ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Find the *Waters 600E* at our website: ***Click HERE***

Waters
Division of MILLIPORE

WATERS 600E
MULTISOLVENT DELIVERY SYSTEM

Operator's Manual

Address Comments
Regarding This Publication To:

MILLIPORE CORPORATION
WATERS CHROMATOGRAPHY DIVISION
PUBLICATIONS PB
34 MAPLE STREET
MILFORD, MASSACHUSETTS 01757

MANUAL NUMBER 62771
First Edition, March 1989

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

ATTENTION

For general laboratory use as well as for *in vitro* diagnostic use.
This is a highly sensitive instrument.
Read the accompanying manual before using.

When using the instrument, follow generally accepted procedures for quality control and methods development.

If you observe a change in the retention of a particular compound, in the resolution between two compounds or in peak shape, you must immediately take steps to determine the reason for the changes. Until you determine the cause of the changes, do not rely upon the results of the separations.

WARNING: For continued protection against fire hazard, replace fuses only with those of the same type and rating.

ATTENTION

Pour emploi general en laboratoire ainsi que pour diagnostic *in vitro*.
Ceci est un instrument délicat.
Lire le manuel d'instructions avant emploi.

Pour l'usage de cet instrument, l'opérateur doit suivre les procédures généralement acceptées en contrôle de qualité et développemente de méthodes.

Si l'opérateur observe un changement dans le temps de rétention d'un produit particulier, une modification de la résolution entre deux composés, ou un changement dans la forme du pic, son premier souci doit être la recherche de la raison de ce changement. Aucun résultat ne doit être tenu comme fiable sans l'explication de ce phénomène.

ATTENTION: Pour une protection efficace contre les risques électriques, n'utilisez que les fusibles préconises par le constructeur.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

ACHTUNG!

Für allgemeine Anwendungen im Labor und für *In-Vitro*-Andwendungen.
Dies ist ein hochempfindliches Gerät.
Bitte lesen Sie die Bedienungsanleitung sorgfältig,
bevor Sie es benutzen.

Der Benutzer dieses Instrument ist angehalten, allgemein anerkannte Vorschriften der Qualitätskontrolle und Methodenentwicklung zu beachten.

Falls eine Veränderung der Retention einer Probensubstanzer, der Auflösung zwischen zwei Probensubstanzen oder der Peakform beobachtet wird, sollte sofort der Grund für diese Veränderung festgestellt werden. Bevor dieser Grund bestimmt worden ist, sind die Analysenergebnisse als unzuverlässig zu betrachten.

VORSICHT: Sicherungen nur durch Sicherungen gleicher Stärke ersetzen.

ATENCIÓN

Para uso común en el Laboratorio, asi como tanbién
para aplicationes de diagnostico *en vitro*.
Este es un instrumento muy sensible.
Favor leer el manual de instrucciones
adjunto antes de usarse.

Durante el uso de este instrumento, el operador deberá seguir procedimientos normalmente aceptados por las disciplinas de Control de Calidad y de Desarollo de Métodos Analíticos.

Si el operador del instrumento observa un cambio en el tiempo de retención de un compuesto, o en el tiempo de separación entre dos compuestos, o en la forma del pico, el operador deberá tomar acción immediata para determinar la causa de los cambios, y hasta que esta causa sea determinada, no debe confiar en los resultados de la separación.

ADVERTENCIA: Para prevenir posibles cortos circuitos, reemplaze los fusibles solamente por aquellos de su mismo tipo y capacidad.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TABLE OF CONTENTS

BOOK I HOW TO USE THE 600E

1	**USING THE FRONT PANEL**	1-1
1.1	THE FRONT PANEL	1-1
1.1.1	The Display Screen	1-2
1.1.2	ON/OFF Switch	1-2
1.2	KEYPAD	1-3
1.3	FUNCTION KEYS	1-4
1.4	SCREEN KEYS	1-4
2	**ROUTINE OPERATION**	2-1
2.1	DAILY STARTUP	2-1
2.1.1	Powering Up the System	2-2
2.1.2	Sparging the Reservoirs	2-3
2.1.3	Purging Air from the System	2-4
2.2	DAILY ROUTINE OPERATION	2-7
2.3	USING THE OPTIONAL U6K MANUAL INJECTOR	2-9
2.4	CHANGING SOLVENTS	2-10
3	**USING THE GRADIENT CONTROLLER**	3-1
3.1	CONFIGURING THE HARDWARE	3-3
3.1.1	Using PUMP SETUP Screen	3-4
3.1.2	Using PUMP CONFIGURATION Screen	3-8
3.2	PERFORMING AN ISOCRATIC APPLICATION	3-11
3.3	PERFORMING A GRADIENT APPLICATION	3-15
3.3.1	Developing a Gradient Table	3-19
3.3.1.1	Setting Up the Gradient Table	3-19
3.3.1.2	Entering/Editing the Gradient Table	3-19
3.3.1.3	Saving the Gradient Table	3-22
3.3.1.4	Specifying Autostart	3-23
3.3.1.5	Deleting Previous Gradient Tables	3-23
3.3.2	Developing a Program Event Table	3-24
3.3.2.1	Setting Up the Program Event Table	3-24
3.3.2.2	Entering the Program Event Table	3-25

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.3.3 Running the Gradient Application 3-27
3.3.3.1 Selecting a Gradient/Event Table 3-27
3.3.3.2 Running the Gradient/Event Table 3-28
3.3.3.3 Changing to Another Table During Operation 3-30
3.3.3.4 Editing a Table During Gradient Operation 3-30
3.3.3.5 Aborting Gradient Operation 3-31

4 USING THE POWERLINE SYSTEM CONTROLLER 4-1

4.1 CONFIGURING THE HARDWARE 4-3

4.1.1 Using PUMP SETUP Screen 4-4
4.1.2 Using PUMP CONFIGURATION Screen 4-8
4.1.3 Using SYSTEM CONFIGURE Screen 4-11
4.1.4 Using AUTO-INJECTOR SETUP Screen 4-13
4.1.4.1 Specifying Auto-Injector Injection Parameters 4-17
4.1.4.2 Specifying Auto-standards 4-18
4.1.4.3 Specifying Dissolution Control 4-18
4.1.5 Using DETECTOR SETUP Screen 4-21

4.2 PERFORMING A DIRECT CONTROL (ISOCRATIC) APPLICATION 4-26

4.2.1 Setting Fluid Handling Unit Conditions 4-29
4.2.2 Setting External Event Switches 4-30
4.2.3 Setting Auto-injector Conditions 4-31
4.2.4 Setting Detector Conditions 4-31
4.2.5 Performing Direct Control 4-32

4.3 CREATING A TIME-BASED METHOD APPLICATION 4-34

4.3.1 Developing a Time-Based Program Table 4-39
4.3.1.1 Developing the Gradient Table 4-39
4.3.1.2 Developing the Program Event Table 4-44
4.3.1.3 Developing the Detector Table 4-46
4.3.2 Developing the Program Methods Table 4-49
4.3.2.1 Setting up the Program Methods Table 4-49
4.3.2.2 Entering the Program Methods Table 4-50
4.3.2.3 Saving the Program Methods Table 4-52
4.3.2.4 Deleting the Program Methods Table 4-53
4.3.3 Running the Multi-Method Application 4-53
4.3.3.1 Selecting Initial Operating Parameters 4-53
4.3.3.2 Running the Program Methods Table 4-54
4.3.3.3 Modifying the Program Methods Table During Operation 4-57
4.3.3.4 Editing a Program Table During Operation 4-57
4.3.3.5 Aborting Operation 4-57

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

BOOK II REFERENCE

1	**INTRODUCTION**	1-1
1.1	WATERS 600E OVERVIEW	1-1
1.2	600E MODULES	1-3
1.3	POWERLINE SYSTEM CONTROLLER OVERVIEW	1-5
1.4	OPTIONS	1-8
2	**GRADIENT CONTROLLER SCREENS**	2-1
2.1	POWER UP SCREEN	2-2
2.2	PUMP SETUP SCREEN	2-2
2.2.1	Pump Setup Keys	2-3
2.2.2	Pump Setup Parameters	2-4
2.3	PUMP CONFIGURATION SCREEN	2-6
2.3.1	Pump Configuration Keys	2-7
2.3.2	Pump Configuration Parameters	2-7
2.4	ISOCRATIC SCREEN	2-8
2.4.1	Isocratic Keys	2-8
2.4.2	Isocratic Parameters	2-8
2.5	PROGRAM GRADIENT SCREEN	2-9
2.5.1	Program Gradient Keys	2-10
2.5.2	Program Gradient Parameters	2-11
2.5.3	Gradient Table Programming Considerations	2-12
2.6	PROGRAM EVENT SCREEN	2-13
2.6.1	Program Event Keys	2-14
2.6.2	Program Event Parameters	2-15
2.7	INITIAL OPERATE GRADIENT SCREEN	2-16
2.7.1	Operate Gradient Keys	2-17
2.7.2	Operate Gradient Parameters	2-17
2.8	OPERATE GRADIENT SCREEN	2-17
2.8.1	Operate Gradient Keys	2-18
2.8.2	Operate Gradient Screen Parameters	2-19

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3 POWERLINE SYSTEM CONTROLLER SCREENS 3-1

3.1 POWER UP SCREEN 3-2

3.2 PUMP SETUP SCREEN 3-2

3.2.1 Pump Setup Keys 3-3
3.2.2 Pump Setup Parameters 3-4

3.3 PUMP CONFIGURATION SCREEN 3-6

3.3.1 Pump Configuration Keys 3-7
3.3.2 Pump Configuration Parameters 3-7

3.4 SYSTEM CONFIGURATION SCREEN 3-9

3.5 AUTO-INJECTOR SETUP SCREEN 3-9

3.5.1 Auto-Injector Keys 3-10
3.5.2 Auto-Injector Setup Parameters 3-10

3.6 DISSOLUTION SETUP SCREEN 3-11

3.6.1 Dissolution Setup Keys 3-12
3.6.2 Dissolution Setup Parameters 3-12

3.7 DETECTOR SETUP SCREEN 3-13

3.7.1 Detector Setup Keys 3-14
3.7.2 Detector Setup Parameters 3-15

3.8 DIRECT CONTROL SCREEN 3-16

3.8.1 Direct Control Keys 3-17
3.8.2 Direct Control Parameters 3-17

3.9 PROGRAM GRADIENT SCREEN 3-19

3.9.1 Program Gradient Keys 3-20
3.9.2 Program Gradient Parameters 3-21
3.9.3 Program Gradient Programming Considerations 3-23

3.10 PROGRAM EVENT SCREEN 3-24

3.10.1 Program Event Keys 3-25
3.10.2 Program Event Parameters 3-25

3.11 DETECTOR TABLE SCREEN 3-27

3.11.1 Detector Table Keys 3-28
3.11.2 Detector Table Parameters 3-28

3.12 PROGRAM METHODS SCREEN 3-29

3.12.1 Program Methods Keys 3-30
3.12.2 Program Methods Parameters 3-30

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.13 OPERATE METHODS SCREENS 3-32

3.13.1 Initial OPERATE METHODS Screen 3-33
3.13.1.1 Operate Methods Keys 3-33
3.13.1.2 Operate Methods Parameters 3-33
3.13.2 OPERATE METHODS Screen 3-34
3.13.2.1 Operate Methods Keys 3-35
3.13.2.2 Operate Methods Parameters 3-36

4 ERROR MESSAGES 4-1

4.1 WARNING MESSAGES 4-2

4.2 SHUTDOWN MESSAGES 4-6

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

BOOK III INSTALLATION AND SERVICE

1	**SETUP AND INSTALLATION**	1-1
1.1	SETUP AND INSPECTION	1-1
1.2	SITE SELECTION	1-2
1.3	ELECTRICAL REQUIREMENTS	1-3
1.3.1	Adaption for 50 Hz Operation	1-4
1.3.2	Voltage Selection	1-4
1.4	CONTROLLER CONNECTIONS	1-6
1.4.1	Rear Panel Description	1-6
1.4.2	Rear Panel Connections	1-10
1.4.3	IEEE-488 Electrical Connections	1-13
1.4.4	RS-232 Connections	1-18
1.5	FLUID HANDLING UNIT CONNECTIONS	1-18
1.5.1	Solvent Reservoir Setup	1-19
1.5.2	System Sparge/Helium Setup	1-21
1.5.2.1	System Sparging Overview	1-22
1.5.2.2	Connecting Compression Fitting Assembly	1-22
1.5.2.3	Connecting Sparge Tubing	1-23
1.6	OPTIONS INSTALLATION	1-24
1.6.1	Steel Column	1-25
1.6.2	Steel Column Heater	1-26
1.6.3	RCSS Heater Module	1-29
1.6.4	RCM 8x10 Installation	1-32
1.7	CARTRIDGE AND COLUMN PREPARATION	1-33
1.8	INJECTOR CONNECTIONS	1-33
1.8.1	Manual Injector	1-34
1.8.2	Auto-Injector	1-34
1.9	DETECTOR CONNECTIONS	1-36
1.10	OPTIONAL DISSOLUTION COMPONENTS CONNECTIONS	1-37
1.10.1	Electrical Connections	1-38
1.10.2	Tubing Connections	1-40

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2 DIAGNOSTICS AND TROUBLESHOOTING 2-1

2.1 SELF-DIAGNOSTIC ROUTINES 2-1

2.2 EXTENDED TEST ROUTINES 2-2

2.3 INDIVIDUAL EXTENDED TESTS 2-4

2.3.1 Stop Flow Input Test 2-4
2.3.2 External Inject Test 2-4
2.3.3 External Switch (S1 - S4) Output Test 2-5
2.3.4 Hold Output Test 2-5
2.3.5 Chart Test 2-6
2.3.6 Sparge Valves Test 2-6
2.3.7 Pump and Solvent Valves Test 2-7
2.3.8 IEEE-488 Address Test 2-8

2.4 FLUID SYSTEM TROUBLESHOOTING 2-9

2.5 PRESSURE TRACE RECORDING TO AID TROUBLESHOOTING 2-11

2.6 INJECTOR SYSTEM TROUBLESHOOTING 2-14

2.7 SOLVENT VALVE PAIR TEST 2-14

3 MAINTENANCE PROCEDURES 3-1

3.1 FLUID HANDLING UNIT 3-2

3.1.1 Pressure Transducer Maintenance 3-3
3.1.2 Pump Maintenance Procedures 3-5
3.1.2.1 Reference Valve Installation 3-8
3.1.2.2 Pump Head Assembly 3-9
3.1.3 Sparge Valve Assembly Maintenance 3-18
3.1.4 Solvent Proportioning Valve Replacement 3-21

3.2 ELECTRONICS SYSTEM 3-24

3.2.1 Fuse Installation 3-25
3.2.2 Replacing the Control Board 3-26

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

ABOUT YOUR DOCUMENTATION

Introduction

The 600E Operator's Manual describes the setup, installation, operation, and maintenance of the 600E Multisolvent Delivery System. This manual describes both the gradient controller and the PowerLine system controller versions of the 600E.

This manual is intended for both novice and experienced users.

Organization

The 600E Operator's Manual is divided into three books to provide easy access to all levels of information, from installation and setup to system operation. The content of the 600E Operator's Manual is divided into:

- Book I - How to Use the 600E
- Book II - Reference
- Book III - Installation and Service

Structure

Book I, How to Use the 600E, provides the step-by-step procedures of using the 600E system in various modes of operation. It includes procedures on:

- Using the 600E front panel
- Performing routine operating procedures
- Using the 600E gradient controller
- Using the 600E PowerLine system controller

Book II, Reference, contains all of the reference information on the 600E including:

- 600E system introduction
- 600E gradient controller screens
- 600E PowerLine system controller screens
- Error messages

Book III, Installation and Service, provides the procedures to set up, install, troubleshoot, and maintain your 600E system. It includes procedures on:

- Setup and installation
- Diagnostics and troubleshooting
- System maintenance

Type conventions

This manual uses the following special type conventions to make text easier to understand:

- **Bold text** in examples or operating instructions indicates user input, that is, what you must type or enter
- *Italic text* generally introduces new or important words (also used for emphasis)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Using this documentation

If you are a new user, the recommended reading path is:

Book	Book Title	Chapter	Chapter Title
III	Installation and Service	1	Setup and Installation
I	How to Use the 600E	1	Using the Front Panel
II	Reference	2	Gradient Controller Screens
		or	
		3	PowerLine System Controller Screens
I	How to Use the 600E	2	Routine Operation
I	How to Use the 600E	3	Using the Gradient Controller
		or	
		4	Using the PowerLine System Controller

If you are an experienced user, the recommended reading path is:

Book	Book Title	Chapter	Chapter Title
III	Installation and Service	1	Setup and Installation
I	How to Use the 600E	2	Routine Operation
I	How to Use the 600E	3	Using the Gradient Controller
		or	
		4	Using the PowerLine System Controller
II	Reference	Any applicable	

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TABLE OF CONTENTS

HOW TO USE THIS BOOK v

1 USING THE FRONT PANEL 1-1

1.1 THE FRONT PANEL 1-1

1.1.1 The Display Screen 1-2
1.1.2 ON/OFF Switch 1-2

1.2 KEYPAD 1-3

1.3 FUNCTION KEYS 1-4

1.4 SCREEN KEYS 1-4

2 ROUTINE OPERATION 2-1

2.1 DAILY STARTUP 2-1

2.1.1 Powering Up the System 2-2
2.1.2 Sparging the Reservoirs 2-3
2.1.3 Purging Air from the System 2-4

2.2 DAILY ROUTINE OPERATION 2-7

2.3 USING THE OPTIONAL U6K MANUAL INJECTOR 2-9

2.4 CHANGING SOLVENTS 2-10

3 USING THE GRADIENT CONTROLLER 3-1

3.1 CONFIGURING THE HARDWARE 3-3

3.1.1 Using PUMP SETUP Screen 3-4
3.1.2 Using PUMP CONFIGURATION Screen 3-8

3.2 PERFORMING AN ISOCRATIC APPLICATION 3-11

3.3 PERFORMING A GRADIENT APPLICATION 3-15

3.3.1 Developing a Gradient Table 3-19
3.3.1.1 Setting Up the Gradient Table 3-19
3.3.1.2 Entering/Editing the Gradient Table 3-19
3.3.1.3 Saving the Gradient Table 3-22
3.3.1.4 Specifying Autostart 3-23
3.3.1.5 Deleting Previous Gradient Tables 3-23
3.3.2 Developing a Program Event Table 3-24
3.3.2.1 Setting Up the Program Event Table 3-24
3.3.2.2 Entering the Program Event Table 3-25
3.3.3 Running the Gradient Application 3-27
3.3.3.1 Selecting a Gradient/Event Table 3-27
3.3.3.2 Running the Gradient/Event Table 3-28
3.3.3.3 Changing to Another Table During Operation 3-30
3.3.3.4 Editing a Table During Gradient Operation 3-30
3.3.3.5 Aborting Gradient Operation 3-31

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4 USING THE POWERLINE SYSTEM CONTROLLER 4-1

4.1 CONFIGURING THE HARDWARE 4-3

4.1.1 Using PUMP SETUP Screen 4-4
4.1.2 Using PUMP CONFIGURATION Screen 4-8
4.1.3 Using SYSTEM CONFIGURE Screen 4-11
4.1.4 Using AUTO-INJECTOR SETUP Screen 4-13
4.1.4.1 Specifying Auto-Injector Injection Parameters 4-17
4.1.4.2 Specifying Auto-standards 4-18
4.1.4.3 Specifying Dissolution Control 4-18
4.1.5 Using DETECTOR SETUP Screen 4-21

4.2 PERFORMING A DIRECT CONTROL (ISOCRATIC) APPLICATION 4-26

4.2.1 Setting Fluid Handling Unit Conditions 4-29
4.2.2 Setting External Event Switches 4-30
4.2.3 Setting Auto-injector Conditions 4-31
4.2.4 Setting Detector Conditions 4-31
4.2.5 Performing Direct Control 4-32

4.3 CREATING A TIME-BASED METHOD APPLICATION 4-34

4.3.1 Developing a Time-Based Program Table 4-39
4.3.1.1 Developing the Gradient Table 4-39
4.3.1.2 Developing the Program Event Table 4-44
4.3.1.3 Developing the Detector Table 4-46
4.3.2 Developing the Program Methods Table 4-49
4.3.2.1 Setting up the Program Methods Table 4-49
4.3.2.2 Entering the Program Methods Table 4-50
4.3.2.3 Saving the Program Methods Table 4-52
4.3.2.4 Deleting the Program Methods Table 4-53
4.3.3 Running the Multi-Method Application 4-53
4.3.3.1 Selecting Initial Operating Parameters 4-53
4.3.3.2 Running the Program Methods Table 4-54
4.3.3.3 Modifying the Program Methods Table During Operation 4-57
4.3.3.4 Editing a Program Table During Operation 4-57
4.3.3.5 Aborting Operation 4-57

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

LIST OF FIGURES

1-1 The Front Panel 1-2
1-2 CLEAR LINE Screen Key 1-5

2-1 Power Up Screen 2-2
2-2 Pump Priming 2-6
2-3 U6K Injector 2-9

3-1 Gradient Controller Screens 3-2
3-2 PUMP SETUP Screen Selections 3-5
3-3 PUMP SETUP Screen 3-6
3-4 PUMP CONFIGURATION Screen Selections 3-9
3-5 PUMP CONFIGURATION Screen 3-10
3-6 ISOCRATIC Screen Selections 3-12
3-7 ISOCRATIC Screen 3-13
3-8 Developing a Gradient Table and Program Event Table 3-16
3-9 Running the Gradient Application 3-17
3-10 Example of a Gradient Table 3-19
3-11 PROGRAM GRADIENT Screen 3-20
3-12 Example of a Program Event Table 3-25
3-13 PROGRAM EVENT Screen 3-25
3-14 Initial OPERATE GRADIENT Screen 3-27
3-15 OPERATE GRADIENT Screen 3-28
3-16 Gradient to Isocratic CAUTION Screen 3-31

4-1 PowerLine System Controller Screens 4-2
4-2 PUMP SETUP Screen Selections 4-5
4-3 PUMP SETUP Screen 4-6
4-4 PUMP CONFIGURATION Screen Selections 4-9
4-5 PUMP CONFIGURATION Screen 4-10
4-6 SYSTEM CONFIGURE Screen Selections 4-12
4-7 SYSTEM CONFIGURE Screen 4-13
4-8 AUTO-INJECTOR SETUP Screen Selections 4-15
4-9 AUTO-INJECTOR SETUP Screen 4-17
4-10 DISSOLUTION SETUP Screen 4-19
4-11 DETECTOR SETUP Screen Selections 4-23
4-12 DETECTOR SETUP Screen 4-24
4-13 DIRECT CONTROL Screen Selections 4-27
4-14 DIRECT CONTROL Screen 4-29
4-15 Transition from DIRECT CONTROL to OPERATE METHODS 4-33
4-16 Developing a Program Table 4-35
4-17 Developing the Program Methods Table 4-36
4-18 Running the Multi-Methods Application 4-37
4-19 Example of a Gradient Table 4-39
4-20 PROGRAM GRADIENT Screen 4-40
4-21 Example of a Program Event Table 4-44
4-22 PROGRAM EVENT Screen 4-45
4-23 Example of a Detector Table 4-47
4-24 DETECTOR TABLE Screen 4-47
4-25 PROGRAM METHODS Screen 4-50
4-26 Initial OPERATE METHODS Screen 4-54
4-27 OPERATE METHODS Screen 4-55
4-28 ABORT CAUTION Screen 4-58

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

HOW TO USE THIS BOOK

Book I Book I, How To Use the 600E, provides the step-by-step procedures on using the controller in its defined modes of operation (including the routine operating procedures for starting the system, changing solvent, and so on).

Other books Use Book II, Reference, for background information on topics such as front panel controls and indicators, screen displays, and associated parameter values and ranges for each screen display.

Book III, Installation and Service, provides installation and/or maintenance information.

Organization This book is organized to help you use the system as a gradient controller and as a PowerLine system controller. It is divided into chapters that describe similar categories of information, applicable to the controller in general, or to operation as either a gradient controller or PowerLine system controller. In addition, chapters are divided by titled tab dividers, providing easy access to all information on particular subjects.

Using this book Chapter 1 provides the background to use the controller front panel. It contains an overview of the:

- Front panel
- Keypad
- Screen keys
- Function keys

Chapter 2 provides routine operating procedures for starting up and operating the system on a daily basis.

Chapter 3 includes procedures on using the gradient controller for:

- Configuring the hardware
- Performing an isocratic application
- Performing a time-based gradient application

Chapter 4 includes procedures on using the PowerLine system controller for:

- Configuring the hardware
- Performing a direct control (isocratic) application
- Creating a time-based multi-method application

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1

USING THE FRONT PANEL

This chapter introduces you to the basic operation of the controller front panel to enable you to quickly use the system.

1.1 THE FRONT PANEL

Overview In addition to the display screen and ON/OFF Switch, the front panel (Figure 1-1) consists of three groupings of keys:

- **Keypad** - Contains the cursor movement keys, the ENTER key, the CLEAR key, and the number keys.
- **Function Keys** - Consist of a row of labeled keys located on the lower front panel. They allow you to switch modes of system operation.
- **Screen Keys** - Consist of a row of unlabeled keys which are located directly below the screen key name displayed at the bottom of every screen. The screen keys vary with different screens used during operation.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

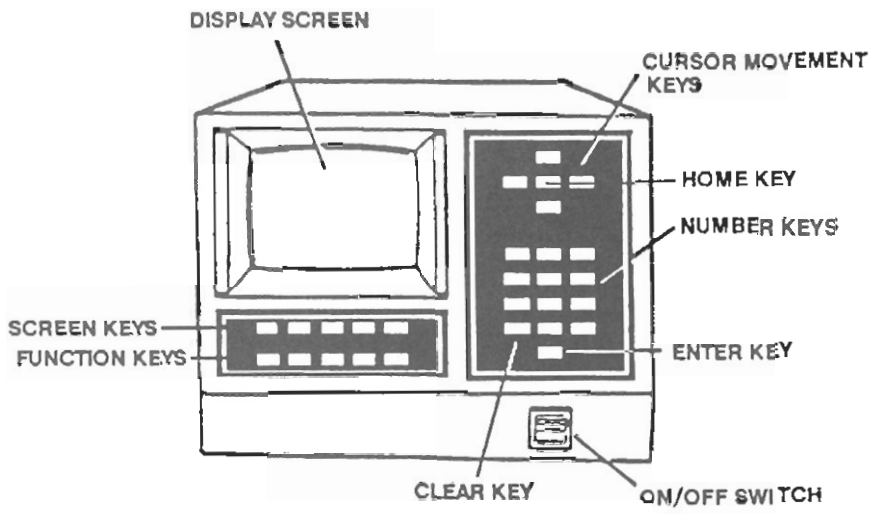


Figure 1-1 The Front Panel

1.1.1 The Display Screen

The display screen shows you the screen of each operation and its entries as well as messages created by the system. It also shows the cursor as a bright rectangle against a dark background.

1.1.2 ON/OFF Switch

The ON/OFF switch powers the controller up and down:

- Press ON (1) to turn the controller on
- Press OFF (0) to turn the controller off

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1.2 KEYPAD

Overview The Keypad contains several different keys:

- **Cursor Movement keys** - Use these four keys to move the cursor up, down, left, and right as indicated by the arrows on the keys. The cursor location on each page is readily visible as a light rectangle. The width of the cursor generally indicates the size of the entry permitted for any given parameter. For example, the cursor width for a double number is larger than the width for a single number.

- **HOME key** - The cursor movement is also controlled by the HOME key on the front panel. You use this key to move the cursor directly to the home, or first entry, position on that screen from anywhere on the screen.

- **ENTER key** - After you supply the data, press this key to enter, or register, the data onto the system. The system checks the entry for proper range and places the values into temporary storage.

- **CLEAR key** - Use this key to clear the value just entered, and the value previously occupying the space reappears. It can also be used to clear warning messages from the screen.

- **Number keys** - Use these keys to enter numeric data on the screens. The keys display the numbers 0 to 9 and a decimal point. Use the decimal point to represent a decimal point or start diagnostics from the Power Up screen.

Entering values To use the number keys:

1. Position the cursor at the field on the screen where the new value is desired.

2. Enter a valid number for the selected parameter.

3. Press the ENTER key. The new value is automatically checked to see if it is the correct type of entry and within the proper range.

   If the entry is acceptable, it becomes the current parameter value and the cursor moves to the next logical entry position. If the entry is not acceptable, an error message appears at the bottom of the screen and the previous value remains as the current parameter value. The next key pressed removes the error message, and the cursor remains in position to accept a correct value.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1.3 FUNCTION KEYS

Function keys are the five keys located directly under the screen keys. The labels on these keys vary depending on whether you have the gradient controller or PowerLine system controller.

For the gradient controller, the labels are:

- SETUP
- ISOCRATIC
- OPERATE GRADIENT
- PROGRAM EVENT
- PROGRAM GRADIENT

For the PowerLine system controller, the labels are:

- SETUP
- DIRECT
- OPERATE METHODS
- PROGRAM METHODS
- PROGRAM TABLES

Each mode of operation is enabled by pressing one of these keys to provide access to logically associated values. For example, press the **SETUP** key to access the screen that allows you to enable reservoirs to be sparged.

To use the function keys, press the appropriately marked key.

1.4 SCREEN KEYS

Screen keys are the five unlabeled keys located directly below the display screen. The functions performed by the screen keys are indicated by labels that appear on the bottom of the displayed screen immediately above each key. Figure 1-2 shows the relative location of the label to the key.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

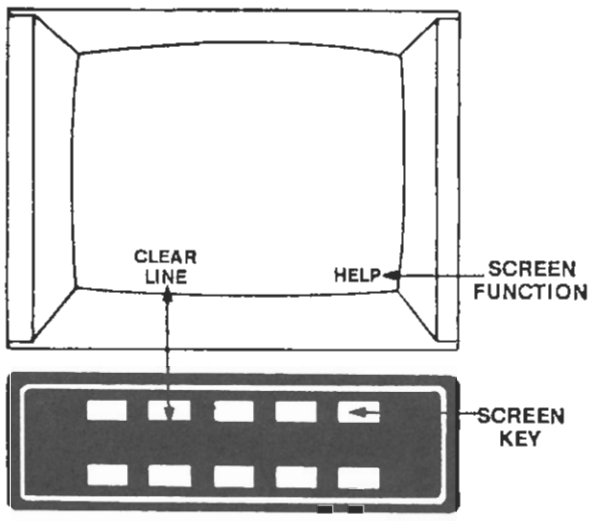
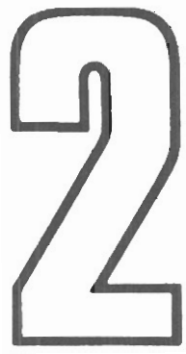


Figure 1-2 CLEAR LINE Screen Key

To use the screen keys, press the key directly below the label on the display screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



ROUTINE OPERATION

This chapter outlines routine operating procedures. It includes:

- Starting up the system on a daily basis (performing such activities as sparging the reservoirs, purging air, and priming the pumps)
- Performing daily routine operating procedures to prepare the system for sample injection (including a listing of recommended good operating practices)
- Using the optional U6K injector
- Changing solvents

2.1 DAILY STARTUP

This section describes the daily startup procedure. Daily startup is divided into:

- Powering up the system
- Sparging the reservoirs
- Removing air from the pump heads and solvent supply lines
- Priming the pumps

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

NOTE: Fluid handling unit components such as pump seals and check valves have a reasonable life expectancy (even under less than ideal operating conditions). To ensure this:

- Monitor the condition of your system by establishing baseline performance characteristics (to measure against) when calibration and maintenance are performed
- Take care at daily startup and shutdown to keep the system clean and in good operating order

2.1.1 Powering Up the System

Power on Turn the front power switch on. The Power Up screen appears (Figure 2-1) indicating the revision level of the software and the results of the self-diagnostic tests. Diagnostics are performed each time the controller is turned on and are completed within a few seconds.

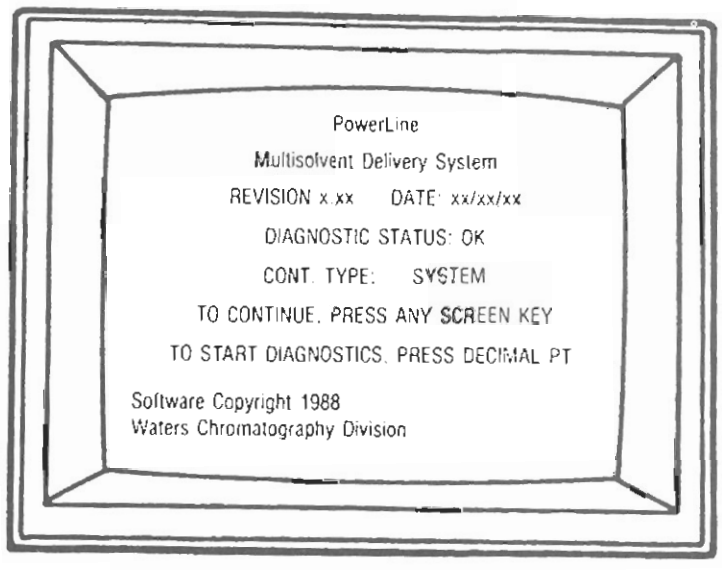


Figure 2-1 Power Up Screen

When the tests are completed, the system displays a message indicating that all tests passed or which tests failed. If the system fails during one of the required tests, the test in progress displays on the screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Running extended tests

To access the extended (service level) diagnostic tests, press the decimal point on the numeric keypad. For detailed information on performing extended diagnostic tests, refer to Book III, Installation and Service, Chapter 2.

2.1.2 Sparging the Reservoirs

WARNING

Always observe good lab practices when handling solvents.

Considerations

When sparging the reservoirs:

- The sparge and solvent tubing are assembled and connected to the fluid unit as outlined in Book III, Installation and Service, Chapter 1.
- It is good practice to sparge (degas) the solvent daily because air may diffuse into the system through the solvent tubes overnight (degassing information is included in this section and Appendix C, Solvent Properties).
- The appropriate sparge method depends on analytical requirements. An initial high flow rate, reduced to a low maintenance rate, is suggested.

WARNING

Sparging into open air may be harmful with certain solvents. Use an exhaust hood to remove fumes emitted by the reservoirs.

Procedure

1. Verify the helium tank regulator pressure. If necessary, adjust it to a setting between 50 and 90 psi.

Selecting reservoirs

2. Press the **SETUP** key. The PUMP SETUP screen displays.
3. In the Reservoirs to Sparge fields (A through D), type **1** to enable each solvent reservoir to be sparged (assuming sparge tubing is previously connected). This opens a sparge valve in the fluid handling unit.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Selecting a flow rate

4. Press the **ISOCRATIC** or **DIRECT** key (depending on your version of the 600E).

5. From the ISOCRATIC or DIRECT screen, at the Sparge field, type an initial flow rate of **100** ml/min for the sparge gas (helium). Press ENTER.

6. Flow helium at 100 ml/min for 15 minutes, then repeat step 5 and reduce flow to:

   - 10 to 15 ml/min for aqueous mobile phases
   - 15 to 20 ml/min for aqueous and acetonitrile
   - 30 ml/min for aqueous and methanol

7. Maintain helium flow conditions continuously while the system is running.

2.1.3 Purging Air from the System

WARNING

Exercise caution when bleeding solvents from the system. Follow good laboratory practices and wear eye protection.

This section describes how to:

- Purge air from the pump heads and the solvent supply lines
- Prime the pumps

Considerations

When purging the fluid handling system:

- Always wear safety glasses when working with solvents.
- Prior to operation, always check for miscibility with the previous solvent used or change solvents.
- If organic and aqueous buffers are used together, ensure that they do not precipitate salt in the pump heads and valves. Allow proper changeover steps when priming and recycling programs from final to initial conditions.
- Standard 225 µl pump heads usually do not require priming once solvent has been introduced to the draw-off valve. The smaller displacement 100 µl heads may require additional priming with some solvents.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- Priming must be performed with a suitable syringe (such as the one available from Waters). During purging, do not apply excessive force to the syringe by injecting solvent more quickly than the 600E pumps can accept.

Initial setup

The initial setup to purge air or previous solvents from the pumping system requires venting the solvent somewhere before the column. Use one of the following methods to vent the solvent.

NOTE: For the first three methods listed below, place a small glass beaker under the open tubing or injection port (an absorbent paper towel may be sufficient to catch small volumes of solvent).

- Open the slide-out drawer. Disconnect the fluid tubing at the column inlet (as outlined in Book III, Installation and Service, Section 1.6). Disconnecting the fluid line avoids introducing air into the column and reduces backpressure resistance to priming.
- Open the reference valve if it is mounted on the pump above the pump heads.
- If using the U6K option, place the LOAD/INJECT handle to the INJECT position (as outlined in Section 2.3, Using the Optional U6K Injector) and place the retaining plug handle to the OPEN (down) position.
- If using a WISP™ auto-injector, put it into purge mode.

Initiating flow

1. Press the **ISOCRATIC** or **DIRECT** key (depending on your controller). At the **FLOW:** field, type a flow rate of **1** ml/min (the proportioning valve is not actuated at 0 ml/min).
2. At the %A field, type a value of **100** to set the flow to 100 percent for solvent reservoir A.
3. Open the solvent draw-off valve (turn the knurled knob counterclockwise) and attach the priming syringe (Figure 2-2). Draw 10 ml of solvent.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

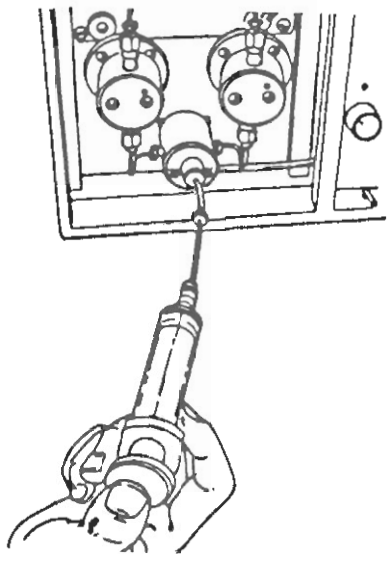


Figure 2-2 Pump Priming

4. Close the solvent draw off valve and remove the priming syringe. Expell the solvent in the syringe into an appropriate solvent waste container.

5. Switch to the next solvent reservoir and repeat steps 2 and 3 until all four reservoirs are purged.

Purging pumps and lines

1. At the %A field, type a value of **100** to set the flow to 100 percent for solvent reservoir A.

2. At the Flow field, make sure you have vented the system prior to the column (as described earlier under Initiating Flow) to avoid damaging the column.

   Increase the solvent flow rate to 9 ml/min. Allow the solvent to flow for several minutes to clear the lines of all bubbles.

   If using a mixture of solvents for initial conditions (dial-a-mix), set the initial conditions and let the solvents flow for several minutes at 9 ml/min.

   If the flow is erratic, apply pressure to the syringe plunger.

3. At the Flow field, decrease the solvent flow rate to 1.0 ml/min.

4. Depending upon your system configuration, perform one of the following:

   - Place the U6K retaining plug handle in the CLOSED (up) position
   - Close the optional reference valve
   - Press RESET on the WISP 710B, 712, or 715

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5. Restart the pump flow rate to the flow you will be using for your chromatography, for example, 1.0 ml/min.

6. Observe the Pressure field on the 600E screen. Pulsations should be approximately 50 to 100 psi at the crossover point of the plungers.

7. Repeat steps 1 through 6 for each solvent reservoir or if pulsations exceed the recommended level.

8. Close the solvent draw-off valve (turn the knurled knob clockwise) and remove the priming syringe.

2.2 DAILY ROUTINE OPERATION

This section outlines the routine operating steps to get the system up to a point where it is ready for the sample to be injected.

Initial startup

1. Fill the solvent reservoirs with sufficient solvent for the day's operation. Check that all solvent considerations are met (as outlined in Book III, Installation and Service, Chapter 1).

2. Turn the system power on.

   NOTE: Oxygen can dissolve into the solvent overnight. If you are not using fresh solvent, sparge each solvent reservoir for a minimum of 20 minutes at 100 ml/min before flushing the system to replace the older solvent.

Flushing the fluid handling unit

1. For a thorough flushing, disconnect the pump outlet tube (from the column inlet) and place the outlet tube in a waste container.

   If thorough flushing is not required, leave the pump outlet tube connected and flush fresh solvent through the system to waste. If using the U6K option, place the LOAD/INJECT handle to the INJECT position and place the retaining plug handle to the OPEN (down) position.

2. Press the **ISOCRATIC** or **DIRECT** key (depending upon your version of the controller). From the Flow Rate field, set the flow rate to **2.00** ml/min.

3. Purge for 2 to 5 minutes

4. If your system pressure fluctuates more than 100 psi once the system has reached the operating flow rate, prime the system again as directed in Section 2.1.3., Purging Air from the System.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5. If the column in the system has been used before, use sufficient solvent for the column to equilibrate. If the column is new, allow solvent to go to waste before connecting the solvent outlet to the detector. Refer to the associated column Care and Use Manual for equilibration instructions.

System operation

For information on running the samples(s) or system, refer to Chapter 3, Using the Gradient Controller, or Chapter 4, Using the PowerLine System Controller.

Refer to the specific operator's manual for operating instructions on the Waters U6K manual injector, Rheodyne 7125 manual injector, or the Waters auto-injector.

Good operating practices

The following is a summary of recommended operating practices when using the system:

- Always follow good laboratory practices when handling solvents.
- Use only clean solvents; prefilter and/or purify them as necessary.
- Program the pump to stop flow following the completion of a gradient table to help ensure fault-free unattended operation. Solvent waste is minimized, and there is less chance of running the solvent reservoirs dry.
- If running buffered mobile phases, do not let the system sit in buffers overnight without a flow through the system. Reducing the flow rate is useful to accomplish this after the runs are completed.
- Ensure that solvents are miscible before changing from one solvent to another.
- Never pump solvent that reacts with the material of the wetted surfaces.
- After using halide ions, flush the system thoroughly.
- Never place solvents on top of the controller.
- Be careful when changing from buffered aqueous solvents to organic solvents. Flush the system with distilled water or another appropriate solvent before introducing the organic solvent. Otherwise, the buffer salts may precipitate and block the proportioning valves.
- Maintain sufficient solvent in the reservoirs to ensure that the reservoirs do not run dry.
- Whenever possible, use solvents of similar viscosity when running a gradient.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- Degas solvents. Sonic bath and vacuum are recommended.
- Sparge all solvents.
- Know the properties of the solvents you use. For example, cyclohexane solidifies at 3500 psi (245 kg/cm^2).
- For system storage, always remove buffers and clean the system with distilled water, then methanol. (Remove the column if it is incompatible with this storage protocol.)

Refer to Section 2.4, Changing Solvents, and Appendix C, Solvent Properties, for solvent changeover recommendations.

2.3 USING THE OPTIONAL U6K MANUAL INJECTOR

This section is an overview on using the optional U6K manual injector. Refer to the U6K Operator's Manual for specific operating instructions.

Procedure

1. Place the upper LOAD/INJECT handle to the LOAD (right) position (Figure 2-3).

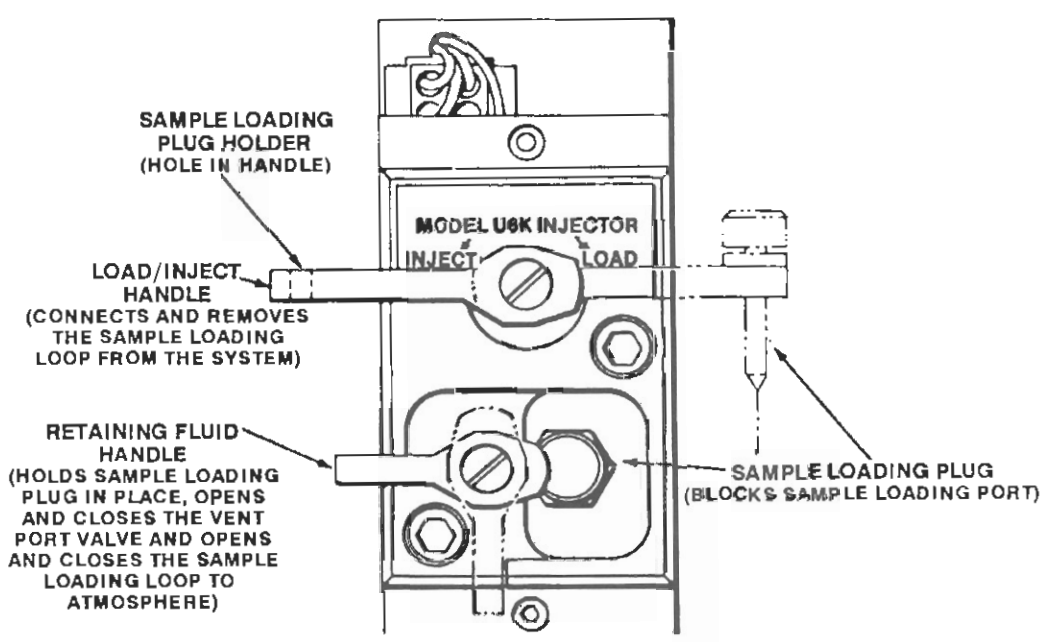


Figure 2-3 U6K Injector

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2. Place the sample retaining plug handle (lower) to the open (vertical) position.

3. Remove the sample loading plug. The hole in the LOAD/INJECT handle is provided as a convenient holder for the plug during sample loading and prevents making an injection without the sample loading plug in place.

CAUTION

Take care not to contaminate the wire at the end of the sample loading plug.

4. Insert the syringe into the sample loading port until the syringe bottoms and then fill the loop.

5. Remove the syringe, replace the sample loading plug, and place the sample retaining plug handle in the closed (horizontal) position.

6. Place the LOAD/INJECT handle to the INJECT (left) position.

7. Position the LOAD/INJECT handle as follows:

   NOTE: Allow sufficient time for the sample to clear the injector before repositioning the U6K LOAD/INJECT handle.

   - If operating in gradient mode, or if the next sample is not ready to be loaded, leave the LOAD/INJECT handle in the INJECT position.

   - If operating in direct/isocratic mode, or if the next sample is ready to be loaded, place the LOAD/INJECT handle in the LOAD position.

2.4 CHANGING SOLVENTS

This section outlines the recommended procedure for changing solvents in the 600E fluid handling unit. This procedure is appropriate for each intermediate solvent required as well as any solvent that will be used in the system.

Considerations When changing solvents:

- Changes involving two miscible solvents can be made immediately, without an intermediate solvent.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- Changes involving two solvents that are not totally miscible, for example, from chloroform to water, always require an intermediate solvent. Refer to Appendix C, Solvent Properties, for more information.

- To prevent solvent contamination, use the same container to prepare, supply, and store a solvent. Once a container is used for one solvent, it should not be used for any other solvent without a thorough cleaning.

- If organic solvents and aqueous buffers are used together, take care not to precipitate salt in the pump and valves during solvent changeovers or between cycles of a program (final and initial conditions).

- You can maintain the fluid handling unit in good operating condition when using solvents containing halide ions if you observe the following precautions:

  Organic solvents - Program a low flow rate following analysis instead of a complete flow shutdown.

  Aqueous solvents - Flush the system completely with water before shutdown. The controller easily automates the process using either Reservoir C when performing binary gradients or Reservoir D when performing ternary gradients.

  For long-term storage of the unit, flush the system with an aqueous mixture containing 10 percent methanol to prevent any bacterial growth during storage.

  As the last step in your gradient table, run water (from an appropriate solvent reservoir) through the system for a few minutes. Consider the total volume of your system to ensure adequate flushing of the entire wetted surfaces.

Procedure To change solvents:

1. Turn the system off.

2. Place the solvent reservoir below the pump unit and allow the solvent to drain back into the reservoir.

3. Remove the column from the flow path. Connect the pump outlet and detector inlet with a union if the column is removed rather than switched out of the path.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4. Prepare a small quantity of the new solvent to flush the tubes. Discard the solvent when you finish the procedure.

5. Turn the system on.

6. Press either the **ISOCRATIC** or **DIRECT** key (depending upon the 600E being used). From the ISOCRATIC or DIRECT CONTROL screen, set the flow rate at **2.0** ml/min.

7. Run the system for 10 to 20 minutes (using 20 to 40 ml of solvent) to flush the previous solvent from the pump.

   Additional solvent is required to flush the remainder of the system. The exact amount of solvent required to flush the entire system depends on the type and number of detectors as well as the length of interconnecting tubing.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3

USING THE GRADIENT CONTROLLER

This chapter consists of a series of procedures on using the system as a gradient controller. It is structured so that you can understand the different modes of operation and how these modes interact with one another. Each main gradient controller function is presented in a sequence of steps to take your system up to a point where it is ready to run an application.

Operating modes

Use of the gradient controller involves the following operating modes:

- Configuring the system hardware from the SETUP screen
- Running the system from the ISOCRATIC screen for direct control
- Designing a time-based gradient application (which includes developing a gradient table, developing a program event table, and running the gradient application)

Figure 3-1 is an overview of the gradient controller screens and their associated screens.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

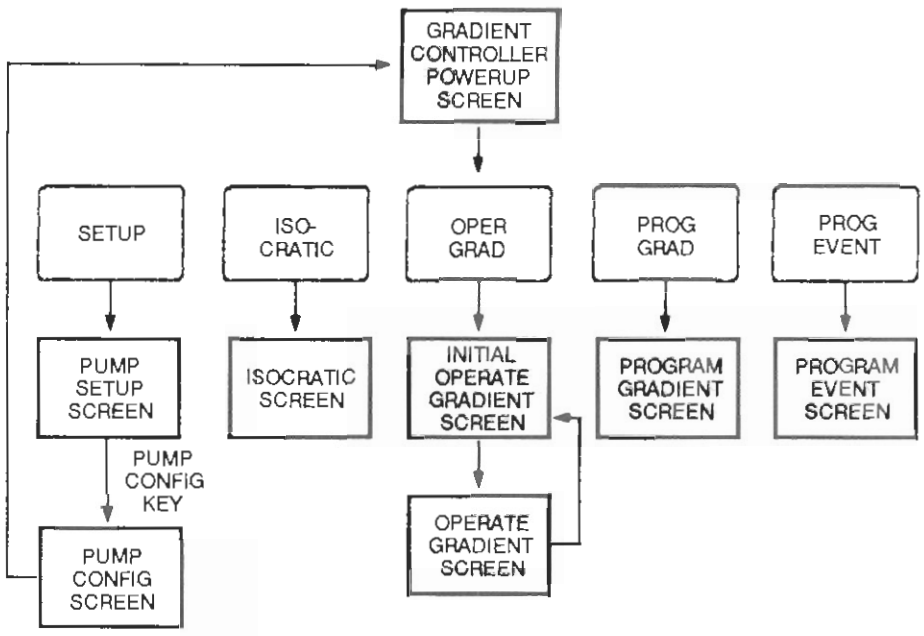


Figure 3-1 Gradient Controller Screens

The system is programmed and operated from its front panel keypad. Chapter 1, Using the Front Panel, provides the basics on using the keypad. It is recommended that you review that chapter before performing the procedures included in this chapter.

Background Information

This chapter assumes that you have initially set up, installed, and configured the system. For background information on setup and installation, refer to Book III, Installation and Service, Chapter 1.

For background information on each screen key, function key, and screen parameters, refer to Book II, Reference, Chapter 2.

For online reference information for each screen selection, use the HELP key found on each screen display. The HELP screen provides a synopsis for each screen parameter.

Control through an optional workstation

The gradient controller can be used in conjunction with the Waters 840, 845, or 860 Data and Chromatography Control Station (operating with Version 6, or later, software). In this configuration, the system is controlled over the IEEE-488 interface.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

When used in this mode, the control station screens are similar to those found on the system itself (as outlined in this chapter) and provide the same programming capabilities. In addition, this configuration has the added advantage of full system, single keyboard control (including detectors and auto-injectors), data acquisition, and multi-method capabilities available only with the control station. Reports of each analysis can be tailored to include full system conditions documentation.

3.1 CONFIGURING THE HARDWARE

The hardware is configured using the SETUP key. This key accesses the PUMP SETUP screen, which provides you with a series of hardware selections that are modified on a frequent basis.

From the PUMP SETUP screen, you access the PUMP CONFIGURATION screen, which provides you with a second level of hardware selections that are modified on a less frequent basis (such as selecting unit type or changing pump head volume selection).

These parameters apply to all controller operations, whether you are running an isocratic or gradient application. All values are preserved in memory and appear as default values upon next power on.

This section describes how to configure the hardware. Hardware configuration consists of:

- Setting parameters on the PUMP SETUP screen
- Setting parameters on the PUMP CONFIGURATION screen

Setting the Unit Type

The Unit Type parameter of the PUMP CONFIGURATION screen defines how the controller is to operate and modifies the different screen displays (along with their associated parameters). If you need to change the Unit Type parameter, do this prior to configuring any other Parameters. Refer to Section 3.1.2 for the procedure for changing the controller to a gradient controller.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.1.1 Using PUMP SETUP Screen

The PUMP SETUP screen includes the following hardware configuration selections:

- Enabling reservoirs to be sparged
- Setting the high temperature limit for an optional column/cartridge heater module
- Setting the low and high operating pressure limits for the fluid handling unit
- Enabling an external chart output selection
- Selecting autostart
- Locking the keyboard

Figure 3-2 is an overview on the hardware selections of the PUMP SETUP screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

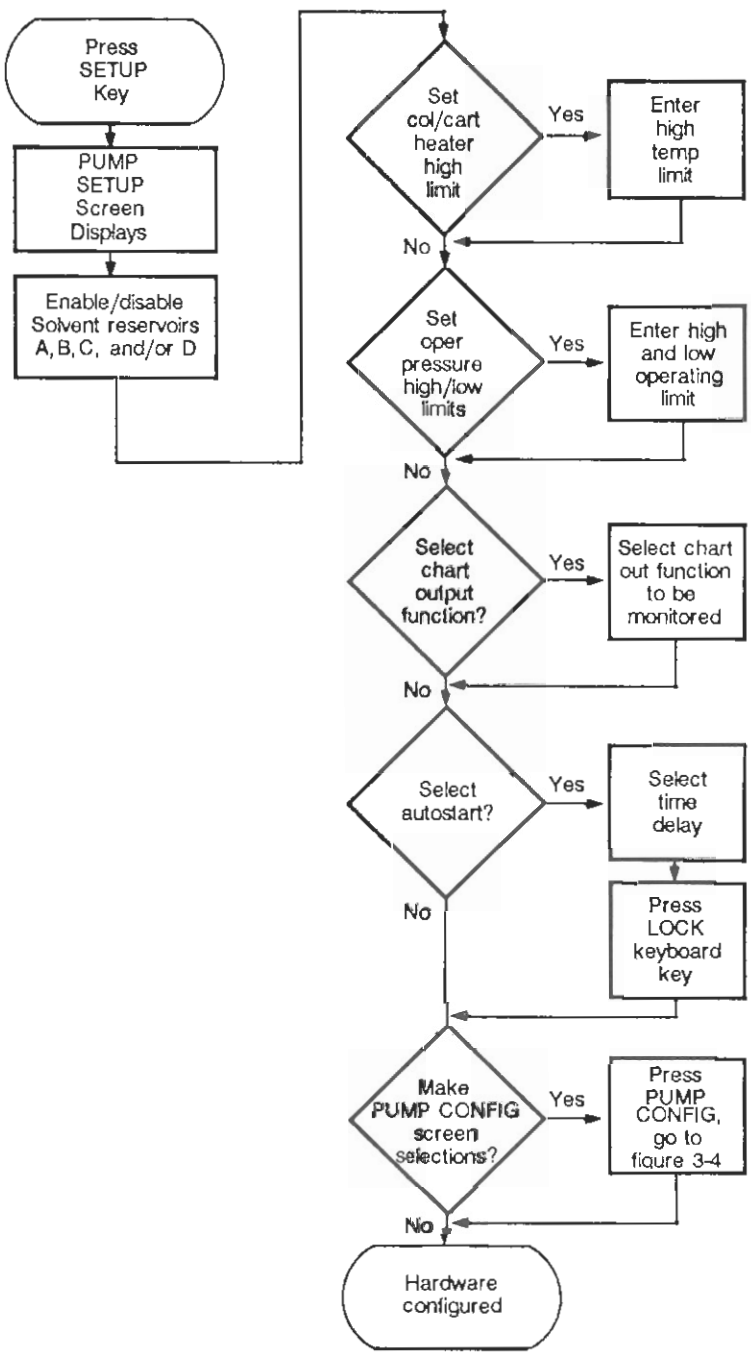


Figure 3-2 PUMP SETUP Screen Selections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Accessing PUMP SETUP screen

To view and/or change values on the PUMP SETUP screen, press the **SETUP** key. The PUMP SETUP screen displays with a series of default values (Figure 3-3).

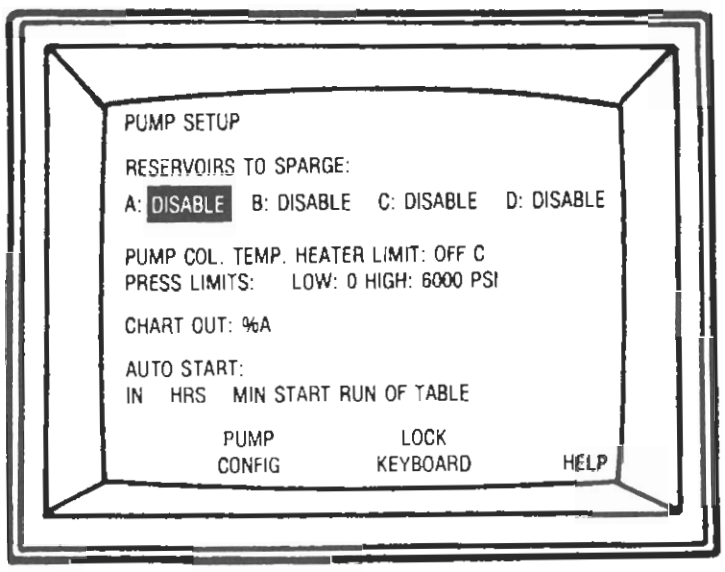


Figure 3-3 PUMP SETUP Screen

Enabling sparging

To enable or disable sparging on individual solvent reservoirs, at the Reservoirs to Sparge field, type the appropriate value to enable (**1**) or disable (**0**) sparging for a solvent reservoir, then press ENTER.

Regulating temperature limits

To modify the high temperature limit of the optional column/ RCSS heater module, at the Pump Col. Temp. Heater Limit field, type the appropriate high temperature limit for the heater module, then press ENTER.

NOTE: To prevent damage to the RCSS column heater or Radial-Pak™ cartridge, the heater module shuts down when the programmed temperature limit is exceeded for more than 1.2 seconds.

CAUTION

For the RCSS column heater, do not set the temperature limit greater than 64 °C or damage could occur to the Radial-Pak cartridge.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Regulating pressure limits

To modify the low and high pressure limits of the fluid handling unit, at the Pressure Limits Low and High fields, type the low and high pressure limits, then press ENTER. The pressure limits are determined by your column and chemistry. Read the manual supplied with your column to determine the maximum pressure limits.

NOTE: To prevent damage to the column or HPLC system, the pumps shut down when the programmed high pressure limit is exceeded for more than 1.2 seconds and the low pressure limit is exceeded for 60 seconds.

Monitoring output trace

To modify the external chart output trace, at the Chart Out field, type the value of the trace to be monitored on the external chart (individual solvent reservoir composition, pump flow rate, or optional heater module temperature), then press ENTER.

Using autostart

The Autostart parameter specifies the total time an application (gradient program) is to be delayed. Autostart is used in conjunction with locking the controller keyboard.

To enter an autostart delay time for running a gradient table:

1. At Autostart, the Hrs and Min fields, type the total delay time. Press ENTER.

2. At the Start Run of Table # field, type the appropriate table number for the gradient table to be delayed. Press ENTER.

   For example, if you have a program entered as Table #1 and you want to preheat and equilibrate your system 12 hours from now, type the following for Autostart

   IN 12 HRS 0 MIN START RUN OF TABLE # 1

   The autostart countdown starts when the keyboard is locked. If you want to cancel a countdown, unlock the keyboard.

   NOTE: Once the keyboard is locked, you cannot make a manual injection. Although a run can still be initiated from an external auto-injector, the program specified in the Autostart parameter always takes precedence.

Locking the keyboard

Locking the keyboard prevents accidental alteration of gradient flow conditions and is automatic when programming autostart times. When the keyboard is locked, the displayed legend changes to **UNLOCK KEYBOARD**. When lock is selected, **UNLOCK KEYBOARD** is the only operational key on the PUMP SETUP screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

This dual-purpose key also disables all screen keys except for:

- SETUP
- ISOCRATIC (if currently in ISOCRATIC operation)
- OPER GRAD and PROG EVENT (if operating in gradient mode)

NOTE: Ensure that all gradient and event programs are complete and correct before locking the keyboard. Multiple injections using the START RUN key are not possible while the keyboard is locked.

To lock the keyboard:

From the PUMP SETUP screen, press the **UNLOCK KEYBOARD** key. The bottom-right corner of the screen indicates the keyboard is now locked (**LOCK KEYBOARD**).

To unlock the keyboard:

From the PUMP SETUP screen, press the **LOCK KEYBOARD** key. The bottom-right corner of the screen indicates the keyboard is now unlocked (**UNLOCK KEYBOARD**).

3.1.2 Using PUMP CONFIGURATION Screen

The PUMP CONFIGURATION screen includes the following hardware configuration selections:

- Changing the unit type of the controller
- Changing the pump head volume selection
- Changing the RS-232 host link
- Defining the type of report to be printed on a 745B integrator
- Changing the serial communication interface

NOTE: The last three items on this list are only enabled with the PowerLine system controller.

Figure 3-4 is an overview on the hardware selections of the PUMP CONFIGURATION screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

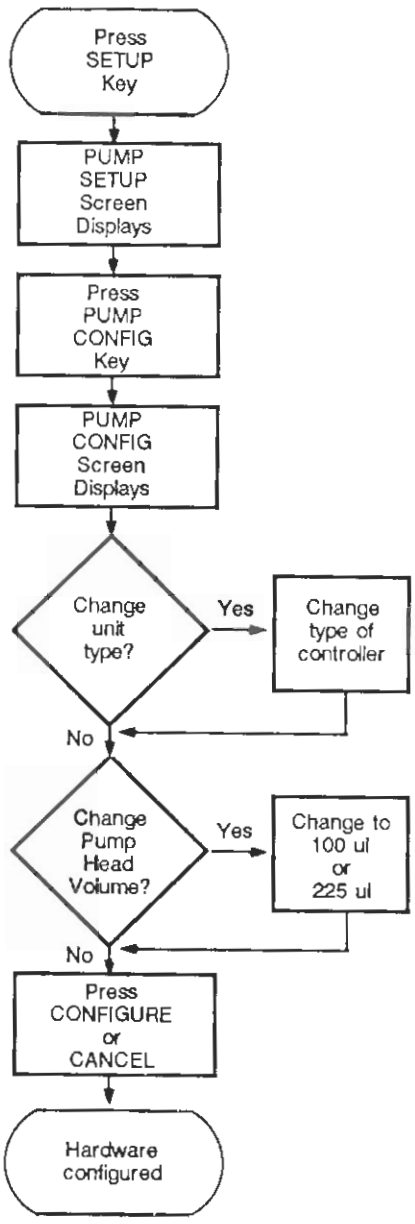


Figure 3-4 PUMP CONFIGURATION Screen Selections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Accessing PUMP CONFIGURATION screen

To view and/or change values on the PUMP CONFIGURATION screen, press the **PUMP CONFIGURATION** key. The PUMP CONFIGURATION screen displays with a series of default values (Figure 3-5).

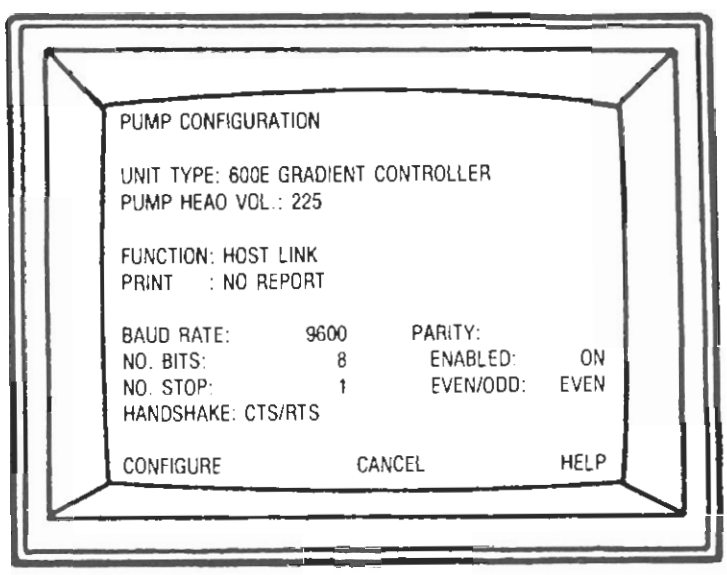


Figure 3-5 PUMP CONFIGURATION Screen

NOTE: If, at any time, you want to leave this screen without modifying any parameters, press the **CANCEL** key. CANCEL does not save any previously modified parameters. Any parameters requiring change must be saved using the CONFIGURE key.

Changing unit type to gradient controller

To change the unit type to a gradient controller, at the Unit Type field, type **0**, then press ENTER.

Changing pump head volume

To modify the pump head volume selection to match your fluid fluid system (100 µl or 225 µl), at the Pump Head Vol. field, type the appropriate volume, then press ENTER. Note that decreasing the pump head volume clears any previously saved gradient tables.

NOTE: Always change the Pump Head Vol. parameter after changing to a pump head with a different volume. If you do not, the flow rate delivered will not be the flow rate specified.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Enabling PUMP CONFIGURATION screen changes

When all required parameters are changed:

1. Press the **CONFIGURE** key. This resets the system software to the new controller configuration. The Power Up screen displays with the new selected controller.

2. Press the **SETUP** key to return to the PUMP SETUP screen.

3.2 PERFORMING AN ISOCRATIC APPLICATION

Isocratic operation allows manual control of an analysis that requires a constant mobile phase. Isocratic operation does not use a timebase (as does gradient operation) and runs only one set of conditions. It can be used for such operations as daily startup, running the mobile phase solvent to equilibrate the system, or for priming the pump.

Isocratic operation is performed directly from the ISOCRATIC screen. This section describes how to use the system to perform an isocratic application.

Isocratic operation consists of:

- Setting the solvent flow rate
- Entering mobile phase solvent composition
- Setting the sparge flow rate
- Setting the temperature of the optional heater module
- Enabling external event switches
- Controlling pump operation

Figure 3-6 is an overview on the isocratic selections.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

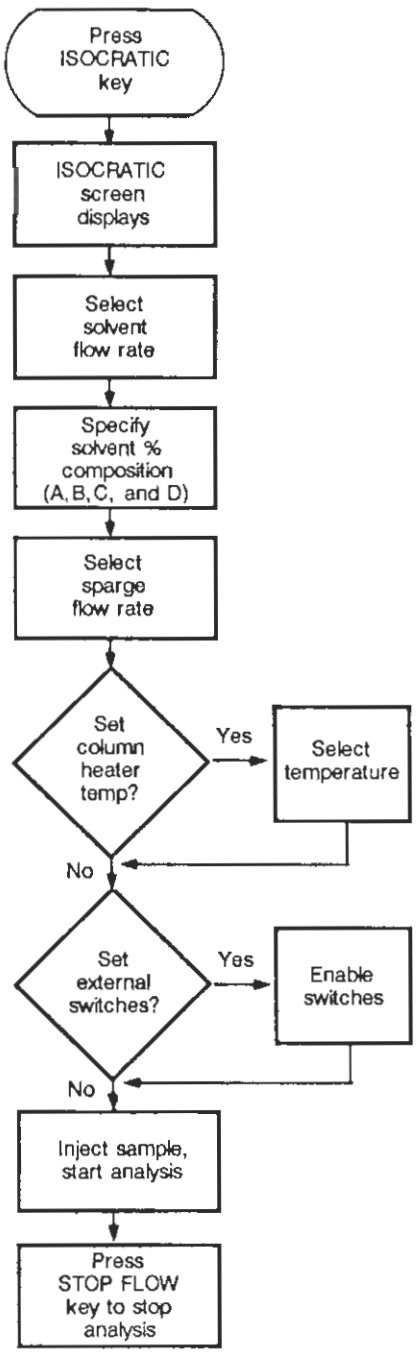


Figure 3-6 ISOCRATIC Screen Selections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Accessing ISOCRATIC screen

Press the **ISOCRATIC** key. The ISOCRATIC screen displays (Figure 3-7) with the cursor positioned at the Flow Rate field.

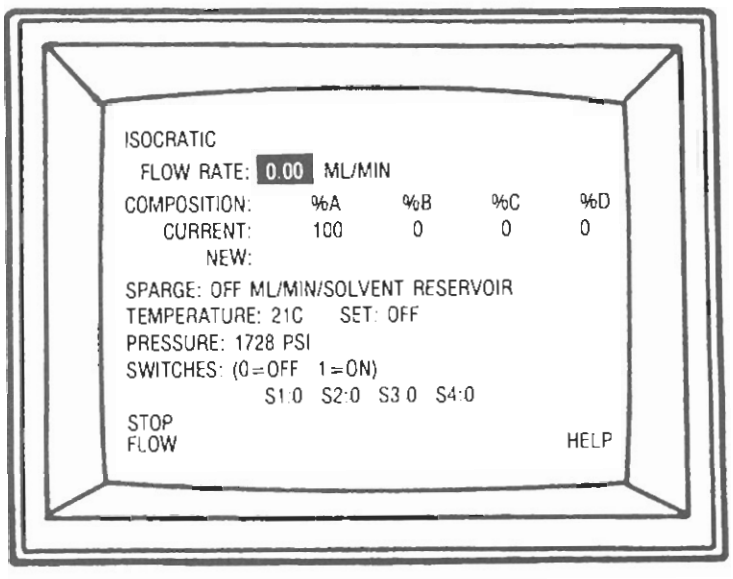


Figure 3-7 ISOCRATIC Screen

Setting solvent flow rate

To set the solvent flow rate, at the Flow Rate field type the appropriate solvent flow rate for operation. Press ENTER.

Entering mobile phase solvent composition

To enter the pump percentage composition for the four solvent reservoirs:

1. Move the cursor to the Composition field, at the the New line.

   NOTE: The values from the Current line are copied whenever the cursor is moved to the New line.

2. Enter the pump percentage composition for the mobile phase (0 to 100, no decimals) for solvent reservoir A. Press ENTER.

3. Repeat steps 1 and 2 for all *four* solvent reservoirs. The sum of all four entries must equal 100 percent.

4. Press ENTER. The mobile phase flows as soon as the pump is started, with the new solvent composition displayed on the Current line.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Setting sparge flow rate

To set the sparge flow rate, at the Sparge field, type the appropriate helium sparging flow rate, then press ENTER. This value is used by all solvent reservoirs enabled on the PUMP SETUP screen.

NOTE: The actual sparge method is dependent on the individual analytical requirements, but an initial high sparge flow rate, reduced to a low maintenance rate, is recommended. Refer to Appendix C, Solvent Properties, for degassing information.

Setting heater module temperature

To set the column/cartridge heater module temperature at the Temperature field, type the appropriate temperature for the chromatography to be run.

NOTE: The range of temperatures that the column or cartridge heater module can operate at is listed on the label of the unit.

The Temperature parameter controls and maintains a stable column/cartridge operating temperature. This value must be less than or equal to the high temperature limit.

NOTE: Separation methods requiring elevated temperatures should be verified at the chosen temperature. Cooling is dependent on the proper condition of the system (fan operating, covers in place), application, and final operating temperature.

Enabling external switch operation

The four external switches (S1 through S4) on the rear panel control externally attached devices (such as a fraction collector or a column switching valve). The ISOCRATIC screen allows you to manually enable external devices through these switches. Prior to enabling an external device, attach the device as outlined in Book III, Installation and Service, Chapter 1.

To enable an external switch, at the appropriate switch field (S1 through S4) type **1** (ON) to turn the associated external switch on. Press ENTER.

To disable an external switch, at the appropriate switch field (S1 through S4) type **0** (OFF). Press ENTER.

Controlling pump operation

1. To stop the pump during isocratic operation, press the **STOP FLOW** key (at the bottom of the screen).

2. To resume pump operation, enter a new flow rate. The composition percentages remain as they were prior to the interruption.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.3 PERFORMING A GRADIENT APPLICATION

The creation of a time-based gradient application is divided into three procedures:

- Developing a gradient table
- Developing a program event table
- Running the gradient application

This section outlines the development and implementation of a gradient application through the gradient table (the PROGRAM GRADIENT screen) and program event table (PROGRAM EVENT screen), and then running the gradient application through the OPERATE GRADIENT screen.

Figure 3-8 illustrates developing and entering a gradient table and program event table. Figure 3-9 illustrates running the gradient application.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

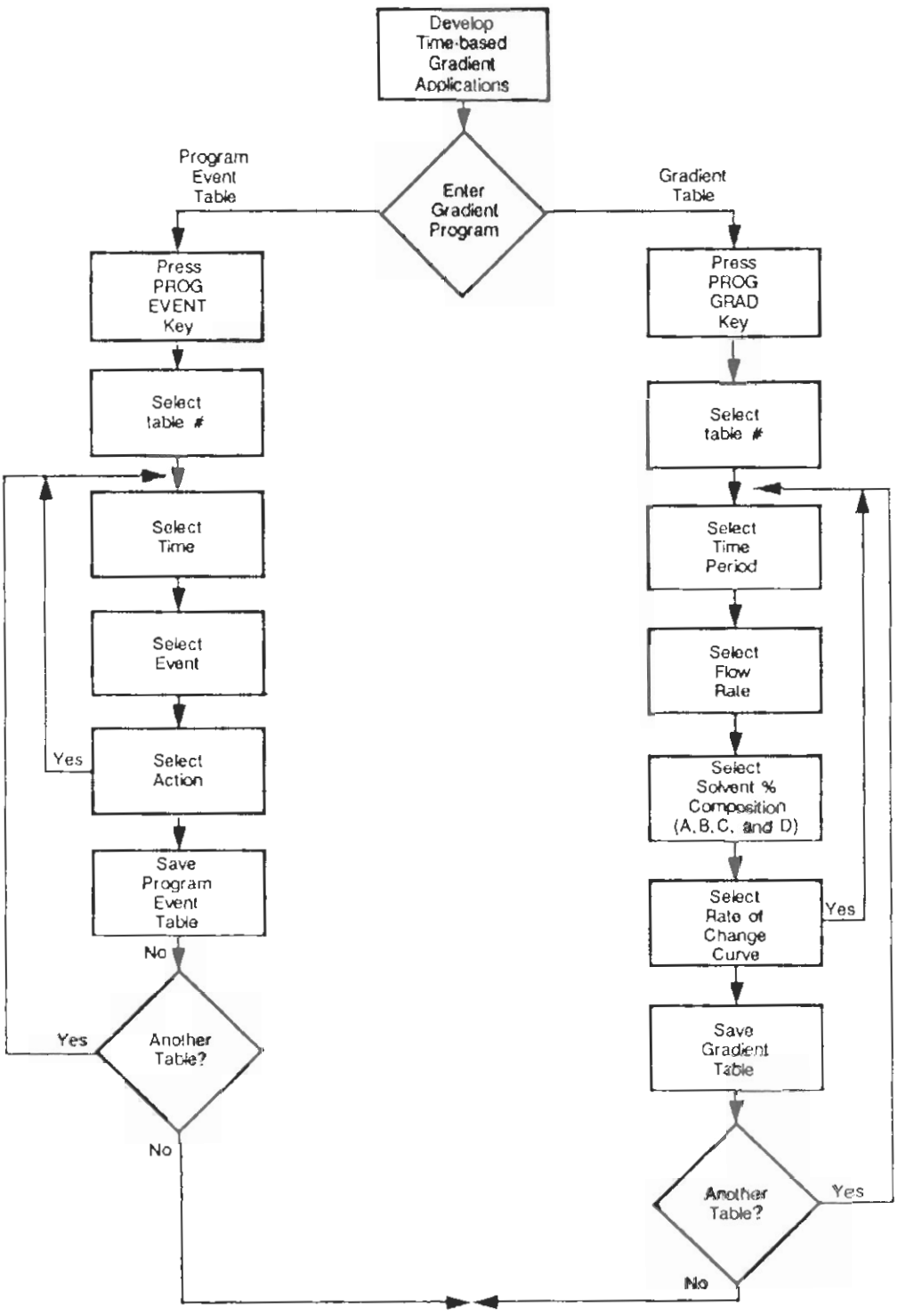
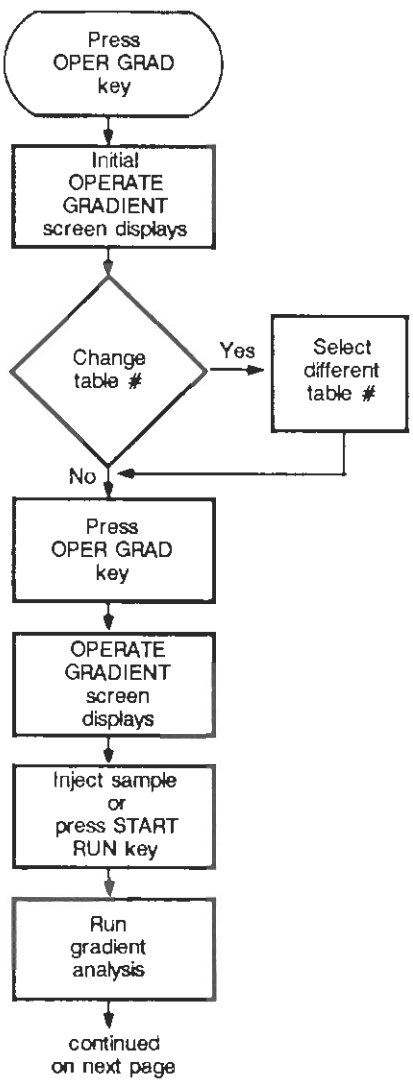


Figure 3-8 Developing a Gradient Table and Program Event Table

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



continued
on next page

Figure 3-9 Running the Gradient Application

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

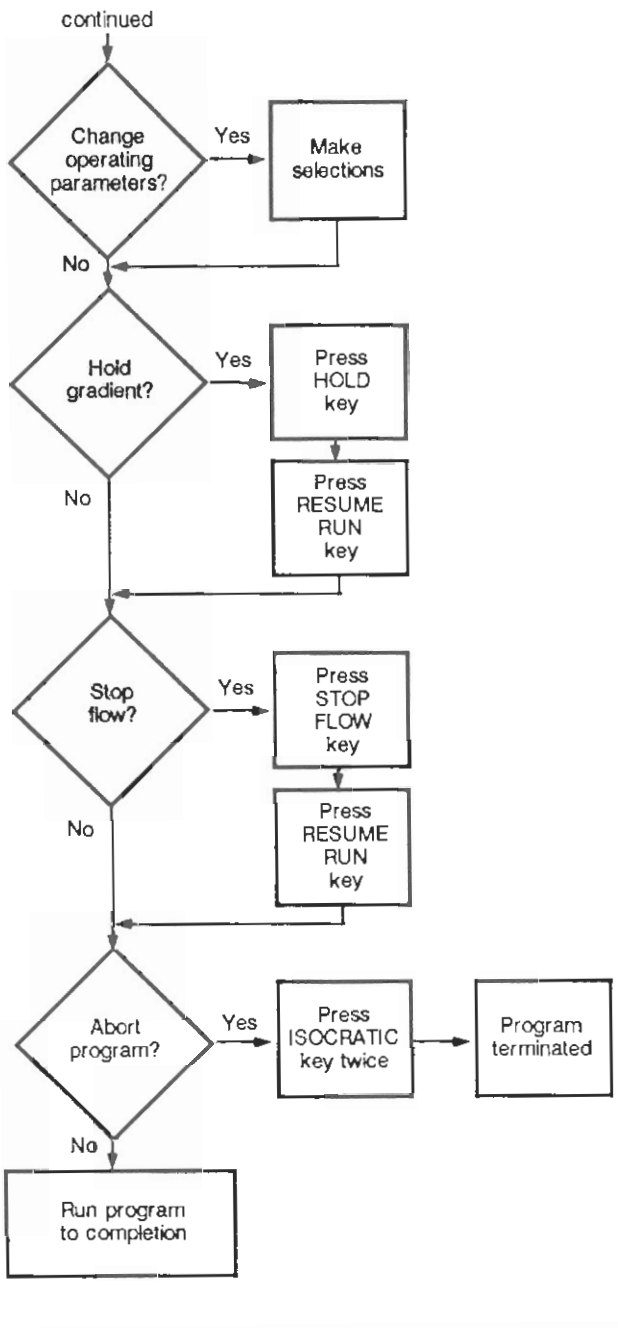


Figure 3-9 (Cont.) Running the Gradient Application

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.3.1 Developing a Gradient Table

This section describes how to develop a gradient table. It contains the following procedures:

- Setting up the gradient table
- Entering/editing the gradient table
- Saving the gradient table
- Specifying Autostart
- Deleting previous gradient tables

Refer to Figure 3-8 for an overview on this process.

3.3.1.1 Setting Up the Gradient Table

Make a photocopy of the Analysis Plan and File Sheet in Appendix D. Develop your gradient table by writing it as individual lines on the sheet. Using the Analysis Plan and File Sheet assists in the development process and also serves as a permanent record for future reference.

Enter each gradient segment time, flow rate, solvent composition, and rate of change curve into the grid. The total number of rows used in the grid (up to 14 rows plus initial conditions) is determined by the number of steps you need to execute in the gradient application.

Figure 3-10 illustrates a typical gradient table.

GRADIENT TABLE

TIME	FLOW	% A	% B	% C	% D	CURVE
INITIAL	1.00	100	0	0	0	*
30.00	1.00	0	100	0	0	6
35.00	1.00	100	0	0	0	6
50.00	0.00	100	0	0	0	11

Figure 3-10 Example of a Gradient Table

3.3.1.2 Entering/Editing the Gradient Table

This section describes how to enter lines in a gradient table. It outlines the parameters required to complete a gradient table.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Accessing PROGRAM GRADIENT screen

Press the **PROG GRAD** key. The PROGRAM GRADIENT screen displays (Figure 3-11) with the cursor at the Flow field.

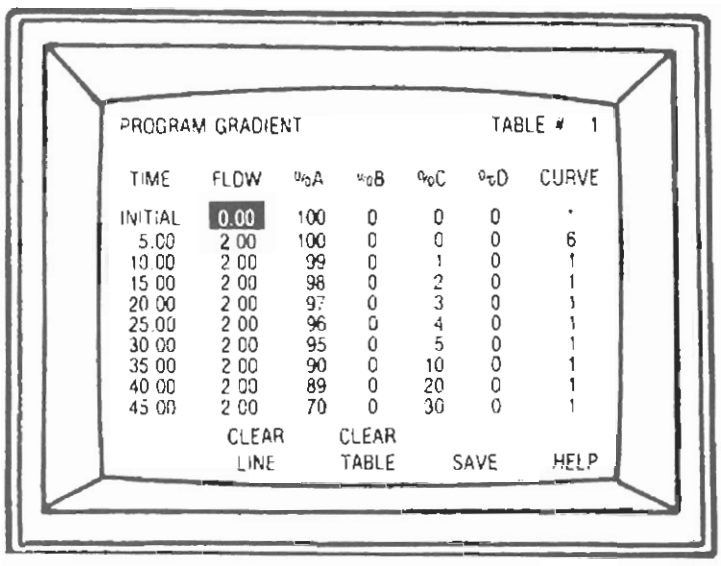


Figure 3-11 PROGRAM GRADIENT Screen

Assigning a table number

At the Table # field, type the desired gradient table number, then press ENTER. If a program is already stored under this number, it is now displayed on the screen. If necessary, at the Table # field select another table number, then press ENTER.

Entering a time period

At the Time field, type the appropriate time period over which that phase of the gradient analysis is to occur. Press ENTER.

Each time entered in the table must be unique.

NOTE 1: If you are on the Initial line, the Time field represents the default starting point for the gradient analysis. You cannot enter a value.

NOTE 2: When adding a new line to a table, the values from the previous line appear after the time is entered for the new line.

Entering the flow rate

At the Flow field, type the desired flow rate. Press ENTER.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Entering mobile phase solvent composition

To enter the pump percentage composition for the four solvent reservoirs:

1. At the %A field, type the percentage composition of the mobile phase (0 to 100, no decimals) for solvent reservoir A. Press ENTER.

2. Repeat step 1 for all *four* solvent reservoirs.

   The sum of the four solvent percentages must equal 100 percent when %D is completed.

Entering rate of change curve

At the Curve selection, type the appropriate curve value for the desired proportional rate of change for the time period during that segment of the gradient application (convex, concave, or linear). Press ENTER. (The HELP key will display the available choices.)

Deleting lines

To delete individual lines from a gradient table:

1. Move the cursor to any position on the line to be deleted.

2. Press the **CLEAR LINE** key. This *immediately* clears the line the cursor is presently on and moves succeeding lines up one line.

Inserting lines

To insert individual lines into a gradient table:

1. Move the cursor to the end of the table.

2. Type in the time, and the table will rearrange itself according to time.

Returning to initial conditions

When making multiple injections, include a line in the gradient table to return the system to initial conditions (those conditions defined at the start of the analysis). This ensures, without operator intervention, that the system is re-equilibrated before the next injection.

NOTE: The number of steps (lines) used to return the system to initial conditions and the length of time required depend on your actual application requirements (type of column, mobile phase, and so on).

At the line following the actual analysis section of the table, enter the following:

1. At the Time field, type an appropriate time period for the return to initial conditions to occur. Press ENTER.

2. At the Flow field, change to the flow rate used in the Initial line. Press ENTER.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3. At the %A through %D fields, change to the pump percent composition values used in the Initial line. Press ENTER

4. At the Curve field, change to curve #11 (default value). Press ENTER.

Programmed flow changes

Programming the pump to stop flow following a completed gradient table helps ensure fault-free unattended operation and prevents unnecessary solvent consumption. Include an additional line at the end of the gradient table containing the following information:

- Set sufficient time after the last table line to allow completion of the analysis.
- Enter a flow rate of either 0.0 ml/min or a reduced flow rate.
- Enter the appropriate solvent composition percentages for %A through %D or copy the previous line.
- Specify curve #11. The flow rate will therefore decrease only when the Time programmed for the line is reached, not gradually during the segment as with other rate of change curve profiles.

3.3.1.3 Saving the Gradient Table

Gradient tables are placed in scratch pad memory as they are configured. This is a temporary memory location. To store in permanent memory, each table must be saved. Up to 15 tables may be saved in memory, under numbers 1 to 15.

The table values that are recalled from memory when the system is turned on each day are the last values saved before power was interrupted. Therefore, any changes, from a single value to completely restructuring the table, require you to save the table.

Procedure

To save a gradient table:

1. Press the **SAVE** key at the bottom of the screen. The **ENTER TABLE NUMBER (1-15)** prompt appears. Only saved tables can be run or accessed for future use.

2. Type in the program number to be saved. Press ENTER.

   The contents of the existing program previously saved under that number is displayed with:

REPLACE WITH NEW TABLE? 1 = YES 0 = NO

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3. If you choose to replace the previous table and assign its table number to the newly created table, type **1**. Note that this replacement erases the contents of the existing table.

   A message appears indicating the new table is saved in memory (under the previous table's table number). The keyboard is locked during the process.

   If you choose not to replace the existing table, type **0**. The screen displays the newly created table and the new table remains in temporary memory.

   To save this table, repeat steps 1 and 2 and assign a different table number to the table. Continue this process until you locate a table that can be replaced with the new table.

4. To exit, press any screen key.

3.3.1.4 Specifying Autostart

If you want to delay operation of the gradient application for a period of time, use Autostart to instruct the system of the total delay time. Refer to Section 3.1.1, Using PUMP SETUP Screen, for information on using autostart, along with information on locking the keyboard.

3.3.1.5 Deleting Previous Gradient Tables

When 15 tables are stored on the system, it will be necessary to replace one of the existing tables in memory in order to enter and use a new table. If you want to save the information from the table you are replacing, use a photocopy of the Analysis Plan and File Sheet found in Appendix D.

NOTE: When deleting a gradient table, it may also be necessary to delete the corresponding program event table.

To delete the previous table:

1. At the Table # field, type the number of the table to be replaced. Press ENTER.

2. If modifications to the existing table are minimal, enter new values by typing over the existing table, then save the table.

   When changes from the old table to the new table are extensive, press the **CLEAR TABLE** key to erase the entire table. This *immediately* removes the entire table from the screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Deleting the table from permanent memory

To delete the table from permanent memory:

1. Press the **SAVE** key.
2. At the **ENTER TABLE NUMBER (1-15)** prompt, type in the table number to be deleted from memory. Press ENTER.
3. At the **REPLACE WITH NEW TABLE?** prompt, type **1** for yes. This deletes the table from permanent memory.

3.3.2 Developing a Program Event Table

This section describes how to develop a program event table. It contains the following procedures:

- Setting up the program event table
- Entering the program event table

Refer to Figure 3-9 for an overview on this process.

To save or delete a program event table, follow the same procedures as those described in Section 3.3.1.3, Saving the Gradient Table, and Section 3.3.1.5, Deleting Previous Gradient Tables.

3.3.2.1 Setting Up the Program Event Table

Make a photocopy of the Analysis Plan and File Sheet in Appendix D. Develop your program event table by writing it as individual lines on the sheet. Align the entries with the lines used for the individual gradient segments in the gradient table. This helps you to visualize the method being entered.

Enter the time each event is to be activated, the choice of event, and the event action. Time values do not have to be unique. Several events can be programmed at the same time. The number of rows in the grid (up to 15) is determined by the number of events programmed.

NOTE: If Event 8 or 9 is not specified, the last condition established remains in effect when the run time expires.

Figure 3-12 illustrates a typical example of a program event table.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PROGRAM EVENTS TABLE

TIME	EVENT	ACTION
INITIAL	1	2
3.00	2	1
3.55	2	0

Figure 3-12 Example of a Program Event Table

3.3.2.2 Entering the Program Event Table

This section describes how to enter lines in a program event table. It outlines the different parameters required to complete a program event table.

Accessing PROGRAM EVENT screen

Press the **PROG EVENT** key. The PROGRAM EVENT screen displays (Figure 3-13) with the cursor positioned at the Event field.

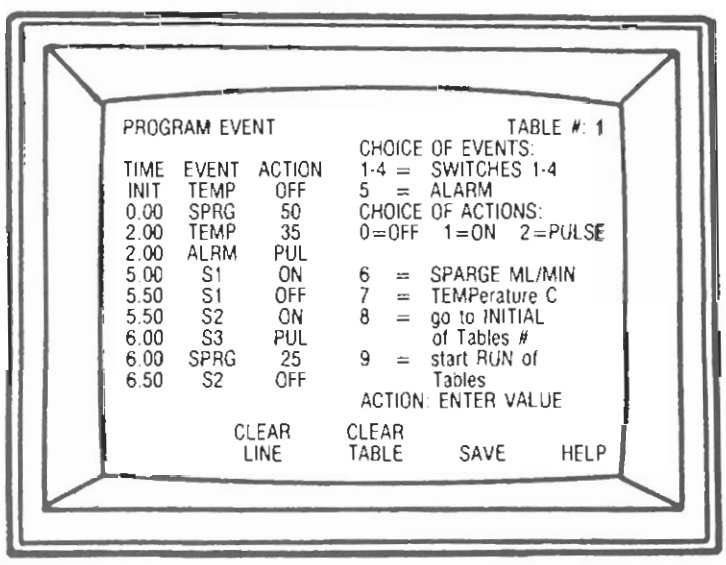


Figure 3-13 PROGRAM EVENT Screen

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Assigning a table number

At the Table # field, type the desired program event table number (1 to 15), then press ENTER. If a program is already stored under this number, it will now be displayed on the screen. If necessary, at the Table # field select another table number, then press ENTER. Ensure that the selected table number is appropriate for the corresponding gradient table.

Entering the time

At the Time field, type the appropriate time value at which the event is to occur. Press ENTER.

You can use the same time value for scheduling multiple events.

NOTE 1: If you are on the Initial line, the Time field represents the default starting point for program event operation. You cannot enter a value.

NOTE 2: When adding a new line to a table, the values from the previous line appear after the time is entered for the new line.

Assigning an event

At the Event field, type the value for the event to be scheduled. Press ENTER.

NOTE 1: Solvent reservoir sparging is used frequently during a gradient application. As a good operating practice, your final line in the program event table can instruct the system to turn off sparging.

NOTE 2: Events 8 and 9 specify the next table to be run in sequence. Since these two events begin new method tables, they *must* be the last event in the table. Event 8 holds your analysis at the initial conditions of the new table until an inject signal is received. Event 9 begins executing the table without an inject signal.

Assigning an action

At the Action field, type the appropriate value for the action required by the selected event. Press ENTER.

Deleting lines

To delete individual lines from a program event table:

1. Move the cursor to any position on the line to be deleted.
2. Press the **CLEAR LINE** key. This *immediately* clears the line the cursor is presently on and moves succeeding lines up one line.

Inserting lines

To insert individual lines into a program event table:

1. Move the cursor to the end of the table.
2. Type in the time, and the table will rearrange itself according to time.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.3.3 Running the Gradient Application

This section describes how to run the gradient program. It contains the following procedures:

- Selecting a gradient/event table
- Running the gradient/event table
- Changing to another table during operation
- Editing a table during gradient operation
- Aborting gradient operation

Refer to Figure 3-9 for an overview on this process.

3.3.3.1 Selecting a Gradient/Event Table

This section describes how to select a gradient/event table for operation.

Accessing Initial OPERATE GRADIENT screen

Press the **OPER GRAD** key. The initial OPERATE GRADIENT screen displays (Figure 3-14) with the current pump parameters of the last specified table (at the Current line). If coming from the ISOCRATIC screen, **ISOC** will be displayed under **TABLES**, along with the last set of defined isocratic conditions.

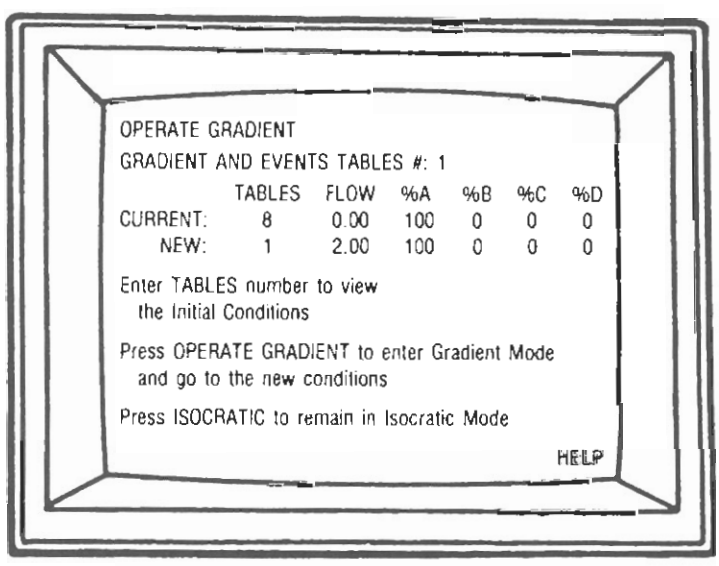


Figure 3-14 Initial OPERATE GRADIENT Screen

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Selecting a table To select a table number, at the Gradient and Event Tables # field, type the desired table number. Press ENTER. The screen displays the initial conditions for the table you will be switching to (at the New line).

NOTE: Remember that a gradient program always runs with the program event table of the same number.

Accessing OPERATE GRADIENT screen Press the OPER GRAD key again. The OPERATE GRADIENT screen displays (Figure 3-15).

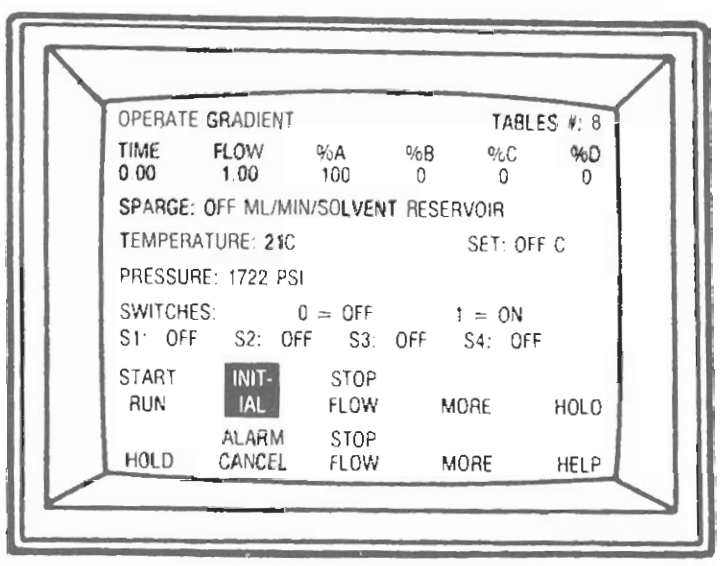


Figure 3-15 OPERATE GRADIENT Screen

NOTE: The top row of screen keys are the selections you immediately see when the screen appears. The bottom row of keys are the alternate screen functions available when you press the **MORE** screen key.

3.3.3.2 Running the Gradient/Event Table

This section describes how to run the gradient and event tables from the OPERATE GRADIENT screen. It outlines how to:

- Start gradient operation
- Change parameters during operation
- Hold the gradient constant
- Stop flow during operation

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Starting gradient operation

To automatically start the gradient/event tables, inject the sample (as outlined in Chapter 2 of this book).

To manually start the program, press the **START RUN** key.

NOTE: Automated analyses using an auto-injector must be initiated from the injector to allow sample withdrawal and preparation time.

When the trigger signal is received by the system, gradient operation begins. The current conditions of the program are displayed on the screen.

The INJECT or RUN START signal from the injector starts the operating sequence to begin at run time 0.00.

The gradient program runs until the program is completed or you stop the program, or another injection resets the gradient clock and restarts the gradient.

NOTE: The conditions specified on the last line of the events program remain in effect after the program is finished. Unless the next program instructs the system to return to initial conditions (including resetting external switches), all devices remain in the state to which they were last set. The external switches are not automatically reset off.

Changing parameters during operation

The sparge rate, column/cartridge heater module temperature, and event switch selections can be changed during gradient operation when the keyboard is not locked. To modify a setting, at the parameter to be changed, type the new value, then press ENTER.

Holding the gradient constant

The HOLD key keeps the solvent flow rate and pump percentage at an unchanging rate during gradient operation. The run time is suspended during this function. The hold function may be particularly useful in methods development (where time is suspended but flow and composition remain constant).

Although the pump remains in operation at a constant flow rate and the separation has progressed in time, the operation occurred isocratically (with a constant flow and composition).

To hold a gradient from change during operation:

1. Press the **MORE** key to show the new screen.

2. Press the **HOLD** key. The bottom-left corner of the screen indicates the hold function is enabled (the **HOLD** key changes to **RESUME RUN**).

3. To continue the gradient from where it was held, press the **RESUME RUN** key (the **RESUME RUN** key selection changes back to **HOLD**).

Stopping flow during operation

The stop flow function is generally used upon completion of a run, but also serves as a manual control for temporary shutdown (for example, when performing stop flow scanning) or emergency shutdown.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

To stop flow and hold the gradient application:

1. Press the **STOP FLOW** key. The flow rate is set to zero. The bottom-left corner of the screen indicates the stop flow function is enabled (the **STOP FLOW** key changes to **RESUME RUN**).

2. To continue the gradient from where it was stopped and restart the flow, press the **RESUME RUN** key. From that point, the pump ramps up to resume flow operation. Note that that this ramping period affects any current analysis.

3.3.3.3 Changing to Another Table During Operation

To run a new table during gradient operation:

1. At the Table # field, type the new table number, then press ENTER.

2. The initial OPERATE GRADIENT screen reappears (see Figure 3-14) with the current gradient/event table flow conditions displayed on the Current line.

   The initial conditions of the newly selected table are displayed on the New line (without disrupting the gradient application in progress). This allows you to examine any impending changes in solvent or flow rate to avoid column damage from sudden increases in the flow rate or from precipitation caused by incompatible organic/aqueous mixtures.

3. Press the **OPER GRAD** key to proceed to the OPERATE GRADIENT screen.

4. Initiate the new gradient program.

3.3.3.4 Editing a Table During Gradient Operation

During gradient operation, it is possible to edit the gradient or program event table that is in process or the table that has completed. Remember that you cannot save a table using the same number as the one presently in progress. You must substitute a number other than the one currently displayed or abort gradient operation.

To edit the table in progress:

1. Press the appropriate table key (gradient or program event).

2. At the Table # field, type a table number that is different than the one in progress. Press ENTER.

3. Modify the table.

4. Save this new table under a different table number and substitute the amended table for the original.

5. Restart the analysis.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.3.3.5 Aborting Gradient Operation

To abort the gradient application:

1. Press the **ISOCRATIC** key. The CAUTION screen displays (Figure 3-16).

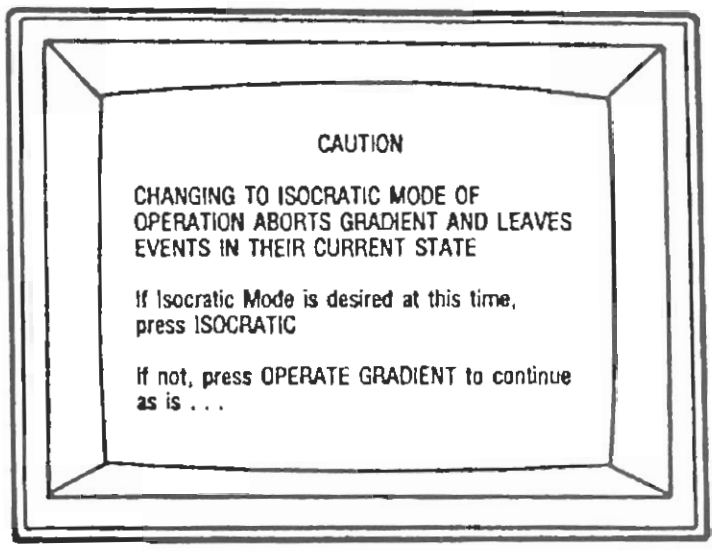


Figure 3-16 Gradient to Isocratic CAUTION Screen

2. If you want to return to the OPERATE GRADIENT screen and not abort gradient operation, press the **OPER GRAD** key.

3. If you want to abort gradient operation, again press the **ISOCRATIC** key. This proceeds to the ISOCRATIC screen and stops the gradient program.

   When gradient operation is aborted, gradient and event program execution ceases and any enabled external switches remain in their current (or last set) state.

   The switches can then be manually changed on the ISOCRATIC screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4

USING THE POWERLINE SYSTEM CONTROLLER

This chapter consists of a series of procedures on using the system as a PowerLine system controller. It is structured so that you can understand the different modes of operation and how these modes interact with one another. Each main system controller function is presented as a sequence of steps to take your system up to a point where it is ready to run an application.

Operating modes

Use of the system controller involves the following operating modes:

- Configuring the hardware from the SETUP screen.
- Running the system from the DIRECT CONTROL screen for direct (isocratic) control.
- Designing a time-based gradient application. This comprises developing a program table (consisting of a gradient table, program event table, and a detector table), developing a system control method, and running the multi-method gradient application.

Figure 4-1 is an overview on the system controller screens and their associated screens.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

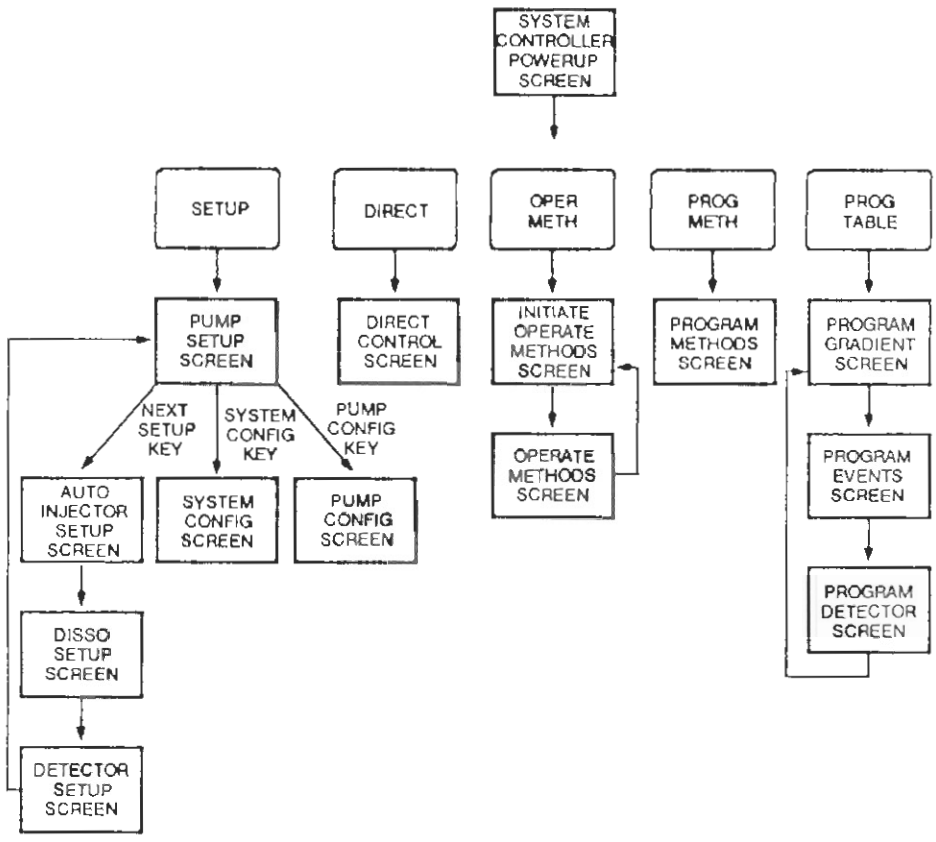


Figure 4-1 PowerLine System Controller Screens

The system is programmed and operated from its front panel keypad. Chapter 1, Using the Front Panel, provides the basics on using the keypad. It is recommended that you review that chapter before performing the procedures included in this chapter.

Background Information

This chapter assumes that you have initially setup, installed, and configured the system. For background information on setup and installation, refer to Book III, Installation and Service, Chapter 1.

For background information on each screen key, function key, and screen parameters, refer to Book II, Reference, Chapter 2.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

For online reference information for each screen selection, use the HELP key found on each screen display. The HELP screen provides a synopsis for each screen parameter.

Screen Keys

Your PowerLine system contains a set of gradient controller keys in the startup kit. The PowerLine system is shipped with the PowerLine function keys installed on the front panel. It will be necessary to replace these keys with the supplied gradient controller keys if you choose to configure the controller as the gradient-only version for use with the 840 or 845 Data and Control system.

Control through an optional workstation

The system can be used in conjunction with the Waters 840 Data and Chromatography Control Station (operating with Version 6, or later, software). In this configuration, the system is controlled through the IEEE-488 interface.

When used in this mode, the control station screens are similar to those found on the system itself (as outlined in this chapter) and provide the same programming capabilities. In addition, this configuration has the added advantage of full system, single keyboard control (including detectors and auto-injectors), data acquisition, and multi-method capabilities available only with the control station. Reports of each analysis can be tailored to include full system conditions documentation.

4.1 CONFIGURING THE HARDWARE

The hardware is configured using the SETUP key. This key accesses the PUMP SETUP screen, which provides you with a series of hardware selections that are modified on a frequent basis (such as enabling reservoirs to be sparged, defining fluid handling unit operating pressure limits).

From the PUMP SETUP screen, you access the:

- PUMP CONFIGURATION screen
- SYSTEM CONFIGURE screen
- AUTO-INJECTOR SETUP screen
- DETECTOR SETUP screen

These hardware configuration screens apply to all controller operations, whether you are running a direct control (isocratic) or multi-method gradient application. All values are preserved in memory and appear as default values upon next power on.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

This section describes how to configure the hardware. Hardware configuration consists of:

- Setting system hardware parameters on the PUMP SETUP screen
- Setting system hardware parameters on the PUMP CONFIGURATION screen
- Enabling devices on the SYSTEM CONFIGURE screen
- Setting PowerLine auto-injector, dissolution control, and detector(s) parameters through the NEXT SETUP key

Setting the Unit Type

The Unit Type parameter of the PUMP CONFIGURATION screen defines how the controller is to operate and modifies the different screen displays (along with their associated parameters). If you need to change the Unit Type parameter, do this prior to configuring any other PUMP SETUP or PUMP CONFIGURATION parameters. Refer to Section 4.1.2 for the procedure for changing the controller to a PowerLine system controller.

4.1.1 Using PUMP SETUP Screen

The PUMP SETUP screen includes the following hardware configuration selections:

- Enabling reservoirs to be sparged
- Setting the high temperature limit for an optional column/cartridge heater module
- Setting the low and high operating pressure limits for the fluid handling unit
- Enabling an external chart output selection
- Selecting autostart
- Locking the keyboard

Figure 4-2 is an overview on the hardware selections of the PUMP SETUP screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

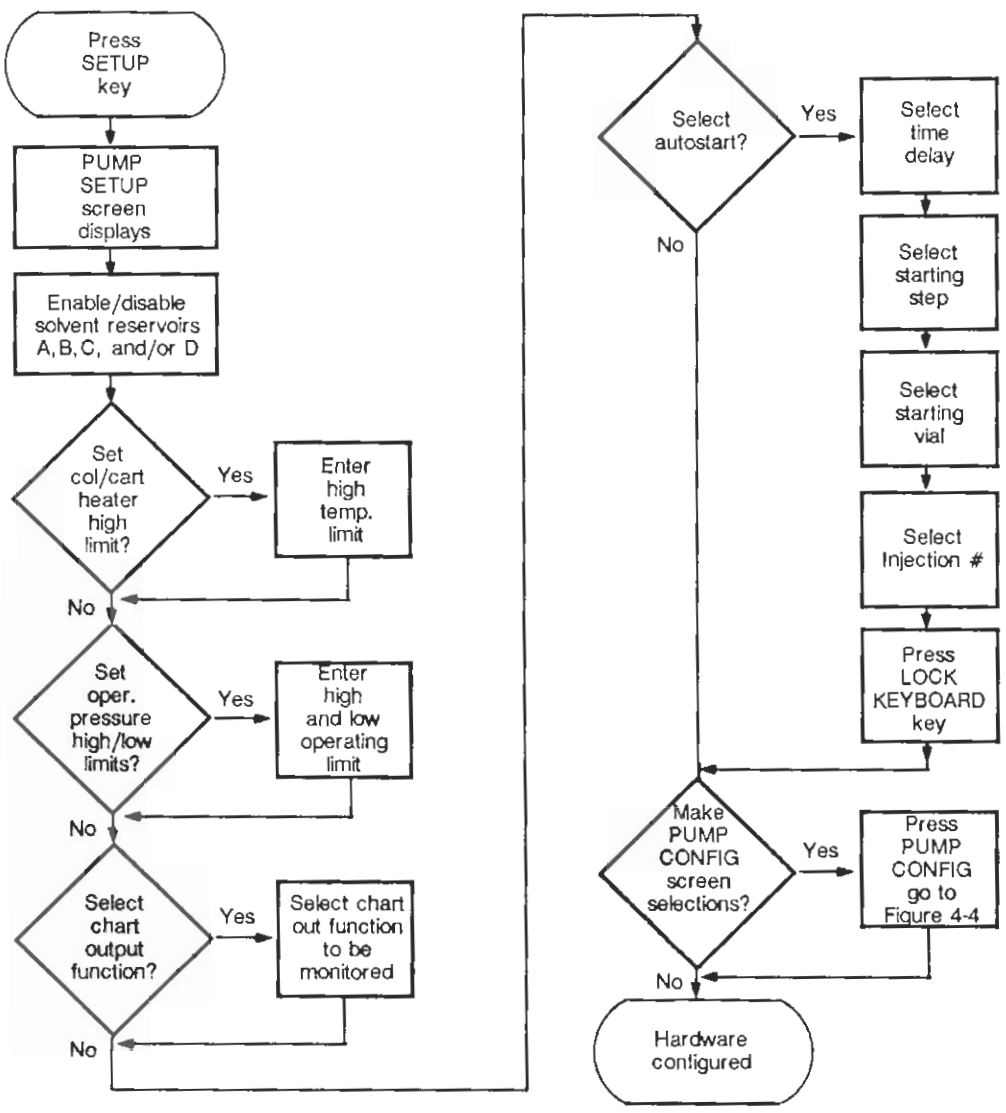


Figure 4-2 PUMP SETUP Screen Selections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Accessing PUMP SETUP screen

To view and/or change values on the SETUP screen, press the **SETUP** key. The PUMP SETUP screen displays with a series of default values (Figure 4-3).

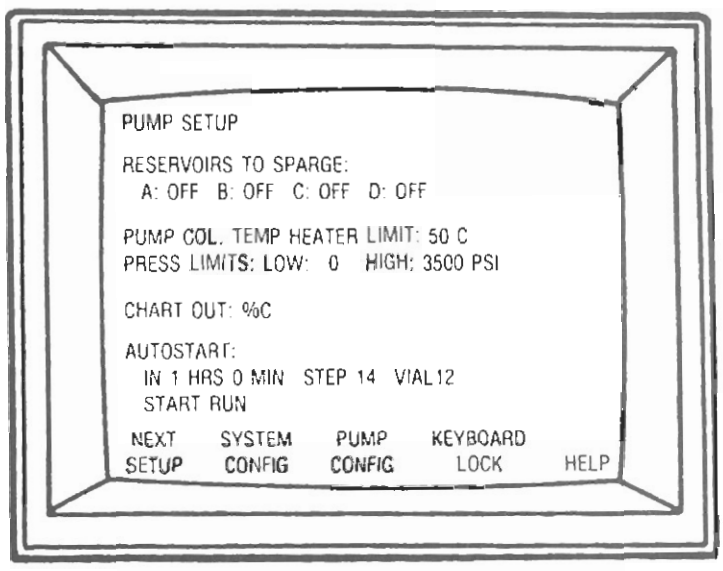


Figure 4-3 PUMP SETUP Screen

Enabling sparging

To enable or disable helium sparging on individual solvent reservoirs, at the Reservoirs to Sparge field, type the appropriate value to enable (**1**) or disable (**0**) sparging for a solvent reservoir, then press ENTER.

Regulating temperature limits

To modify the high temperature limit of the optional column/RCSS heater module, at the Pump Col. Temp Heater Limit field, type the appropriate high temperature limit for the heater module, then press ENTER. The upper limit of the heater unit is listed on the module's label.

NOTE: To prevent damage to the column or RCSS Radial-Pak cartridge, the heater module shuts down when the programmed temperature limit is exceeded for more than 1.2 seconds.

CAUTION

For the RCSS column heater, do not set the temperature limit greater than 64°C or damage could occur to the Radial-Pak cartridge.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Regulating pressure limits

To modify the low and high pressure limits of the column or system, at the Pressure Limits Low and High fields, type the low and high pressure limits (in psi), then press ENTER.

Low and high values are determined by your column and chemistry. Refer to the Care and Use Manual supplied with your column to determine the maximum pressure to which your column should be exposed.

NOTE: To prevent damage to the fluid handling unit, the pumps shut down when the programmed high pressure limit is exceeded for more than 1.2 seconds and the low pressure limit is exceeded for 60 seconds.

Monitoring output trace

To select the external chart output trace, at the Chart Out field, type the value of the trace to be monitored:

- % composition of one of the four solvent reservoirs
- Pump flow rate
- Optional heater module temperature

Press ENTER.

Using Autostart

The Autostart parameter specifies the total time the automated program methods table is to be delayed. In addition, Autostart instructs the system where to begin execution in the program methods table (step number and vial number) once the delay has transpired.

Autostart is used in conjunction with locking the controller keyboard.

To enter an autostart delay time for running the program methods table:

1. At Autostart, in the Hrs and Min fields, type the total delay time. Press ENTER.

2. At the Step field, type the appropriate step number of the program method table where program execution is to start. Press ENTER.

3. At the Vial field, type the appropriate vial number (of the specified program methods step number) where sample analysis is to start. Press ENTER.

   For example, if you want to preheat and equilibrate your system 12 hours from now, type the following for Autostart:

   IN 12 HRS 0 MIN STEP 1 VIAL 115

The autostart countdown starts when the keyboard is locked. If you want to cancel a countdown, unlock the keyboard.

NOTE: Once the keyboard is locked, you cannot make a manual injection. Although a run can still be initiated from an external auto-injector, the program specified in the Autostart parameter always takes precedence.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Locking the keyboard

Locking the keyboard prevents accidental alteration of gradient flow conditions and is automatic when programming autostart times. When the keyboard is locked, the displayed legend changes to **UNLOCK KEYBOARD**. When lock is selected, **UNLOCK KEYBOARD** is the only operational key on the PUMP SETUP screen.

This dual-purpose key also disables all keys except for:

- SETUP
- DIRECT (if currently in DIRECT CONTROL operation)
- OPER METH and PROG METH (if operating in multi-methods gradient mode)

NOTE: Ensure that all gradient, event, and detector tables are complete and correct before locking the keyboard. Multiple injections using the START RUN key are not possible while the keyboard is locked.

To lock the keyboard:

From the PUMP SETUP screen, press the **LOCK KEYBOARD** key. The key appears as **UNLOCK KEYBOARD**.

To unlock the keyboard:

From the PUMP SETUP screen, press the **UNLOCK KEYBOARD** key. The key appears as **LOCK KEYBOARD**.

4.1.2 Using PUMP CONFIGURATION Screen

The PUMP CONFIGURATION screen includes the following hardware configuration selections:

- Changing the unit type of the controller
- Changing the pump head volume selection
- Changing the RS-232 function
- Defining the type of report to be printed on a Waters 745B integrator

Figure 4-4 is an overview on the hardware selections of the PUMP CONFIGURATION screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

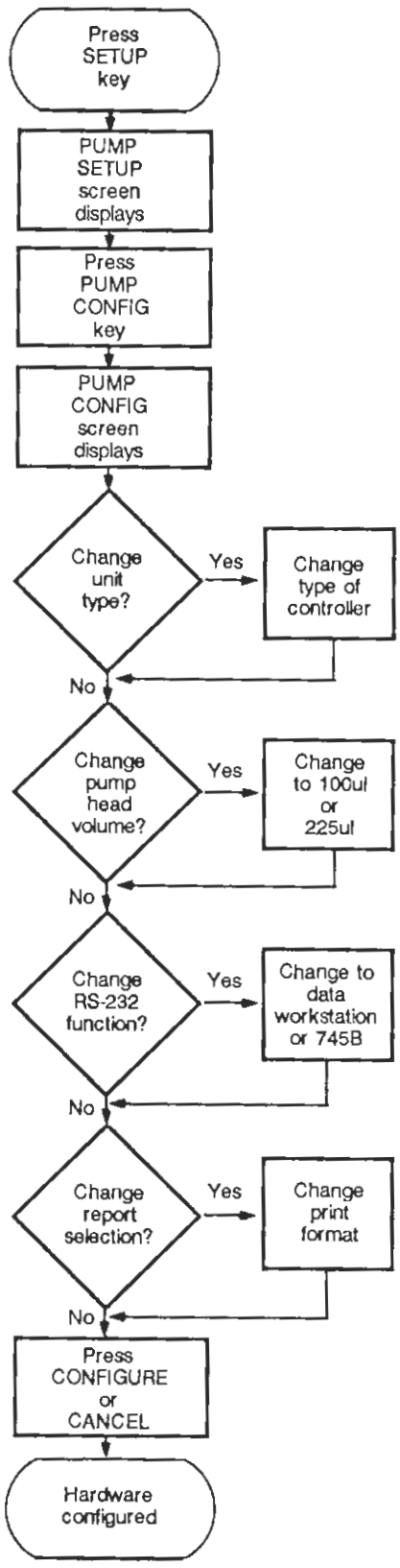


Figure 4-4 PUMP CONFIGURATION Screen Selections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Accessing PUMP CONFIGURATION screen

From the PUMP SETUP screen, to view and/or change values on the PUMP CONFIGURATION screen, press the **PUMP CONFIGURATION** key. The PUMP CONFIGURATION screen displays with a series of default values (Figure 4-5).

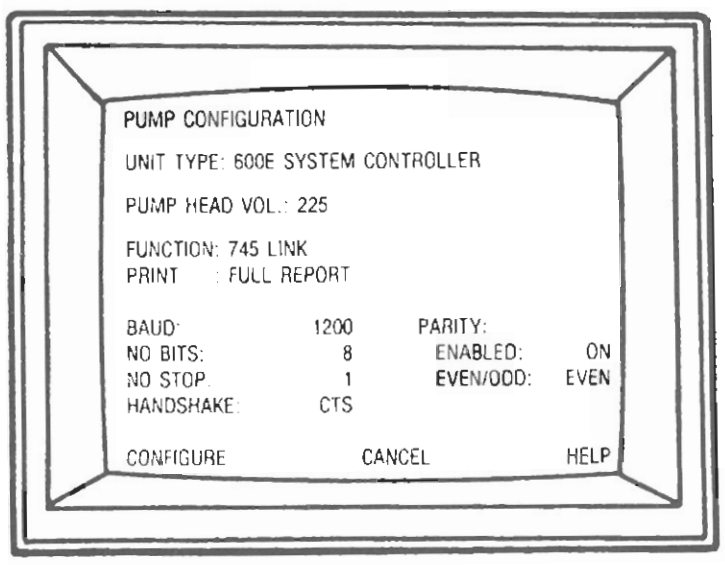


Figure 4-5 PUMP CONFIGURATION Screen

NOTE: If at any time you want to leave this screen without modifying any parameters, press the **CANCEL** key. CANCEL does not save any previously modified parameters. Any parameters requiring change must be saved using the CONFIGURE key.

Changing Unit Type to PowerLine system controller

To change the unit type to a PowerLine System Controller, at the Unit Type field, type 1, then press ENTER.

Changing pump head volume

To modify the pump head volume selection to match your fluid system (100 µl or 225 µl), at the Pump Head Vol. field, type the appropriate volume, then press ENTER. Note that decreasing the pump head volume clears any previously saved gradient tables.

NOTE: Always change the Pump Head Vol. parameter after changing to a pump head with a different volume. If you do not, the flow rate delivered will not be the flow rate specified.

Modifying host link

To modify the RS-232 host link for operation with an MS-DOS based data workstation (such as the 990+, 815, or 825) or with a Waters 745B integrator, at the Function field, type the appropriate value for the external system, then press ENTER.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

To use an MS-DOS based system, set Function to host link (**0**). To use the Waters 745B interator, set Function to 745 (**1**).

When the Function parameter is selected, the RS-232 communication interface parameters (at the bottom of the screen) automatically default to the correct values for the enabled host link.

CAUTION

Do not change the default RS-232 serial communication parameters at the bottom of the screen or communication problems will result.

Specifying type of report

To modify the type of report to be printed on the Waters 745B integrator (short, abridged, full, or no), at the Print field, type the value for the appropriate print selection, then press ENTER.

NOTE 1: Using the dissolution control feature of the system affects the report printed on the Waters 745B integrator. The DISSOLUTION SETUP screen will always follow the AUTO-INJECTOR SETUP screen whenever the AUTO-INJECTOR SETUP screen is printed.

NOTE 2: If using the system with a host computer (PowerLine 990+ detector or 815/825 data stations), type **0** to select no report.

Enabling PUMP CONFIGURATION screen changes

When all required parameters are changed:

1. Press the **CONFIG** key. This resets the system software to the new controller configuration. The Power Up screen displays with the new selected controller. (Pump flow will be set to zero when you press the CONFIG key.)

2. Press the **SETUP** key to return to the PUMP SETUP screen.

4.1.3 Using SYSTEM CONFIGURE Screen

The SYSTEM CONFIGURE screen serves two functions:

- Displays PowerLine modules attached on the IEEE-488 communication interface
- Indicates what PowerLine modules are active and lists the associated IEEE-488 address of the module

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Up to three PowerLine detectors and one PowerLine auto-injector are allowed in the SYSTEM CONFIGURE screen.

Figure 4-6 is an overview on the SYSTEM CONFIGURE screen selections.

NOTE: On Power Up, the system controller will automatically scan the IEEE bus to locate active modules.

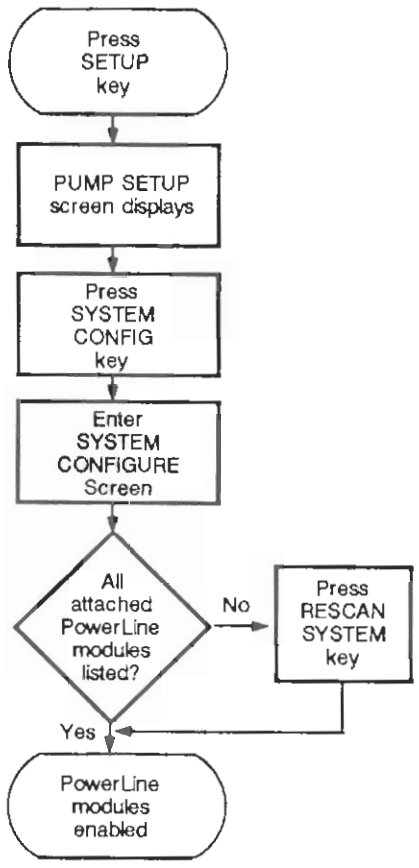


Figure 4-6 SYSTEM CONFIGURE Screen Selections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Accessing SYSTEM CONFIGURE screen

To view and/or enable PowerLine modules, press the **SYSTEM CONFIG** key. The SYSTEM CONFIGURE screen displays (Figure 4-7).

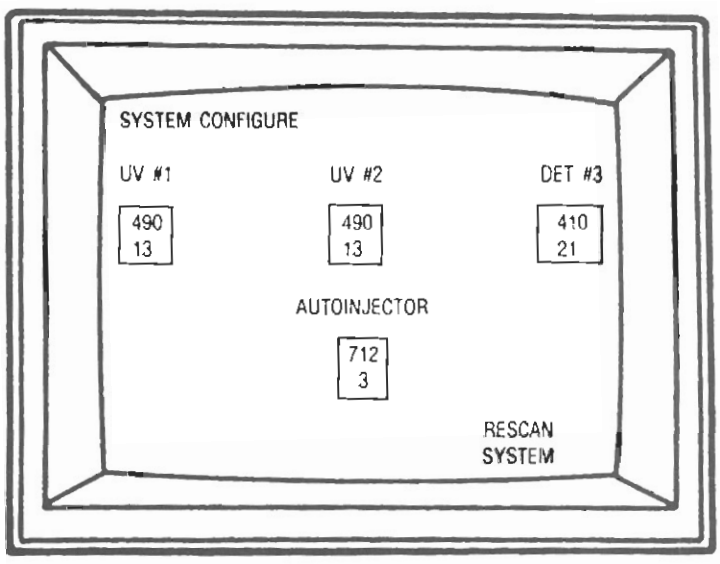


Figure 4-7 SYSTEM CONFIGURE Screen

Activating PowerLine modules

From the SYSTEM CONFIGURE screen, all active PowerLine modules (up to three detectors and an auto-injector) are listed within the appropriate box on the screen (see Figure 4-7).

If a module was turned on after system powerup, or you have recently added the module to the PowerLine system, press the **RESCAN SYSTEM** key. This instructs the PowerLine software to verify for modules attached through the IEEE-488 interface.

NOTE: All PowerLine modules on the IEEE-488 bus must finish their individual power up calibration sequences before they will be recognized by the system controller.

4.1.4 Using AUTO-INJECTOR SETUP Screen

The AUTO-INJECTOR SETUP screen allows you to define operating parameters for an externally attached PowerLine auto-injector (through the IEEE-488 interface). This screen also allows you to enable the dissolution control function.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The PowerLine auto-injector setup hardware configurations include:

- Specifying auto-injector injection parameters:
  - Syringe draw rate
  - Injection delay
- Specifying auto-standard parameters:
  - Number of standard vials
  - Number of sample vials in between standards
  - Number of injections
  - Injection volume
- Specifying dissolution control parameters:
  - Safety window time
  - Dissolution delay time
  - Activate external pill drop mechanism
  - Sample collection time period

Figure 4-8 is an overview on the AUTO-INJECTOR SETUP screen selections.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

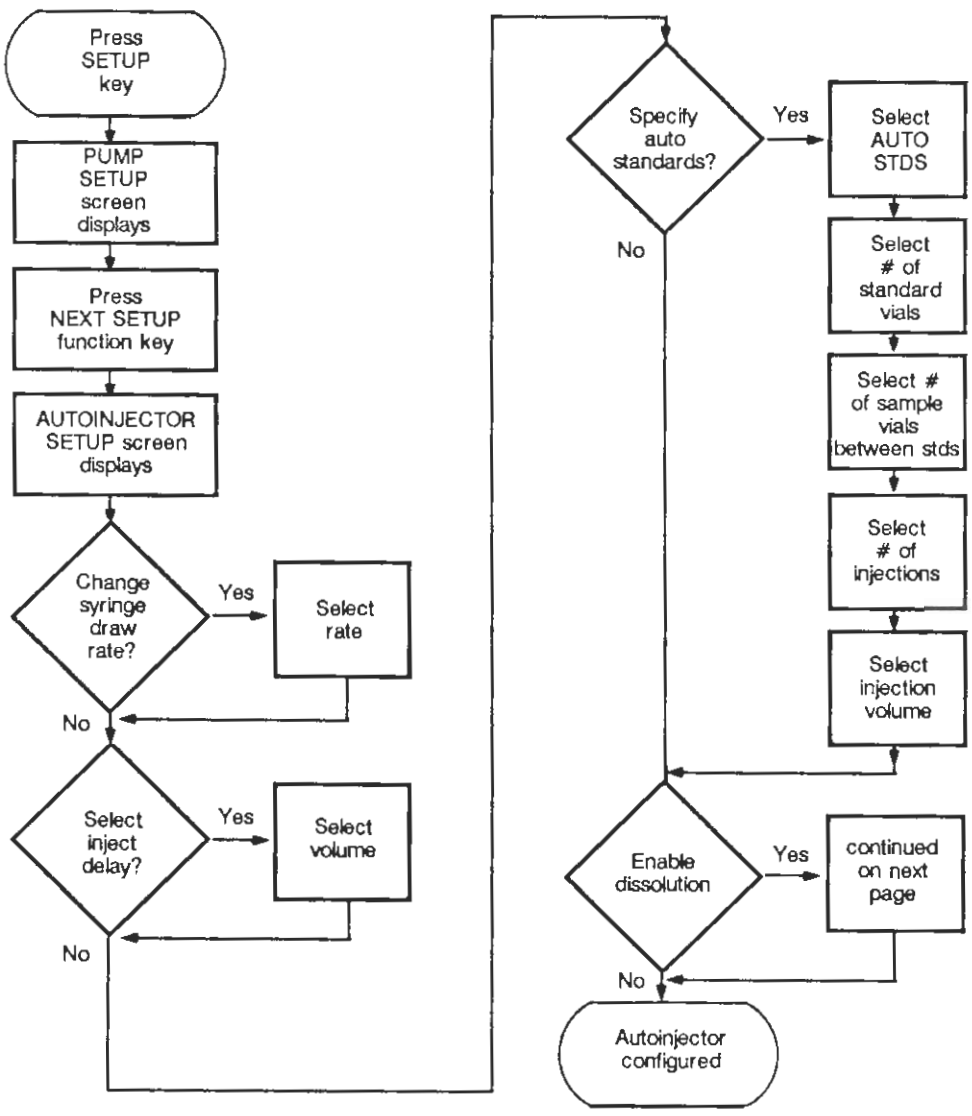


Figure 4-8 AUTO-INJECTOR SETUP Screen Selections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

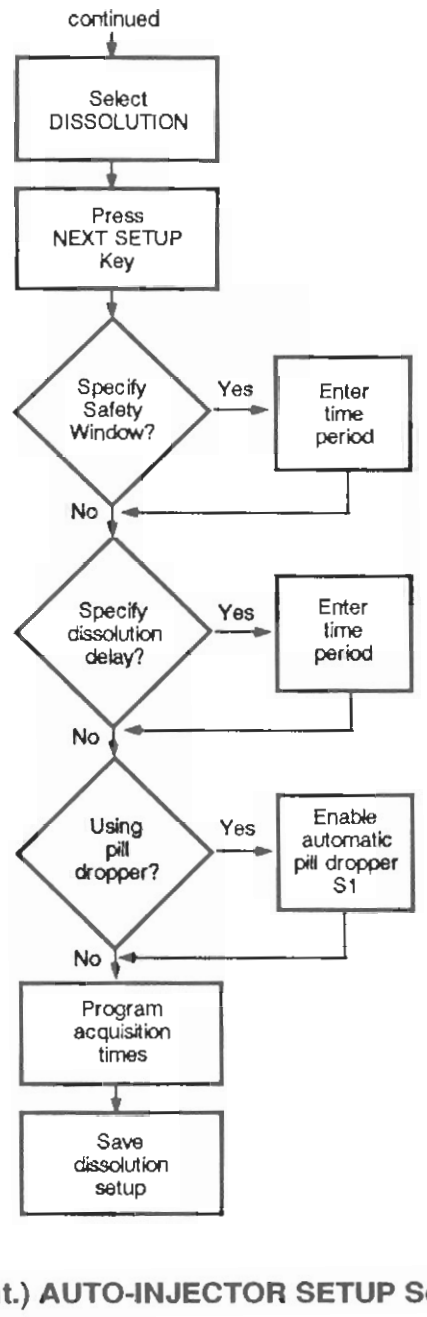


Figure 4-8 (Cont.) AUTO-INJECTOR SETUP Screen Selections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.1.4.1 Specifying Auto-Injector Injection Parameters

This section describes how to set the injection parameters of the PowerLine auto-injector using the AUTO-INJECTOR SETUP screen.

Accessing AUTO-INJECTOR SETUP Screen

To view and/or change the PowerLine auto-injector parameters, press the **NEXT SETUP** key located on the PUMP SETUP screen. The AUTO-INJECTOR SETUP screen displays (Figure 4-9).

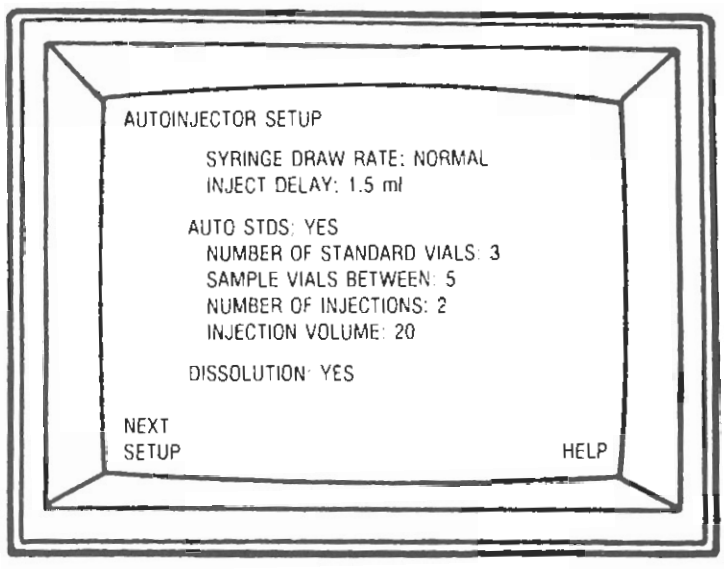


Figure 4-9 AUTO-INJECTOR SETUP Screen

Modifying syringe draw rate

To modify the rate at which the auto-injector is to draw the sample, at the Syringe Draw Rate field, type the appropriate value for normal (**1**) or slow (**0**) operation, then press ENTER. The default is equal to normal (1).

Specifying inject delay

Inject delay offsets the beginning of the gradient formation from the sample injection. The Inject Delay parameter instructs the system how much solvent to pump prior to performing an injection.

At the Inject Delay field, type the appropriate solvent volume, then press ENTER.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.1.4.2 Specifying Auto-standards

The AUTO-INJECTOR SETUP screen allows you to instruct the PowerLine auto-injector to automatically run a defined number of standard vials in between a defined number of sample vials.

When engaged, the system automatically runs the standards at the beginning of the method. It will then repeat the standards after processing the specified number of sample vials between standards. Note that standards must be located in the first five vial locations of the auto-injector carousel, beginning with vial one.

To specify auto standards:

1. At the Auto Stds field, type **1**, then press ENTER.
2. At the Number of Standard Vials field, type the number of standard vials to run (no more than five). Press ENTER.
3. At the Sample Vials Between field, type the number of sample vials to be processed between standards. Press ENTER.
4. At the Number of Injections field, type the number of injections to be made from each standard vial. Press ENTER.
5. At the Injection Volume field, type the volume to be drawn from the standard vial. Press ENTER.

4.1.4.3 Specifying Dissolution Control

The DISSOLUTION SETUP screen allows you to coordinate the collection and transfer of dissolution samples from a Hanson Transfer Controller into the WISP 712D auto-injector's sample vials. When the system is used for dissolution control, the collection of dissolution samples becomes the highest priority function of the system. When the 712D is *not* in the process of collecting dissolution samples, chromatography of previously collected samples or calibration standards can be run.

This section describes how to use the DISSOLUTION SETUP screen to set up the external dissolution application. Refer to Book III, Installation and Service, Chapter 1 for information on connecting the system to the 712D auto-injector and Hanson Transfer Controller.

Enabling dissolution control

To enable the dissolution control function, at the Dissolution field on the AUTO-INJECTOR SETUP screen, type **1**, then press ENTER.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Accessing DISSOLUTION SETUP screen

To view and/or change the Dissolution Setup parameters, press the **NEXT SETUP** key. The DISSOLUTION SETUP screen displays (Figure 4-10).

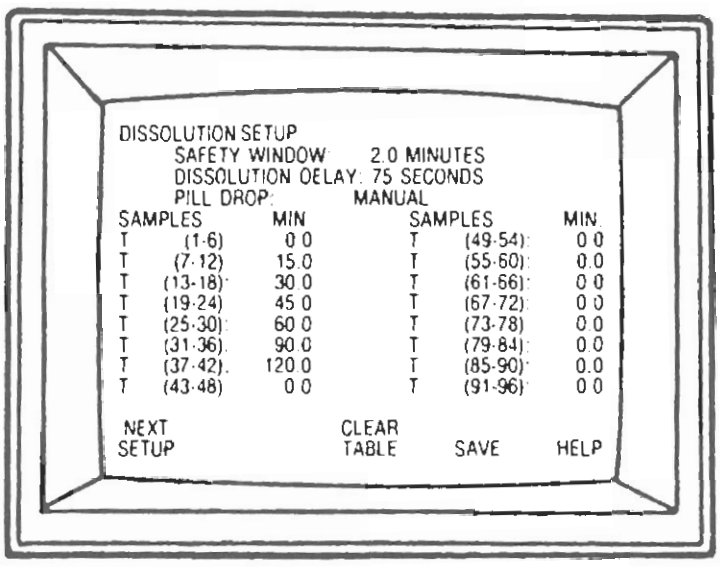


Figure 4-10 DISSOLUTION SETUP Screen

Specifying safety window

The Safety Window parameter defines a time period for the system to wait between chromatographic runs. This time period represents the estimated length of time it takes your data workstation or 745B integrator to process the dissolution results and prepare to accept data from the next scheduled injection.

Using the Safety Window parameter, the system monitors whether the 712D auto-injector has sufficient time to complete the next injection prior to the next scheduled sampling interval. If it does not, the system instructs the 712D to position the sample carousel to the next appropriate sampling position and wait for the acquisition of dissolution samples.

To specify a safety window time period, at the Safety Window field, type the desired time, then press ENTER. The default value is three minutes.

Specifying dissolution delay

Dissolution delay instructs the 712D auto-injector how long to sit in any carriage position during the collection of samples from the Hanson Transfer Controller. The choice is based on eight programmed steps on the Hanson Controller. To determine the correct dissolution delay, total the seconds programmed for each step (as outlined in the Hanson Transfer Controller Operator's Manual) and add 10 seconds to that value.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

To specify the dissolution delay time period, at the Dissolution Delay field, type the desired delay time, then press ENTER.

Enabling automatic pill drop

Pill drop automatically instructs the Hanson Transfer Controller to sample at t_0 of the dissolution run. This sampling causes the pill drop device to drop the pill into the dissolution bath, starting the dissolution test.

NOTE: Blank media is removed and placed in vial locations 1 through 6 if this option is enabled.

When the START RUN key, on the OPERATE METHODS screen, is pressed, S1 automatically transmits a pulse to the Hanson pill dropper.

NOTE: External event switch S1 is always reserved when the system is used as a dissolution controller. It should not be programmed to activate through the program event table (of the PROGRAM TABLES screen).

To specify automatic operation, at the Pill Drop field, type **1**, then press ENTER.

To specify manual operation (you are not using a pill drop mechanism and do not want a trigger signal sent) at the Pill Drop field, type **0**, then press ENTER.

Defining the dissolution setup

The bottom section of the DISSOLUTION SETUP screen outlines the individual time intervals for the collection of the dissolution samples by the Hanson Transfer Controller. The DISSOLUTION SETUP divides the auto-injector vials into six sample groups (for sample vials 1 through 96), each with a user-defined collection time period. This breakdown corresponds to the six vessels in the dissolution bath.

You define the time range for sample collection for a group of six sample vials. This time range varies with your test requirements.

For each time greater than 0, a pulse is transmitted through external event switch S1 to the START terminal on the Hanson Controller for a time equal to the value in the table.

During this process, the system automatically positions the 712D sample carriage (controlled through the IEEE-488 interface) to the appropriate six sample vial positions.

Procedure

To define the dissolution setup:

1. Move the cursor to the appropriate Samples line.
2. At the Min. field, type the required time period for the six sample vials being filled.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3. Repeat step 2 for other groups of dissolution samples being collected.

4. When completed, press the SAVE key. This stores the dissolution table in permanent memory.

NOTE: Warning Message #2601 appears on the 712D in the system message display 10 seconds prior to the sample acquisition process. It is displayed throughout the sampling process and turns off at 10 seconds after completion of sample acquisition. This is only an informational message.

WARNING

When sampling from the dissolution bath is about to begin, do not open the 712D door. If the door is opened during this time you will abort the sampling process and not collect any samples for that time interval.

Clearing the table

When changes to the dissolution setup are extensive, press the **CLEAR TABLE** key to erase the entire table. This immediately removes the entire table from the screen.

To delete the table from permanent memory, press the **SAVE** key after clearing the table.

4.1.5 Using DETECTOR SETUP Screen

The DETECTOR SETUP screen allows you to define operating parameters for a number of externally attached PowerLine detectors (Waters 484, 490, 410, or 431) through the IEEE-488 interface. On this hardware setup screen:

- Detectors #1 and #2 are reserved for UV detection (two 484 detectors, two channels of the 490, or one 484 and one 490).
- Detector #3 is reserved for the 410 RI detector *or* the 431 conductivity detector. Depending upon what detector is attached through the IEEE-488 interface, the system automatically changes the DET #3 field for operation with either a 410 or 431.

The PowerLine detector setup hardware configurations include:

- Specifying associated parameters of the UV absorbance detectors #1 and/or #2:
  - Data channel
  - Filter
  - Autozero
  - Polarity

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- Specifying associated parameters of the 410 RI detector #3:
    - Data channel
    - Filter
    - Autozero
    - Polarity
    - Internal cell temperature
    - Temperature of external heaters 1 and 2
- Specifying associated parameters of the 431 conductivity detector #3:
    - Data channel
    - Filter
    - Autozero
    - Polarity
    - Balance

NOTE: When using the Waters 484 as detector 1 and channel 2 of the Waters 490 as detector 2, ensure that the IEEE-488 address of the 484 is less than the address of the 490.

Figure 4-11 is an overview on the DETECTOR SETUP screen selections.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

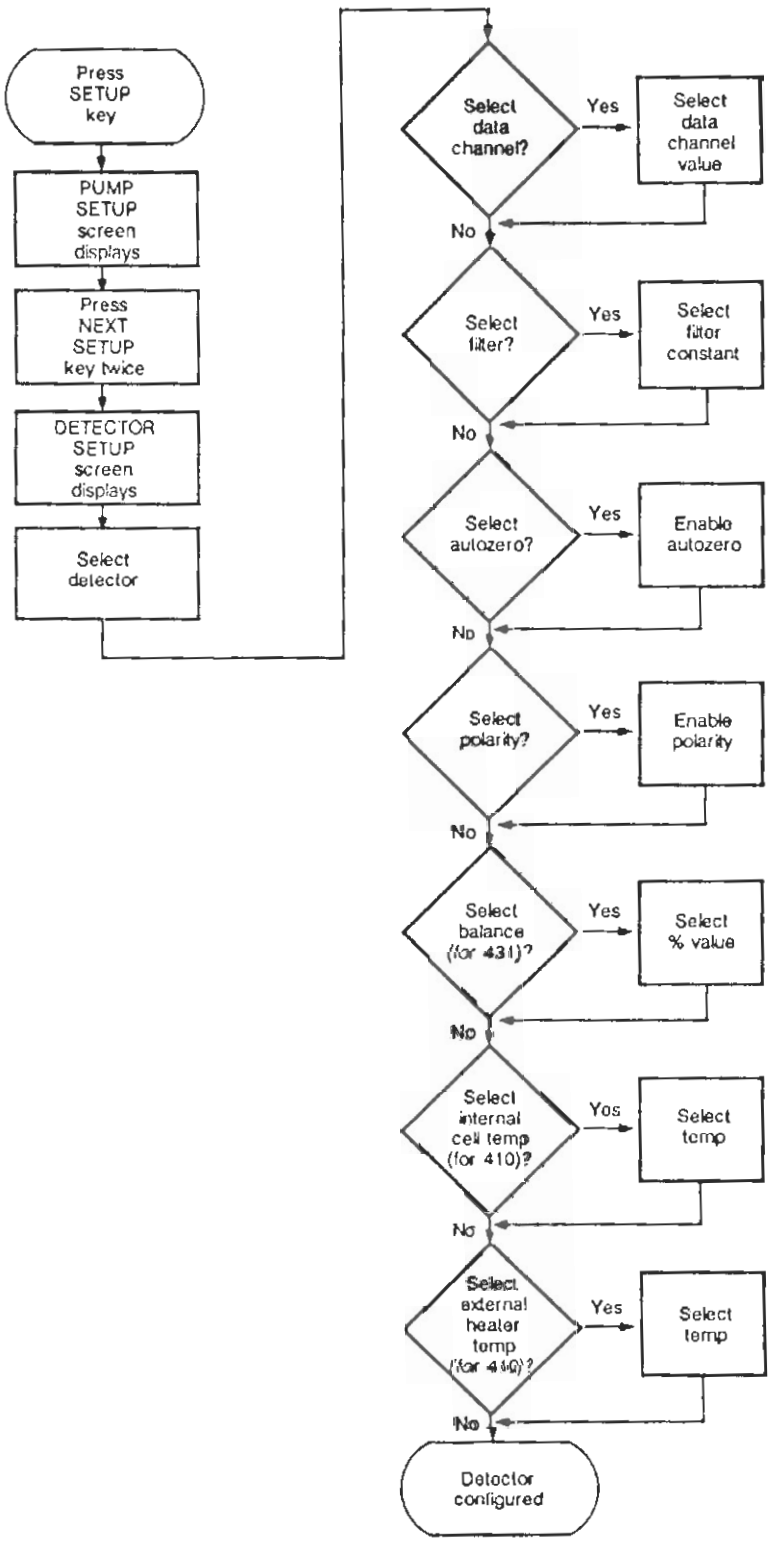
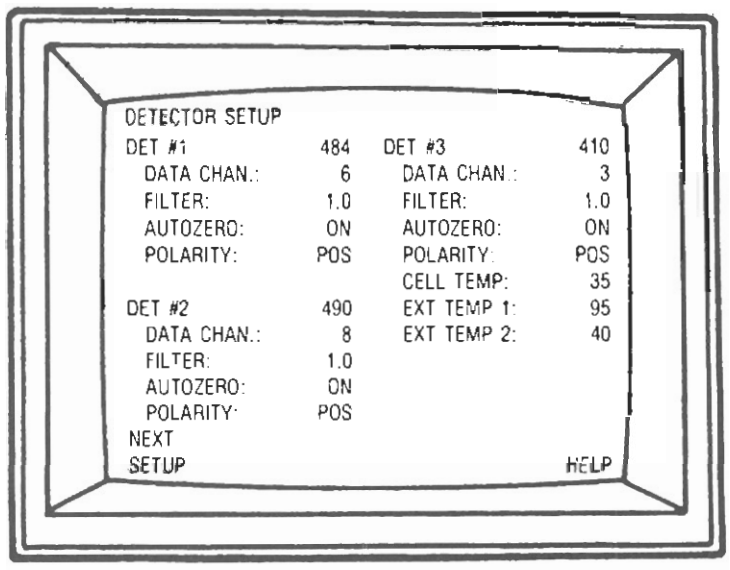


Figure 4-11 DETECTOR SETUP Screen Selections

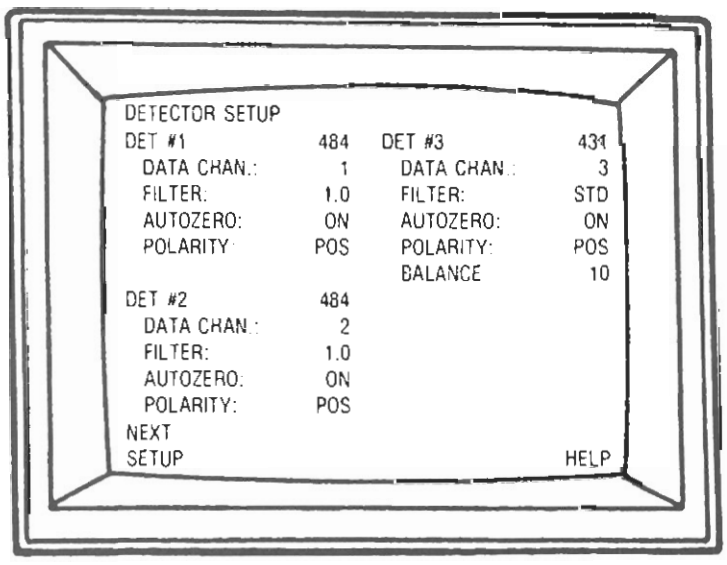
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Accessing DETECTOR SETUP screen

To view and/or change the PowerLine detector parameters, press the **NEXT SETUP** key. The DETECTOR SETUP screen displays (Figure 4-12).



A. With 410 Detector



B. With 431 Detector

Figure 4-12 DETECTOR SETUP Screen

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Selecting a detector

The DETECTOR SETUP screen contains fields for three detectors (where DET #1 and DET #2 are dedicated for UV absorbance detectors and DET #3 is dedicated for either a 410 or 431 detector). Move the cursor to the detector you want to configure.

Selecting a data channel

If you are using an integrator or data workstation and you want to assign a data channel to the detector, at the Data Chan. field, type an appropriate data channel value. Press ENTER.

NOTE: This parameter is used only as a reminder to the operator of where the analog signals from the detector are wired to a data system. It does not affect operation.

Selecting a filter constant

At the Filter field, type the appropriate time constant used by the detector's noise filter. Press ENTER. The default is 1.

Enabling autozero

At the Autozero field, type the appropriate value to enable (**1**) or disable (**0**) autozeroing of the detector's output. Press ENTER. The default is enable (1).

Enabling polarity

At the Polarity field, type the appropriate polarity value for the detector's data output (positive or negative). Press ENTER. The default is positive.

431-Specific parameters

In addition to the parameters defined above, the 431 DET #3 detector setup parameters contain a selection for manually setting the percentage of baseline offset of the external chart recorder attached to the 431 conductivity detector.

To specify the baseline offset, at the Balance field, type the appropriate offset percentage value, then press ENTER. The initial default is 0.

410-Specific parameters

In addition to the parameters defined above, the 410 DET #3 detector setup parameters contain selections for regulating the temperature of the 410's internal cell heater and for regulating the temperature of up to two optional external column heaters (connected to the 410).

Depending upon your heater requirements, access the appropriate parameters as outlined below.

Setting internal cell temperature

At the Cell Temp field, type the required operating temperature for the 410's internal heater. Press ENTER. The default is OFF.

NOTE: The Cell Temp parameter instructs the system to trigger an alarm at the detector when the temperature rises 5° above the specified temperature.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Setting external heater temperature

At the appropriate Ext Temp field (1 or 2), type the required operating temperature for the column or cartridge heater attached to the 410 detector. Press ENTER. The default is OFF.

4.2 PERFORMING A DIRECT CONTROL (ISOCRATIC) APPLICATION

Direct control (or isocratic) operation allows manual control of an analysis that requires a constant mobile phase. Direct control operation does not use a timebase and runs only one set of conditions. It can be used for such operations as:

- Daily startup
- Downloading setup parameters to the PowerLine modules
- Running the mobile phase solvent
- Equilibrating the system
- Priming the pump
- Developing methods

This section describes how to use the system to perform a direct control application. Direct control operation consists of:

- Setting the fluid handling unit operating conditions:
  - Flow rate
  - Mobile phase composition
  - Helium sparge rate
  - Optional heater module operating temperature
- Setting the external event output switches
- Setting the PowerLine auto-injector operating conditions:
  - Vial number
  - Injection volume for each vial
- Setting the PowerLine detector operating conditions:
  - Absorbance units full scale (AUFS)
  - Wavelength
  - Sensitivity
- Performing direct control operation

Figure 4-13 is an overview on the DIRECT CONTROL screen selections.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

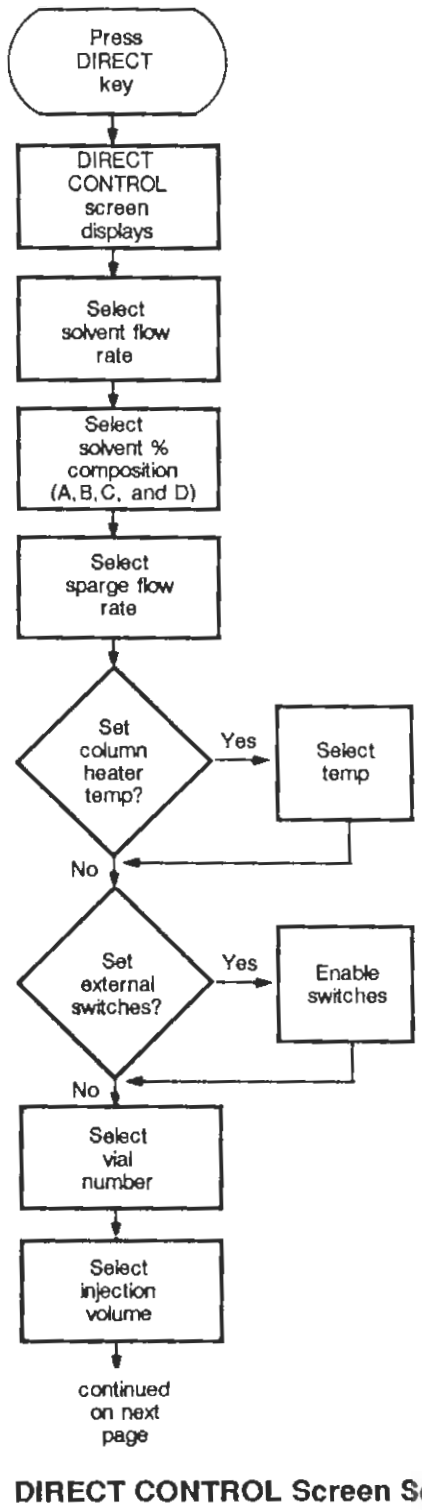


Figure 4-13 DIRECT CONTROL Screen Selections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

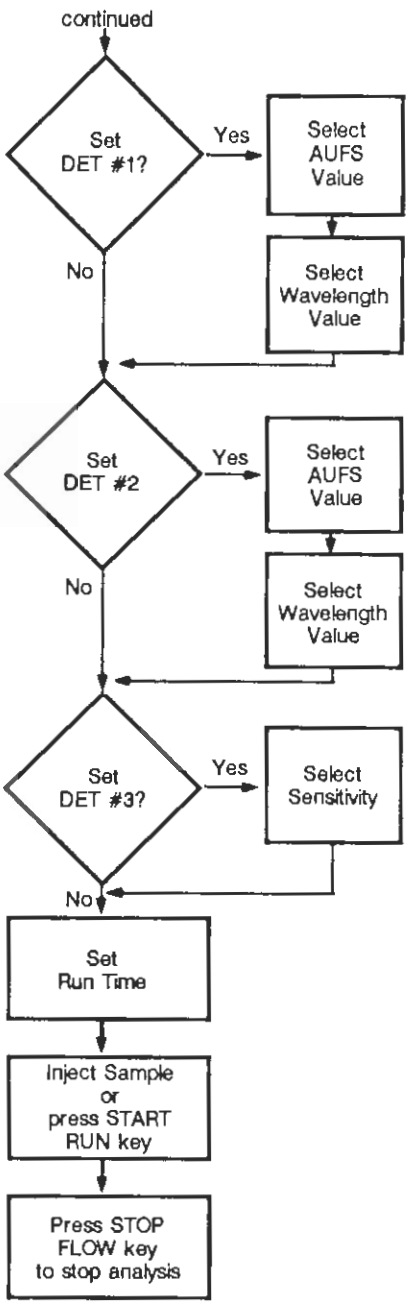


Figure 4-13 (Cont.) DIRECT CONTROL Screen Selections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.2.1 Setting Fluid Handling Unit Conditions

This section describes how to specify fluid handling unit operating conditions on the DIRECT CONTROL screen.

Accessing DIRECT CONTROL screen

Press the **DIRECT** key. The DIRECT CONTROL screen displays (Figure 4-14) with the cursor positioned at the Flow field.

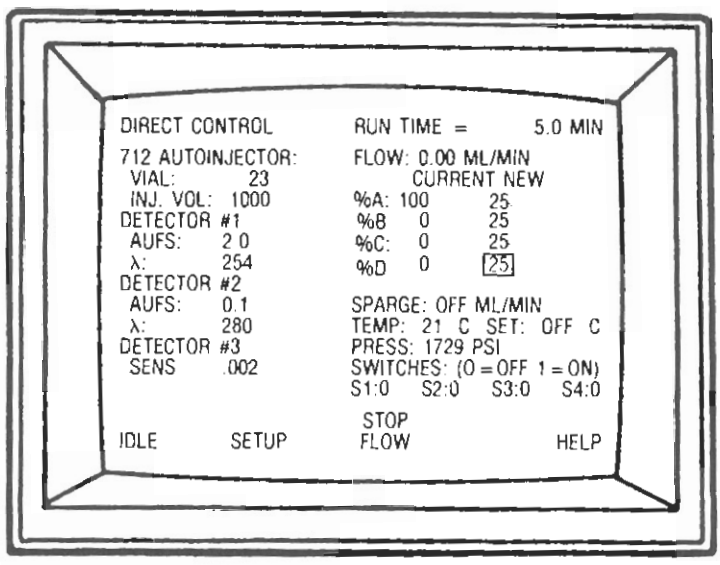


Figure 4-14 DIRECT CONTROL Screen

Selecting solvent rate

At the Flow field, type the appropriate solvent flow rate for operation. Press ENTER. The default is 0.00 ml/min.

Entering mobile phase solvent composition

To enter the pump percentage composition for the four solvent reservoirs:

1. Move the cursor to the %A field, at the New column.

   NOTE: The Current values indicate how the pump is currently operating. The values from the Current column are copied whenever the cursor is moved to the New column.

2. Type the pump percentage composition for the mobile phase (0 to 100, no decimals) for solvent reservoir A. Press ENTER.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3. Repeat steps 1 and 2 for all *four* solvent reservoirs. The sum of all four entries must equal 100 percent.

4. Press ENTER. The mobile phase flows as soon as the pump is started, with the new solvent composition displayed in the Current column.

Setting sparge flow rate

To set the helium sparge flow rate, at the Sparge field, type the appropriate helium sparging flow rate, then press ENTER. This value is used by the solvent reservoirs enabled on the PUMP SETUP screen.

NOTE: The actual sparge method is dependent on the individual analytical requirements, but an initial high sparge flow rate, reduced to a low maintenance rate, is recommended. Refer to Appendix C, Solvent Properties, for degassing information.

Setting heater module temperature

To set the optional column/cartridge heater module temperature, at the Temp field, type the appropriate temperature for the chromatography to be run. Press ENTER.

The Temp parameter controls and maintains a stable column/cartridge operating temperature. The range of temperature that the column or cartridge heater module can operate is listed on the module's label. This value must be less than or equal to the high temperature limit.

NOTE: Separation methods requiring elevated temperatures should be verified at the chosen temperature.

4.2.2 Setting External Event Switches

There are four external switches (S1 through S4) on the controller's rear panel for controlling externally attached devices such as a fraction collector or a column switching valve. The DIRECT CONTROL screen allows you to manually enable external devices through these switches. Prior to enabling an external device, attach the device as outlined in Book III, Installation and Service, Chapter 1.

To enable an external switch, at the appropriate switch field, type **1** (ON) to turn the associated external switch on. Press ENTER.

To disable an external switch, at the appropriate switch field, type **0** (OFF) to turn the associated external switch off. Press ENTER.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.2.3 Setting Auto-injector Conditions

This section describes how to specify PowerLine auto-injector operating conditions using the DIRECT CONTROL screen.

Selecting vial number

At the **VIAL:** field, type the appropriate vial number, then press ENTER. The **VIAL** parameter allows you to direct the system to:

- Make an injection (automatic or manual)
- Equilibrate the system
- Purge 410 flow cell
- Purge auto-injector
- Operate in prep mode
- Instruct 431 to execute auto baseline routine
- Instruct 410 or 431 (DET #3) to operate with positive polarity
- Instruct 410 or 431 (DET #3) to operate with negative polarity

Selecting injection volume

At the Inj Vol field, type the appropriate sample volume to be injected. Press ENTER.

4.2.4 Setting Detector Conditions

This section describes how to specify PowerLine detector operating conditions using the DIRECT CONTROL screen. The DIRECT CONTROL screen supports up to three detectors.

1. Move the cursor to the appropriate detector column (DET #1 and #2 for an absorbance detector, DET #3 for either a 410 RI *or* 431 conductivity detector).

Absorbance detectors

2. At the AUFS field, type the required absorbance units full scale for the detector. Press ENTER.
3. At the wavelength field, type the required detector operating wavelength. Press ENTER.
4. Repeat steps 1 through 3 if using a second absorbance detector.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

410 RI detector 5. If using a 410 RI detector, at the Sens field, type the required RI sensitivity. Press ENTER.

431 conductivity detector 6. If using a 431 conductivity detector, at the Sens field, type the required conductivity sensitivity. Press ENTER.

4.2.5 Performing Direct Control

This section describes how to run an application using the DIRECT CONTROL screen. Enter the conditions you want to run, including the run time.

Starting operation To start operation, press the **SETUP** key. Once the key changes to the INITIAL key and the START RUN key is displayed, begin the chromatography as follows:

- If using a PowerLine auto-injector, press the **START RUN** key.
- If using a manual injector with a chart mark switch connected to the system, inject the sample.
- If using a non-PowerLine auto-injector, start the auto-injector. Note that the system is programmed in this case as if it were running with a manual injector because it must wait for the external inject signal from the auto-injector.

NOTE: Automated analyses using a non-PowerLine auto-injector must be initiated from the auto-injector to allow sample withdrawal and preparation time.

When the trigger signal is received by the system, operation begins. The current conditions of the program display on the screen.

Changing conditions during operation The pump, external event, auto-injector, and detector parameters can be changed during operation. To modify a setting, move the cursor to the associated parameter, type in the new value, then press ENTER.

Controlling pump operation

1. To stop the pump during direct control operation, press the press the **STOP FLOW** key (at the bottom of the screen).
2. To resume pump operation, enter a new flow rate or press the RESUME key. The composition percentages remain as they were prior to the interruption.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Making a transition from DIRECT CONTROL to OPERATE METHODS

During direct control (isocratic) operation, it is possible to make a transition to the OPERATE METHODS screen (assuming that you have previously developed and saved a program methods table as outlined in Section 4.3).

To make this transition:

1. From the DIRECT CONTROL screen, press the **OPER METH** function key. The initial OPERATE METHODS screen appears (Figure 4-15) with the current direct control flow conditions displayed on the Current line.

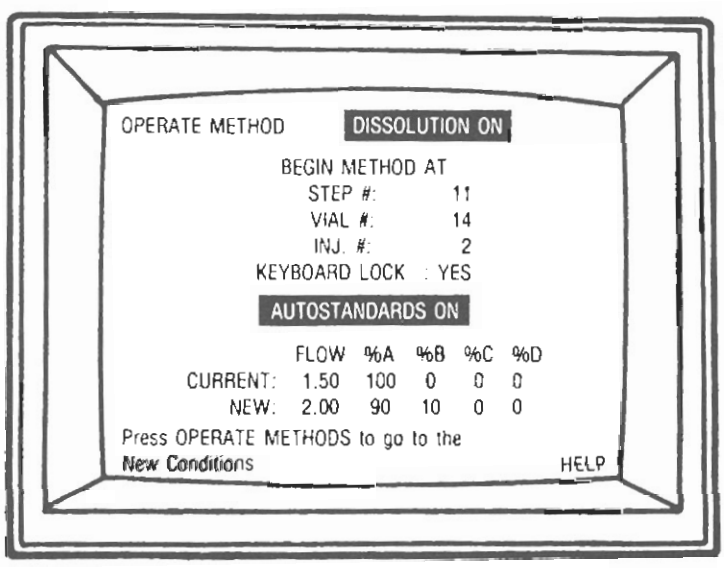


Figure 4-15 Transition from DIRECT CONTROL to OPERATE METHODS

2. Type the Step #, Vial #, and Inj. # values where you want the multi-methods application to start. The initial conditions of the selected step (from its corresponding table) are displayed on the New line. This allows you to examine any impending changes in solvent or flow rate to avoid damage or improper operation.

3. To access the OPERATE METHODS screen, press the **OPER METH** key. Refer to Section 4.3.3, Running the Multi-Method Application, for information on running a multi-methods gradient application.

4. If you prefer not to begin the programmed method, press any other function key.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.3 CREATING A TIME-BASED METHOD APPLICATION

The creation of a time-based, multi-method gradient application is divided into three procedures:

- Developing a time-based program table (consisting of a gradient table, event table, and a detector table)
- Developing the program methods table (including auto-injector operational parameters)
- Running the multi-methods application

This section outlines the process behind developing and running a multi-method program.

Figure 4-16 illustrates developing and entering a time-based program table. Figure 4-17 illustrates developing and entering the program methods table. Figure 4-18 illustrates running the multi-methods gradient application.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

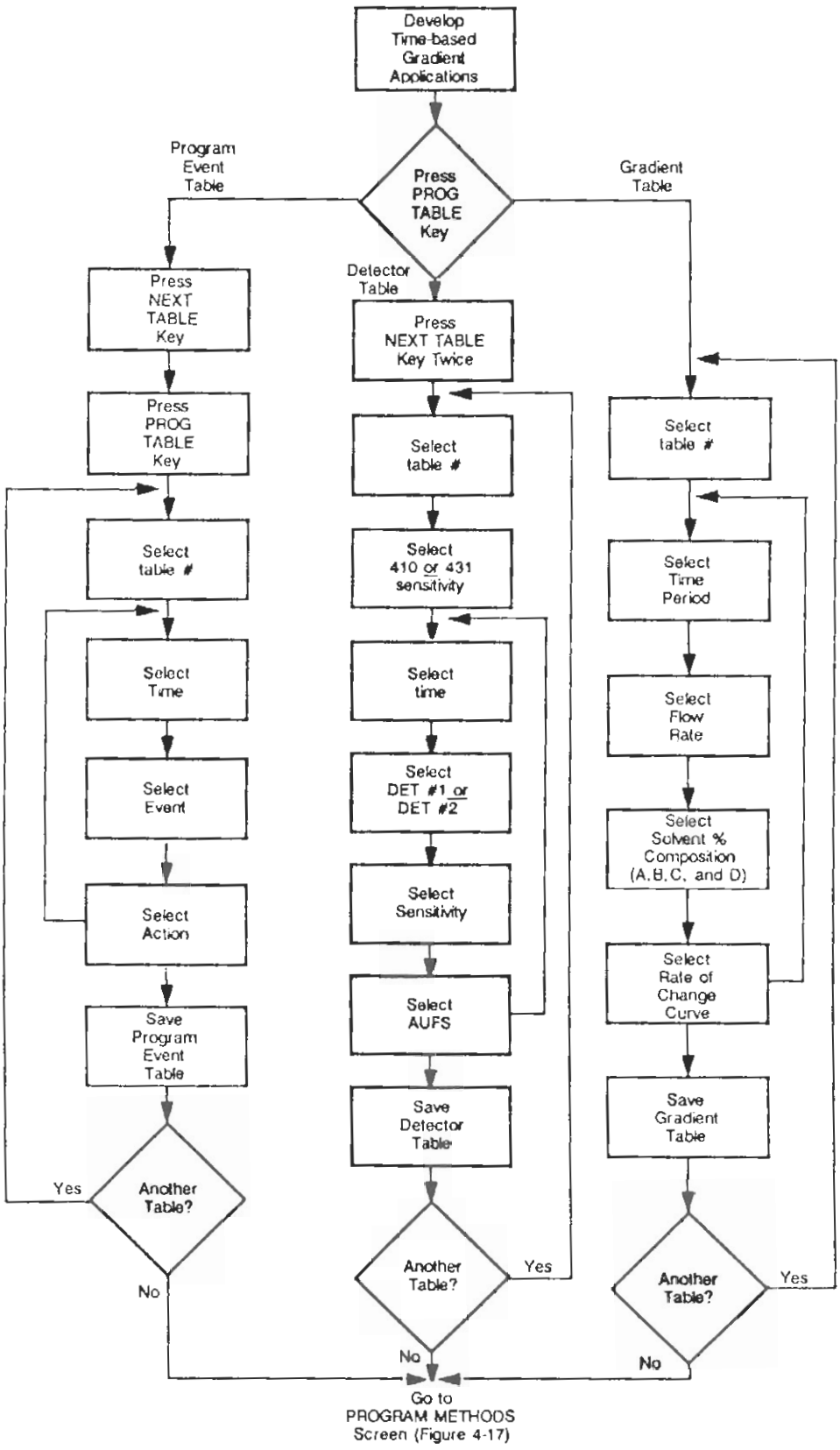


Figure 4-16 Developing a Program Table

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

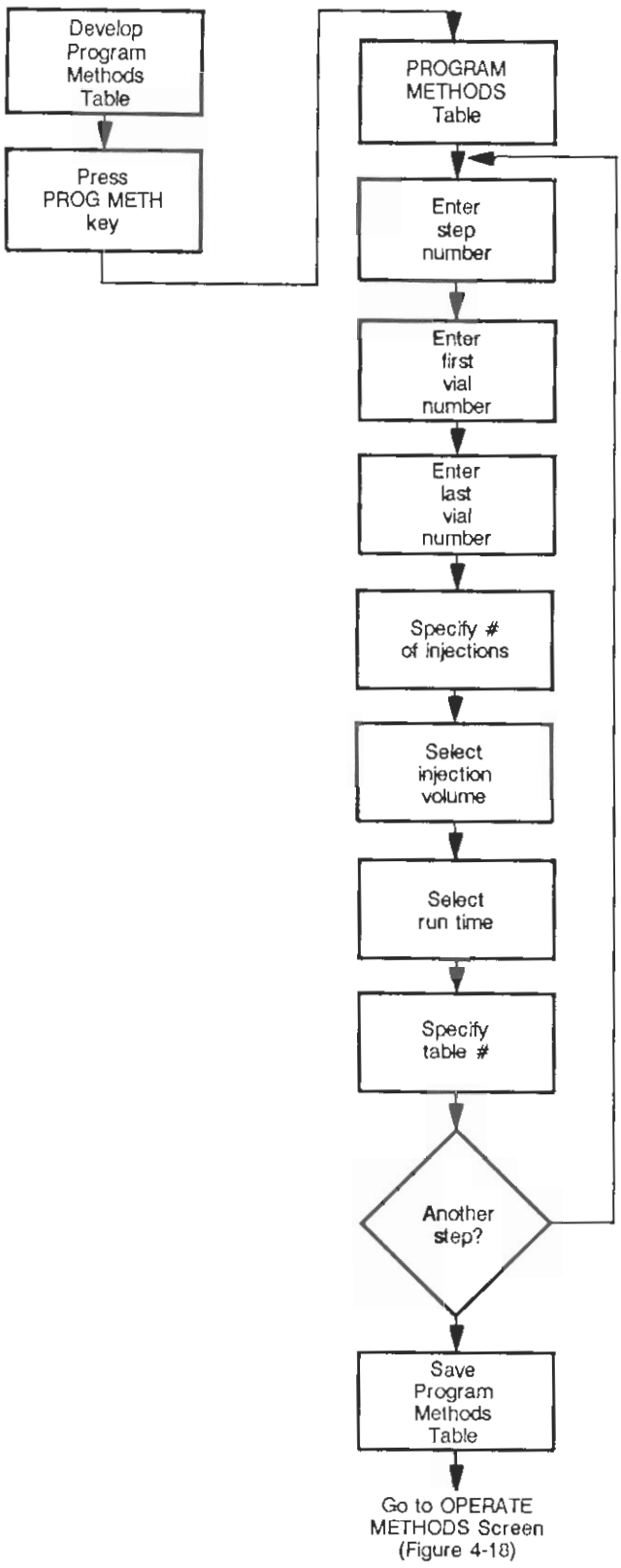
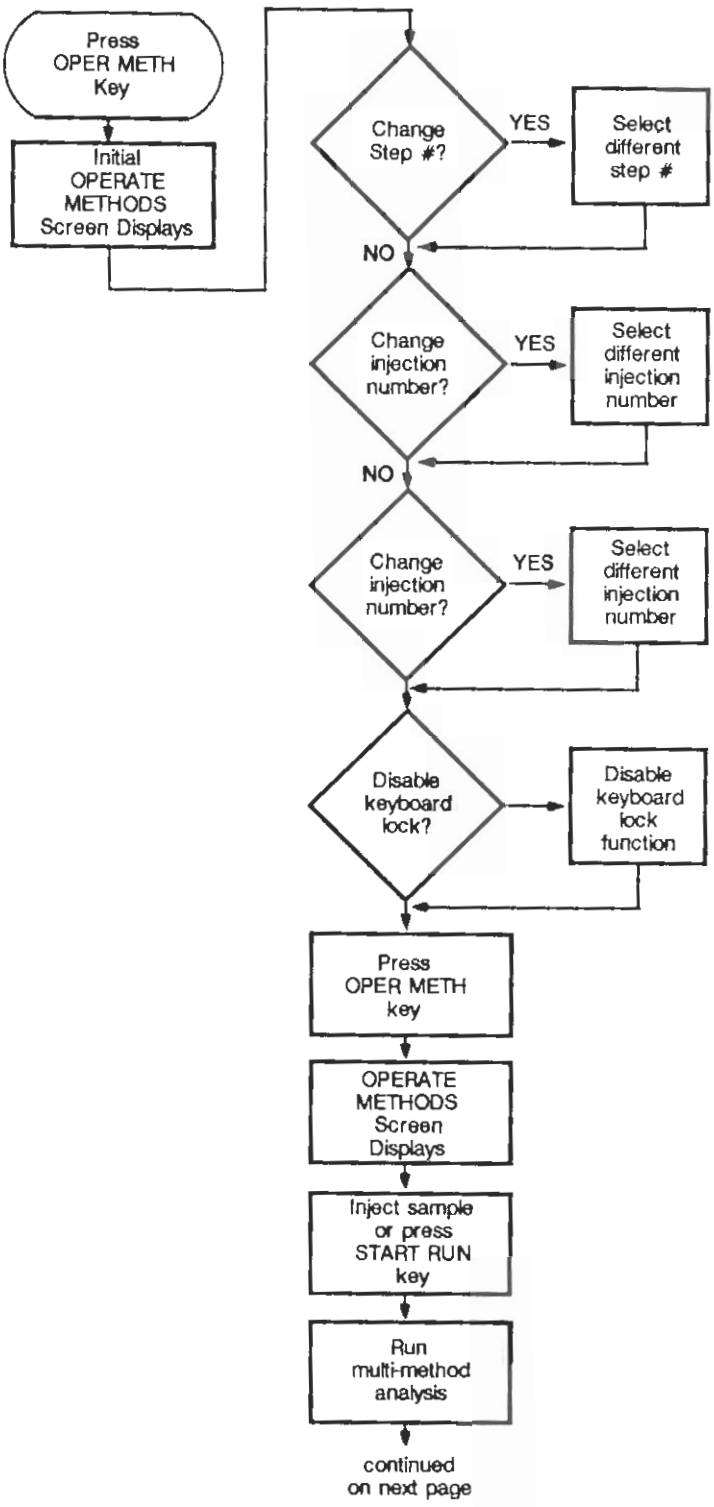


Figure 4-17 Developing the Program Methods Table

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



continued
on next page

Figure 4-18 Running the Multi-Methods Application

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

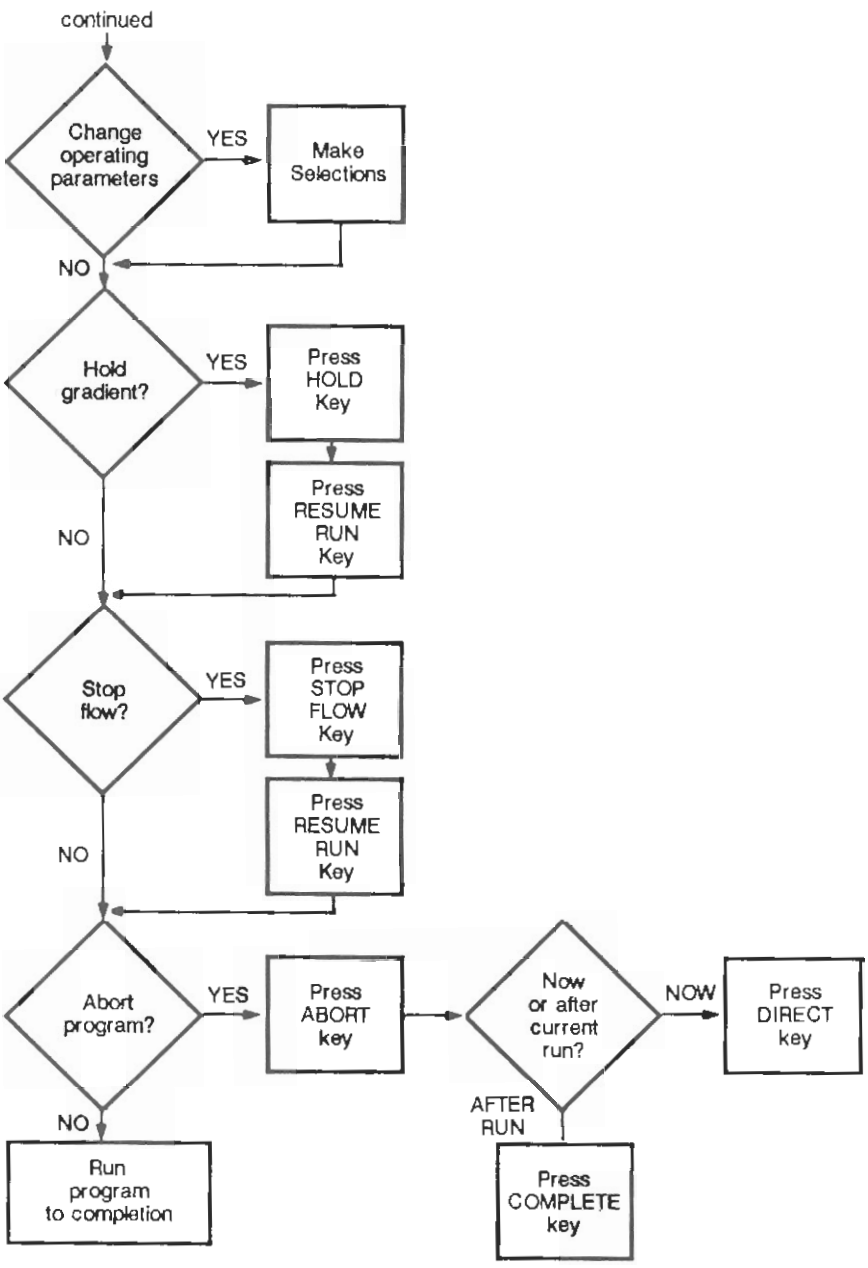


Figure 4-18 (Cont.) Running the Multi-Methods Application

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.3.1 Developing a Time-Based Program Table

This section describes how to develop a time-based program table consisting of a gradient table, a program event table, and a detector table. It is grouped into the following main procedures:

- Developing, entering, and saving the gradient table
- Developing, entering, and saving the program event table
- Developing, entering, and saving the detector table

Refer to Figure 4-16 for an overview on this process.

4.3.1.1 Developing the Gradient Table

Initial development Make a photocopy of the Analysis Plan and File Sheet in Appendix D. Develop your gradient table by writing it as individual lines on the sheet. Using the Analysis Plan and File Sheet assists in the development process and also serves as a permanent record for future reference.

Enter each gradient segment time, flow rate, solvent composition, and rate of change curve into the grid. The total number of rows used in the grid (up to 14 rows plus initial conditions) is determined by the number of steps you need to execute in the gradient application.

Figure 4-19 illustrates a typical gradient table.

GRADIENT TABLE:

TIME *	FLOW *	% A	% B	% C	% D	CURVE
INITIAL	1.00	100	0	0	0	*
30.00	1.00	0	100	0	0	6
35.00	1.00	100	0	0	0	6
50.00	0.00	100	0	0	0	11

Figure 4-19 Example of a Gradient Table

Accessing PROGRAM GRADIENT screen Press the **PROG TABLE** key. The PROGRAM GRADIENT screen displays (Figure 4-20) with the cursor at the Flow field.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

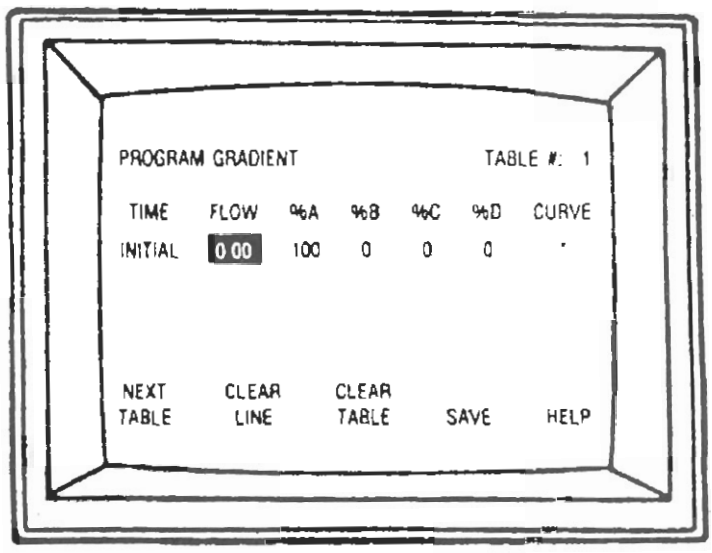


Figure 4-20 PROGRAM GRADIENT Screen

Entering the gradient table

1. At the Table # field, type the desired gradient table number (1 to 15), then press ENTER. If a program is already stored under this number, it will now be displayed on the screen. If necessary, at the Table # field select another table number, then press ENTER.

2. At the Time field, enter the appropriate time period over which that phase of the gradient analysis is to occur. Press ENTER.

   Each time entered in the table must be unique.

   NOTE 1: If you are on the Initial line, the Time field represents the default starting point for the gradient analysis. You cannot enter a value.

   NOTE 2: When adding a new line to a table, the values from the previous line appear after the time is entered for the new line.

3. At the Flow field, type the desired flow rate. Press ENTER.

4. At the %A field, type the appropriate pump percentage composition of the mobile phase for solvent reservoir A. Press ENTER.

   Repeat this step for all *four* solvent reservoirs. The sum of the four solvent percentages must equal 100 percent when %D is completed.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5. At the Curve field, type the appropriate curve value for the desired proportional rate of change for the time period during that segment of the gradient application (convex, concave, or linear). Press ENTER. (The HELP screen will display the available choices.)

6. Repeat this process for every step within the gradient table.

Deleting lines

To delete individual lines from a gradient table:

1. Move the cursor to any position on the line to be deleted.

2. Press the **CLEAR LINE** key. This *immediately* clears the line the cursor is presently on and moves succeeding lines up one line.

Inserting lines

To insert individual lines into the gradient table:

1. Move the cursor to the end of the table.

2. Type in the time. The table automatically rearranges according to time.

Returning to initial conditions

When making multiple injections, include a line in the gradient table table to return the system to initial conditions (those conditions defined at the start of the analysis). This ensures, without operator intervention, that the system is re-equilibrated before the next injection.

NOTE: The number of steps (lines) used to return the system to initial conditions and the length of time required depend on your actual application requirements (type of column, mobile phase, and so on).

At the line following the actual analysis section of the table, enter the following:

1. At the Time field, type an appropriate time period for the return to initial conditions to occur. Press ENTER.

2. At the Flow field, change to the flow rate used in the Initial line. Press ENTER.

3. At the %A through %D fields, change to the pump percent composition values used in the Initial line. Press ENTER

4. At the Curve field, change to curve #11 (default value). Press ENTER.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Programmed flow changes

Programming the pump to stop flow following a completed gradient table helps ensure fault-free unattended operation and prevents unnecessary solvent consumption. Include an additional line at the end of the gradient table containing the following information:

- Set sufficient time after the last table line to allow completion of the analysis.
- Enter a flow rate of either 0.0 ml/min. or a reduced flow rate.
- Enter the appropriate solvent composition percentages for %A through %D or copy the previous line.
- Specify curve #11. The flow rate will therefore decrease only when the Time programmed for the line is reached, not gradually during the segment as with other Curve profiles.

Saving the Gradient Table

Gradient tables are placed in scratch pad memory as they are configured. This is a temporary memory location. To store in permanent memory, each table must be saved as outlined below.

Fifteen complete tables may be saved in permanent memory, under table numbers 1 through 15.

The table values that are recalled from memory when the system is turned on are the last values saved before power was interrupted. Therefore, any changes, from a single value to completely restructuring the table, require you to save the table.

Procedure

To save a gradient table:

1. Press the **SAVE** key at the bottom of the screen. The **ENTER TABLE NUMBER (1-15)** prompt appears. Only saved tables can be run or accessed for future use.

2. Type in the program number to be saved. Press ENTER.

   The contents of the existing program previously saved under that number is displayed with:

   REPLACE WITH NEW TABLE? 1 = YES 0 = NO

3. If you choose to replace the previous table and assign its table number to the newly created table, type **1**. Note that this replacement erases the contents of the existing table.

   A message appears indicating the new table is saved in memory (under the previous table's Table Number). The keyboard is locked during the process.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

If you choose not to replace the existing table, type **0**. The screen displays the newly created table and the new table remains in temporary memory.

To save this table, repeat steps 1 and 2 and assign a different table number to the table. Continue this process until you locate a table that can be replaced with the new table.

4. To exit, press any screen key.

Specifying Autostart

To delay operation of the gradient application for a period of time, use the Autostart function to instruct the system of the total delay time. Refer to Section 4.1.1, Using PUMP SETUP Screen, for information on using autostart, along with information on locking the keyboard.

NOTE: Ensure that all gradient, event, and detector programs are complete and correct before locking the keyboard. Multiple injections using the DIRECT screen are not possible while the keyboard is locked. A run can be initiated from the external injector; however, the program specified in autostart will take precedence.

Editing existing tables

Tables may be edited at any time. It is also possible to edit a currently executing program. However, when in the program tables mode you must either save the modified program under a new table number or abort the chromatographic run and save the program under the current number (see Section 4.3.3).

As changes are made, the system automatically sorts an addition (or deletion) to the table based on the time entered for the line. This constitutes a new program and must be saved before attempting to use it for operation.

Deleting gradient tables

When 15 sets of tables are stored on the system, it will be necessary to replace one of the existing tables in storage in order to enter and use a new program. If you want to save the information you are replacing, use a photocopy of the Analysis Plan and File Sheet found in Appendix D.

NOTE: When deleting a gradient table, it may also be necessary to delete the corresponding program event and detector tables.

To erase a previous program:

1. At the Table # field, type the number of the program to be replaced. Press ENTER.

2. If modifications to the existing table are minimal, enter new values by typing over the existing table, then save the table.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3. When changes from the old table to the new table are extensive, press the **CLEAR TABLE** key to erase the entire table. This *immediately* removes the entire table from the screen.

Deleting the table from permanent memory

To delete the table from permanent memory:

1. Press the **SAVE** key.
2. At **ENTER TABLE NUMBER (1-15)** prompt, type the table number to be deleted from memory. Press ENTER.
3. At the **REPLACE WITH NEW TABLE?** prompt, type **1** for yes. This deletes the table from permanent memory.

4.3.1.2 Developing the Program Event Table

Initial development

Make a photocopy of the Analysis Plan and File Sheet in Appendix D. Develop your program event table by writing it as individual lines on the sheet. Align the entries with the lines used for the individual gradient segments in the gradient table. This helps you visualize the method being entered.

Enter the time each event is to be activated, the choice of event, and the event action. Time values do not have to be unique. Several events can be programmed at the same time. The number of rows in the grid (up to 15) is determined by the number of events programmed.

NOTE: If Event 8 or 9 is not specified, the last condition established remains in effect when the run time expires.

Figure 4-21 illustrates a typical example of a program event table.

PROGRAM EVENTS TABLE

TIME	EVENT	ACTION
INIT	S1	PULSE
3.00	S2	ON
3.55	S2	OFF

Figure 4-21 Example of a Program Event Table

Accessing PROGRAM EVENT screen

From the PROGRAM GRADIENT screen, press the **NEXT TABLE** key. The PROGRAM EVENT screen displays (Figure 4-22) with the cursor at the Event field.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

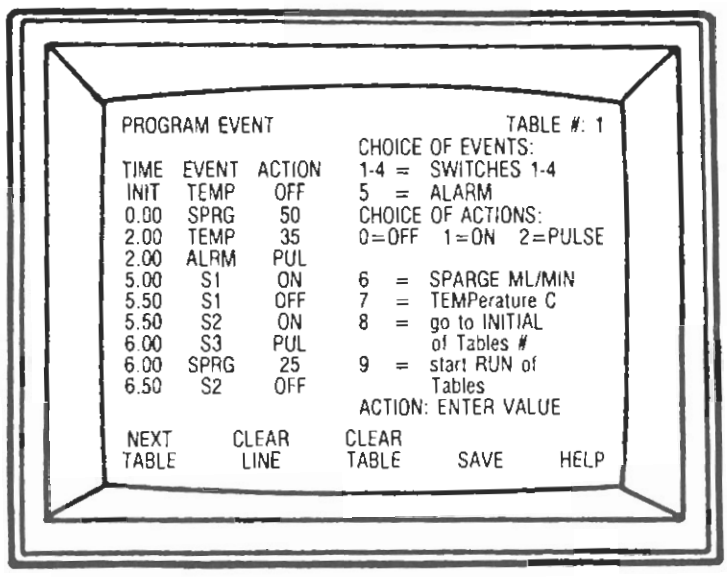


Figure 4-22 PROGRAM EVENT Screen

Entering the program event table

1. At the Table # field, type the desired program event table number (1 to 15), then press ENTER. If a program is already stored under this number, it will now be displayed on the screen. If necessary, at the Table # field select another table number, then press ENTER. Ensure that the selected table number is appropriate for the corresponding gradient table.

2. At the Time field, type the appropriate time value at which the event is to occur. Press ENTER.

   You can use the same time value for scheduling multiple events.

   NOTE 1: If you are on the Initial line, the Time field represents the default starting point for program event operation. You cannot enter a value.

   NOTE 2: When adding a new line to the table, the values from the previous line appear after the time is entered for the new line.

3. At the Event field, type the value for the event to be scheduled. Press ENTER.

   NOTE 1: When using the system for dissolution control (as outlined in Section 4.1.4.3), external event switch S1 is dedicated for operation with the Hanson Controller. S1 must not be programmed in the program event table.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

NOTE 2: Events 8 and 9 specify the next table to be run in sequence. Since these two events begin new method tables, they *must* be the last event in the table. Event 8 holds your analysis at the initial conditions of the new table until an inject signal is received. Event 9 begins executing the table without an inject signal.

4. At the Action field, type the appropriate value for the action required by the selected event. Press ENTER.

5. Repeat this process for all steps within the event table.

Deleting lines

To delete individual lines from the program event table:

1. Move the cursor to any position on the line to be deleted.

2. Press the **CLEAR LINE** key. This *immediately* clears the line the cursor is presently on and moves succeeding lines up one line.

Inserting lines

To insert individual lines into the program event table:

1. Move the cursor to the end of the table.

2. Type in the time. The table automatically rearranges according to time.

Saving the program event table

Program event tables are placed in scratch pad memory as they are configured. This is a temporary memory location. To store in permanent memory, each table must be saved. The procedure for saving a table is outlined in Section 4.3.1.1, Developing the Gradient Table.

When saving a program event table, verify the contents of the corresponding gradient and detector tables of the same number.

Editing/erasing existing program event tables

Program event tables may be edited or erased at any time. The procedure for editing or erasing a table is outlined in Section 4.3.1.1., Developing the Gradient Table.

4.3.1.3 Developing the Detector Table

Initial development

Make a photocopy of the Analysis Plan and File Sheet in Appendix D. Develop your detector table by writing it as individual lines on the sheet. Align the entries with the lines used for the individual gradient segments in the gradient table. This helps you visualize the method being entered.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Enter the time a detector change is to occur. Also enter the detector number and detector parameters to change. Note that time values do not have to be unique if programming for a different detector. You may have up to 15 lines in your detector table.

Figure 4-23 illustrates a typical example of a detector table.

DETECTOR TABLE

410 SENS	1024
431 SENS	

TIME	DET/ CHAN	SENS	AUFS
INITIAL	1	254	0.1
3.10	1	240	0.005
4.62	1	245	0.01

Figure 4-23 Example of a Detector Table

Accessing the detector table

From the PROGRAM GRADIENT screen, press the **NEXT TABLE** key twice. The DETECTOR TABLE screen displays (Figure 4-24) with the cursor positioned at the Det/Chan field.

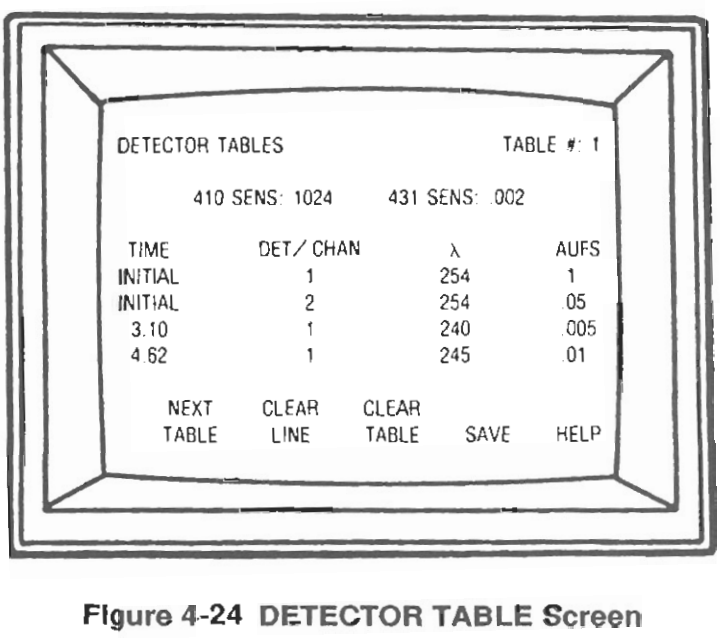


Figure 4-24 DETECTOR TABLE Screen

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Entering the detector table

1. At the Table # field, type the detector table number (1 to 15), then press ENTER. If a program is already stored under this number, it will now be displayed on the screen. If necessary, at the Table # field select another table number, then press ENTER. Ensure that the selected table number is appropriate for the corresponding gradient and program event tables.

   NOTE: When adding a new line to a table, the values from the previous line appear after the time is entered for the new line.

Selecting 410/431 sensitivity

2. To set the sensitivity of either the 410 RI detector *or* the 431 conductivity detector:

   - At the 410 Sens field, type the required operating sensitivity for the RI detector. Press ENTER.
   - At the 431 Sens field, type the required operating sensitivity for the conductivity detector. Press ENTER.

   NOTE: These values cannot be changed during a run, and are not programmable by time.

Defining UV detector table

3. If using a UV detector (DET #1 and/or DET #2), at the Time field, type the appropriate time value at which a change is to occur to either UV DET #1 or DET #2. Press ENTER.

   NOTE: If you are on the Initial line, the Time field represents the default starting point for the detector. You cannot enter a value.

4. At the Det/Chan field, type the appropriate value for the UV detector to be changed (DET #1 or DET #2). Press ENTER.

5. At the wavelength field, type the required wavelength setting for the detector. Press ENTER.

6. At the AUFS field, type the required full scale absorbance units setting for the detector. Press ENTER.

7. Repeat this process for all steps within the detector table.

Deleting lines

To delete individual lines from the detector table:

1. Move the cursor to any position on the line to be deleted.

2. Press the **CLEAR LINE** key. This *immediately* clears the line the cursor is presently on and moves succeeding lines up one line.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Inserting lines

To insert individual lines into the detector table:

1. Move the cursor to the end of the table.

2. Type in the time. The table automatically rearranges according to time.

Saving the detector table

Detector tables are placed in scratch pad memory as they are configured. This is a temporary memory location. To store in permanent memory, each table must be saved. The procedure for saving a table is outlined in Section 4.3.1.1, Developing the Gradient Table.

When saving a detector table, verify the contents of the corresponding gradient and program event tables of the same number.

Editing/erasing existing detector tables

Detector tables may be edited or erased at any time. The procedure for editing or erasing a table is outlined in Section 4.3.1.1, Developing the Gradient Table.

4.3.2 Developing the Program Methods Table

This section describes how to develop the program methods table. It outlines:

- Setting up the program methods table
- Entering the program methods table
- Saving the program methods table
- Deleting the program methods table

Through the PROGRAM METHODS screen you sequentially link a series of individual program table numbers (considered the methods) along with the injections to be processed and associated run times to define a multi-method application program.

In addition, there are a set of specialized functions that can be run from this screen. These functions are used by the system, PowerLine detectors, and PowerLine auto-injector for such events as equilibration, prep runs, and purge operations.

Refer to Figure 4-17 for an overview on this process.

4.3.2.1 Setting up the Program Methods Table

If you have not already done so, develop and enter your required sets of program tables (consisting of a gradient, program event, and detector table). For development information, refer to Section 4.3.1.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Depending on your gradient application, determine the sequence of steps that best suits the analysis. The PROGRAM METHODS screen holds up to 48 individual steps. These steps are retained in program memory using the SAVE key.

4.3.2.2 Entering the Program Methods Table

This section describes how to enter lines in the program methods table. It outlines the different parameters required to complete a program methods table.

Accessing PROGRAM METHODS screen

Press the **PROG METH** function key. The PROGRAM METHODS screen displays (Figure 4-25) with the cursor at the Step field.

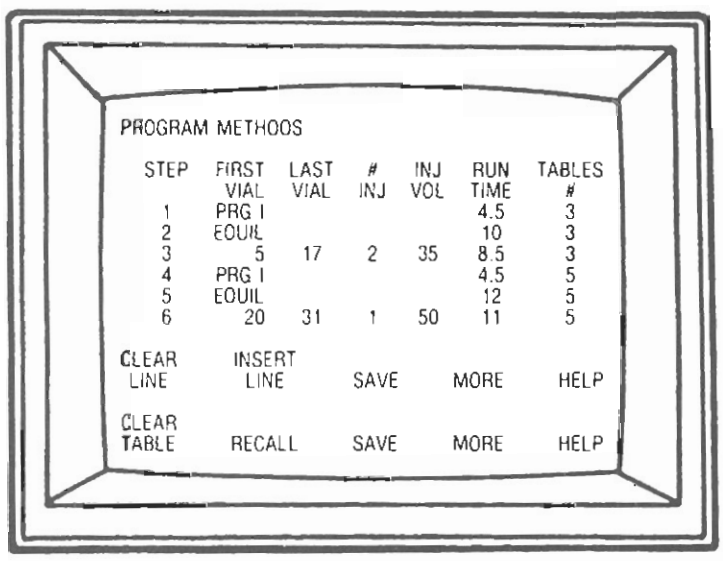


Figure 4-25 PROGRAM METHODS Screen

Assigning a step number

At the Step field, type the appropriate step number. Press ENTER.

Selecting vial numbers

At the First Vial field, type the appropriate vial number for the injection process. Press ENTER.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The First Vial parameter allows you to direct the system to:

- Make an injection (automatic or manual)
- Equilibrate the system
- Purge 410 flow cell
- Purge auto-injector
- Operate in prep mode
- Instruct 431 to execute auto baseline routine
- Instruct 410 or 431 (DET #3) to operate with positive polarity
- Instruct 410 or 431 (DET #3) to operate with negative polarity

The equilibrate and purge functions ensure, without operator intervention, that the system and PowerLine modules can change methods, bring the system to equilibration at the new conditions, and begin running a new method without operator intervention (or that solvent change over is complete when changing gradient tables in a method).

It is good gradient programming practice to include the system equilibration and auto-injector/detector purge steps throughout the program methods table to ensure system performance.

NOTE 1: The time required to equilibrate a system to initial conditions varies according to the column, mobile phase, and so on. This must be substantiated through experience with your particular system.

NOTE 2: If a value other than an auto-injector vial is selected (100 through 107), this may affect what additional parameters can be specified for that step. For example, if 101 (system equilibration) is specified, the remaining parameters for that step are Run Time and Tables #.

At the Last Vial field, type the appropriate vial number for the last vial in the automatic injection process. Press ENTER.

Selecting number of injections

At the # Inj field, type the appropriate number of injections to be made from each sample vial. Press ENTER. The range is 1 to 9 and the default is 1.

NOTE: If you are using the system for prep analysis, the # Inj field allows you to automatically perform multiple prep runs.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Selecting injection volume

At the Inj Vol field, type the appropriate sample volume for each injection. Press ENTER. The range is 1 to sample loop size. When using a manual injector, the value is for reference and documentation purposes only.

NOTE: The maximum value is determined by the size of the sample loop included in the auto-injector.

Selecting run time

At the Run Time field, type the appropriate time period over which that step in the method is to occur. Press ENTER. The range is 1 to 655 minutes.

Selecting table number

At the Tables # field, type the appropriate table number for the associated set of tables (gradient, program event, and detector) that are to execute simultaneously under this step number. The range is 1 to 15.

Deleting lines

To delete individual lines from the program methods table:

1. Move the cursor to any position on the line to be deleted.
2. Press the **CLEAR LINE** key. This *immediately* clears the line the cursor is presently on and moves succeeding lines up one line.

Inserting a Line

To copy and insert a line into the program methods table:

1. Move the cursor to directly above the line you want copied.
2. Press the **INSERT LINE** key. This copies the line the cursor is presently on and reorders the step numbers.

4.3.2.3 Saving the Program Methods Table

The program methods table is placed in scratch pad memory as it is configured. This is a temporary location. This table must be stored in permanent memory for it to be operated or preserved for subsequent system powerups.

To save the contents of the PROGRAM METHODS table into permanent memory, press the **SAVE** key.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.3.2.4 Deleting the Program Methods Table

The entire program methods table may be deleted from the screen by performing the following:

1. Press the **MORE** key, then the **CLEAR TABLE** key. This *immediately* removes the entire table from the screen.

2. To recall the last *saved* table from memory, reenter the table number and press ENTER.

4.3.3 Running the Multi-Method Application

This section describes how to run the program methods table. It is grouped into the following procedures:

- Selecting initial operating parameters
- Running the program methods table
- Modifying the program methods table during operation
- Editing a program table during operation
- Aborting operation

Refer to Figure 4-18 for an overview on this process.

4.3.3.1 Selecting Initial Operating Parameters

This section describes how to select the initial operating parameters for running the program methods table.

Accessing Initial OPERATE METHODS screen

Press the **OPER METH** key. The initial OPERATE METHOD screen displays (Figure 4-26) with the cursor at the Begin Method at Step # field. The current pump parameters of the last specifed run are displayed at the Current line and the latest set of gradient parameters (if any) at the New line.

If auto-standards are enabled from the AUTO-INJECTOR SETUP screen, the **AUTOSTANDARDS ON** message appears in the middle of this screen.

If dissolution control operation is enabled from the AUTO-INJECTOR SETUP screen, the **DISSOLUTION ON** message appears at the top of this screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

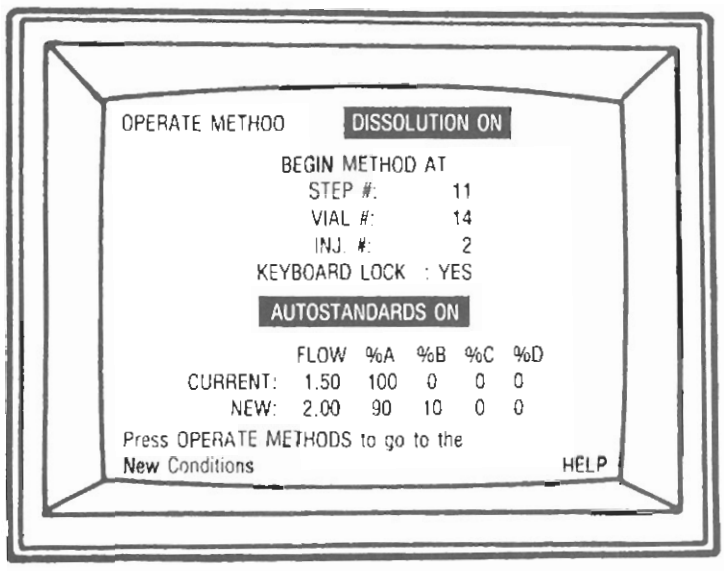


Figure 4-26 Initial OPERATE METHODS Screen

Selecting initial operating parameters

To start the program methods table at a step other than the first step of the PROGRAM METHODS table, at the Step # field, type the appropriate starting step. Press ENTER.

To start the program at a vial other than the first vial listed in the associated step number, at the Vial # field, type the appropriate vial number. Press ENTER.

To start the injections at a number other than the initial injection, at the Inj. # field, type the appropriate injection number. Press ENTER.

To disable the Keyboard Lock parameter (it always defaults to yes to automatically lock the keyboard during operation), at the Keyboard Lock field, type a value of **0**. Press ENTER.

NOTE: If the Autostart function and KEYBOARD LOCK key of the PUMP SETUP screen are engaged, these override any changes and the keyboard will automatically lock during operation. Use UNLOCK KEYBOARD to stop function.

4.3.3.2 Running the Program Methods Table

Accessing OPERATE METHODS screen

Press the **OPER METH** key. The OPERATE METHODS screen displays (Figure 4-27).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

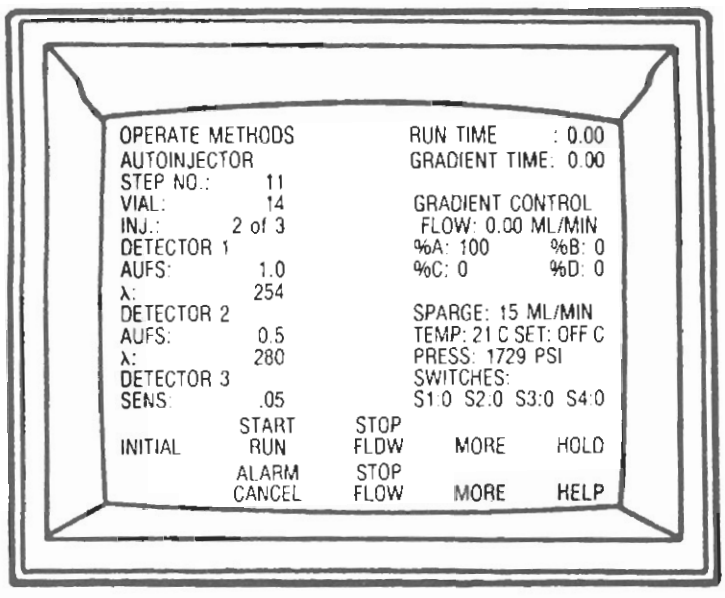


Figure 4-27 OPERATE METHODS Screen

Starting operation

If using a PowerLine auto-injector, press the **START RUN** key to begin operation.

If using a manual injector with an inject start output, make the injection to begin the run.

NOTE 1: When using the system for dissolution control (as outlined in Section 4.1.4.3) and an optional Hanson pill drop mechanism is being used, every time the START RUN key is pressed, this automatically transmits a pulse through external event switch S1 to the Hanson pill dropper to instruct it to drop a tablet into the dissolution bath.

NOTE 2: Automated analyses using a non-PowerLine auto-injector must be initiated from the injector to allow sample withdrawal and preparation time.

When the trigger signal is received by the system, multi-method operation begins. The current conditions of the table display on the screen.

The inject or Run Start signal from the injector starts the operating sequence to begin at run time 0.00.

The program methods table runs until completed, you stop operation with the ABORT key, or another injection resets the run time clock and starts operation again.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

NOTE: The conditions specified on the last line of the events program remain in effect after the program is finished. Unless the next table instructs the system to return to initial conditions (including resetting external switches), all devices remain in the state to which they were last set. The external switches are not automatically reset to off.

Changing parameters during operation

The helium sparge rate, column/cartridge heater module temperature, event switch selection, and operating parameters for any of the detectors can be changed during operation (assuming that the keyboard is not locked). To modify a setting, move the cursor to the associated selection, type in the new value, then press ENTER.

NOTE: Any time-based changes in the tables you are running will override any manual changes made during a run.

Holding the table constant during operation

The hold function keeps the solvent flow rate and pump percentage at an unchanging rate during operation. The run time is suspended during this function. The hold function may be particularly useful in methods development (where time is suspended but flow and composition remain constant).

To hold the program methods table from change during operation:

1. Press the **HOLD** key. The bottom right corner of the screen indicates the hold function is enabled (the HOLD key changes to RESUME).

2. To continue the program methods table from where it was held, press the **RESUME** key (the RESUME key selection changes back to HOLD). The run time will resume as will the gradient table.

Stopping flow during operation

The stop flow function is generally used upon completion of a run, but also serves as a manual control for temporary shutdown (for example, when performing stop flow scanning) or emergency shutdown.

To stop flow and suspend the program methods table:

1. Press the **STOP FLOW** key. The flow rate is set to zero. The bottom of the screen indicates the stop flow function is enabled (the STOP FLOW key changes to RESUME). The run clock stops.

2. To continue the program methods table from where it was stopped and restart the flow, press the **RESUME RUN** key. From that point, the pump ramps up to resume flow operation. Note that this ramping period affects any current analysis.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.3.3.3 Modifying the Program Methods Table During Operation

To modify the contents of the PROGRAM METHODS screen during operation:

1. Press the **PROG METH** key. The PROGRAM METHODS screen displays (see Figure 4-25). Revise and save the table as outlined in Section 4.3.2, Developing the Program Methods Table, and save.

2. Press the **OPER METH** key again to resume monitoring the operation of the automated methods.

NOTE: In modifying the PROGRAM METHODS screen while running, you cannot modify the step which is currently running. Any subsequent steps may be changed.

4.3.3.4 Editing a Program Table During Operation

During operation, it is possible to edit the contents of a table that is in process (gradient, event, or detector). Remember that you cannot save a table using the same number as the one presently in progress. You must substitute a number other than the one currently displayed or abort operation (using the ABORT key).

To edit the table in progress:

1. Press the **PROG TABLE** key.

2. Select the control table to be modified (gradient, program event, or detector) using the **NEXT TABLE** key.

3. Move the cursor to the Table # field and type a table number that is in progress. Press ENTER.

4. Modify the table.

5. Save this new table under a different table number and substitute the amended table for the original.

6. Restart the analysis.

4.3.3.5 Aborting Operation

To abort operation of the program methods table:

1. Press the **ABORT** key. The CAUTION screen displays (Figure 4-28).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

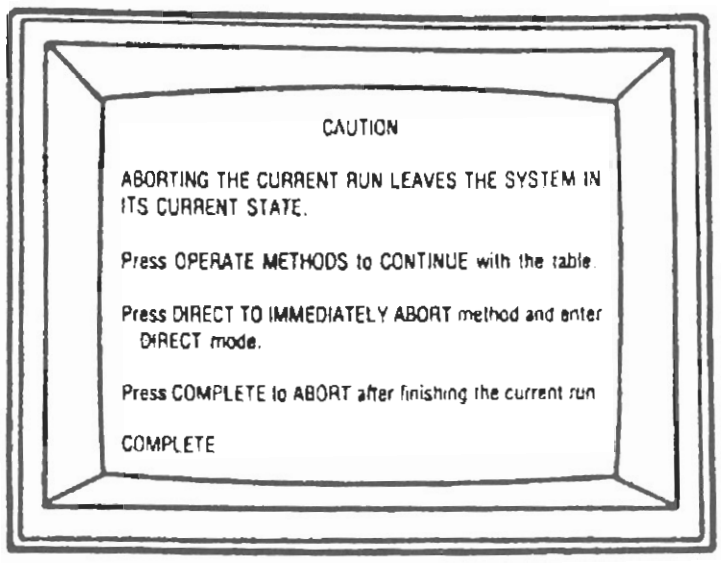


Figure 4-28 ABORT CAUTION Screen

2. The screen prompts you as to whether you want to immediately abort the program or abort after the current run is finished.

    - To immediately abort operation, press the **DIRECT** key. This proceeds to the DIRECT CONTROL screen and stops the multi-methods program.

    - To abort the program after the currently executing chromatographic run, press the **COMPLETE** key. This instructs the system to finish the current run and then abort the program.

3. If you want to return to the OPERATE METHODS screen and not abort operation, press the **OPER METH** key.

4. When the program is aborted, gradient, event, and detector program execution ceases and any enabled external switches remain in their current (or last set) state.

    The switches can be manually changed on the DIRECT CONTROL screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

How To Use the 600E
Index

A

Aborting,
- gradient operation, 3-31
- PowerLine operation, 4-57

Absorbance detectors, 4-31

Accessing
- AUTO-INJECTOR SETUP screen, 4-17
- DETECTOR SETUP screen, 4-24
- Detector Table, 4-47
- DIRECT CONTROL screen, 4-29
- DISSOLUTION SETUP screen, 4-19
- ISOCRATIC screen, 3-13
- Initial OPERATE GRADIENT screen, 3-27
- Initial OPERATE METHODS screen, 4-53
- OPERATE GRADIENT screen, 3-28
- OPERATE METHODS screen, 4-54
- PROGRAM EVENT screen, 3-25, 4-44
- PROGRAM GRADIENT screen, 3-20, 4-39
- PROGRAM METHODS screen, 4-50
- PUMP CONFIGURATION screen, 3-10, 4-10
- PUMP SETUP screen, 3-6, 4-6
- SYSTEM CONFIGURE screen, 4-13

Action, assigning, 3-26, 4-46

AUTO-INJECTOR SETUP screen,
- accessing, 4-17
- configuring the hardware, 4-3
- modifying syringe draw rate, 4-17
- setting conditions, 4-31
- specifying injection parameters, 4-17
- specifying auto standards, 4-18
- specifying dissolution control, 4-18
- specifying inject delay, 4-17
- using, 4-13

Automatic pill drop, enabling, 4-20

Auto standards, specifying, 4-18

Autostart,
- specifying, 3-23, 4-43
- using, 3-7, 4-7

Autozero, enabling, 4-25

B

Balance, selecting, 4-25

C

Changing solvents, 2-10
- aqueous solvents, 2-11
- considerations, 2-10
- organic solvents, 2-11
- procedure, 2-11

Changing,
- conditions during operation, 4-32
- parameters during operation, 3-29, 4-56
- pump head volume, 3-10, 4-10
- to another table during operation, 3-30

Configuring the hardware, 3-3, 4-3
- AUTO-INJECTOR SETUP screen, 4-13
- DETECTOR SETUP screen, 4-21
- DISSOLUTION SETUP screen, 4-18
- PUMP CONFIGURATION screen, 3-8, 4-8
- PUMP SETUP screen, 3-4, 4-4
- setting gradient controller, 3-10
- setting PowerLine system controller, 4-10
- SYSTEM CONFIGURE screen, 4-11

Controlling pump operation, 3-14, 4-32

Curve, entering, 3-21, 4-41

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

D

Daily,
routine operation, 2-7
startup, 2-1

Data Channel, selecting, 4-25

Defining UV Detector Table, 4-48

Delay,
dissolution, 4-19
Inject, 4-17

Deleting lines, 3-23, 3-30, 4-41, 4-46, 4-48, 4-52

Deleting gradient tables, 3-23, 4-43

Detector,
absorbance, 4-31
410 RI Detector, 4-32
431 Conductivity Detector, 4-32
selecting, 4-25

Detector Conditions, setting, 4-36

DETECTOR SETUP screen,
accessing, 4-24
configuring the hardware, 4-21
enabling Autozero, 4-25
enabling Polarity, 4-25
410 specific parameters, 4-25
431 specific parameters, 4-25
selecting Balance, 4-25
selecting Data Channel, 4-25
selecting detector, 4-25
selecting external heater temperature, 4-26
selecting Filter Constant, 4-25
selecting internal cell temperature, 4-25
using, 4-21

Detector Table,
accessing, 4-57
defining UV, 4-48
developing, 4-46
editing/erasing, 4-49
entering, 4-48
saving, 4-49

DIRECT CONTROL Screen,
accessing, 4-29
entering isocratic application, 4-26
making transition from DIRECT CONTROL to OPERATE METHODS, 4-33
performing, 4-32

Dissolution control,
enabling, 4-18
specifying, 4-18

Dissolution Delay, specifying, 4-19

Dissolution setup,
defining, 4-20
Delay, 4-19
overview, 4-18
Pill Drop, 4-20
Safety Window, 4-19

Dissolution Table, accessing, 4-19

E

Editing,
existing tables, 4-43
previous gradient tables, 3-23
previous program event tables, 3-46
program table during operation, 4-57
table during gradient operation, 3-30

Enabling,
automatic pill drop, 4-20
Autozero, 4-25
dissolution control, 4-18
external switch operation, 3-14
sparging, 3-6, 4-6
Polarity, 4-25
Pump Configuration changes, 3-11, 4-11

Entering,
detector table, 4-48
direct control/isocratic application, 4-26
flow rate, 3-20, 4-40
gradient table, 3-19, 4-40
mobile phase solvent composition, 3-21, 4-29, 4-40
program event table, 3-25, 4-45
program methods table, 4-50
rate of change curve, 3-23
time, 3-26, 4-45
time period, 3-20 4-40

Developing,
detector table, 4-46
gradient table, 3-19, 4-39
program event table, 3-24, 4-44
program methods table, 4-49
time-based program table, 4-39

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Erasing,
DISSOLUTION SETUP table, 4-21
previous gradient tables, 3-23, 4-43
previous program event tables, 4-46
program method tables, 4-53

Event,
assigning, 3-26, 4-45
running table, 3-27

Extended tests, running, 2-3

External switch operation,
enabling, 3-14, 4-30

External heater temperature,
selecting, 4-26

F

Filter Constant, selecting, 4-25

Flow,
entering rate, 3-20, 4-40
initiating, 2-5
programmed changes, 3-22 4-42

Fluid handling unit conditions,
flushing, 2-7
setting, 4-33

Flushing, fluid handling unit, 2-7

410/431,
conductivity detector, 4-24, 4-32, 4-48
RI detector, 4-24, 4-32, 4-48
selecting sensitivity, 4-48
specific parameters, 4-25

Front panel, 1-1
display screen, 1-2
function keys, 1-1, 1-4
keypad, 1-1
ON/OFF switch, 1-2
overview, 1-1
screen keys, 1-1, 1-4
using, 1-1

Function keys, 1-4

G

Good operating practices, 2-8

Gradient application,
performing 3-15
running, 3-27

Gradient constant, holding, 3-29

Gradient operation,
aborting, 3-31
editing a table during, 3-30
starting, 3-29

Gradient table,
deleting, 3-23, 4-43
developing, 3-19, 4-39
entering, 3-19, 4-40
return to initial conditions, 3-21, 4-41
running, 3-28
saving, 3-22, 3-42
setting up, 3-19, 4-39

H

Heater module temperature, setting,
3-14, 4-30

Holding,
gradient constant, 3-29
table constant during operation, 4-56

Host Link, modifying, 4-10

I

Initial conditions, 3-21, 4-41

Initial,
development, 3-19, 3-24, 4-39, 4-44, 4-46
setup, 2-5
startup, 2-7

Initiating flow, 2-5

Inject Delay, specifying, 4-17

Injection Volume, selecting, 4-31, 4-52

Inserting lines, 3-23, 3-26, 4-41,
4-46, 4-49, 4-52

Internal Cell Temperature, 4-25

Isocratic application,
performing, 3-11
performing direct control, 4-26

ISOCRATIC screen, accessing, 3-13

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

K

Keyboard, locking, 3-7, 4-8

Keypad, 1-3
- CLEAR key, 1-3
- cursor movement keys, 1-3
- ENTER key, 1-3
- Entering values, 1-3
- HOME key, 1-3
- number keys, 1-3
- overview, 1-2

L

Lines,
- deleting, 3-23, 3-30, 4-41, 4-46, 4-48, 4-52
- inserting, 3-23, 3-26, 4-41, 4-46, 4-49, 4-52

Locking, keyboard, 3-7, 4-8

M

Making,
- Transition from DIRECT CONTROL to OPERATE METHODS, 4-33

Mobile Phase Solvent Composition, 3-13, 3-21, 4-29, 4-40

Modifying,
- Host Link, 4-10
- program methods table during operation, 4-57
- Syringe Draw Rate, 4-17

Monitoring, output trace, 3-7, 4-7

Multi-method application, running, 4-53

N

Number of injections, selecting, 4-51

O

OPERATE GRADIENT screen
- accessing, 3-28
- accessing initial screen, 3-27
- initial screen, 3-31
- selecting a table, 3-28

OPERATE METHODS screen,
- accessing, 4-54
- accessing initial screen, 4-53
- making transition from DIRECT CONTROL, 4-33

Operation,
- aborting, 3-31, 4-57
- changing conditions during, 4-32
- controlling pump, 3-14, 4-32
- editing program table during, 4-57
- good practices, 2-8
- routine, 2-1
- starting, 3-29, 4-32, 4-55
- stopping flow during, 3-14, 3-30, 4-32, 4-56

Operating parameters, selecting initial, 4-53

Output trace, monitoring, 3-7, 4-7

P

Pill Drop, 4-20

Polarity, enabling, 4-25

Powering up, system, 2-2

PowerLine modules, activating, 4-13

Pressure limits, regulating, 3-7, 4-7

PROGRAM GRADIENT screen, accessing, 3-20, 4-39

PROGRAM EVENT screen,
- accessing, 3-25, 4-44
- entering, 3-25, 4-45

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Program event table,
developing, 3-24, 4-44
editing, 4-46
entering, 3-25, 4-45
erasing, 4-46
saving, 3-22, 4-46
setting up, 3-24, 4-44

PROGRAM METHODS screen,
accessing, 4-50

Program methods table,
deleting, 4-53
developing, 4-49
entering, 4-50
modifying during operation, 4-57
programming considerations, 4-51
running, 4-54
saving, 4-52
setting up, 4-49

Programmed flow changes, 3-22, 4-42

PUMP CONFIGURATION screen, 3-8, 4-8
accessing, 3-10, 4-10
changing Pump Head Volume, 3-10, 4-10
enabling pump configuration changes, 3-11, 4-11
modifying Host Link, 4-10
selecting Unit Type, 3-10, 4-10
setting serial communication parameters, 4-11
specifying type of report, 4-11
using, 3-8, 4-8

Pump Head Volume, changing, 3-10, 4-10

Pump operation,
controlling, 3-14, 4-32
purging pumps and lines, 2-6

PUMP SETUP screen, 3-6, 4-4
accessing, 3-6, 4-6
enabling sparging, 3-6, 4-6
locking the keyboard, 3-7, 4-8
monitoring output trace, 3-7, 4-7
regulating pressure limits, 3-7, 4-7
Regulating temperature limits, 3-6, 4-6
using, 3-6, 4-4
using Autostart, 3-7, 4-7

Purging air from the system, 2-4
considerations, 2-4
initial setup, 2-5
initiating flow, 2-5
purging pumps and lines, 2-6

R

Rate of change, entering, 3-21, 4-41

Regulating,
pressure limits, 3-7, 4-7
temperature limits, 3-6, 4-6

Report, 4-11

Reservoirs,
selecting, 2-3
sparging, 2-3

Returning to initial conditions, 4-41

Routine operation, 2-1
daily, 2-7

Run time, selecting, 4-52

Running,
event table, 3-28
extended tests, 2-3
gradient application, 3-27
gradient table, 3-28
multi-method application, 4-53
program methods table, 4-54

S

Safety Window, specifying, 4-19

Saving,
detector table, 4-49
gradient table, 3-22, 4-42
program event table, 3-22, 4-46
program methods table, 4-52
Screen keys, 1-4

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Selecting,
Balance, 4-25
Data Channel, 4-25
detector, 4-25
external heater temperature, 4-26
Filter Constant, 4-25
flow rate, 2-4
410/431 sensitivity, 4-48
gradient controller, 3-3, 3-10
gradient/event table, 3-27
Injection Volume, 4-31, 4-52
internal cell temperature, 4-25
initial operating parameters, 4-53
PowerLine system controller, 4-4, 4-10
Number of injections, 4-51
Reservoirs, 2-3
Run time, 4-52
Solvent rate, 3-13, 4-29
Table, 3-28
Table #, 4-52
Vial numbers, 4-31, 4-50

Serial communication parameters, 4-11

Setting,
Auto-injector conditions, 4-31
detector conditions, 4-31
External event switches, 3-14, 4-30
Fluid handling unit conditions, 3-13, 4-29
Heater module temperature, 3-14, 3-29, 4-30, 4-56
Solvent flow rate, 3-13, 4-29
Sparge flow rate, 3-14, 4-30

Setting up,
dissolution, 4-18
gradient table, 3-19, 4-39
initial, 2-5
program event table, 3-24, 4-44
program methods Table, 4-49

600E as gradient controller,
background information, 3-2
configuring the hardware, 3-3
control through an optional workstation, 3-2
operating modes, 3-1
selecting, 3-10,
using, 3-1

600E as PowerLine system controller,
background information, 4-2
configuring the hardware, 4-3
control through an optional workstation, 4-3
operating modes, 4-1
selecting, 4-10

Solvents,
aqueous, 2-11
changing, 2-10
organic, 2-11
setting flow rate, 3-13, 4-29

Sparge flow rate, setting, 3-14, 4-34

Sparging the reservoirs, 2-3
considerations, 2-3
enabling, 3-6, 4-6
procedure, 2-3
selecting reservoirs, 2-3
selecting a flow rate, 2-4

Specifying,
auto-injector injection parameters, 4-17
Auto standards, 4-18
Autostart, 3-23, 4-43
dissolution control, 4-18
Dissolution Delay, 4-19
410 parameters, 4-25
431 parameters, 4-25
Inject Delay, 4-17
Safety Window, 4-19
type of report, 4-11

Starting,
direct control operation, 4-32
gradient operation, 3-29
multi-method operation, 4-55

Startup, daily, 2-1

Step #, assigning, 4-50

Stopping flow during operation, 3-30, 4-56

Syringe Draw Rate, modifying, 4-17

System,
powering up, 2-2
purging air from, 2-4
sparging, 2-3

SYSTEM CONFIGURE screen,
accessing, 4-13
configuring the hardware, 4-11
using, 4-11

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

T

Table,
changing to another during operation, 3-30
clearing the dissolution setup, 4-21
deleting previous, 3-23, 4-43
developing detector, 4-46
developing gradient, 3-19, 4-39
developing program event, 3-24, 4-44
developing program methods, 4-49
developing time-based program, 4-39
editing existing, 4-43
saving, 3-22, 4-42
selecting, 3-28

Table #,
assigning, 3-20, 3-26, 4-40
selecting, 3-28, 4-52

Temperature limits, regulating, 3-6, 4-6

Time-based method application, creating, 4-34

Time-based program table, developing, 4-39

Time (event), entering, 3-26, 4-45

Time period (gradient), entering, 3-20, 4-40

Transition,
DIRECT CONTROL to OPERATE METHODS, 4-33

Type of report, specifying, 4-11

U

U6K manual injector, using, 2-9

UV detector table, defining, 4-48

V

Vial #, selecting, 4-31, 4-50

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TABLE OF CONTENTS

HOW TO USE THIS BOOK vii

1 INTRODUCTION 1-1

1.1 WATERS 600E OVERVIEW 1-1

1.2 600E MODULES 1-3

1.3 POWERLINE SYSTEM CONTROLLER OVERVIEW 1-5

1.4 OPTIONS 1-8

2 GRADIENT CONTROLLER SCREENS 2-1

2.1 POWER UP SCREEN 2-2

2.2 PUMP SETUP SCREEN 2-2

2.2.1 Pump Setup Keys 2-3
2.2.2 Pump Setup Parameters 2-4

2.3 PUMP CONFIGURATION SCREEN 2-6

2.3.1 Pump Configuration Keys 2-7
2.3.2 Pump Configuration Parameters 2-7

2.4 ISOCRATIC SCREEN 2-8

2.4.1 Isocratic Keys 2-8
2.4.2 Isocratic Parameters 2-8

2.5 PROGRAM GRADIENT SCREEN 2-9

2.5.1 Program Gradient Keys 2-10
2.5.2 Program Gradient Parameters 2-11
2.5.3 Gradient Table Programming Considerations 2-12

2.6 PROGRAM EVENT SCREEN 2-13

2.6.1 Program Event Keys 2-14
2.6.2 Program Event Parameters 2-15

2.7 INITIAL OPERATE GRADIENT SCREEN 2-16

2.7.1 Operate Gradient Keys 2-17
2.7.2 Operate Gradient Parameters 2-17

2.8 OPERATE GRADIENT SCREEN 2-17

2.8.1 Operate Gradient Keys 2-18
2.8.2 Operate Gradient Screen Parameters 2-19

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3 **POWERLINE SYSTEM CONTROLLER SCREENS** 3-1

3.1 POWER UP SCREEN 3-2

3.2 PUMP SETUP SCREEN 3-2

3.2.1 Pump Setup Keys 3-3
3.2.2 Pump Setup Parameters 3-4

3.3 PUMP CONFIGURATION SCREEN 3-6

3.3.1 Pump Configuration Keys 3-7
3.3.2 Pump Configuration Parameters 3-7

3.4 SYSTEM CONFIGURATION SCREEN 3-9

3.5 AUTO-INJECTOR SETUP SCREEN 3-9

3.5.1 Auto-Injector Keys 3-10
3.5.2 Auto-Injector Setup Parameters 3-10

3.6 DISSOLUTION SETUP SCREEN 3-11

3.6.1 Dissolution Setup Keys 3-12
3.6.2 Dissolution Setup Parameters 3-12

3.7 DETECTOR SETUP SCREEN 3-13

3.7.1 Detector Setup Keys 3-14
3.7.2 Detector Setup Parameters 3-15

3.8 DIRECT CONTROL SCREEN 3-16

3.8.1 Direct Control Keys 3-17
3.8.2 Direct Control Parameters 3-17

3.9 PROGRAM GRADIENT SCREEN 3-19

3.9.1 Program Gradient Keys 3-20
3.9.2 Program Gradient Parameters 3-21
3.9.3 Program Gradient Programming Considerations 3-23

3.10 PROGRAM EVENT SCREEN 3-24

3.10.1 Program Event Keys 3-25
3.10.2 Program Event Parameters 3-25

3.11 DETECTOR TABLE SCREEN 3-27

3.11.1 Detector Table Keys 3-28
3.11.2 Detector Table Parameters 3-28

3.12 PROGRAM METHODS SCREEN 3-29

3.12.1 Program Methods Keys 3-30
3.12.2 Program Methods Parameters 3-30

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.13 OPERATE METHODS SCREENS 3-32

3.13.1 Initial OPERATE METHODS Screen 3-33
3.13.1.1 Operate Methods Keys 3-33
3.13.1.2 Operate Methods Parameters 3-33
3.13.2 OPERATE METHODS Screen 3-34
3.13.2.1 Operate Methods Keys 3-35
3.13.2.2 Operate Methods Parameters 3-36

4 ERROR MESSAGES 4-1

4.1 WARNING MESSAGES 4-2
4.2 SHUTDOWN MESSAGES 4-6

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

LIST OF TABLES

2-1 Curve Numbers 2-11

3-1 Curve Numbers 3-22

4-1 Warning Messages 4-2
4-2 Shutdown Messages 4-7

LIST OF FIGURES

1-1 Waters 600E Multisolvent Delivery System 1-1
1-2 Waters 600E Major Components 1-4
1-3 Waters 600E System Communications 1-6
1-4 Typical PowerLine Dissolution System 1-7

2-1 Gradient Controller Screens 2-1
2-2 POWER UP Screen 2-2
2-3 PUMP SETUP Screen 2-3
2-4 System Pressure Limit Range Versus Flow Rate 2-5
2-5 PUMP CONFIGURATION Screen 2-6
2-6 ISOCRATIC Screen 2-8
2-7 PROGRAM GRADIENT Screen 2-10
2-8 Gradient Curve Shapes 2-11
2-9 Example Gradient Table 2-12
2-10 PROGRAM EVENT Screen 2-14
2-11 Initial OPERATE GRADIENT Screen 2-16
2-12 OPERATE GRADIENT Screen 2-18

3-1 PowerLine Screens 3-1
3-2 POWER UP Screen 3-2
3-3 PUMP SETUP Screen 3-3
3-4 System Pressure Limit Range Versus Flow Rate 3-5
3-5 PUMP CONFIGURATION Screen 3-7
3-6 SYSTEM CONFIGURATION Screen 3-9
3-7 AUTO-INJECTOR SETUP Screen 3-10
3-8 DISSOLUTION SETUP Screen 3-12
3-9 DETECTOR SETUP Screen 3-14
3-10 DIRECT CONTROL Screen 3-16
3-11 PROGRAM GRADIENT Screen 3-20
3-12 Gradient Curve Shapes 3-22
3-13 Example Gradient Table 3-22
3-14 PROGRAM EVENTS Table 3-24
3-15 DETECTOR TABLE Screen 3-27
3-16 PROGRAM METHODS Screen 3-29
3-17 Initial OPERATE METHODS Screen 3-33
3-18 OPERATE METHODS Screen 3-35

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

HOW TO USE THIS BOOK

Book II Book II, Reference, contains all of the reference information on the system. You will find information on the System Introduction, the gradient controller screens, and the PowerLine system controller screens. As in Book I, How To Use the 600E, this information is organized by modes of operation. The reference information is intended for:

- Novice users
- Users who require a level of information beyond that found in the controller HELP screens
- Users who are not near the system

Keeping the reference material separate from the procedural information, serves both the novice user (Reference) and the experienced user (How To Use).

Other books Use Book I, How to Use the 600E, for step-by-step procedures on using the system in various modes of operation.

Book III, Installation and Service, provides installation and/or maintenance information.

Organization This book is organized to help you use the controller as a gradient controller and as a PowerLine system controller. It is divided into chapters that describe the controller as either a gradient controller or system controller. In addition, chapters are divided by titled tab dividers, providing easy access to all information.

Using this book Chapter 1 provides an overview on the system.

Chapter 2 provides detailed information on the gradient controller screen displays:

- Description of screen keys
- Function keys
- Their associated parameters

Chapter 3 provides detailed information on the PowerLine system controller screen displays.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1

INTRODUCTION

This chapter contains the following information:

- Overview of the Waters 600E
- Description of the Waters 600E modules
- Overview of the PowerLine System Controller
- Description of options

1.1 WATERS 600E OVERVIEW

The Waters 600E Multisolvent Delivery System (Figure 1-1) is a modular High Performance Liquid Chromatography solvent delivery system. The 600E system is capable of automatically selecting flow and gradient composition to blend up to four solvents.

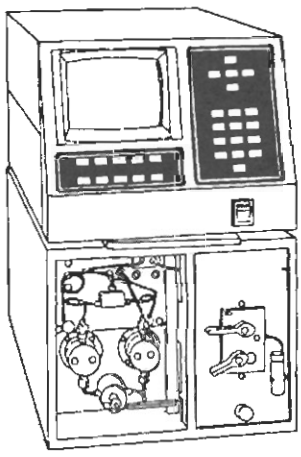


Figure 1-1 Waters 600E Multisolvent Delivery System

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

There are two versions of the Waters 600E:

- The Gradient Controller
- The PowerLine System Controller

Details on the Waters 600E Gradient Controller screens and associated selections can be found in Chapter 2. Details for the 600E PowerLine System Controller screens can be found in Chapter 3.

Gradient Controller

The Gradient Controller allows you to:

- Program isocratic methods and gradient methods with up to four solvents through the use of concave, convex, and linear composition profiles.
- Program tables (which are saved in memory) that define the varying percentage composition of the mobile phase, the flow rate, and the time range for each phase of the gradient operation. Tables are developed for gradient programs and programmed events.

Powerline System Controller

The Powerline System Controller has all of the Gradient Controller functions along with the System Controller features and an RS-232 interface. You can use this system as either a Gradient Controller or as a PowerLine System Controller. The Powerline System Controller allows you to:

- Provide automatic setup and control of all gradient injection (manual and automatic), event, and detection parameters directly from the 600E keypad.
- Create multi-method programs that link time-based control tables. Each time-based table comprises a gradient table, a program events table, and a detector table.
- Interface with PowerLine injectors, detectors, and data workstations.
- Control an automatic Dissolution/HPLC system.

600E Features

The Waters 600E offers the following features:

- Single keypad control
- Setup capability allowing you to set default parameters
- Methods recall allowing you to access previously created methods tables
- System control over external auto-injectors and detectors (PowerLine system only)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- 225 microliter (µl) volume (45 ml/min maximum flow rate) or 100 µl volume (20 ml/min maximum flow rate) pump head design
- 6000 psi maximum system pressure that varies with pump head and flow rate
- Optional column/RCSS heater module monitoring and control
- Flow and operating pressure monitoring
- Column switching valve, or similar external device control
- Stop flow to allow such techniques as stop flow scanning
- Preprogrammed gradient curves (convex, concave, and linear)
- IEEE control interface with other system components (PowerLine ssstem only)
- RS-232 serial communications interface (PowerLine system only)

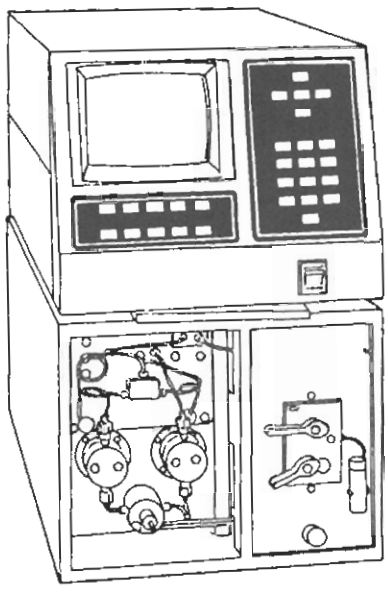
1.2 600E MODULES

The Waters 600E system is divided into two modules:

- The fluid handling unit contains devices such as the pump, pressure transducer, solvent inlet manifold, sparge valve, and solvent proportioning valve.
- The controller unit contains the electronics, firmware, and the power supply.

These two modules are connected by a control cable. To save bench space, it is possible to stack the controller unit on top of the fluid handling unit. Figure 1-2 illustrates the relationship between the fluid handling unit and the controller unit.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



FUNCTIONS:

Control

Pumping
Sparging
Gradient formation
Manual injection (option)
Column heating (option)

Figure 1-2 Waters 600E Major Components

Fluid handling unit The fluid handling unit contains the components required to deliver solvents from four solvent reservoir bottles to the injector.

Fluids metering Solvent metering and mixing take place on the low pressure (or intake) side of the solvent delivery system. Additional mixing occurs at high pressure on the delivery side.

The unique capability to mix as many as four solvents (even in extreme proportions) with high reproducibility is the result of the evolution of a patented valve control algorithm based on the Waters pump technology. The switching valve construction produces precise gradient segments regardless of solvent compressibility and system back pressures.

Flow path Solvent is sparged (degassed) in the solvent reservoirs. From the solvent reservoirs, the solvents flow through the Teflon® tubing to the solvent proportioning valves. Next, the solvent flows into the inlet manifold, and then into the two pump heads. The pump heads move a volume of 100/225 µl (pump head dependent) with each stroke and can pump at a maximum flow rate of 20/45 milliliters/minute (mls/min).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

From the pump heads the flow converges at a "T", or reference valve, before flowing into the pressure transducer. The flow continues to the injector where the sample is injected. From here flow continues out of the system to the column and detector(s).

Controller units

The gradient controller unit allows you to control the gradient, fluid handling, flow, external events, sparging, and the optional column heaters.

In addition to fluid handling unit operation, the PowerLine System Controller allows you to control operation of an auto-injector, up to three detectors, and user-created programs. Communication occurs through the control cable, the IEEE-488 cable, and the RS-232 cable depending on the options and configuration of the system.

Column switching valves, or similar external devices, are controlled manually from screen displays or through programmed event tables by four event actuation switches (on the 600E rear panel). An auxiliary power terminal (+12 volts) is also provided for devices requiring operating current.

When you use the 600E as a gradient controller, operation with an injector is initiated through the inject start terminal on the 600E rear panel. The inject terminal accepts the signal from the manual or automatic injector to start the analysis.

When you use the 600E as a PowerLine System Controller, operation with an injector can be initiated through either the IEEE-488 communications interface (for use with a PowerLine auto-injector) or the inject start terminal (for use with a manual injector or non-PowerLine auto-injector).

Servicing of the electronics unit is made easy with the integrated single-board design which can be removed from the rear of the unit for troubleshooting, adding options, or repair.

1.3 POWERLINE SYSTEM CONTROLLER OVERVIEW

The Waters 600E PowerLine System Controller includes the RS-232 interface as well as the PowerLine System Controller software. The system controller allows you to use the 600E to control a system that includes one or all of the following:

- Waters 410 Differential Refractometer
- Waters 431 Conductivity Detector
- Waters 484 Tuneable UV Detector
- Waters 490 Programmable UV Multiwavelength Detector
- Waters IEEE-based Auto-Injectors
- Any external devices that can be triggered by the controller's external events

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The IEEE-488 interface allows you to control the Waters 600E as a system component from:

- 860 Networking Computer System
- 845 Chromatography Data and Control Station
- 840 Data and Chromatography Control Station with Waters Rev 6, Expert™ software

The RS-232 serial communications interface allows the 600E to be controlled by one of the following:

- Waters 990+ Photodiode Array Absorbance Detector
- Waters 815/825 series computers

The RS-232 interface also allows you to use the 600E to generate reports on the Waters 745B Data Module. The basic system communications connections are shown in Figure 1-3.

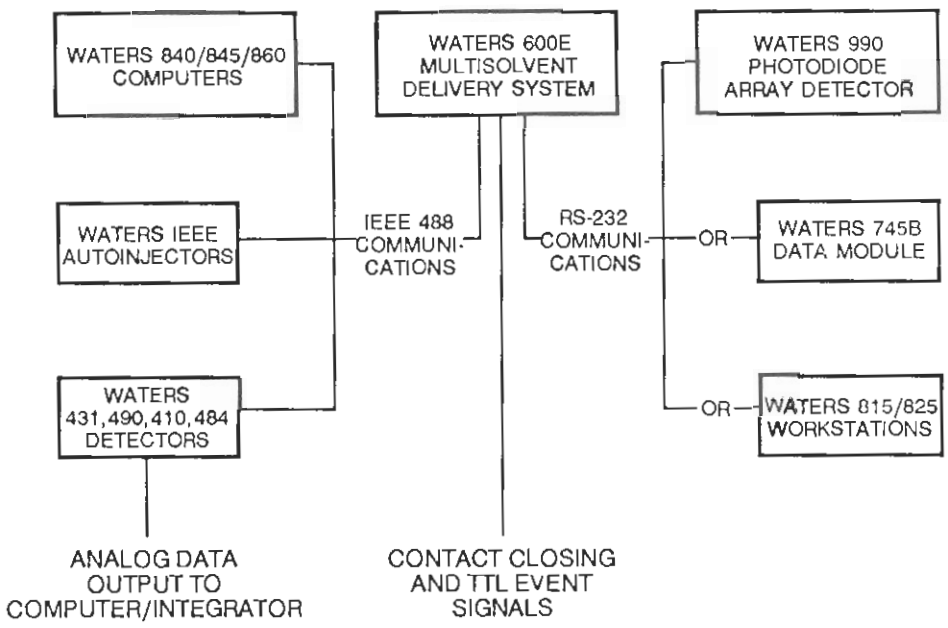


Figure 1-3 Waters 600E System Communications

Operation When the 600E is running as a system controller, you may program and then save in permanent memory the following parameters:

- Methods specifying vial numbers
- Number of injections from each vial
- Standards (how many and how often)
- Run times
- Method number
- Dissolution control table

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The system controller provides storage for sets of 15 tables. Each set comprises a:

- Gradient table (containing a maximum of 15 operational steps for each)
- Program event table (containing a maximum of 15 operational steps each)
- Detector control table (containing a maximum of 15 operational steps each)

The methods program enables you to design a time-based program with up to 48 individual steps (each step accesses a program table).

Dissolution control

The Waters 600E PowerLine System Controller can be used to coordinate dissolution testing with the following optional components:

- Waters 712D WISP™ Multiport Sample processor
- Dissolution bath
- Hanson Transfer Controller (including the volumetric manifold and transfer air/vacuum source)

This is the basic configuration to perform dissolution testing. In addition you can use a Waters Data and Chromatography Control Station (such as the 810/820, 840, 845, or 860) as a workstation.

In dissolution control operation, the Waters 600E PowerLine System Controller coordinates the acquisition of dissolution samples at timed intervals from the Hanson Transfer Controller while coordinating the positioning of the sample carousel in the 712D. Six samples are taken simultaneously from the dissolution bath by the Hanson Transfer Controller and routed directly to sample vials in the 712D. The 600E also supports the triggering of an optional mechanical Hanson tablet dropper at the start of operation. Figure 1-4 illustrates the typical 600E dissolution system.

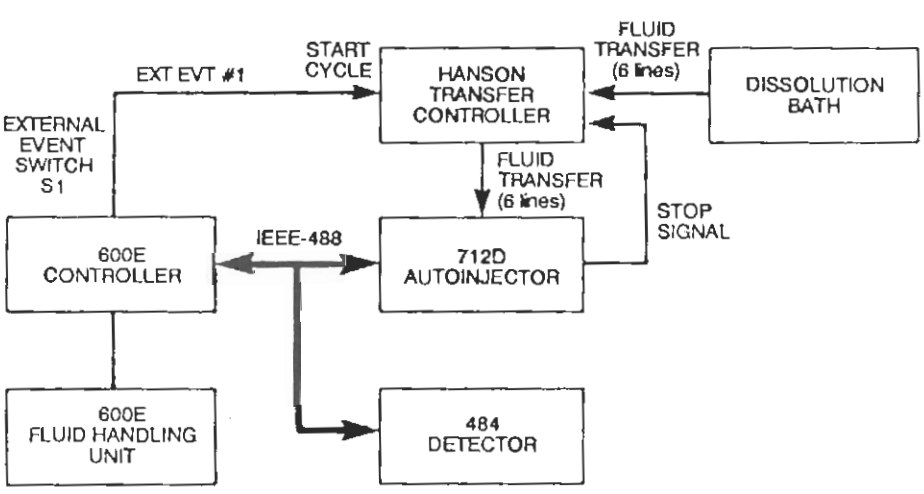


Figure 1-4 Typical PowerLine Dissolution System

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

For information on the dissolution components available for operation with the 600E, contact Hanson Research Corporation, P.O. Box 35, Northridge CA, 91328 (1 (800) 821-8165).

1.4 OPTIONS

The Waters 600E system has several options which allow you to expand the capability of your instrument.

Manual Injector Adapter Kits The Waters 600E can be adapted to use either the Waters U6K Universal Liquid Chromatography Injector (P/N 62011) or the Rheodyne Model 7125 Mounting Kit (P/N 62337). The Waters U6K kit includes the injector. The Rheodyne Mounting Kit requires the injector and chart mark accessory (Rheodyne P/N 7161-020) be purchased separately.

Solvent Reservoir Rack The Waters 600E Solvent Reservoir Rack (P/N 62060) provides a safe convenient method to store up to four one-liter solvent bottles alongside the system while minimizing required bench space.

RCSS Heater Module The Radial Compression Separation System (RCSS) heater module (P/N 62012) provides temperature control (ambient to 64°C) for Radial-Pak™ cartridges. The insulated jacket keeps external temperatures below 40°C even while operating at elevated temperatures. The module fits into the slide-out compartment in the fluid unit for easy access and safety.

Stainless Steel Column Heater Module The Stainless Steel Column Heater Module (P/N 62079) provides temperatures to 99°C for steel columns up to 8 mm by 30 cm in size. The insulated jacket keeps external temperatures below 40°C even while operating at elevated temperatures. Like the RCSS, it fits into the slide-out compartment in the fluid handling unit for easy access and safety.

Reference Valve The Reference Valve (P/N 26592) routes solvent to the reference cell in a detector. It replaces the mixing tee on the front of the 600E fluid handling unit.

System Interface RS-232 The addition of the RS-232 serial interface allows the Waters 600E to communicate with the Waters 745B integrator, Waters 815/825 computer products, and the Waters 990+ Photodiode Array Absorbance Detector.

This interface is included as standard equipment in the Waters 600E PowerLine System Controller discussed in Chapter 3.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2

GRADIENT CONTROLLER SCREENS

This chapter contains a description of the screens you use when operating the system as a gradient controller (Figure 2-1).

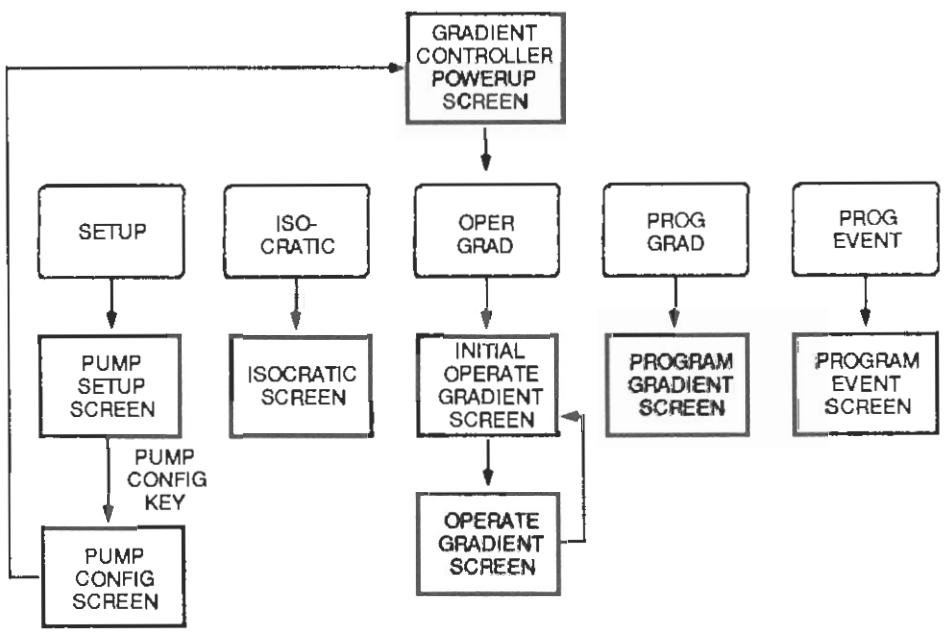


Figure 2-1 Gradient Controller Screens

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2.1 POWER UP SCREEN

When you turn on the system the first screen you see is the POWER UP screen (Figure 2-2). The POWER UP screen provides information about the system. You are able to:

- Identify the revision level of the software
- See the results of the self-diagnostic tests
- Identify the controller (gradient or system) selected for the system
- Continue with operation by pressing any screen key
- Access the extended (service level) tests by pressing the decimal point key

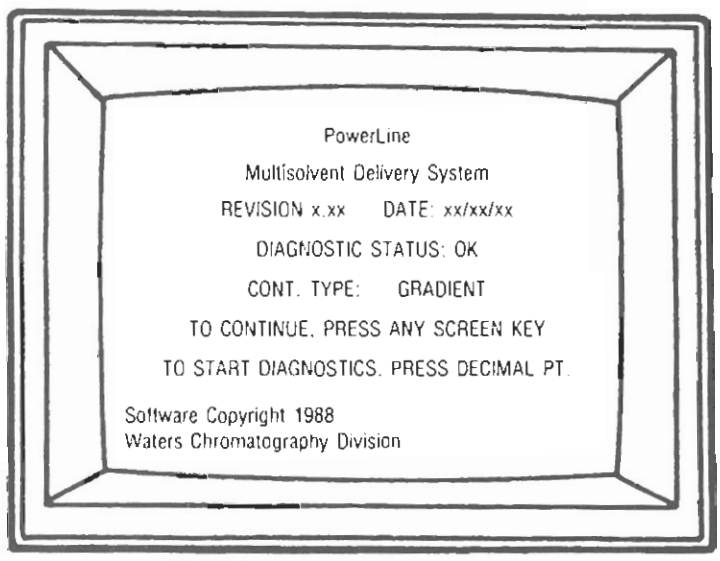


Figure 2-2 POWER UP Screen

2.2 PUMP SETUP SCREEN

You use the PUMP SETUP screen (Figure 2-3) to make the hardware configurations. (Pressing the SETUP key brings you to the PUMP SETUP screen.) Once the pump is initially set up, the configuration is typically not changed. Values you enter on the PUMP SETUP screen apply to all Waters system operations. Once configured, these values are stored in memory and are used as the default values during subsequent powerups. The last entries stored in permanent memory appear when you access this screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

NOTE: From the PUMP SETUP screen, you access the PUMP CONFIGURATION screen which displays a more detailed hardware configuration screen.

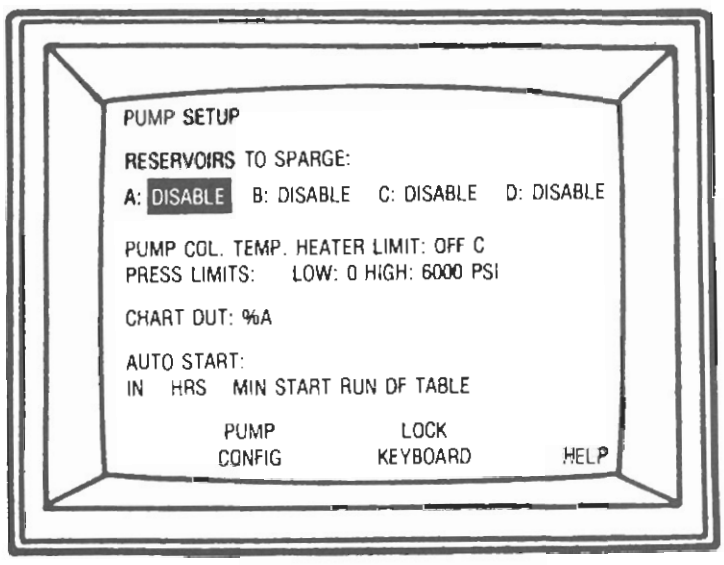


Figure 2-3 PUMP SETUP Screen

2.2.1 Pump Setup Keys

There are three active keys when the PUMP SETUP screen is displayed:

- **PUMP CONFIGURATION** - Brings you to the PUMP CONFIGURATION screen.
- **KEYBOARD LOCK** - Provides protection against accidental entries or alteration of a program during operation or once the Autostart function has been engaged.

  Pressing this key locks or unlocks the keyboard. The keyboard is always unlocked at powerup.
- **HELP** - Provides online field-level reference information for each parameter selection.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2.2.2 Pump Setup Parameters

There are six parameters on the PUMP SETUP screen:

- Reservoirs to Sparge
- Column/cartridge temperature heater limit*
- Operating pressure limits*
- Chart out
- Autostart
- Keyboard lock

Parameters marked with an asterisk (*) are displayed and monitored during operation. If the system exceeds the set limits, system shutdown occurs and a HOLD signal is sent from the terminal trip at the rear of the controller to the automatic injector. Other parameters are held in their current states. See Chapter 4 for error messages and shutdown causes.

Reservoirs to Sparge

The Reservoirs to Sparge field is a *required* parameter to use helium sparging. It is enabled only on the SETUP screen and allows you to indicate which reservoirs you want to enable for helium sparging. The settings for this parameter are:

0 = Disabled
1 = Enabled

The actual sparge flow rate for all active reservoirs is set on the ISOCRATIC or OPERATE GRADIENT screen.

Temperature Limit

Sets the upper temperature limit for an optional column heater. The valid ranges for this parameter are:

0 = Off
Minimum = 5°C over ambient
Maximum = 64°C for RCSS heater
99°C for stainless steel heater

The heater temperature limit must always be greater than the operating temperature set on the ISOCRATIC, OPERATE GRADIENT, or PROGRAM EVENT screen. Exceeding the maximum temperature for more than 1.2 seconds causes shutdown.

Pressure Limits

Defines the high and low operating pressure limits of the fluid handling unit. If the system pressure exceeds or goes below the pressure limits set for your system, the system shuts down. In determining the high pressure limit for your system, keep in mind the pressure limitations of your column and refer to the column manual. Figure 2-4 displays the system pressure limit range versus the flow rate.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

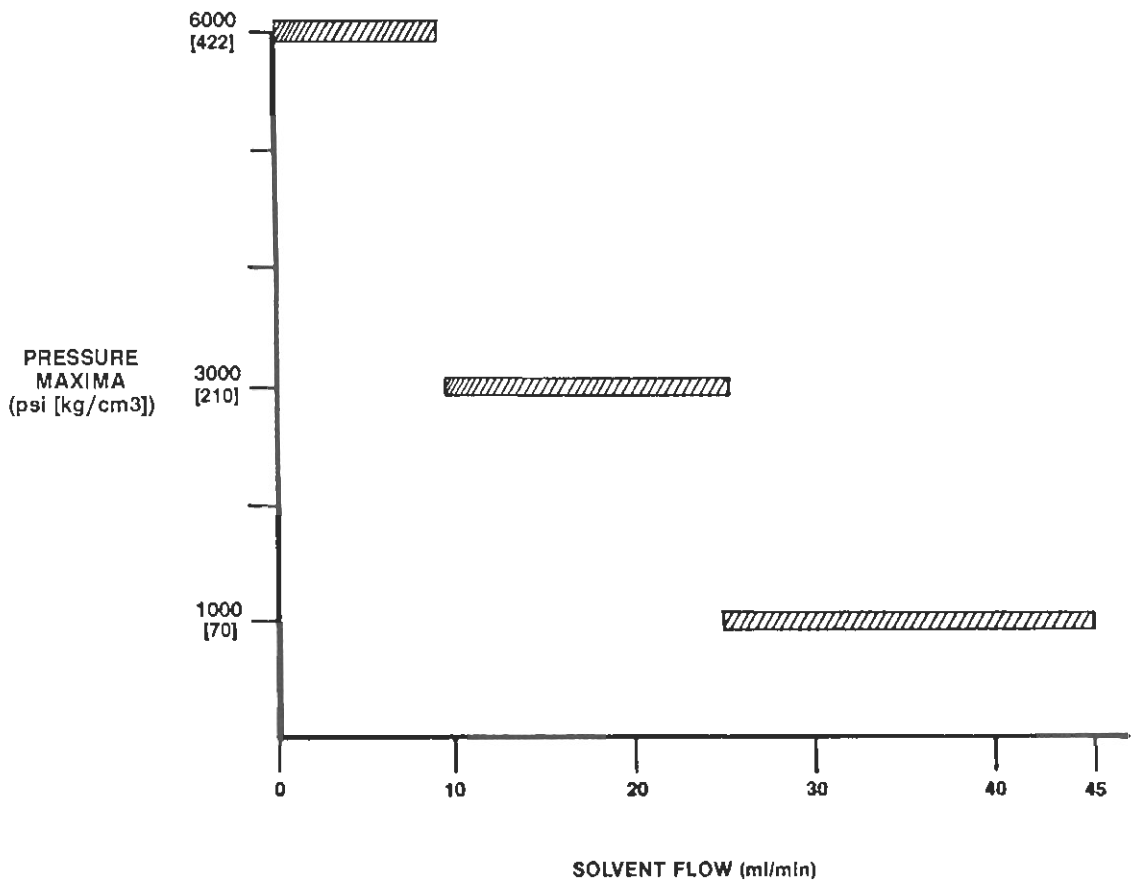


Figure 2-4 System Pressure Limit Range Versus Flow Rate

The high limit range is 51 to 6000 psi (3.5 to 422 kg/cm^2). Exceeding the high pressure limit for 1.2 seconds will cause shutdown. The low limit range is 0 to 5950 psi (0 to 418.5 kg/cm^2). Not meeting the low pressure limit for 60 seconds will cause shutdown.

Chart Out Monitors the flow rate and composition percentage of one of the four solvents, or temperature traces from the controller's CHART OUT connection. The results can be sent to an external data device. The range is 1 to 6.

Choose #	To record
1-4	Pump percent composition for solvent reservoirs A, B, C, or D
5	Flow rate
6	Column temperature

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Autostart Specifies in hours and minutes the amount of time you want to delay the start of gradient/event tables. The ranges are:

Functions	Allowable Ranges
Hours	0 to 99
Minutes	0 to 59
Tables	1 to 15

NOTE: If a gradient is running when Autostart reaches 00:00:00, it will be aborted and the tables selected for Autostart will be run. Locking the keyboard enables the Autostart feature.

2.3 PUMP CONFIGURATION SCREEN

You use the PUMP CONFIGURATION screen (Figure 2-5) to set the hardware configuration of your system. The parameters you set on this screen are seldom changed. You set values for:

- Unit type
- Pump head volume

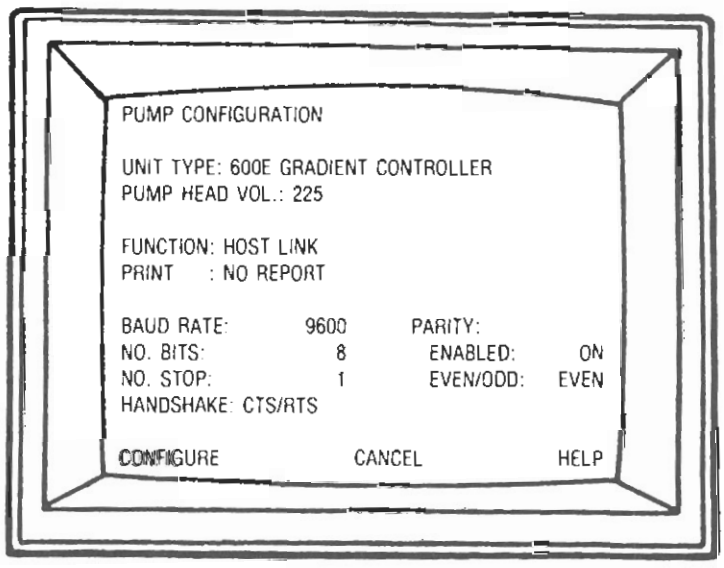


Figure 2-5 PUMP CONFIGURATION Screen

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2.3.1 Pump Configuration Keys

Other than the HELP key, there are two active keys when the PUMP CONFIGURATION screen is displayed:

- **CONFIGURATION** - If changes are made to the PUMP CONFIGURATION screen, the CONFIGURATION key must be pressed for the controller to accept the new selection. This reboots the system and all pump flows go to 0 mls/min.
- **CANCEL** - Returns you to the PUMP SETUP screen without making changes. The system does not reboot.

2.3.2 Pump Configuration Parameters

This section describes the parameters on the PUMP CONFIGURATION screen.

Unit Type Selects the mode of the system (operation as a gradient controller or system controller). The value is:

0 = Gradient Controller

NOTE: Unit Type entries 2 through 8 are dedicated for Waters preparative systems that use a 100 µl and above displacement pump heads and nonmetallic systems that use 50 µl displacement heads.

Pump Head Volume Identifies what pump head size is being used on the fluid unit. This parameter must match the actual pump head volume. The values are:

0 = 225 µl standard heads, #3 is stamped on the front face of the head

1 = 100 µl optional heads (low flow), nothing is stamped on the front face of the head

NOTE: Not correctly entering the pump head volume for your system causes incorrect flow rates to result. All other parameters on this screen have no function at this time.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2.4 ISOCRATIC SCREEN

The ISOCRATIC screen (Figure 2-6) allows direct, immediate control of an analysis that requires a constant mobile phase composition. There are no programmable (events table) functions in this mode.

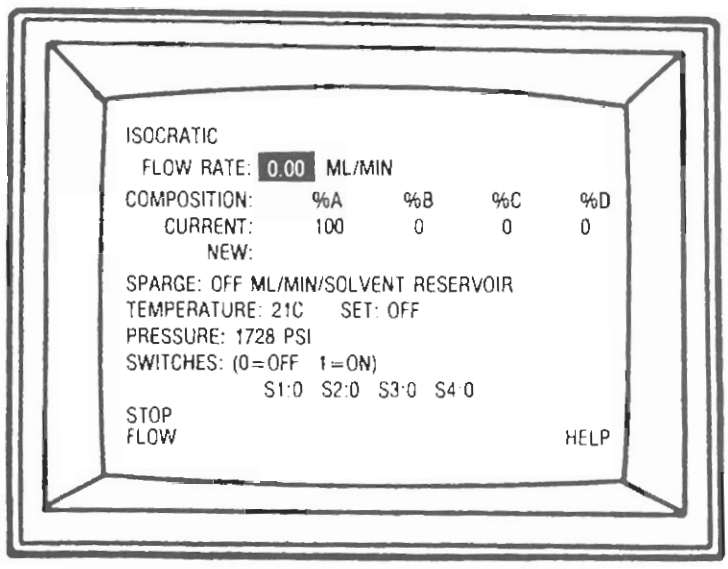


Figure 2-6 ISOCRATIC Screen

2.4.1 Isocratic Keys

Other than the HELP key, the only active key when the ISOCRATIC screen is displayed is the STOP FLOW key. This key stops the pump. To restart the flow, enter a new rate.

2.4.2 Isocratic Parameters

This section describes the parameters on the ISOCRATIC screen.

Flow Rate The flow rate depends on the type of pump selected on the PUMP SETUP screen. The ranges are:

0 to maximum flow
100 µl = 20.00 ml/min
225 µl = 45.00 ml/min

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Composition Specify the percentage of solvent flow from each reservoir. The total of all solvents (%A, %B, %C, and %D) must equal 100 percent. The range is:

0 to 100% per reservoir

Sparge Specifies the sparge rate for enabled reservoirs as set up in the PUMP SETUP screen. The range is:

0 to 100 ml/min per reservoir

CAUTION

Do not exceed 64°C when using the RCSS heater or damage may occur to the cartridge.

Temperature Specifies the desired operating temperature for the optional internal column heater. It must be less than or equal to the high temperature limit. The ranges are:

0 = Off
Minimum = 5°C over ambient
Maximum = 64°C for RCSS heater
99°C for stainless steel heater

Pressure Actively monitors the operating pressure (you cannot set this).

External Switches S1, S2, S3, and S4 correspond to the terminal blocks on the rear panel. Each parameter represents a contact closure switch used to control output to external devices. For more information, see Book III, Installation and Service. The values for each parameter are:

0 = Off
1 = On

2.5 PROGRAM GRADIENT SCREEN

The PROGRAM GRADIENT screen (Figure 2-7) allows you to perform gradient elution. Gradient elution is dependent on time-controlled changes of two or more solvents. Each solvent contributes varying percentages of the total mobile phase throughout the separation as determined by the gradient table. Flow rate and the time each unique set of conditions is in effect are used to generate a chromatogram of well-defined peaks in a minimum of time.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

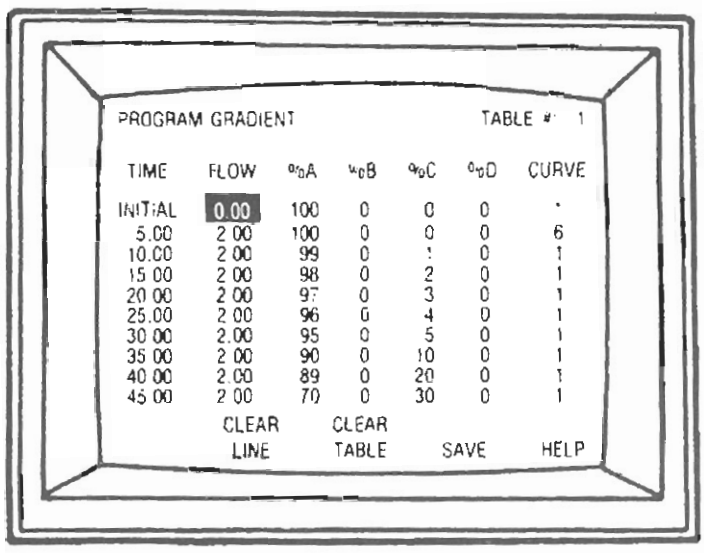


Figure 2-7 PROGRAM GRADIENT Screen

An essential part of the gradient program is the control you can exercise over the rate of change of the individual solvents in each segment. Each segment is described through the use of concave, convex, and linear composition profiles.

Beyond gradient separations, programs can be devised to prepare a system (for example, equilibration, solvent changeovers, cleanup following buffer use, or regulated flow rate increase for column warmup) using the four-reservoir capability of the system. Refer to Book I for more detail on creating automatic programs.

2.5.1 Program Gradient Keys

Other than the HELP key, there are three active keys when the PROGRAM GRADIENT screen is displayed:

- **CLEAR LINE** - Clears the line on which the cursor rests but does not erase the line from permanent memory.
- **CLEAR TABLE** - Clears the entire table currently displayed on the screen and returns the initial conditions line to default status. The table is not erased from permanent memory, until a new table is saved.
- **SAVE** - Saves the table currently displayed on the screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2.5.2 Program Gradient Parameters

This section describes the parameters on the PROGRAM GRADIENT screen.

Table # Specifies the particular program gradient table you want to run, edit, or create. The number of tables is:

1 to 15

Time Specifies the duration of the run which begins when the injection is made. The range is:

0.00 to 655.34 minutes

Flow Specifies the flow rate which depends on the type of pump. The ranges are:

0 to 100 µl = 20.00 ml/min maximum flow
0 to 225 µl = 45.00 ml/min maximum flow

%A, %B, %C, %D Specify the percentage of solvent flow from each reservoir. The total of all solvents (%A, %B, %C, and %D) must equal 100 percent. The range is:

0 - 100% per reservoir

Curve Specifies the rate of change of solvent composition or flow rate over time based on the curve number selected and the length of the gradient segment. Curve is specified on each line of the gradient table for the solvent composition or the flow rate. The range is 1 to 11. The available gradient curve shapes are shown in Figure 2-8 and described in Table 2-1.

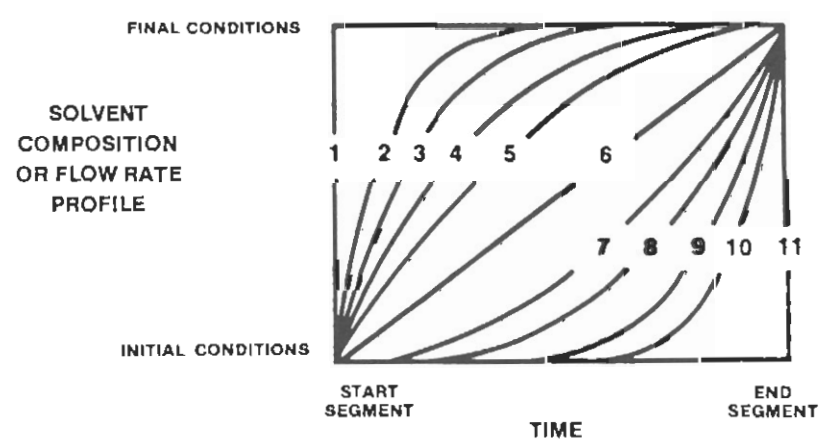


Figure 2-8 Gradient Curve Shapes

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 2-1 Curve Numbers

Curve number	Description
1	Go to end condition immediately
2 to 5	Convex
6	Linear
7 to 10	Concave
11	Maintain start conditions until end of segment (used to create step gradients)

For example, in the gradient table shown in Figure 2-9, mobile phase flows as soon as the pump is started with 100% Solvent A at 2 ml/min. The solvent composition changes to 80% Solvent A and 20% Solvent B in a steady, gradual fashion over the next three minutes using curve number 6. The flow rate remains unchanged.

GRADIENT TABLE

TIME *	FLOW *	% A	% B	% C	% D	CURVE
INITIAL	2.0	100	0	0	0	*
3.00	2.00	80	20	0	0	6

Figure 2-9 Example Gradient Table

Generally, whenever you want resolution at specific conditions within an analysis, couple the last curve with an opposite shape in the next timed segment. Whenever you wish to expedite the solvent change over (no resolution is taking place), use a steep curve.

2.5.3 Gradient Table Programming Considerations

It is good gradient programming practice to return the system to INITIAL conditions after the chromatography is complete. This allows the system to reequilibrate before the next injection. Included below are a series of programming considerations for incorporation into your gradient program.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Programmed return to initial conditions

The time required to equilibrate a system to initial conditions varies according to the type of column, mobile phase, application, and so on. Any standard must be substantiated through experience with your particular application. A return to initial conditions, allowing for sufficient equilibration time, can be accomplished regardless of the auto-injector used in the system.

The return to initial conditions should be programmed into the gradient table when performing automated runs.

Integrate the following into your gradient program:

- Program the line following the actual analysis for a time interval and reverse the pump percents and flow rate (if necessary) to the conditions at the start of the run.
- As indicated above, the number of steps (lines) used to return to initial conditions and the length of time required depend on your actual application requirements.

Programmed flow changes

Programming the pump to stop flow following a completed gradient program provides many benefits for ensuring fault-free, unattended operation. Solvent waste is minimized, and there is less chance of running the solvent reservoirs dry. If you are running buffered mobile phases, you do not want to let the system sit in buffers overnight without a flow through the system. Reducing the flow rate is useful to accomplish this after the runs are completed.

Include an additional line on the gradient table containing the following information:

- Set sufficient time after the last program line to allow completion of the analysis.
- Enter a flow rate of either 0.0 ml/min or a reduced flow rate.
- Enter the appropriate solvent composition percentages for %A through %D or copy the previous line.
- Enter curve number 11. The flow rate will therefore decrease only when the Time programmed for the line is reached, not gradually during the segment as with other curve profiles.

2.6 PROGRAM EVENT SCREEN

The PROGRAM EVENTS screen (Figure 2-10) allows you to schedule external events using the Program Event table. This table schedules external events which can be used to trigger fraction collectors or solvent switching valves or make changes in sparge rate and heater module temperature.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

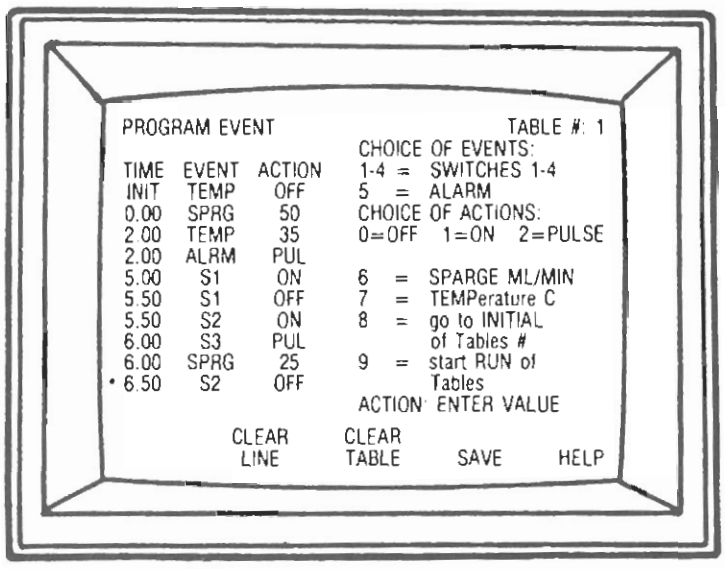


Figure 2-10 PROGRAM EVENT Screen

Synchronized output to external devices (such as fraction collectors or solvent switching valves) is incorporated into gradient operation by specifying the time, event, and action (on, off, pulse, temperature, or beginning a new set of tables) in a Program Event table.

An internal alarm (Event 5) can be used to serve as a reminder to the operator (for example, when programmed to signal the end of a run).

Devices connected to switches 1 through 4 can be turned ON or OFF at specific times during the analysis, or PULSED once (100 millisecond) at any programmed time (for example, to switch a column switching valve).

The Program Event table can also sequence or link existing tables to one another to form continuous methods outside of the program method.

Always check the contents of the Program Event table that has the same number as the Gradient table you have just edited. The Program Event table is required to run when the Gradient table with the same number is run.

2.6.1 Program Event Keys

Other than the HELP key, there are three active keys when the PROGRAM EVENT screen is displayed.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- **CLEAR LINE** - Clears the line on which the cursor rests but does not delete the line from permanent memory.
- **CLEAR TABLE** - Clears the entire table currently displayed on the screen and returns the initiai conditions line to default status. The table is not erased from permanent memory, until a new table is saved.
- **SAVE** - Saves the table currently displayed on the screen.

2.6.2 Program Event Parameters

This section describes the parameters on the PROGRAM EVENT screen.

Time Specifies the time during the run at which the specified Event and Action occur. The range is:

0.00 to 655.34 minutes

Event and Action Specifies the Event and Action occuring at the specified Time. The Events and available Actions are shown below.

Switches Events 1-4 Corresponds to the terminal blocks on the rear panel. Events 1-4 represent a contact closure switch used to control output to external devices. For more information, see Book III, Installation and Service. The action values for these events are:

0 = Off
1 = On
2 = Pulse (generates 100 millisecond pulse)

Alarm Event 5 Specifies whether the alarm is on or off. The action values for these events are:

0 = Off
1 = On
2 = Pulse

Sparge Event 6 Sets the sparge rate for the reservoirs enabled on the PUMP SETUP screen. The range is:

0 to 100 ml/min

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

CAUTION

Do not exceed 64°C when using the RCSS heater or damage may occur to the cartridge.

Temperature Event 7 — Sets the column heater temperature. Always check the method for adequate heating time before beginning the analysis. The ranges are:

RCSS heater = ambient +5°C to 64°C
Steel column heater = ambient +5°C to 99°C

Go Initial of Table # Event 8 — Takes you to the appropriate table and holds at initial conditions until an injection occurs upon which the new gradient and events tables are run.

Start run of Table # Event 9 — At whatever time this is executed, control of the run is handed over to the table number specified. The method begins immediately without an inject signal.

2.7 INITIAL OPERATE GRADIENT SCREEN

The OPERATE GRADIENT screens allow you to actually start the operation. There are two OPERATE GRADIENT screens which allow you to engage the program gradient and events tables saved in memory. The initial OPERATE GRADIENT screen (Figure 2-11) allows you to specify the Gradient and Event tables to be used.

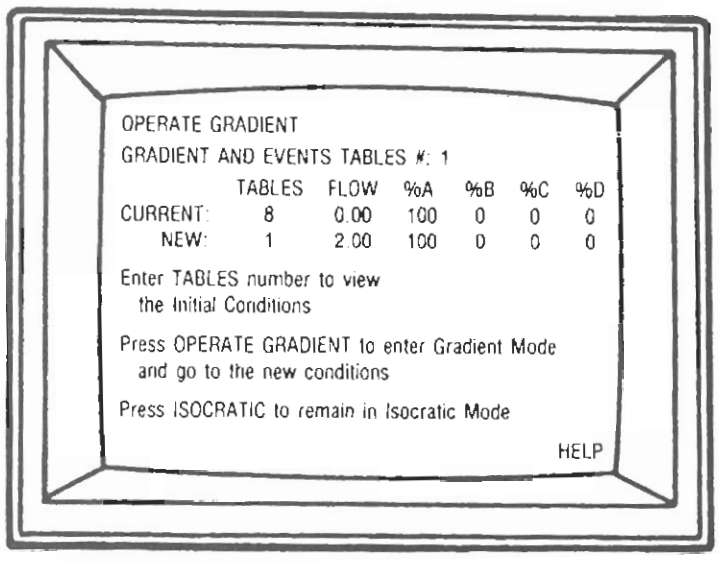


Figure 2-11 Initial OPERATE GRADIENT Screen

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2.7.1 Operate Gradient Keys

Other than the HELP key, the only active key when the initial OPERATE GRADIENT screen is displayed is the OPERATE GRADIENT key. This key engages the program gradient and events information saved in memory and displays the second OPERATE GRADIENT screen on which you supply or check information.

2.7.2 Operate Gradient Parameters

This section describes the parameters on the initial OPERATE GRADIENT screen.

Gradient and Event Tables # Specifies the Gradient and Event tables to be executed simultaneously. The cursor appears at this location and cannot be moved since this is the only accessible entry. The range of tables is:

1 to 15

Current Displays the composition and flow through the system for the current Gradient and Event table. These values are for display only.

New Indicates the initial conditions (composition and flow through the system) for the Gradient and Event tables entered in the Gradient and Event Tables # field. These values are for display only.

2.8 OPERATE GRADIENT SCREEN

The second OPERATE GRADIENT screen (Figure 2-12) allows you to check the initial conditions of the run. The system stays at initial conditions until you press the START RUN key.

NOTE: Any changes made to this screen may be overridden by a programmed change in the Gradient or Event tables.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

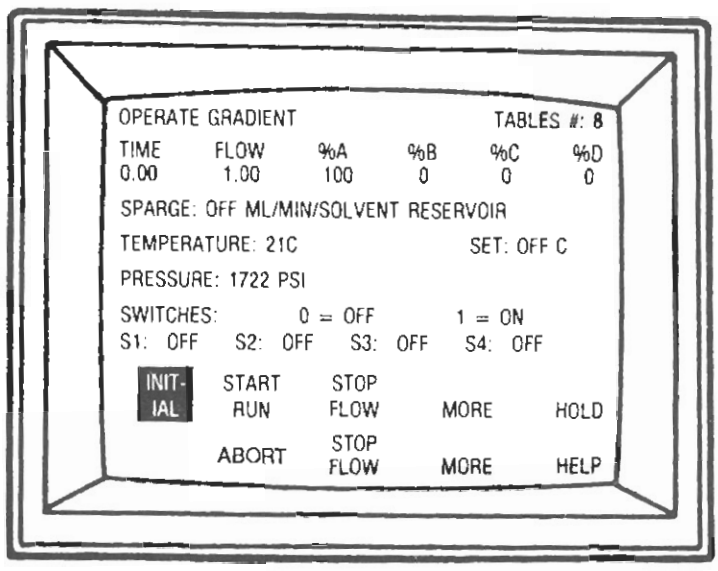


Figure 2-12 OPERATE GRADIENT Screen

2.8.1 Operate Gradient Keys

Other than the HELP key, there are seven active keys when the OPERATE GRADIENT screen is displayed:

- **START RUN** - Starts the gradient and run time at 00:00 minutes.
- **INITIAL** - Sends the program to initial conditions of the table. Ensure that the system is at initial conditions before a run start or an inject start input to the rear of the controller is transmitted.
- **STOP FLOW** - Stops solvent flow immediately without resetting the gradient time clock. This function key toggles with the RESUME key.
- **RESUME** - Allows the gradient time clock to continue once the HOLD key or STOP FLOW key is pressed. The clock does not reset to 00:00 minutes, but continues the run from where it was stopped.
- **MORE** - Provides access to additional function keys (available for this screen as listed below).
- **HOLD** - Stops the clock and keeps the composition and flow constant until RESUME is pressed, which allows the clock to continue.
- **ABORT** - Aborts the current operating gradient.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2.8.2 Operate Gradient Screen Parameters

This section describes the parameters on the second OPERATE GRADIENT screen.

Sparge Specifies the rates at which all reservoirs are enabled for helium sparging from the PUMP SETUP screen. The range is:

0 to 100 ml/min per reservoir

CAUTION

Do not exceed 64°C when using the RCSS heater of damage may occure to the cartridge.

Temperature Specifies the desired temperature for the internal column heater. It must be less than or equal to the high temperature limit on the PUMP SETUP screen. It changes if a modification has been specified in the Program Event table. The ranges are:

0 = Off
Minimum = 5°C over ambient
Maximum = 64°C for RCSS heater
99°C for stainless steel heater

Pressure Actively monitors system pressure.

Switches Specifies whether the external event switch output on the rear terminal strip is off or on. It changes if a change has been specified in the Program Event table. The ranges are:

0 = Off
1 = On
2 = Pulse

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3

POWERLINE SYSTEM CONTROLLER SCREENS

This chapter contains a description of the screens you use when operating the system as a PowerLine System Controller.

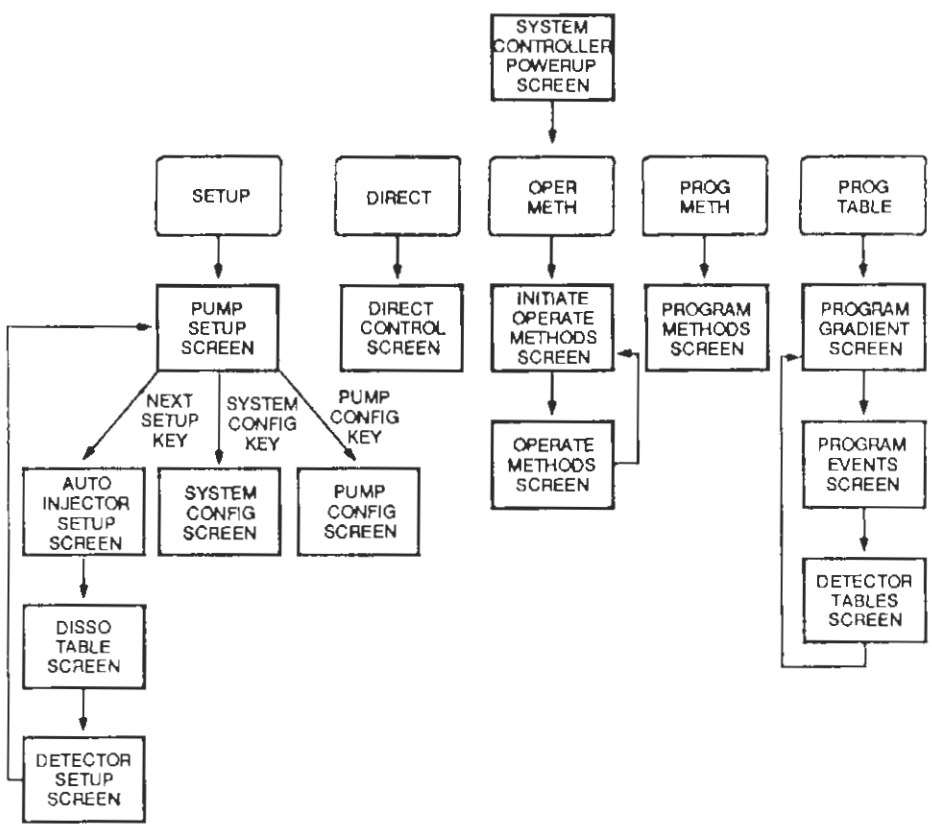


Figure 3-1 PowerLine Screens

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.1 POWER UP SCREEN

When you turn on the system the first screen you see is the POWER UP screen (Figure 3-2). The POWER UP screen provides information about the system. You are able to:

- Identify the revision level of the software
- See the results of the self-diagnostic tests
- Identify the controller (gradient or PowerLine) selected for the system
- Continue with operation by pressing any function key
- Access the extended (service level) tests by pressing the decimal point key

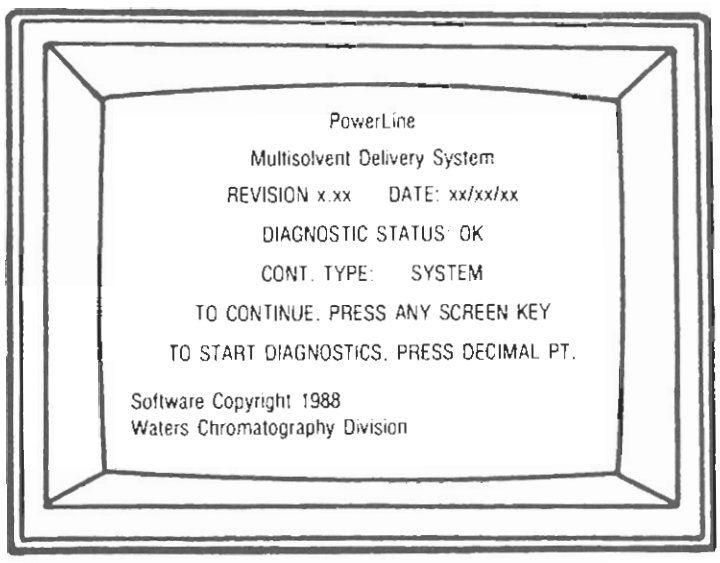


Figure 3-2 POWER UP Screen

3.2 PUMP SETUP SCREEN

You use the PUMP SETUP screen to make the initial system hardware configurations. From the PUMP SETUP screen, you access five secondary hardware configuration screens.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- PUMP CONFIGURATION screen displays the general operating conditions of the pump.
- SYSTEM CONFIGURATION screen displays the IEEE modules that are currently active.
- AUTO-INJECTOR SETUP screen displays the choices for the setup controls for vial injection.
- DISSOLUTION SETUP screen displays the choices for the setup controls for dissolution.
- DETECTOR SETUP screen displays the setup controls for UV conductivity or RI detection.

NOTE: Once configured these values are stored In memory and are used as the default values during subsequent powerups. The last entries stored in permanent memory appear when you access this screen. Values you enter on the PUMP SETUP screen apply to all system operations.

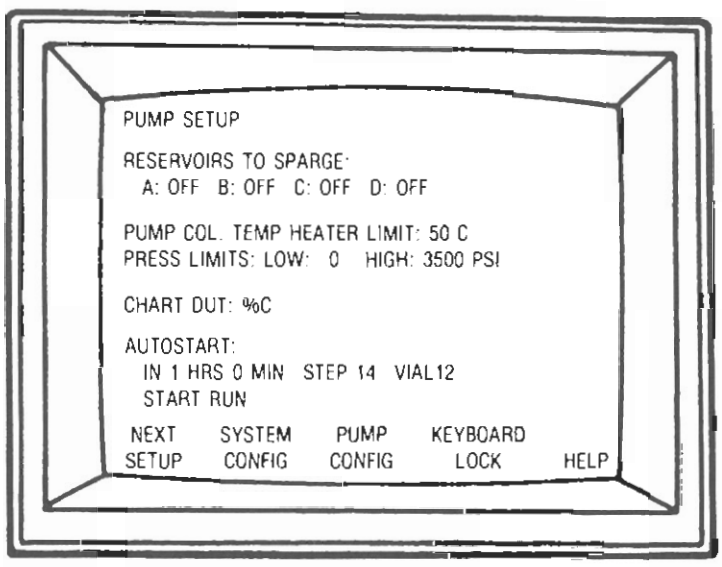


Figure 3-3 PUMP SETUP Screen

3.2.1 Pump Setup Keys

There are five active keys when the PUMP SETUP screen is displayed:

- **NEXT SETUP** - Brings you to the AUTO-INJECTOR SETUP screen. It can also take you from the AUTO-INJECTOR screen to the DISSOLUTION screen to the DETECTOR SETUP screen, if specified. From the DETECTOR SETUP screen it takes you back to the PUMP SETUP screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- **SYSTEM CONFIGURATION** - Brings you to the SYSTEM CONFIGURATION screen.
- **PUMP CONFIGURATION** - Brings you to the PUMP CONFIGURATION screen.
- **KEYBOARD LOCK** - Provides protection against the accidental entries or alteration of a program during operation or once the Autostart function has been engaged.

  Pressing this key locks or unlocks the keyboard. The keyboard is always unlocked at powerup.
- **HELP** - Provides online field-level reference information for each screen parameter.

3.2.2 Pump Setup Parameters

There are six parameters on the PUMP SETUP screen:

- Reservoirs to sparge
- Column/cartridge temperature heater limit*
- Operating pressure limits*
- Chart out
- Autostart
- Keyboard lock

Parameters marked with an asterisk (*) are displayed and monitored during operation. If the system exceeds the set limits, system shutdown occurs and a HOLD signal is sent from the terminal trip at the rear of the controller to the automatic injector. Other parameters are held in their current states. See Chapter 4 for error messages and shutdown causes.

Reservoirs to Sparge

The Reservoirs to Sparge field is a *required* parameter to use helium sparging. It is enabled on the PUMP SETUP screen and allows you to indicate which reservoirs you want to enable for helium sparging. The settings for this parameter are:

0 = Disabled
1 = Enabled

The actual sparge flow rate for all enabled reservoirs is set on the DIRECT CONTROL, OPERATE METHODS, or PROGRAM EVENT screens.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

CAUTION

Do not exceed 64°C when using the RCSS heater or damage may occur to the cartridge.

Temperature Limit Sets the upper temperature limit for the optional stainless steel column/RCSS heater modules. The valid ranges for this parameter are:

0 = Off
Minimum = 5°C over ambient
Maximum = 64°C for RCSS heater
99°C for stainless steel heater

The heater temperature limit must always be greater than the operating temperature set on the DIRECT CONTROL, OPERATE METHOD, or PROGRAM EVENT screen. Exceeding the maximum operating temperature for more than 1.2 seconds causes the system to shutdown.

Pressure Limits Defines the high and low operating pressure limits of the fluid handling unit. This selection is *required* for high backpressure/high flow rate operation with the U6K injector. Optionally, use this parameter to prevent instrument or column damage if an obstruction or leak occurs after the pump. Figure 3-4 displays the system pressure limit range versus the flow rate.

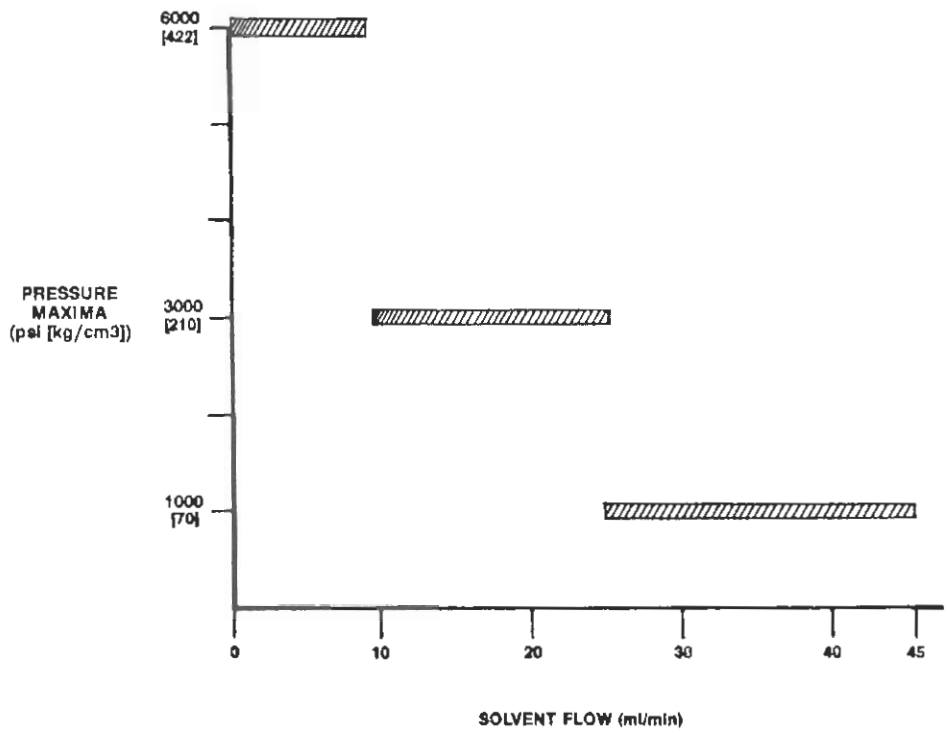


Figure 3-4 System Pressure Limit Range Versus Flow Rate

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The high limit range is 51 to 6000 psi (3.5 to 422 kg/cm^2). Exceeding the high pressure limit for 1.2 seconds will cause shutdown. The low limit range is 0 to 5950 psi (0 to 418.5 kg/cm^2). Not meeting the low pressure limit for 60 seconds will cause shutdown.

Chart Out Monitors the flow rate, % composition of one of the four solvents, or temperature traces from the controller's CHART OUT connections. The results can be sent to an external data device. The range is 1 to 6.

Choose #	To record
1-4	Pump percent composition for solvent reservoirs A, B, C, or D
5	Flow rate
6	Column temperature

Autostart Specifies in hours and minutes the amount of time you want to delay the start of an automatic method. The ranges are:

Functions	Allowable Ranges
Hours	0 to 99
Minutes	0 to 59
Step #	1 to 48
Vial #	1 to 48/96

Specify where you want the Program Method table to begin execution by entering the desired Step # and Vial #.

When you want to enable Autostart, press the **LOCK KEYBOARD** key. The legend changes to UNLOCK KEYBOARD. Press this to cancel the Autostart and unlock the keyboard.

NOTE: If a gradient is running when Autostart reaches 00:00:00, it will be aborted and information selected for Autostart will be run.

3.3 PUMP CONFIGURATION SCREEN

You use the PUMP CONFIGURATION screen (Figure 3-5) to set the hardware configuration of your system. The parameters you set on this screen are seldom changed. You set values for:

- Unit type
- Pump head volume
- RS-232 host link selection
- Integrator reporting selection
- Serial communication selections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

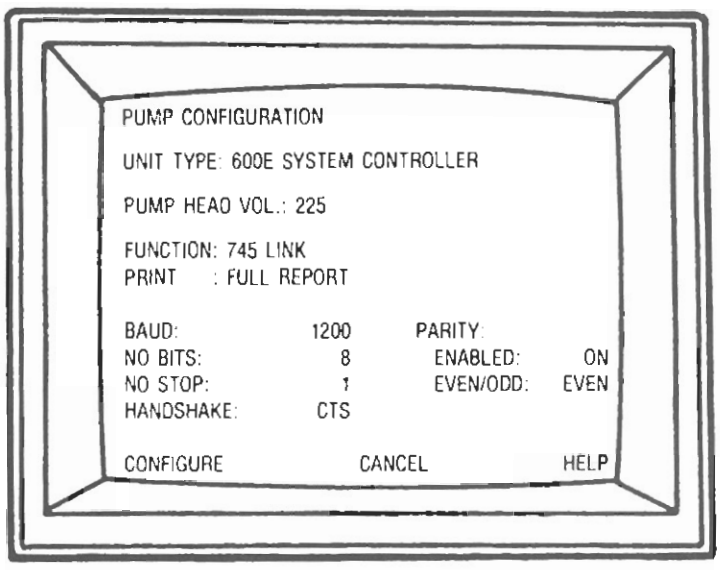


Figure 3-5 PUMP CONFIGURATION Screen

3.3.1 Pump Configuration Keys

Other than the HELP key, there are two active keys when the PUMP CONFIGURATION screen is displayed:

- **CONFIGURATION** - If changes are made to the PUMP CONFIGURATION screen, the CONFIGURATION key must be pressed for the controller to accept the new selection. This reboots the system and the pump flow goes to zero.
- **CANCEL** - Returns you to the PUMP SETUP screen without making changes.

3.3.2 Pump Configuration Parameters

This section describes the parameters on the PUMP CONFIGURATION screen.

Unit Type Selects the mode of the system (operation as a gradient controller or system controller). The value is:

0 = Gradient Controller
1 = Powerline System Controller

NOTE: Entries 2 through 8 are dedicated for Waters preparative systems that use a 100 µl and above displacement pump heads and nonmetallic systems that use 50 µl displacement heads.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Pump Head Volume Identifies what pump head size is being used on the fluid unit. This parameter must match the actual pump head volume. The values are:

0 = 225 µl standard heads, #3 is stamped on the front face of the head

1 = 100 µl optional heads (low flow), nothing is stamped on the front face of the head

NOTE: Not correctly entering the pump head volume for your system causes incorrect flow rates to result. All other parameters on this screen have no function at this time.

Function Selects the RS-232 host link. The values are:

0 = For use with a Waters Data and Control Workstation (825, 815, 990) (default)
1 = For use with a Waters 745B Integrator

NOTE: If no communication is desired, use the default.

Print Sets the type of printout to be generated on the Waters 745B Integrator. The print selections are:

0 = No report (default)
1 = Short report
2 = Abridged report
3 = Full report

RS-232 Parameters Define the RS-232 serial communications interface for the controller. The correct default values are supplied when you select the Function.

CAUTION

Do not change any of the default parameters or communication errors will result.

The defaults defined by the system are:

	Function = 0 (Host Link)	Function = 1 (745B)
Baud rate	9600	1200
Bit number	8	8
Stop bits number	1	1
Handshake	CTS/RTS	CTS
Parity:		
Enabled	NO	NO
Even/odd	Even	Even

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.4 SYSTEM CONFIGURATION SCREEN

The SYSTEM CONFIGURATION screen (Figure 3-6) allows you to verify what PowerLine modules are currently active on the IEEE 488 interface, along with the IEEE 488 address of each.

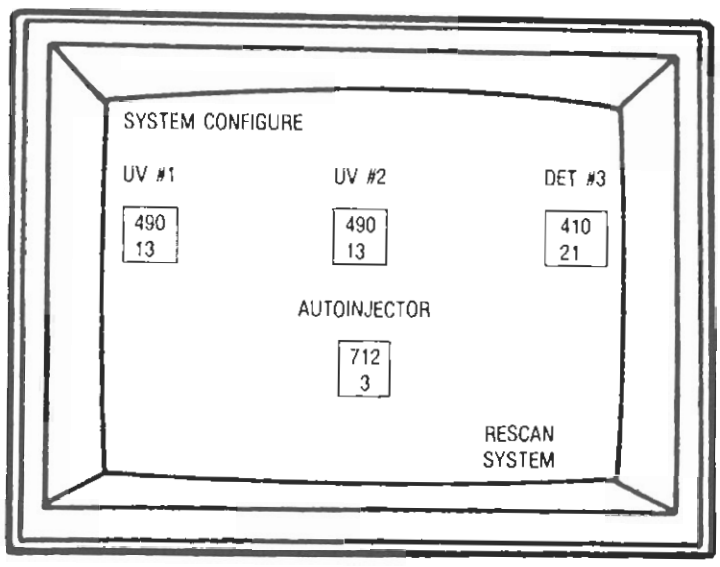


Figure 3-6 SYSTEM CONFIGURATION Screen

Screen keys The one active key when the SYSTEM CONFIGURATION screen is displayed is RESCAN SYSTEM. If a module is turned on after the controller is powered up or it has been added as a unit to the system, press the RESCAN SYSTEM key. The controller screen acknowledges the presence of the unit by displaying it with other units in the configuration. All modules on the IEEE 488 bus must have finished their individual powerup calibration sequences before they are recognized by the controller.

3.5 AUTO-INJECTOR SETUP SCREEN

The AUTO-INJECTOR SETUP screen (Figure 3-7) allows you to configure an externally attached PowerLine Auto-Injector. You set values for:

- Syringe draw rate
- Inject delay
- Auto standards
- Dissolution

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

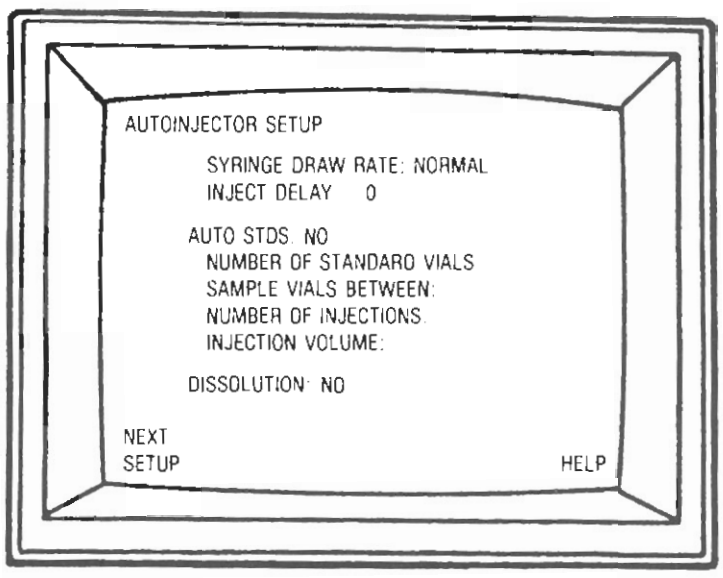


Figure 3-7 AUTO-INJECTOR SETUP Screen

3.5.1 Auto-Injector Keys

Other than the HELP key, the one active key when the AUTO-INJECTOR SETUP screen is displayed is NEXT SETUP. The NEXT SETUP function key cycles you through the AUTO INJECTOR SETUP screen, the DETECTOR SETUP screen, and then back again to PUMP SETUP screen. If DISSOLUTION is specified, pressing NEXT SETUP from the AUTO-INJECTOR SETUP screen cycles you to the DISSOLUTION SETUP screen (See Figure 3-8).

3.5.2 Auto-Injector Setup Parameters

This section describes the parameters on the AUTO-INJECTOR SETUP screen.

Syringe Draw Rate Selects the rate at which the auto-injector draws the sample from the vial. The draw rate values are:

0 = Slow (1.8 µl per second)
1 = Normal (3.7 µl per second) (default)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Inject Delay Allows you to delay the injection. The gradient method starts and the system waits until the specified volume of solvent has been pumped before the injection occurs. The range is:

0.0 to 9.9 ml
0.0 = default

Auto Standards Runs the standards specified at the beginning of the method. The standards are repeated after the specified number of sample vials are processed. Standards, as defined for auto standards, must be located in the first five vial locations of the carousel beginning with Vial # 1. The auto standards values are:

0 = No (default)
1 = Yes

Entering 1 (yes) allows you to input the following parameters:

Number of Standard Vials: 1 to 5
Sample Vials Between: 1 to 48/96
Number of Injections: 1 to 9
Injection Volume: 1 to 2000

NOTE: When an equilibrate function has been run, it resets the autostandards. The standards are run immediately after an equilibrate step when autostandards is enabled.

Dissolution Enables the Dissolution Control function and displays the DISSOLUTION SETUP screen.

0 = No (Default)
1 = Yes

3.6 DISSOLUTION SETUP SCREEN

The DISSOLUTION SETUP screen (Figure 3-8) is used to coordinate the transfer of the dissolution samples into the WISP carousel while performing chromatography on previously collected samples or calibration standards. The primary function is acquiring the samples from the dissolution bath at the times listed in the Dissolution table. When the 712D auto-injector is not in the process of collecting samples, chromatography may be run. The setup in Figure 3-8 indicates that samples taken at 15, 30, 45, 60, 90, and 120 minutes will be placed in locations 7 to 42.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

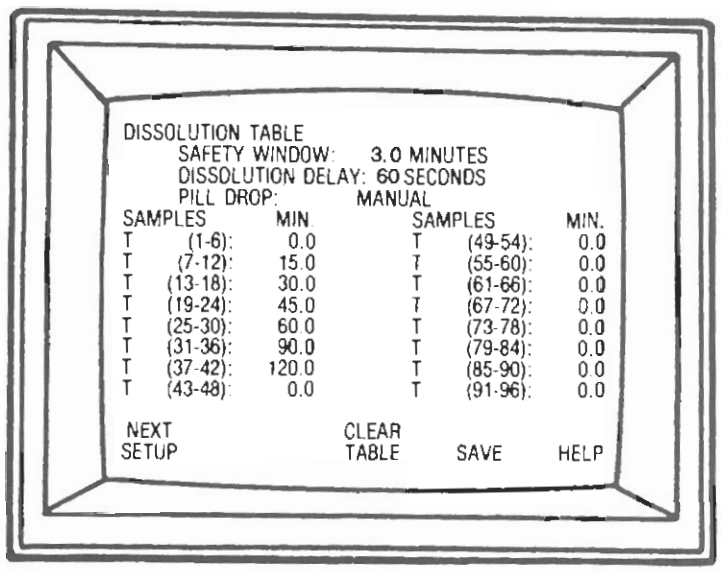


Figure 3-8 DISSOLUTION SETUP Screen

3.6.1 Dissolution Setup Keys

Other than the HELP key, there are three active keys when the DISSOLUTION SETUP screen is displayed:

- **NEXT SETUP** - Cycles you to the DETECTOR SETUP screen.
- **CLEAR TABLE** - Clears the entire table currently displayed on the screen and returns the initial conditions line to default status. The table is not erased from permanent memory, until a new table is saved.
- **SAVE** - Saves the table currently displayed on the screen.

3.6.2 Dissolution Setup Parameters

This section describes the parameters on the DISSOLUTION SETUP screen.

Safety Window Specifies the chromatography run time plus the subsequent sample and system setup time. This completed cycle of time ensures that the PowerLine system controller, data workstation, or integrator can sufficiently complete the downloading of methods or analysis prior to injecting the next scheduled sampl. This period of time is monitored by the system. The default is three minutes.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Dissolution Delay Specifies the time that the 712D carousel sits in the correct position to accept the dissolution samples from the dissolution bath. The value can be obtained by adding 10 seconds to the sum of the times for all eight events. The default is 60 seconds.

Pill Drop Refers to the method in which the tablets are introduced into the dissolution test station. If Auto is selected, the dissolution test station must be equipped with a Hanson mechanical pill dropper which can be obtained directly from Hanson Research Corporation.

Manual - Indicates that the tables will be placed in the dissolution test station by the operator. Once the tablets are placed into the dissolution test station the operator starts the controller by pressing the START RUN key. No pulse of Event #1 will take place, therefore vial locations 1 to 6 can be used to store all standard vials.

Automatic - When Auto is activated, Event #1 is pulsed when the START RUN key is pressed at the beginning of the operation of the multi-method (t_0). The Hanson Transfer Controller transfers blank dissolution media into vial locations 1 to 6. This sampling process at the beginning of the dissolution test causes the mechanical pill dropper to dispense the tablets into the dissolution media, therefore starting the dissolution test.

Samples Establishes the time points and vial locations for acquisition of the dissolution samples from the Hanson Transfer Controller. For each time in the table that is greater than 0, a pulse is sent over Event #1 to the Hanson Transfer Controller at a time equal to the value in the program methods table. The program methods table always provides the order of events. The range for values is:

0.0 to 9,999.9 minutes

3.7 DETECTOR SETUP SCREEN

The DETECTOR SETUP screen allows you to configure externally attached PowerLine detectors. You may configure three different detectors; two UV absorbance detectors (Waters 484 and/or 490) and one refractive index (RI) detector (Waters 410) or one conductivity detector (Waters 431). DET#1 and DET#2 are dedicated for the UV detectors, and DET#3 is always dedicated for the RI or conductivity detectors. The UV selections for DET#1 and DET#2 accommodate the following combinations

- Two channels dedicated to the 484s
- Two channels dedicated to the 490
- One channel dedicated to the 484 and the other dedicated to the 490

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

If you want DET#1 for the 484 and DET#2 for the 490, then the IEEE address of the 484 must be less that the address of the 490. If the IEEE address of the 484 is higher, the controller assigns both channels to the 490 and does not recognize the 484.

If you change the IEEE address of these devices you must turn them off and on again to reset the address internally.

Figure 3-9 depicts the DETECTOR SETUP screen for two Waters 484s and one Waters 431.

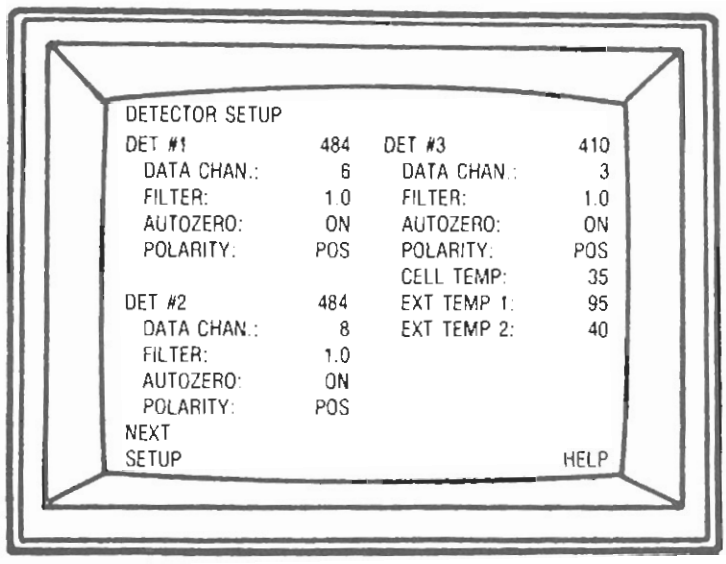


Figure 3-9 DETECTOR SETUP Screen

3.7.1 Detector Setup Keys

Other than the HELP key, the one active key when the DETECTOR SETUP screen is displayed is NEXT SETUP. The NEXT SETUP function key cycles you through the AUTO-INJECTOR SETUP screen, the DETECTOR SETUP screen, and back to PUMP SETUP screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.7.2 Detector Setup Parameters

This section describes parameters on the DETECTOR SETUP screen.

Data Channel Documents specific analog input to a data workstation but does not affect operation. It is a place for you to make a note on what channel of the data system the detector analog signal is wired to. The range is:

1 to 9

UV Filter Constant Specifies the time constant of the digital noise filter applied to the output of the detector. The range is:

0 to 99.9
1 = default

Auto Zero Specifies whether the detector should zero its output at every injection and wavelength change. The values are:

1 = ON (default)
0 = OFF

Polarity Specifies whether the data output of the detector is normal (positive polarity) or whether the data should be inverted (negative polarity). The values are:

1 = POS (default)
0 = NEG

410 Filter Constant Specifies the time constant of the digital noise filter applied to the output of the detector. The values are:

0.0 = default
0.2
1.0
3.0
10.0

431 Filter Constant Specifies the time constant to optimize the analog output signal-to-noise rates (without affecting sensitivity). The values are:

0 = Fast (0.25 seconds)
1 = Normal (0.5 seconds) (default)
2 = Slow (1.0 second)

431 Balance Allows you to manually set the baseline offset of the external chart recorder. The range is:

0 to 100% in 1% increments (default is 0)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Cell Temperature Sets the internal oven temperature of the 410 and defines an alarm to be set at 5° above that temperature. The range is:

Off = default
30° to 50°

External Temperature 1 and External Temperature 2 Specifies the set temperature of external column heater (1 and 2) connected to the 410. The values are:

0 = Off (default)
Radial Heater Module (RHM) = 0 to 70°
Column Heater Module (CHM) = 0 to 150°

3.8 DIRECT CONTROL SCREEN

The DIRECT CONTROL screen (Figure 3-10) allows you to directly control all operating parameters.

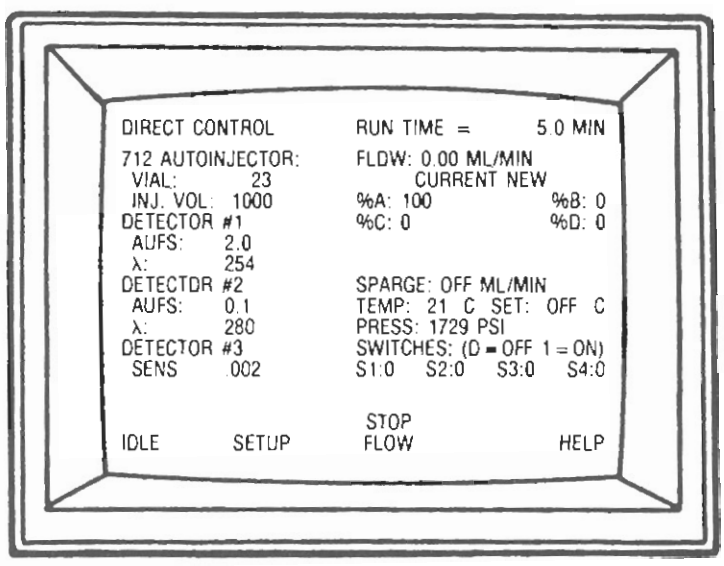


Figure 3-10 DIRECT CONTROL Screen

The right side of the screen allows you to control pump and event conditions such as changing flow rate as well as setting sparge rate, temperature, and switches.

The left side of the screen allows you to control detector and injector conditions such as vials, injection volume for each vial, absorbance units full scale and wavelength (or sensitivity).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.8.1 Direct Control Keys

Other than the HELP key, there are five active keys when the DIRECT CONTROL screen is displayed:

- **IDLE** - Specifies that the system is not currently running. It toggles with the SETUP key.
- **SETUP** - Allows you to set the system to the new parameters. Press START RUN from this screen to begin operation.
- **STOP FLOW** - Stops the pump. To restart the flow, enter a new rate or press RESUME.
- **RESUME** - Toggles with STOP FLOW. It returns you to the previous conditions.
- **ABORT** - Stops the run in progress.

Two messages are displayed that describe the state of the system:

- **START RUN** - Indicates that the system run has been started by a contact closure or an auto-injector.
- **INITIAL** - System is on Initial conditions waiting for a start from an external closure or auto-injector to start the run.

3.8.2 Direct Control Parameters

This section describes the parameters on the DIRECT CONTROL screen.

Auto-Injector Specifies the auto-injector vial and injection volume for drawing a sample or a special function as indicated by a Vial number of 100 or above.

Vial — Specifies the auto-injector vial number. The available values for drawing a sample are:

1 to 96 = auto-injector vials

Injection volume — Specifies the amount of sample drawn from the vial. The range is:

0.1 to 200/2000 µl

Vial special functions — Allow you to program the system to perform a number of special functions. The values are:

100 Manual Injector - Tells the controller that the injection occurs by a manual injector. This can be used either a manual injector or from a contact closure from a non-PowerLine auto-injector.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

101 Equilibrate system - The system goes to the initial conditions of the table indicated, and holds these conditions for the specified run time.

102 Purge 410 Detector - Puts the 410 flow path into purge mode, goes to initial conditions of the table specified, and holds these conditions for the specified run time.

103 Purge Auto-injector - Places the auto-injector into the purge routine. The run time defaults to 4.5 minutes. The system goes to the initial condition of the specified table.

104 Prep (no injection) - Runs preparative chromatography where the sample is pumped onto the column via one of the solvent lines. It allows the system to run with no injector. The # of Injections column allows you to do multiple prep runs automatically. You can also use this to run blank gradients as well as to reequilibrate a column using a gradient curve to get to final conditions.

105 Auto Base - Holds the system at the initial conditions of the table indicated for the RUN TIME indicated. At the end of the RUN TIME, it executes the Auto Baseline routine.

106 DET#3 Pos Polarity - Sets the Polarity of Detector #3 to positive. Updates detector setup screen for documentation purposes. No other fields on this step are accessible if vial 106 is selected.

107 DET#3 Neg Polarity - Sets the Polarity of Detector #3 to negative. Updates detector setup screen for documentation purposes. No other fields on this step are accessible if Vial 107 is selected.

DET#1 **DET#2** These channels are reserved for UV detection and are automatically assigned by the controller. The detector values are:

AUFS Absorbance Units Full Scale (AUFS) specifies the full scale sensitivity of these detectors. The range is:

0.001 to 2 AU

Lambda (λ) Specifies the UV wavelength that the detector should use for operation. The range is:

190 to 600 nm

DET#3 Setup specifically for use with the 410 or 431 detector.

SENS Specifies the sensitivity of the 410 or 431 detector. The values are:

410: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024
431: 0.1, 0.05, 0.02, 0.01, 0.005, 0.002, 0.001, 0.0005

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Run Time Specifies the duration of the run which begins when the injection is made. **The 710/712 has a minimum 1.00 minute run time.** The range is:

0.00 to 655.34 minutes

Flow Rate The flow rate depends on the type of pump selected on the PUMP SETUP screen. The ranges are:

0 to maximum flow
100 µl = 20.00 ml/min
225 µl = 45.00 ml/min

Composition Specify the percent solvent flow from each reservoir. The total of all solvents, %A, %B, %C, %D, must equal 100 percent. The range is:

0 to 100% per reservoir

Sparge Specifies the sparge rate for enabled reservoirs as set up on the PUMP SETUP screen. The range is:

0 to 100 ml/min per reservoir

CAUTION

Do not exceed 64°C when using the RCSS heater or damage may occur to the cartridge.

Temperature Specifies the desired operating temperature for the optional internal column heater. It must be less than or equal to the high temperature limit. The ranges are:

0 = Off
Minimum = 5°C over ambient
Maximum = 64°C for RCSS heater
99°C for stainless steel heater

3.9 PROGRAM GRADIENT SCREEN

The PROGRAM TABLE key accesses three control tables:

- PROGRAM GRADIENT
- PROGRAM EVENT
- DETECTOR TABLE

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The PROGRAM GRADIENT screen (Figure 3-11) allows you to perform gradient elution. Gradient elution is dependent on time-controlled changes of two or more solvents. Each solvent contributes varying percentages of the total mobile phase throughout the separation as determined by the gradient table.

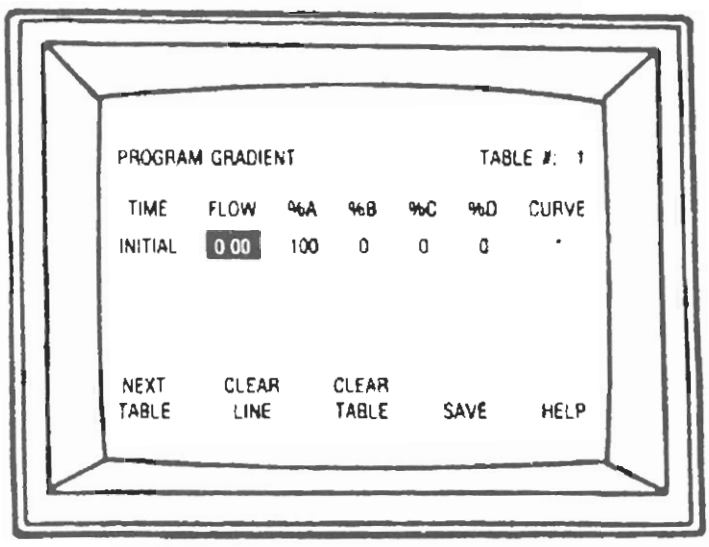


Figure 3-11 PROGRAM GRADIENT Screen

An essential part of the gradient program is the control you can exercise over the rate of change of the individual solvents in each segment. Each segment is described through the use of concave, convex, and linear composition profiles.

Beyond gradient separations, programs can be devised to prepare a system (for example, equilibration, solvent changeovers, cleanup following buffer use, or regulated flow rate increase for column warmup) using the four-reservoir capability of the system. Refer to Book I for more detail on creating automatic programs.

3.9.1 Program Gradient Keys

Other than the HELP key, there are four active keys when the PROGRAM GRADIENT screen is displayed:

- **NEXT TABLE** - Cycles you through the PROGRAM EVENT screen, DETECTOR TABLES screen, and back to the PROGRAM GRADIENT screen.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- **CLEAR LINE** - Clears the line on which the cursor rests but does not erase the line from permanent memory.
- **CLEAR TABLE** - Clears the entire table currently displayed on the screen and returns the initial conditions line to default status. The table is not erased from permanent memory, until a new table is saved.
- **SAVE** - Saves the table currently displayed on the screen. You must save the table before you go to the next screen.

3.9.2 Program Gradient Parameters

This section describes the parameters on the PROGRAM GRADIENT screen.

Table # Specifies the Program Gradient table you want to create or edit. The range of tables is:

1 to 15

Time Specifies the duration of the analysis which begins when the injection is made. The range is:

0.00 to 655.34 minutes

Flow Specifies the flow rate which depends on the type of pump. The ranges are:

0 to maximum flow
100 µl = 20.00 ml/min
225 µl = 45.00 ml/min

%A, %B, %C, and %D Specify the percentage solvent flow from each reservoir. The total of all solvents, %A, %B, %C, and %D, must equal 100 percent. The range is:

0 to 100% per reservoir

Curve Specifies the rate of change of solvent composition or flow rate over time based on the curve number selected and the length of the gradient segment. Curve is specified on each line of the gradient table for the solvent composition or the flow rate. The range is 1 to 11. The available gradient curve shapes are shown in Figure 3-12 and described in Table 3-1.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

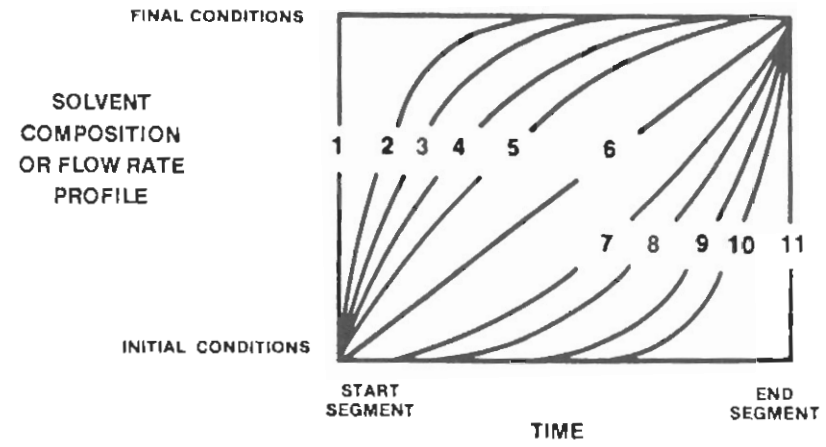


Figure 3-12 Gradient Curve Shapes

Table 3-1 Curve Numbers

Curve number	Description
1	Go to end condition immediately
2 to 5	Convex
6	Linear
7 to 10	Concave
11	Maintain start conditions until end of segment (used to create step gradients)

For example, in the gradient table shown in Figure 3-13, mobile phase flows as soon as the pump is started with 100% Solvent A at 2 ml/min. The solvent composition changes to 80% Solvent A and 20% Solvent B in a steady, gradual fashion over the next three minutes using curve number 6. The flow rate remains unchanged.

GRADIENT TABLE

TIME *	FLOW *	% A	% B	% C	% D	CURVE
INITIAL	2.0	100	0	0	0	*
3.00	2.00	80	20	0	0	6

Figure 3-13 Example Gradient Table

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Generally, whenever you want resolution at specific conditions within an analysis, couple the last curve with an opposite shape in the next timed segment. Whenever you wish to expedite the solvent change over (no resolution is taking place), use a steep curve.

3.9.3 Program Gradient Programming Considerations

It is good gradient programming practice to return the system to initial conditions after the chromatography is complete. This allows the system to reequilibrate before the next injection. Included below are a series of programming considerations for incorporation into your gradient program.

Programmed return to initial conditions

The time required to equilibrate a system to initial conditions varies according to the type of column, mobile phase, application, and so on. Any standard must be substantiated through experience with your particular application. A return to initial conditions, allowing for sufficient equilibration time, can be accomplished regardless of the auto-injector used in the system.

The return to initial conditions should be programmed into the gradient table when performing automated runs.

Integrate the following into your gradient program:

- Program the line following the actual analysis for a time interval and reverse the pump percents and flow rate (if necessary) to the conditions at the start of the run.
- As indicated above, the number of steps (lines) used to return to initial conditions and the length of time required depend on your actual application requirements.

Programmed flow changes

Programming the pump to stop flow following a completed gradient program provides many benefits for ensuring fault-free, unattended operation. Solvent waste is minimized, and there is less chance of running the solvent reservoirs dry. If you are running buffered mobile phases, you do not want to let the system sit in buffers overnight without a flow through the system. Reducing the flow rate is useful to accomplish this after the runs are completed.

Include an additional line on the gradient table containing the following information:

- Set sufficient time after the last program line to allow completion of the analysis.
- Enter a flow rate of either 0.0 ml/min or a reduced flow rate.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- Enter the appropriate solvent composition percentages for %A through %D or copy the previous line.
- Enter curve number 11. The flow rate will therefore decrease only when the Time programmed for the line is reached, not gradually during the segment as with other curve profiles.

3.10 PROGRAM EVENT SCREEN

The PROGRAM EVENT screen (Figure 3-14) allows you to create an event table to:

- Activate external devices (such as fraction collector or solvent switching valves) through switches S1 to S4
- Activate an internal alarm as an operator prompt
- Set the sparge flow rate
- Set the column/cartridge heater temperature
- Proceed to a new table and hold analysis
- Proceed to a new table and automatically begin execution

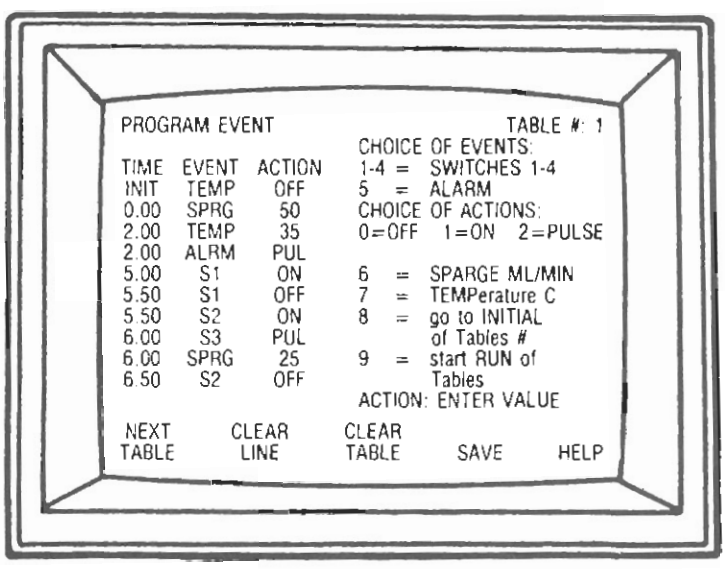


Figure 3-14 PROGRAM EVENTS Table

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Synchronized output to external devices (such as fraction collectors or solvent switching valves) is incorporated into gradient operation by specifying the time, event, and action (on, off, pulse, temperature, or beginning a new set of tables) in a Program Event table.

An internal alarm (Event 5) can be used to serve as a reminder to the operator (for example, when programmed to signal the end of a run).

Devices connected to switches 1 through 4 can be turned ON or OFF at specific times during the analysis, or PULSED once (100 millisecond) at any programmed time (for example, to switch a column switching valve).

The Program Event table can also sequence or link existing tables to one another to form continuous methods outside of the program method.

The Program Event table is not *required* to run a method, but it will execute with the detector and gradient tables when accessed from the PROGRAM METHODS screen.

3.10.1 Program Event Keys

Other than the HELP key, there are four active keys when the PROGRAM EVENT screen is displayed:

- **NEXT TABLE** - Cycles you through the DETECTOR TABLES and back to the PROGRAM GRADIENT screen.
- **CLEAR LINE** - Clears the line on which the cursor rests but does not erase the line from permanent memory.
- **CLEAR TABLE** - Clears the entire table currently displayed on the screen and returns the initial conditions line default status. The table is not erased from permanent memory, until a new table is saved.
- **SAVE** - Saves the table currently displayed on the screen. The table must be saved before you move to the next screen.

3.10.2 Program Event Parameters

This section describes the parameters on the PROGRAM EVENT screen.

Table # Specifies the Program Event table you want to create or edit. The range of tables is:

1 to 15

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Time Specifies the time during the run at which the specified Event and Action occur. The range is:

0.00 to 655.34 minutes

Event and Action Specifies the Event and Action occurring at the specified Time. The Events and available Actions are shown below.

Switches Events 1-4 Corresponds to the terminal blocks on the rear panel. Events 1-4 represent a contact closure switch used to control output to external devices. For more information, see Book III, Installation and Service. The action values for these events are:

0 = Off
1 = On
2 = Pulse (generates 100 millisecond pulse)

Alarm Event 5 Specifies whether the alarm is on or off. The action values for these events are:

0 = Off
1 = On
2 = Pulse

Sparge Event 6 Sets the sparge rate for the reservoirs enabled on the PUMP SETUP screen. The range is:

0 to 100 ml/min

CAUTION

Do not exceed 64°C when using the RCSS heater or damage may occur to the cartridge.

Temperature Event 7 Sets the column heater temperature. Always check the method for adequate heating time before beginning the analysis. The ranges are:

RCSS heater = ambient +5°C to 64°C
Steel column heater = ambient +5°C to 99°C

Go Initial of Table # Event 8 Takes you to the appropriate table and holds at initial conditions until an injection occurs upon which the new gradient and events tables are run.

Start run of Table # Event 9 At whatever time this is executed, control of the run is handed over to the table number specified. The method begins immediately without an inject signal.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.11 DETECTOR TABLE SCREEN

The DETECTOR TABLE screen (Figure 3-15) allows you to establish what time-based changes will occur to the Powerline detectors during a chromatographic run.

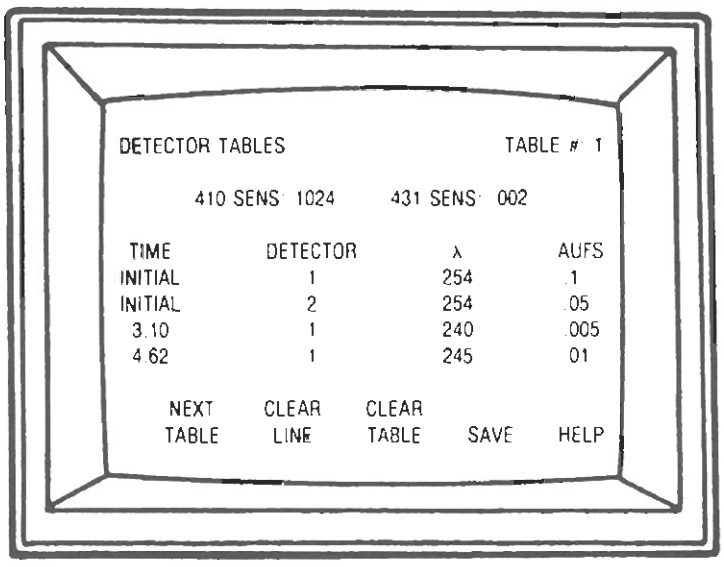


Figure 3-15 DETECTOR TABLE Screen

Here you can set the sensitivity of the 410 or 431. This value is set at the beginning of the run and remains in effect for the duration of the run. The rest of the table is used to establish the wavelength and AUFS changes to occur on the UV detectors. Fifteen lines of time-based changes can be programmed here and can be split up between the two UV detectors in any fashion that you want.

Like the Event and Gradient tables, the Detector table is identified by a number and is run automatically whenever the method with the same number is run. One line is programmed for each UV detector for initial wavelengths and absorbance units, additional lines are entered to allow changing wavelength or absorbance unit at a specific time within an analysis.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.11.1 Detector Table Keys

Other than the HELP key, there are four active keys when the DETECTOR TABLES screen is displayed:

- **NEXT TABLE** - Cycles you through the DETECTOR TABLES and back to the PROGRAM GRADIENT screen.
- **CLEAR LINE** - Clears the line on which the cursor rests but does not erase the line from permanent memory.
- **CLEAR TABLE** - Clears the entire table currently displayed on the screen and returns the Initial conditions line default status. The table is not erased from permanent memory, until a new table is saved.
- **SAVE** - Saves the table currently displayed on the screen. You must save the table before you move to the next screen.

3.11.2 Detector Table Parameters

This section describes the parameters on the DETECTOR TABLE screen.

Table # Specifies the Detector table you want to create or edit. The range of tables is:

1 to 15

SENS Specifies the sensitivity of the 410 or 431 detector. The values are:

410: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024
431: 0.1, 0.05, 0.02, 0.01, 0.005, 0.002, 0.001, 0.0005

Time Defines the time at which the UV detector change specified on this line will take place. The values are:

0 = Initial
0 to 655.34 minutes

Det/Chan Specifies whether the change on this line is for UV detector #1 or #2. The values are:

1 or 2

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

AUFS Defines the full scale sensitivity to which the UV detector on this line should switch at the time indicated. The range is:

0.001 to 2 AU

Lambda (λ) Specifies the wavelength to which the UV detection this line should switch at the time indicated. The range is:

190 to 600 nm

3.12 PROGRAM METHODS SCREEN

The PROGRAM METHODS screen (Figure 3-16) allows you to construct a detailed multi-method system control program by combining various pre-programmed tables in any sequential order.

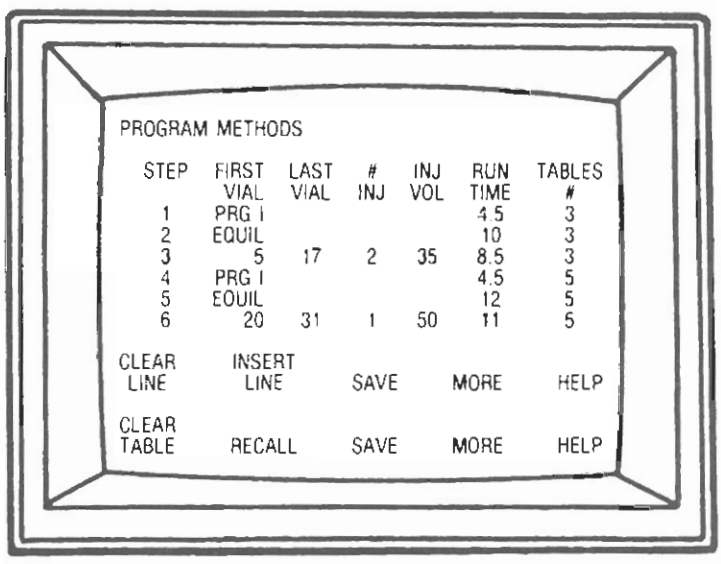


Figure 3-16 PROGRAM METHODS Screen

The Program Methods table can be programmed to prepare the system for:

- Equilibration
- Solvent changeovers
- Purge the auto-injector fluidics
- Purge the 410 detector flow cell
- Cleanup following buffer use
- Shutting system flow down after an analysis

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The Program Methods table has a total of 48 available steps which must be saved in memory in order to run. Each line in the program executes in order by step number and runs according to the specified run time. If changes are made, and the table is not saved, the controller runs what was last saved.

3.12.1 Program Methods Keys

Other than the HELP key, there are six active keys when the PROGRAM METHODS screen is displayed:

- **CLEAR LINE** - Clears the line on which the cursor rests but does not erase the line from permanent memory, until a new table is saved.
- **INSERT LINE** - Copies the line the on which the cursor currently rests to the line immediately below. Useful for programming limited changes to a table.
- **MORE** - Provides access to additional keys for this screen.
- **SAVE** - Saves the table currently displayed on the screen. You must save the table before you run the method.
- **CLEAR TABLE** - Clears the entire table currently displayed on the screen and returns the first line to default status. The table is not erased from permanent memory, until a new table is saved.

3.12.2 Program Methods Parameters

This section describes the parameters on the PROGRAM METHODS screen.

Step Step numbers represent the order in which the lines of the method are executed. Entering existing step number centers that line on the screen. The values are:

1 to 48

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

First/Last Vial Specifies the auto-injector vial number for drawing a sample or a special function as indicated by a Vial number of 100 or above.

Auto-injector vial Specifies the auto-injector vial number. The available values for drawing a sample are:

1 to 96 = auto-injector vials

Special functions Allow you to program the system to perform a number of special functions. The values are:

100 Manual Injector - Tells the controller that the injection occurs by a manual injector. This can be used either a manual injector or from a contact closure from a non-PowerLine auto-injector.

101 Equilibrate system - Equilibrates the system at initial conditions of the specified table for the specified run time.

102 Purge 410 Detector - Puts the 410 flow path into purge mode, goes to initial conditions of the table specified, and holds these conditions for the specified run time.

103 Purge Auto-injector - Places the auto-injector into the purge routine. The run time defaults to 4.5 minutes. The system goes to the initial condition of the specified table.

104 Prep (no injection) - For preparative chromatography where the sample is pumped onto the column via one of the solvent lines. It allows the system to run with no injector. The # of Injections column allows you to do multiple prep runs automatically. You can also use this to run blank gradients as well as to reequilibrate a column using a gradient curve to get to final conditions.

105 Auto Base - Holds the system at the initial conditions of the table indicated for the RUN TIME indicated. At the end of the RUN TIME, it executes the Auto Baseline routine.

106 DET#3 Pos Polarity - Sets the Polarity of Detector #3 to positive. Updates detector setup screen for documentation purposes. No other fields on this step are accessible if vial 106 is selected.

107 DET#3 Neg Polarity - Sets the Polarity of Detector #3 to negative. Updates detector setup screen for documentation purposes. No other fields on this step are accessible if vial 107 is selected.

Injection # Specifies the number of injections to be performed from each auto-injector vial specified. The values are:

1 to 9

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Injection Volume Specifies the volume for each injection specified by this line. Maximum is determined by loop size installed in the auto-injector. The value is:

0 to 200/2000 µl

Run Time Specifies the duration of the run which begins when the injection is made. **710/712 has a 1.00 minute minimum run time.** The time range is:

0.00 to 655.34 minutes

Table # Specifies the appropriate tables to be executed. The Gradient, Event, and Detector Tables are executed simultaneously. The range of tables is:

1 to 15

3.13 OPERATE METHODS SCREENS

There are two OPERATE METHODS screens which allow you to engage the Program Method tables saved in memory.

The initial OPERATE METHODS screen allows you to specify when the Program Method table will begin according to Step, Vial, and Injection numbers. This is important when handling *stat* samples. You also have the option to lock the keyboard of the controller and other IEEE devices while the run is in progress.

The second OPERATE METHODS screen allows you to make changes to the Program Method table, if the keyboard is not locked.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.13.1 Initial OPERATE METHODS Screen

The initial OPERATE METHODS screen (Figure 3-17) allows you to specify different starting values for the Program Method table. It also displays the conditions for both the current flow conditions (CURRENT) and the latest selected step/table (NEW).

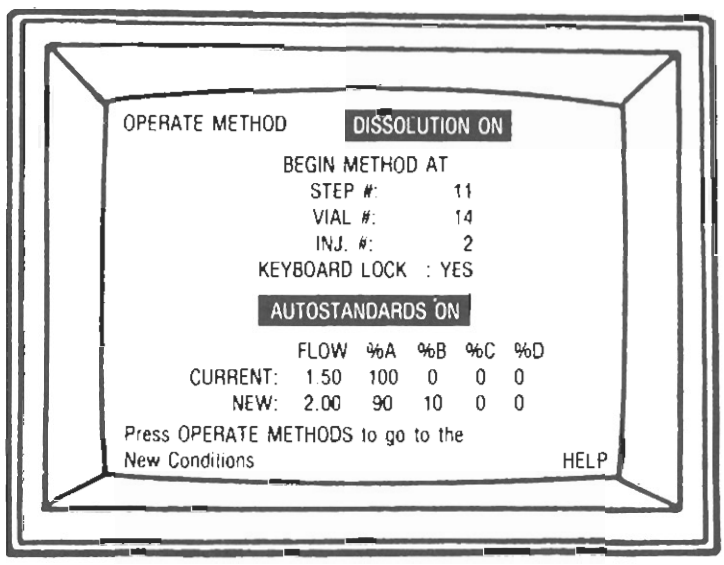


Figure 3-17 Initial OPERATE METHODS Screen

3.13.1.1 Operate Methods Keys

Other than the HELP key, the only active key when the initial OPERATE METHODS screen is displayed is OPERATE METHODS. The OPERATE METHODS key engages the Program Method table information saved in memory and displays the second OPERATE METHODS screen.

3.13.1.2 Operate Methods Parameters

This section describes the parameters on the initial OPERATE METHODS screen.

Step # Specifies the step at which the Program Method table will begin. The range is:

1 to 48

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Vial # Specifies the valid vial number in the range indicated in the Step on the Program Method table. The range is:

1 to 96
100 = Manual Injector
101 = Equilibrate
102 = Purge 410 Detector
103 = Purge Auto-injector
104 = Prep (no injection)
105 = Auto Base
106 = DET#3 Pos Polarity
107 = DET#3 Neg Polarity

Injection # Specifies the number of injections as indicated in the Step on the Program Method table. The range is:

0 to 9

Keyboard Lock Specifies whether the system should lock all keyboards during the run. Keyboards are always locked during setup. The action values are:

0 = No
1 = Yes (default)

Current/New These values are for display only. The Current values indicate the composition and flow currently in the system. The New conditions indicate the active conditions you switch to when engaging the displayed Program Method table.

3.13.2 OPERATE METHODS Screen

The second OPERATE METHODS screen (Figure 3-18) allows you to monitor the PROGRAM METHODS information. The system stays at initial conditions until you press the START RUN key.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

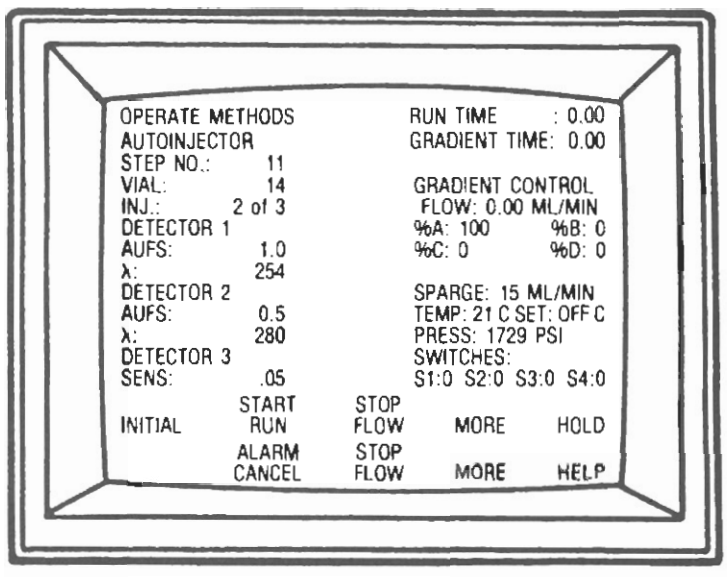


Figure 3-18 OPERATE METHODS Screen

3.13.2.1 Operate Methods Keys

Other than the HELP key, there are seven active keys when the OPERATE METHODS screen is displayed:

- **START RUN** - At initial conditions, pressing this key starts the programmed tables and time clock. If you are using an auto-injector, this key is activated when the injection occurs.
- **SETUP** - Indicates that the controller is setting up the IEEE modules.
- **MORE** - Provides access to the additional function keys available for this screen, which are described as follows:
- **STOP FLOW** - Stops solvent flow immediately without resetting the gradient time clock. RESUME continues the analysis (and time) from that point.
- **ABORT** - Brings up the CAUTION screen to present choices on how to prematurely end a Program Method table.
- **HOLD** - Stops the clock and keeps the composition and flow constant until RESUME is pressed, which allows the clock and programmed gradient to continue.
- **RESUME** - Allows the clock to continue once the HOLD or STOP FLOW keys have been pressed.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The system displays three messages that describe the state of the system:

- **INJECTION WAIT** - The system is waiting for an auto-injector signal to start the run.
- **INITIAL** - The system is at initial conditions.
- **RUNNING** - Shows the system is performing a chromatographic run.

3.13.2.2 Operate Methods Parameters

This section describes the parameters on the second OPERATE METHODS screen.

Step number Displays the current step number being processed.

Vial number Displays the current vial number.

Injection volume Displays the injection volume for the current injection.

Injection number Displays the current injection number.

Detector #1
Detector #2 These channels are reserved for UV detection and are automatically assigned by the controller. The detector values are:

AUFS Absorbance Units Full Scale (AUFS) specifies the full scale sensitivity of these detectors. The range is:

0.001 to 2 AU

Lambda (λ) Specifies the UV wavelength that the detector should use for operation. The range is:

190 to 600 nm

Detector #3 Set up specifically for use with the 410 or 431 detector.

SENS Specifies the sensitivity of the 410 or 431 detector. The values are:

410: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024

431: 0.1, 0.05, 0.02, 0.01, 0.005, 0.002, 0.001, 0.0005

Run Time Displays the duration of the run which begins when the injection is made.

Gradient Time Displays the duration of the gradient segment specified in the Program Method table.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Flow Rate Displays the current flow rate.

%A, %B, %C, and %D Displays the current percent composition from each reservoir. The total of all solvents, %A, %B, %C, and %D, equals 100 percent.

Sparge Specifies the helium flow rate to all reservoirs enabled from the PUMP SETUP screen. The range is:

0 to 100 ml/min per reservoir

CAUTION

Do not exceed 64°C when using the RCSS heater or damage may occur to the cartridge.

Temperature Displays the set temperature and allows you to specify a new temperature for the optional column/cartridge heater module. The new temperature must be less than or equal to the high temperature limit on the PUMP SETUP screen. It changes if a modification has been specified in the Program Event table. The ranges are:

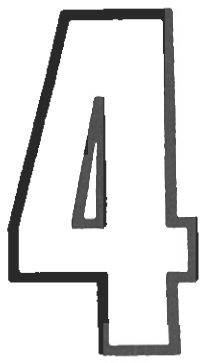
0 = Off
Minimum = 5°C over ambient
Maximum = 64°C for RCSS heater
99°C for stainless steel heater

Pressure Actively monitors the system pressure.

Switches Specifies whether the external event switch outputs (S1, S2, S3, and S4) on the rear terminal strip is OFF or ON. Switch settings change if a change has been specified in the Program Event table. The ranges are:

0 = Off
1 = On

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



ERROR MESSAGES

The system provides two types of error messages:

- Warning Messages
- Shutdown Messages

Error messages appear on the controller screens during programming when you:

- Enter an Improper value
- Use an unacceptable entry method

Error messages are for informational purposes and may or may not require operator action.

To resume programming after a warning message, you may either:

- Press CLEAR
- Wait a few seconds until the message disappears

Instructions on how to resume programming after a Shutdown Message are in Section 4.2.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.1 WARNING MESSAGES

Warning messages remind you to:

- Enter acceptable values
- Check your work

Warnings must be heeded and corrective action taken. Table 4-1 lists the warning messages displayed on the controller.

Table 4-1 Warning Messages

Message Displayed	Meaning
Value Entered Is Out Of Range	Programming/isocratic/direct control operation message: Enter a valid value.
Enter Table Number for New Table	Gradient operation: Appears when using the SAVE function. The table currently in memory and the table number you entered appear on the screen. The table currently in memory will be replaced with the new table in the next step.
Replace with New Table 1 = Yes 0 = No	Gradient operation: Only appears when using the Save function. Allows you to abort the save if the table associated with the number entered should not be erased.
Rear Panel Stop Flow Input Detected	Message can appear anytime following a signal at the STOP FLOW terminal. Will suspend system operation until the source of the signal is removed.

Con't.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Message Displayed	Meaning
Can't Save Table Currently Executing	Gradient operation: The table number you wished to save for a new or modified table is the same as the one running. Abort the run or wait until finished to replace it with the modified table.
Table Being Stored... Please Wait	Programming: Keyboard is locked while the Save function is storing the new table.
Check Corresponding Gradient Table/Events Table	Programming: Since the Gradient and Event tables always run together (dictated by the table number), any modifications made to the Gradient table should be consistent with the Event table of the same table number.
An Inject Occurred	Operation: Informational message indicating that an inject signal has been sent.
Line Is Incorrect Or Incomplete	Programming: Finish the entries required before attempting to move the cursor to a new location.
Unable To Setup Detector	Operation: The detector has not been turned on and calibrated. Turn on detector and wait for calibration to complete. Go to the SYSTEM CONFIGURATION screen and rescan IEEE bus.

Con't.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Message Displayed	Meaning
Unable To Setup Injector	WISP 710/700 Operation: • Auto-injector has not been turned on • Sample carriage is not in place • WISP auto-injector sample carriage door is open
Unable To Setup Injector	WISP 715 Operation: • Door is open • Sample carriage is not locked in place • Auto-calibration of the WISP 715 Fluid Pak has not been performed • 715 not turned on. Turn on, go to the SYSTEM CONFIGURATION screen, and rescan IEEE bus.
UV Detector 1 Not Found UV Detector 2 Not Found RI Detector Not Found 431 Detector Not Found Injector Not Found	Operation: Device has disappeared from the IEEE bus. Check if the PowerLine module was turned on *or* if the PowerLine module was turned on before the controller was turned on. Go to the SYSTEM CONFIGURATION screen and rescan IEEE bus.
Illegal Vial Number	Vial is greater than the maximum value for the selected carousel.
Number Out Of Range	Check the range for the parameter using the HELP key.

Con't.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Message Displayed	Meaning
Composition MUST sum to 100%	The composition values for %A, %B, %C, and %D do not total 100%. Check entered values for all solvent reservoirs.
Step Does Not Exist	A step number was inserted into the initial OPERATE METHODS screen which does not exist in the method table. Check the PROGRAM METHODS table.
Invalid Injection Number	The Injection Number is not part of the Step indicated. Check the PROGRAM METHODS table.
Invalid Vial Number	A vial number was selected that is not included in the selected step of the program method. Check the PROGRAM METHODS table.
First Vial Greater Than Last Vial	Refer to the PROGRAM METHODS screen. The last vial must always be in a higher location than the first vial.
Table Is Full	Exceeded the maximum 48 steps for this table.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4.2 SHUTDOWN MESSAGES

Shutdown messages appear on the controller screens when an operator-set limit has been exceeded.

Shutdown messages require operator action. Determine appropriate action by referring to Table 4-2 in this section.

To resume programming:

1. Press CLEAR
2. Check the PUMP SETUP parameters.
3. Make adjustments.
4. If the problem continues to occur, notify Waters Service Department at 1-800-252-HPLC.

System Shutdown Response

When a shutdown occurs the system responds with the following actions:

1. A message appears as "Shutdown Occurred - Reason: .....".
2. The system turns the flow rate to 0.0 ml/min. Flow and composition can be viewed on the display.
3. The HOLD output (on the controller's rear panel) is activated indicating to the connected instrument (for example, the auto-injector) that the system is not ready for operation.
4. Gradient, program event, and detector tables that were running are aborted.
5. The Autostart time and Table # fields are reset to blank.
6. External output switches S1 through S4, sparge valves, and the Alarm are left in their current state (on or off).
7. If the high temperature limit was exceeded or the temperature setpoint was greater than zero and the column heater was attached, the temperature setpoint is set to OFF (0).
8. Temperature will be controlled throughout the shutdown (or shut off depending on the situation) and sparging will continue at the last entered sparge rate.

The shutdown message will remain on the screen until you press the CLEAR key.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

When Stop Flow signal occurs

If a signal is detected at the STOP FLOW terminal during a shutdown, a message appears on the screen. An inject input is not recognized while the system is in shutdown.

If the cause is an obvious equipment malfunction, remove the cause (this may mean removing the faulty device from the system) and continue as follows.

Shutdown not caused by Stop Flow signal

If the shutdown was not caused by a stop flow signal, or the situation has been corrected, press the CLEAR key to resume operation and:

- For ISOCRATIC operation (monitor display), enter the flow rate
- For GRADIENT operation (monitor display), press the **RESUME** key to resume operation where it was halted by the failure

Another shutdown may occur if the cause is not corrected before restart.

WARNING

The controller only recognizes the first shutdown cause. Other subsequent shutdown conditions are ignored once shutdown occurs.

Table 4-2 Shutdown Messages

Message Displayed	Meaning
Low Pressure Limit	Value entered on SETUP screen was not maintained. If low pressure limit was set high, check for small leaks at fittings and unions. Shutdowns with low limit settings are caused by large noticeable failures or an empty solvent reservoir.

Con't.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Message Displayed	Meaning
High Pressure Limit	Value entered on SETUP screen was exceeded. If high pressure limit was set relatively low, check for increase in backpressure (such as older column with accumulated debris at the inlet and blockage in the fluid tubing).
High Temp Limit	Value entered on SETUP screen was exceeded. Before suspecting a heater unit failure, check that the setpoint and high limit were sufficiently separated to allow minimal temperature fluctuation around the setpoint without triggering a shutdown.
Pump Flow Limit	Check value entered on PUMP CONFIGURATION screen for the Pump Head Vol. parameter. If this setting and the type of pump heads (analytical or extended) do not match, a mismatch in flow rate will occur and cause a shutdown. Check this parameter before suspecting internal failure (such as pump drive circuits and pump mechanics).
Set Point > 0 and No Heater	Whenever temperature values are entered on the SETUP screen, the column heater must be connected or a shutdown will occur. This feature reminds you not to start a method which specifies heat without engaging the heater.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Reference Index

A

ABORT, 2-18, 3-17, 3-35

Alarm event #5, 2-15, 3-26

AUFS, 3-18, 3-29, 3-36

Auto-injector, 3-9, 3-17, 3-31

Auto-injector keys, 3-10
- HELP, 3-10
- NEXT SETUP, 3-10

AUTO-INJECTOR SETUP screen, 3-10

AUTO-INJECTOR SETUP screen parameters, 3-10
- auto standards, 3-11
- dissolution, 3-11
- Inject Delay, 3-11
- Syringe Draw Rate, 3-10

Auto standards, 3-11

Autostart, 2-6, 3-6

Autozero, 3-15

C

CANCEL, 2-7, 3-7

Cell Temperature, 3-16

Chart out, 2-5, 3-6

Controller units, 1-5
- Gradient controller, 2-1
- System controller, 3-1

Current, 2-17, 3-34

Curve, 2-11, 3-21

Curve Numbers, 2-12, 3-22

CLEAR LINE, 2-10, 2-15, 3-25, 3-28, 3-30

CLEAR TABLE, 2-10, 2-15, 3-25, 3-28, 3-30

Composition, 2-9, 2-11, 3-19, 3-37

CONFIGURATION, 2-7, 3-7

D

Data Channel, 3-15

Det #1, 3-13, 3-18, 3-36

Det #2, 3-13, 3-18, 3-36

Det #3, 3-13, 3-18, 3-36

Det/Chan, 3-28

Detector keys, 3-14
- HELP, 3-14
- NEXT SETUP, 3-14

DETECTOR SETUP screen, 3-13

DETECTOR SETUP screen parameters, 3-15
- 410 Filter Constant, 3-15
- 431 Balance, 3-15
- 431 Filter Constant, 3-15
- Autozero, 3-15
- Cell Temperature, 3-16
- Data Channel, 3-15
- Det #1, 3-13
- Det #2, 3-13
- Det #3, 3-13
- External Temperature 1, 3-16
- External Temperature 2, 3-16
- Filter Constant, 3-15
- Polarity, 3-15
- UV Filter Constant, 3-15

Detector table keys, 3-28
- CLEAR LINE, 3-28
- CLEAR TABLE, 3-28
- HELP, 3-28
- NEXT TABLE, 3-28
- SAVE, 3-28

Detector table screens, 3-27

Detector table screen parameters, 3-28
- AUFS, 3-29
- Det/Chan, 3-28
- Lambda, 3-29
- Time, 3-28

Direct control keys, 3-17
- HELP, 3-17
- IDLE, 3-17
- RESUME, 3-17
- SETUP, 3-17
- STOP FLOW, 3-17

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

DIRECT CONTROL screen, 3-16

DIRECT CONTROL screen parameters, 3-17
- AUFS, 3-18
- Auto-injector, 3-17
- Composition, 3-19
- Det #1, 3-18
- Det #2, 3-18
- Det #3, 3-18
- Flow Rate, 3-19
- Injection Volume, 3-17
- Lambda, 3-18
- Run Time, 3-19
- Sparge, 3-19
- Temperature, 3-19
- Vial Special Functions, 3-17

Dissolution control, 1-7, 3-11

Dissolution delay, 3-13

Dissolution keys, 3-12
- CLEAR TABLE, 3-12
- HELP, 3-12
- SAVE, 3-12
- SETUP, 3-12

DISSOLUTION SETUP screen, 3-11

DISSOLUTION SETUP screen parameters, 3-12
- dissolution delay, 3-13
- pill drop, 3-13
- safety window, 3-12

E

Error messages, 4-1
- warning Messages, 4-2
- shutdown Messages, 4-6

External event switches (S1 to S4), 2-9, 2-15, 2-19, 3-26, 3-37

External Temperature 1, 3-16

External Temperature 2, 3-16

F

Filter Constant, 3-15

First/Last Vial, 3-31

Flow path, 1-6

Flow Rate, 2-8, 2-11, 3-19, 3-37

410 Filter Constant, 3-15

431 Balance, 3-15

431 Filter Constant, 3-15

Function, 3-8

Fluid handling unit, 1-4

Fluid metering, 1-4

G

Go initial of table # event #8, 2-16, 3-26

Gradient and event table #, 2-17

Gradient controller screens, 2-1

Gradient time, 3-36

H

HELP, 2-3, 3-4

HOLD, 2-18, 3-35

I

Idle, 3-17

INITIAL, 2-18, 3-17, 3-36

Inject delay, 3-11

Injection #, 3-31, 3-34, 3-36

Injection volume, 3-17, 3-32

Injection wait, 3-36

INSERT LINE, 3-30

ISOCRATIC screen, 2-8

Isocratic keys, 2-8
- HELP, 2-8
- STOP FLOW, 2-8

ISOCRATIC screen parameters, 2-8
- Composition, 2-9
- External Switches, 2-9
- Flow Rate, 2-8
- Pressure, 2-9
- Sparge, 2-9
- Temperature, 2-9

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

K

KEYBOARD LOCK, 2-3, 3-4, 3-34

L

Lambda, 3-18, 3-29, 3-36

M

MORE, 2-18, 3-30, 3-35

N

NEXT SETUP, 3-3, 3-10, 3-14

NEXT TABLE, 3-25, 3-28

New, 2-17, 3-34

O

Operate gradient initial keys, 2-16
- help, 2-17
- operate gradient, 2-17

Operate gradient keys, 2-16
- ABORT, 2-18
- HELP, 2-18
- HOLD, 2-18
- INITIAL, 2-18
- MORE, 2-18
- RESUME, 2-18
- RUN, 2-18
- START, 2-18
- STOP FLOW, 2-18

OPERATE GRADIENT screen
- Initial OPERATE GRADIENT screen, 2-16
- Second OPERATE GRADIENT screen, 2-17

OPERATE GRADIENT initial screen parameters
- Current, 2-17
- Gradient and Event Table #, 2-17
- New, 2-17

OPERATE GRADIENT screen parameters, 2-19
- Pressure, 2-19
- Sparge, 2-19
- Switches, 2-19
- Temperature, 2-19

Operate methods initial keys, 3-33

Operate methods keys, 3-35
- ABORT, 3-35
- HELP, 3-35
- HOLD, 3-35
- MORE, 3-35
- RESUME, 3-35
- SETUP, 3-35
- START RUN, 3-35
- STOP FLOW, 3-35

OPERATE METHODS screen
- Initial OPERATE METHODS screen, 3-33
- Second OPERATE METHODS screen, 3-34

OPERATE METHODS initial screen parameters, 3-33
- Current, 3-34
- Injection #, 3-34
- Keyboard Lock, 3-34
- New, 3-34
- Step #, 3-33
- Vial #, 3-34

OPERATE METHODS screen parameters, 3-36
- AUFS, 3-36
- Composition, 3-37
- Det#1, 3-36
- Det#2, 3-36
- Det#3, 3-36
- Flow Rate, 3-37
- Gradient Time, 3-36
- Injection #, 3-36
- Lambda, 3-36
- Pressure, 3-37
- Run Time, 3-36
- Sens, 3-36
- Sparge, 3-37
- Step #, 3-36
- Switches, 3-37
- Temperature, 3-37
- Vial #, 3-36

Options, 1-10
- Manual injector adapter kits, 1-8
- RCSS heater module, 1-8
- Reference value, 1-8
- RS-232 system interface, 1-8
- Solvent reservoir rack, 1-8
- Stainless Steel column heater module, 1-8

P

Pill drop, 3-13
- automatic, 3-13
- manual, 3-13

Polarity, 3-15

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PowerLine system controller
overview, 1-5
screens, 3-1

POWER UP screen, 2-2, 3-2

Pressure, 2-4, 2-9, 2-19, 3-5, 3-37

Print, 3-8

Program event key, 2-14
CLEAR LINE, 2-15, 3-25
CLEAR TABLE, 2-15, 3-25
HELP, 2-14, 3-25
NEXT TABLE, 3-25
SAVE, 2-15, 3-25

PROGRAM EVENT screen, 2-13, 3-24

Program event screen parameters, 2-15, 3-25
alarm event #5, 2-15, 3-26
Go initial of table # event #8, 2-16, 3-26
Sparge event #6, 2-15, 3-26
Start run of table # event #9, 2-16, 3-26
Switches events #1-4, 2-15, 3-26
Table #, 3-25
Temperature event #7, 2-16, 3-26
Time, 2-15, 3-26

Program gradient keys
CLEAR LINE, 2-10, 3-21
CLEAR TABLE, 2-10, 3-21
HELP, 2-10, 3-20
NEXT TABLE, 3-20
SAVE, 2-10, 3-21

Program gradient programming considerations, 2-12, 3-23

PROGRAM GRADIENT screen, 2-9, 3-19

Program gradient screen parameters
Composition, 2-11, 3-21
Curve, 2-11, 3-21
Curve Values, 2-12, 3-22
Flow, 2-11, 3-21
Table #, 2-11, 3-21
Time, 2-11, 3-21

Program methods keys, 3-30
CLEAR LINE, 3-30
CLEAR TABLE, 3-30
HELP, 3-30
INSERT LINE, 3-30
MORE, 3-30
SAVE, 3-30

PROGRAM METHODS screen, 3-29

Program methods screen parameters, 3-30
First/Last Vial, 3-31
Injection #, 3-31
Injection Volume, 3-32
Run Time, 3-32
Step, 3-30
Table #, 3-32

Pump configuration keys, 2-6, 3-6
CANCEL, 2-7, 3-7
CONFIGURATION, 2-7, 3-7
HELP, 2-7, 3-7

Pump configuration screen parameters, 2-7, 3-7
function, 3-8
pump head volume, 2-7, 3-8
print, 3-8
RS-232 parameters, 3-8
unit type, 2-7, 3-7

Pump head volume, 2-7, 3-8

Pump setup keys, 2-3
HELP, 2-3, 3-4
KEYBOARD LOCK, 2-3, 3-4
NEXT SETUP, 3-3
PUMP CONFIGURATION, 2-3, 3-4
SYSTEM CONFIGURATION, 3-4

PUMP SETUP screens, 3-3
AUTO-INJECTOR SETUP 3-3
DETECTOR SETUP, 3-3
DISSOLUTION SETUP, 3-3
PUMP CONFIGURATION, 3-3
SYSTEM CONFIGURATION, 3-3

Pump setup screen parameters, 2-4, 3-4
Autostart, 2-6, 3-6
Chartout, 2-5, 3-6
Pressure Limit, 2-4, 3-4
Reservoirs to Sparge, 2-4, 3-4
Temperature Limit, 2-4, 3-5

R

RESCAN SYSTEM, 3-9

Reservoirs to Sparge, 2-4, 3-4

RESUME, 2-18, 3-17, 3-35

RS-232 interface, 1-6, 3-8

Run Time, 3-19, 3-32, 3-36

Running, 3-36

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

S

Safety window, 3-12

Sample, 3-13

SAVE, 2-10, 2-15, 3-12, 3-25, 3-28, 3-30

Screen keys,
- ABORT, 2-18, 3-17, 3-35
- CANCEL, 2-7, 3-7
- CLEAR LINE, 2-10, 2-15, 3-25, 3-28, 3-30
- CLEAR TABLE, 2-10, 2-15, 3-25, 3-28, 3-30
- CONFIGURATION, 2-7, 3-7
- function, 3-8
- HELP, 2-3, 3-4
- HOLD, 2-18, 3-35
- INITIAL 2-18
- INSERT LINE, 3-30
- KEYBOARD LOCK, 2-3, 3-4
- MORE, 2-18, 3-30, 3-35
- NEXT SETUP, 3-3, 3-10, 3-14
- NEXT TABLE, 3-25, 3-28
- PUMP CONFIGURATION, 2-3, 3-4
- RESCAN SYSTEM, 3-9
- RESUME, 2-18, 3-17, 3-35
- SAVE, 2-10, 2-15, 3-12, 3-25, 3-28, 3-20, 3-30
- START RUN, 2-18, 3-17, 3-35
- STOP FLOW, 2-8, 2-18, 3-17, 3-35
- SYSTEM CONFIGURATION, 3-4

Screen parameters,
- 410 Filter Constant, 3-15
- 431 Balance, 3-15
- 431 Filter Constant, 3-15
- AUFS, 3-18, 3-29, 3-36
- Alarm Event #5, 2-15, 3-26
- Auto-nnjector, 3-17
- Auto standards, 3-11
- Autostart, 2-6, 3-6
- Autozero, 3-15
- Cell temperature, 3-16
- Chart out, 2-5, 3-6
- Composition, 2-9, 2-11, 3-19, 3-37
- Current, 2-17, 3-34
- Curve, 2-11, 3-21
- Curve numbers, 2-12, 3-22
- Data channel, 3-15
- Det/Chan, 3-28
- Det #1, 3-13, 3-18, 3-36
- Det #2, 3-13, 3-18, 3-36
- Det #3, 3-13, 3-18, 3-36
- Dissolution, 3-11
- Dissolution Delay, 3-13
- External Switches, 2-9, 2-15, 2-19, 3-26, 3-37
- External Temperature 1, 3-16
- External Temperature 2, 3-16
- Filter Constant, 3-15
- First/Last Vial, 3-31
- Flow Rate, 2-8, 3-11, 3-19, 3-37
- Function, 3-8
- Go Initial of Table # Event #8, 2-16, 3-26
- Gradient and Event Table #, 2-17
- Inject Delay, 3-11
- Injection #, 3-31, 3-34, 3-36
- Injection Volume, 3-17, 3-32
- Keyboard Lock, 3-34
- Lambda, 3-18, 3-29, 3-36
- Pill Drop, 3-13
- Polarity, 3-15
- Pressure, 2-4, 2-9, 2-19, 3-5, 3-37
- Print, 3-8
- Pump head volume, 2-7, 3-8
- Reservoirs to Sparge, 2-4, 3-4
- Run Time, 3-19, 3-32, 3-36
- Safety Window, 3-12
- Sens, 3-18, 3-28, 3-36
- Sparge, 2-9, 2-19, 3-19, 3-37
- Sparge Event #6, 2-15, 3-26
- Start Run of Table # Event #9, 2-16, 3-26
- Step #, 3-30, 3-33, 3-36
- Switches Events #1-4, 2-15, 3-26, 3-37
- Syringe Draw Rate, 3-10
- Table #, 2-11, 3-32
- Temperature, 2-9, 2-19, 3-19, 3-37
- Temperature Event #7, 2-16, 3-26
- Temperature Limit, 2-4, 3-5
- Time, 2-11, 2-15, 3-21, 3-26, 3-28
- Unit Type, 2-7, 3-7
- Vial #, 3-17, 3-34

Sens, 3-18, 3-28, 3-36

Setup, 2-2

Sparge, 2-9, 2-19, 3-19, 3-37

Sparge event #6, 2-15, 3-26

START RUN, 2-18, 3-17, 3-35

Start run of table # event #9, 2-16, 3-26

Step #, 3-30, 3-33, 3-36

STOP FLOW, 2-8, 2-18, 3-17, 3-35

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Switches, events #1-4, 2-15, 3-26, 3-37

Syringe Draw Rate, 3-10

SYSTEM CONFIGURATION, 3-9

System configuration keys, 3-9
    HELP, 3-9
    RESCAN SYSTEM, 3-9

SYSTEM CONFIGURATION screen, 3-9

T

Table #, 2-11, 3-32

Temperature, 2-9, 2-19, 3-19, 3-37

Temperature event #7, 2-16, 3-26

Temperature limit, 2-4, 3-5

Time, 2-11, 2-15, 2-21, 3-26, 3-28

U

Unit type, 2-7, 3-7

V

Vial, 3-17, 3-31

Vial #, 3-17, 3-34

Vial special functions, 3-17, 3-31

W

Waters 600E multisolvent delivery system, 1-1
    controller units, 1-5
    dissolution control, 1-7
    features, 1-2
    fluid handling unit, 1-4
    functionality, 1-3
    Gradient controller, 1-2
    modules, 1-3
    options, 1-8
    overview, 1-1
    PowerLine System Controller, 1-2, 1-5

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TABLE OF CONTENTS

HOW TO USE THIS BOOK v

1 SETUP AND INSTALLATION 1-1

1.1 SETUP AND INSPECTION 1-1

1.2 SITE SELECTION 1-2

1.3 ELECTRICAL REQUIREMENTS 1-3

1.3.1 Adaption for 50 Hz Operation 1-4
1.3.2 Voltage Selection 1-4

1.4 CONTROLLER CONNECTIONS 1-6

1.4.1 Rear Panel Description 1-6
1.4.2 Rear Panel Connections 1-10
1.4.3 IEEE-488 Electrical Connections 1-13
1.4.4 RS-232 Connections 1-18

1.5 FLUID HANDLING UNIT CONNECTIONS 1-18

1.5.1 Solvent Reservoir Setup 1-19
1.5.2 System Sparge/Helium Setup 1-21
1.5.2.1 System Sparging Overview 1-22
1.5.2.2 Connecting Compression Fitting Assembly 1-22
1.5.2.3 Connecting Sparge Tubing 1-23

1.6 OPTIONS INSTALLATION 1-24

1.6.1 Steel Column 1-25
1.6.2 Steel Column Heater 1-26
1.6.3 RCSS Heater Module 1-29
1.6.4 RCM 8x10 Installation 1-32

1.7 CARTRIDGE AND COLUMN PREPARATION 1-33

1.8 INJECTOR CONNECTIONS 1-33

1.8.1 Manual Injector 1-34
1.8.2 Auto-Injector 1-34

1.9 DETECTOR CONNECTIONS 1-36

1.10 OPTIONAL DISSOLUTION COMPONENTS CONNECTIONS 1-37

1.10.1 Electrical Connections 1-38
1.10.2 Tubing Connections 1-40

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2 DIAGNOSTICS AND TROUBLESHOOTING 2-1

2.1 SELF-DIAGNOSTIC ROUTINES 2-1

2.2 EXTENDED TEST ROUTINES 2-2

2.3 INDIVIDUAL EXTENDED TESTS 2-4

2.3.1 Stop Flow Input Test 2-4
2.3.2 External Inject Test 2-4
2.3.3 External Switch (S1 - S4) Output Test 2-5
2.3.4 Hold Output Test 2-5
2.3.5 Chart Test 2-6
2.3.6 Sparge Valves Test 2-6
2.3.7 Pump and Solvent Valves Test 2-7
2.3.8 IEEE-488 Address Test 2-8

2.4 FLUID SYSTEM TROUBLESHOOTING 2-9

2.5 PRESSURE TRACE RECORDING TO AID TROUBLESHOOTING 2-11

2.6 INJECTOR SYSTEM TROUBLESHOOTING 2-14

2.7 SOLVENT VALVE PAIR TEST 2-14

3 MAINTENANCE PROCEDURES 3-1

3.1 FLUID HANDLING UNIT 3-2

3.1.1 Pressure Transducer Maintenance 3-3
3.1.2 Pump Maintenance Procedures 3-5
3.1.2.1 Reference Valve Installation 3-8
3.1.2.2 Pump Head Assembly 3-9
3.1.3 Sparge Valve Assembly Maintenance 3-18
3.1.4 Solvent Proportioning Valve Replacement 3-21

3.2 ELECTRONICS SYSTEM 3-24

3.2.1 Fuse Installation 3-25
3.2.2 Replacing the Control Board 3-26

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

LIST OF TABLES

1-1 Operating Voltage Ranges 1-5
1-2 Controller Rear Panel Functions 1-7
1-3 IEEE-488 Address Switch Settings 1-16

2-1 Pump Troubleshooting Guide 2-9
2-2 Gradient Table 2-15

3-1 Pump Unit Assemblies 3-7
3-2 Sparge Valve Unit Functions 3-19
3-3 Proportioning Valve Assembly 3-22
3-4 Operating Voltage Ranges 3-25

LIST OF FIGURES

1-1 Installation Clearances 1-3
1-2 Operating Frequency Adjustment 1-4
1-3 Changing the Voltage Setting 1-5
1-4 Controller Rear Panel Connections 1-6
1-5 Multiple Injectors and Integrator Connections to Controller 1-10
1-6 Detector Cable Connections 1-11
1-7 Integrator and Chart Recorder Connections to Controller 1-11
1-8 External Device Connections 1-12
1-9 Controller Connected Directly to Waters 840 1-13
1-10 Controller Connected Directly to Waters 845 or 860 1-13
1-11 Controller Connected to Waters 840 Using an Interface Module 1-14
1-12 IEEE-488 Waters 840 Connections for Multisystems 1-14
1-13 IEEE-488 Waters 845 Vax Station and Waters 860 Vax Connections for Multisystems 1-15
1-14 Powerline System Controller Connections 1-15
1-15 Waters 600E Rear Panel IEEE-488 Address and Interface Positions 1-17
1-16 Fluid Handling Unit Connections 1-18
1-17 One-liter Reservoir Caps 1-19
1-18 Solvent Reservoir Filter Placement 1-20
1-19 Compression Screw Assembly 1-22
1-20 Sparge Gas Inlet Connection 1-23
1-21 Column Compartment Assemblies 1-25
1-22 Steel Column Installation 1-26
1-23 Steel Column Heater Orientation 1-27
1-24 Steel Column Heater Signal Cable Connection 1-28
1-25 Solvent Outlet Connection 1-28
1-26 Optional RCSS Heater Orientation 1-29
1-27 RCSS Heater Signal Connection 1-30
1-28 Solvent Outlet Tubing 1-30
1-29 Removing the Cartridge 1-31
1-30 Installing the Cartridge 1-32
1-31 RCM 8x10 Installation 1-33
1-32 Auto-injector Only 1-35
1-33 Auto-injector and Manual Injector in Series 1-36
1-34 Typical Dissolution System 1-38
1-35 Dissolution Electrical Connections 1-39
1-36 Plastic Compression Fittings 1-40

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2-1 Jumper Wire Construction 2-3
2-2 Rear Panel Terminals and Ground 2-3
2-3 LEDs Connected to Driver Outputs 2-7
2-4 Pressure Trace Recording To Aid Troubleshooting 2-12
2-5 Test Results With All Valves Working 2-16

3-1 Fluid Handling Unit 3-2
3-2 Transducer Control Screw 3-4
3-3 Transducer Replacement 3-4
3-4 Transducer Connection on the Interconnect Board 3-5
3-5 Pump Unit 3-6
3-6 Reference Value Mounting Location 3-8
3-7 Reference Valve Mounting 3-8
3-8 Pump Head Assembly 3-9
3-9 Pump Head Removal 3-11
3-10 Plunger Seal Orientation 3-11
3-11 Removing the Plunger Support Assembly 3-12
3-12 Plunger Disassembly 3-13
3-13 Inlet Check Valve Removal 3-14
3-14 Inlet Check Valve Assembly 3-15
3-15 Outlet Check Valve Removal 3-16
3-16 Outlet Check Valve Assembly 3-17
3-17 Sparge Valve and Manifold Assembly 3-19
3-18 Connector Board Cabling 3-20
3-19 Sparge Valve Connections 3-20
3-20 Proportioning Valve Assembly 3-21
3-21 Drawer Cable 3-22
3-22 Solvent Inlet Lines 3-23
3-23 Controller with Cover Removed 3-24
3-24 Installing A Fuse 3-25
3-25 Control Board Cabling 3-26
3-26 Removing the Control Board 3-27

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

HOW TO USE THIS BOOK

Book III Book III provides the information you need to install your system and maintain it on a routine basis. Refer to this book for setup and installation procedures, and also for information on error messages, how to diagnose a problem, and general servicing for the fluid handling unit and controller.

Other books Use Book I, How to Use the 600E, for step-by-step procedures on using the system in various modes of operation.

Use Book II, Reference, for background information on topics such as front panel controls and indicators, screen displays, and associated parameter values and ranges for each screen display.

Organization This book is organized to help the reader locate information about installing and servicing the system. It is divided into chapters that describe similar categories of information. In addition, chapters are divided by titled tab dividers, providing easy access to all information on particular subjects.

Using this book The information in this manual is divided into three logical parts:

- Chapter 1 provides the information and procedures needed for getting your system ready for operation.
- Chapter 2 lists the extensive self-diagnostic tests the controller automatically performs. These tests check out the entire system and will alert you to any potential problem area. This chapter also provides an explanation of error messages issued by the controller, and a troubleshooting section listing solutions for various symptoms.
- Chapter 3 includes assembly drawings and general maintainence procedures.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1

SETUP AND INSTALLATION

Introduction This chapter describes how to install the Waters 600E. Instructions are included for:

- Unpacking
- Site Selection
- Electrical requirements
- Controller connections
- Fluid handling unit connections
- Column and cartridge installations
- Injector connections
- Detector connections
- Optional dissolution components connections

1.1 SETUP AND INSPECTION

The system is shipped in two cartons containing the:

- Controller (electronics unit)
- Fluid handling unit

Options and the startup kit are packed separately. Check the contents of the startup kit (P/N 62721) against the list included in the kit.

Save the shipping cartons in case the unit needs to be transported or shipped in the future.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Unpacking To unpack the system:

1. Remove the packing material from the cartons.
2. Grasp the two units from the bottom and lift them straight up and out.
3. Examine the cartons and packing material carefully to make sure that all parts have been removed.
4. After unpacking the system and the associated parts, check the contents against the packing slip and confirm that all items are included.
5. Inspect all items for damage.

   Immediately report any damage to both the shipping carrier and to:

   Waters Chromatography Division
   Order Entry Department
   (1-800-252-HPLC).

   If any items are damaged, use the shipping container for subsequent claim purposes.

1.2 SITE SELECTION

Install the system in an area where:

- Temperature is 4°C to 38°C (39°F to 100°F). Avoid direct sunlight, heat registers, or air conditioning vents.
- Relative humidity is 20 to 90% non-condensing.
- Bench space is adequate.
- The bench is capable of supporting 48 lbs (32.9 kg)
- The back of the unit has three-inch (7.62 cm) clearance for ventilation.
- Vibration is negligible. Prevent wobble or instability by making sure all four rubber feet sit securely on bench top.
- No extreme shock is felt.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Bench arrangement Place the units side by side on the bench top or with the controller unit on top of the fluid handling unit. Figure 1-1 illustrates the overall clearances of the system when placed on top of one another.

CAUTION

Never stack fluid handling units and devices on top of electronic units without adequate leak protection.

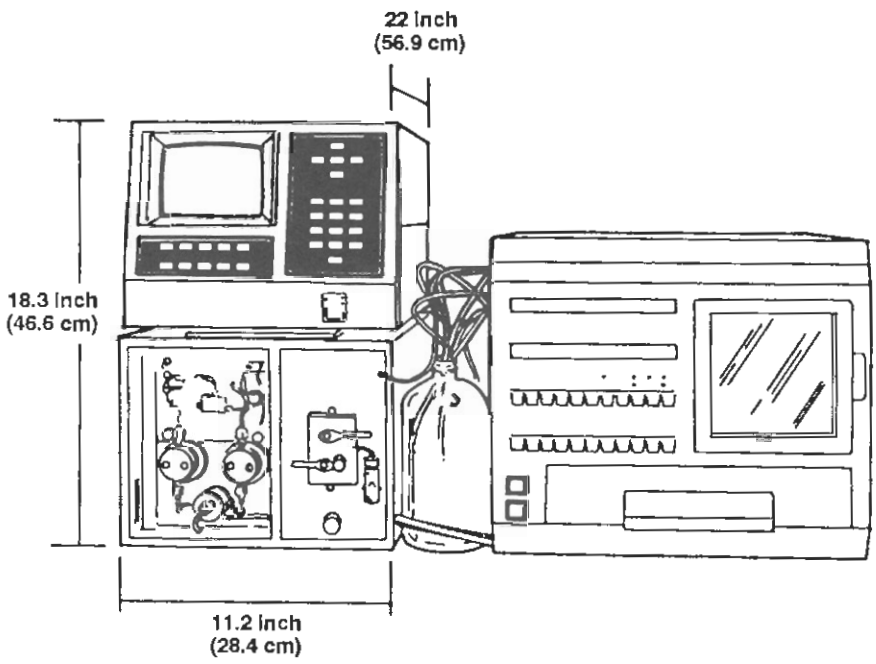


Figure 1-1 Installation Clearances

1.3 ELECTRICAL REQUIREMENTS

This section describes the various electrical features that can be configured with the system.

WARNING

Disconnect the power cord from the rear panel of the instrument before performing the procedures in this section.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Power requirements The system requires:

- Grounded AC power supply
- No nearby source of electronic noise
- No abrupt load fluctuations
- Proper fuses installed (see Table 1-1 in Section 1.3.2, Voltage Requirements)

The unit is shipped adapted for 60 Hz operation and can be changed to 50 Hz.

1.3.1 Adaption for 50 Hz Operation

To adapt the unit for 50 Hz use, remove the cover of the electronics unit and change the position of the switch (mounted under the CRT on the circuit board) as indicated in Figure 1-2.

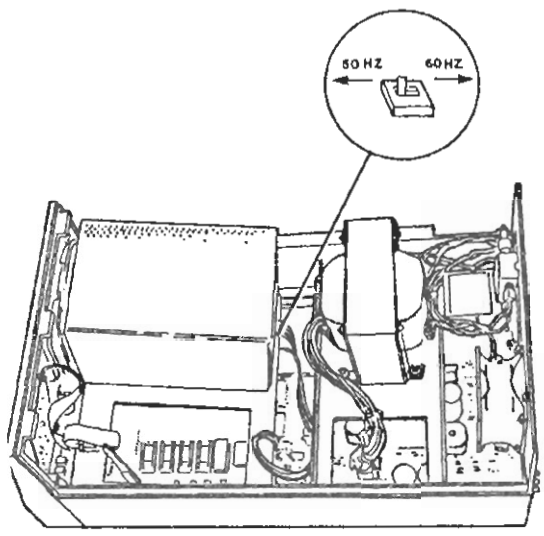


Figure 1-2 Operating Frequency Adjustment

1.3.2 Voltage Selection

The system can be adapted to operate at the nominal voltages listed in Table 1-1.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 1-1 Operating Voltage Ranges

Nominal Voltage	Voltage Range	Fuse (AMP)
100	+10%	2
120	+10%	2
220	+10%	1
240	+10%	1

Changing voltage

The system is delivered with voltage preset at the factory. To change the voltage:

1. Make sure the instrument is not plugged in.
2. Pry open the power connector cover with a flat-blade screwdriver.
3. Remove the voltage selection barrel, locate the correct setting.
4. Replace the voltage selection barrel so the voltage chosen will show through the window when the cover is closed (see Figure 1-3).

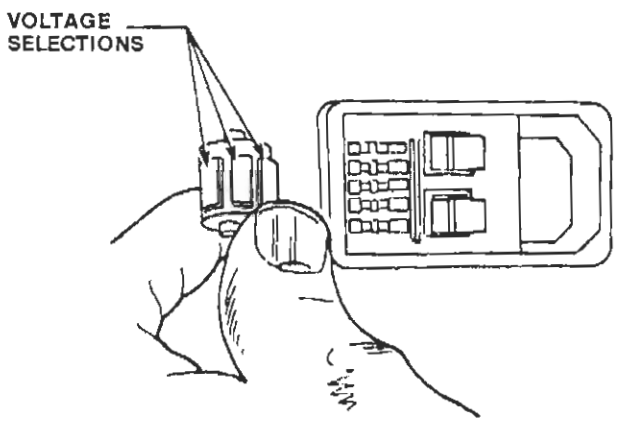


Figure 1-3 Changing the Voltage Setting

5. Close the power connector cover.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1.4 CONTROLLER CONNECTIONS

This section describes the controller rear panel and the connections you need to make before operation.

CAUTION

Operate the system with covers in place to ensure proper ventilation. Failure to operate the system properly will shorten the life expectancy of some parts and invalidate the warranty.

1.4.1 Rear Panel Description

The controller includes rear panel electrical connections for the:

- Chart recorder
- Injector start input
- Output terminals
- Ground and chassis ground terminals
- Control cable
- IEEE-488 connection and address settings
- RS-232 interface connector
- 12 V power source

Figure 1-4 identifies each rear panel connection. Table 1-2 describes each rear panel connection and its function.

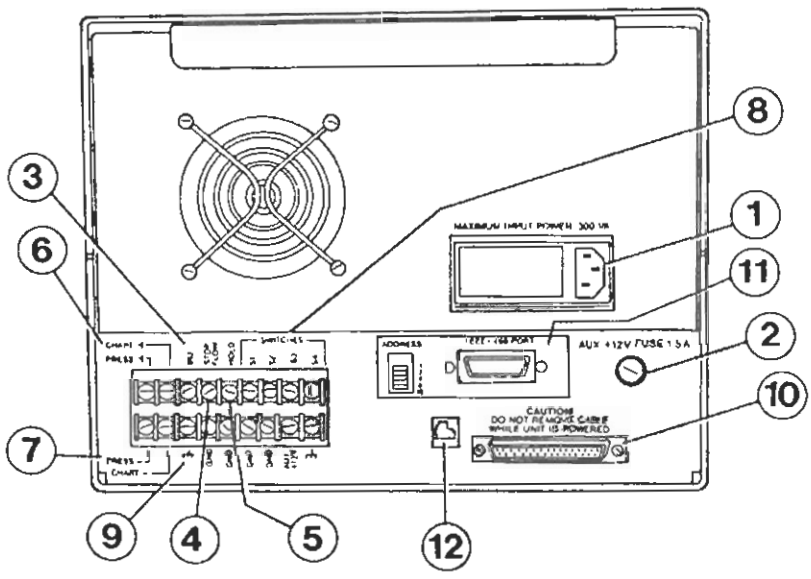


Figure 1-4 Controller Rear Panel Connections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

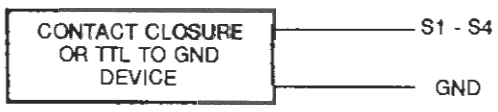
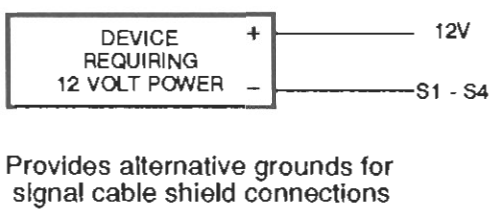
Table 1-2 Controller Rear Panel Functions

Key	Description	Function
1	Power connection site	Selects operating voltage and installs fuses (voltage selection and fuses)
2	Auxiliary power fuse	Contains 1.5 V fuse for the +12 V power terminal
Signal (TTL*) Terminals For Stand-Alone Operation		
3	INJect and GND	Accepts a signal from an injector to begin a run (duration: 100 msec minimum; 1 sec maximum) and produces a signal to start data integrators (with compatible inputs). Provides output signal when using the manual injector to produce a chart mark and integrator start for manual operation.**
4	STOP FLOW	Accepts a contact closure to stop the pump. The terminal can accept a signal from a programmable detector for stop flow scanning.
5	HOLD and GND	Produces a signal output to prevent further injections in case of power failure, pressure shutdown, or abort condition. May be connected to the HOLD input on the Model 700 with the optional BCD board installed or any compatible device that must be stopped under these conditions.
External Output Terminals		
6	CHART (+, -)	10 mV full scale output. Plot output which can represent pump percentage composition (%A through %D), flow rate, or heater module temperature (0-100°C) to a recording device as set on the SETUP screen. For example, plot %B to a trace gradient curve profile during analysis.
7	PRESSURE (+, -)	10mV represents full scale output. Direct pressure trace output from the pump transducer (0 to 6000 psi full scale).

(cont'd)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 1-2 (Cont'd) Controller Rear Panel Functions

Key	Description	Function
External Event (TTL) Terminals		
8	Output terminals and ground	Four switches (S1-S4) under time or operator control, used to control external devices (maximum current capacity is 1 A per switch) with a 12 V power terminal for devices requiring up to 1.5 A total current. **Direct Access:** • PowerLine System Controller - DIRECT CONTROL and OPERATE METHODS screen • Gradient Controller - ISOCRATIC and OPERATE GRADIENT screen **Program Access:** Through time-based PROGRAM EVENT screen, S1-S4 programmed as ON, OFF, or PULSE **Type of Control:** Three types of devices can be controlled from S1-S4: • Devices that require a contact closure at their input. • Devices that require a TTL-compatible* output, connect as follows:  • Devices that require 12 V auxiliary power, connect as follows (note that the GND terminals are not used): 
9	Ground and chassis terminal	Provides alternative grounds for signal cable shield connections

(cont'd)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 1-2 (Cont'd) Controller Rear Panel Functions

Key	Description	Function
Control Cable Connector		
10	Control cable	Provides system communication between the controller and the fluid unit through a 37-pin connector cable
IEEE-488 Interface Connector And Switches		
11	IEEE-488 connector and address switches	Provides communication interface between: • Gradient Controller and Waters 840 Data and Chromatography Control Station (Version 6 or later).*** • Gradient Controller and 845 Chromatography Data and Control Station or a Waters 860 Networking Computer System. • PowerLine System Controller and and other PowerLine-compatible detectors and auto-injectors.***
RS-232 Connector		
12	RS-232 connector	Provides communication interface for Waters 990+ Photodiode Array Detector, Waters 745B integrator, Waters 815 data workstation, or Waters 825 data workstation

NOTES

*Transistor-to-transistor logic (TTL):
+5 V = OFF (switch open)
0 V = ON (switch closed)

**Multiple instruments may be connected either stacked on the terminal or in series. For example, a Waters autoinjector, an external manual injector, and a 745B integrator can be connected simultaneously. The Waters autoinjector must be used to start the run. Because of its sample withdrawal time, the autoinjector must generate the analysis start signal when the sample is ready for injection.

***IEEE-488 based instruments do not require external connections when connected as a system.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1.4.2 Rear Panel Connections

CAUTION

Applying incorrect voltages may damage the instrument. Shorting the 12V terminal to ground or an event output will cause the 12V fuse to blow.

1. Make sure that the voltage, frequency, and fuse selections match the power source as outlined earlier in this chapter.

2. Connect any non-PowerLine external integrator and injectors to the controller's rear panel as illustrated in Figure 1-5.

   Figure 1-5 illustrates auto-injector and manual injector connections to the controller's INJECT terminals through a chart mark cable. A Model 745/745B Data Module (from its REMOTE input) is also connected to the INJECT terminal through a remote start cable.

   This configuration allows either the manual or non-PowerLine automatic injector to send the start signal to the data module to ensure synchronized integration.

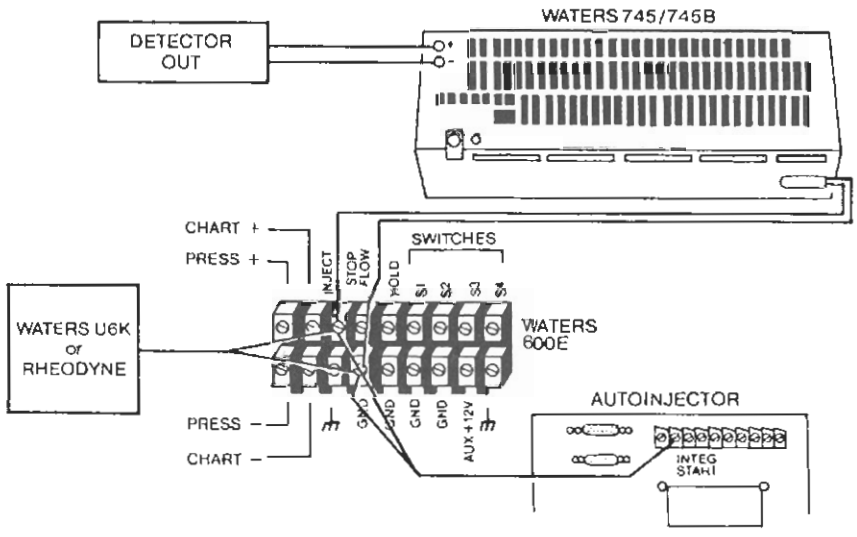


Figure 1-5 Multiple Injectors and Integrator Connections to Controller

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3. Make the remaining connections between detectors and integrators or chart recorders (as outlined in Figures 1-6 and 1-7).

   Figure 1-6 illustrates:

   - Detector cable connections to the Waters 745/745B or similar integrator from the Waters 481/484 1V/AU output terminals or 410 INT OUT terminals (refer to the specific recommendations in the appropriate detector Operator's Manual).

   - Detector cable connections to chart recorder from the 481/484 10 millivolt output.

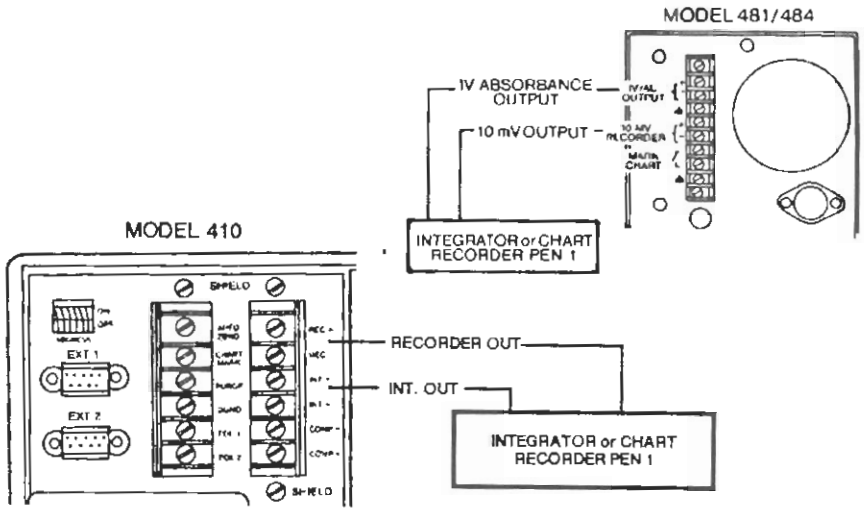


Figure 1-6 Detector Cable Connections

Figure 1-7 shows controller's CHART output terminal connections to an integrator or chart recorder's second pen. This allows you to document gradient profiles by connecting it to the second pen.

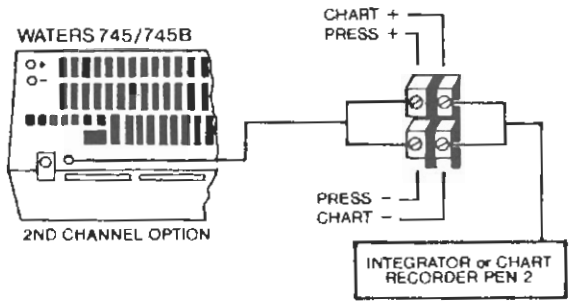


Figure 1-7 Integrator and Chart Recorder Connections to Controller

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4. Connect a programmable multiwavelength detector, such as the Waters 490, as shown in Figure 1-8.

   A contact closure from the detector event output terminal is sufficient to stop the fluid handling unit's pump flow and allow multiwavelength scans on a given peak. Flow continues when the detector again opens the contacts.

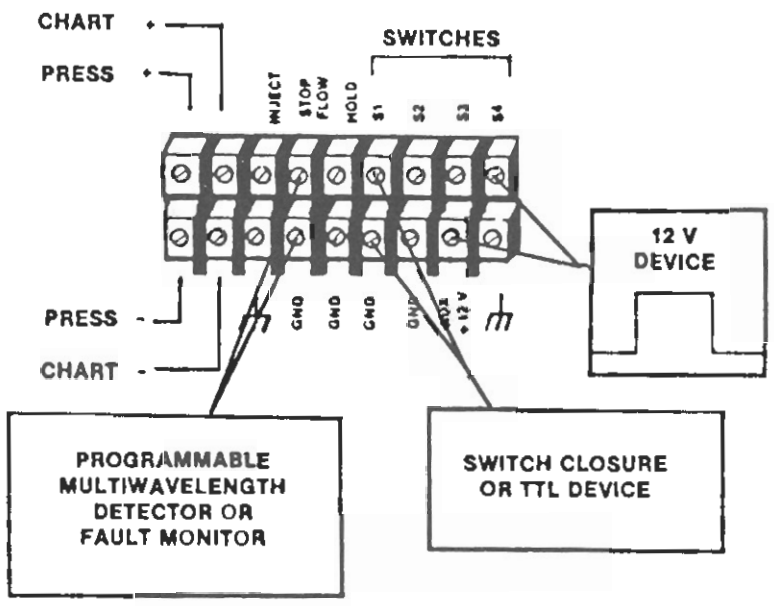


Figure 1-8 External Device Connections

5. Connect any devices requiring 5-volt (TTL level) signals to the switch terminals (S1 through S4) and the associated grounds on the controller's rear panel (see Figure 1-8).

   A 12 volt source is also available for devices requiring 12 volts to operate.

   NOTE: The maximum current available from the 12 V power source (divided among all the devices in use) is 1.5 AMPS. It may be used by a single device requiring up to 1 AMP or shared by any of the devices and switches, providing their total is equal to or less than 1.5 AMPS.

6. Connect the 10mV PRESS (pressure) output (located on the controller's rear panel) to a chart recorder to monitor pump pressure during service procedures, (such as ramp testing), or to monitor the effects that different solvents have on pressure during various phases of gradient operation.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

CAUTION

Be sure the power is off before proceeding with step 7. Failure to do this may cause damage to the controller.

7. With the power turned off, connect the control cable at the rear of the controller and fluid handling unit.

1.4.3 IEEE-488 Electrical Connections

Single system configurations

The Waters 600E controller can be connected directly to the IEEE-488 interface as a single system to a Waters 840, 845, or 860 as shown in Figures 1-9, 1-10, and 1-11.

NOTE: The following configurations assume a Waters 840 system unit with Rev. 6.0 or later software, and a Waters 845/860 system unit with Rev. 2.0 or later software.

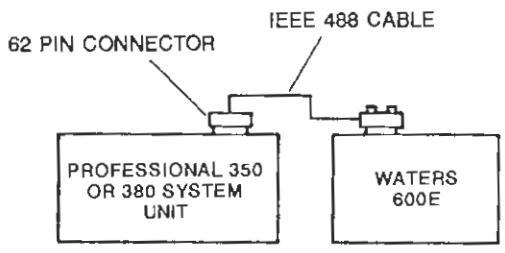


Figure 1-9 Controller Connected Directly to Waters 840

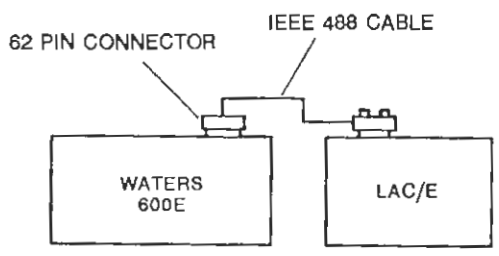


Figure 1-10 Controller Connected Directly to Waters 845 or 860

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

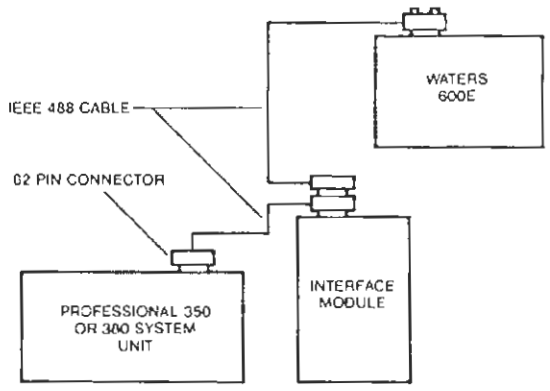


Figure 1-11 Controller Connected to Waters 840 Using an Interface Module

Multiple system configuration

The Waters 600E controller can be connected through the IEEE-488 cable in multisystem configurations as shown in Figures 1-12 and 1-13.

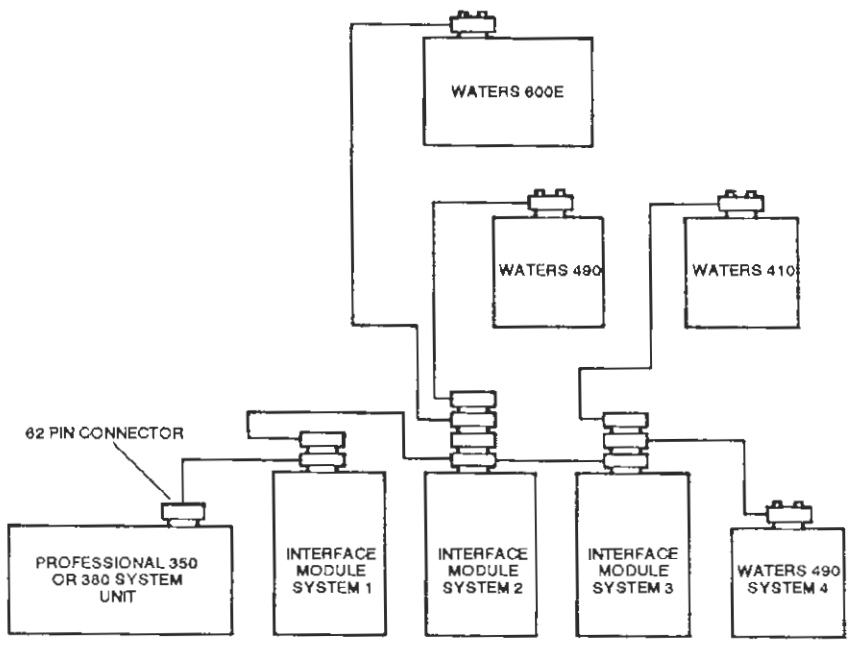


Figure 1-12 IEEE-488 Waters 840 Connections for Multisystems

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

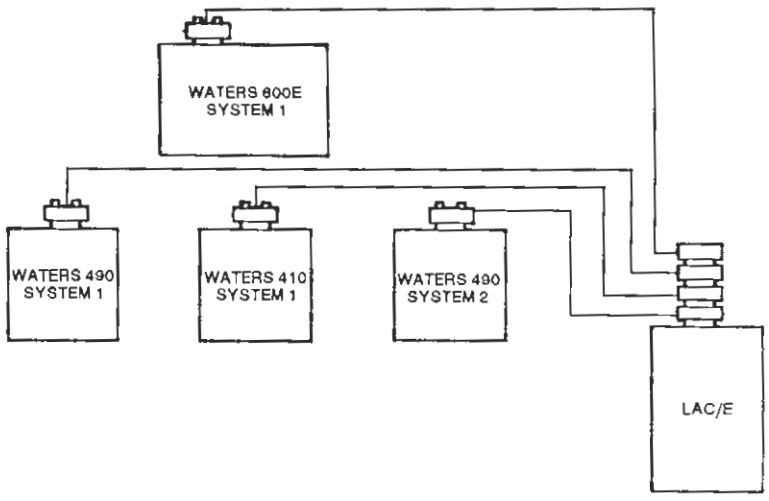


Figure 1-13 IEEE-488 Waters 845 Vax Station and Waters 860 Vax Connections for Multisystems

Procedure

1. Connect one end of the IEEE cable to the IEEE interface on the controller's rear panel.
2. Connect the other end of the cable to the connector on any other IEEE device or the port on the back of the Waters 840 or the IEEE connection on the LAC/E for an 845 or 860 system.

   If the controller is a PowerLine system controller, make connections as shown in Figure 1-14 .
3. Make sure that all IEEE cable screws are fastened securely.

NOTE: The connections shown in Figure 1-14 are only suggested. IEEE connections allow any component to be connected to any other as long as the addresses are properly set as described below.

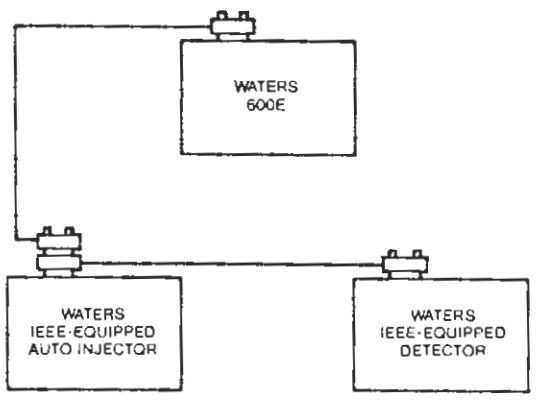


Figure 1-14 Powerline System Controller Connections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

IEEE-488 address switch settings

In order to interact with the computer, each device on the IEEE-488 communications bus must have an unique individual address. In single system use, the IEEE-488 address allows you to connect multiple devices to a single system. In multisystem use, the IEEE-488 address allows devices to communicate with the computer as identifiably separate systems.

Address requirements

The address for each device must be unique and represented by the switch settings as a number between 2 and 29, as shown in Table 1-3. These switches are located on the rear panel of the modules.

IEEE-488 connections allow any component to be interconnected as long as addresses are set as described in Table 1-3. Do not use address settings not listed in Table 1-3.

Table 1-3
IEEE-488 Address Switch Settings

IEEE Address	Switch Setting				
	1	2	3	4	5
2	OFF	ON	OFF	OFF	OFF
3	ON	ON	OFF	OFF	OFF
4	OFF	OFF	ON	OFF	OFF
5	ON	OFF	ON	OFF	OFF
6	OFF	ON	ON	OFF	OFF
7	ON	ON	ON	OFF	OFF
8	OFF	OFF	OFF	ON	OFF
9	ON	OFF	OFF	ON	OFF
10	OFF	ON	OFF	ON	OFF
11	ON	ON	OFF	ON	OFF
12	OFF	OFF	ON	ON	OFF
13	ON	OFF	ON	ON	OFF
14	OFF	ON	ON	ON	OFF
15	ON	ON	ON	ON	OFF
16	OFF	OFF	OFF	OFF	ON
17	ON	OFF	OFF	OFF	ON
18	OFF	ON	OFF	OFF	ON
19	ON	ON	OFF	OFF	ON
20	OFF	OFF	ON	OFF	ON
21	ON	OFF	ON	OFF	ON
22	OFF	ON	ON	OFF	ON
23	ON	ON	ON	OFF	ON
24	OFF	OFF	OFF	ON	ON
25	ON	OFF	OFF	ON	ON
26	OFF	ON	OFF	ON	ON
27	ON	ON	OFF	ON	ON
28	OFF	OFF	ON	ON	ON
29	ON	OFF	ON	ON	ON

ON = closed (or 1), OFF = open (or 0)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Figure 1-15 shows the IEEE switch of the Waters 600E controller. When controlling the 600E system from an 840 or 845, the IEEE address needs to be set to one of the values shown in Table 1-3.

NOTE: After you set the address in an IEEE device, power the device down and up again to set the address. The device will not be recognized until it has performed any calibration or diagnostic routines the device does upon startup.

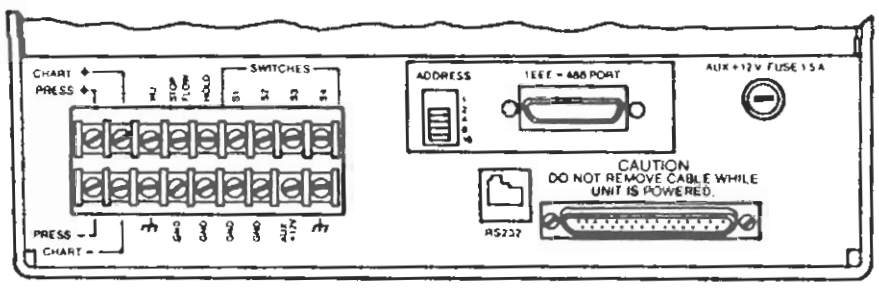


Figure 1-15 Waters 600E Rear Panel
IEEE-488 Address and Interface Positions

Waters 484 and Waters 490

If you are connecting a Waters 484 and a 490 detector to a single PowerLine system controller, the address of the 484 must be lower than that of the 490. In this configuration:

- UV detector number 1 = 484
- UV detector number 2 = channel 1 of the 490

IEEE power-up

Power-up the instruments in an IEEE-488 controlled system in the sequence shown below:

840 or 845/860 systems

1. External equipment not controlled over IEEE-488
2. External equipment controlled by the Waters 840 or 845/860 through IEEE-488 except for interface modules or system units
3. Interface modules or system units
4. Printer
5. Computer

Power to all instruments must be on and calibration or diagnostics must be performed before operating the Waters 840 or 845/860 or it will not recognize these units as part of the system.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Powerline system controllers

1. External equipment not controlled over IEEE
2. IEEE Controlled devices
3. PowerLine System Controller
4. 815 or 825 Data/Control Station

1.4.4 RS-232 Connections

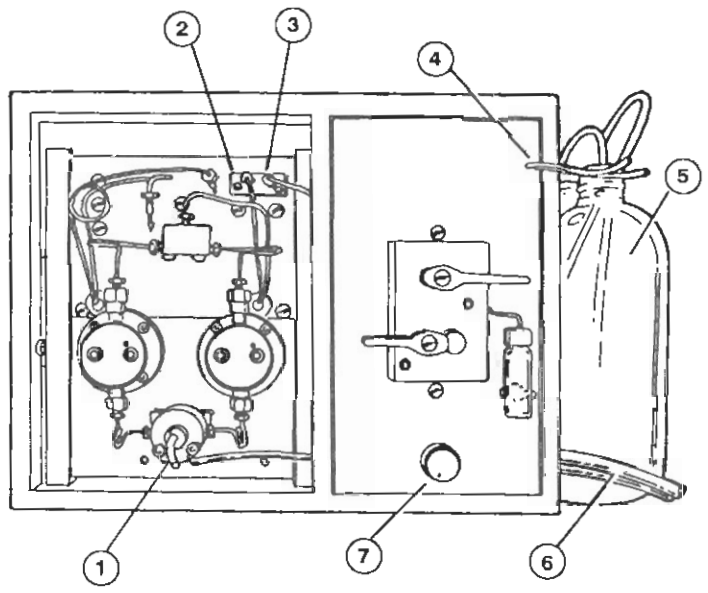
The RS-232 interface PowerLine cable connects to the controller with a simple telephone-like snap-in cable. The other end of this cable will be plugged differently depending on whether it is to connect to a Waters 990+, Waters 815/825, or Waters 745B. Please consult the specific manual for this information.

1.5 FLUID HANDLING UNIT CONNECTIONS

This section describes the following fluid handling unit connections:

- Solvent reservoir setup
- System sparge/helium setup

The fluid handling unit is illustrated in Figure 1-16.



1. Draw off valve
2. Pressure transducer inlet
3. Pump outlet
4. Outlet tubing from column to detector
5. Solvent reservoir
6. Sparge and solvent tubing from fluid handling unit
7. Front panel latch

Figure 1-16 Fluid Handling Unit Connections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1.5.1 Solvent Reservoir Setup

Solvent reservoir caps

Solvent reservoir caps (Figure 1-17) help to maintain a continuously sparged environment in the reservoirs and ensure optimal performance from the solvent delivery system. Each cap has three feather-edged holes to produce a positive seal around the solvent, sparge, and vent tubes (see Figure 1-17). The reservoir caps are available in one-liter bottle size and four-liter bottle size.

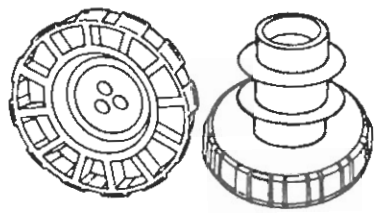


Figure 1-17 One-liter Reservoir Caps

Choose solvent reservoirs (bottles) which provide a snug fit for the reservoir caps. We recommend one-liter bottles. You can either place the bottles on a bench or put them in the optional reservoir rack.

To set up the reservoir:

1. Position the solvent bottles in a convenient location.

CAUTION

Do not place the solvent bottles on top of the cabinet. Leakage may cause damage to the system.

2. If using a solvent reservoir rack, place the four one-liter solvent bottles in the rack and place the solvent reservoir rack in a convenient location.

3. Turn the front panel latch on the slide-out drawer and pull the drawer out.

Remove the protective wrapping from the four Teflon tubes marked Solvent A through Solvent D and the four Teflon tubes marked Sparge A through Sparge D.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4. Uncoil the tubing underneath and slide it through the openings provided toward the front on the right side of the cabinet. The sparge lines go through the openings further back on the right side of the cabinet.

Solvent and sparge tube connections

To connect a solvent reservoir to the fluid handling unit:

1. Disconnect the solvent reservoir filter from the end of one of the solvent tube, and push the tube through a hole in a reservoir cap.

   Make sure you push enough tubing through the cap to reach the bottom of the solvent reservoir bottle (Figure 1-18).

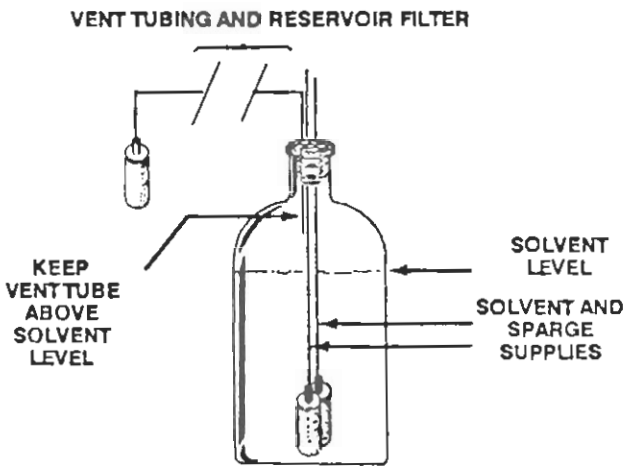


Figure 1-18 Solvent Reservoir Filter Placement

2. Replace the solvent reservoir filter that was removed from the tubing.

3. Repeat steps 1 and 2 for the corresponding sparge tube.

4. Adjust the length of the sparge line to ensure that the sparge filter is long enough to reach the bottom of the reservoir bottle(see Figure 1-18).

5. Repeat steps 1 through 4 for *all* solvent and sparge tubes.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Vent tube connection

To connect the vent tube from the solvent reservoir to a fume hood:

1. Cut 3-foot (92 cm) lengths of Teflon tubing (provided in the startup kit). Push one end through the remaining hole in each reservoir cap. This tubing is the solvent reservoir bottle vent.

WARNING

Make sure the end of the vent tubing within the bottle remains above the level of the solvent. If not, solvent will be forced from the bottle.

2. Connect the other end of the vent tube to a solvent reservoir filter (supplied in the startup kit).

   The filter will maintain the sparged condition while solvent is being withdrawn.

3. Place the end of the vent tube in a fume hood.

WARNING

Harmful effects could result from improperly vented solvent/sparge reservoirs. Be sure to remove vented fumes via fume hood and proper ventilation.

4. Insert the supplied solvent reservoir caps (see Figure 1-17) into the top of each solvent bottle.

1.5.2 System Sparge/Helium Setup

This section describes how to connect a helium tank to the fluid handling unit to sparge the solvent reservoirs. It is divided into the following sections:

- System sparging overview
- Connecting compression fitting assembly
- Connecting the sparge tubing

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1.5.2.1 System Sparging Overview

Helium sparging reduces the total dissolved gas in the solvent reservoirs and maintains that condition during operation. Use an ultra-pure carrier (UPC) grade of helium to prevent solvent contamination.

The helium disperses through the system in the following route:

1. The helium sparge gas is introduced into the solvent through a sintered stainless steel filter which disperses the helium stream into small bubbles.

2. The bubbles increase the effectiveness of the sparge by increasing the surface area of helium exposed to solvent.

3. The reduction in total dissolved gas occurs as the pure helium equilibrates at the gas-liquid interface.

4. The displaced gases are carried to the surface, and expelled through the bottle vent.

For more information on this process, refer to Appendix C, Solvent Properties.

1.5.2.2 Connecting Compression Fitting Assembly

This procedure outlines how to cut tubing to make the compression fitting connections. This process must be performed before you can attach the helium line from the fluid handling unit to the helium tank (as outlined in Section 1.5.2.3). Refer to Figure 1-19 when performing this procedure.

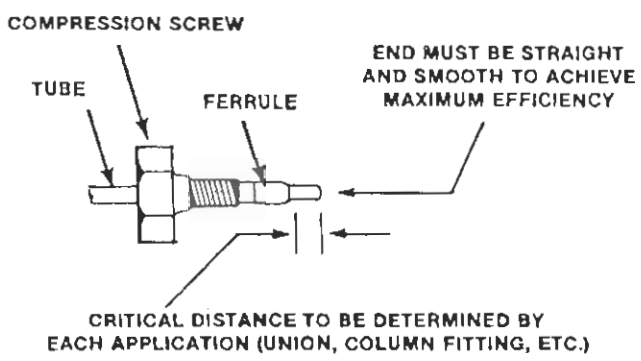


Figure 1-19 Compression Screw Assembly

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1. Using a file with a cutting edge, scribe the circumference of the tubing at the desired mark.

2. Grasp the tubing on both sides of the scribe mark with cloth-covered pliers (to prevent marring the tube surface) and gently work the tube back and forth until it separates.

3. Slide the compression fitting followed by the ferrule (large end of the taper first) over the tube.

   Bottom the tube in the fitting seat to set the ferrule the proper distance from the tube end.

4. Tighten the compression screw 3/4 of a turn from finger tight to initially seat the ferrule on the tube.

   Subsequent connections do not require 3/4 of a turn, but should be gently tightened to make the seal.

1.5.2.3 Connecting Sparge Tubing

To connect the sparge tubing:

1. Regulate the helium tank or house supply source between 50 and 90 psi (3.5 and 6.3 atm).

2. Connect the helium line from the helium tank to the fluid handling unit rear panel (Figure 1-20) with 0.062-inch OD stainless steel tubing and Waters compression screws and ferrules. Attach the compression screw assembly as outlined above.

Adapters may have to be used at the regulator end depending on your source fittings.

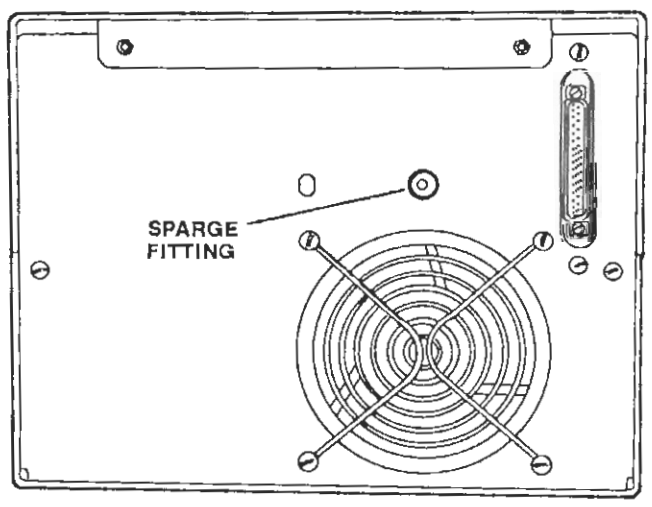


Figure 1-20 Sparge Gas Inlet Connection

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1.6 OPTIONS INSTALLATION

Description The fluid handling unit accommodates the following column/cartridge options (see Figure 1-21):

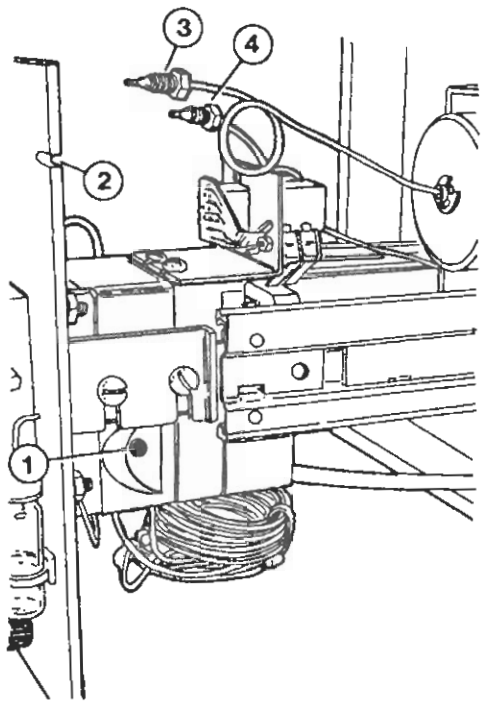
- Steel column up to 30 cm long with optional steel column heater
- Plastic column up to 30 cm long
- Radial compression separation system (RCSS) consisting of the RCSS heater module and the Radial-Pak cartridge
- RCM 8x10 radial compression cartridge (no heater available)

The steel column/RCSS heater module allows you to:

- Maintain a heat controlled environment from 5°C over ambient to 64°C for the RCSS column or 99°C for the cartridge heater module
- Manually set or program temperature set points
- Monitor actual temperature
- Provide safety shutdown limits

Preparation Before installing the column, column/cartridge heater, or RCM 8x10, prime the pump (refer to Book I, How to Use, Chapter 2).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



1. Waters Model U6K Injector (Option) Outlet
2. Detector Tubing Access Hole (To Detector)
3. Column Outlet
4. RCSS Option Inlet Connector

Figure 1-21 Column Compartment Assemblies

1.6.1 Steel Column

This section describes how to install a steel column in the slide-out drawer of the fluid handling unit.

To install the steel column:

1. Turn the latch on the front of the fluid handling unit (the manual injector side) and pull out the slide-out drawer.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2. Remove the union from the plumbing and replace it with the column.

3. Place the column in the tray with the arrow on the label pointing towards the rear of the drawer. Allow the column to lie flat in the tray (see Figure 1-22).

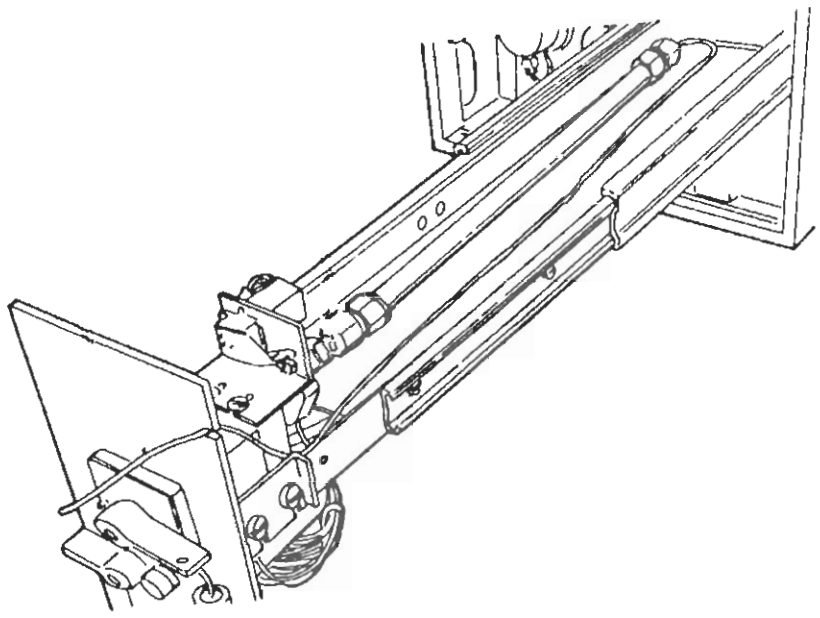


Figure 1-22 Steel Column Installation

4. With a 5/16 inch wrench, attach the inlet tubing and outlet tubing to the column (Figure 1-22). **Be careful not to overtighten**. Do not use a wrench on plastic fittings, finger tighten only.

5. Pass the column outlet tubing from the rear of the drawer, through the notch in the front panel and connect it to your detector.

6. Check for leaks by pumping solvent through the connections. Verify that there are no leaks.

1.6.2 Steel Column Heater

This section describes how to install the steel column heater (along with the column) in the slide-out drawer of the fluid handling unit.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

To install the column heater module and steel column:

NOTE: Operating specifications for the heater are included with the unit.

1. Turn the latch on the front of the fluid handling unit (the manual injector side) and pull out the slide-out drawer.

2. Remove the cover from the heater module assembly (lift straight off).

3. Place the heater module in the slide-out drawer with the column inlet tubing pointing forward as shown in Figure 1-23.

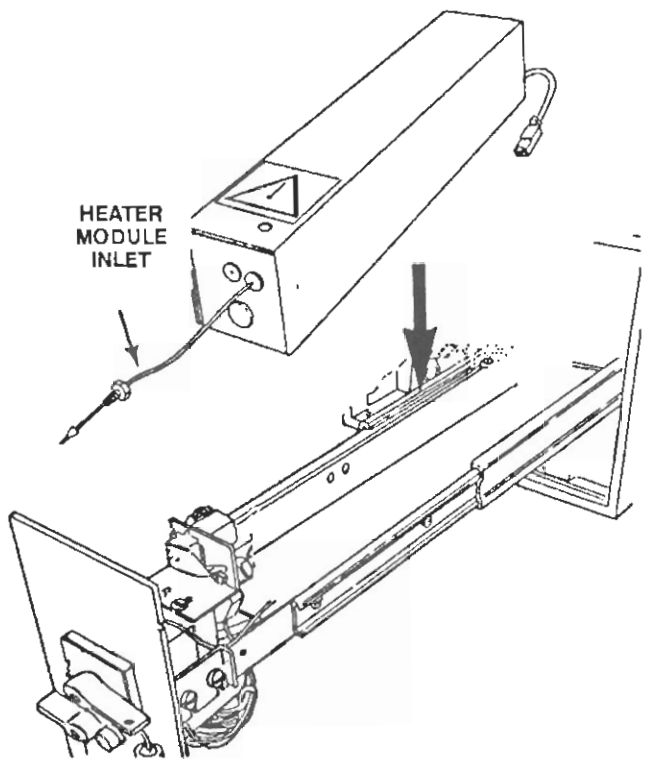


Figure 1-23 Steel Column Heater Orientation

4. Plug the signal cable into the receptacle on the right side of the drawer as shown in Figure 1-24.

   The receptacle is keyed to ensure correct alignment.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

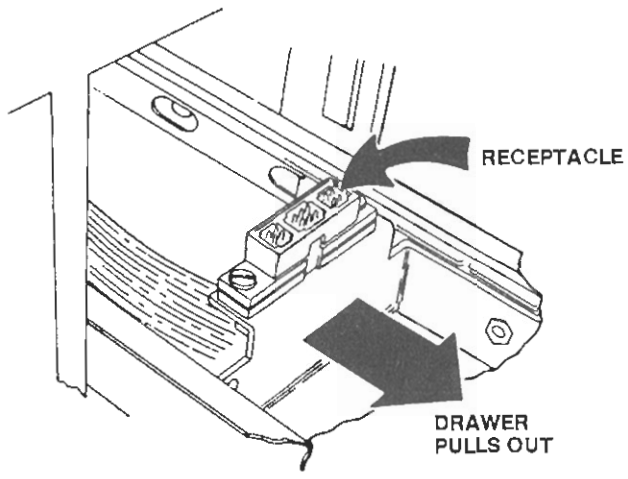


Figure 1-24 Steel Column Heater Signal Cable Connection

5. Place your column (up to 8 mm by 30 cm) in the center channel of the heater tray.

6. Connect the solvent supply tube from the fluid handling unit to the heater module inlet. This requires a union.

   Make sure that the column label (indicating flow direction) points to the front of the module.

7. Pass a piece of 0.009 inch ID tubing through the front left port on the heater tray . Prepare compression fittings for each end and connect the tubing to the column outlet (see Section 1.5.2.1, Connecting Compression Fitting Assembly).

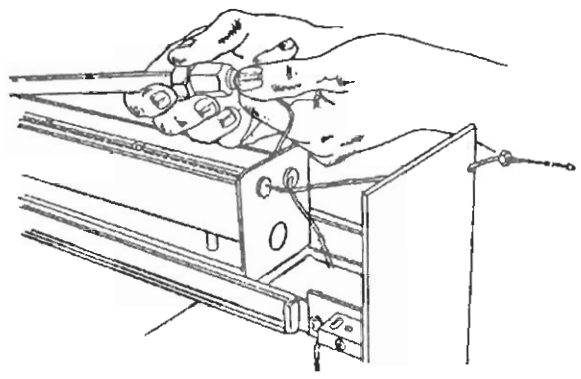


Figure 1-25 Solvent Outlet Connection

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

8. Pass the column outlet tubing through the notch in the front panel and connect it to your detector.

9. Check for leaks by pumping solvent through the connections. Verify that there are no leaks and replace the heater module cover.

1.6.3 RCSS Heater Module

This section describes how to install the RCSS heater in the slide-out drawer of the fluid handling unit. The Radial-Pak cartridge installation procedure is included at end of this section.

Radial-Pak cartridges are used in combination with the RCSS heater module. They are available in a wide variety of packings that provide maximum reproducibility and reliability at relatively rapid flow rates. The Radial-Pak cartridges are made from a flexible high density polyethylene and are available in either 5 or 10 micron particle size packings.

To install the RCSS heater module:

NOTE: Operating specifications for the heater are included with the unit.

1. Turn the latch on the front of the fluid handling unit and pull out the slide-out drawer.

2. Remove the cover from the RCSS heater module assembly (lift straight off).

3. Place the heater module in the slide-out drawer with the column inlet tubing pointing forward as shown in Figure 1-26.

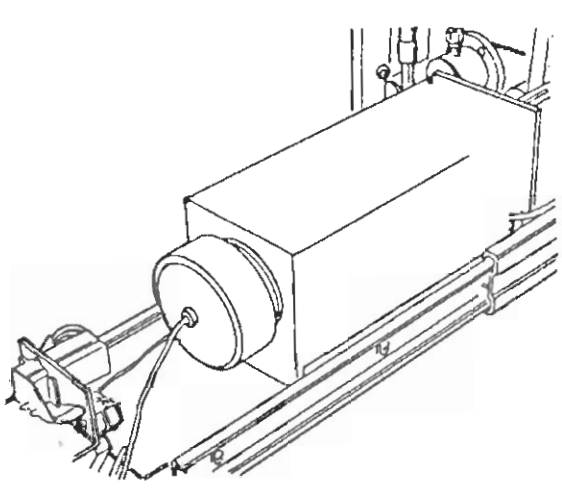


Figure 1-26 Optional RCSS Heater Orientation

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4. Plug the signal cable into the right receptacle in the drawer as shown in Figure 1-27.

   The receptacle is keyed to ensure correct alignment.

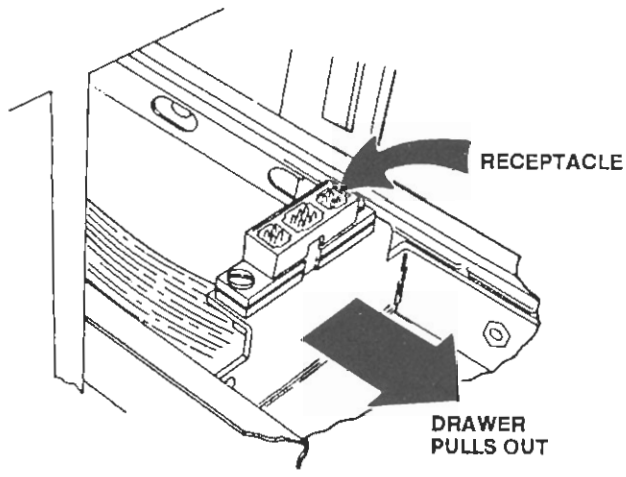


Figure 1-27 RCSS Heater Signal Connection

5. Connect the solvent supply tube from the fluid handling unit to the heater module inlet. This requires a union. (The inlet tube is the one that goes through the notch on the front of the heater.)

6. Connect the outlet tube to the inlet tube of your detector (Figure 1-28).

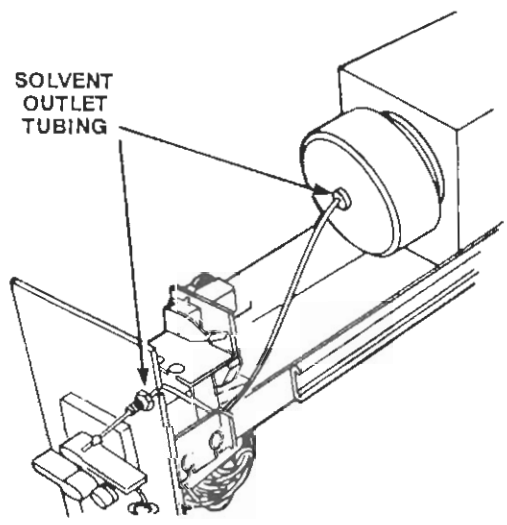


Figure 1-28 Solvent Outlet Tubing

7. Check for leaks by pumping solvent through the connections. Verify that there are no leaks and replace the heater module cover.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Installing a Radial-Pak cartridge

This section includes information on replacing your Radial-Pak cartridges. Refer to the Care and Use Manual supplied with your particular cartridge for specific information.

WARNING

The RCSS heater module will be hot after use. Use care when installing a cartridge.

1. Turn the latch on the front of the fluid handling unit and pull out the slide-out drawer.

2. Remove the cover from the RCSS heater module assembly (lift straight off).

3. Using the hex wrench (supplied in the startup kit), loosen the four compression bolts (Figure 1-29).

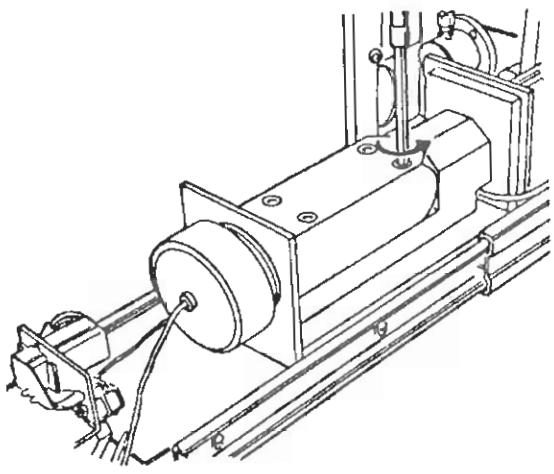


Figure 1-29 Removing the Cartridge

4. Unscrew the knurled column inlet cap. Remove the cartridge. It slides out of the compression chamber attached to the inlet cap.

5. Carefully install the cartridge into the cap holder. To properly align the cartridge, tighten the two bolts on the far end of the compression chamber until the two blocks are 0.04 to 0.08 inch (1 to 2 mm) apart.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6. Carefully slide the cartridge into the compression chamber and screw the inlet cap on securely (Figure 1-30).

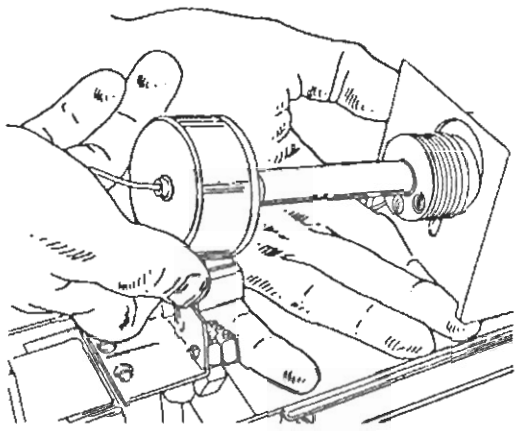


Figure 1-30 Installing the Cartridge

7. Tighten the front two bolts until the two blocks are 0.04 to 0.08 inch (1 to 2mm) apart.

8. Tighten all four compression bolts diagonally (1/2 turn at a time) to ensure an even seat pressure.

1.6.4 RCM 8x10 Installation

This section describes how to install the RCM 8x10 in the slide-out drawer of the fluid handling unit.

1. Turn the latch on the front of the fluid handling unit (the manual injector side) and pull out the slide-out drawer.

2. Place the RCM 8x10 in the slide-out drawer with the column inlet tubing pointing forward as shown in Figure 1-31.

3. Attach the inlet tubing and outlet tubing as shown in Figure 1-31. Allow the RCM 8x10 to lie flat in the tray.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

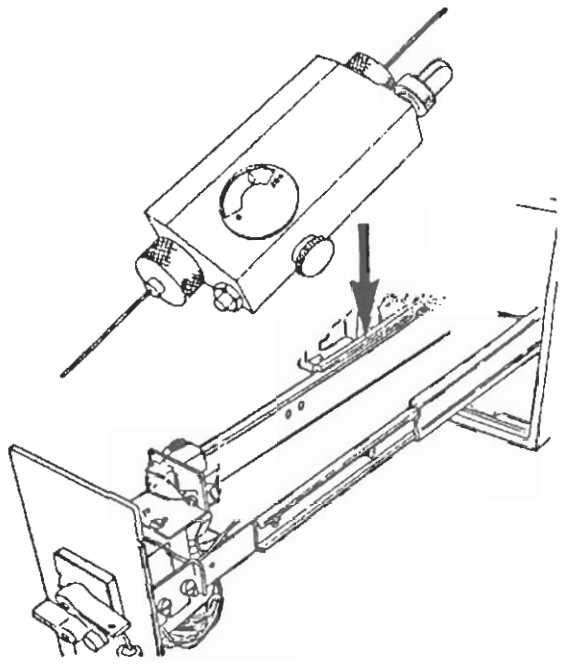


Figure 1-31 RCM 8x10 Installation

4. Connect the solvent supply tube from the fluid handling unit to the RCM inlet.

5. Pass the outlet tubing through the notch in the front panel and connect it to your detector.

6. Check for leaks by pumping solvent through the connections. Verify that there are no leaks.

Refer to your Waters RCM 8x10 Operator's Manual for detailed operation information.

1.7 CARTRIDGE AND COLUMN PREPARATION

Refer to the Care and Use Manual supplied with your column or cartridge for specific information on solvent selection and equilibration before use, and observe precautions during use.

1.8 INJECTOR CONNECTIONS

The Waters 600E can use either an automatic or manual injector, or both connected in a series. This section includes procedures for connecting the injectors to the fluid handling unit.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

1.8.1 Manual Injector

The following manual injector options and kits for installation are available from Waters:

- Waters U6K Injector kit (includes injector)
- Mounting kit for Rheodyne Injector for attaching a Rheodyne 7125 injector on Rheodyne Position Sensing Kit. The injector and chart mark switch must be supplied separately.

The manuals shipped with these kits include the procedures you will need for installation.

1.8.2 Auto-Injector

Although the optional Waters U6K manual injector is shown in many of the illustrations throughout this manual, other combinations of manual and automatic injectors are possible with the Waters 600E.

The auto-injector can be used in one of two ways:

- The preferred means of making an injection
- The first injector in a series with a manual injector connected to the fluid handling unit.

Procedure To connect the auto-injector without a manual injector:

1. Place the Waters auto-injector on the selected side of the system. Allow room for access to the solvent reservoirs.
2. Connect the blue (inlet) line from the auto-injector to the pressure transducer outlet of the fluid handling unit (Figure 1-32). This requires a union.
3. Connect the red (outlet) line from the auto-injector to the column inlet (see Figure 1-32).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

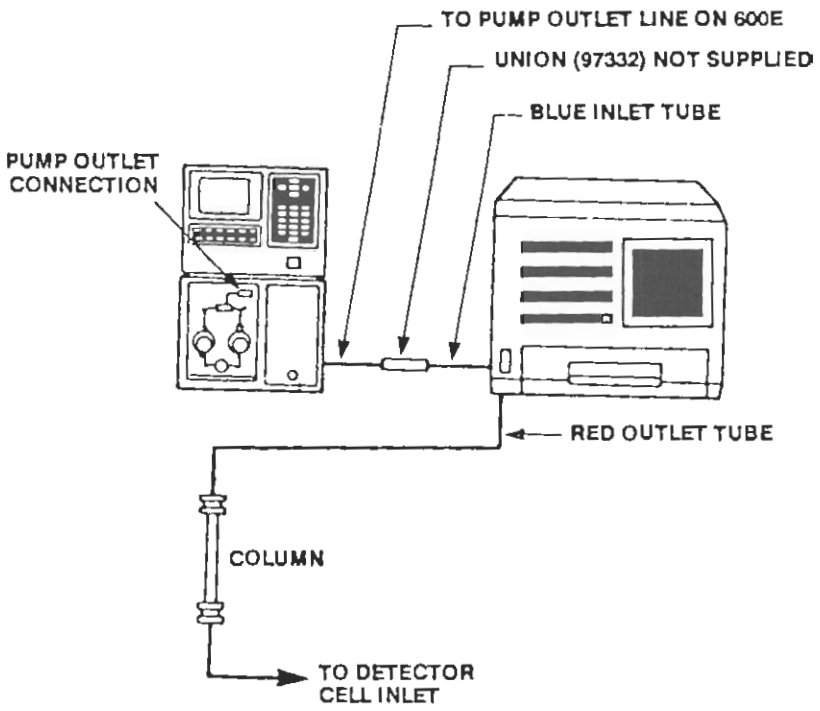


Figure 1-32 Auto-Injector Only

Refer to Section 1.6.1, Steel Column Installation, in this chapter for additional information on attaching a column.

Series connection procedure

The following procedure allows you to connect the auto-injector in series with a manual injector.

NOTE: Using a manual injector and auto-injector in series may create bandspreading problems due to the additional tubing between the injector and the column. To minimize bandspreading, keep the U6K handle in the LOAD position.

1. Place the Waters auto-injector on the selected side of the system.

   Allow room for access to the solvent reservoirs.

2. Connect the blue (inlet) line from auto-injector to the pressure transducer outlet of the fluid handling unit (see Figure 1-33). This requires a union.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

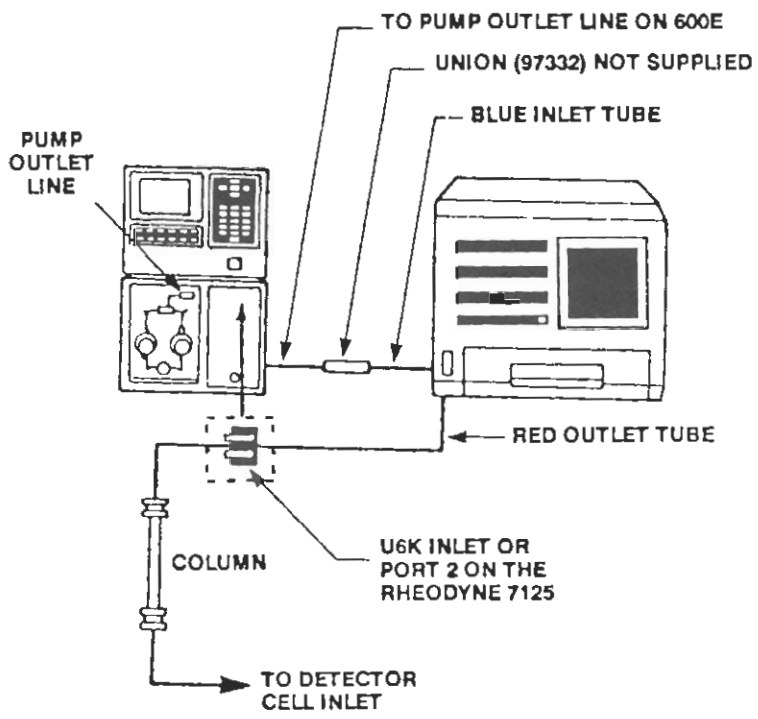


Figure 1-33 Auto-Injector and Manual Injector In Series

3. Connect the red (outlet) line from the auto-injector to the Waters U6K inlet port (on the right side of the injector when facing the fluid handling unit).

   If using a Rheodyne injector instead of a U6K, use Rheodyne compression fittings to make this connection to the Rheodyne 7125 (Port 2).

4. Connect the U6K outlet port (on the right side of the injector when facing the fluid handling unit) to the column inlet.

   If using a Rheodyne injector, connect Port 3 on the Rheodyne 7125 to the column inlet.

1.9 DETECTOR CONNECTIONS

CAUTION

Never stack fluid handling units and devices on top of electronic units without adequate leak protection.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

To connect the detector:

1. Connect the shortest length of 0.009 inch ID tubing possible between the detector cell inlet and the column outlet.

2. Pass the waste line from the detector cell outlet to a proper receptacle.

1.10 OPTIONAL DISSOLUTION COMPONENTS CONNECTIONS

The PowerLine System Controller can be used as a dissolution controller with the following optional components:

- Waters 712D Multi-Port Sample Processor
- Dissolution Bath
- Hanson Transfer Controller (including the volumetric manifold and Transfer Air/Vacuum Source)

If required, an optional mechanical tablet dropper is also available from Hanson Research Corporation.

This section describes how to connect these components to the controller's rear panel. In addition, this section outlines the required tubing connections between the Hanson Transfer Controller and the Waters 712D. Specific information on each of the dissolution system components is available in the respective operator's manuals.

Once your dissolution system has been setup, you can define the dissolution control application as outlined in Book I, How to Use, Chapter 4.

Figure 1-34 illustrates a typical installations with the PowerLine system controller and dissolution components.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

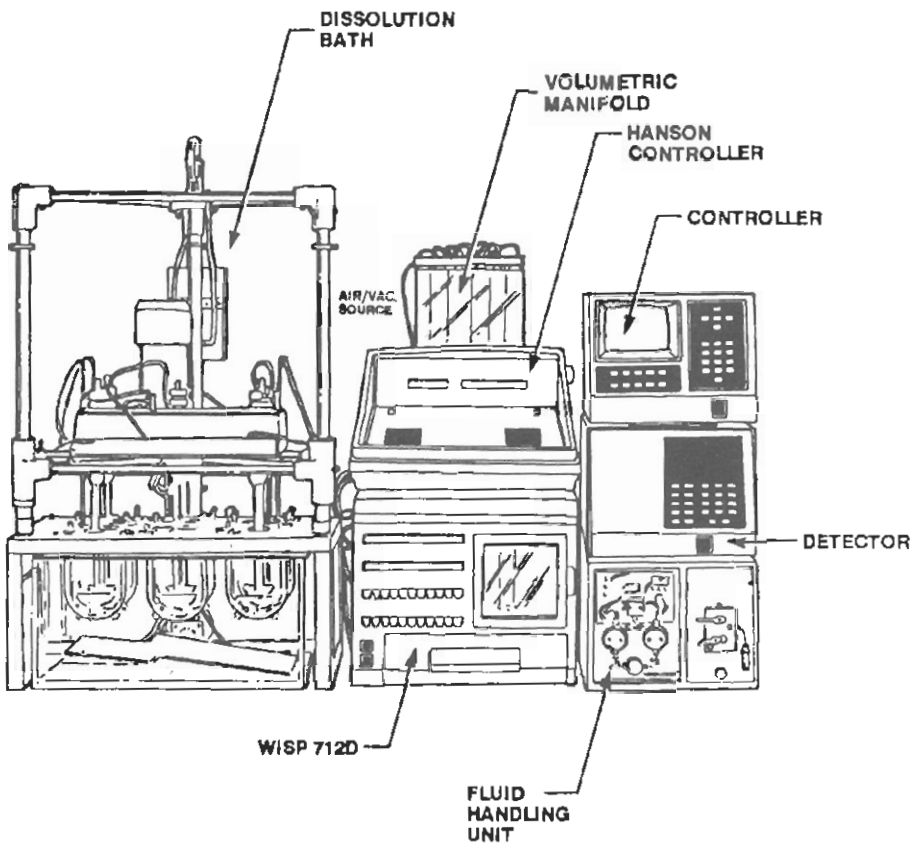


Figure 1-34 Typical Dissolution System

1.10.1 Electrical Connections

Initial electrical requirements Prior to making electrical connections, ensure that the following conditions are met:

- Each component is properly unpacked, setup, and installed as outlined in the respective operator's manual.
- Each component operates from a properly grounded ac power source that is relatively free of transients and fluctuations.
- The rear panel voltage selection switches for each component are properly set.

Electrical connections The following steps outline how to make the electrical connections between the PowerLine system controller and the optional dissolution components. Refer to Figure 1-35 when performing this procedure.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

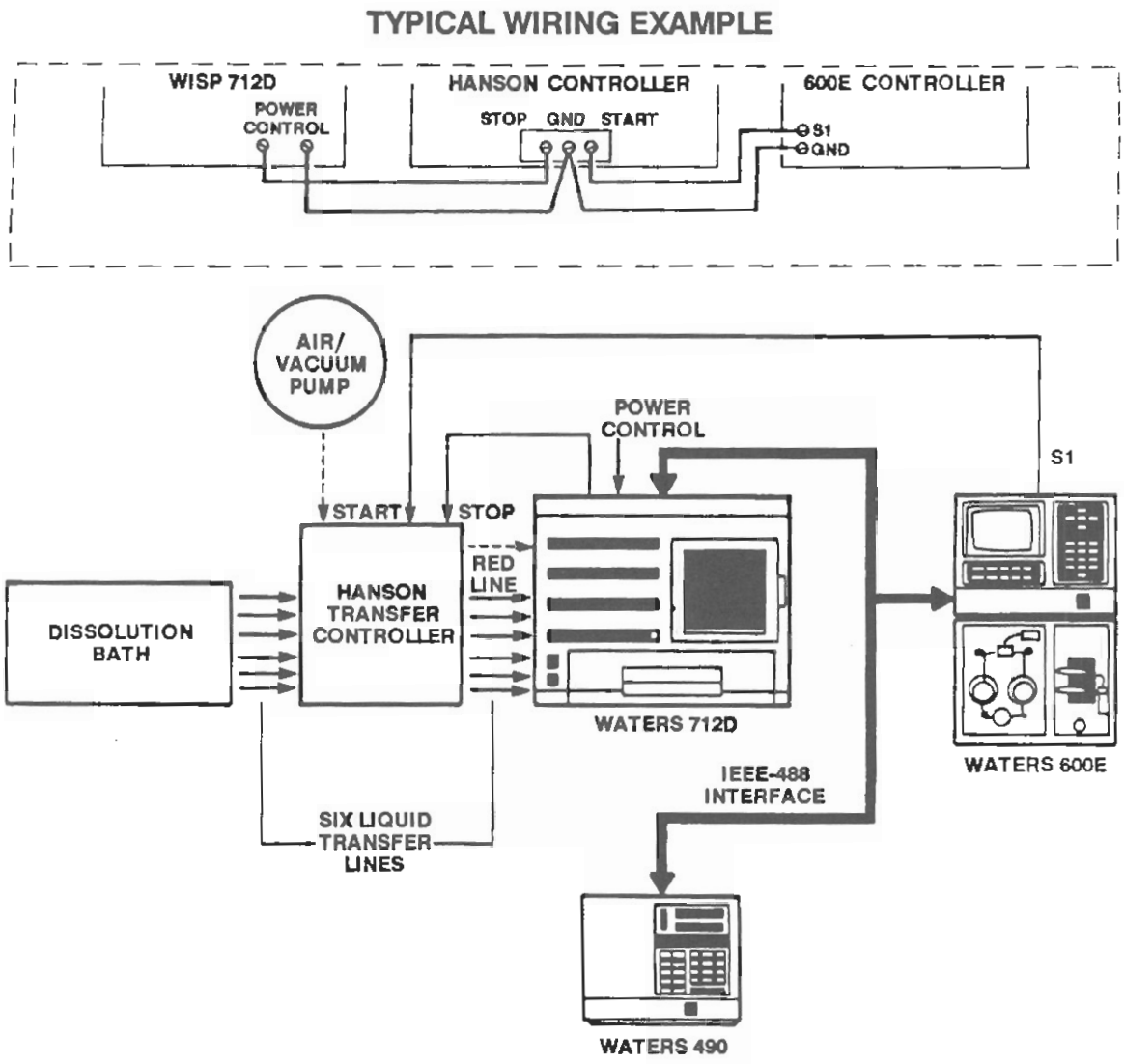


Figure 1-35 Dissolution Electrical Connections

1. Connect external switch S1 and ground terminals on the controller's rear panel to the START and GND terminals on the Hanson Transfer Controller. This signal instructs the Hanson Controller when to take samples from the dissolution bath.

2. Connect the IEEE-488 cable between the controller's IEEE-488 connector and the Model 712D connector. All control and data information passes between the PowerLine system controller and 712D through this connection.

   Refer to Section 1.4.3, IEEE-488 Electrical Connections, for information on address requirements.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3. Connect the 712D's POWER CONTROL terminals to the STOP terminals on the Hanson Transfer Controller. This prevents the Hanson Transfer Controller from collecting samples from the dissolution bath during instances where a problem develops with the 712D (for example, if the sample carriage compartment door is opened this ensures that no samples are transferred to the 712D when the sample carriage is not installed).

1.10.2 Tubing Connections

This section outlines the required tubing connections between the Waters 712D and the Hanson Transfer Controller. Prior to performing these connections, ensure that the Waters 712D is properly connected to the fluid handling unit as described in Section 1.8, Injector Connections.

Connecting transfer lines

Six transfer lines extend out from the volumetric manifold (which measures the dissolution aliquots to be transferred) and transfer air/vacuum source (which provides a separate air source to drive the multi-port sample dispenser). These six lines connect to six lines which pass through an opening in the rear panel of the Waters 712D.

Connect each numbered line to its mating line (connect #1 to #1, #2 to #2, and so on) using the plastic compression fittings shown in Figure 1-36.

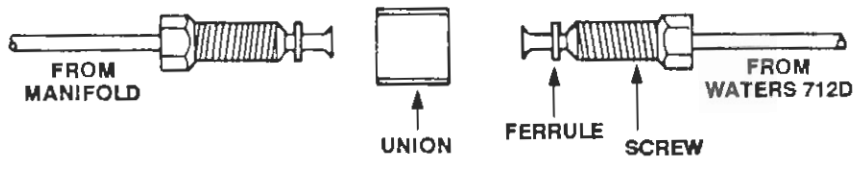
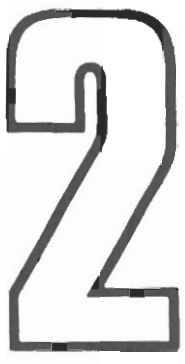


Figure 1-36 Plastic Compression Fittings

Connecting the air tube

The Waters 712D contains an additional air tube (red Tygon tube) which connects to the inject valve air port on the rear of the Hanson Transfer Controller. This air line provides isolated control over the multi-port sample dispenser located inside the 712D.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



DIAGNOSTICS AND TROUBLESHOOTING

This chapter explains how to evaluate the self-diagnostic routines automatically performed at each powerup and includes instructions for running the Extended Test routine. System errors, messages and troubleshooting procedures are also included in this chapter.

WARNING

Be sure to use good laboratory practices when handling solvents.

2.1 SELF-DIAGNOSTIC ROUTINES

The system performs a series of self-diagnostic tests automatically at every powerup. These routines test:

- The 68000 processor, associated clock and reset circuitry, LEDs and drive circuitry, ROM containing code preceding first entry
- ROM, associated address decoding, bus latch and drive circuits
- Address at each RAM location, associated address decoding, bus latch and drive circuits

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- Video RAM
- EEPROM location with interrupt, read/write, associated address decoding, bus latch and drive circuits
- Real time clock, oscillator, counters and associated interrupt circuitry

When the self-diagnostic routine has been successfully completed, the power up display will reappear on the screen.

No screen display If there are no results displayed on the screen, the failure could have prevented the program from controlling the CRT display.

Restart Restart the program by turning the power switch off and back on.

2.2 EXTENDED TEST ROUTINES

After the automatic self-diagnostic routine has been completed, you may select the extended test routine by pressing the decimal key on the front panel keyboard. The extended test routine tests the following functions in the following order:

- Keyboard operation
- Video operation
- Switch outputs
- Chart terminal
- Pump operation
- Solvent valves
- Sparge valves
- Rear panel connections

The extended test routine proceeds by prompting you to perform certain actions. In most cases, this is to press the ENTER key. Tests requiring you to perform additional procedures are discussed individually below.

NOTE: If any tests fail during this procedure, contact Waters Service department at 1-800-252-HPLC.

Tools The only tools required for the extended test routine are a jumper wire (Figure 2-1) to short various controller rear panel terminals (Figure 2-2) to ground, and a screwdriver.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

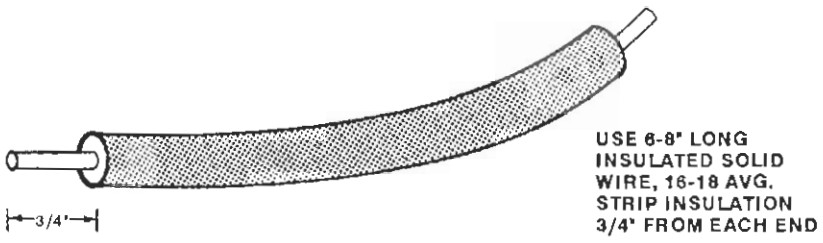


Figure 2-1 Jumper Wire Construction

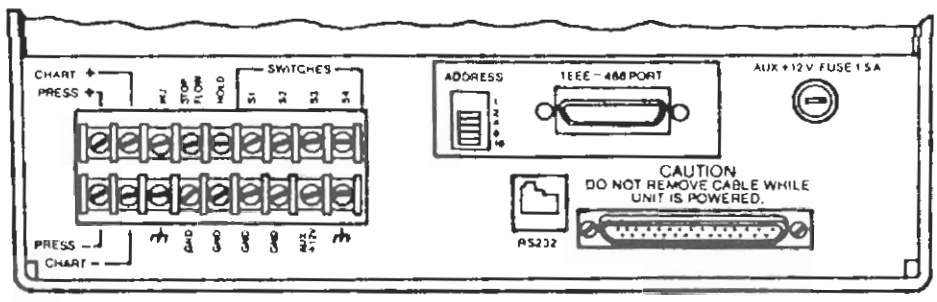


Figure 2-2 Rear Panel Terminals and Ground

General Instructions

The following are general instructions for running the extended test routine. Specific instructions are given for each test in the following sections.

Each test uses the screen to ask the operator to do one or more of the following:

- Press a key
- Place a jumper across terminals
- Make an observation

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

You must cycle through the tests in order (either performing or bypassing them) to exit the extended test sequence.

Advance to the next test by pressing ENTER. Skip unwanted tests by pressing ENTER a second time.

When the tests are complete the Power Up screen reappears. At this time you may:

- Rerun the extended test routine by pressing the decimal key.
- Resume normal operation by pressing any function key.

2.3 INDIVIDUAL EXTENDED TESTS

The following individual tests require you to perform some procedures that may need some explanation. For that reason, they have been listed here.

2.3.1 Stop Flow Input Test

The STOP FLOW is a switch closure that stops the pump. This test verifies that the STOP FLOW input switch is functioning.

Procedure

1. Attach a jumper wire from the STOP FLOW switch on the rear of the panel to GND terminal also on the rear on the panel (see Figure 2-2).
2. Press ENTER.

   If the test has been successful the screen will display **Got Stop Flow**. If the test has failed, it will display **Did Not Get Stop Flow**.
3. Press ENTER.
4. Remove the jumper wire.
5. Press ENTER to proceed to the next test.

2.3.2 External Inject Test

The internal inject (INJ) switch accepts a signal from the injector to start a run. This test verifies that the INJ switch is functioning.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Procedure

1. Attach a jumper wire from INJ on the rear panel to the GND terminal on the rear of the panel (see Figure 2-2).
2. Press ENTER.

   If the test has been successful, the screen will display **Got Inject**. If the test failed, the screen will display **Did Not Get Inject**.
3. Press ENTER.
4. Remove the jumper wire.
5. Press ENTER to proceed to the next test.

2.3.3 External Switch (S1 - S4) Output Test

This test verifies that the external switches S1 through S4 are functioning. This test leads directly into the test for the HOLD switch by requesting you to move the jumper wire *before* pressing ENTER.

Procedure

1. Attach jumper wire from the S1 terminal on the rear panel to the INJ terminal on the rear of the panel.
2. Press ENTER.

   The screen will display **Test Passed** or **Test Failed**.
3. Press ENTER.
4. Repeat steps 1 through 3 for all four external switches.
5. When all four external switches have been tested, the screen will display **Connect Hold To Inject**. If you wish to proceed to the hold output test, *do not press ENTER until after you have attached HOLD to INJ.*

   If you want to bypass the hold output test, simply press ENTER.

2.3.4 Hold Output Test

The Hold switch produces a signal to prevent further injections in case of power failure, pressure shutdown or an abort procedure.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Procedure

1. Attach a jumper wire from HOLD to GND on the rear panel.
2. Press ENTER.

   The screen will display **Test Passed** or **Test Failed**.
3. Press ENTER.
4. Remove the jumper wire.
5. Press ENTER.

2.3.5 Chart Test

During this test, the chart output is ramped from 0 to 100% and then dropped immediately to 0%.

Procedure

1. Connect your chart recorder to the CHART + and - terminals.
2. Set the recorder to accept a 10mv Full Scale signal. A triangular (sawtooth) trace will appear on the chart recorder if the test is successful.
3. Press ENTER to proceed to the next test.

2.3.6 Sparge Valves Test

This test verifies that the sparge valves are functioning.

WARNING

High voltage present. Always turn off the power and disconnect power cord before removing the controller top.

Procedure

1. Remove the controller cover by loosening the two screws on the back pannel and lifting the top off.
2. Press ENTER.
3. Check for bubbling in the solvent reservoir as each sparge valve is exercised.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4. Observe the LED (DS4) connected to the driver outputs (Figure 2-3).

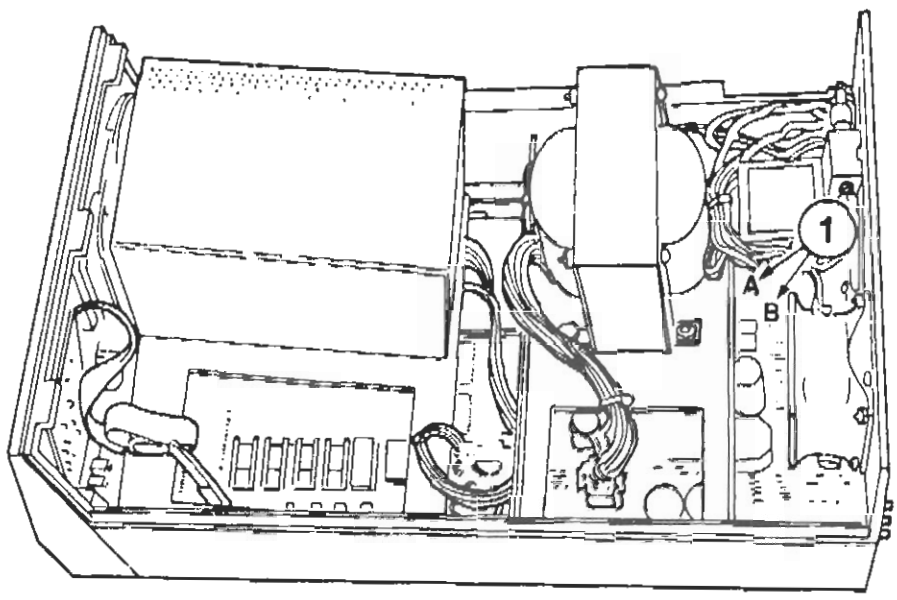


Figure 2-3 LEDs Connected to Driver Outputs

The sparge valves cycle OFF and ON in order, one at a time. If the test is successful, they blink in sequence.

5. Press ENTER to proceed to the next test.

2.3.7 Pump and Solvent Valves Test

This test verifies that the pump delivers the correct amount of solvent.

WARNING

High voltage present. Always turn off the power and disconnect power cord before removing the controller top.

Procedure 1. If you have not removed the controller cover for the previous test, do so now by loosening the two screws on the back pannel and lifting the top off.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2. Press ENTER.

3. Observe the LED (DS5) designated for the gradient proportioning valve drive output (see Figure 2-3).

   The valves will blink in sequence as the valves open and close. When the LEDs have blinked, the pump and all the sparge valves have been tested.

4. Replace cover.

5. Press ENTER to proceed to the next test.

2.3.8 IEEE-488 Address Test

This test verifies that the system is reading the current address by displaying it on the screen. When this test begins, the current address is displayed on the screen.

Procedure

1. Change the position of any of the IEEE-488 address DIP switches on the back of the controller panel. The address shown on the screen will change.

2. Repeat step 1 for each DIP switch.

3. Press ENTER to proceed to the next test.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2.4 FLUID SYSTEM TROUBLESHOOTING

Table 2-1 is a general listing of potential pump unit symptoms that may occur during operation, along with the possible causes and solutions.

Table 2-1
Pump Troubleshooting Guide

Symptom	Possible Cause	Solution
Pump will not run	No line power	Check the power source and make sure the power cord is connected at both ends.
	Pressure limit set at zero	Readjust the pressure limit on the PUMP SETUP screen to the correct pressure.
	Blown fuse	Replace the fuse. Refer to Chapter 3 of this book.
	Broken plunger jamming the pump	Replace the damaged plunger. Refer to Pump Plunger Replacement procedure in Chapter 3 of this book.
	Defective motor	Contact Waters Service Department for corrective action.
	Defective circuit board	Contact Waters Service Department for corrective action.
	Defective transducer	Refer to Transducer Replacement procedure in Chapter 3 of this book.
Pump leaks solvent	Worn plunger seals	Replace the seals. Refer to Plunger Seal Replacement procedure in this section.
	Loose pump head	Tighten the loose pump head(s) with a 5/32-inch Allen-head wrench.
	Loose compression screw(s) on the pump head	Tighten the loose compression screw(s) with a 5/16-inch open-end wrench.
	Loose inlet or outlet valve	Tighten the loose check valve(s).

con't.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 2-1 (Cont'd)
Pump Troubleshooting Guide

Symptom	Possible Cause	Solution
Erratic flow	Dirty check valve(s)	Clean the check valve(s). Refer to Check Valve Cleaning and Replacement procedure in Chapter 3.
	Faulty check valve(s)	Replace the check valve(s).
	Plugged solvent filter	Clean or replace the filter.
	Broken plunger	Replace the damaged plunger.
	Gas dissolved in the mobile phase	Sparge the solvents (see Appendix C).
Mechanical/Electronic Noise:		
Squeak	Binding plunger seal	Replace the plunger seal assembly. Refer to Plunger Seal Replacement procedure in Chapter 3.
Click	Binding piston indicator rod	Hold each piston indicator rod out, by hand (one at a time) to determine which is at fault. If click stops when the rod is held, replace the piston indicator rod.
Loud snap	Binding plunger seal	If it does not stop (and cannot be isolated to one pump head), replace plunger seals (one at a time). Refer to Plunger Seal Replacement procedure in this section.
Hum (different from operating hum)	Flow rates between 0.1 and 0.3 ml/min	None.

con't.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 2-1 (Cont'd)
Pump Troubleshooting Guide

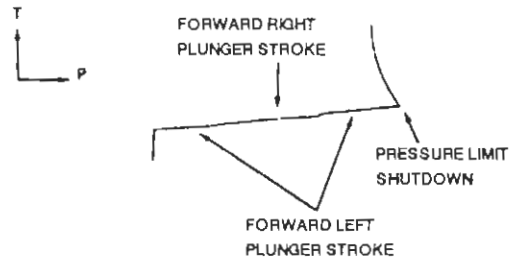
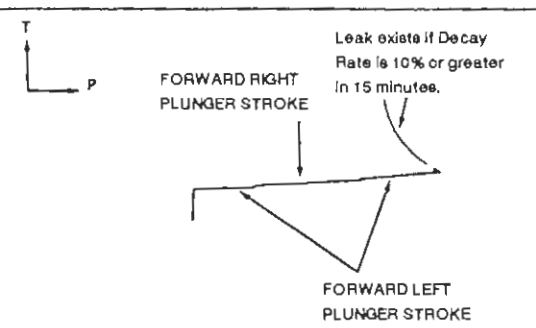
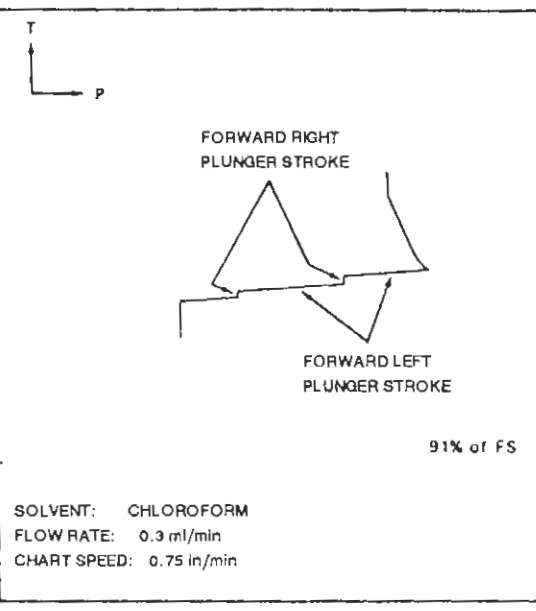
Symptom	Possible Cause	Solution
Chromatographic Problems:		
Doubled retention times	Broken plunger	Replace the plunger.
Increased retention times	Separation chemistry	Check mobile phase and column.
	Air in pump head	Degas all solvents.
	Clogged filters	Clean or replace filters.
	Dirty check valves	Clean the check valves.
Noisy baseline	Pump not primed	Prime the pump.
		Check for air in the pump, bad filters or seals.
	Ground circuit	Connect cable shield at appropriate terminal.
	Solvents not properly degassed	See degassing procedure in Appendix C

2.5 PRESSURE TRACE RECORDING TO AID TROUBLESHOOTING

The following procedure will help you locate specific problems and avoid unneccessary part replacement:

1. Connect a 10 millivolt chart recorder to the pressure moniter terminal jacks.
2. Open the reference valve.
3. Plug the pump outlet with a fitting plug.
4. Set high pressure limit on the PUMP SETUP screen to 6000 psi.
5. Set the flow rate to 0.3 mL/min.
6. Close reference valve and allow pressure to build until pump stops.
7. Compare your pump operation characteristics to those shown in Figure 2-4.

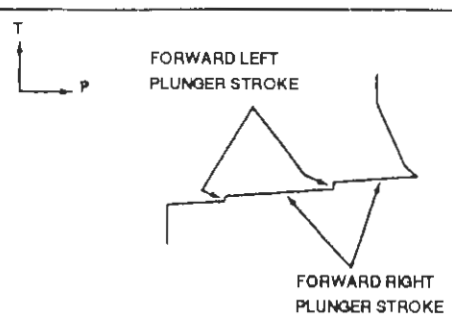
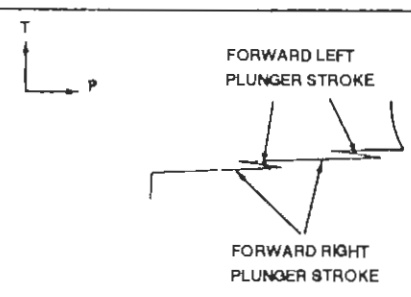
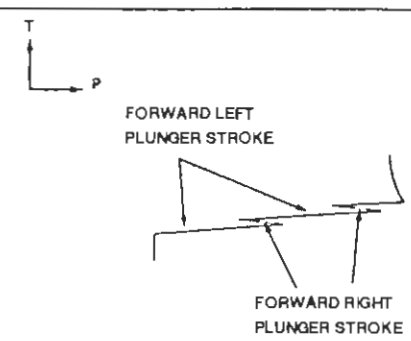
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

RECORDING NUMBER	PRESSURE RECORDING	INDICATION	RECOMMENDED ACTION
1	 SOLVENT: CHLOROFORM FLOW RATE: 0.3 ml/min CHART SPEED: 0.75 in/min 91% OF FS	Normal Recording	High sensitivity accessory defective Replace.
2	 SOLVENT: CHLOROFORM FLOW RATE: 0.3 ml/min CHART SPEED: 0.75 in/min 90% of FS	Leak	Check all valves, plumbing and indicator rod openings.
3	 SOLVENT: CHLOROFORM FLOW RATE: 0.3 ml/min CHART SPEED: 0.75 in/min 91% of FS	Gas in Right Pump Head or Right Pump Head Malfunction.	Withdraw solvent degas and reinject. If pump still malfunctions, check pump heads and plunger seals.

NOTE: FS = full scale, P = pressure, T = time

Figure 2-4 Pressure Trace Recording To Aid Troubleshooting (with Transducer Outlet Plugged)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

RECORDING NUMBER	PRESSURE RECORDING	INDICATION	RECOMMENDED ACTION
4	 SOLVENT: CHLOROFORM FLOW RATE: 0.3 ml/min CHART SPEED: 0.75 in/min 91% of FS	Gas In Left Pump Head or Left Pump Head Malfunction	Same as recording #3.
5	 SOLVENT: CHLOROFORM FLOW RATE: 0.3 ml/min CHART SPEED: 0.75 in/min 92% of FS	Right Pump Head Malfunction	Check pump head.
6	 SOLVENT: CHLOROFORM FLOW RATE: 0.3 ml/min CHART SPEED: 0.75 in/min 92% of FS	Left Pump Head Malfunction	Check pump head.

NOTE: FS = full scale, P = pressure, T = time.

Figure 2-4 (Cont'd) Pressure Trace Recording To Aid Troubleshooting

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2.6 INJECTOR SYSTEM TROUBLESHOOTING

For troubleshooting information on the injector system, refer to the operator's manual associated with your injector.

2.7 SOLVENT VALVE PAIR TEST

The solvent valve pair test allows you to evaluate the system when you suspect a defective valve as a result of erratic chromatographic results.

Requirements The test can be performed in less than one hour using:

- Pure methanol solvent
- UV absorbing sample

The sample is used to "spike" one reservoir of methanol, and must be linear in absorbance throughout the test range.

Prepare solvent To prepare the solvent for the solvent valve-pair test:

1. Fill reservoirs A and B with Solvent 1 (100% methanol).

2. Fill reservoirs C and D with Solvent 2 (100% methanol with 5.6 mg/L propylparaben added).

The concentration of propylparaben in methanol shown here for Solvent 2 should produce approximately 0.45 AUFS in this test. If you substitute another sample in the procedure determine the best concentration for your own use.

NOTE: UV absorbing samples may be substituted for propylparaben. Do not use acetone as the sample since the lack of linearity will cause problems in interpreting the results.

Flush the solvent lines Be sure to flush any previous solvents from the system and change over thoroughly to the test solvents as outlined in Book I, How To Use, Chapter 2.

Recorder settings The recommended recorder settings allow you to easily visualize 1% compositional variances (1% input changes are set equal to 5% of full scale on the recorder). Therefore the 10% changes programmed into the table will be visible as 50% full scale on the recorder (as shown in Figure 2-5).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Adjust the recorder

To adjust the recorder:

1. Set the detector to 0.5 AUFS.
2. Pump solvent 1 (reservoir A or B) isocratically at 5 ml/min and adjust the recorder to zero.
3. Pump solvent 2 (reservoir C or D) isocratically at 5 ml/min and adjust the recorder to full scale using the recorder's variable full scale input.

The recorder is now set to respond so that:

- 0% composition (pure methanol in solvent 1) = 0% Full Scale.
- 100% composition (methanol containing propylparaben sample in solvent 2) = 100% Full Scale.

Program gradient table

Enter and save the following gradient table (as outlined in Book I, How To Use):

Table 2-2 Gradient Table

TIME	FLOW	%A	%B	%C	%D	CURVE
INITIAL	2.00	100	0	0	0	*
5.00	2.00	90	0	10	0	11
10.00	2.00	100	0	0	0	11
15.00	2.00	90	0	0	10	11
20.00	2.00	0	100	0	0	11
25.00	2.00	0	0	10	0	11
30.00	2.00	0	100	0	0	11
35.00	2.00	0	90	0	10	11
40.00	2.00	0	100	0	0	11
45.00	0.00	0	100	0	0	11

Procedure

1. Go to the OPERATE GRADIENT or OPERATE METHODS screen.
2. Press the **START RUN** function key.
3. When the detector baseline is stable at 0%:
   - Change the detector sensitivity to 0.1 AUFS
   - adjust the baseline to 10% full scale by adjusting the recorder's zero adjustment

A 5% change on the recorder now equals a 1% change in composition.

Evaluate results

Figure 2-5 is typical of the results obtained from this test when all valves are in proper working condition.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Valve Failure A valve failure would show as a difference in height between the sections common to that valve.

For example, if Valve A is malfunctioning Peaks 3 and 4 (the only two containing contributions from Valve A) will be irregular when compared to Peaks 1 and 2. Similarly, if Valve B is bad, Peaks 1 and 3 will be irregular.

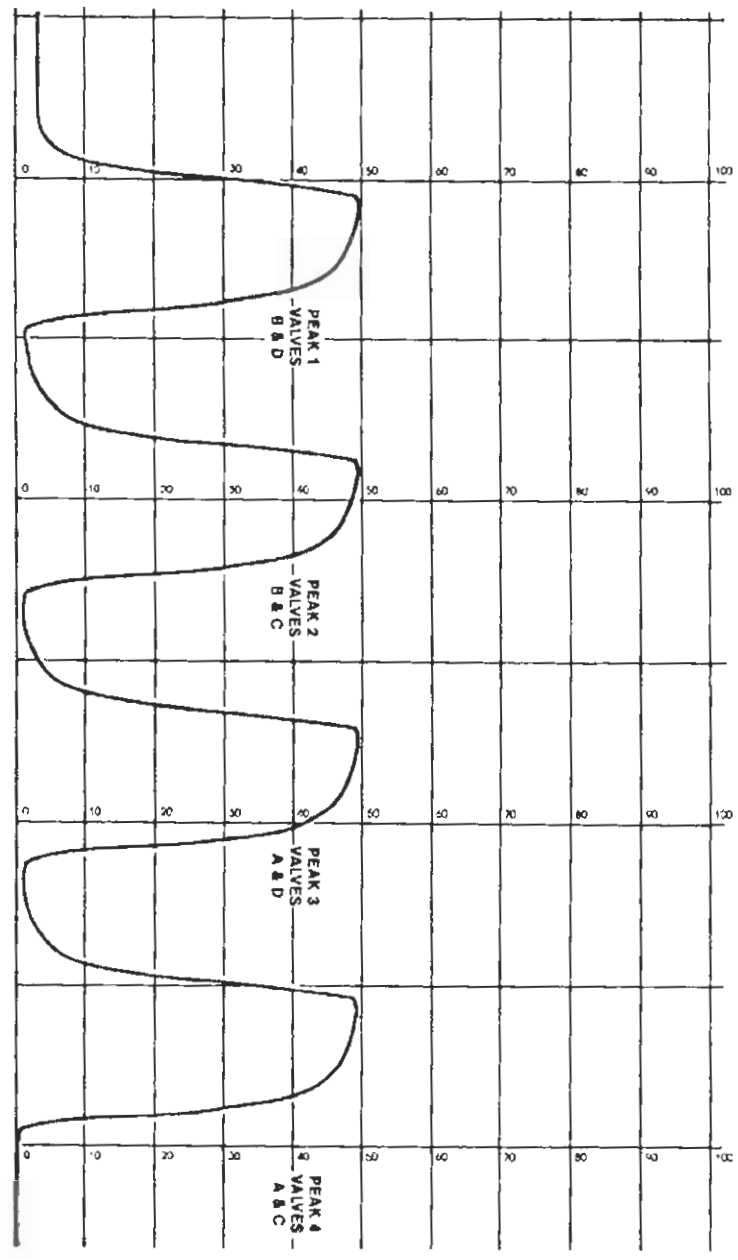


Figure 2-5 Test Results With All Valves Working

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



MAINTENANCE PROCEDURES

This chapter includes:

- Suggestions for routine care of the Waters 600E
- Maintenance procedures for the fluid handling system
- Maintenance procedures for the electronics system

Spare parts Appendix B lists recommended spare parts that you may want to have on hand. Parts not included in Appendix B may not be recommended for field replacement. Contact the Service Department for assistance.

Field service Waters staff of service specialists provides preventive and/or corrective maintenance. Contact the Waters Service Department or your local representative if you have questions regarding instrument repair or performance. The telephone number is 1-800-252-HPLC.

CAUTION

Before handling the controller board make sure you have already grounded yourself by touching a screw or other metal component on the chassis of the unit. Do not touch any of the integrated circuit chips or other components which do not specifically require manual adjustment.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.1 FLUID HANDLING UNIT

WARNING

Always turn off power and disconnect power cord from unit before removing cover.

Observe good lab practices when handling solvents.

This section describes the maintenance procedures for the fluid handling unit (see Figure 3-1). The fluid handling unit consists of:

- Transducer
- Pump
- Sparge valves
- Proportioning valves

Figure 3-1 identifies the parts of the fluid handling unit upon which you can perform maintenance procedures.

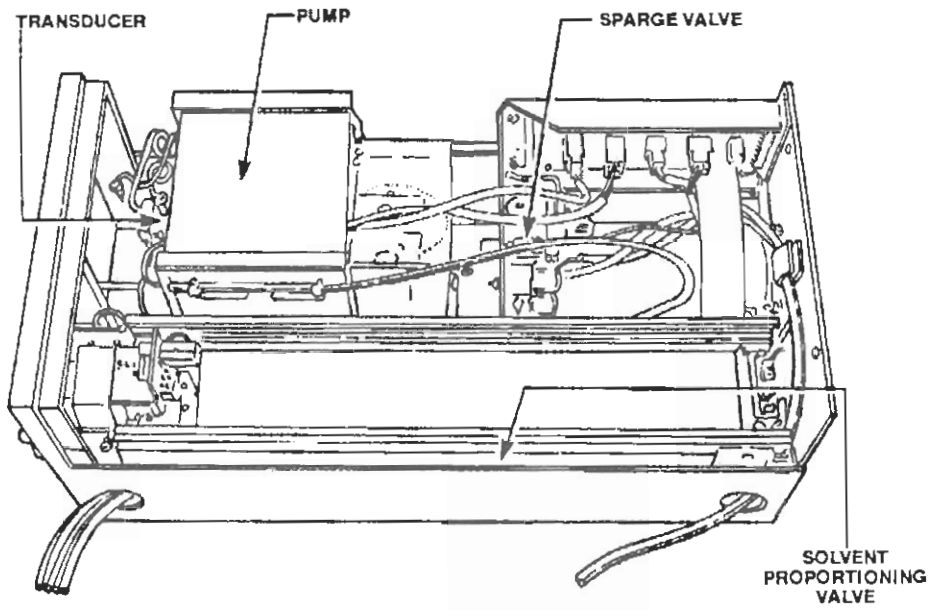


Figure 3-1 Fluid Handling Unit

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Included in this section are:

- Pressure transducer maintenance procedures:
- Pump maintenance procedures
- Sparge valve assembly replacment
- Solvent proportioning valve replacement

Spare parts are shown where applicable. For a complete list of spare parts and part numbers see Appendix B.

3.1.1 Pressure Transducer Maintenance

This section includes the following maintenance procedures:

- Pressure transducer adjustments
- Transducer replacement

Calibration Adjustments

The fluid unit must be calibrated properly to ensure accurate day-to-day operation.

The calibration check is done by adjusting a screw on the front of the pump unit. The checkout and replacement procedures require you to remove the cover of the controller unit.

CAUTION

Always disconnect the transducer outlet from the system when performing calibration.

To check the pressure transducer calibration:

1. Turn the power switch on the controller to ON.

2. Access the ISOCRATIC or DIRECT CONTROL screen (depending on your configuration of the controller).

3. On the screen, set the flow rate to 0.0 ml/min.

   Verify that the flow rate is at approximately 0.0 ml/min. If necessary, use the transducer zero adjust screw on the front of the fluid handling unit (Figure 3-2) to adjust the pressure until the display on the screen reads zero.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

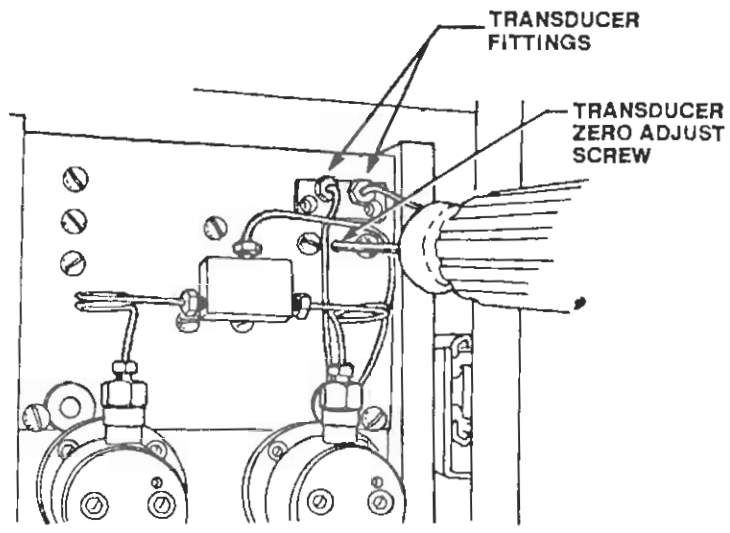


Figure 3-2 Transducer Control Screw

Replacing the pressure transducer

To replace the pressure transducer:

1. Turn the power to OFF and disconnect the power cord.

2. Remove the retaining screws from the upper rear panel and both sides of the front panel of the fluid handling unit and slide the cover off.

3. Disconnect the transducer fittings on the front panel (see Figure 3-2).

4. Loosen but do not remove the retaining screws just above the pump heads and on the top rear corners of the pump unit cover. Then lift the pump cover off.

5. Remove the two screws just below the pressure transducer fittings on the front panel (Figure 3-3).

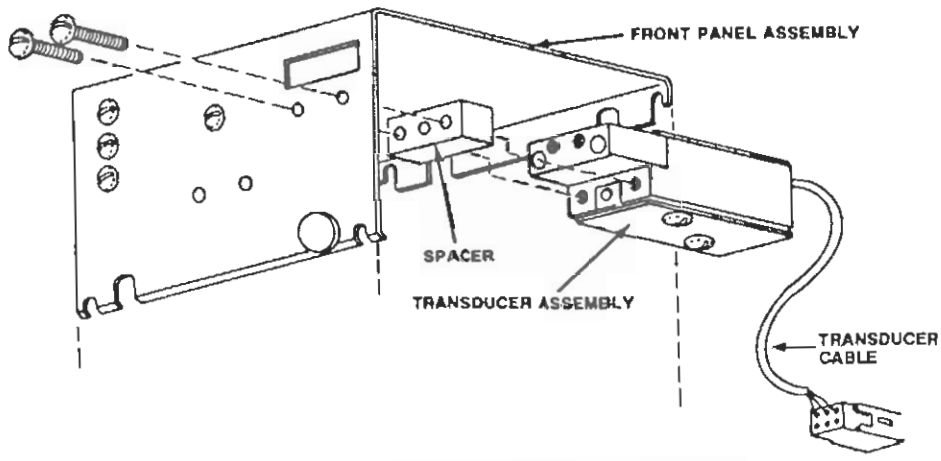


Figure 3-3 Transducer Replacement

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

6. Disconnect the pressure transducer connector on the interconnect board (Figure 3-4).

   The interconnect board is on the left rear of the fluid handling unit. The transducer connector is located on the lower front of the board.

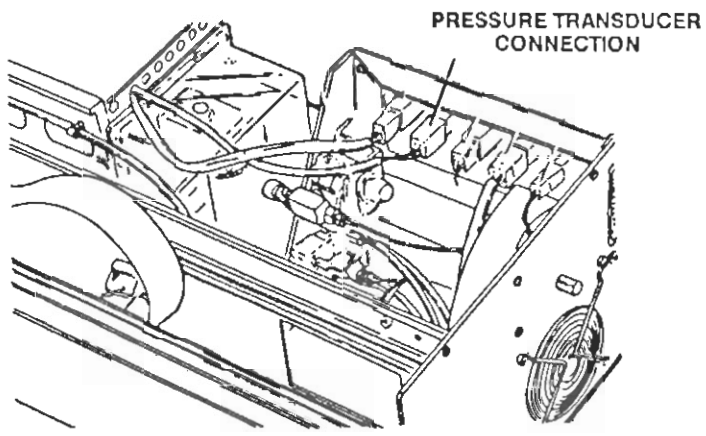


Figure 3-4 Transducer Connection on the Interconnect Board

7. Remove the transducer and spacer from behind the front panel.

8. To install the new transducer, line up the spacer and transducer and replace the two screws on the front panel.

9. Reconnect the transducer cable on the interconnect board at J2 and replace the pump cover and tighten the four retaining screws. Connect the pressure transducer connector on the interconnect board (refer to Figure 3-4).

10. Replace the cover of the fluid handling unit and connect the power cord.

11. Check the calibration of the transducer as outlined in the Calibration Adjustments section.

3.1.2 Pump Maintenance Procedures

This section includes the following procedures:

- Reference valve installation
- Pump head assembly

In addition, Figure 3-5 and Table 3-1 provide an overview of the pump assemblies.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

WARNING

Disconnect the power cord from the controller rear panel when working on the electronics unit. Always disconnect the the pump from the controller and injector before troubleshooting.

A. Accumulator inlet - connects to the mixing tee (6) in place of the pressure filter inlet (C) for high flow rate work.

B. Accumulator outlet - connects to the pressure transducer (8) in place of the pressure filter outlet (D).

C. Pressure filter inlet shown connected to the mixing tee inlet.

D. Pressure filter outlet shown connected to the pressure transducer inlet.

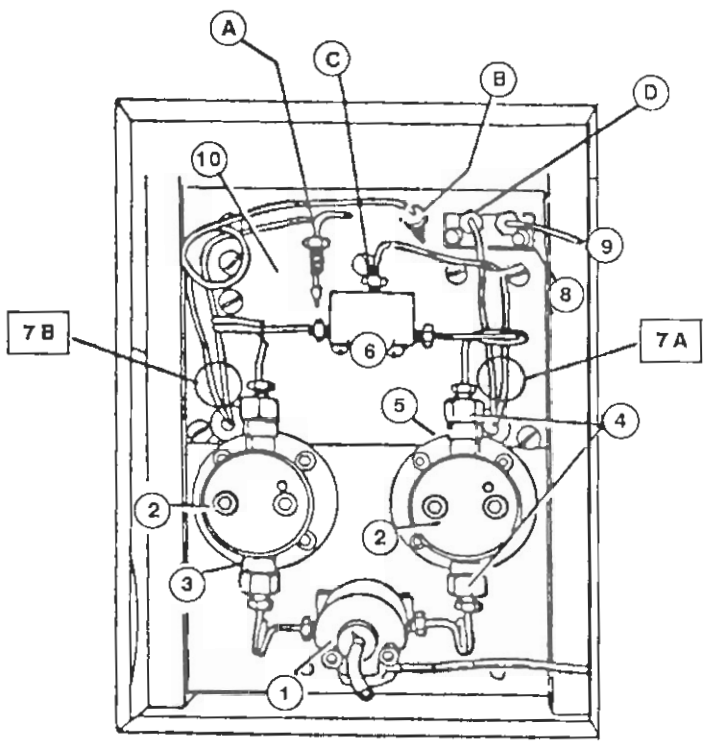


Figure 3-5 Pump Unit

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 3-1 Pump Unit Assemblies

	Description	Function
	The numbers in the first column of this table refer to the call-outs in Figure 3-5	
1	Draw-off Valve	Pump priming/purging, solvent draw-off.
2	Left and Right Pump Head Assemblies	Draws in/expels solvent.
3	Drain Holes (behind the inlet check valves)	Drains any solvent which may collect behind the plunger seals (position on left head shown).
4	Inlet (lower) and Outlet (upper) check valves	Maintains flow direction by opening in one direction only. Example: Inlet valve - opens on piston intake stroke and closes on delivery stroke (positions on right head shown).
5	Vent Holes (top of flange)	Provides access for flushing residue from the backs of the plungers (positions on right head shown).
6	Tee Connector	Joins solvent flow from both pump heads.
7	A - Pressure Filter (connected)solvent B - Accumulator (unconnected)	Pressure filter smooths minor flow fluctuations and enhances solvent mixing during multi-solvent operation. The larger volume accumulator performs a similar function for high flow rate preparative work. To use, disconnect the fittings for one and substitute (Figure 3-5).
8	Pressure Transducer	Senses backpressure, developed by resistance of system to solvent flow.
9	Pump Outlet	Outlet for solvent flow to column (or similar device, such as a switching valve).
10	Reference Valve (optional - not shown)	Assists pump priming; used with detectors requiring reference solvent stream.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.1.2.1 Reference Valve Installation

The reference valve (Figure 3-6) is installed in place of the mixing tee. Mount the reference valve in the two holes provided on the front panel of the pump unit.

1. Disconnect the two pump head outlet tubes and the inlet to the pressure filter from the mixing tee.

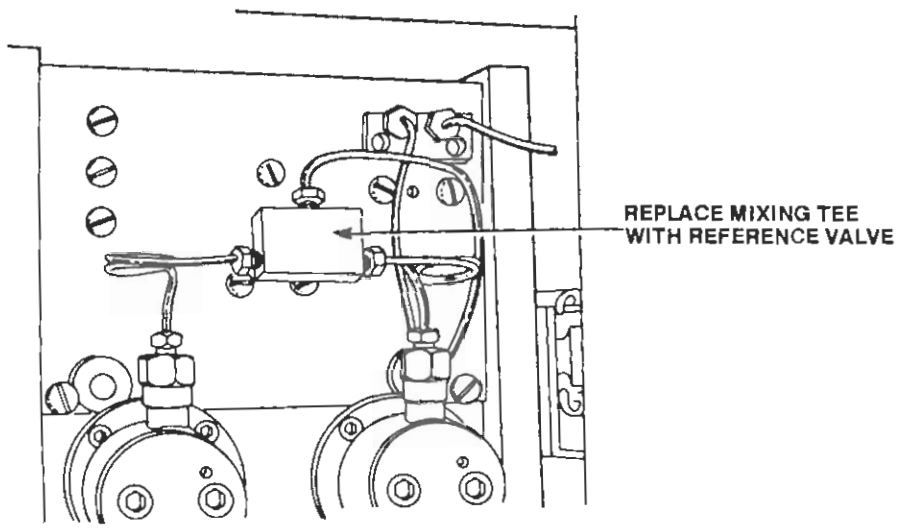


Figure 3-6 Reference Value Mounting Location

2. Remove and discard the two screws from the reference valve mounting holes in the front panel.

3. Mount the reference valve to the front panel (Figure 3-7) with the two cap screws provided in the reference valve kit. An Allen wrench is provided with your startup kit.

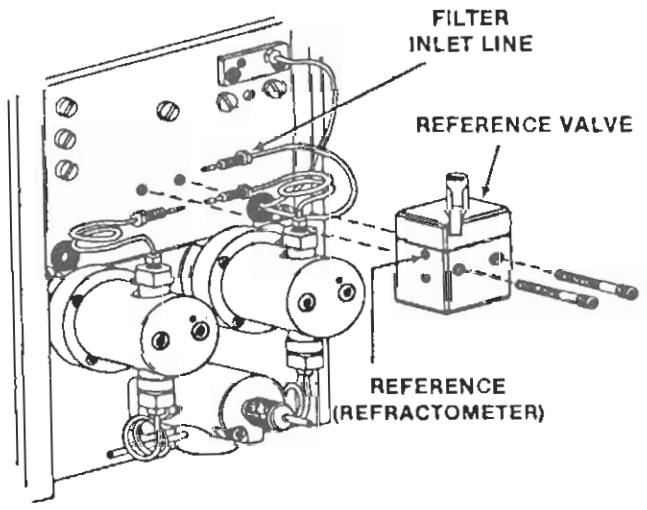


Figure 3-7 Reference Valve Mounting

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4. Connect the two pump head outlet tubes to the lower ports on either side of the reference valve.

5. Connect the inlet to the pressure filter to the top port on the right side of the valve.

6. Connect the top port on the left side of the valve to the reference inlet of an instrument (a refractometer).

   If no instrument is to be connected, install a length of stainless steel tubing to this port. The tube can be used to transport solvent to a waste container when flushing or priming the pumping system.

3.1.2.2 Pump Head Assembly

The following procedures are performed on parts of the pump head:

- Pump head removal
- Plunger seal replacement
- Plunger replacement
- Check valve cleaning
- Check valve replacement

Figure 3-8 is an exploded diagram of a pump head. Refer to Appendix B for a list of pump head replacement parts.

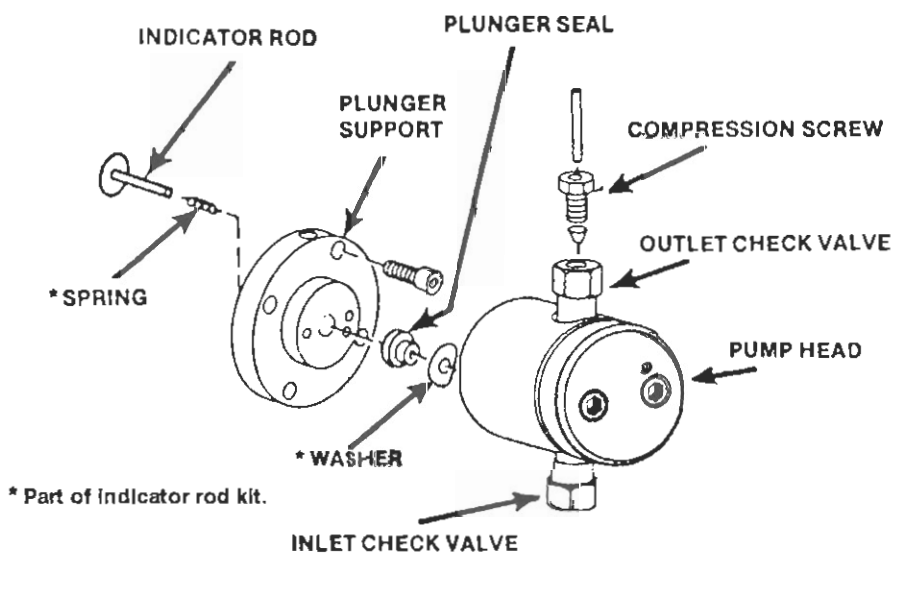


Figure 3-8 Pump Head Assembly

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Pump head removal

1. Place the solvent reservoir below the level of the solvent inlet line.

2. Remove the inlet line from the pump inlet manifold and allow the solvent to drain back into the reservoir.

3. Turn on the pump and set the flow rate to at least 0.1 ml/min. Run the pump until the indicator rod is fully retracted into the pump head you wish to remove.

4. Turn the pump off.

5. Use a 5/16-inch open-end wrench to loosen the outlet line from the outlet check valve, then disconnect the line from the pump head.

6. Remove the inlet line from the inlet check valve.

CAUTION

When operating the unit with the pump head removed, pull out and hold the piston indicator rod to prevent damage.

7. Remove the pump head assembly mounting bolts with a 5/32-inch Allen-head wrench. Loosen the screws 1/2 turn at a time for the first two turns. Slide the pump head assembly off the pump (Figure 3-9), being careful to pull the head straight away from the pump.

CAUTION

Pulling the pump head up, down, or side-to-side could damage the piston indicator rod.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

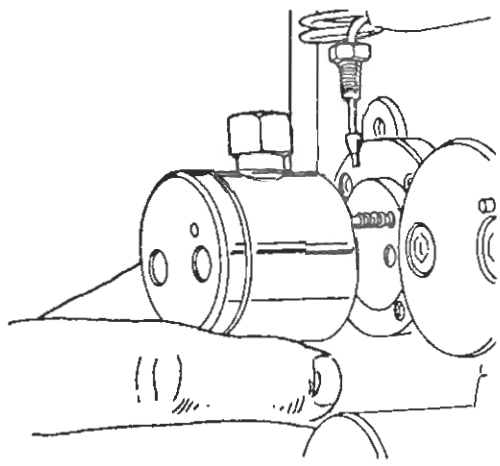


Figure 3-9 Pump Head Removal

Plunger seal replacement

1. Carefully pry the seal out with a small screwdriver. Take care not to damage the seat or surrounding metal surfaces.

2. Place the new plunger seal on the seat, for the analytical heads, and insert the plunger seal into the pump head assembly. Refer to Figure 3-8 for orientation.

   For 225 µl heads insert the seal with the solid side facing out. Refer to Figure 3-10 for seal orientation.

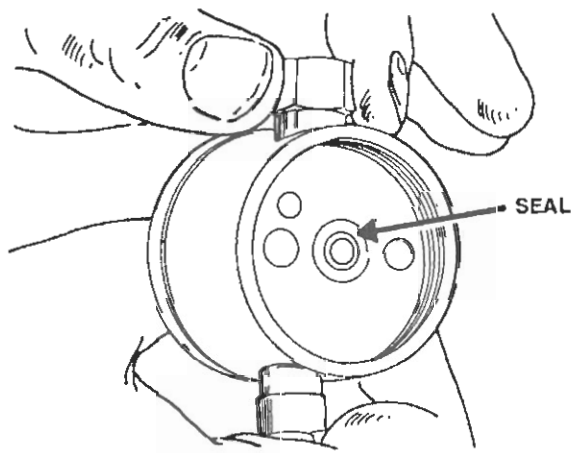


Figure 3-10 Plunger Seal Orientation

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3. Slide the pump head assembly into position over the plunger and replace the two pump head mounting bolts. Tighten the bolts evenly by alternately tightening one then the other by half turns.

4. Turn on the pump and set the flow rate to 0.3 ml/min.

5. Check that the indicator rod moves freely.

6. Reconnect the solvent lines, reposition the solvent reservoir, and prime the pump.

Plunger replacement

Buffers, PIC^{R} reagents and impurities in solvents can coat pump plungers and reduce seal life. If you suspect this condition, remove the plunger as outlined in the following procedure and clean it with a fine pumice.

Clean the plunger thoroughly to remove all traces of the abrasive, then reassemble with new seals. If this does not extend seal life, replace the plunger.

1. Remove the pump head.

2. Remove the four plunger support bolts with a 9/64-inch Allen wrench. Slide the plunger support assembly and the indicator rod off the plunger (Figure 3-11).

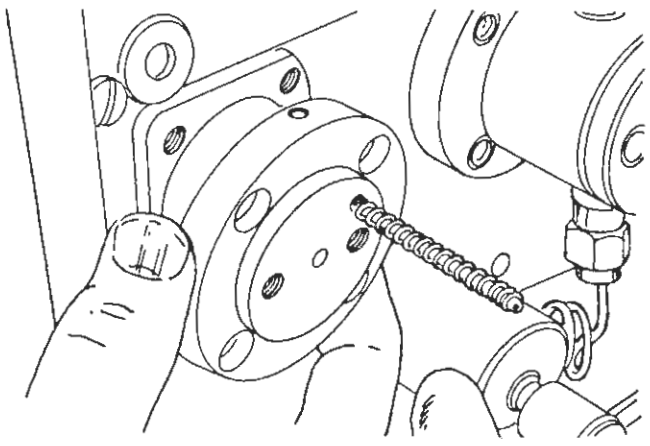


Figure 3-11 Removing the Plunger Support Assembly

3. Set the flow rate to 1.0 ml/min.

4. Turn on the pump and run it until the plunger is fully extended, then turn the pump off.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

5. Remove the plunger using a pair of snap-ring pliers

6. To reinstall the plunger, reassemble the components on the new plunger and insert it into the cavity (Figure 3-12). Use the proper plunger insertion tool to reinsert the plunger.

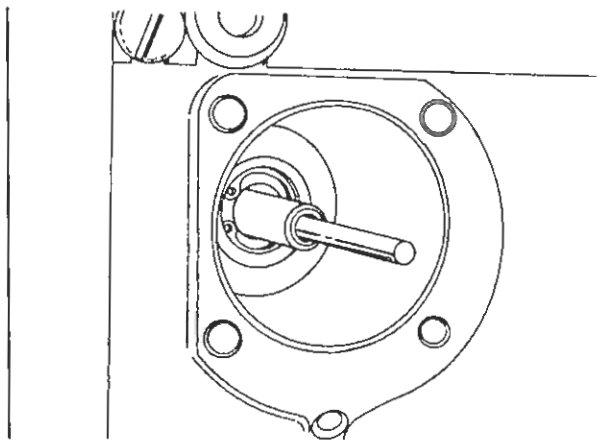


Figure 3-12 Plunger Disassembly

7. Turn on the pump to retract the plunger, then shut the pump off.

8. Replace the plunger support assembly with the indicator rod in the upper right corner. Alternately tighten the four screws.

9. Gently slide the pump head onto the plunger and alternately tighten the two screws.

10. Turn on the pump and set the flow rate to 0.3 ml/min. Pull out and release the indicator rod. If it does not snap back, the head must be realigned.

11. Reconnect the solvent lines, reposition the solvent reservoir, and prime the pump.

Check valve cleaning

Check valves may be cleaned by running a detergent solution through the pump heads. If you find that this does not sufficiently clean the check valves, you can remove them from the pump as described below and place in methanol in a ultrasonic bath for ten minutes.

NOTE: Handle the ball in the valve with tweezers after sonicating to prevent contamination.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

To clean the check valves in the pump head:

1. Fill the solvent reservoir with a compatible cleaning solvent, such as a 1:1 mixture of methanol and water with liquid detergent added. See the precautions in Book I, How To Use, Chapter 2, concerning use with halide ions.

2. Set the flow rate to 3.0 ml/min and purge with this detergent solution for 10 minutes.

If the check valve still does not operate properly after cleaning in place. Remove the valve.

Inlet check valve disassembly

1. Place the solvent reservoir below the level of the solvent inlet line. Remove the inlet line from the inlet manifold and allow the solvent to drain back into the reservoir.

2. Remove the tubing/compression screw connection (Figure 3-13) and loosen the check valve with a 1/2-inch open-end wrench.

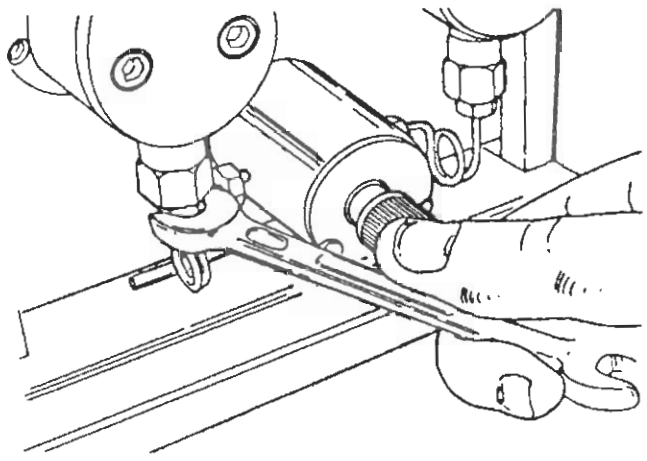


Figure 3-13 Inlet Check Valve Removal

3. Remove the inlet check valve housing assembly from the pump head and disassemble by tipping the housing upside down.

   Check the retainer and the ball and seal (Figure 3-14) for damage or debris.

4. Clean and replace worn or damaged parts as necessary. The old housing seal may be difficult to remove but does not normally need to be replaced.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

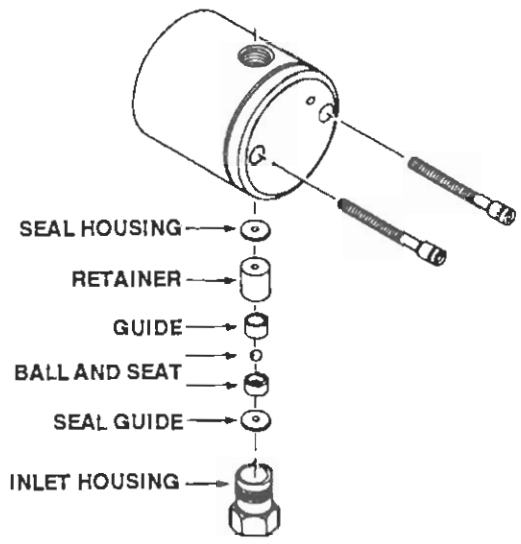


Figure 3-14 Inlet Check Valve Assembly

Inlet check valve reassembly

CAUTION

To protect the parts from contamination, use a forceps or a tweezers to handle the parts after you have cleaned them and when reassembling the inlet check valve.

1. Position the housing so you are looking down into it and can see the guide seal.
2. Place the seat in the housing, with the shiny side of the seat facing up.
3. Drop the ball into the seat.
4. Place the guide over the ball.
5. Place the retainer over the guide.
6. The housing seal often remains inside the pump head when the housing assembly is removed. If the housing seal came out when you removed the housing assembly, place it back into the pump head cavity.
7. Holding the reassembed inlet check valve housing assembly right side up, screw the assembly up into the pump head, being careful not to tip the housing.
8. Hand tighten the assembly.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Outlet check valve disassembly

1. Disconnect the solvent outlet, loosen the check valve assembly (Figure 3-15), and remove the pump head.

CAUTION

To protect the parts from contamination, use a forceps or a tweezers to handle the parts after you have cleaned them and when reassembling the outlet check valve.

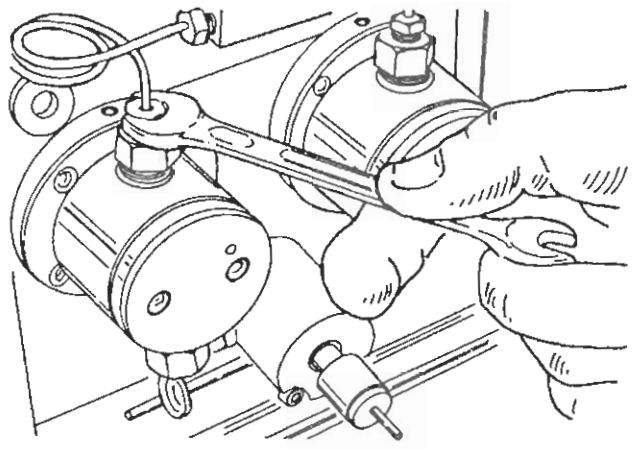


Figure 3-15 Outlet Check Valve Removal

2. Remove the outlet check valve housing assembly from the pump head. Disassemble check valve by tipping the housing upside down.

3. Check the retainer and the ball and seal (Figure 3-15) for damage or debris. The old housing seal may be difficult to remove but does not normally need to be replaced.

4. Clean and replace worn or damaged parts as necessary.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Outlet check valve reassembly

The outlet check valve reassembly (Figure 3-16) can be divided into three stages:

- Housing preparation
- Ball and seat reassembly
- Outlet check housing reassembly

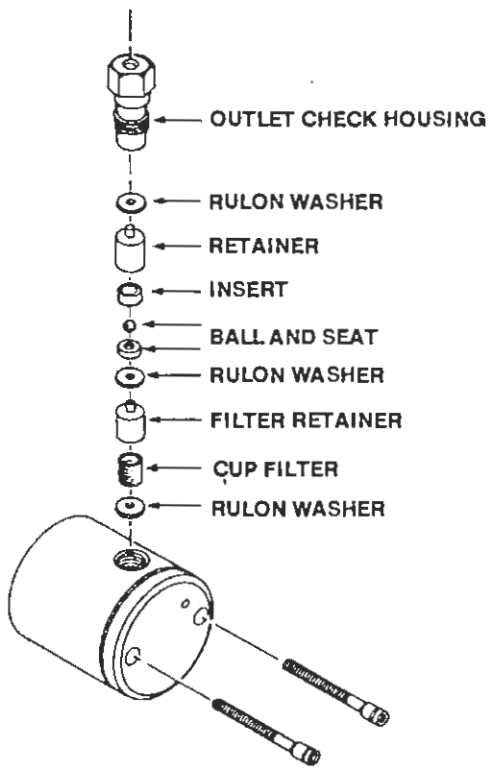


Figure 3-16 Outlet Check Valve Assembly

Housing preparation

1. Hold the outlet check housing so you can look down into it.
2. Drop the rulon washer inside the housing. Place the housing aside until it is needed.

Ball and seat reassembly

1. Hold the retainer so the cupped side of the retainer is facing up.
2. Place the insert inside the retainer.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3. Place the ball inside the insert.

4. Position the seat over the ball, with the shiny side facing the ball.

Outlet check housing reassembly

1. Fit the retainer, with the insert, ball and seat, into the washer inside the outlet housing.

   To insert the retainer and other parts into the housing without dropping parts or misaligning them, hold the retainer and with forceps, insert it up into the stainless steel housing. Turn the housing and retainer right side up again.

2. Place the second rulon washer over the seat.

3. Fit the filter retainer into the rulon washer.

4. Put the cup filter inside the filter retainer.

5. Place the third rulon washer on top of the cup filter.

6. Turn the pump head upside down and screw in the outlet check housing.

7. Hand tighten the assembly.

8. Replace the pump head.

9. Tighten the check valve assembly to seal.

3.1.3 Sparge Valve Assembly Maintenance

The Waters 600E sparge valve (Figure 3-17) delivers inert gas (helium) from an outside source under constant pressure to maintain any sparge-enabled solvent reservoir in a constant degassed state. Descriptions and functions of the sparge valve are listed following Figure 3-17 and Table 3-2.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

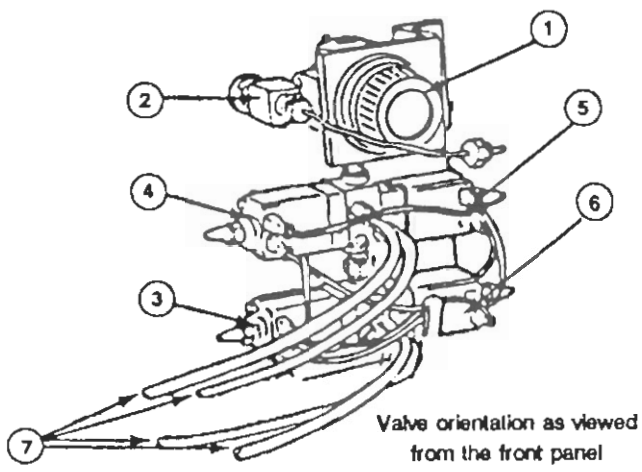


Figure 3-17 Sparge Valve and Manifold Assembly

Table 3-2 Sparge Valve Unit Functions

Description	Function
1 Regulator for helium sparge gas	Preset to operate with externally regulated supply at 50 - 90 psi.
2 Manifold inlet	Tubing connected from bulkhead fitting on rear panel. Includes over pressure safety relief valve set at 150 psi.
Sparge valve solenoids	
3 Solvent A 4 Solvent B 5 Solvent C 6 Solvent D	Independently operated equivalent valves cycled to open by time at constant flow rates.
7 Output tubing	Continues through the access holes to the reservoirs.

Sparge valve assembly removal

1. Turn off the helium supply and disconnect the power cord from the instrument rear panel.

2. Remove the two screws at the top of the rear panel and lift the fluid handling unit cover off.

3. Label all cables and harness connections before removing to ensure proper reassembly to the new Sparge unit. Disconnect the five cables from the connector board, (Figure 3-18).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

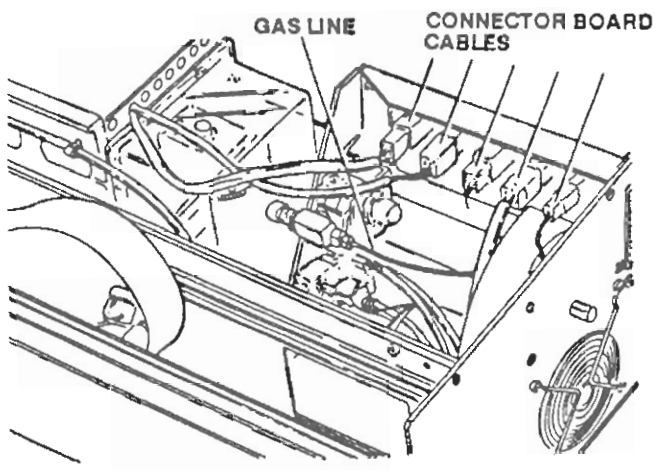


Figure 3-18 Connector Board Cabling

4. Disconnect the gas line at the compression fitting on the relief valve (see Figure 3-18).

5. Remove the four Teflon output lines from the adapters on the back of the sparge valve manifold.

6. Remove the two screws at the rear of the sparge valve bracket near the regulator.

7. Loosen the two nuts at the front of the bracket, remove the screws and lift the valve assembly out of the fluid unit.

Sparge valve assembly replacement

1. Attach the cable harness to the new sparge valve (Figure 3-19).

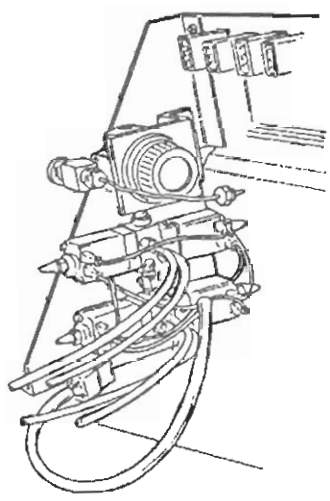


Figure 3-19 Sparge Valve Connections

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

2. Place the new assembly in the fluid handling unit and secure it to the bracket using the same four screws as in steps 6 and 7 in the Sparge Valve Assembly Removal procedure.

3. Reconnect the Teflon output lines and the gas input lines.

4. Reconnect the five cables to the connector board.

3.1.4 Solvent Proportioning Valve Replacement

The solvent proportioning valve assembly (Figure 3-20) is located inside the fluid handling unit. Table 3-3 lists the function of different assembly parts.

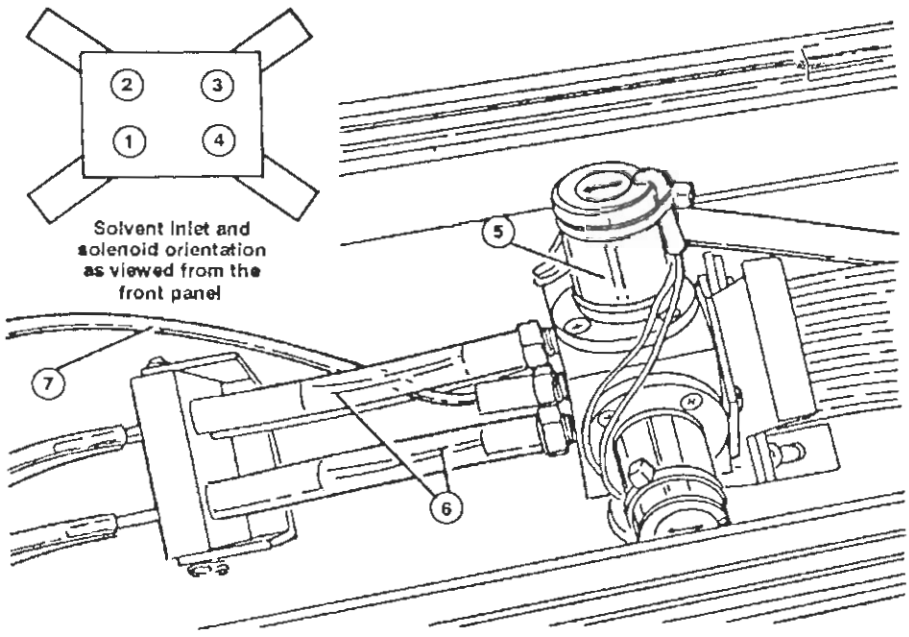


Figure 3-20 Proportioning Valve Assembly

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table 3-3 Proportioning Valve Assembly

Description	Function
Solvent Inlet Lines	
1 Solvent A 2 Solvent B 3 Solvent C 4 Solvent D	View in direction in inset. Preassembled tubing and reservoir filter assemblies pass through the access holes.
5 Solenoid valves	Independent equivalent valves produce accurate proportioning over a wide range of solvent composition requirements.
6 Valve Accumulators	Ensure uniform flow and consistent solvent delivery from reservoirs under all pumping conditions.
7 Pump inlet tube	Connects the valve manifold with the pump inlet manifold.

Solvent proportioning valve assembly removal

1. Disconnect the power cord from the instrument rear panel.
2. Remove the two screws at the top of the rear panel and lift the fluid handling unit cover off.
3. Disconnect the gradient cable from the connector board and the drawer cable from the back of the drawer (Figure 3-21).

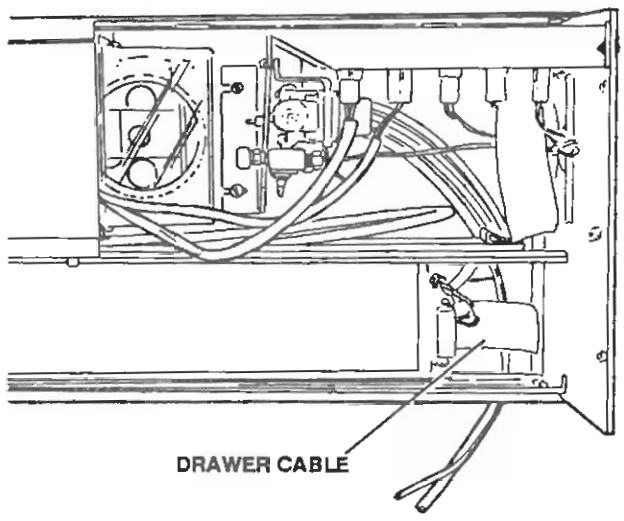


Figure 3-21 Drawer Cable

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4. Pull the drawer out to allow access to the proportioning valve assembly.

5. Drain the solvent from the Teflon inlet lines back into each reservoir by placing the reservoir lower than the solvent valve.

6. Disconnect the solvent line from the inlet manifold at the pump and allow to drain.

7. Disconnect the four solvent lines from the stainless steel adapter tubes at the front of the accumulator manifold (Figure 3-22).

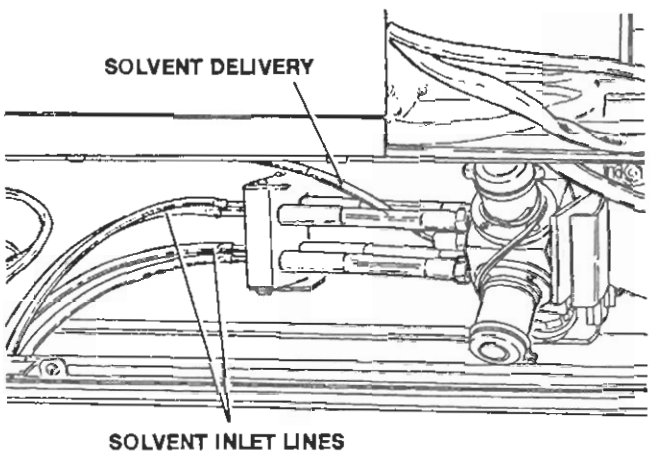


Figure 3-22 Solvent Inlet Lines

8. Remove the screw securing the tray to the bottom of the fluid unit and remove the assembly by pulling it out through the front.

Valve replacement

1. Place the new proportioning valve assembly and tray into position and secure using the screw removed in the removal procedure.

2. Reconnect the solvent lines to the valve assembly outlet and the pump unit inlet manifold.

3. Attach the four solvent lines to the accumulator manifold.

4. Reconnect the drawer cable to the back of the drawer and the gradient cable to the connect board.

5. Tighten any compression fittings loosened and refer to Book I, How To Use, Chapter 2.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.2 ELECTRONICS SYSTEM

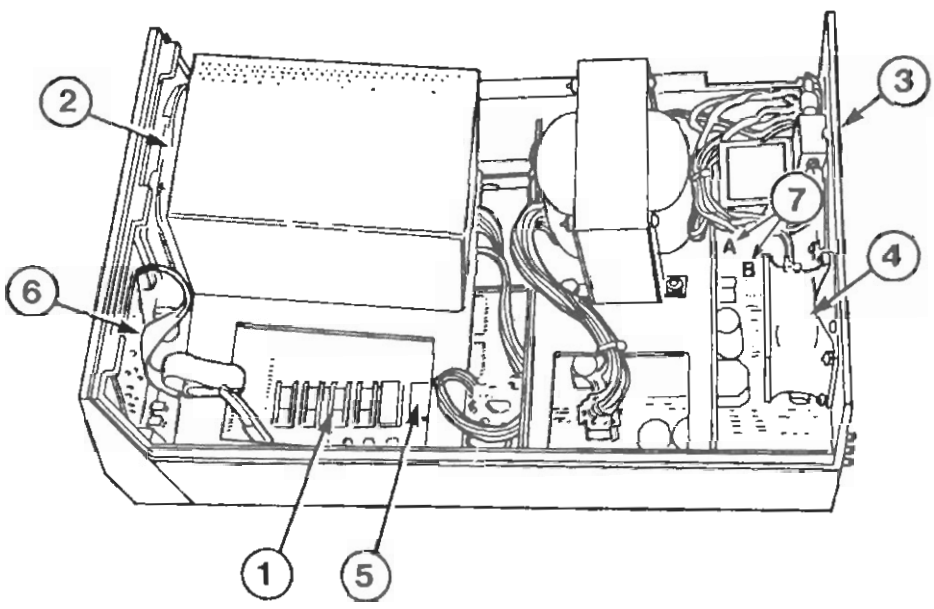
This section includes procedures for

- Replacing fuses
- Replacing the control board

To perform these procedures, you will have to remove the controller cover. Do this by unscrewing the two screws at the top of the controller at the back, and lifting the cover off. Figure 3-23 shows the controller with the cover off.

WARNING

Disconnect power from unit before removing cover.



1 IC set (Firmware)
2 CRT display screen
3 Control interconnect cable (socket location only shown)
4 AC Fan
5 EEPROM (not shown)
6 Keyboard
7 LED diagnostic position
A DS4 Sparge valve actuation
B DS5 Solvent valve actuation

Figure 3-23 Controller with Cover Removed

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.2.1 Fuse Installation

The Waters 600E is shipped with two fuses installed. Spare fuses are included in the startup kit. Check Table 3-4, Operating Voltage Ranges, for the correct fuses for your operating voltage. The 12 volt auxiliary power fuse is housed separately.

Table 3-4 Operating Voltage Ranges

Nominal Voltage	Voltage Range	Fuse (AMP)
100	+10%	2
120	+10%	2
220	+10%	1
240	+10%	1

Fuse replacement

1. Make sure the instrument is not plugged in.
2. Pry open the power connector cover with a flat-blade screwdriver.
3. Pull each fuse holder out as though opening a drawer.
4. Install the correct fuse in the holder and slide it back in place.

   Note that the arrow on each fuse holder points up when in the correct position (Figure 3-24).

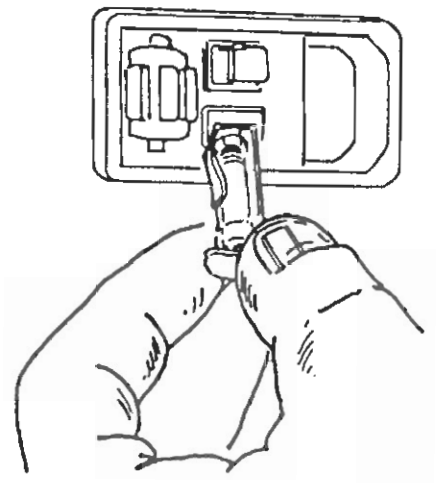


Figure 3-24 Installing A Fuse

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

3.2.2 Replacing the Control Board

The controller electronics for the Waters 600E are contained on a single board. If a failure occurs, the entire board can be replaced as a unit.

CAUTION

The following procedure should only be performed in a static-free environment to avoid damage to the printed circuit board.

Preparation

1. Disconnect the power cord from the instrument rear panel and remove the interconnect cable from the rear of the controller.

WARNING

Turn the instrument off and disconnect external power to the instrument before attempting to remove the circuit board.

2. Remove the two screws at the top of the controller rear panel and left the cover off.

3. Disconnect the front panel cable, the CRT and the transformer cable from the control board (Figure 3-25).

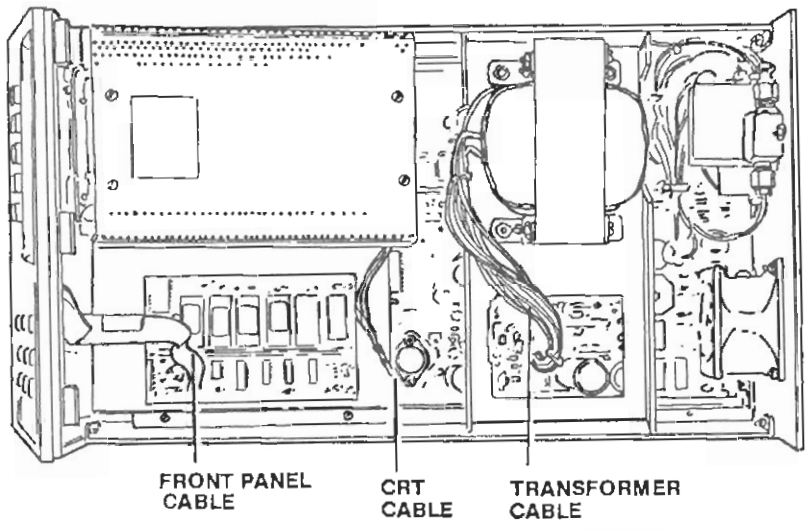


Figure 3-25 Control Board Cabling

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

4. Remove the two screws at both sides of the lower rear panel and slide the control board out of the unit. The barrier strip, fuse holder and interconnect socket are part of the assembly (Figure 3-26).

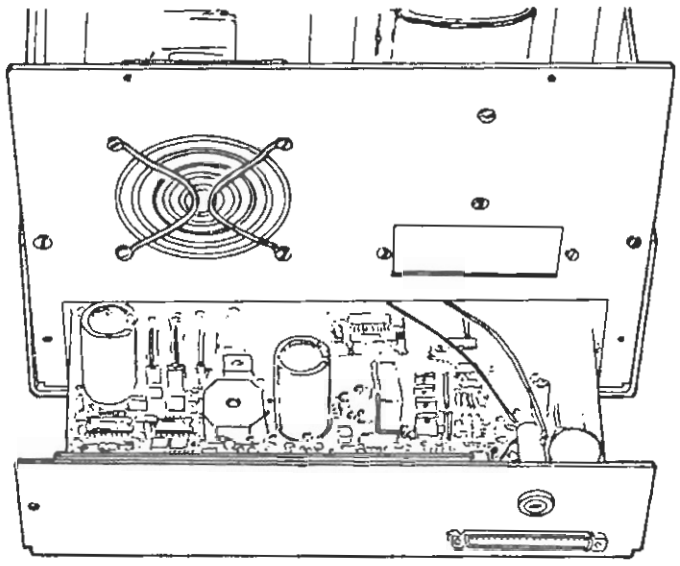


Figure 3-26 Removing the Control Board

Control board replacement

1. Slide the new board into position. Make sure the edges of the board fit between the slots in both sides of the controller unit.

2. Replace the two screws in the rear panel.

3. Reconnect the three cables removed in Step 3 in the previous section and replace the cover.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Installation and Service Index

A

Auto-injector,
- connecting, 1-11, 1-33
- installation, 1-34
- in series with manual injector, 1-35

Auxiliary power fuse, 1-7

B

Bench arrangements, 1-3

C

Cartridge (Radial-Pak) installation, 1-31

Cartridge and column preparation, 1-33

CHART (+,-) terminal, 1-7, 1-11

Chart recorder connection, 1-10, 1-11

Chart test, 2-6

Chassis ground, 1-8

Check valve cleaning, 3-13

Connections,
- controller and fluid handling units, 1-13
- controller rear panel, 1-10
- IEEE-488, 1-13

Control board,
- cabling, 3-26
- replacing, 3-26

Control cable connection, 1-9, 1-13

Controller assembly, 3-24

Controller connections, 1-6

Controller rear panel electrical connections, 1-6
- auxiliary power fuse, 1-7
- CHART (+,-) terminal, 1-7
- control cable connector, 1-9
- GND terminal, 1-7
- HOLD terminal, 1-7
- IEEE-488 connector, 1-9
- INJ terminal, 1-7
- Power connection, 1-7
- Pressure terminal, 1-7
- RS-232 connector, 1-9
- S1-S4 (external output), 1-7
- Terminal and chassis ground, 1-8

Column,
- Compartment assemblies, 1-25
- Heater installation, 1-26
- Installation, 1-25
- Installation preparation, 1-24

Compression fitting assembly, connecting, 1-22

Current (from 12V), 1-11

D

Detector connections, 1-11, 1-36

Dissolution,
- bath, 1-37
- connecting components, 1-38
- installing components, 1-37

Diagnostics, 2-1

Dissolution system, 1-37
- electrical connections, 1-38
- tubing connections, 1-40

DS4 LEDS, 2-7

DS5 LEDS, 2-7

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

E

Electrical requirements, 1-3

Electronic system maintenance, 3-24

External inject test, 2-4

External output switches (S1-S4), 1-8, 1-12

External switch (S1-S4) output test, 2-5

Extended test,
- procedure, 2-3
- routines, 2-2
- tools, 2-2

F

50 Hz operation, adapting, 1-4

5V signal terminals, 1-12

Field service assistance, 3-1

Fluid handling,
- connections, 1-18
- connections summary, 1-18
- unit maintenance, 3-2

Fluid system troubleshooting table, 2-9

Fume hood warning, 1-21

Fuse installation, 3-25

G

GND, 1-7

Ground/chassis terminal, 1-8

Gradient operation monitoring, 1-11

H

Hanson Transfer Controller, 1-37, 1-39

Hold output test. 2-5

HOLD terminal, 1-7

I

IEEE-488,
- address multiple detector configuration, 1-17
- address requirements, 1-16
- address settings, 1-16
- address test, 2-8
- connecting, 1-15
- connector, 1-9
- electrical connections, 1-13
- multiple system configuration, 1-14
- power-up sequence, 600E PowerLine system, 1-18
- power-up sequence, 840/845/860 system, 1-17
- single system configuration, 1-13

INJ terminal, 1-7

Injector connections, 1-10, 1-33
- auto-injector, 1-34
- auto-injector and manual in series, 1-35
- manual, 1-34

Inlet check valve,
- dissassembly, 3-14
- reassembly, 3-15

Inspection, 1-2

Installation clearances, 1-3

Integrator, connecting, 1-10

M

Manifold inlet, 3-19

Manual injector, 1-10, 1-25, 1-34

Manual injector in series with auto-injector, 1-35

Multiwavelength scans, stopping pump during, 1-12

O

Operating frequency adjustment, 1-4

Operating voltage ranges, 1-5, 3-25

Options installation,
- auto-injector, 1-34
- column, 1-25
- column heater, 1-26
- dissolution components, 1-37
- Radial-pak cartridge, 1-31
- RCM 8x10, 1-32
- RCSS heater module, 1-29

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Outlet check valve,
ball and seat reassembly, 3-17
dissassembly, 3-16
housing preparation, 3-17
outlet check housing reassembly, 3-18
Reassembly, 3-17

P

Plunger replacement, 3-12

Plunger seal replacement, 3-11

Power connection, 1-7

Power requirements, 1-4

Pressure output connection, 1-12

Pressure (+,-) terminal, 1-7

Pressure trace recording, 2-12

Pressure transducer,
calibration adjustment, 3-3
connection, 3-5
control screw, 3-4
fittings, 3-4
maintenance, 3-3
replacement, 3-4

Pump head,
assembly, 3-9
removal, 3-10

Pump inlet tube, 3-22

Pump pressure monitoring, 1-12

Pump/solvent valves test, 2-7

Pump unit,
assembly, 3-6, 3-7
maintenance, 3-5

R

Radial-Pak cartridge, installing, 1-31

Ramp testing, 1-12

RCM 8x10, installing, 1-32

RCSS heater module, installing, 1-29

RS-232, connection, 1-9, 1-18

Rear panel,
connections, 1-10, 1-12
description, 1-6

Reference valve, installing, 3-8

Regulator, helium, 1-23, 3-19

Restart, 2-2

S

S1-S4 external switches, 1-8, 1-12

Self-diagnostic routines, 2-1

Setup, 1-1

Site selection, 1-2

Slide-out drawer, 1-19, 1-25

Solvent,
inlet lines, 3-22
proportioning valve assembly, 3-21
proportioning valve removal, 3-22
proportioning valve replacement, 3-21, 3-23
reservoir caps, 1-19, 1-20, 1-21
reservoir filter, 1-20
reservoir filter placement, 1-20
reservoir rack, positioning, 1-19
reservoir setup, 1-19
solenoid valves, 3-22
tube connections, 1-20
tubing, 1-19
tubing, setup, 1-20
valve pair test, 2-14

Spare parts, system, 3-1

Sparge,
helium overview, 1-22
helium setup, 1-21
gas inlet connection, 1-23
tubing, 1-19
tubing, setup, 1-20
valve assembly maintenance, 3-18
valve assembly removal, 3-19
valve assembly replacement, 3-20
valve/manifold assembly, 3-19
valve solenoids, 3-19
valves test, 2-6

Startup kit, 1-1

STOP FLOW terminal, 1-7

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

T

12V maximum current, 1-12

12V source connections, 1-12

TTL logic, 1-9, 1-12

V

Valve accumulators, 3-22

Vent tube connection, 1-21

Voltage selection changing, 1-4

W

Waters,
- 410 connection, 1-11
- 484 connection, 1-11
- 490 connection, 1-12
- 712D with dissolution system, 1-37, 1-39
- 840 connection, 1-13, 1-14
- 845 connection, 1-13, 1-15
- 860 connection, 1-13, 1-15

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

APPENDIX A
SPECIFICATIONS

This Appendix contains specifications for the following:

- Operational
- Electrical
- Environmental
- Physical
- UK6 Injector Options

Table A-1 Operational Specifications

Item	Specification
Number of Solvents	One to four
Modes of Operation	Gradient, isocratic, and flow programming
Flow Range	0.00 to 45 ml/min (standard heads), in 0.01 ml increments.
Composition Range	0 to 100% programmable in 1% increments for each of four reservoirs - A, B, C and D. Total composition must sum to 100%.
Compositional Accuracy	Better than ±0.5%, independent of pressure.

(Cont'd)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table A-1 (Cont'd) Operational Specifications

Item	Specification
Automatic Solvent Sparging	Standard, helium gas, input gas pressure range 50 to 150 psi (3.5 to 10.5 Kg/cm^2). Helium flow rate range 0 to 100 ml/min, programmable to 1 ml/min.
Pressure Maxima	6000 psi (420 Kg/cm^2) at 10 ml/min 1000 psi (70 Kg/cm^2) at 45 ml/min
Programmable Pressure Limits	Upper 51 to 6000 psi (3.5 to 420 Kg/cm^2) Lower 0 to 5950 psi (0 to 415.5 Kg/cm^2)
Program Storage	Storage for sets of 15 tables (gradient, program event, and detector), with a maximum of 15 steps per table. Storage for a time-based multi-method program with up to 48 individual steps. EEPROM stores setup parameters and tables and preserves memory indefinitely following power loss or extended shutdown.
Gradient Profiles	Eleven gradient curves (including linear, Step [2], concave [4] and convex [4]). Up to 80 curve segments can be linked.
CRT Display	5" (12.7 cm) diagonal screen. Sixteen lines with 40 characters per line. Displays current operating conditions. Allows operator to monitor complete gradient and timed event tables on single screens. Reverse video cursor prompts operator through program setup.

(Cont'd)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table A-1 (Cont'd) Operational Specifications

Item	Specification
Keyboard	Dedicated keys provide direct access to all display screens. Cursor movement keys simplify programming, editing and parameter entering. All keys are solvent resistant.
Programmable Timed Events	Eighteen (15) timed events can be programmed and stored for each table. They are: • Set S1-S4 for accessory control • Audible alarm • Set sparge rate • Set column temperature • Return to initial conditions • Change to new gradient table

Table A-2 Electrical Specifications

Item	Specification
Power Requirements	Maximum power - 80 Va.
Frequency	50 or 60 Hz (switch selectable on CPU board).
Fuse	Single side fuse (2 A) except in those countries requiring both sides fused (1 A to 5.2 x 20 mm).
Time or Operator Controllable Switch Closures	Four controllable switch closures to ground. TTL compatible terminals pulled with 10 K ohms to 5 V. May be pulled up to 12 V. Maximum allowable current = 1.0 A. Maximum allowable voltage = 12 V. Outputs may be controlled from keyboard directly or from events program.

(Cont'd)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table A-2 (Cont'd) Electrical Specifications

Item	Specification
	Two modes available from keyboard and events program: ON = switch closed to ground); OFF = switch open, +5 V to ground). Additional mode available from events program; Pulse = single contact closure to ground for 100 millisec.
Auxiliary Power Supply	12 V to ground fused supply. 1A max current.
Hold Output	One (1) TTL compatible switch closure to ground. Maximum current sink: 100 mA. Low output indicates pumps stopped due to: • Exceeding high pressure limit • Below low pressure limit • Abort input • "Power up" condition Used to communicate with HOLD input on Waters auto-injectors (Model 710B and Model 712) or other compatible input to prevent further injections.

(Cont'd)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table A-2 (Cont'd) Electrical Specifications

Item	Specification
Chart Output	Two terminals (+, -) for recording pump pressure traces when performing service procedures or monitoring solvent changes (analog - bypasses microprocessor). 10 mV output.
Ground Terminals	Connected to signal ground used as reference for outputs (HOLD, INJect and switches S1 to S4), inputs (Inject and Abort), or 12 V power supply (not for use with 10 mV outputs).

Table A-3 Environmental Specifications

Item	Specification
Temperature	Operating Range - 4 to 38°C (39.3 to 100.4°F) Storage Range - 0 to 50°C (32 to 122°F)
Humidity	Operating Range - 20% to 90% RH Storage Range - 0% to 90% RH (non-condensing)
Solvent Compatibility	Compatible with solvents consistent with materials of construction.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table A-4 Physical Specifications

Item	Specification
Wetted Surface Material	316 stainless steel, ruby, sapphire, fluorocarbon polymer.
Controller Unit	
Height:	9 1/4 inches (23.5 cm)
Depth:	22 inches (56.9 cm)
Width:	11 1/4 inches (28.6 cm)
Weight:	48 pounds (21.9 kg)

Table A-5 Optional U6K Injector Specifications

Item	Specification
Syringe Needle Size	1.97 in (50 mm) long x 0.020 in (0.51 mm) OD (25 gauge)
Pressure Limit	6000 psi (420 Kg/cm^2)
Wetted Surface Material	316 stainless steel, TFE
Sample Load size	Sample injections from 1 µl to 2 ml with no loop change. Injector mounts directly to fluid handling unit.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

APPENDIX B
WARRANTY/SERVICE INFORMATION

B.1 LIMITED PRODUCT WARRANTY

Millipore Corporation, Waters Chromatography Division (Waters) provides this limited product warranty (the Warranty) to protect customers from non-conformity in the product workmanship or materials. The Warranty covers all new products manufactured by Waters and its subsidiaries.

The Warranty is as follows:

Waters warrants that all products sold by them will be of good quality and workmanship. The products will be fit for their intended purpose(s) when used strictly in accordance with Waters instructions for use during the applicable warranty period.

The foregoing warranty is exclusive and in lieu of all other express and implied warranties, including but not limited to fitness for any other purpose(s). In no event will Waters be liable for consequential, economic or incidental damages of any nature. Waters reserves the right not to honor this warranty if the products are abused by the customer. The Warranty will not be deemed to have failed of its essential purpose so long as Waters is able and willing to repair or replace any non-conforming part or product.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

B.1.1 Warranty Service

Warranty service will be performed at no charge and at Waters option in one of three ways

- A service representative will be dispatched to the customer's facility.
- The product will be repaired at a Waters repair facility.
- Replacement parts with appropriate installation instructions will be sent to the customers.

Non-conforming parts or products will be repaired, replaced with new or like-new parts, or refunded in the amount of the purchase price, when the product is returned. Warranty service will be performed only if the customer notified Waters within 30 days of discovering any non-conformity.

Unless otherwise agreed at the time of sale, warranty service will not be provided by dispatching a service representative when the equipment has been removed from the initial installation location to a new location outside the home country of the selling company.

Warranty service will not be performed on:

- Any product or part which has been repaired by others, improperly installed, altered, or damaged in any way.
- Product or parts identified prior to sale as not manufactured by Waters. In such cases, the warranty of the original manufacturer will apply.
- Products that malfunction because the customer has failed to perform maintenance, calibration checks, or observe good operating procedure.

Repair or replacement will not be made:

- For expendable items such as filament devices, panel lights, fuses, batteries, and seals, if such items were operable at the time of initial use.
- Because of decomposition due to chemical action.
- For used equipment.
- Because of poor facility, operating conditions, or utilities.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

B.1.2 Warranty Period

The warranty period begins when the product is installed or, in the case of a customer installation, fifteen days after shipment from Waters. In no case will the warranty period extend beyond 15 months from date of shipment.

The warranty period for the system is divided as shown in Table B-1.

Table B-1 Warranty Periods

Parts	Warranty
Controller Unit	
Electronic Printed Circuit Board Switches Front Panel Power Transformer Fan (115 Vac) CRT Assembly Cables	1 Year
Service Workmanship Replacement Parts	30 Days
Fuses	Expendable Items
Fluid Handling Unit	
Pump Mechanics Assembly	
Transducer Assembly Gearing Assembly Oil Seals Casting Motor Cables Inlet Manifold Assembly	1 Year
Inlet Check Valve Outlet Check Valve Sapphire Plungers Draw-off Valve Pressure Filter (for Accumulator) Head Support Plates Indicator Rods	90 Days
Service Workmanship Replacement Parts	30 Days

(Cont'd)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table B-1 (Cont'd) Warranty Periods

Parts	Warranty
Pump Head Seals Filters Fuses Seal Insert (Inlet Manifold) Tubing and Fittings Syringes	Expendable Items
Gradient Proportioning Valves Assembly	
The proportioning valve assembly (Part Number 62037) is covered as follows:	1 year
Normal Warranty as stated 50% Trade-in allowance based on list price	up to 3 months 3-12 months
Sparge Valves Assembly	
Valve Assembly (Part Number 62010)	1 Year
Service Workmanship Replacement Parts	30 Days

WARNING

Warranty may be void if inferior grade of helium gas is used in this system. Please refer to to recommended specifications published in this operator's manual.

(Cont'd)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table B-1 (Cont'd) Warranty Periods

Parts	Warranty
U6K Injector	
Manifold Assembly Bearings Chart Mark Assembly Cables	1 Year
Service Workmanship Replacement Parts	30 Days
Actuator Pins TFE Seal Valves Tubing/Fittings Sample Loading Plug Syringes	Expendable Items
Column Heater Assembly	1 Year

B.2 ORDERING INFORMATION

This section describes:

- Where to place an order
- How to place an order
- Pricing information
- Terms of payment

B.2.1 Where to Place Orders

Mail Orders	Millipore Corporation Waters Chromatography Division 34 Maple Street, Milford, MA 01757 Attn: Order Processing Department.
Telephone Orders*	1-800-252-HPLC - Customer Sales Department
Telex Orders	94-8413
International	Consult the listing of Waters Sales/Service offices at the end of this manual.

*Confirming orders mailed after a telephone order has been placed must be clearly marked "CONFIRMING" to avoid duplication.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

B.2.2 How to Place Orders

Normally, delays or errors in processing orders are caused by incorrect or incomplete information. To minimize delays and errors in processing your orders please provide all of the information required below. Pleas list part numbers in ascending numerical order.

1. Catalog numbers and description as given.
2. Quantity desired.
3. Complete purchase order number - orders cannot be processed without it. Requisition numbers are insufficient.
4. Complete "Ship To" address and marking if applicable.
5. Complete "Bill To" address if other than "Ship To".
6. Required delivery date.
7. Method of transportation desired.
8. Name and telephone number of person to contact if clarification is required.

B.2.3 Pricing

Prices listed are FOB Milford, MA, unless otherwise agree. Prices and product information contained in any catalog or price list were current at the time of printing. In a continuing effort to provide the finest products available, Waters reserves the right to change specifications, models, or prices without notice and without liability for such changes. Where price changes have occurred, prices prevailing at time of receipt of your order will apply.

B.2.4 Terms of Payment

Our terms are net 30 days from invoice date with approved credit. If your credit has not been previously established with Waters, our terms are payment in advance or COD.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

B.3 SHIPMENTS, DAMAGES, CLAIMS, RETURNS

This section describes what to do if damage has occurred to your system.

B.3.1 Shipments

As all shipments are made FOB Milford, MA, we suggest insurance be authorized on all shipments. Instruments and major components will be packed and shipped via surface, unless otherwise required. Supplies and/or replacement parts are packed and shipped via UPS, UPS Blue, air parcel part, or parcel post unless otherwise requested.

B.3.2 Damages

The Interstate Commerce Commission has held that carriers are as responsible for concealed damage as for visible damage in transit. Unpack shipment promptly after receipt as there may be concealed damage even though no evidence of it is apparent. When concealed damage is discovered, cease further unpacking of the unit involved and request immediate inspection by local agent or carrier and secure written report of his findings to support claim. This request must be made within 15 days of receipt. Otherwise, claim will not be honored by the carrier. Do not return damaged goods to factory without first securing an inspection report and contacting Waters for a return authorization number.

B.3.3 Claims

After a damage inspection report has been secured, Waters will cooperate fully in supplying replacements and handling of a claim which may be initiated by either party.

B.3.4 Returns

No returns may be made without prior notification and authorization. If for any reason it is necessary to return material to us, please contact our Customer Service Department or your nearest Waters subsidiary/representative for a return authorization number and forwarding instructions.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

B.4 SPARE PARTS

The parts listed in Table B-2 are recommended for customer installation. Procedures other than those explained in detail in Book III, Installation and Service, of this manual may not be considered feasible unless performed by trained service representatives. Damage incurred by performing unauthorized work in your unit may invalidate certain warranties.

Table B-2 Replacement Parts

Item	Part #	Quantity
Standard Volume Heads (225 microliter)		
Pump Head Assembly*	60303	2
Outlet Check Valve Assembly	25216	1
Outlet Check Valve Rebuild Kit	26014	1
Inlet Check Valve Rebuild Kit	88223	1
Inlet Check Valve Assembly	60307	1
Inlet Manifold Rebuild Kit**	60448	1
Plunger Seal	26644	1
Plunger Support	60305	2
Plunger Spring	25236	1
Plunger (Sapphire)	60304	2
Indicator Rod Kit	69583	1
Indicator Rod, Spring, Washer Compression Screw Assembly	25604	1
Low Volume Heads (Optional 100 microliter; Kit Part Number 62335)		
Pump Head Assembly*	60058	2
Outlet Check Valve Assembly	25230	1
Outlet Check Valve Rebuild Kit	26016	1
Inlet Check Valve Assembly	25214	1
Inlet Check Valve Rebuild Kit**	26012	1
Inlet Manifold Rebuild Kit**	60448	1
Plunger Seal	26613	1
Plunger Support	26650	2
Plunger Spring	25236	1
Plunger (Sapphire)	25656	2
Indicator Rod Kit	60088	1
Indicator Rod, Spring, Washer Compression Screw Assembly	25604	1

*Left and right head assemblies include inlet and outlet check valves for each side.

**Each package includes five compression screws and five ferrules.

(Cont'd)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Item	Part #
Inlet Check Valve Assembly	
Housing Seal	32706
Retainer	32707
Guide	32705
Ball &Seat	32646
Guide seal	32704
Inlet housing	60306
Outlet Check Valve Assembly	
Outlet housing	25207
Rulon washer	25027
Retainer	25003
Insert	25490
Ball & Seat	25306
Rulon washer	25318
Filter retainer	25316
Cup filter	25495
Rulon washer	25318
Inlet Manifold	
Tubing to left pump head	60037
Ball seal	60040
Draw-off valve	25740
Seal insert	60039
Tubing to right pump head	60038
Ball	25753
Washer	60254
Binder screws	40324
Inlet assembly	60426
Manifold body	60035
Controller	
Gradient Controller	62415
PowerLine Controller	62702
CRT display screen	62324
Control interconnect cable	62307
AC fan	26381
EEPROM	62101
Keyboard	62042
Complete Circuit Board	
Gradient Controller	62684
PowerLine Controller	62703

(Cont'd)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table B-2 (Cont'd) Replacement Parts

Item	Part #
Fluid Handling Unit	
Sparge valve	62010
Solvent proportioning valve	62037
Waters U6K manual injector option	62011
Tubing connections	
Reservoir rack	62060
4-liter bottle	62474
4-liter	62347
Reservoir filter	22531

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

APPENDIX C
SOLVENT CONSIDERATIONS

WARNING

Always follow good laboratory practices when handling solvents.

C.1 INTRODUCTION

The use of clean solvents is important not only for reproducible results but also for operation with minimal maintenance. Poor solvent condition can cause baseline noise and drift, and particulate matter can block the solvent reservoir and inlet filters. Table C-1 lists the physical properties of some commonly used solvents.

When operating a system with water, clean the water just before use to eliminate the presence of bacteria. To clean water, distill it in glass and pass it through a water purification system. Contact your Waters representative for information.

Avoid drawing foreign particles into the pump where they can accumulate and affect pump operation. If the filter becomes plugged, clean or replace it. Filters may be cleaned by sonicating in 6N nitric acid (HNO_3) for 5 to 10 minutes, followed by thorough flushing.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

C.2 SOLVENT MISCIBILITY

Before changing from one solvent to another, refer to Table C-1 to determine the miscibility of the solvents to be used. The following considerations apply when changing solvents:

- Changes involving two miscible solvents may be made directly. Changes involving two solvents which are not totally miscible (for example, from chloroform to water, require an intermediate solvent (such as methanol).

- Solvent miscibility is affected by temperature. If operating at an elevated temperature, consider the effect of the higher temperature on solvent solubility.

- Buffers dissolved in water may precipitate when mixed with organic solvents. When switching from a strong buffer to an organic solvent, flush the buffer out of the system with distilled water before adding the organic solvent. Also, when using a strong buffer, flush all pathways with distilled water before shutting the system down and leave distilled water in the system (flush with 20% methanol in water for shutdowns scheduled to be more than one day).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Table C-1 Physical Properties Of Solvents[1]

Polarity Index	Solvent	Viscosity CP, 20°C	Boiling Point, °C (1 atm)	Miscibility Number (M)	Wavelength Cutoffs (nm)
-0.3	N-decane	0.92	174.1	29	--
-0.4	Iso-octane	0.50	99.2	29	210
0.0	N-hexane	0.313	68.7	29	--
0.0	Cyclohexane	0.98	80.7	28	210
C.7	Butyl ether	0.70	142.2	26	--
C.8	Triethylamine	0.38	89.5	26	--
2.2	Isopropyl ether	0.33	68.3	--	220
2.3	Toluene	0.59	10C.6	23	285
2.4	P-xylene	0.70	138.0	24	290
3.0	Benzene	0.65	80.1	21	280
3.3	Benzyl ether	5.33	288.3	--	--
3.4	Methylene chloride	0.44	39.8	20	245
3.7	Ethylene chloride	0.79	83.5	20	--
3.9	Butyl alcohol	3.00	117.7	--	--
3.9	Butanol	3.01	177.7	15	--
4.2	Tetrahydrofuran	0.55	66.0	17	220
4.3	Ethyl acetate	0.47	77.1	19	260
4.3	1-propanol	2.30	97.2	15	210
4.3	2-propanol	2.35	117.7	15	--
4.4	Methyl acetate	0.45	56.3	15, 17	260
4.5	Methyl ethyl ketone	0.43	80.0	17	330
4.5	Cyclohexanone	2.24	155.7	28	210
4.5	Nitrobenzene	2.03	210.8	14, 20	--
4.6	Benzonitrile	C.22	19C.1	15, 19	--
4.8	Dioxane	C.54	10C.3	17	220
5.2	Ethanol	C.20	78.3	14	210
5.3	Pyridine	0.94	115.3	16	305
5.3	Nitroethane	0.68	114.0	--	--
5.4	Acetone	0.32	56.3	15, 17	330
5.5	Benzyl alcohol	5.80	205.5	13	--
5.7	Methoxyethanol	C.72	124.6	13	--
6.2	Acetonitrile	0.37	8C.6	11, 17	210
6.2	Acetic acid	C.26	117.9	14	--
6.4	Dimethylformamide	0.90	153.0	12	--
6.5	Dimethylsulfoxide	2.24	189.0	9	--
6.6	Methanol	0.60	64.7	12	210
7.3	Formamide	3.76	210.5	3	--
9.0	Water	C.00	100.0	--	--

[1] Adapted from: Godfrey, Norman B., *Solvent Selection via Miscibility Number*, CHEMTECH, 359-363 (1972).

C.2.1 How To Use Miscibility Numbers (M-Numbers)[1]

Miscibility numbers (M-numbers) are used to predict the miscibility of a liquid with one of the standard solvents (see Table C-1).

To predict the miscibility of the two liquids, subtract the smaller value from the larger.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

- If the difference between the two M-numbers equals 15 or less, the two liquids are miscible in all proportions at 15°C.
- A difference of 16 units shows that the two liquids possess a critical solution temperature between 25 and 75°C, with 50°C as the optimal temperature.
- If the difference equals 17 or more, the two liquids are immiscible or their critical solution temperature is above 75°C.

Some solvents prove immiscible with solvents at both ends of the lipophilicity scale. These solvents receive a dual M-number. The first number, always lower than 16, indicates the degree of miscibility with highly lipophilic solvents. The second number applies to the opposite end of the scale. A large difference between these two numbers indicates a limited range of miscibility. For example, some fluorocarbons are immiscible with all the standard solvents and have M-numbers of 0, 32. Two liquids with dual M-numbers are usually miscible with each other.

A liquid is classified in the M-number system by testing for miscibility with a sequence of standard solvents. A correction term of 15 units is then either added or subtracted from the cutoff point for miscibility.

C.3 BUFFERED SOLVENTS

When using a buffer, obtain a good quality reagent and filter it through a 0.45 micron filter (such as those in the Solvent Clarification Kit available from Waters).

Do not leave the buffer stored in the pump after use. When you are through, clean the buffer out completely by flushing the outlet line, inlet line, and filter with approximately 40 ml of filtered distilled water containing 0.2% sodium azide. Use a syringe to flush distilled water through the vent holes while running the pump. After flushing with water, flush the pump with methanol before shutdown.

C.4 HEAD HEIGHT

Position the solvent reservoir at a level higher than that of the inlet manifold. This height will vary depending on the solvent used and the flow rate. To determine if the solvent reservoir is high enough above the inlet manifold, open the draw-off valve two or three turns whiles operating the pump at the desired flow rate. If solvent continually drips out of the draw-off valve, the head height is sufficient; if not, raise the solvent reservoir. A good rule is to have a minimum head height of 4 inches.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

C.5 SOLVENT VISCOSITY

Generally when operating with a single solvent or under low pressure, viscosity is not important. However when running a gradient, the viscosity changes which occur as the solvents are mixed in different proportions can result in pressure changes during the run. For example, a 1:1 mixture of water and methanol produces twice the pressure of either water or methanol alone. If the extent to which the pressure changes will affect the analysis is not known, monitor the pressure during the run using the controller's CHART output provided for this purpose (select %A or %B).

C.6 MOBILE PHASE SOLVENT DEGASSING

Mobile phase difficulties account for 70% or more of all liquid chromatographic problems. Degassing solvents used in the mobile phase is one of the most effective measures to eliminate these problems. The benefits are:

- Stability in the baseline and enhanced sensitivity in some types of chromatographic detectors
- Reproducible retention times for eluting peaks
- Reproducible inject volumes for quantitification
- Stable pump operation

Only a finite amount of gas can be dissolved in a given volume of liquid under specific conditions. This amount depends on the temperature of the liquid, pressure on the liquid, and the chemical affinity of the gas for the liquid.

Generally, a gas will be most soluble in a solvent where the intermolecular attractive forces between molecules of the solvent are similar to those of the gas ("like dissolves like"). If the main attractive forces are Van der Waals forces, the gas will be more soluble in this solvent than in one with dipole forces or hydrogen bonding. Thus, a larger amount of helium, nitrogen, oxygen, or hydrogen will dissolve in alkanes and benzene than in water.

Temperature affects the solubility of gases in two ways. First, the higher the boiling point of a gas, the more soluble the gas will be in a given solvent. Second, increasing the temperature of the gas/liquid solution affects the percentage of gas in solution. If the heat of solution results in an exothermic reaction, the percentage of gas in solution is reduced. If the reaction is endothermic, the percentage increases. For example, solubility of helium in water decreases with an increase in temperature, but the solubility of helium in benzene increases in direct proportion to the temperature.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The mass of gas dissolved in a given volume of solvent is proportional to the partial pressure of the gas in the vapor phase of the solvent. If the pressure of the gas decreases, the amount of that gas in solution also decreases.

Dissolved oxygen affects detector performance in several ways[1]. Oxygen dissolved in solvents may form a UV absorbing complex, the amount of which is considerably different in different solvents. The effect is particularly strong with wavelengths below 260 nm. Therefore, any change in dissolved O_2 content may affect a UV baseline considerably. This phenomenon is particularly evident in the solvent tetrahydrofuran (THF). Dissolved O_2 does not seem to affect the absolute sensitivity of a UV system, but primarily causes baseline drift. This effect will be especially noticeable during gradient operation where the dissolved oxygen content varies between the different solvents and, as the composition changes, causes erratic baselines or even peak shaped artifacts on the baseline.

Dissolved oxygen in a fluorescence detector has quite a different effect. It results in a tremendous loss of sensitivity. Bowen and Williams[2] have discussed the quenching of aromatic hydrocarbons by dissolved oxygen in fluorescence detectors. Parker and Barnes[3] have reported a 95% reduction in sensitivity of the fluorescence of borate-benzoin complex in air equilibrated ethanol. The oxygen quenching varies with different types of compounds and aromatic hydrocarbons, aliphatic aldehydes, and ketones are especially susceptible.

If for any reason the characteristics of the solvent change, the precision and accuracy of the solvent delivery system may be adversely affected. This may cause variations in both peak retention and, to some extent, peak height or area.

1 S.R. Bakalyar, M.B.T. Bradley, R. Hoganen, *Journal of Chromatography*, 158 (1978) 277.

2 E.J. Bowen and A.H. Williams, Trans. Faraday Soc., 35 (1939) 65.

3 C.A. Parker and W.J. Barnes, Trans. Faraday Soc., 82 (1957) 606.

C.7 SOLVENT DEGASSING METHODS

There are four main methods used to degas solvents: sparging with a less-soluble gas, heating, reducing presure by vacuum, and sonication. These methods may be used independently or in various combinations.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

C.7.1 Sparging

Sparging, or bubbling a gas through solvent, reduces the partial pressure of the unwanted gas on the surface of the solvent. This will remove unwanted gas from the solution, but it will saturate the solvent with the second gas. Sparging with helium will remove background absorbance on a UV detector and the quenching phenomenon caused by dissolved oxygen on a fluoresence detector. Helium sparging also tends to give a more stable baseline on a refractive index detector than air equilibrated solvents, and the absolute mass of dissolved gas is considerably lower than with air equilibrated solvents. Somewhat better pumping reproducibility is obtained from helium degassed solvents in a piston pump. Gas sparging brings the solvent to a state of equilibrium, which can then be maintained by a constant flow rate diffusion of the sparge gas through the solvent.

In addition, sparging with helium reduces the absolute mass of gas dissolved in the solvent.

The figures on the next two pages demonstrate the effect of sparging on the absorbance of some common solvents. Notice the dramatic reduction in absorbance at the lower wavelengths for methanol, hexane, and ispropyl alcohol.

C.7.2 Heat

Heat raises the vapor pressure of the solvent at its surface. As the partial pressure of the solvent is raised, the partial pressure of the gas decreases proportionally. This prevents any further absorption of the gas into the solution. This is true for most gases in water, but not necessarily true with organic solvents. Temperature changes also affect the RI of solvents; if the temperature is not kept constant, the RI of the solvent will change.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

C.7.3 Vacuum

A vacuum reduces pressure on the surface of the solvent. The mass of gas in the solution is proportional to the partial pressure of the gas at the surface of the solvent. As pressure is reduced, the mass of gas in the solution is reduced.

C.7.4 Sonication

Sonication with high energy sound waves drives energy into the solvent and causes the submicron-sized "particles" of gas to aggregate. As the gas aggregates, the bubbles become large enough to float out of the solvent and dissipate. Sonication alone will degas a gallon of solvent in approximately 20 minutes.

C.7.5 Degassing Summary

Select the most efficient degassing operation for your application. The preferred combination of methods for RI is heating the solvent to operating temperature while maintaining a blanket of helium inside the bottle.

To remove the gas as quickly as possible, consider the following:

- Helium sparging gives stable baselines and better sensitivity, and prevents the reabsorption of atmospheric gases.
- To degas a solvent by heat you must boil the solvent; this is not practical for mixed solvents. However, low levels of heat will raise the partial pressure of the solvent, and thereby reduce the rate of reabsorption of the gas. The RI of the solvent changes as the temperature decreases.
- Vacuum degassing is not recommended for use with RI detectors. It may also change the composition of mixed solvents.
- Sonication plus vacuum will degas a liter of solvent very quickly. This technique will not change the composition of mixed solvents.

WARNING

It is dangerous to apply vacuum to the brown gallon bottles in which solvent is shipped. They stand a high risk of implosion under these conditions.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

ANALYSIS PLAN AND FILE SHEET

ANALYSIS NAME: _____

MEMORY LOCATION (TABLE NUMBER): _____

GRADIENT TABLE

TIME	FLOW	% A	% B	% C	% D	CURVE
INITIAL						•

PROGRAM EVENTS TABLE

TIME	EVENT	ACTION

NOTES

CHOICE OF EVENTS:

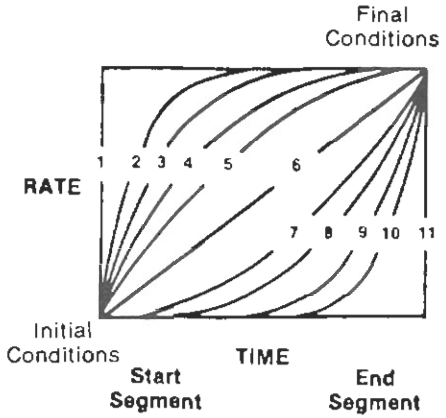
1-4 = Switches 1-4
5 = Alarm
6 = Sparge ml/min
7 = Temperature
8 = Go to Initial of Tables #
9 = Start Run off Tables #

EVENTS 1-5
CHOICE OF ACTIONS:
0 = OFF 1 = ON 2 = PULSE
EVENTS 6-9
CHOICE OF ACTIONS:
SELECT A VALUE

DETECTOR TABLE

410 SENS	
431 SENS	

TIME	DET/ CHAN	SENS	AUFS
INITIAL			



Curve - 1 go to end condition immediately
2-5 convex
6 linear
7-10 concave
11 maintain start conditions until end of segment (used to create step gradients)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

ANALYSIS PLAN AND FILE SHEET

ANALYSIS NAME: _____

MEMORY LOCATION (TABLE NUMBER): _____

GRADIENT TABLE

TIME	FLOW	% A	% B	% C	% D	CURVE
INITIAL						*

PROGRAM EVENTS TABLE

TIME	EVENT	ACTION

NOTES

DETECTOR TABLE

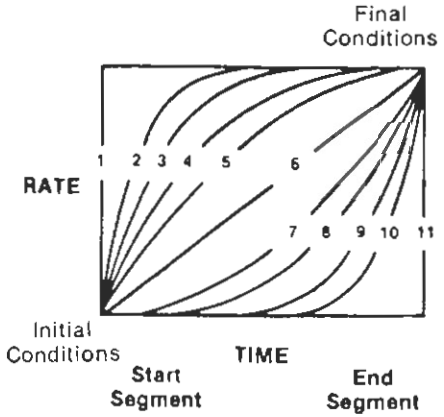
410 SENS	
431 SENS	

TIME	DET/ CHAN	SENS	AUFS
INITIAL			

CHOICE OF EVENTS:

1-4 = Switches 1-4
5 = Alarm
6 = Sparge ml/min
7 = Temperature
8 = Go to Initial of Tables #
9 = Start Run off Tables #

EVENTS 1-5
CHOICE OF ACTIONS:
0 = OFF 1 = ON 2 = PULSE
EVENTS 6-9
CHOICE OF ACTIONS:
SELECT A VALUE



Curve - 1 go to end condition immediately
2-5 convex
6 linear
7-10 concave
11 maintain start conditions until end of segment (used to create step gradients)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

ANALYSIS PLAN AND FILE SHEET

ANALYSIS NAME: _____

MEMORY LOCATION (TABLE NUMBER): _____

GRADIENT TABLE

TIME	FLOW	% A	% B	% C	% D	CURVE
INITIAL						

PROGRAM EVENTS TABLE

TIME	EVENT	ACTION

NOTES

CHOICE OF EVENTS:

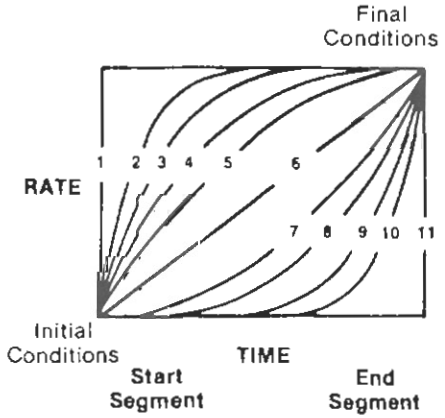
1-4 = Switches 1-4
5 = Alarm
6 = Sparge ml/min
7 = Temperature
8 = Go to Initial of Tables #
9 = Start Run off Tables #

EVENTS 1-5
CHOICE OF ACTIONS:
0 = OFF 1 = ON 2 = PULSE
EVENTS 6-9
CHOICE OF ACTIONS:
SELECT A VALUE

DETECTOR TABLE

410 SENS	
431 SENS	

TIME	DET/ CHAN	SENS	AUFS
INITIAL			



Curve - 1 go to end condition immediately
2-5 convex
6 linear
7-10 concave
11 maintain start conditions until end of segment (used to create step gradients)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

GLOSSARY

A

ACCURACY - Generally, the quality of freedom from mistake or error; that is, of conformity to truth or a rule. Specifically, the ratio of error to full-scale output of the ratio of error to output at a specific point of interest. The accuracy of the injector to deliver a specified injection volume in terms of transferred fluid.

A/D (Analog to Digital) - Conversion of the analog signal from the detector to a digital signal that the computer can understand by the System Interface Module.

AFFINITY - A general term for all modes of separation that rely on the relative attractions between the surface of the packing material, the solvent and the components in solution.

ALPHA (a) - A measure of the separation of two components at their peaks. It does not take into account any overlapping of the peak areas. Also called selectivity factor, separation factor, chemistry factor.

ALTERNATING CURRENT (ac) - Current that reverses at regularly recurring intervals of time and that has alternately positive and negative values.

AMBIENT TEMPERATURE - The average temperature of the surrounding medium such as air, water, or earth into which the heat of the equipment is dissipated.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

ANALOG - Pertaining to representation by means of continuously variable physical quantities. (See also DIGITAL).

ARTIFACT - An unwanted peak or response to detected substances shown in the chromatogram. An artifact can be caused by inadequate sample preparation, solvent changes, unstable baseline, or improperly degassed solvent.

AUFS - Absorbance units (per) full scale (deflection). In ion chromatography, sensitivity is measured in µSFS (microsiemens full scale).

B

BAND BROADENING - The dilution of the sample with mobile phase during the injection process. For example, a 10 µl aliquot is injected. By the time it reaches the head of the column, the sample components are spread over a 12 µl volume. Band broadening does not affect quantification, but in some cases can affect resolution of peaks within the chromatogram.

BASELINE - The portion of a chromatogram recorded when only the mobile phase is flowing through the detector; the reference position from which peak detection and calculations are derived.

BASELINE RESOLUTION - Separation of components at the peak base, that is, no overlap between any peak areas.

BEGINNING PEAK WIDTH - The minimum peak width that you want to recognize.

BINARY - The representation of numbers in terms of powers of two, using the two digits 0 and 1. Commonly used in computers, since the values 0 and 1 can easily be represented in physical form in a variety of ways, such as the presence or absence of current, positive or negative voltage, or a white or black dot on the display screen.

BIT - A binary digit (0 or 1); the smallest possible unit of information, consisting of a simple two-way choice, such as yes or no, on or off, positive or negative, something or nothing. 0 commonly represents absence of a pulse and 1 represents presence of a pulse.

BLOCK - A group of characters or words stored on a volume (disk or diskette) as a unit in binary format. A block has 512 bytes (roughly 512 characters).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

BUFFER - (1) A substance capable of neutralizing both acids and bases; (2) an area of the computer's memory reserved for a specific purpose, such as holding graphical information to be displayed on the screen or reading text characters.

BYTE - A unit of information consisting of a fixed number of bits.

C

CALIBRATION - The determination, by measurement or comparison with a standard, of the corrected value (area) of an injected sample.

CAPACITY FACTOR (k') - The ratio of the total amount of compound on the stationary phase to the total amount of compound in the mobile phase; measured by the equation:

$$k' = \frac{V_r - V_o}{V_o}$$

where:

V_r = retention volume (or time or distance)
C_o = void volume

(See ELUTION VOLUME, VOID VOLUME (V_O).)

CARRY OVER - The presence of peaks in a chromatogram that were not components of the injected sample. Carry over has many causes: in all cases the integrity of the specific analysis has been violated. It can be classified as an analysis problem.

CHANNEL THRESHOLD - See PEAK DETECTION THRESHOLD.

CHEMISTRY FACTOR - See ALPHA (a).

CHROMATOGRAM - A printed or displayed plot of a chromatographic separation in which the time and relative amounts of sample components are indicated by peaks.

CHROMATOGRAPHY - A method of separating and analyzing mixtures of chemical substances.

COLUMN - In chromatography, a steel or plastic tube packed with a particulate, which separates similar molecular groups from a common matrix or sample.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

COLUMN VOLUME - A volume of solvent equal to the specific void volume of the system. (See also VOID VOLUME(V_O).).

COMMAND - A communication from the user to a computer system (usually typed from the keyboard) directing it to perform some immediate action.

CONDUCTANCE - The ability of a substance to measure electricity.

CONDUCTIVITY - The amount of electricity that will flow through a unit cube of a given substance in a unit of time; the reciprocal of resistivity. Conductivity is measured in siemens (S).

CONNECTOR - A physical device (such as a plug, socket, or jack) used to connect one hardware component of a system to another.

CONTACT CLOSURE - Terminals not normally in electrical contact (open circuit) which are placed in contact (closed or short circuited) at certain times.

CONVERT - To change the representation of data from one form to another, without changing the information it conveys; for example, radix conversion from punched cards to magnetic tape, analog to digital conversion.

CENTRAL PROCESSING UNIT (CPU) - A unit of a computer that includes circuits controlling the interpretation and execution of instructions. Synonymous with central processor, main frame. (See also MICROPROCESSOR, PROCESSOR.)

CROSS CONTAMINATION - To alter the sample in the vial by the injection process. Cross contamination violates the integrity of the chromatogram and the analysis. Unlike carry over, cross contamination can only be caused by the injection process. Once cross contamination has occurred, the entire sample is compromised.

CURSOR - A marker or symbol displayed on the screen that marks where the user's next action will take effect or where the next character typed from the keyboard will appear.

CURVE NUMBER - A number from 1 through 11 indicating a curve shape that represents the rate of solvent composition change over time during a gradient separation.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

D

DEGASSING - To remove dissolved gas from the mobile phase to prevent bubble formation in the pump or the fluid system.

DEFAULT - The predefined value of a selection assumed by the computer when you do not specify a value or command.

DETECTOR - The device used to detect the presence of a molecular or ionic entity.

DEVICE - (1) A physical apparatus for performing a particular task or achieving a particular purpose; (2) in particular, a hardware component of a computer system.

DIAGNOSTIC - Pertaining to the detection and isolation of a malfunction or mistake.

DIAL-A-MIX - A Waters 840 mixing method that provides continuous solvent mixing at a fixed percentage of flow from the pumps, with flow and composition remaining constant throughout the run.

DIGIT - (1) One of the characters, 0 through 9, used to express numbers in decimal form; (2) one of the characters used to express numbers in some other form, such as 0 and 1 in binary or 0 through 9 and A through F in hexadecimal.

DIGITAL - Pertaining to digits or to the representation of data or physical quantities by digits. (See also ANALOG.)

DIGITAL CIRCUIT - A circuit that has only two stable states and operates in the manner of a switch; it is either ON or OFF or HIGH or LOW (high voltage or low voltage).

DIP - Dual In-line Package. The address selection switches on the rear panel of the controller.

DIRECT CURRENT (dc) - A unidirectional current in which the changes in value are zero or close to zero; a virtually nonpulsating current.

DISABLE - To deactivate a device or function by computer command. (see also ENABLE.)

DISPLAY - (1) Information exhibited visually, especially on the screen of a display device; (2) to exhibit information visually.

DOWNLOAD - The transfer of data (commands, instructions) from the computer to the interface module.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

DRAW-OFF VALVE - A valve on the lower face of the pump that provides access to the solvent lines and pump head to remove air, similar to a bleeder valve.

E

EDIT - To prepare data for a later operation. Editing may include the rearrangement or the addition of data, the deletion of unwanted data, format control, code conversion, and the application of standard processes such as zero suppression. In Expert Ease, making changes to method parameters that control chromatography data acquisition and processing.

EFFICIENCY - A measure of how much solvent is required to move each sample component through the column. Ideally the concentration of the component is the greatest at the midpoint of that volume.

ELUTE - To emerge from the stationary phase in a liquid chromatography (LC) separation.

ELUTION VOLUME - The amount of solvent required to elute a certain component from the column. (See also CAPACITY FACTOR, RETENTION VOLUME.)

ENABLE - To activate a device or function by computer command. (See also DISABLE.)

EQUILIBRATION - The process of bringing a system (solvent, column, and interactive surfaces) to a state at which forward and reverse reactions occur at equal rates so the balance of the system does not change during the run. Usually indicated by a stable, drift-free baseline resulting from proper conditioning of the column, followed by flushing the system with the intended mobile phase (assuming the rest of the system is clean and functioning properly).

EQUILIBRATION DELAY - Time between the end of a run and the next injection. Allows time for reequilibration. (See also EQUILIBRATION TIME.)

EQUILIBRATION TIME - The time required to place, or return, a system to its chemically stable state. (See also EQUILIBRATION DELAY.)

ERROR MESSAGE - A message displayed or printed to notify the user of an error or problem in the execution of a program.

EVENT - See EXTERNAL EVENT.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

EXECUTE - To perform or carry out a specified action or sequence of actions, such as those described by a program.

EXPONENTIAL SKIM - A procedure for removing the area of a peak considered to be an artifact.

EXTERNAL EVENT - An action performed by an external device under the control of the current instrument.

EXTERNAL STANDARD - A substance of known quantities used to create a calibration curve against which a sample containing the same quantities in unknown amounts will be compared.

F

FIELD - An area on a screen that will accept user entries.

FIRMWARE - Those components of a computer system consisting of programs stored permanently in read-only memory. Such programs are built into the computer at the factory; they can be executed at any time but cannot be modified or erased from main memory. (See also HARDWARE, SOFTWARE.)

FLOATING GROUND - A reference point or voltage in a circuit that is not tied to an actual external ground.

FLOW PROGRAMMING - To increase the flow rate in a predetermined manner to decrease analysis time, either continuously or in steps. This technique is normally used when low flow rates are needed to obtain sufficient resolution for early eluting materials and less precision is needed for late eluting materials.

FRONTING - See TAILING

FLOW RATE - The rate at which a volume of solvent is flowing per unit of time.

G

GPC - Gel Permeation Chromatography.

GRADIENT - A method of changing the percentage composition of two or more discrete solvents over time.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

GRADIENT ELUTION - A method of changing the percentage composition of the mobile phase to ensure the elution of all peaks within a reasonable period of time. This may be performed continuously over the course of the run or in step increments (step gradient).

GROUND - A conducting path, intentional or accidental, between an electric circuit or equipment and the earth, or some large conducting body serving in place of the earth (a voltage reference).

GROUND TERMINALS - The terminals used to connect the ground or earth lead of a signal or contact closure cable. Generally denoted (depending on country of usage) as the black or green lead.

H

HARDWARE - Those components of a computer system consisting of physical (electronic or mechanical) devices. (See also FIRMWARE, SOFTWARE.).

HOLDING LOOP - A loop of tubing with a calibrated volume, usually in microliters, attached to manual and automatic injectors which holds only the stated amount (when filled to excess).

HPLC - High Performance Liquid Chromatography.

I

IEEE - Institute of Electrical and Electronics Engineers. Whenever a product bears these initials, it has met the standards (internationally accepted) of the IEEE organization.

IEEE BUS - A cable of 16 wires, or bus lines, that connect SIM modules to the LAC/E module.

INDEX - A list of the contents of a file or a document, along with keys or references for locating the contents.

INJECTION - The act of introducing a measured sample into the solvent (mobile phase) stream and onto the column.

IN-LINE FILTER - A small stainless steel container mounted in the sample tubing between the pump and the injector.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

INPUT - (1) The data entered into a computer for processing; (2) the process of entering data; (3) pertaining to the devices that enter data.

INTEGRATION - The process of interpreting raw data referenced to a calibration curve in analysis.

INTEGRATION DELAY - A time (minutes from injection) during which integration is inhibited and data points are discarded.

INTERFACE - The devices, rules, or conventions by which one component of a system communicates with another.

INTERLINK INTERFACE - A hardware and software communications interface.

INTERNAL STANDARD - A known, measured component, analogous to an unknown component that exhibits a different retention time, used for calibration and added to a sample for reference purposes.

ISOCRATIC SEPARATION - A method of separating sample components using a single solvent.

K

k' - See CAPACITY FACTOR

KEYPAD - The component (similar to a typewriter keyboard) that enables you to communicate with the instrument or computer.

KEYSTROKE - The act of pressing a single key or a combination of keys (such as CONTROL-C) on the keyboard.

L

LC - Liquid Chromatography.

LEAST SQUARES FIT - A calibration technique of fitting a curve close to some given points, which minimizes the sum of the squares of the deviations of the given points from the curve.

LIGHT EMITTING DIODE (LED) - A solid-state light source that emits visible or infrared radiation.

LINEARITY - The closeness of a calibration curve to a specified straight line; the degree to which the output of a linear device is proportional to its input.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

LOCK - To protect a disk file from being changed or erased.

M

MENU - A list of choices presented by a program, usually on the display screen, from which the user can select.

METHOD - A single program or a series of programs to accomplish an analysis or a series of analyses.

MICROPROCESSOR - A single integrated circuit that performs the functions of a CPU. (See also CENTRAL PROCESSING UNIT.)

MICROSECOND - One-millionth of a second.

MICROSIEMENS - In ion chromatography, the sensitivity of a system is measured in µSFS (microsiemens per full scale deflection). (See also SIEMENS.)

MILLISECOND - One-thousandth of a second.

MOBILE PHASE - The liquid phase of a chromatographic separation that carries the dissolved sample through the stationary phase in liquid chromatography. (See also STATIONARY PHASE.)

MULTIMETHOD - A programmed sequence of individual methods and samples for unattended operation.

MULTIPOINT CALIBRATION - Calibration by the point-to-point or least-squares-fit method. The use of multiple standard amounts to produce a calibration curve.

MULTITASKING - The ability of a computer to overlap functions, or to perform two or more operations at one time.

N

NANOSECOND - One-billionth of a second.

NEGATIVE PEAK DETECTION - An integration event on the Waters 840 that allows you to detect and integrate negative (inverted) peaks in the same manner as positive peaks.

NORMAL CURVE DISTRIBUTION - 68% of test results will fall within ±1 SD (standard deviation), 95% of test results will fall within ±2 SD, 99% of test results will fall within ± 3 SD.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

NORMAL PHASE - A form of chromatography where the packing material surface is relatively polar (for example, silica gel) and the mobile phase is relatively nonpolar (for example, chloroform). In normal phase separations, nonpolar sample components elute first. (See also REVERSE PHASE.)

O

OFFSET - The amount (difference) in voltage from 0 (zero) volts that denotes the starting point of a baseline.

OPERATING SYSTEM - A software system that organizes the computer's resources and capabilities and makes them available to the user or to application programs running on the computer.

OUTPUT - Information transferred from a computer to some external destination, such as the display screen, a disk drive, a printer, or a modem.

OUTPUT DEVICE - Equipment that transfers data from a computer to an output medium.

P

PARAMETER - A quantity (volume, time, and so on) that is constant under a given set of conditions; a combination of such quantities used as guidelines for an analysis.

PEAK AREA - On a chromatogram, the area, in relative units within the outline of a peak, and the associated baseline.

PEAK DETECTION THRESHOLD - The system must decide for itself when a peak starts or stops. This is accomplished with a smooth, noise-free signal. If the voltage signal changes more than some minimum threshold during a certain time period, it is a peak.

PEAK GROUPING - To display a total area or amount of a group of compounds as if they were one unit. Peak grouping can be accomplished by summing the areas of sequential peaks or by summing the concentration of nonsequential peaks.

PEAK HEIGHT - The distance (on a chromatogram) from the base of the peak to the highest point of the peak, used to determine area.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PEAK MAXIMUM - The point on the peak at which the distance to the peak base is at maximum.

PEAK WIDTH - In a chromatogram (plot of rise and fall versus time), the width of the base (time duration) of a peak from baseline point to baseline point, used to determine area and characterize the peak to optimize data acquisition settings.

PLATES - A meausre of the efficiency of the column based on the elution volume and the peak width at the baseline. The narrower the peak, the more efficient the column and the higher the plate count (N).

POINT-TO-POINT CALIBRATION - A calibration method using two or more injection amounts of the same standard to extrapolate peak areas from lines drawn from the origin (0,0) through the points. (See also SINGLE-POINT CALIBRATION.)

POWER FAIL - Protective circuitry to prevent data loss when power is lost.

PRECISION - Closeness of test results to one another; a measurement of reproducibility.

PRESSURE TRANSDUCER - See TRANSDUCER.

PROCESSOR - The hardware component of a computer that performs the actual computation by directly executing instructions represented in machine language and stored in main memory. (See also CENTRAL PROCESSING UNIT.)

PROMPT - A request displayed on the screen for you to type in certain information, or perform a certain task.

PULSE - A variation in a quantity that is normally constant; it has a finite duration and is usually brief compared to the time scale of interest.

PUMP HEAD VOLUME - The measure of volume that is displaced by the pump heads.

PURGE - To flush the fluid system of the sample processor with fresh solvent.

Q

QUANTIFICATION - The computer process of calculating component amounts, using the retention times and areas (stored in the system) for all peaks detected during a run.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

R

RAW DATA - Data that has not been processed; binary representation of the analog detector signal.

READ-ONLY MEMORY (ROM) - Memory whose contents can be read but not written; used for storing firmware. Information is written into read-only memory once, during manufacture; it then remains there permanently, even when the computer's power is turned off, and can never be erased or changed.

REFLECTION - The change of direction experienced by a beam of light as it strikes a surface.

REFRACTION - The bending of a beam of light as it passes from one medium into another of a different density.

REPETITIVE PULSE (RPULSE) - See PULSE.

REPROCESS - Reintegrate raw data referenced to a calibration curve in analysis.

REPRODUCIBILITY - The precision with which peak heights or areas are repeated from injection to injection. A measure of total system performance.

RESISTANCE - The property of opposing the passage of current, causing electric energy to be transformed into heat.

RESISTIVITY - The capacity for resistance.

RESOLUTION - The degree to which each sample component in a chromatographic separation can be clearly identified.

RESPONSE FACTOR - A calculation that represents the area under the plotted peak outline divided by the amount (of a component).

RETENTION TIME - The time from injection to the apex of the first peak.

RETENTION VOLUME - A measure of the attraction of a sample component for the stationary phase when a specific solvent and operating conditions are used. (See also ELUTION VOLUME.)

REVERSE PHASE - A form of chromatography where the packing material surface is hydrophobic and the mobile phase is aqueous/organic. Highly polar (water soluble) samples are well suited for reverse phase analysis. (See also NORMAL PHASE.)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

ROUTINE - A part of a program that accomplishes some task subordinate to the overall task of the program.

RUN - (1) To execute a program; (2) a complete LC separation process.

RUN TIME - The time from injection to the end of the chromatographic separation.

S

SAMPLE - A representative fraction of material tested or analyzed in order to determine the nature, composition, and percentage of specified constituents.

SAMPLE RATE - The frequency at which samples of the detector analog signal are transformed into binary to reconstruct the signal for digital processing.

SCALE FACTOR - The factor by which the reading of an instrument or the solution of a problem should be multiplied to give the true final value when a corresponding scale factor is used initially to bring the magnitude within the range of the instrument or computer.

SCROLL - To change the contents of all or part of the display screen by shifting information out at one end (most often the top) to make room for new information appearing at the other end (most often the bottom), producing an effect like that of moving a scroll of paper past a fixed viewing window.

SELECTIVITY FACTOR - See ALPHA (a).

SENSOR - The element of a transducer that changes some physical paramenter to an electrical signal. See Transducer.

SEPARATION - The process in chromatography in which the mobile and stationary phases compete for sample molecules and cause the components of a sample to break apart and elute at different rates.

SEPARATION FACTOR - See ALPHA (a).

SERIAL INTERFACE - An interface in which information is transmitted sequentially, one bit at a time, over a single wire or channel.

SIEMENS - The unit of measure for conductivity. (See also MICROSIEMENS.)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

SINGLE-POINT CALIBRATION - A calibration method using a single standard amount (regardless of the number of injections) to determine analytical system response and produce a comparable area value. A calibration curve extrapolated from the origin (0,0) through this point. (See also POINT-TO-POINT CALIBRATION.)

SLOPE - The measurement of line direction between data points; vertical distance from point A to point B, divided by the horizontal distance from point A to point B.

SOFTWARE - The computer program, language used, and its physical form in contrast to the actual physical structure, or hardware, of the instrument. (See also FIRMWARE, HARDWARE.)

SOLVENT - In chromatography, the mobile phase that flows through the fluid system; a substance capable of dissolving another to form a uniformly dispersed solution. Solvents may be either polar (such as water) or nonpolar (such as n-hexane).

SOLVENT DELIVERY SYSTEM - A pump that delivers mobile phase to the column.

SPARGING - A technique for removing dissolved gas in a solvent by replacing the gas with an inert gas such as helium or nitrogen. See Appendix C, Solvent Considerations.

SPECIAL FUNCTION KEY - A key on the computer keyboard whose function varies depending on the application currently in use.

STANDARD - An accepted reference sample used for establishing a unit for the measurement of a physical quantity.

STATIONARY PHASE - The stationary material in a column or on a flat surface that competes with the mobile phase for sample molecules, thus causing chromatographic separation. (See also MOBILE PHASE.)

SYSTEM - A coordinated collection of interrelated and interacting parts organized to perform some function or achieve some purpose.

SYSTEM INTERFACE MODULE - The unit that serves as a link for the transfer of data and control commands between the liquid chromatography system and the computer.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

T

TAILING - A condition where the front of the peak is steeper than the rear, relative to the baseline. (See also FRONTING.)

TERMINAL - A special-purpose input and/or output device (often using a keyboard and sometimes a CRT) that receives and/or transmits data. An intelligent terminal may also do some processing.

TERNARY OPERATION - Gradient operation with three solvents.

TIME INIT. (GRADIENT) - Time zero (from injection) from which gradient segment changes are referenced.

TRANSDUCER - A device that converts one form of energy to another. The energy may be in any form such as electrical, mechanical, acoustical, and so on. This term is often restricted to a device in which the magnitude of an applied stimulus is converted into an electrical signal proportional to the quantity of the stimulus. (See also SENSOR.)

TRANSIENTS - A spurious significant increase or decrease in current or voltage, usually sporadic in occurrence. It may cause abnormal operation of the instrument or may appear on the plot during analysis.

TROUBLESHOOT - To locate and correct the cause of a problem or malfunction in a computer system. Typically used to refer to hardware-related problems.

TTL - Transistor-to-Transistor Logic. A signal state determined by the presence or absence of $\pm$5 V.

V

VARIABLE - A quantity that can assume any set of values.

VISCOSITY - The degree to which a fluid resists flow under applied force. The more resistance, the greater the viscosity.

VOID VOLUME (V_O) - The volume of solvent in a packed column; the amount of solvent required to elute a sample component which does not interact with the stationary phase. (See also CAPACITY FACTOR (k'), COLUMN VOLUME.)

VOLUME - (1) A generic name for a magnetic, file-storage medium, such as a disk or diskette. (2) the amount of a liquid solution.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

W

WINDOW PERCENTAGE - The percent deviation (+/-) from the expected retention time within which you want the system to recognize a peak.

WISP - The Waters Intelligent Sample Processor.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP