		**Step 00**	**Link 02**	Gradient Controller Pump
T000.3		**%A 080**	**%B.020**	

At the completion of Method 01, the system will immediately switch to Method 02, because of the link built into Method 01. A typical screen that will be seen during Method 02 is shown below.

Pressure			**XXXXpsi**	Typical Screen seen
Flow	**01.000**	**ml/min**		during Method 01
Mthd 02		**Step 00**	**Link 02**	Gradient Controller Pump
T000.2		**%A 080**	**%B 020**	

This screen shows that the method has progressed to Time = .2 minutes and that the solvent composition is constant at 80% A and 20% B. This composition will be maintained during the entire time that Method 02 is running. The length of Method 02 can be as long as wanted by the user. It should be long enough to keep the system in equilibrium until it is time to make another injection to start another gradient run.

When the user wants to make a second injection to initiate another gradient run, he must again set both pumps in “Flow” mode, then press “ACTIVATE” and “ENTER”. The system will then be ready for the second injection. When the user turns the lever on the injector valve, the second run starts.

Figure 3: Starting a Method on a Manual Injection

SERVICE ADDENDUM

Section 1: General Service Information

There are a number of repairs and some replacement of parts that can be performed by the user in the users lab. These are typical of many pumps used in Liquid Chromatography and are described in detail in this section. Other repairs will need to be performed by the factory, and may be arranged through the users Sales Representative. The repairs that may be addressed by the user, are associated with the pump mechanism itself and the hydraulics module, both of which are accessible from the front panel, or just under the front edge of the cover.

WARNING

WHEN THE COVER IS REMOVED, HAZARDOUS VOLTAGES ARE EXPOSED!
All work that would require removal of the cover MUST be performed with the power cable unplugged from the instrument.

Section 2: Pump Head Repairs

1. Replacing the Piston Seals

Remove the 1/16" SST Interconnect Tube that connects the output of the Pump Head to the Purge Valve Body. Use a ¼" open end wrench to loosen the tube to its respective ports. *(See Figure 1)*

Fig. 1 Front Panel

Loosen and remove the (4) Socket Head Cap Screws that retain the Pump Head to the Manifold and the Spring Housing (a 9/64" Allen Wrench with a T bar handle is most useful for this operation). This step will expose the two Piston Seal Assemblies. These Seal Assemblies are available from the factory, through the Sales Representative. The Seals may be grasped with the finger tips and gently pulled forward and free of the pistons. Use care when pulling these seals off, to avoid scratching of the pistons. *(See Figure 2 on next page)*

Figure 2 Seals Exposed

When replacing the Piston Seal Assemblies, push the seal assembly over the end of the piston, up against the front surface of the Manifold. Push with the finger tips, but do not allow your finger nails (or any other hard or sharp object) to contact the seal as damage may occur.

Carefully replace the Pump Head on the Manifold. The two alignment pins will guide the Head into perfect alignment with the seals and pistons. Use care to insure that accidental contact of the Pump Head and the pistons does not occur as damage to the pistons may occur.

Re-insert the (4) 8-32 X 1-1/2" Socket Head Cap Screws and fully tighten. The use of a T Bar Allen Wrench is recommended to insure that the repair person has the ability to fully tighten these screws. Insert the ends of the Interconnect Tube into their respective ports and tighten the two nuts with a ¼" open end wrench.

2. Replacing the Pistons: (**Note:** When replacing the pistons and seals, <u>always</u> replace the pistons first.)

The removal of the Piston Seals, as described in the section above is the first step to start the removal of the pistons. The pistons used in the analytical pump which are to be removed, are part number 500-1004 (Piston Assembly, 10 mL). The face of the Manifold is now exposed, along with the pistons.

The second step is to remove the Manifold, by pulling directly away from the Pump Front Panel. Again use care to insure that there is no damage to the pistons. This step will expose the face of the Spring Housing Assembly (500-1250).

Using the same T Bar Allen Wrench, carefully back out the (4) 8-32 X 5/8" Socket Head Cap Screws that retain the Spring Housing Assembly to the face of the pump casting. Since the two Piston Springs are in compression, within this assembly, it is best to back the screws out about one turn at a time, alternating from the left side to the right side and back again to the left side. When these screws are removed, the Spring Housing Assembly is free.

CAUTION!

The Piston Assemblies are now loose in the Spring Housing, and may fall out the back of the housing assembly if this assembly is tilted. Pull the Spring Housing Assembly straight out of the casting using care that the pistons don't drop. *(See Figure 3 on next page)*

Grasp each piston at the rear of the Spring Housing, and pull them from the assembly. Replace the pistons with new pistons, and then reverse the procedure described above to replace the Spring Housing, Manifold, Piston Seals and Pump Head, following the directions below.

Note: The two alignment pins protruding from the Spring Housing Body are near the TOP edge of the part. Replace the Spring Housing in the casting with these pins UP.

Alignment Pin, Upper

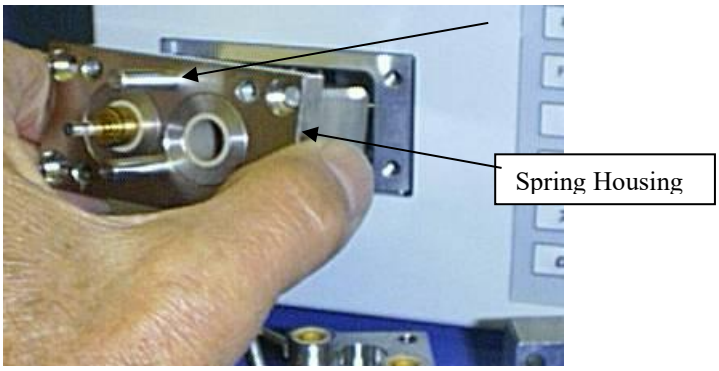

Figure 3 Removal of Spring Housing

Re-insert the (4) 8-32 X 5/8" Socket Head Cap Screws and retighten, by first tightening the left hand screws about one turn and then tightening the right hand screws about the same amount. During this operation the face of the Spring Housing should be kept fairly parallel to the face of the casting and the front panel of the pump. Continue tightening these screws as defined until the Spring Housing is seated firmly against the machined face of the casting and the screws are fully tightened.

Replace the Manifold by sliding it over the two alignment pins. Use care to not damage the exposed pistons.

Replace the Piston Seals as described in the section above. Remember to use care not to damage the seal assembly with your finger nails.

Replace the Pump Head as directed in the previous section. Fully tighten the (4) screws.

Section 3: Hydraulic Module Repairs

1. Replacing the Hydraulics Module

Several problems which may affect the Hydraulics Module are user repairable. They are: replacement of the Purge Valve Assembly and changing the Mixer Cartridge.

Any other problem will require that the entire module be refurbished or replaced by or at the factory. Contact your Sales Representative for costs and lead time. The Hydraulics Module is eTianZhaoly removed by loosening the (4) 6-32 screws attaching it to the Front Panel. Additionally, it is necessary to slide the cover back slightly, and unscrew the Transducer from the rear of the Mixer Body Assembly. Keep the Transducer with the pump when removing the Hydraulics Module.

2. Replacing the Purge Valve Assembly

Replacement of the Purge Valve Assembly may become necessary if a leak develops. Remove the knob on the front of the Purge Valve/Pulse Damper assembly by loosening the set screw positioning the knob on the stem of the Purge Valve.. See Figure 4. Removing the knob will expose the ½" nut on the front of the Purge Valve cartridge. Loosen the nut with a ½" open end wrench, and remove the cartridge from the P V/Damper Body.

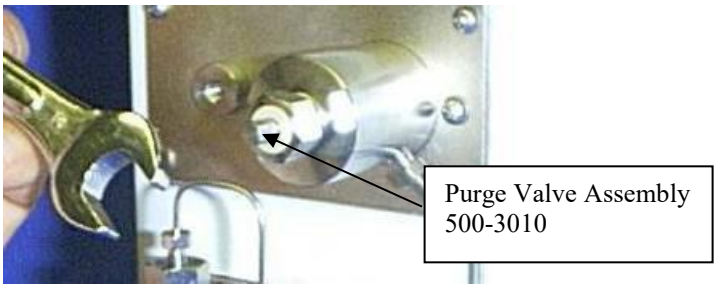

Figure 4 Purge Valve Removal

This Purge Valve cartridge assembly (500-3010) may be obtained from the factory. Consult with your Sales Representative. When the cartridge is removed, a white Teflon gasket may remain in the Purge Valve Housing. It is also possible that the PEEK Disc (Purge Valve Seat) may remain lodged I the PV housing. If so, it too must be removed. The new cartridge assembly will come with this gasket readily visible. If the same gasket is visible in the Housing, the gasket must be removed from the new Purge Valve cartridge prior to insertion into the Housing. As an alternative, this gasket may be carefully removed from the Housing with a small screw driver or similar tool. Screw the replacement Purge Valve Assembly into the Housing and fully tighten with a ½" open end wrench. Replace the Knob, being sure that the Allen Set Screw is positioned over the flat on the valve stem. Tighten the set screw.

3. Replacing the Mixer Cartridge

This operation may be completed from the Front Panel of a sealed instrument. First loosen the large nut on the front of the Mixer Body Assembly with a Crescent Wrench. When the nut is unscrewed and extracted from the Body, the Mixer Cartridge will be visible. It may be pulled from the rear of the nut assembly. There are a number of replacement Mixer Cartridges available from the factory. These are described below. Note that the smaller volume Mixer Cartridges require an adapter. The available Mixer Cartridges are: 5, 10, 25, 50, 150, 250, 350 and 500 uL. The 350uL and the 500uL Mixer Cartridges will fit directly into the Mixer Nut Assembly. The smaller cartridges will require an adapter as described below.

MIXER VOLUME	CARTRIDGE PART NO.	ADAPTER PART NO.
5 uL	400-0005	500-3111
10 uL	400-0010	500-3111
25 uL	400-0025	500-3111
50 uL	410-0050	500-3113
150 uL	410-0150	500-3113
250 uL	410-0250	500-3113
350 uL	420-0350	Not Required
500 uL	420-0500	Not Required

After replacing the Mixer Cartridge and the Adapter, (if required) screw the Mixer Nut back into the Body, and fully tighten with a Crescent Wrench.

SERVICE ADDENDUM

SECTION 2: CALIBRATION OF THE PRESSURE TRANSDUCER

Pressure Transducer Calibration Procedure

All pumps must be calibrated per this instruction. The procedure is done using two pumps, one of which is the pump to be calibrated (Primary) and the other which provides the system pressure, which is called the Auxillary pump in this procedure. The pumps are tee'd together at the outputs. The output of the tee is routed to a pressure gauge, and the pump to be calibrated is calibrated against this gauge at 1000psi and 3500psi. (See the accompanying diagram for the hydraulic schematic.) The Hydraulic Schematic shows two M 501 pumps for convenience. One of the pumps may be a M 500. Plumb bTianZhaocally the same way, except the system output, from the front of the Mixer Assembly on the M 500, must be sealed off, with a "no-hole" ferrule.

Primary Pump (to be calibrated):

- Default Display is set
- Hit "EDIT" key
- Right Cursor X 5 (To Frequency Factor Field)
- Key in 0 and hit ENTER (Set point = 1000 psi on display) (Calibration Screen is displayed)

Auxillary Pump (provides system pressure):

- Close purge valves on both pumps.
- Set flow rate of the Auxillary Pump to about .5 to1.0mL/minute.
- Run this pump until pressure on gauge = exactly 1,000psi (Purge if desired to speed process, but approaching the 1,000psi point is best done at a low flow rate, for example .5 mL/min.)
- At exactly 1000psi, stop flow of Auxillary pump and hit ENTER on primary pump. The Primary pump display will now read 3500psi. The pump is still in the Calibration mode.
- Re-start Auxillary pump, with a low flow rate of about 0.5mL/min., (improves accuracy) and let gauge pressure rise to exactly 3500psi. Stop Auxillary Pump FLOW, and hit ENTER on Primary pump.
- Open purge valves and to speed the pressure dropping process, you may open the fitting at the outlet of the Primary pump.

Go to the "FLOW" display on the Primary pump. The indicated pressure of this pump MUST fall to 0psi. If it doesn't, the calibration must be run again. If for some reason the 0psi indication is not achieved, it may be necessary to check the Pressure Transducer The cables have been sometimes found to be faulty and rarely, a transducer could fail. Continuing problems in getting the Primary Pump being calibrated, to fall back to 0psi could indicate a faulty PWA.

CHECK VALVE MAINTENANCE AND TROUBLE SHOOTING

Several things limit the life of check valves. Mainly these are contamination or salt build up in the valve. A more normal and re occurring problem is that valves for all pumps may stick and require service to open to normal flow. Most check valves use ruby, sapphire or ceramic balls and seats. These are very similar materials with a very smooth surface finish and they will stick at some time. (In early 2004, TIANZHAO began to use check valves with a proprietary ball material. These valves do not stick nearly as much as conventional valves.) It is almost always easy to clean them and make them function properly again. Users must take care to always use a solvent bottle filter of no more than 10 microns porosity, to keep solvent contaminants from clogging the valves. Check the bottle filter now and then to make sure that it is not clogged.

Sometimes it is possible to determine whether the inlet valve or the outlet valve is the one that is stuck. If there is solvent flow in the inlet tube, from the bottle, but it is suspected that there is a valve problem, introduce an air bubble into the line by lifting the filter out of the solvent for a few seconds, then drop it back into the solvent. If the air bubble travels in uniform pulses up the tube the valves are both working properly. If the bubble moves forward and then falls back on each pump cycle, then the inlet valve is partially stuck.

If there is no solvent flow at all, out of the bottle, then you must check the solvent bottle filter for clogging, and both valves to determine if one is completely stuck closed. No flow at all, often means that the outlet valve is stuck or possibly that the filter in the outlet valve is clogged. (TIANZHAO no longer uses an outlet valve with a filter, as the seal material we currently use, does not produce much wear material.)

Remove the valve from the housing. The valve may be flushed out with water or alcohol by forcing the solvent through the valve, in the direction of the arrow on the valve body, using a syringe. (WEAR SAFETY GLASSES) Before flushing, rap the valve on the bench top a few times. An alternative to using solvent is to use air pressure. This is sometimes safer and eTianZhaoer. It is possible to buy air contained in aerosol cans from Mc Master-Carr or Grainger. If the lab has a compressor, this will work too. Always blow the air thru the valves in the direction of the arrow.

If a valve is very contaminated, it may be necessary to sonicate it of 20 minutes in a solution of 20% nitric acid. After sonication, flush the valve with water from a syringe. ALWAYS WEAR SAFETY GLASSES in this operation.

It is a good idea to replace the check valves every other time a piston seal is changed. Please refer to the maintenance section starting on page 103 or the TIANZHAO catalog. Check valve cleaning.doc