Thermo SCIENTIFIC

Dionex ICS-5000 Ion Chromatography System Operator's Manual

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1 • Introduction

1.1 Thermo Scientific Dionex ICS-5000 System Overview

Figure 1-1. *Dual Dionex ICS-5000 System with RFIC-EG™*

The Thermo Scientific Dionex ICS-5000 Ion Chromatography System offers a full range of Reagent-Free™ IC (RFIC™) components. RFIC-EG combines automated eluent generation and self-regenerating suppression to make IC easier and more powerful than ever before. It is no longer necessary to spend time preparing eluents and regenerants. All you need is deionized water—the IC system automatically generates eluent in the exact amount and concentration needed for your application, ensuring superior analytical

results. In combination with capillary columns at flow rates of 0.010 mL/min, the Dionex ICS-5000 system can be used for long periods of continuous operation and minimal eluent consumption.

The dual-analysis capabilities (both simultaneous and sequential) of the Dionex ICS-5000 system let you maximize efficiency and throughput and minimize downtime. The modular system design lets you quickly configure and customize hardware.

The single-channel Dionex ICS-5000 can be configured to run either capillary IC applications or microbore or standard bore IC applications.

- Capillary IC applications use 0.4 mm diameter columns with flow rates typically from 0.005 to 0.02 mL/min.
- Microbore IC applications use 2 mm diameter columns and with flow rates typically from 0.2 to 0.5 mL/min.
- Standard bore IC applications use 4 mm diameter columns with flow rates typically from 1.0 to 2.0 mL/min.

A dual Dionex ICS-5000 system can be configured with any combination of the above application types (for example, one capillary IC channel and one microbore IC channel, or two capillary IC channels, or one microbore IC channel and one standard bore IC channel).

1.1.1 Dionex ICS-5000 System Components

The table below identifies modules in the Dionex ICS-5000 product line, as well as additional products that can be added to a Dionex ICS-5000 system. Refer to the page number indicated here for a brief product overview.

Product Type	Product Name	Page
Pump	Dionex ICS-5000 Dual Pump	page 3
	Dionex ICS-5000 Single Pump	page 3
Eluent Generator	Dionex ICS-5000 Eluent Generator	page 5
Eluent Organizer	Dionex ICS-5000 Eluent Organizer	page 6
Detector/Chromatography Compartment	Dionex ICS-5000 Detector/Chromatography Module	page 7
IC Cube™ (inside DC)	Dionex IC Cube	page 7

Product Type	Product Name	Page
Detector (inside DC)	Dionex ICS-5000 Conductivity Detector	page 7
	Dionex ICS-5000 Electrochemical Detector	page 7
Accessory (inside DC)	Dionex ICS-5000 Automation Manager	page 8
Detector (outside DC)	ICS Series Photodiode Array Detector	page 9
	ICS Series Variable Wavelength Detector	page 10
Thermal Compartment	Dionex ICS-5000 Thermal Compartment	page 8
Autosampler	Dionex AS Autosampler	page 9
	Dionex AS-DV Autosampler	page 9
Mass Spectrometer	MSQ Plus™	page 10

Dionex ICS-5000 Dual Pump (DP) and Dionex ICS-5000 Single Pump (SP)

Each Dionex ICS-5000 pump can be configured for either capillary IC applications or analytical (standard bore and microbore) IC applications. Capillary IC pumps are always isocratic (they deliver one eluent). Analytical IC pumps can be either isocratic or low pressure proportioned gradient. Gradient pumps deliver gradient mixtures of up to four eluent components. The eluent composition selected for a gradient pump can be delivered as isocratic, isocratic proportioned, linear ramp, step, curved, or any combination of these.

The SP contains one of the following pump types:

- Isocratic capillary IC pump
- Isocratic analytical IC pump
- Gradient analytical IC pump

The DP contains two pumps in any combination of the three types listed above (for example, two isocratic capillary IC pumps, or two isocratic analytical IC pumps, or one isocratic capillary IC pump and one gradient analytical IC pump).

The second pump in the DP can be operated as a second-channel chromatography pump, an auxiliary dependent pump, or an auxiliary independent pump.

Capillary IC

Capillary IC pumps operate at flow rates ranging from 0.001 to 3.0 mL/min and operating pressures up to 41 MPa (6000 psi) (without RFIC) and up to 35 MPa (5000 psi) (with RFIC).

IMPORTANT

Capillary IC pumps shipped before February 17, 2011 were rated for lower operating pressures than the pumps currently being shipped. The older pumps can be operated at pressures up to 35 MPa (5000 psi) (without RFIC) and up to 21 MPa (3000 psi) (with RFIC). Before operating at pressures above these limits, verify that you have the appropriate pump.

- **HPC** is stamped on the secondary pump heads of the older (lower pressure rated) capillary IC pumps.

- **HPC-2** is stamped on the secondary pump heads of the newer (higher pressure rated) capillary IC pumps.

A Capillary Pump High-Pressure Upgrade Kit (P/N 075994) is available for converting a lower pressure rated capillary IC pump to a higher pressure rated pump. The kit includes the HPC-2 secondary pump head and high-pressure pump seals.

NOTE A high-pressure EG degas (capillary) cartridge (P/N 074459) is also required when operating a capillary RFIC system at pressures up to 35 MPa (5000 psi). For details, see page 5.

Analytical IC

Analytical IC pumps operate at flow rates ranging from 0.00 to 10.0 mL/min and operating pressures up to 35 MPa (5000 psi) without RFIC and up to 21 MPa (3000 psi) with RFIC. Both microbore and standard bore IC applications are supported.

Dionex ICS-5000 Eluent Generator (EG)

The EG generates high purity acid or base eluents online from deionized water. The EG can be configured for single- or dual-channel operation. Each channel includes:

- A high precision programmable current source (power supply)

For each channel, the following options must be ordered separately for installation inside the EG.

- A disposable eluent generator cartridge (EGC). Each cartridge contains an electrolyte concentrate solution, appropriate for the eluent being generated.
- A Continuously Regenerated Trap Column (CR-TC) to remove any extraneous contaminants from the deionized water source. The CR-TC is electrolytically-regenerated, which allows it to operate for extended periods without chemical regeneration.
- A high-pressure gas removal device that removes electrolysis gases created during eluent generation

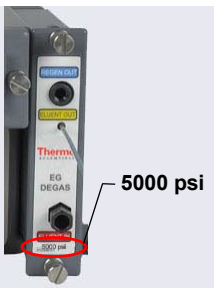
Two versions of EGC and CR-TC are available: one for capillary IC systems and one for analytical IC systems.

Capillary IC

IMPORTANT

If your system includes a capillary pump linked to an EGC, check the label on the EG degas (capillary) cartridge in the IC Cube and verify that 5000 psi is printed on the label (see the figure on the right).

If 5000 psi is not on the label, you must change the high pressure limit to **21 MPa (3000 psi)** (see page 158) or replace the cartridge with an EG degas (capillary) cartridge that is rated for 35 MPa (5000 psi) (P/N 074459).



Analytical IC

Reagent-Free IC with Eluent Regeneration (RFIC-ER™)

RFIC-ER is available as an option for Dionex ICS-5000 systems without an EG. Eluent regeneration uses the suppressor to reconstitute the starting eluent, allowing use of a single 4-liter bottle of eluent for up to four weeks. Because the system is a closed loop, it can run continuously, eliminating the need for recalibration or re-equilibration during the 28 days of non-stop operation. RFIC-ER uses carbonate, carbonate/bicarbonate, or MSA eluents for isocratic separations on standard bore columns.

Dionex ICS-5000 Eluent Organizer (EO)

The EO holds eluent reservoirs in a liner that contains spills and leaks. Up to two EOs can be installed on top of the DC. Each EO accommodates up to four 1-liter or 2-liter reservoirs *or* up to two 4-liter reservoirs. The EO is typically ordered configured with four 2-liter reservoirs (P/N 072058).

All eluent reservoirs available for use with the DP/SP can be pressurized. If you plan to pressurize the eluent reservoirs, the optional EO Regulator Accessory and Stand (P/N 074423) is required.

The Regulator Accessory includes a pressure regulator and gauge assembly with four outputs (for connections to four eluent reservoirs), as well as the tubing and connection fitting required. If more reservoirs are required, order a second regulator (P/N 074422).

Reagent-Free IC with Electrolytic Sample Preparation (RFIC-ESP™)

RFIC-ESP systems enable a range of automated sample preparation techniques which use proprietary electrolytic devices to provide reduced cost and higher value analyses.

RFIC-ESP devices and techniques can be used for removing cations from an anion sample before analysis by using a Dionex CR-TC device, or neutralizing a strongly acidic or basic solution—25% phosphoric acid or sodium hydroxide solutions, for example—with an AutoNeutralization™ device. An Electrolytic Water Purifier is available which provides water of extremely high purity (backgrounds below sub ng/L levels are possible) for use in trace-level analytical work where use of a concentrator column is necessary.

Dionex ICS-5000 Detector/Chromatography Module (DC)

The DC provides a temperature-controlled environment for Dionex ICS-5000 chromatography components. The DC can accommodate components for two channels, plumbed either serially or in parallel.

The following components may be installed in the DC:

- Conductivity detectors
- Electrochemical detectors
- Injection valves
- Switching valves
- Guard and separator columns
- Suppressors
- Dionex IC Cubes or Dionex ICS-5000 Automation Manager

Dionex ICS-5000 Conductivity Detector (CD)

The CD is a modular detector with an integrated cell. The CD has a signal range up to 15,000 µS and supports high background, nonsuppressed applications. The CD is installed in the upper compartment of the DC. For a dual-system, two CDs can be installed.

Dionex ICS-5000 Electrochemical Detector (ED)

The ED is a modular detector and a modular cell. The ED supports multiple waveforms, multiple integration times, and post-analysis data manipulation. With Chromeleon 6.8, the ED is also capable of providing 3D amperometry data. The ED cell can be configured with gold, silver, platinum, carbon, or glassy carbon working electrodes. The ED is installed in the upper compartment of the DC. For a dual-system, two EDs can be installed.

Capillary IC

Dionex IC Cube (IC Cube)

The IC Cube houses components for running capillary IC applications. Each IC Cube includes an injection valve, a column heater, and removable cartridges containing capillary IC components. Cartridges for the following components are available: carbonate removal device (CRD), suppressor, guard and separator columns, and EG degasser. The IC Cube is installed in the

upper compartment of the DC. For a dual-system, two IC Cubes can be installed.

Analytical IC

Dionex ICS-5000 Automation Manager (AM)

The AM consists of a component mounting panel on a base tray. The AM provides mounting sites for sample preparation and post-column application components: high-pressure (switching) valves, low-pressure (solenoid) valves, reaction coils, etc. The AM is installed in the upper compartment of the DC, above the detector.

Analytical IC

Dionex ICS-5000 Thermal Compartment (TC)

The TC provides a temperature-controlled environment for Dionex ICS-5000 chromatography components. The TC is intended for applications that do not require conductivity or electrochemical detection.

The TC is available in four configurations:

- With one 2-position, 6-port high-pressure injection valve
- With two 2-position, 6-port high-pressure injection valves
- With one 2-position, 6-port high-pressure injection valve and one 2-position, 10-port high-pressure injection valve
- With no injection valves

An optional temperature stabilizer (standard bore, P/N 064548; microbore, P/N 064650) can be installed inside the TC, if necessary. The temperature stabilizer brings the eluent to the column temperature before it enters the column.

Dionex AS-AP Autosampler (AS-AP)

The AS-AP provides high-performance, automated sample processing for ion chromatography applications. Key features of the AS-AP include:

- Excellent reproducibility with RSDs less than 0.3% for full-loop injections
- All-PEEK™ flow paths, compatible with aqueous and reversed-phase eluents, safe from metal contamination

- Carousel and moving-needle design to guarantee reliable sampling from a variety of vial sizes and well plates
- 10 mL polystyrene sample vials with wide openings for large-volume injections and trace analysis
- High sample capacity, from 81 (10 mL vials) to 1152 (three 384-position well plates)
- Sample preparation function to automate sample and standard preparations, saving time and labor

Optional features of the AS-AP include sample tray temperature control, simultaneous injections, sequential injections, sample preparation, or fraction collection and reinjection, and 6-port or 10-port valves.

Dionex AS-DV Autosampler

The AS-DV is a basic autosampler that is capable of delivering between 0.1 and 5.0 mL of sample (in 0.1 mL increments) to the sample loop or concentrator column in an ion chromatography system.

The Dionex ICS-5000 holds 50 vials (either 0.5 mL or 5.0 mL, or a combination of the two sizes). Vials can be sampled in any order and multiple samples can be taken from each vial. The Dionex AS-DV remembers the vial size and volume delivered for each vial position, allowing multiple samples to be taken from a vial non-sequentially.

Dionex AS Autosampler (AS)

The AS is a powerful, full-featured autosampler that precisely delivers from 1.0 to 100 µL (in 0.1 µL increments) or 100 to 8000 µL (in 1 µL increments) of sample to an injection valve. In addition to the normal mode, the autosampler can operate in several other modes, including concentrate, simultaneous, and sequential injections.

Dionex ICS Series Photodiode Array Detector (PDA)

The PDA optical detector is capable of measuring the absorbance spectrum from 190 to 800 nm. A deuterium lamp optimizes the UV range (190 to 380 nm) and a tungsten lamp optimizes the visible range (380 to 800 nm).

The PDA enables you to collect up to five single wavelengths (2D chromatograms) without being required to collect 3D data. Collecting

chromatograms at individual wavelengths instead of from spectra offers two advantages: it eliminates the need to perform extractions for chromatograms that do not require spectral data and it conserves disk space.

Dionex ICS Series Variable Wavelength Detector (VWD)

The VWD is a dual-beam, variable wavelength photometer with one measurement and one internal reference beam. Spectral capability from 190 to 900 nm is provided by two light sources: a deuterium lamp for ultraviolet detection and a tungsten lamp for visible wavelength operation. The four-channel detector measures at up to four wavelengths simultaneously. The VWD contains a built-in holmium oxide filter for wavelength verification. To suppress higher-order radiation, two optical filters can be inserted (automatically) into the light path.

MSQ Plus Mass Spectrometer

The MSQ Plus is an advanced analytical instrument that includes an MS detector, vacuum pumps, and data system. When integrated with an IC system, the MSQ Plus provides the separation capability of an IC and the detection capability of a single-quadrupole MS detector. This provides a strong starting point for sample analysis by offering a quick and clear mass identification for chromatographic peaks.

The MS detector contains an atmospheric pressure ionization (API) source, advanced high efficiency transmission ion optics of a square quadrupole RF lens and dual RF generators, a mass analyzer, and an ion detection system. An optional cone wash pump is available for improved performance when dealing with dirty matrices.

The MS detector is equipped with FastLock™ probes for two complementary ionization techniques: atmospheric pressure chemical ionization (APCI) and electrospray ionization (ESI).

During a scan, ions of selected mass-to-charge ratios are sequentially transmitted through a quadrupole mass filter analyzer. The MS detector can perform both full-range scans and selected ion monitoring (SIM) scans.

1.1.2 Dionex ICS-5000 System Control

The Dionex ICS-5000 system is controlled by a PC configured with Thermo Scientific Dionex Chromeleon™ 7 Chromatography Data System (release 7.0 SR1 or later) or Thermo Scientific Dionex Chromeleon 6.8 Chromatography Data System (release 6.8 SR9a or later). Chromeleon 7 and Chromeleon 6.8 provide complete instrument control, data acquisition, and data management.

Optionally, the Dionex ICS-5000 system can be controlled by a PC configured with Chromeleon Xpress. Chromeleon Xpress provides real-time control and monitoring of Dionex chromatography instruments, but does not include data management capabilities.

In Chromeleon 7, an *ePanel Set* provides centralized system control. You can use the ePanel Set to view system status information and issue commands for controlling each module. In Chromeleon 6.8, these functions are available on a *panel tabset*. In both the ePanel Set and the panel tabset, a convenient **Home** panel shows the overall system status and provides basic module control functions. Individual tabs provide quick access to additional functions for each module and detailed status and diagnostics functions. Figure 1-2 shows

the Home panel in Chromeleon 7 and Figure 1-3 shows the Home panel in Chromeleon 6.8

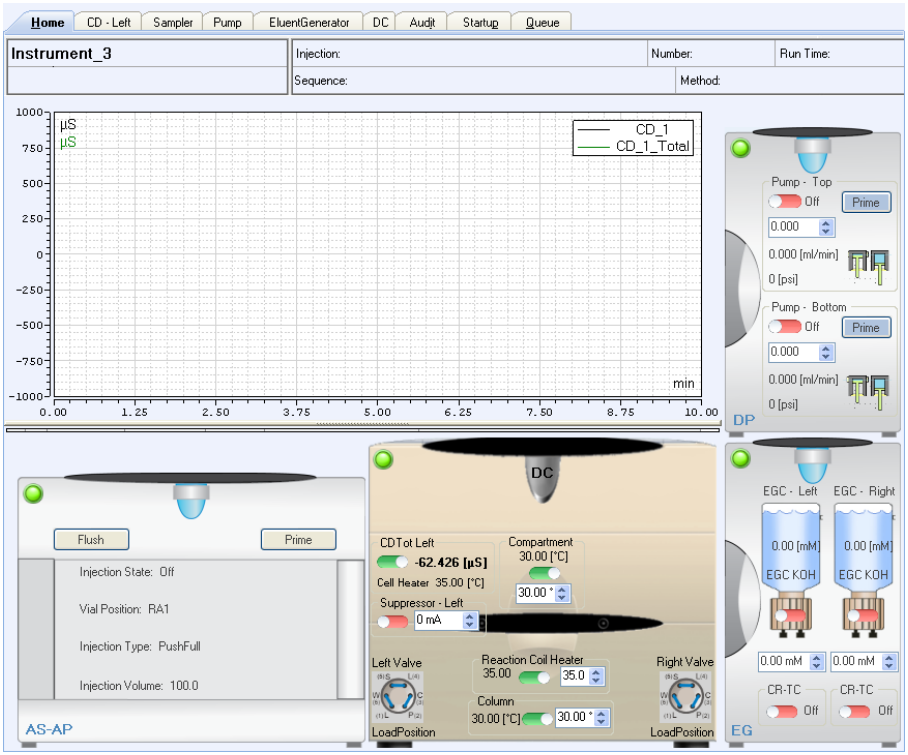


Figure 1-2. *Chromeleon 7 ePanel Set (Dionex ICS-5000 Home Panel Shown)*

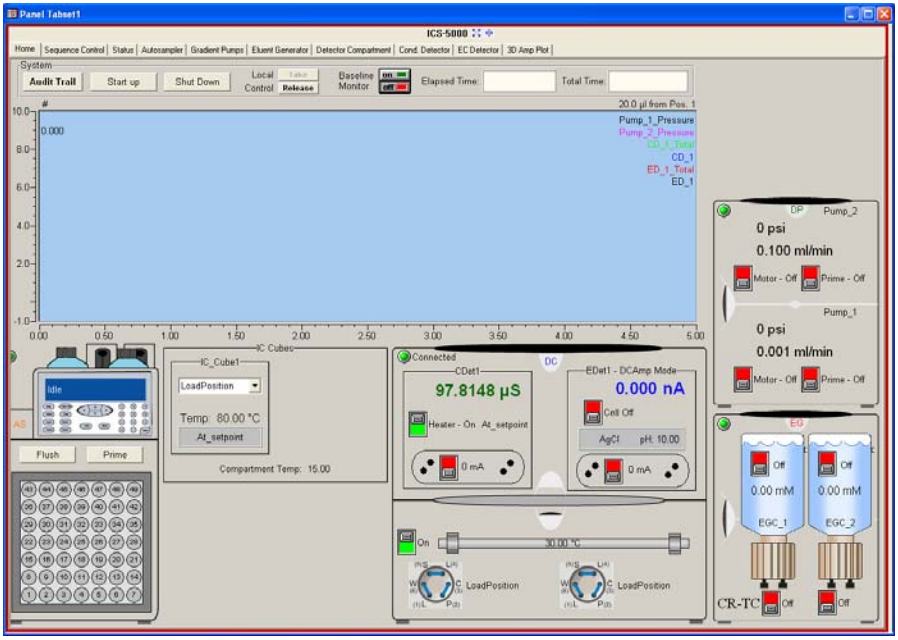


Figure 1-3. *Chromeleon 6.8 Panel Tabset (Dionex ICS-5000 Home Panel Shown)*

1.2 Dionex ICS-5000 System Documentation

Every effort has been made to provide complete and accurate user documentation for the Dionex ICS-5000 system. The table below lists the primary sources of product information and the formats in which information is available.

Source	Part Number	PDF File	Printed Manual
Thermo Scientific Dionex ICS-5000 Ion Chromatography System Operator's Manual	065342	Yes	No
Installing the Thermo Scientific Dionex ICS-5000 Ion Chromatography System	065343	Yes	Yes
Dionex AS Autosampler Operator's Manual	065051	Yes	No
Dionex ICS Series Photodiode Array Detector Operator's Manual	065147	Yes	No
Dionex ICS Series Variable Wavelength Detector Operator's Manual	065141	Yes	No
Chromeleon 7 Installation Guide	071686	Yes	Yes
Chromeleon 7 Quick Start Guide	071679	Yes	Yes
Chromeleon 7 online Help	N/A	N/A	N/A
Chromeleon 6.8 Software User's Guide	4829.5060	Yes	No
Installing the Chromeleon 6.8 Chromatography Management System with a Dionex Ion Chromatograph (IC)	031883	Yes	No
Chromeleon 6.8 online Help	N/A	N/A	N/A

All Adobe® PDF files listed above are shipped on the Thermo Scientific Reference Library DVD (P/N 053891), which is included in the ship kit of each Dionex ICS-5000 system module. In addition, the software manuals are provided as PDF files on the Chromeleon DVD. A printed copy of the software installation instructions is provided in the software ship kit.

Consumables documentation: For complete information about columns, suppressors, eluent generator cartridges, etc., refer to the appropriate product manual. These manuals are provided on the Reference Library DVD.

1.3 The Dionex ICS-5000 System Operator's Manual

The electronic version (i.e., PDF file) of the Dionex ICS-5000 system operator's manual contains numerous links that you can click to go to other locations within the manual. These links include:

- Table of contents entries
- Index entries
- Cross-references (underlined in blue) to sections, figures, tables, etc.

If you are not familiar with how to navigate PDF files, refer to the Help system for Adobe® Acrobat® or Adobe Reader® for assistance.

Chapter 1 Introduction	An overview of the Dionex ICS-5000 system; includes a brief description of the Dionex ICS-5000 modules, the software required for Dionex ICS-5000 operation, and the Dionex ICS-5000 user manuals.
Chapter 2 Description	Detailed descriptions of Dionex ICS-5000 system components and important operating features; includes an introduction to Chromeleon software.
Chapter 3 System Configurations	Detailed illustrations of component plumbing for several Dionex ICS-5000 system configurations.
Chapter 4 Getting Started	Tasks to be performed before beginning operation of the Dionex ICS-5000 system.
Chapter 5 Operation	Instructions for routine operation of the Dionex ICS-5000 system.
Chapter 6 Shutdown	Short-term and long-term shutdown procedures for the Dionex ICS-5000 system.
Chapter 7 Maintenance	Routine preventive maintenance procedures for the Dionex ICS-5000 system.

Chapter 8 Troubleshooting	List of Chromeleon Audit Trail error messages and a list of minor problems that may occur during operation of the Dionex ICS-5000 system. The possible cause of each message or problem and the corrective action to take is included.
Chapter 9 Service	Instructions for routine service and parts replacement procedures the user can perform for the Dionex ICS-5000 system.
Appendix A Specifications	Specifications and installation site requirements for the Dionex ICS-5000 modules.
Appendix B Reordering Information	Spare parts for the Dionex ICS-5000 modules.

1.4 Safety and Regulatory Information

The Thermo Scientific Dionex ICS-5000 Ion Chromatography System was manufactured by Thermo Fisher Scientific Corporation at the following location: 527 Lakeside Drive, Sunnyvale, CA 94088-3603 U.S.A. The Dionex ICS-5000 system is designed for IC (ion chromatography) and HPLC (high-performance liquid chromatography) applications and should not be used for any other purpose. Operation of a Dionex ICS-5000 module in a manner not specified by Thermo Fisher Scientific may result in personal injury.

If there is a question regarding appropriate usage, contact Technical Support for Dionex products. In the U.S. and Canada, call 1-800-346-6390. Outside the U.S. and Canada, call the nearest Thermo Fisher Scientific office.

1.4.1 Safety Messages and Notes

This manual contains warnings and precautionary statements that can prevent personal injury and/or damage to the Dionex ICS-5000 system when properly followed. Safety messages appear in bold type and are accompanied by icons, as shown below.

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. Also used to identify a situation or practice that may seriously damage the instrument, but will not cause injury.

IMPORTANT

Indicates that the function or process of the instrument may be impaired. Operation does not constitute a hazard.

Messages d'avertissement en français

Signale une situation de danger immédiat qui, si elle n'est pas évitée, entraînera des blessures graves à mortelles.

Signale une situation de danger potentiel qui, si elle n'est pas évitée, pourrait entraîner des blessures graves à mortelles.

Signale une situation de danger potentiel qui, si elle n'est pas évitée, pourrait entraîner des blessures mineures à modérées. Également utilisé pour signaler une situation ou une pratique qui pourrait gravement endommager l'instrument mais qui n'entraînera pas de blessures.

Warnhinweise in Deutsch

Bedeutet unmittelbare Gefahr. Mißachtung kann zum Tod oder schwerwiegenden Verletzungen führen.

Bedeutet eine mögliche Gefährdung. Mißachtung kann zum Tod oder schwerwiegenden Verletzungen führen.

Bedeutet eine mögliche Gefährdung. Mißachtung kann zu kleineren oder mittelschweren Verletzungen führen. Wird auch verwendet, wenn eine Situation zu schweren Schäden am Gerät führen kann, jedoch keine Verletzungsgefahr besteht.

Notes

Informational messages also appear throughout this manual. These are labeled NOTE and are in bold type:

NOTE NOTES call attention to certain information. They alert you to an unexpected result of an action, suggest how to optimize instrument performance, etc.

Capillary IC Sections preceded with the Capillary IC flag indicate that the information in the section applies to capillary IC systems only.

Analytical IC Sections preceded with the Analytical IC flag indicate that the information in the section applies to analytical IC systems only.

If a section is not flagged, the information in the section applies to both capillary IC and analytical IC systems.

1.4.2 Safety Symbols

These symbols appear on the Dionex ICS-5000 modules or on labels affixed to the modules:

Alternating current

Primary protective conductor terminal

Secondary protective conductor terminal

Power supply is on

Power supply is off

Indicates a potential hazard. Refer to this operator's manual for an explanation of the hazard and how to proceed.

1.4.3 Declaration of Conformity

The cETLus or cTUVus and CE marks on the model/data labels on each Dionex ICS-5000 module indicate that the modules are in compliance with the following standards.

DIONEX

MANUFACTURERS
DECLARATION OF CONFORMITY

Product Identification

Product:	Ion Chromatography System
Brand:	Dionex
Model:	ICS-5000 DC, SP, DP, EG,TC

Manufacturer
Dionex Corporation
1228 Titan Way
Sunnyvale, California 94088
USA

Representative
Larry McNary
Dionex Corporation
1228 Titan Way
Sunnyvale, CA, USA 94085

Function: Director, Engineering

Means of conformity
The product(s) listed above are in conformity to the following listed directives and standards. All products were tested and evaluated to the corresponding current standard based on the date this document was signed.

Low Voltage/Safety Directive:	2006/95/EC
EMC Directive:	2004/108/EC
Safety Standards:	EN 61010-1 UL 61010-1 CAN/CSA-C22.2 No. 61010-1
EMC Standards:	EN 61326 –1

Signature of Representative: Larry McNary

Name: Larry McNary
Place: Sunnyvale, CA, USA
Date: 28 MAY.2010

1.5 Deionized Water Requirements for IC

For eluent generation or when manually preparing eluent and regenerant, use ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Table 1-1.

Contaminant	Specification
Ions–Resistivity	>18.0 (megohm-cm)
Organics–TOC	<10 ppb
Iron/Transition Metals*	<1 ppb
Pyrogens	<0.03 (Eu/mL)
Particulates > 0.2 µm	<1 (units/mL)
Colloids–Silica	<10 ppb
Bacteria	<1 (cfu/mL)
* Iron/transition metal content not specified for ASTM Type I Water	

Table 1-1. *ASTM Filtered, Type I Deionized Water Specifications for Ion Chromatography*

ICS-5000 DP/SP

DP/SP Description

2.1 DP/SP Front Features

A status bar on the front of the Dionex ICS-5000 Dual Pump (DP) and Dionex ICS-5000 Single Pump (SP) includes buttons for controlling certain pump functions, as well as LEDs (light emitting diodes) that indicate the status of several pump functions (see Figure 2-1 and Figure 2-2).

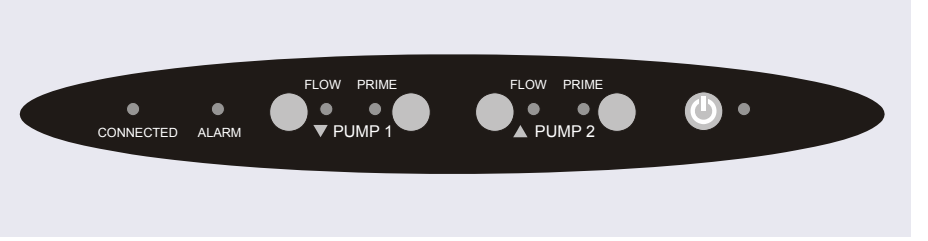


Figure 2-1. *DP Status Bar*

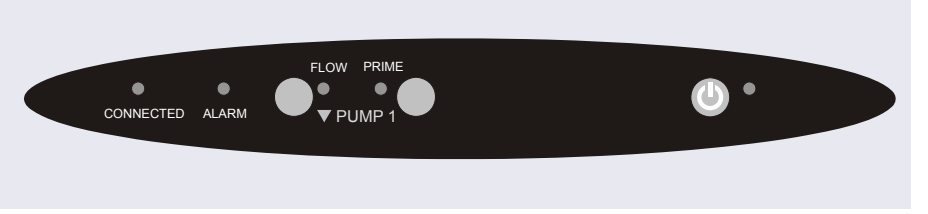


Figure 2-2. *SP Status Bar*

Button/LED Label	If the LED Is On	If the LED Is Flashing
CONNECTED	The DP/SP is connected to a Chromeleon 7 instrument or Chromeleon 6.8 timebase.	Does not flash.
ALARM	A DP/SP-related problem has occurred (for example, a pressure limit was activated). Check the Chromeleon Audit Trail for the cause.	Does not flash.
PUMP 1 FLOW* **PUMP 2 FLOW****	Use the **FLOW** button to start and stop the pump flow. The LED indicates when the flow is on.	Does not flash.
PUMP 1 PRIME* **PUMP 2 PRIME****	Use the **PRIME** button to prime the pump (see Section 9.5). The LED indicates whether the pump is being primed.	The pump is being primed.
POWER	Use this **POWER** button for routine on/off control of the DP/SP. When the power is on, this LED is lighted. To turn off the DP/SP, press and hold this **POWER** button for 2 seconds. **Note:** The main power switch is on the rear panel.	Does not flash.

* Pump 1 is always installed in the lower half of the DP/SP enclosure.
** This button is not present on the SP.

2.2 DP/SP Interior Components

The pump's mechanical components are located directly behind the front door of the module. Figure 2-3 shows the mechanical components of a DP that contains a gradient analytical pump (pump 1) and an isocratic capillary pump (pump 2). Figure 2-4 identifies the pump components that are unique to a gradient analytical pump.

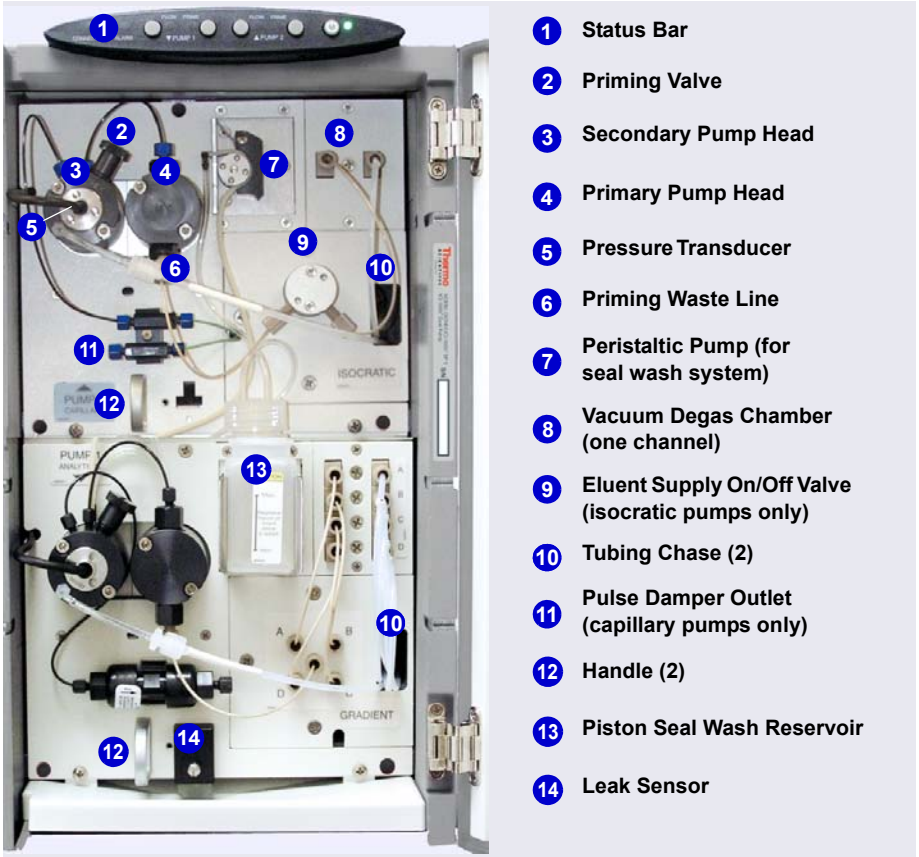


Figure 2-3. *Example DP Interior Components:*
Pump 1: Analytical Gradient Pump
Pump 2: Capillary Isocratic Pump

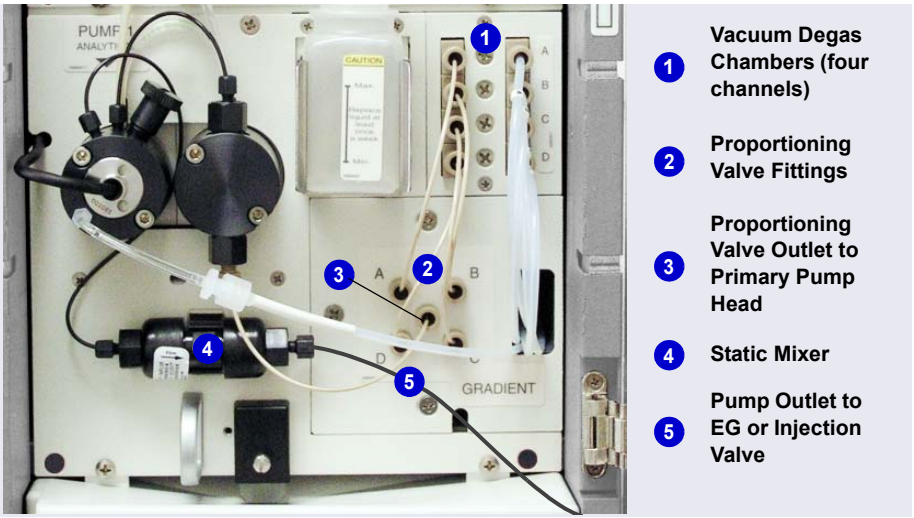


Figure 2-4. *Analytical Gradient Pump Components*

NOTE For easier access to pump components when performing service procedures, the pump panel can be pulled forward to the front of the pump compartment. First, make sure that the five red Phillips screws are removed from the component panel. Then, use the handles to pull the panel forward. The upper and lower component panels slide forward together.

2.2.1 Pump Heads

The DP/SP is a low-pulsation, serial dual-piston pump with electronic compressibility compensation. Two pump heads—a *primary* head and a *secondary* head—are connected in series. Eluent passes through both pump heads in succession.

The primary pump head delivers eluent at the selected flow rate, while simultaneously filling the secondary pump head. The latter serves as a reservoir and delivers eluent while the primary head carries out the refill stroke.

The characteristic feature of the patented isokinetic pre-compression phase is the programmed overlapping of the delivery strokes of the two pump heads. When delivering compressible liquids without controlled pre-compression,

the pulsation increases as the operating pressure increases, because part of the delivery stroke is required to compress eluent in the pump head.

During the pre-compression phase, pulsation is minimized. A patented secondary control system (automatic compressibility compensation) ensures highly constant eluent delivery. The flow rate remains constant in relation to the pressure.

2.2.2 Pressure Transducer

The secondary pump head contains a built-in pressure transducer to measure the system pressure. The DP/SP instrument control firmware installed in the pump precisely controls the pump motor speed to ensure flow rate accuracy and to maintain constant flow and constant pressure.

Analytical IC

2.2.3 Proportioning Valves (Gradient pump only)

In the gradient pump, which is available for analytical IC applications only, eluent flows from the eluent reservoirs, through the vacuum degas chambers, and into a four-way proportioning valve assembly (see Figure 2-4). Programmed percentages of each eluent are proportioned by the four valves.

2.2.4 Vacuum Degassing Module

The DP/SP vacuum degassing module provides continuous, online eluent degassing. Eluent quality significantly affects DP/SP performance, and vacuum degassing eluents is one way to ensure high eluent quality.

Degassing helps prevent bubbles (caused by eluent outgassing) from forming in the eluent proportioning valves (gradient pump only), pump heads, and detector cell. Degassing eluents is especially important when combining aqueous and nonaqueous components (for example, water and acetonitrile).

The vacuum degassing module is either single-channel (in an isocratic pump) or quad-channel (in a gradient pump). The module consists of:

- A degas chamber (with degassing membranes) with internal capacity of 670 µL per channel
- A dual-stage diaphragm vacuum pump
- An on-board vacuum sensor

- The electronics required to operate the vacuum pump
- Tubing, fittings, and other accessories

The vacuum degassing module is automatically activated when the DP/SP power is turned on. Allow about 10 minutes for the module to equilibrate.

NOTE Make sure the run time is long enough to ensure that the vacuum degassing module delivers the optimal degassing performance.

Manual Control of the Vacuum Degassing Module

The vacuum degassing module normally remains on continuously. To turn it off (for example, to investigate a leak), follow these steps:

1. Open the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset.
2. Press the **F8** key to open the Commands dialog box.
3. Select the pump name.
4. Select the **Degasser** property and select **Off**.
5. For Chromeleon 6.8, click **Execute**.
6. To turn on the degasser again, select **On**.

2.2.5 Piston Seal Wash System

The piston seal wash system consists of a peristaltic pump, a reservoir containing wash solution, and the connecting tubing. The wash solution is usually ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5.

When seal washing is activated, the back of the main piston seal is rinsed with wash solution; this prolongs seal lifetime by preventing eluent crystallization on the piston surfaces.

Notes About the DP Piston Seal Wash System

The piston seal wash system is designed for use with only one of the two pumps in a DP module. When the DP is shipped from Thermo Fisher Scientific, the seal wash system is connected to pump 1 (the bottom pump). If

necessary, connect the seal wash system to pump 2 (the top pump), instead. For instructions on how to replumb the system, refer to Section 4.7.

NOTE For users who need to operate a piston seal wash system for both pumps in the DP, Thermo Fisher Scientific offers an External Seal Wash Kit (P/N 063518) or a second seal wash system (P/N 068661).

Analytical IC

2.2.6 Static Mixer (Analytical IC only)

For an analytical pump, a GM-3 or GM-4 static mixer is installed after the secondary pump head (see Figure 2-3). In the gradient pump, the mixer helps to ensure that proportioned eluents are mixed thoroughly. In the isocratic pump, the mixer is optional, but can function as a pulse damper.

The DP/SP gradient delay volume is 600 µL when a GM-3 is installed and 380 µL when a GM-4 is installed. The gradient delay volume (or *dwell volume*) is the volume of liquid in the system between the point where the gradient is formed and the point where it enters the column. This includes the mixer, transfer tubing, and swept volume in the injector or autosampler.

Capillary IC

2.2.7 Pulse Damper (Capillary IC only)

For a capillary pump, flow output from the pressure transducer continues to the pulse damper, which smooths minor pressure variations. From there, flow is directed to the injection valve and then to the remainder of the chromatography system.

2.3 DP/SP Flow Schematics

2.3.1 Isocratic Pump Flow Schematic

Figure 2-5 illustrates the liquid flow path through an isocratic pump.

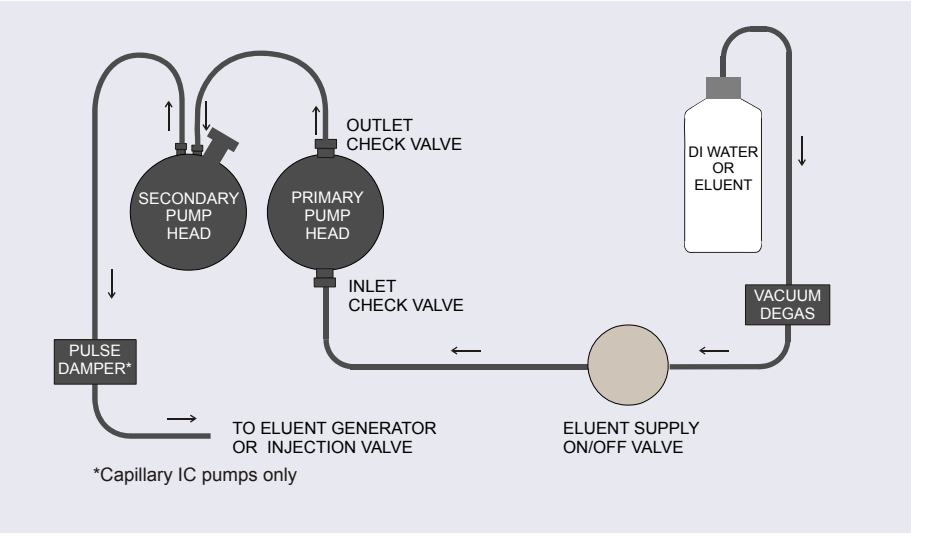


Figure 2-5. *Isocratic Pump Flow Schematic*

- Eluent flows from the reservoir, through the vacuum degas chamber, through the eluent supply on/off valve, and into the inlet check valve on the primary pump head.
- The inlet check valve opens, drawing eluent into the primary pump head. At the same time, the secondary piston pushes forward, pushing eluent into the system. After completing the intake, the primary piston pushes eluent through the outlet check valve and into the secondary pump head.
- Flow exits the secondary pump head and is directed to the eluent generator (if installed) or injection valve and then to the remainder of the chromatography system.

2.3.2 Gradient Pump Flow Schematic

Figure 2-6 illustrates the liquid flow path through a gradient pump.

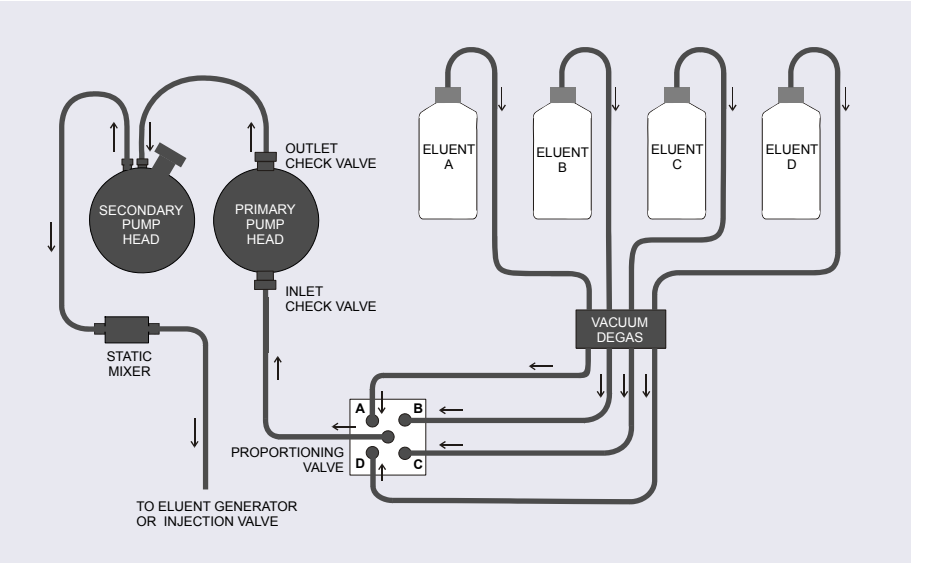


Figure 2-6. *Gradient Pump Flow Schematic*

- Eluent flows from the reservoirs and through the vacuum degas chambers. The selected proportions of eluent flow out of the proportioning valve assembly and into the inlet check valve on the primary pump head.
- The inlet check valve opens, drawing eluent into the primary pump head. At the same time, the secondary piston pushes forward, pushing eluent into the system. After completing the intake, the primary piston pushes eluent through the outlet check valve and into the secondary pump head.
- Flow exits the secondary pump head, continues through the static mixer, and is then directed to the eluent generator (if installed) or injection valve and then to the remainder of the chromatography system.

2.4 DP/SP Rear Panel

Figure 2-1 illustrates the rear panel of the DP/SP.

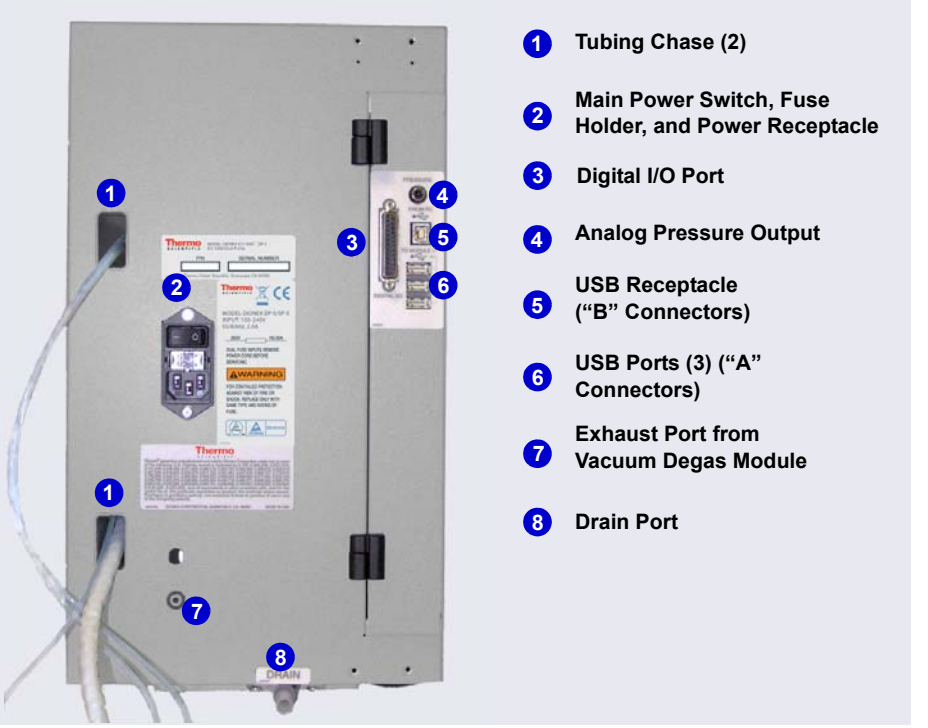


Figure 2-7. *DP/SP Rear Panel*

Tubing Chases

The tubing chases route tubing from the front of the DP/SP, through the interior of the module, and to the rear panel.

Main Power Switch, Fuse Holder, and Power Receptacle

The rear panel power switch is the main power switch for the DP/SP. Turn on the main power switch before initial operation and leave it on unless instructed to turn it off (for example, before performing a service procedure).

NOTE For routine on/off control, use the **POWER** button on the front of the DP/SP (see Figure 2-1 and Figure 2-2). To turn off the pump, press and hold the **POWER** button for 2 seconds.

The fuse cartridge contains two 2-amp IEC 60127-2 slow-blow fuses (P/N 954773). For instructions on how to change the fuses, see Section 9.11.

The power cord plugs into the IEC 320 three-prong receptacle.

The power supply cord is used as the main disconnect device. Make sure the socket-outlet is located near the DC and is easily accessible.

Le cordon d'alimentation principal est utilisé comme dispositif principal de débranchement. Veillez à ce que la prise de base soit située/installée près du module et facilement accessible.

Das Netzkabel ist das wichtigste Mittel zur Stromunterbrechung. Stellen Sie sicher, daß sich die Steckdose nahe am Gerät befindet und leicht zugänglich ist.

Digital I/O Port

The digital I/O port provides a connection to auxiliary devices. The connector includes three TTL inputs and four relay outputs. Table 2-1 indicates the functions assigned to the connector pins.

IMPORTANT **The maximum switching voltage of the relays is 24 V. The switching current must not exceed 100 mA.**

Pin Number	Signal Name	Signal Level	Description
1	-----	-----	Not used
2	-----	-----	Not used
3	Relay 3 Out	Potential-free	Normally open
4	Relay 1 Out	Potential-free	Normally closed
5	Relay 2 Out	Potential-free	Normally closed
6	Relay 3 Out	Potential-free	Normally closed
7	Relay 1 Out	Potential-free	Common

Table 2-1. *25-Pin D-Sub I/O Port (Female)*

Pin Number	Signal Name	Signal Level	Description
8	Relay 2 Out	Potential-free	Common
9	Gnd	Ground	Ground
10	Gnd	Ground	Ground
11	Gnd	Ground	Ground
12	Gnd	Ground	Ground
13	-----	-----	Not used
14	Relay 4 Out	Potential-free	Normally open
15	Relay 4 Out	Potential-free	Common
16	Relay 4 Out	Potential-free	Normally closed
17	-----	-----	Not used
18	Relay 3 Out	Potential-free	Common
19	Relay 1 Out	Potential-free	Normally open
20	Relay 2 Out	Potential-free	Normally open
21	Vcc Out	+5V	+5V, 500 mA
22	TTL Input 1	TTL	Hold/Run
23	TTL Input 2	TTL	Stop
24	TTL Input 3	TTL	Start
25	-----	-----	Not used

Table 2-1. *25-Pin D-Sub I/O Port (Female) (Continued)*

Analog Pressure Output

The analog pressure output indicates the operating pressure of the pump. The pressure output is set to 50 mV/MPa (5 mV/14.51 psi). To monitor the pressure, connect the pressure output to a recorder or an A/D converter. These are the pin assignments for the 2-pin Cinch connector (P/N 8005.9001A):

Signal Level	Function
Inner ring:	Signal (pressure)
Outer ring:	Ground

The analog pressure output defaults to the pump 1 (bottom pump) output signal. To redirect the output to pump 2 (the top pump), follow these steps:

1. Open the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset.
2. Press the **F8** key to open the Commands dialog box.
3. Select the pump name.
4. Select the **AnalogOut** property and select **PumpTop**. For Chromeleon 6.8, click **Execute**.

USB Connections

- One USB receptacle ("B" type connector) allows a connection from the PC on which Chromeleon is installed.
- Three USB (Universal Serial Bus) ports ("A" type connectors) are provided for connections to other Dionex ICS-5000 modules.

One 1.8 m (6 ft) USB cable (P/N 960777) is provided in the pump ship kit:

Pump Ship Kit	Part Number
DP Ship Kit Dual Capillary	072112
DP Ship Kit Dual Analytical	062463
DP Ship Kit Capillary and Analytical	072111
SP Ship Kit Capillary or Analytical	063342

Waste and Drain Lines

- One waste line is connected to the secondary pump head on each pump and is routed through the tubing chace to the rear of the DP/SP.
- The drain port removes any liquid that collects in the drip tray in the bottom of the DP/SP. A clear corrugated drain hose (P/N 055075) is connected to this port during installation.

Place the free ends of the waste lines and drain hose into a waste container. To maintain a positive siphon, position the waste container below the level of the pump.

IMPORTANT **For correct drainage, make sure the waste lines and drain hose are not bent, pinched, or elevated at any point. Do not allow the ends of the lines to be submerged in waste liquid.**

2.5 Eluent Reservoirs

The following reservoirs are available for use with the DP/SP:

- 1-liter plastic reservoir (P/N 063291)
- 2-liter plastic reservoir (P/N 062510)
- 4-liter plastic reservoir (P/N 063292)

Do not use the plastic reservoirs for offline vacuum degassing of eluents. The reservoirs were not designed for this purpose.

N'utilisez pas le réservoir en plastique pour le dégazage à vide hors ligne d'éluants. Le réservoir n'a pas été conçu à cette fin.

Verwenden Sie keine Plastikbehälter zum Offline Vakkum-Entgasen von Eluenten. Die Behälter sind dafür nicht ausgelegt.

2.5.1 EO (Optional)

The Dionex ICS-5000 Eluent Organizer (EO) holds eluent reservoirs in a liner that contains spills and leaks. Up to two EOs can be installed on top of the DC. Each EO accommodates up to four 1-liter or 2-liter reservoirs *or* up to two 4-liter reservoirs. The EO is typically ordered configured with four 2-liter reservoirs (P/N 072058).

2.5.2 Pressurizing Eluent Reservoirs

All eluent reservoirs available for use with the DP/SP can be pressurized. Although the DP/SP does not *require* pressurized reservoirs, Thermo Fisher Scientific recommends pressurizing reservoirs with helium or nitrogen under the following circumstances:

- When using eluents that are sensitive to contamination.

- When combining aqueous and nonaqueous components (for example, water and acetonitrile). Pressurizable reservoirs allow eluents to be stored under a specific atmosphere.

Never pressurize eluent reservoirs above 0.07 MPa (10 psi). Pressurizing reservoirs above this limit can cause the reservoir to explode.

Ne mettez jamais les réservoirs d'éluants sous une pression supérieure à 0,07 MPa (10 psi).

Setzen Sie den Eluentbehälter auf keinen Fall einem Druck über 0,07 MPa aus.

If you plan to pressurize the eluent reservoirs, an optional regulator kit is required. The kit is available in two versions:

- When the DC is installed as the topmost module in the system, the EO Regulator Kit (P/N 074422) is required. The kit includes a pressure regulator and gauge assembly with four outputs (for connections to four eluent reservoirs), as well as the tubing and connection fitting required.
- When the TC, VWD, or PDA is installed as the topmost module in the system, the TC/VWD/PDA Regulator Bracket Kit (P/N 074424) is required. The kit includes the EO Regulator Kit described above, as well as a right-angle regulator bracket and mounting hardware. After attaching the bracket to the TC or detector, you will mount the gas regulator assembly on the bracket.

If more reservoirs are required, order a second regulator (P/N 074423).

For instructions on installing the regulator kits, refer to *Thermo Scientific Dionex ICS-5000 Ion Chromatography System Installation Instructions* (Document No. 065343). The manual is included on the Thermo Scientific Reference Library DVD (P/N 053891).

2.5.3 Filtering Eluent

- Install an end-line filter (P/N 045987) on the end of each reservoir's eluent line. End-line filters are provided in the pump ship kit.
- A Dionex High-Pressure Inline Filter (P/N 044105) can be used to remove particulates down to 0.45 micron from eluent. Connect the inline filter between the pump outlet and the eluent inlet port on the injection valve. For details, see the instructions provided with the inline filter.

EG Description

2.6 EG Front Features

The status bar on the front of the Dionex ICS-5000 Eluent Generator (EG) includes buttons that provide control of certain EG functions, as well as LEDs that indicate the status of several EG functions (see Figure 2-8).

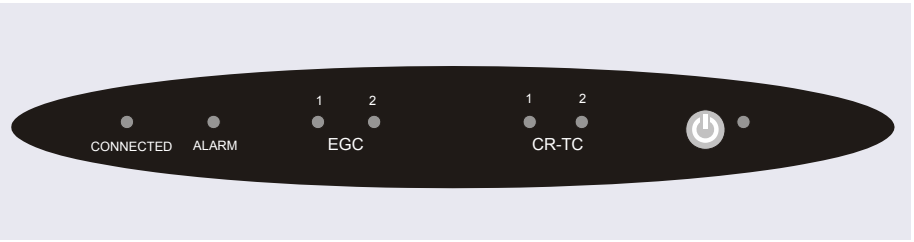


Figure 2-8. *EG Status Bar*

Button/LED Label	If the LED Is On	Comment
CONNECTED	The EG is connected to a Chromeleon 7 instrument or a Chromeleon 6.8 timebase.	-----
ALARM	An EG-related problem has occurred (for example, the eluent generator cartridge (EGC) was disconnected).	Check the Chromeleon Audit Trail for the cause.
EGC 1 **EGC 2**	The EGC is on and is generating eluent.	EGC 1 is always installed in the left section of the component compartment. EGC 2, if present, is installed in the right section of the compartment.
CR-TC 1 **CR-TC 2**	The CR-TC is on.	CR-TC 1 is always installed in the left section of the component compartment. CR-TC 2, if present, is installed in the right section of the compartment.

Button/LED Label	If the LED Is On	Comment
POWER	Use this **POWER** button for routine on/off control of the EG. When the power is on, this LED is lighted. To turn off the EG, press and hold this **POWER** button for 2 seconds.	The main power switch is on the EG rear panel.
NOTE: The EG status bar LEDs do not flash.		

2.7 EG Interior Components

The EG component compartment, which is located directly behind the front door, accommodates the components required for generating eluent in a single system or in both channels of a dual system. A component mounting panel divides the compartment into two sections.

- The left section is for a single-channel EG or for system 1 of a dual-channel EG.
- The right section is for system 2 of a dual-channel EG.

Each section holds the components for either a capillary IC or an analytical IC system. A dual-channel EG can hold components for two capillary IC systems, two analytical IC systems, or one system of each type.

Figure 2-9 shows the component panel for a capillary IC system. Figure 2-10 shows the component panel for an analytical IC system

To access components for maintenance or service procedures, push down on the slide release latch and pull the tray forward until it reaches the stop.

1 EGC (Capillary)

2 Chase for Electrical Cables

3 CR-TC (Capillary)

4 Leak Sensor

5 Drip Tray

6 Slide Release Latch

Note:
For a capillary IC system, the eluent degasser is installed in the IC Cube.

Figure 2-9. *Example EG Interior Components for a Capillary IC System (System 1 Shown)*

Figure 2-10. *Example EG Interior Components for an Analytical IC System (System 2 of a Dual-Channel EG Shown)*

Eluent Generator Cartridge (EGC)

Table 2-2 lists the versions of eluent generator cartridges available for use with the EG. Each EGC contains an electrolyte concentrate solution appropriate for the particular eluent generation. Each EGC is designed to be used in either a capillary IC system or an analytical IC system. An EGC designed for a capillary IC system cannot be used in an analytical IC system, and vice versa.

Analytical IC

Analytical IC systems require EGC III cartridges and (if used) the EPM III Electrolytic pH Modifier. Previous versions of EGC or EPM are not compatible with the Dionex ICS-5000 Eluent Generator.

EGC Version	Part Number	Function
Eluent Generator Cartridges for Capillary IC Systems		
EGC KOH (Capillary)	072076	Generates potassium hydroxide eluent for anion exchange separations.
EGC MSA (Capillary)	072077	Generates methanesulfonic acid eluent for cation exchange separations.
Eluent Generator Cartridges and Accessories for Analytical IC Systems		
EGC III K_2CO_3	074536	Generates potassium carbonate eluent for anion exchange separations.
EPM III Electrolytic pH Modifier	080135	Produces a carbonate/ bicarbonate mixture when installed with the EGC III K_2CO_3. Requires a carbonate mixer: P/N 061686 (4 mm); P/N 063443 (2 mm).
EGC III KOH	074532	Generates potassium hydroxide eluent for anion exchange separations.
EGC III LiOH	074534	Generates lithium hydroxide eluent for anion exchange separations.
EGC III MSA	074535	Generates methanesulfonic acid eluent for cation exchange separations.
EGC III NaOH	074533	Generates sodium hydroxide eluent for anion exchange separations.

Table 2-2. *Capillary and Analytical EGCs*

For more information, refer to the EGC manual. The manual is included on the Thermo Scientific Reference Library DVD (P/N 053891).

Continuously Regenerated Trap Column (CR-TC)

The CR-TC is a high pressure, electrolytically-regenerated trap column. The CR-TC is designed to remove anionic or cationic contaminants in the eluent or deionized water and to reduce drift during gradient separations. The following versions of the CR-TC can be used with the EG:

CR-TC Version	IC System Type	Part Number
Continuously Regenerated Anion Trap Column (Capillary); CR-ATC (Capillary)	Capillary	072078
Continuously Regenerated Cation Trap Column (Capillary); CR-CTC (Capillary)	Capillary	072079
Continuously Regenerated Anion Trap Column; CR-ATC	Analytical	060477
Continuously Regenerated Cation Trap Column; CR-CTC II	Analytical	060478

Figure 2-11. *Capillary and Analytical CR-TCs*

For more information, refer to the CR-TC manual. The manual is included on the Thermo Scientific Reference Library DVD (P/N 053891).

NOTE Do not install a CR-TC in the same channel as an EGC K_2CO_3 or an EPM III Electrolytic pH Modifier.

NOTE The Thermo Scientific Dionex IonPac™ ATC-HC Trap Column (P/N 059604) or Thermo Scientific Dionex IonPac CTC-1 Trap Column (P/N 040192) may be used with the EG. However, both Dionex IonPac trap columns require off-line chemical regeneration. Contact Thermo Fisher Scientific for more information.

RFIC Eluent Degasser

Analytical IC

For analytical IC systems, an RFIC Eluent Degasser (P/N 062137) is installed on the EG component mounting panel. The degasser contains a tubing assembly that purges the electrolysis gas from the freshly-generated eluent before it is directed to the separator column.

Capillary IC

For capillary IC systems, the degasser is installed in the IC Cube (see Section 2.11.2).

Backpressure Coil (Optional)

Analytical IC

For analytical IC systems, the EGC requires at least 14 MPa (2000 psi) of system backpressure for removal of electrolysis gas from the eluent produced by the cartridge. A system backpressure of 16 MPa (2300 psi) is ideal.

If necessary, increase the system backpressure by installing a backpressure coil between the injection valve and the EGC **OUTLET** port. For details, refer to Section 9.17.

EPM III Electrolytic pH Modifier and Carbonate Mixer

Analytical IC

The EGC III K_2CO_3 can be used with an EPM III Electrolytic pH Modifier (P/N 080135) and a carbonate mixer (P/N 061686, 4 mm; P/N 063443, 2 mm) to produce a carbonate/bicarbonate mixture for use with anion exchange separations on carbonate-based Dionex IonPac columns.

After the cartridge generates potassium carbonate eluent, the EPM adjusts the eluent concentration to produce the carbonate/bicarbonate mixture. The carbonate mixer provides mixing necessary to produce a homogenous solution of electrolytically-generated K_2CO_3 and $KHCO_3$ eluent.

For more information about these products, refer to the EGC manual. EGC manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).

Leak Sensor

If liquid collects in the drip tray in the bottom of the EG, a leak sensor reports the leak to Chromeleon, and an error message is displayed in the Audit Trail. In addition, the **Alarm** LED on the EG front panel lights.

Electrical Connections

Electrical connectors provide a connection from the components installed in the EG to the EG power supplies. There are two sets of electrical connectors (one per channel). Connections for the following components are provided:

- Two EGCs *or* one EGC and one EPM

  and

- Two CR-TCs

When operating with an EGC III K_2CO_3 and the EPM III, the EGC is connected to the EGC power supply for one channel and the EPM is connected to the EGC power supply for the second channel. Thus, the EG can accommodate only one such configuration.

2.8 EG Rear Panel

Figure 2-12 illustrates the rear panel of the Dionex ICS-5000 Eluent Generator (EG).

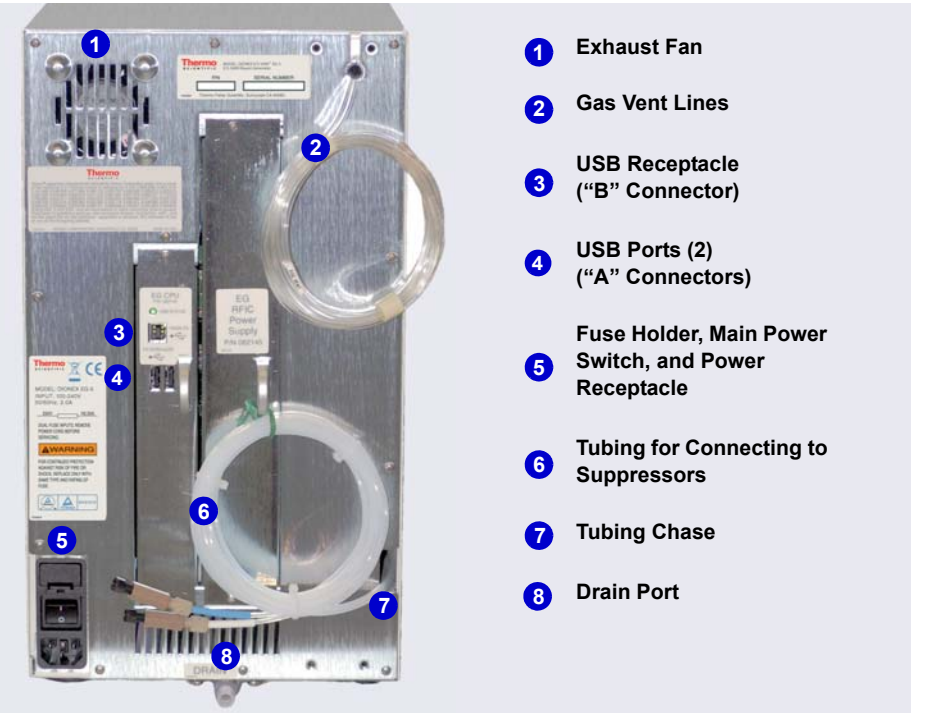


Figure 2-12. *EG Rear Panel*

Exhaust Fan

The exhaust fan cools the interior of the EG and exhausts any hydrogen and oxygen gases that escape during operation.

USB Connections

- One USB receptacle ("B" type connector) allows a connection from the PC on which Chromeleon is installed.
- Two USB (Universal Serial Bus) ports ("A" type connectors) are provided for connections to other Dionex ICS-5000 modules.

One 1.8 m (6 ft) USB cable (P/N 960777) is provided in the EG Ship Kit (P/N 072047).

Fuse Holder, Main Power Switch, and Power Receptacle

The fuse cartridge contains two 2-amp slow-blow fuses (P/N 954773). For instructions on how to change the fuses, see Section 9.18.

The rear panel power switch is the main power switch for the EG. Turn on the main power switch before initial operation and leave it on unless instructed to turn it off (for example, before performing a service procedure).

NOTE For routine on/off control, use the **POWER** button on the front of the EG (see Figure 2-8). To turn off the EG, press and hold the **POWER** button for 2 seconds.

The power cord plugs into the IEC 320 three-prong receptacle.

The power supply cord is used as the main disconnect device. Make sure the socket-outlet is located near the EG and is easily accessible.

Le cordon d'alimentation principal est utilisé comme dispositif principal de débranchement. Veillez à ce que la prise de base soit située/installée près du module et facilement accessible.

Das Netzkabel ist das wichtigste Mittel zur Stromunterbrechung. Stellen Sie sicher, daß sich die Steckdose nahe am Gerät befindet und leicht zugänglich ist.

Tubing Chase

The tubing chase routes tubing from the front of the EG, through the interior of the module, and to the rear panel.

Suppressor, Vent, and Drain Lines

- The lines exiting the tubing chase (white tubing) are for connecting the **REGEN IN** port on the RFIC Eluent Degasser or EPM III Electrolytic pH Modifier to the **REGEN OUT** port on the suppressor.
- The gas vent line (clear tubing) discharges the electrolysis gas (H_2 or O_2) that is vented from the electrolyte reservoir of the EGC.

- The drain port removes any liquid that collects in the drip tray in the bottom of the EG. A clear corrugated drain hose (P/N 055075) is connected to this port during installation.

Place the free ends of the vent lines and drain hose into a waste container. To maintain a positive siphon, position the waste container below the level of the EG.

IMPORTANT **For correct drainage, make sure the vent lines and drain hose are not bent, pinched, or elevated at any point. Do not allow the ends of the lines to be submerged in waste liquid.**

2.9 EG Flow Schematics

Liquid flows through the EG components in the following order:

- The pump delivers deionized water to the EGC. Direct current is applied to the EGC to produce eluent.
- The electrolytically-generated eluent flows to the CR-TC (which traps ionic contaminants) and then into the degasser.
- After exiting the degasser, the eluent flows through the backpressure coil (if installed), through the injection valve to the separator column, and finally to the detector cell.
- The detector cell effluent is directed through the suppressor regenerant chamber, to the degasser regenerant tubing, through the CR-TC regenerant chamber, and finally to waste.

The flow paths for a capillary IC and an analytical IC system are the same. However, in a capillary IC system, a degasser cartridge is located in the IC Cube inside the DC. In an analytical IC system, the degasser is located inside the EG.

Capillary IC Figure 2-13 illustrates the liquid flow path through an EG configured for a capillary IC system.

Analytical IC Figure 2-14 illustrates the liquid flow path through an EG configured for an analytical IC system.

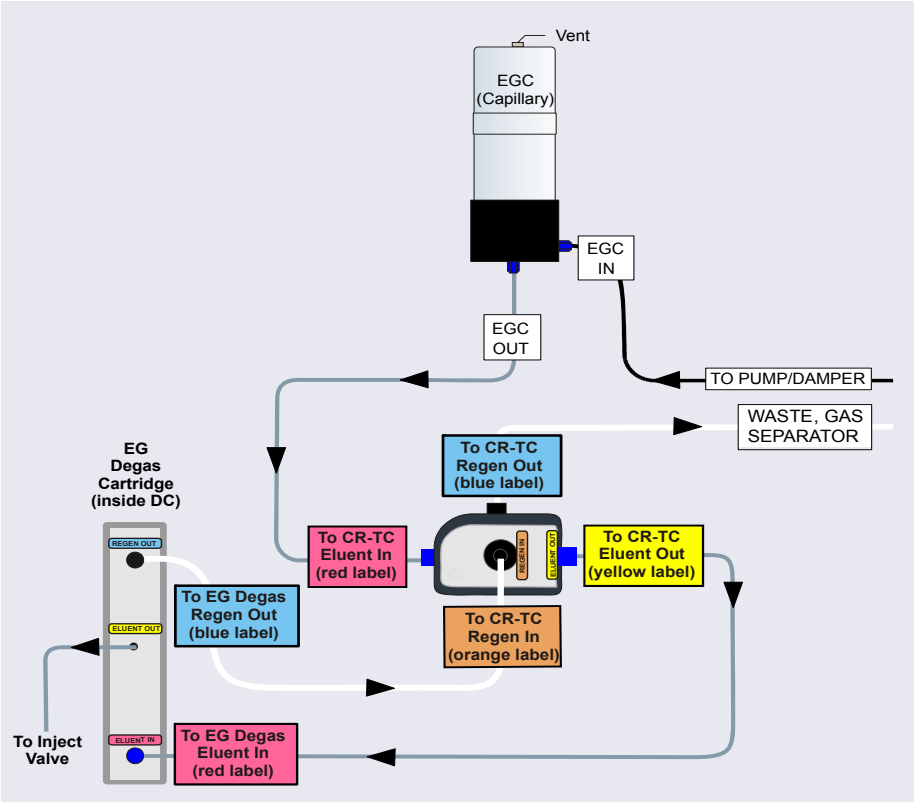


Figure 2-13. *EG Flow Schematic Example for Capillary IC*

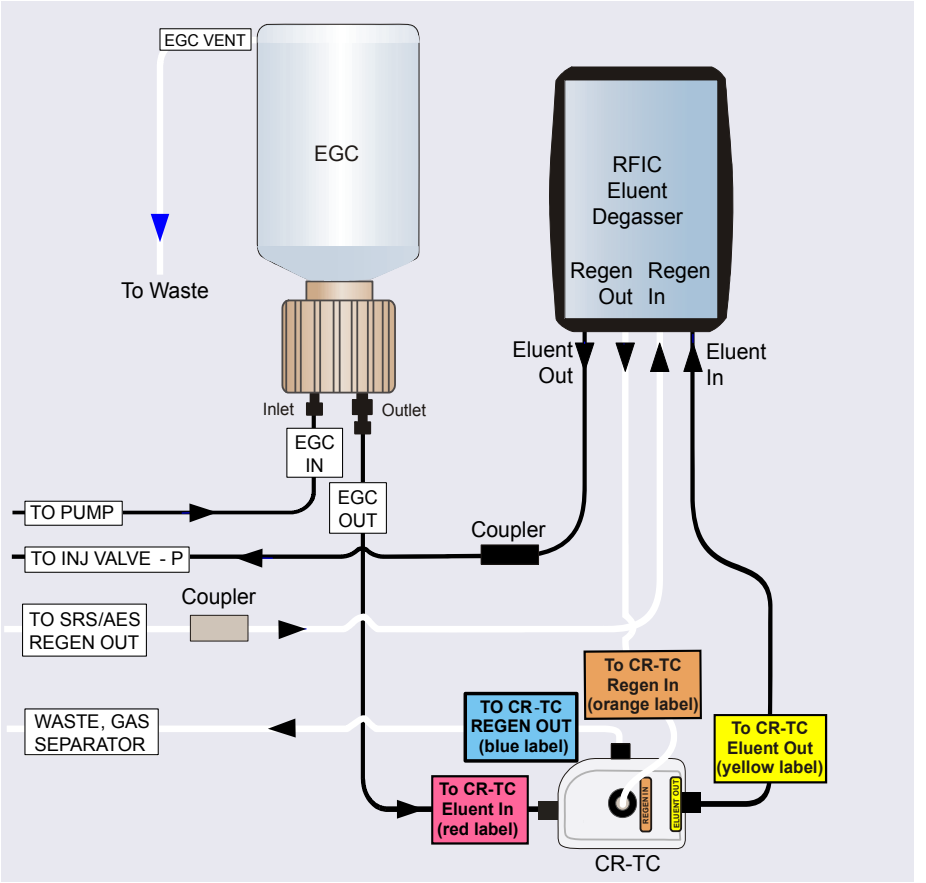


Figure 2-14. *EG Flow Schematic Example for Analytical IC*

NOTE Refer to the EGC-CO_3 Mixer manual for a flow schematic showing the components required to generate a carbonate/bicarbonate mixture. The manual is included on the Thermo Scientific Reference Library DVD (P/N 053891).

2.10 DC Front Features

The status bar on the front of the Dionex ICS-5000 Detector/Chromatography Module (DC) (see Figure 2-15) includes buttons for controlling certain DC functions, as well as LEDs that indicate the status of several DC components and functions.

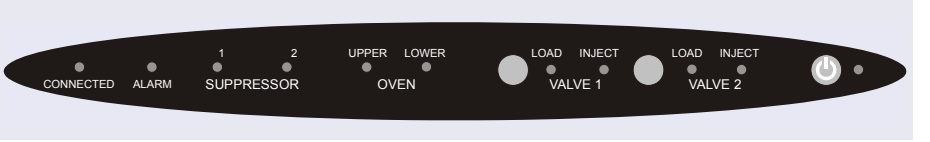


Figure 2-15. *DC Status Bar*

Button/LED Label	If the LED Is On	If the LED Is Flashing
CONNECTED	The DC is connected to a Chromeleon 7 instrument or Chromeleon 6.8 timebase	Does not flash.
ALARM	The leak sensor is wet or there was a valve or suppressor error. Check the Chromeleon Audit Trail for the cause.	Does not flash.
SUPPRESSOR 1 **SUPPRESSOR 2**	The suppressor is on and current is being applied.	Does not flash.
OVEN UPPER	The upper compartment is at its set temperature.	The upper compartment is transitioning to the set temperature. The compartment is not ready for operation.
OVEN LOWER	The lower compartment is at its set temperature.	The lower compartment is transitioning to the set temperature. The compartment is not ready for operation.

Button/LED Label	If the LED Is On	If the LED Is Flashing
VALVE 1 LOAD **VALVE 2 LOAD** **VALVE 1 INJECT** **VALVE 2 INJECT**	Use the **VALVE 1** and **VALVE 2** buttons to manually switch the position of the DC injection valves. The LEDs indicate whether the valve is in the Load or Inject position.	Valve error. See Section 8.25 for troubleshooting.
POWER	Use this **POWER** button for routine on/off control of the DC. When the power is on, this LED is lighted. To turn off the DC, press and hold this **POWER** button for 2 seconds. **Note:** The main power switch is on the DC rear panel.	Does not flash.

NOTE The **VALVE 1** and **VALVE 2** buttons can be enabled and disabled in Chromeleon. When disabled, you can control the valve only from the software. To enable or disable a button, open the **Commands** dialog box (press the **F8** key), select the **Advanced** or **Expert** user level, and select the **Valve1Button** (or **Valve2Button**) property in the list of properties for the DC.

The front of the DC has two sample loading ports (see Figure 2-16) that can be connected to injection valves installed inside the DC. A syringe can then be used to manually load sample through the ports. For automated sample

injection, the DC can be connected to an autosampler. For more information about sample injection, see Section 5.2.

Figure 2-16. *DC Sample Loading Ports*

2.11 DC Interior Components

The interior of the DC consists of two temperature controlled compartments (upper and lower). To access the upper compartment, lift up the top door. To access the lower compartment, pull down the lower door.

The upper and lower compartments are isolated from each other in separate temperature zones. There is no common air flow between the two compartments. For details about DC temperature control, see Section 2.12.

The compartments can accommodate the components necessary for up to two IC systems. The following configurations are possible:

- Single system: one capillary IC or one analytical IC system
- Dual system: two capillary IC systems or two analytical IC systems; or one system of each type (a “hybrid”)

Capillary IC

2.11.1 DC Interior Components for Capillary IC

In capillary ion chromatography systems, the upper compartment of the DC houses the required components. If the DC is used for capillary IC only, the lower compartment is unused.

The DC upper compartment consists of two sections:

- The top section houses one or two Dionex IC Cubes (IC Cube). For details about the IC Cube, see Section 2.11.2. The tray slides forward for easy access to components.
- The lower section houses either one or two Dionex ICS-5000 Conductivity Detectors (CDs), one or two Dionex ICS-5000 Electrochemical Detectors (EDs), or one detector of each type. For details about the CD, see Section 2.14. For details about the ED, see Section 2.15.

Figure 2-17 shows the upper compartments of a DC that is configured for two capillary IC systems. Both systems are configured for conductivity detection.

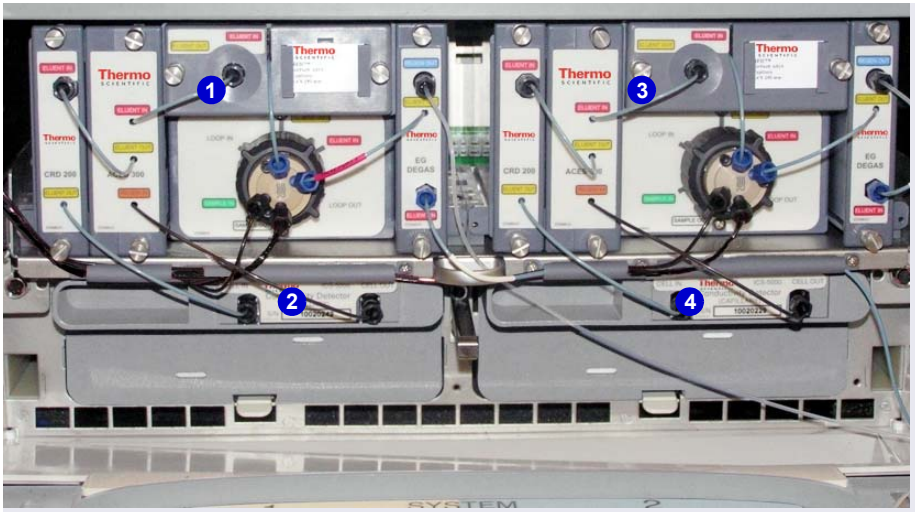


Figure 2-17. *Example DC Interior View (Upper Compartment of a Dual IC System Shown)*

Capillary IC

2.11.2 IC Cube for Capillary IC

The IC Cube houses components for running capillary IC applications. The IC Cube is installed in the upper compartment of the DC. For a dual-system, two IC Cubes can be installed.

NOTE When an IC Cube is installed, a Dionex ICS-5000 Automation Manager cannot be included in the DC.

Each IC Cube includes an injection valve, a column heater, and four component cartridges that slide into the housing. Each cartridge holds a capillary IC component and includes the plumbing required to connect the component to other IC Cube and system components.

Cartridges for the following components are available: carbonate removal device (CRD); suppressor, guard and separator columns; and EG degasser.

NOTE If the IC Cube does not include a CRD or suppressor, bypass cartridges must be installed. Bypass cartridges provide the internal plumbing connections required for eluent and regenerant flow between IC Cube components.

Figure 2-18 illustrates the features of the IC Cube.

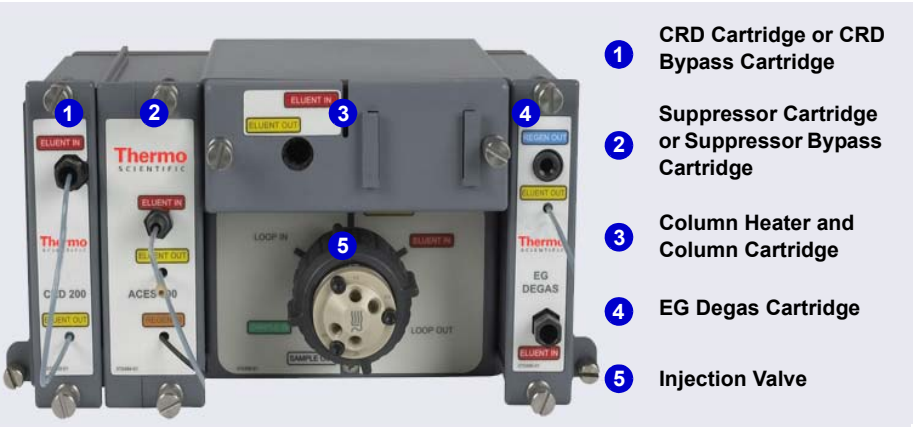


Figure 2-18. *IC Cube Features*

Capillary IC

CRD Cartridge or CRD Bypass Cartridge

The CRD 200 (Capillary) cartridge (P/N 072054) contains a CRD 200 Carbonate Removal Device (Capillary). The CRD 200 (Capillary) removes the carbonate peak contributed by the sample in hydroxide eluent chemistries. Removal occurs immediately after suppression of the eluent, before the sample reaches the detector. The CRD 200 (Capillary) is optimized for operation at the flow rate range typically used with capillary columns.

The CRD and tubing connections inside the cartridge are not accessible. Tubing exits the front of the cartridge to allow connection to other capillary IC components.

Installation of a CRD 200 (Capillary) is optional. However, if one is not used, a CRD bypass cartridge (P/N 072056) must be installed. The bypass cartridge

contains the plumbing connections necessary for eluent and waste flow through the system.

Capillary IC

Suppressor Cartridge or Suppressor Bypass Cartridge

Two versions of capillary suppressor cartridges are available: ACES 300 Anion Capillary Electrolytic Suppressor cartridge (P/N 072052) and CCES 300 Cation Capillary Electrolytic Suppressor cartridge (P/N 072053). Each cartridge holds a suppressor and the required tubing connections for eluent and regenerant flow to the suppressor. The suppressor and tubing connections inside the cartridge are not accessible. Tubing exits the front of the cartridge to allow connection to other capillary IC components.

When the cartridge is installed in the IC Cube, pins on the rear of the cartridge connect the suppressor to its power source. For details about the suppressors, refer to the suppressor manuals. The manuals are on the Thermo Scientific Reference Library DVD (P/N 053891).

Installation of a suppressor is optional. However, if one is not used, a suppressor bypass cartridge (P/N 072055) must be installed. The suppressor bypass cartridge contains the plumbing connections necessary for eluent and waste flow through the system.

Capillary IC

Column Heater and Column Cartridge

The IC Cube column heater provides a temperature-controlled compartment for the capillary guard and separator columns. The heater temperature range is from 5 °C above the temperature of the upper DC compartment to 80 °C.

A column cartridge slides into the column heater and is secured with two thumbscrews. The column cartridge contains the capillary guard column (if included) and the capillary separator column. To access the columns, disconnect the inlet and outlet tubing, loosen the captive screws, and slide the cartridge out of the oven. The cartridge hinges open, providing access to the columns and column plumbing. The capillary columns are ordered separately. For information about how to replace columns and column tubing, see Section 9.26.2.

Capillary IC

EG Degas Cartridge

The EG degas (capillary) cartridge contains a tubing assembly that purges the electrolysis gas from eluent that has been generated by an EG. After passing through the degas tubing the eluent is directed to the injection valve and then to the guard and separator columns.

The EG degas (capillary) cartridge also contains plumbing connections that route the regenerant flow from the suppressor out of the IC Cube to the regenerant inlet port of the Continuously Regenerated Trap Column (Capillary) in the EG.

If the system does not include an EG, the eluent inlet line from the EG degas cartridge is connected directly to the pump outlet. The regenerant outlet line is directed to waste.

Capillary IC

IC Cube Eluent and Regenerant Flow

The numbers on the schematic shown in Figure 2-19 indicate the flow path of eluent and regenerant through the plumbing connections on an IC Cube configured for conductivity detection.

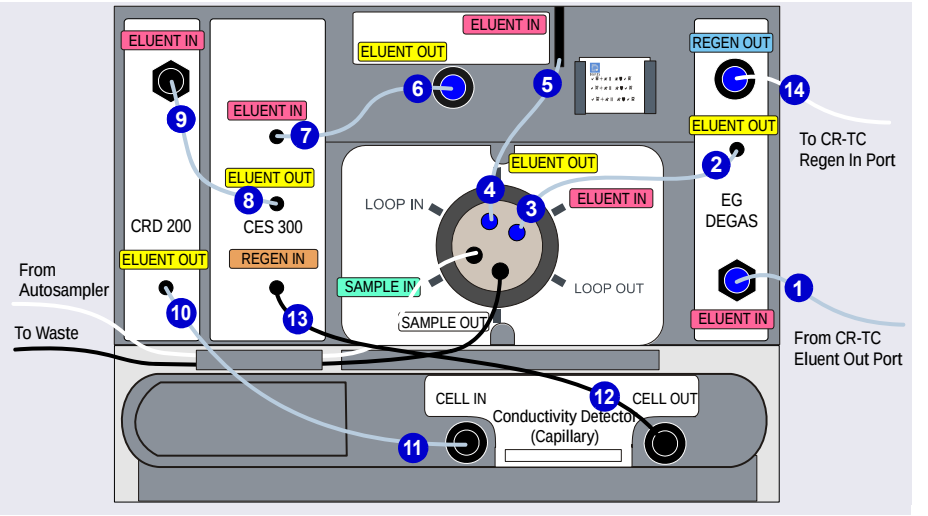


Figure 2-19. *IC Cube Eluent and Regenerant Flow Schematic for Conductivity Detection*

NOTE For the complete conductivity detection flow path, including the flow through components installed inside the IC Cube cartridges, see Section 2.14.3.

The numbers on the schematic shown in Figure 2-20 indicate the flow path of eluent and regenerant through the plumbing connections on an IC Cube configured for electrochemical detection.

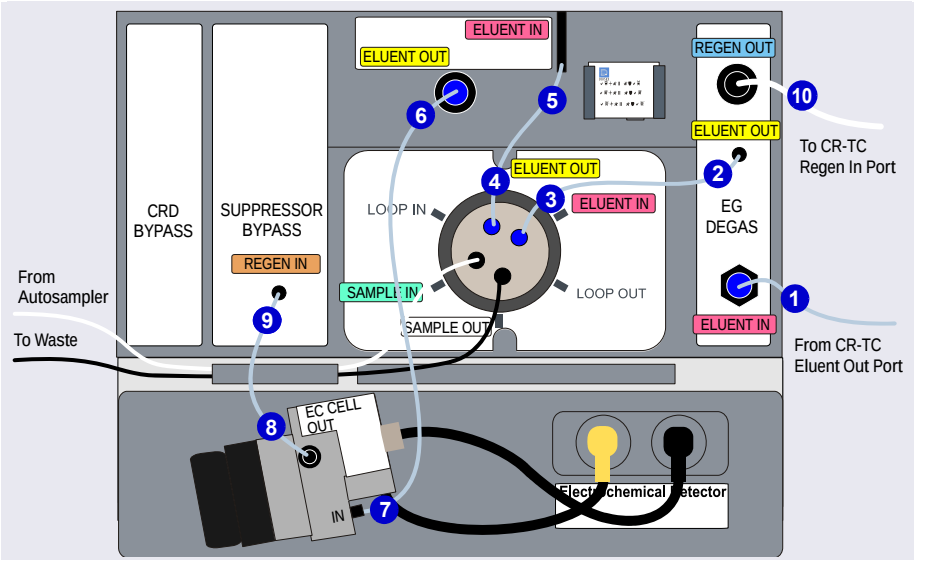


Figure 2-20. *IC Cube Eluent and Regenerant Flow Schematic for Electrochemical Detection (PdH Electrode Shown)*

Analytical IC

2.11.3 DC Interior Components for Analytical IC

Figure 2-21 shows the interior compartments of a DC that is configured with the components for two analytical IC systems. System #1 is used for electrochemical detection applications and system #2 is used for conductivity detection applications.

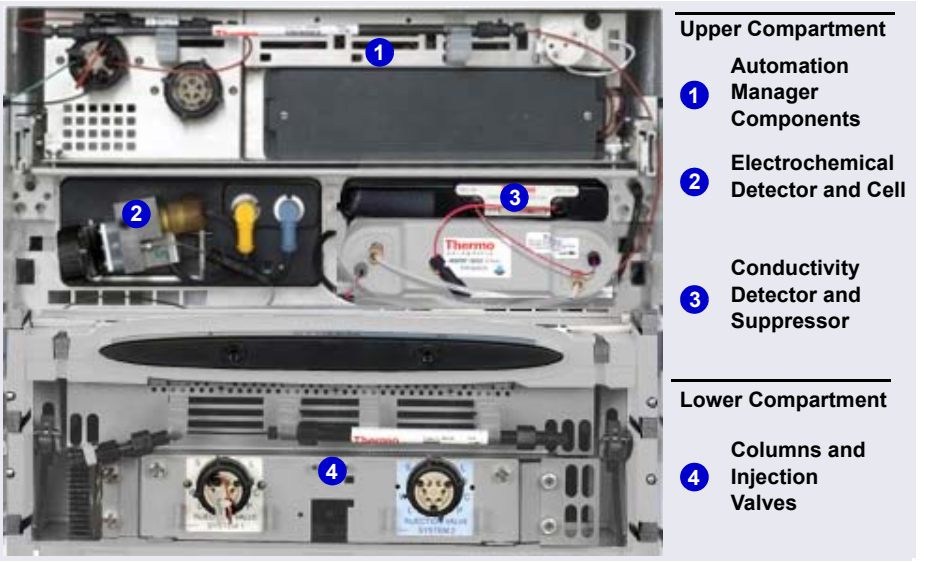


Figure 2-21. *Example DC Interior View (Dual Analytical IC System Shown)*

Upper Compartment Features for Analytical IC

The upper compartment consists of two sections:

- The top section houses an optional Dionex ICS-5000 Automation Manager (AM). The AM contains various components required for performing matrix elimination, large volume pre-concentration, post-column reagent addition, and other functions. See Section 2.18 for details about the AM.
- The lower section houses either one or two Dionex ICS-5000 Conductivity Detectors (CDs), one or two Dionex ICS-5000 Electrochemical Detectors (EDs), or one detector of each type. For details about the CD, see Section 2.14. For details about the ED, see Section 2.15.

Suppressors for conductivity detection are also installed in the upper compartment. The following types of suppressors can be used:

- Thermo Scientific Dionex SRS™ 300 Self-Regenerating Suppressor (2 and 4 mm)
- Thermo Scientific Dionex AES™ Atlas™ Electrolytic Suppressor
- MMS™ 300 MicroMembrane™ Suppressor

Analytical IC

Lower Compartment Features for Analytical IC

The lower compartment can hold up to two column sets (four columns) with IDs of 1 mm to 9 mm and lengths of 100 mm to 250 mm.

The lower compartment also holds one or two injection valves. Two valve versions (6-port and 10-port) are available. Both versions are electrically-activated, two position valves. See Section 2.13 for details about the injection valves.

The compartment tray slides forward about 10 cm (4 in) for easy access to columns and valves. To pull the tray forward, use the handle installed in the center of the compartment (see Figure 2-22).

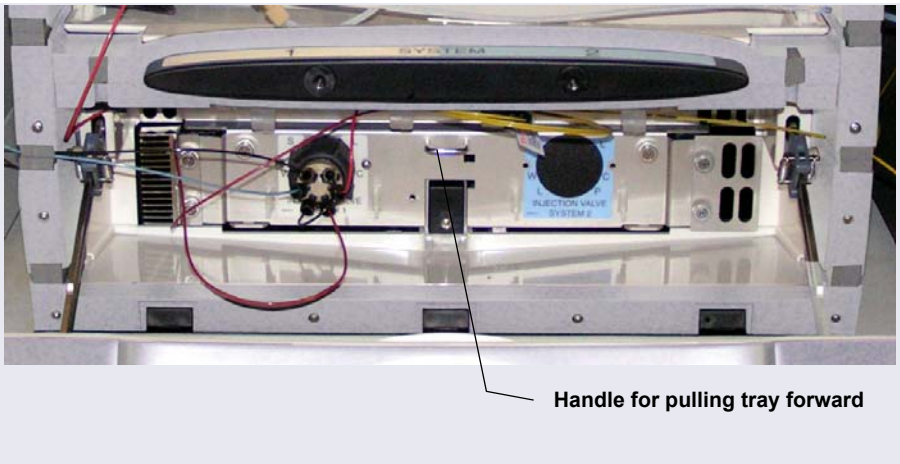


Figure 2-22. *DC Lower Compartment Tray Handle*

2.12 DC Temperature Control Zones

The following temperature control zones are possible with the DC, depending on the options installed:

- DC upper compartment
- DC lower compartment
- Heated conductivity cell

Capillary IC
- IC Cube capillary column heater

Analytical IC
- RCH-1 Reaction Coil Heater (installed in an AM)

The temperatures achieved for a particular zone can vary from the control range, depending on the ambient temperature (see Table 2-3).

Temperature Zone	Control Range	Achieved Temperatures (Based on Ambient)
Upper compartment	10 to 40 °C	• If no temperature-controlled devices (CD cell, IC Cube heater, or RCH-1) are on: Minimum temperature ≥ (ambient – 22 °C) • If a temperature-controlled device is set to 60 °C or above: Minimum temperature ≥ (ambient – 17 °C). **Note:** The achieved temperature can be reduced another few degrees by setting the DC upper compartment fan speed to high (see page 64). • Maximum temperature ≥ (ambient + 20 °C)
Lower compartment	10 to 70 °C	Minimum temperature ≥ (ambient – 15 °C) Maximum temperature ≥ (ambient + 50 °C)
CD cell	15 to 60 °C	Minimum temperature ≥ (upper compartment temperature + 5 °C)
IC Cube column heater	15 to 80 °C	Minimum temperature ≥ (upper compartment temperature + 5 °C)
RCH-1	20 to 80 °C	Minimum temperature ≥ (upper compartment temperature + 5 °C)

Table 2-3. *Achieved Temperatures per DC Temperature Zone*

Minimum temperatures are also affected by the ambient humidity. If the humidity is high, the minimum temperatures achieved for a temperature zone is not as low as those achieved in a low ambient humidity environment.

NOTE A DC Temperature Calibration Kit (P/N 063782) is available. The kit includes the parts and instructions required to verify the temperature calibration of the DC upper and lower compartments and to recalibrate, if required.

To set the fan speed of the DC upper compartment to high:

1. Open the Chromeleon 7 Instrument Configuration program or Chromeleon 6.8 Server Configuration program.
2. Double-click the DC icon under the instrument or timebase.
3. Click the **Thermal Controls** tab and then double-click **Compartment_TC**.
4. Under Fan Speed, click **High Speed** (see Figure 2-23).

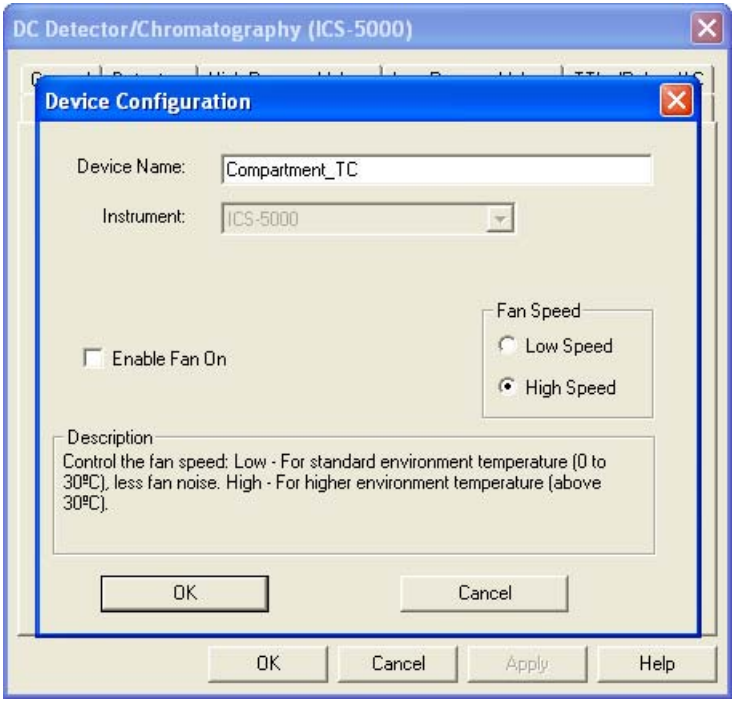


Figure 2-23. *Setting the DC Upper Compartment Fan Speed*

2.13 High-Pressure Valves

Up to four high-pressure valves can be installed in the DC. The following valve models are available: 4-port (P/N 074525), 6-port (P/N 061961), and 10-port (P/N 061962).

Capillary IC

In a capillary IC system, one 4-port high-pressure valve is installed on each IC Cube. This valve is used for sample injection. Optionally, the 6-port valve can be installed instead of the 4-port valve. In addition to the injection valve, one or two high-pressure valves can be installed in the lower compartment. These valves can be used for applications requiring auxiliary valves.

Analytical IC

In an analytical IC system, one 6-port high-pressure valve is installed in the lower compartment for each system configured in the DC.This valve is used for sample injection. Optionally, one or two high-pressure valves can be installed on an AM (see Section 2.18). These valves can be used for applications requiring auxiliary valves.

Each valve has two operating positions. When configured as an injection valve, liquid flows through either the Load or Inject path, depending on the valve position. In the Load position, sample is loaded into the sample loop. In the Inject position, sample is swept to the column for analysis.

When configured as an auxiliary valve, the flow path through system components in each valve position depends on the component configuration.

2.13.1 4-Port Valve

The 4-port valve (P/N 074525) is the standard injection valve for capillary IC systems. It is installed in the IC Cube (see Figure 2-18). The valve has a 0.4 µL internal sample loop. Figure 2-24 shows flow schematics for the 4-port valve.

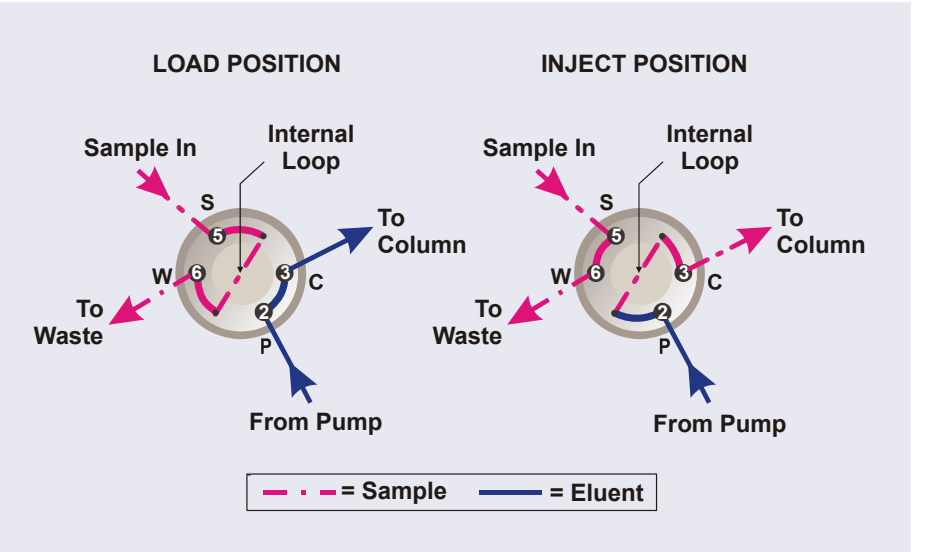


Figure 2-24. *Injection Valve Flow Schematics (4-Port Valve)*

- In the Load position, sample flows from the syringe or autosampler line (if installed), through the valve, and into the internal sample loop, where it is held until injection. Excess sample flows out to waste. Eluent flows from the pump, through the valve, and to the column, bypassing the sample loop.
- In the Inject position, eluent flows from the pump, through the internal sample loop, and on to the column, carrying the contents of the sample loop with it. Section 5.3.1 describes how to inject samples with an autosampler and Section 5.3.2 describes how to inject samples manually.

2.13.2 6-Port Valve

The 6-port valve (P/N 061961) is the standard injection valve for analytical IC systems. It is installed in the lower compartment of the DC (see Figure 2-21). Figure 2-25 shows flow schematics for the 6-port valve.

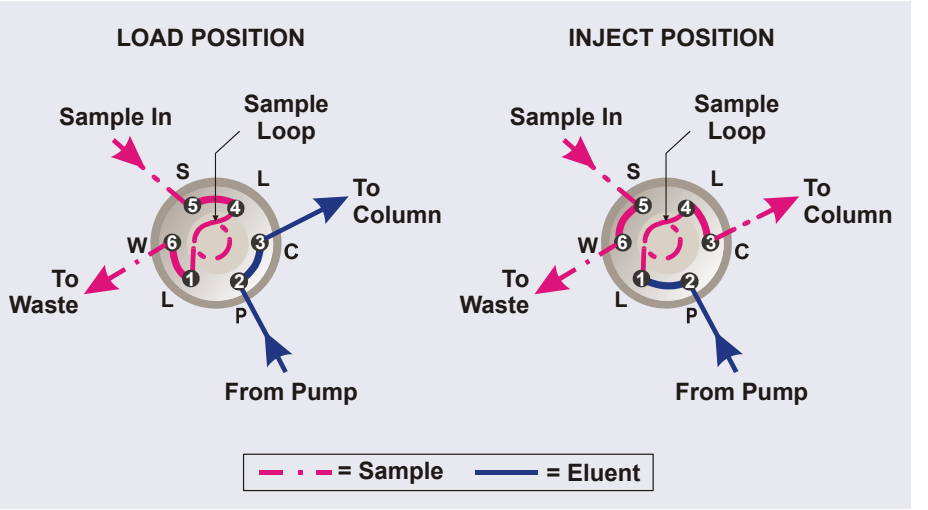


Figure 2-25. *Injection Valve Flow Schematics (6-Port Valve)*

- In the Load position, sample flows from the syringe or autosampler line (if installed), through the valve, and into the sample loop, where it is held until injection. Excess sample flows out to waste. Eluent flows from the pump, through the valve, and to the column, bypassing the sample loop.
- In the Inject position, eluent flows from the pump, through the sample loop, and on to the column, carrying the contents of the sample loop with it. Section 5.3.1 describes how to inject samples with an autosampler and Section 5.3.2 describes how to inject samples manually.

A 10 µL PEEK sample loop (P/N 042949) is installed between ports L (1) and L (4). Thermo Fisher Scientific offers sample loops in various sizes. If needed, the pre-installed 10 µL loop can be replaced with a loop that has a different sample injection volume.

2.13.3 10-Port Valve

The 10-port valve (P/N 061962) is an optional valve, available for various applications. Figure 2-26 shows example flow schematics for the 10-port valve when it is connected for an application that uses a concentrator column.

NOTE Other plumbing configurations for the 10-port valve are possible, depending on the components to be connected to the valve and the application to be run. Refer to the appropriate Application Note for more information.

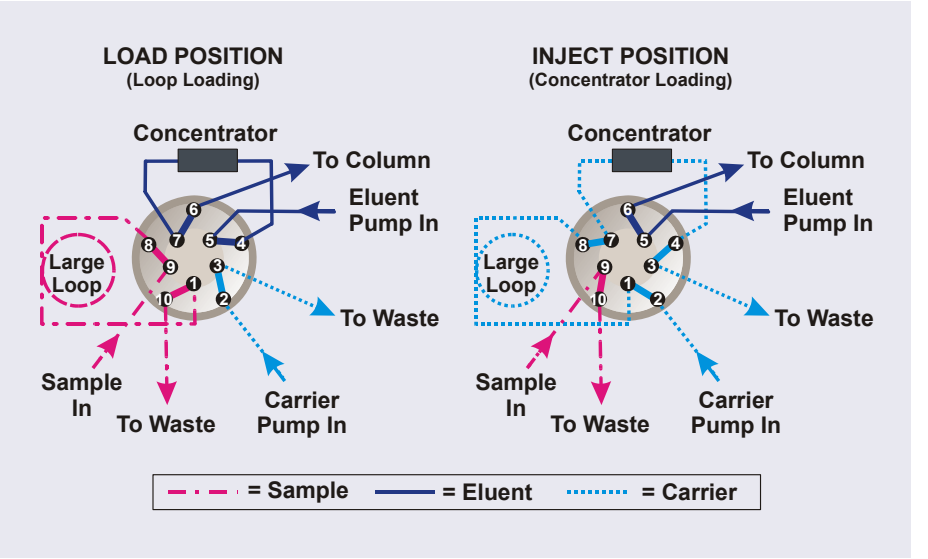


Figure 2-26. *Injection Valve Flow Schematics (10-Port Valve) Example Connections: Large Loop to Concentrator*

Liquid flows through either the Load or Inject path, depending on the valve position. For the example shown in Figure 2-26, the flow occurs as follows:

- In the Load position, sample flows from the syringe or autosampler line, through the valve, and into the sample loop. Excess sample flows out to waste. Eluent flows from the eluent pump, through the valve, through the concentrator column, and to the separator column. If sample was previously loaded onto the concentrator column, it is swept to the separator column for analysis.

- In the Inject position, carrier liquid flows through the sample loop and on to the concentrator column, carrying the contents of the sample loop with it. Excess flows out to waste. Eluent flows from the pump, through the valve, and to the separator column, bypassing the concentrator column.

2.14 CD Conductivity Detector

Each Dionex ICS-5000 Conductivity Detector (CD) consists of a heated conductivity cell and the electronics required for collecting the conductivity data and sending it to the computer and the analog output (if installed). The CD is installed in the upper compartment of the DC (see Figure 2-21).

Two versions of CD are available:

- A capillary CD (P/N 072041), for use in systems running capillary flow rates
- An analytical CD (P/N 061716), for use in systems running analytical (standard bore or microbore) flow rates

The features and functions of the two CD versions are the same. However, because the cell volumes of the two are different, the versions are not interchangeable. The CD version must match the system type (capillary IC or analytical IC). If the CD version and system type are mismatched, chromatograms will be affected (for example, broad peaks or lowered sensitivity).

2.14.1 Heated Conductivity Cell

The flow-through conductivity cell measures the electrical conductance of analyte ions as they pass through the cell. Two passivated 316 stainless steel electrodes are permanently sealed into the PEEK cell body. The cell design provides efficient sweep-out, low volume (<1 µL), and low dispersion. Temperature control and compensation help ensure good peak reproducibility and baseline stability.

Temperature Control

Temperature directly affects the conductivity of a solution. For example, laboratory heating and air conditioning systems can cause a regular slow

cycling in the baseline. This, in turn, can affect the reproducibility of an analysis. The higher the conductivity, the more pronounced the effect.

To reduce the effect of temperature variation, the DC provides temperature control of both the DC compartment and the cell. A heater inside the cell regulates the cell temperature. The cell heater temperature range is from a low of 5 °C above the temperature of the upper DC compartment to a high of 60 °C.

Temperature Compensation

Built-in temperature compensation helps minimize changes in the baseline or in peak heights if the operating temperature is different from the temperature at which the cell was calibrated. The default temperature compensation is 1.7% per °C. This can be reset to between 0% and 3.0% per °C, depending on the eluent. If you notice that the baseline shifts up when the temperature increases, the compensation factor is too low and should be reset to a higher value.

To change the temperature compensation factor:

1. Open the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset.
2. Press the **F8** key to open the Commands dialog box.
3. Select the conductivity detector.
4. Select the **Temperature_Compensation** property and enter the value.
5. For Chromeleon 6.8, click **Execute**.

2.14.2 Suppressor

The suppressor reduces the eluent conductivity and enhances the conductivity of the sample ions, thereby increasing detection sensitivity. Installation of a suppressor is optional.

The capillary and analytical CDs can operate with the following suppressors:

CD Type	Available Suppressors
Capillary CD	Dionex ACES™ 300 (Capillary), Dionex CCES™ 300 (Capillary)
Analytical CD	Dionex AAES™, Dionex CAES™, Dionex AMMS™ 300, Dionex CMMS™, Dionex ASRS™ 300, Dionex CSRS™ 300

For details about any of the suppressors, including guidelines for selecting a suppressor for your application, refer to the suppressor manuals. The manuals are on the Thermo Scientific Reference Library DVD (P/N 053891).

Capillary IC

Capillary IC Suppressor

The suppressor for a capillary IC system is installed inside an IC Cube capillary suppressor cartridge. For details about the IC Cube and the capillary suppressor cartridge, see Section 2.11.2.

Analytical IC

Analytical IC Suppressor

The analytical suppressor is installed on clips on the lower area of the analytical CD (see Figure 2-27). The suppressor cable plugs into the connector next to the detector.

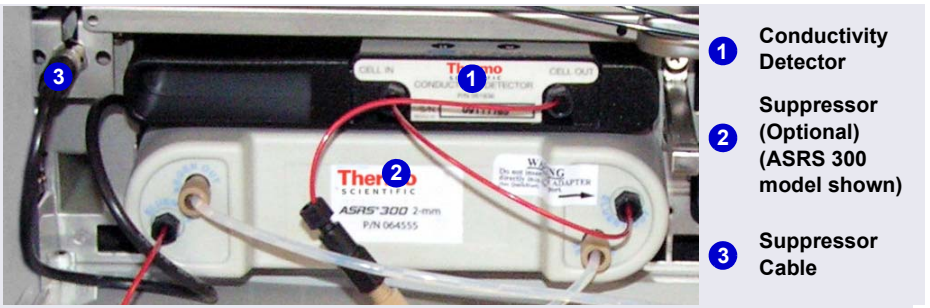


Figure 2-27. *Analytical Conductivity Detector with Suppressor (System #1)*

Analytical IC **NOTE** It is also possible to control an analytical suppressor with a Dionex ICS-5000 Electrochemical Detector (ED). Tabs for installing the suppressor are provided on the front of the DC (next to the ED). The cable connection is the same as for the CD.

NOTE To prevent accumulation of oxygen or hydrogen gases, connect a gas separator waste tube (P/N 045460) to the suppressor waste line during installation For details, refer to *Thermo Scientific Dionex ICS-5000 Ion Chromatography System Installation Instructions* (Document No. 065343).

2.14.3 System Flow Schematics for Conductivity Detection

Figure 2-28 illustrates the flow path through a DC for a conductivity detection application using suppression in recycle mode. For information about other suppression modes, refer to the suppressor manuals. The manuals are on the Thermo Scientific Reference Library DVD (P/N 053891).

NOTE The basic flow path is the same for both capillary IC and analytical IC systems. However, in capillary IC systems, connections to components installed inside IC Cube cartridges (columns, suppressor, and CRD) are not visible.

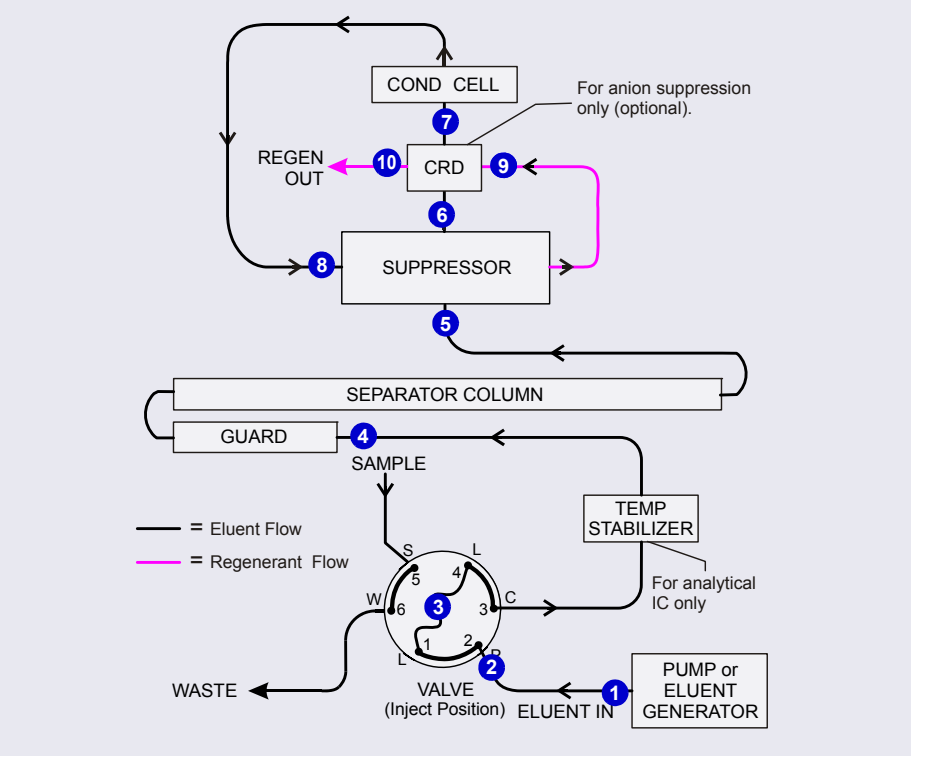


Figure 2-28. *DC Flow Schematic for Conductivity Detection (Suppression in Recycle Mode)*

- Eluent from the pump ❶ flows into the injection valve ❷.
- After sample is loaded into the sample loop ❸ and the injection valve is toggled to the Inject position, eluent passes through the loop.
- The eluent/sample mixture is pumped first through a temperature stabilizer (analytical IC only), through the guard and separator columns ❹, and then through the suppressor ❺.
- From the suppressor, the mixture flows through a CRD ❻ (if installed) to the cell ❼, where the analytes are detected. A digital signal is sent to Chromeleon.
- Finally, the mixture flows out of the cell and is recycled back into the suppressor ❽, where it is used as the water source for the regenerant

chamber. Flow is again routed through the CRD (if installed) 9 and then to waste 10.

Figure 2-29 illustrates the flow path through an EG and a DC for a conductivity detection application using suppression in recycle mode.

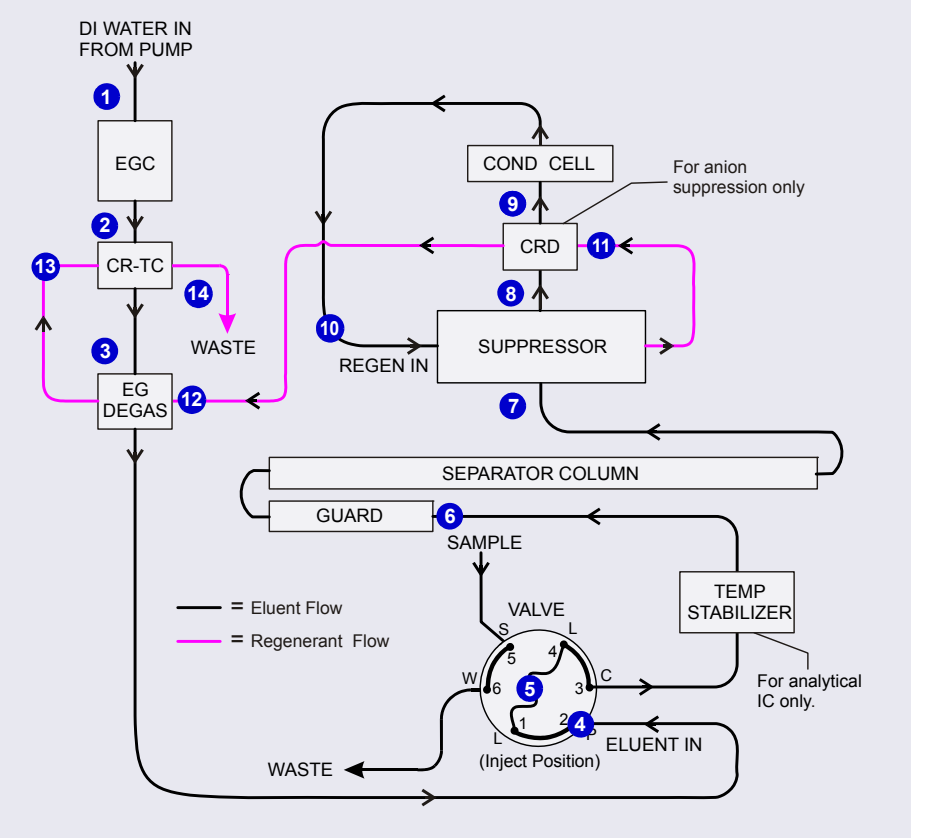


Figure 2-29. *EG and DC Flow Schematic for Conductivity Detection (Suppression in Recycle Mode)*

- Deionized water from the pump 1 enters the EGC, which generates the eluent. Eluent exits the EGC and passes through the CR-TC 2 (which traps ionic contaminants), through the EG degas tubing, 3 and then into the injection valve 4.
- After sample is loaded into the sample loop 5 and the injection valve is toggled to the Inject position, eluent passes through the loop.

- The eluent/sample mixture is pumped through a temperature stabilizer (analytical IC only), through the guard and separator columns 6, and then through the suppressor 7.
- From the suppressor, the mixture flows through a CRD 8 (if installed) to the cell 9, where the analytes are detected. A digital signal is sent to Chromeleon software.
- The mixture flows out of the cell and is recycled back into the suppressor 10, where it is used as the water source for the regenerant chamber. Regenerant flow is routed through the CRD 11 (if installed), through the EG degas tubing 12, through the CR-TC 13, and then out to waste 14.

2.15 ED Electrochemical Detector

One or two Dionex ICS-5000 Electrochemical Detectors (EDs) can be installed in the DC. Each complete ED assembly consists of an amperometric detection cell and the detector electronics required to collect data and send it to the computer and the analog output (if installed). The detector is installed in the upper compartment of the DC (see Figure 2-21). The cell mounts on the front of the detector. The detector electronics are not accessible to the user.

The ED can perform the following electrochemical detection modes:

- DC amperometry (see Section 2.19.1)
- Integrated amperometry—includes pulsed amperometric detection (PAD) and integrated pulsed amperometric detection (IPAD) (see Section 2.19.2)
- Cyclic voltammetry (see Section 2.19.3)

2.15.1 Electrochemical Detector Cell

The ED cell includes three different electrodes. It is a miniature flow-through amperometric detection cell with a titanium cell body (the counter electrode), a working electrode, and a combination pH-Ag/AgCl reference electrode (see Figure 2-30) or a PdH reference electrode. The type of working electrode used depends on the application. Four conventional (non-disposable) working electrode types are available: gold, platinum, silver, and glassy carbon. Five disposable working electrode types are available: gold on two different substrates (polyester or PTFE), silver, platinum, and carbon.

The ED cell can be used in either capillary IC or analytical IC systems. When used in a capillary IC system, the inlet tubing is made of PEEK. When used in an analytical IC system, the inlet tubing is made of titanium (see Figure 2-30).

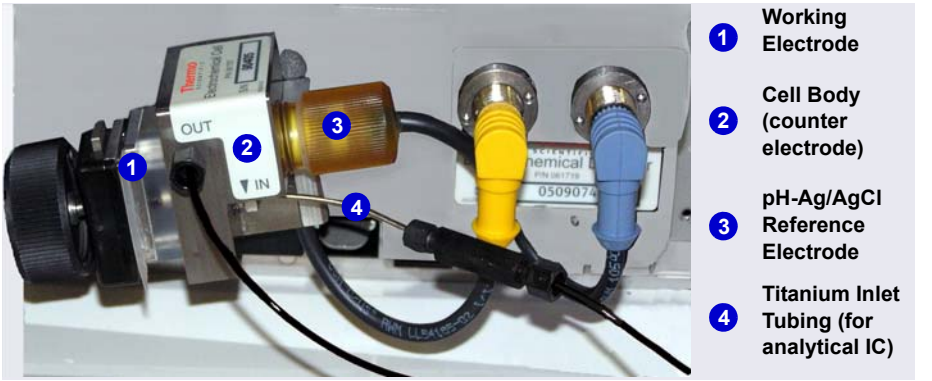


Figure 2-30. *ED Cell with pH-Ag/AgCl Reference Electrode (Cell Configured for Analytical IC Shown)*

Cell Design

The ED cell is a thin-layer design. Eluent flows in a thin channel parallel to the surface of a flat disk electrode. The resulting smooth flow minimizes noise. The low volume (<0.2 µL) of the channel also allows operation with high efficiency, narrow bore columns, and capillary columns. The cell design minimizes the electrical resistance between the working electrode and the counter electrode by positioning the counter electrode (the cell body) directly across the thin-layer channel from the working electrode. This results in a wide linear dynamic range. The inlet tubing is in electrical contact with the counter electrode and through it to ground. The working electrode current is processed using low noise analog amplifiers and filters.

ED Cell Solvent Compatibility

The ED cell can be used with common reversed-phase solvents such as methanol and acetonitrile. If a disposable working electrode on polyester substrate is used, the percentage of methanol should not exceed 30% and the percentage of acetonitrile should not exceed 10%. In addition, prolonged exposure (more than 8 hours) of disposable gold electrodes on polyester substrate to eluents containing hydroxide concentrations greater than 100 mM is not recommended. Shorter rinse periods of 10 to 20 minutes (for example,

the carbonate removal step during monosaccharide and disaccharide chromatography) at high hydroxide concentrations do not affect the electrode performance. If sustained highly alkaline eluent conditions are required, use a disposable gold electrode on a PTFE substrate or a conventional gold electrode. Refer to the disposable electrode manual (Document No. 065040) for additional eluent compatibility information.

Because conventional working electrode blocks are made of Kel-F® and use a gasket made of Ultem®, there is no restriction on the concentration of organic solvents that can be used with them (providing the solvent is compatible with PEEK tubing).

There is also no restriction on the use of organic solvents when disposable gold electrodes on PTFE substrate and PTFE gaskets are used.

2.15.2 Combination pH–Ag/AgCl Reference Electrode

The pH-Ag/AgCl reference electrode is a standard combination pH electrode containing a glass membrane pH half-cell and a Ag/AgCl half-cell. The combination pH electrode monitors eluent pH.

The Ag/AgCl half-cell is typically used as the cell reference electrode. To minimize changes in the baseline, the combination pH–Ag/AgCl electrode can be used as the reference electrode during a pH gradient.

pH Dependence

The potentials at which many redox reactions take place on metallic electrodes are pH-dependent, with the potential shifting -0.059 V per pH unit. This is especially true for metal oxide formation, oxidation, and oxidative desorption. Since the reference potential of the combination pH–Ag/AgCl electrode also shifts by -0.059 V per pH unit, pH-dependent potential shifts at the working electrode are canceled.

Correcting for pH Dependence

At an eluent pH of 7, the reference potential of the entire electrode is the same as that of the Ag/AgCl half-cell. As the eluent pH is increased, the pH half-cell potential decreases approximately 0.059 V per pH unit. For example, at an eluent pH of 12, the reference potential of the pH half-cell would be -0.295 V relative to the Ag/AgCl half-cell. Therefore, at pH 12, the potentials

applied to the working electrode must be raised approximately 0.3 V when switching from the "Ag" reference to the "pH" reference.

In acidic eluents, the reference potential of the pH half-cell is positive with respect to the Ag/AgCl half-cell, and all applied potentials must be decreased by 0.059 V per pH unit when switching from the "Ag" reference to the "pH" reference.

IMPORTANT **Do not allow the pH-Ag/AgCl reference electrode to dry out. Make sure that eluent is being pumped continuously through the cell at a low flow rate (for example, 0.05 mL/min). If the cell will not be used for a short time (less than 2 days), disconnect the tubing from the inlet and outlet fittings and install fitting plugs. For longer shutdowns, remove the electrode from the cell and store it in its storage cap filled with saturated KCl solution. See Section 6.4 for detailed storage instructions.**

Monitoring the ED Cell pH Readout

Monitoring the pH readout of a solution with a known composition lets you detect any reference potential shift that may occur over time. This allows you to determine when the pH-Ag/AgCl reference electrode needs regenerating or replacing, thus improving the reproducibility of your analyses. For instructions on how to monitor the pH readout, see Section 4.1.2.

NOTE Monitor the pH when the pH-Ag/AgCl reference electrode is used in the Ag mode as well as in the pH mode.

2.15.3 Palladium Hydrogen (PdH) Reference Electrode

The PdH reference electrode consists of palladium and platinum electrodes immersed in an aqueous solution. With a potential applied between the two electrodes, palladium is connected as a cathode and platinum as an anode. As a consequence of the applied potential, hydrogen gas is generated at the palladium electrode and oxygen gas at the platinum electrode. Whereas the oxygen gas is swept out of the cell in the liquid stream, a portion of the hydrogen gas is taken up by palladium metal. An equilibrium develops between molecular hydrogen in the liquid phase and the adsorbed hydrogen in palladium. The palladium hydrogen electrode becomes a reference electrode with a half reaction of:

$H^+ + e- = \frac{1}{2} H_2$

Where the hydrogen is supplied by the following process:

$Pd + \frac{1}{2} H_2 \rightarrow Pd\text{-}H_{ads} \rightarrow Pd\text{-}H_{abs}$

The PdH reference electrode is thus similar to the standard hydrogen electrode, which is based on the same half reaction between the hydronium ions and molecular hydrogen. However, there are also some differences. For example, palladium is not as good a catalyst for the electrode half reaction as platinum. As a consequence, under identical conditions, the reference potential of the palladium hydrogen electrode differs from that of the standard hydrogen electrode by a constant potential. In addition, because hydronium ions are involved in the reference half reaction, the potential of the PdH electrode is pH dependent.

Waveforms for PdH Reference Electrodes in Chromeleon

When you create or edit an instrument method in Chromeleon 7 or a program in Chromeleon 6.8, you can select a waveform created for use with the PdH reference electrode. To use a waveform that was created for a pH-Ag/AgCl electrode, select the waveform and then manually correct the potential values in the Waveform Editor. The formula for correction is provided in the Waveform Editor.

No pH Readout with the PdH Reference Mode

If the PdH electrode were connected to another reference electrode (for example, a Ag/AgCl electrode), the PdH electrode could serve as a pH indicator electrode. However, when the PdH electrode functions as a

reference electrode, it cannot indicate pH. In the same manner, a glass electrode alone cannot measure pH; it must be used with a suitable reference electrode.

The pH readout of the ED cell is disabled when the PdH reference mode is selected.

2.16 DC Rear Panel

Figure 2-31 illustrates the rear panel of the DC.

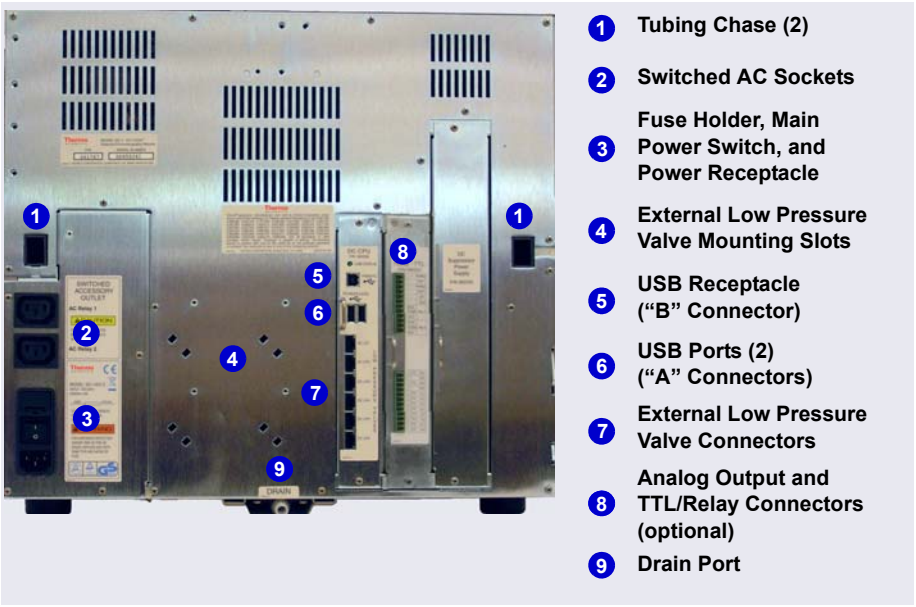


Figure 2-31. *DC Rear Panel*

Tubing Chases

The tubing chases route tubing from the front compartment, through the DC interior, and to the rear panel. Foam inserts insulate the chases.

Switched AC Sockets

The two AC receptacles can be used to control the power to external devices. Use Chromeleon to switch the power on and off. TTL inputs can also be used to control the AC sockets (see Section 2.17.4).

Fuse Holder, Main Power Switch, and Power Receptacle

The fuse holder contains two 10-amp slow-blow fuses (P/N 954772). For instructions on how to change the fuses, see Section 9.22.

The rear panel power switch is the main power switch for the DC. Turn on the main power switch before initial operation and leave the switch on unless instructed to turn it off (for example, before performing a service procedure).

NOTE For routine on/off control, use the **POWER** button on the front of the DC (see Figure 2-16). To turn off the DC, press and hold the **POWER** button for 2 seconds.

The power cord plugs into the IEC 320 three-prong receptacle.

The power supply cord is used as the main disconnect device. Make sure the socket-outlet is located near the DC and is easily accessible.

Le cordon d'alimentation principal est utilisé comme dispositif principal de débranchement. Veillez à ce que la prise de base soit située/installée près du module et facilement accessible.

Das Netzkabel ist das wichtigste Mittel zur Stromunterbrechung. Stellen Sie sicher, daß sich die Steckdose nahe am Gerät befindet und leicht zugänglich ist.

USB Connections

The USB (Universal Serial Bus) receptacle (“B” type connector) allows connection to the PC on which Chromeleon software is installed.

The two USB ports (“A” type connectors) allows connection to other USB devices in the system (for example, the pump and eluent generator).

A 1.8 m (6 ft) USB cable (P/N 960777) is included in the DC Ship Kit (P/N 072011).

External Low Pressure Valve Outputs

Six outputs allow connection to externally-installed low-pressure (solenoid) valves. Low-pressure valves can be used for on/off control of liquid flow (for example, to turn flow on and off from a reagent reservoir). You control the outputs with Chromeleon.

Two low-pressure valves can be installed on a regulator stand and four valves can be installed on the rear of the DC.

Analog Output, TTL, and Relay Connectors (Optional)

If the I/O option (P/N 062201) is installed, the following connections are provided:

- Two analog outputs (one for each detector)
- One +5V power output
- Two relay outputs
- Two TTL outputs
- Eight programmable TTL inputs

See Section 2.17 for details about the I/O option.

Drain Port

The drain port removes any liquid that collects in the drip tray in the bottom of the DC. A clear corrugated drain hose (P/N 055075) is connected to this port during installation. Place the drain hose into a waste container. To maintain a positive siphon, position the waste container below the level of the DC.

IMPORTANT **For correct drainage, make sure the drain hose is not bent, pinched, or elevated at any point. Do not allow the end of the hose to be submerged in waste liquid.**

2.17 I/O Option

When the I/O option (P/N 062201) is installed, two 12-pin connector strips are on the DC rear panel. Figure 2-32 describes the functions assigned to each connector pin.

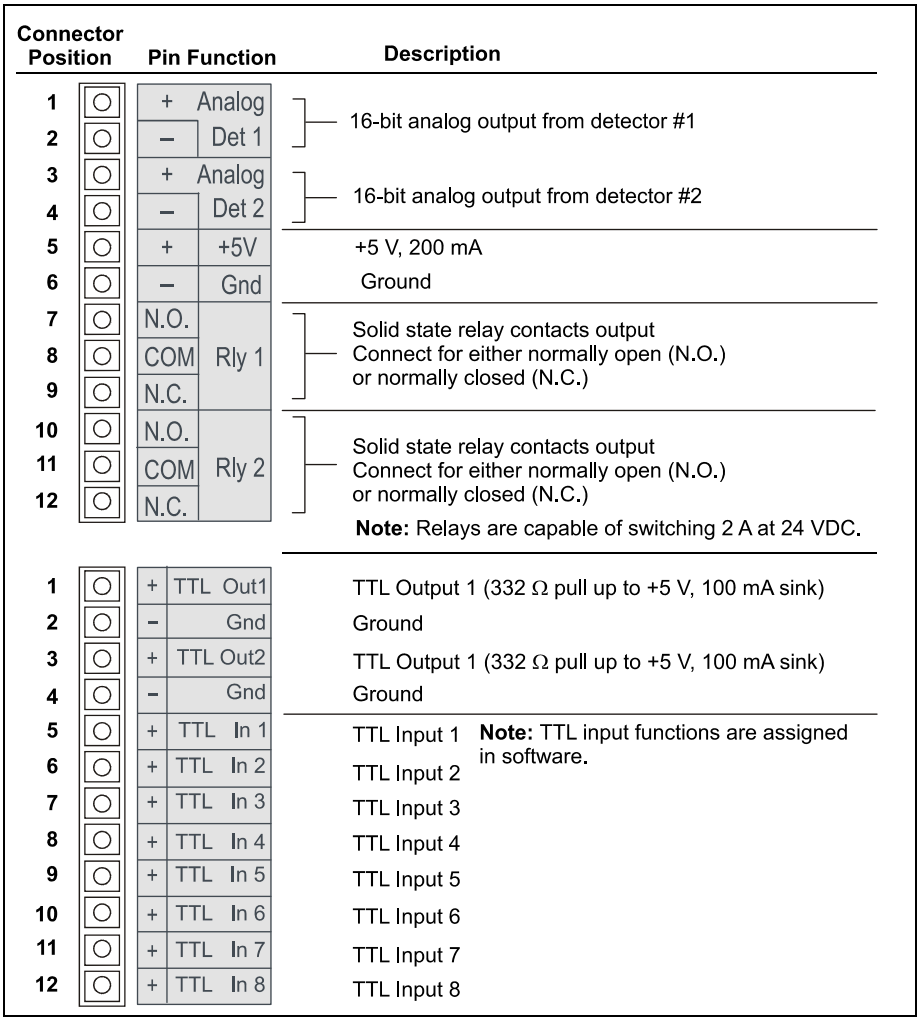


Figure 2-32. *Optional Rear Panel I/O Connector Strips*

2.17.1 I/O Option Connections

1. Locate the twisted pair of wires (P/N 043598) and 12-position connector plugs (P/N 923686) (see Figure 2-33) provided with the I/O option board.

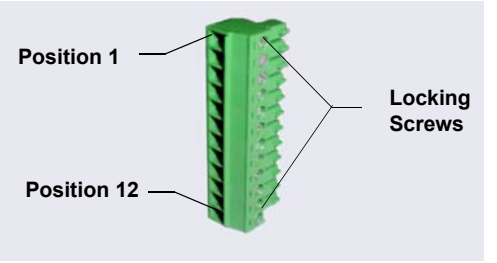


Figure 2-33. *12-Position Connector Plug*

2. For each I/O function to be used, connect an active wire (red) and a ground wire (black) to the 12-position connector plug at the appropriate pin locations. Refer to Figure 2-32 or the label on the DC rear panel for the connector pin assignments.

   To attach a wire to the plug, strip the end of the wire, insert it into the plug, and use a screwdriver to tighten the locking screw. If necessary, multiple ground wires can be attached to a single ground pin.

CAUTION

When attaching wires to the connector plug, be careful not to allow stray strands of wire to short to an adjoining position on the connector.

3. Plug the connector into the appropriate 12-pin connector on the DC rear panel.
4. Connect the wires from the DC connector plug to the appropriate connector pins on the other modules. Additional connector plugs are provided with other Dionex modules.

   NOTE Check the polarity of each connection. Connect signal wires to signal (+) pins and ground wires to ground (-) pins.

5. If you connected a TTL input, verify that the correct function is assigned to the input and that the correct input control type is selected. Select different settings if necessary. Input functions and control types are assigned from the Chromeleon 7 Instrument Configuration program or the Chromeleon 6.8 Server Configuration program (see Section 2.17.4).

2.17.2 Analog Outputs

When the I/O option is installed, two analog outputs (one for each detector) are installed on the DC rear panel (see Figure 2-31). The analog outputs supply a voltage signal proportional to the current measured by the detector cell. The outputs can be connected to an analog-to-digital (A/D) converter such as an integrator or other recording device. Refer to Section 2.17.1 and the documentation for the device for connection instructions.

Several settings are available that allow you to configure the analog output signal for your detector and connected device. Table 2-4 describes the settings. You select the preferred settings on the detector panel on the Chromeleon 7 ePanel Set (see Figure 2-34) or Chromeleon 6.8 panel tabset.

Analog Output Setting	Values	Description
Full-scale voltage	0.01, 0.10, or 1.00 V	Sets the voltage output of a full-scale detector response. The voltage to use depends on the recording device to which the analog output is connected. For example, if the analog output is connected to a device that accepts input voltages up to 1 V, select a full-scale voltage output of 1 V.
Range	Conductivity: 0.01 to 15,000 µS DC Amperometry: 50 pA to 300 µA Integrated Amperometry: 50 pC to 200 µC	Sets the full-scale detector response value. The range to use depends on the detector readings expected for the application. For example, selecting a range of 20 micro Siemens (µS) will limit you to viewing conductivity readings of 20 µS or less.

Table 2-4. *Analog Output Configuration Settings*

Analog Output Setting	Values	Description
Recorder calibration	Zero, Full Scale, Normal	Use this setting to calibrate a recording device. Select **Zero** to set the output signal to zero volts. Select **Full Scale** to set the output signal to the selected full-scale voltage (0.01, 0.10, or 1.00 V). For normal operation, select **Normal** (the default) to output a signal corresponding to the detector output.
Offset level	0 to 100%	Use this setting to adjust the zero position of the analog output when it is plotted. The value entered is a percentage of the full-scale analog output. An offset allows a recording device to plot the signal if it becomes negative. The offset level does not affect the magnitude of the output signal.
Polarity	Positive, Negative	Use this setting to set the polarity of the analog output signal to either positive (the default) or negative. In applications in which the analyte output is lower than the background signal, the polarity must be negative to display peaks instead of dips on the chromatogram.
Mark	10% of the full-scale analog output	Use this setting to send a positive pulse to the analog output as an event marker. A mark is typically used to indicate a sample injection.

Table 2-4. *Analog Output Configuration Settings (Continued)*

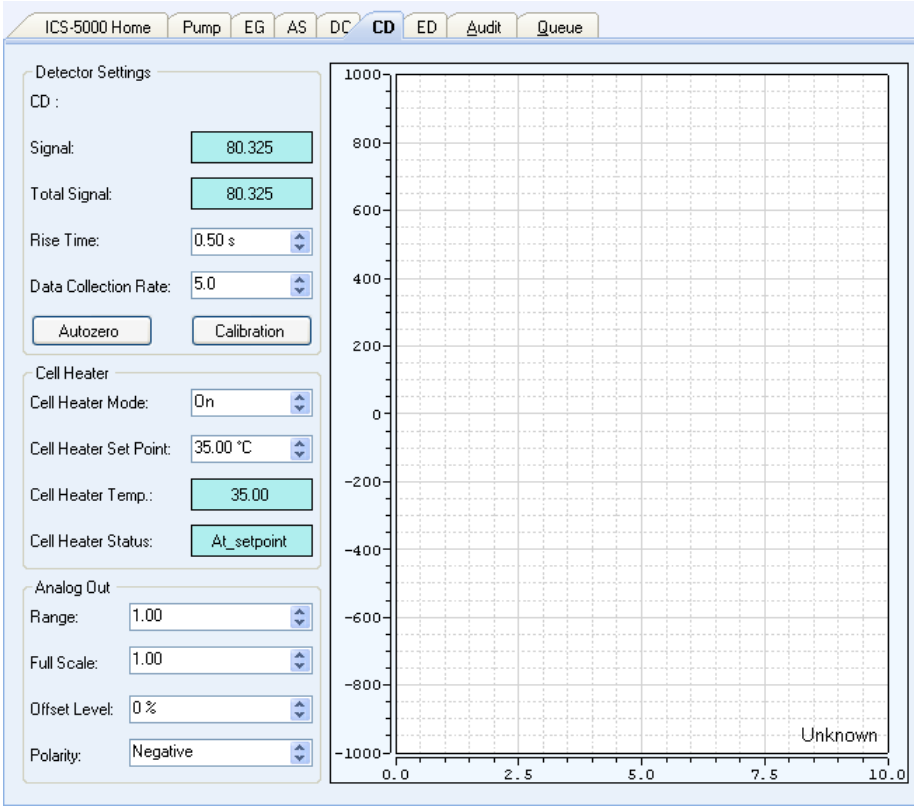


Figure 2-34. *Conductivity Detector Control Panel (Chromeleon 7 Version Shown)*

2.17.3 Power, Relay, and TTL Outputs

The power, relays, and TTL outputs can be used to control functions in external devices such as an autosampler or another Dionex module.

Depending on which pins are connected, the relay connection can be either normally open (N.O.) or normally closed (N.C.) (see Figure 2-35). Choose N.O. or N.C. based on what you want the state of the connected device to be when the DC power is turned off. A normally open relay is open when the relay is switched off and closed when the relay is turned on. A normally closed relay is closed when the relay is off and is open when the relay is on.

The relays can be programmed to switch any low-voltage device. Switched current must be no more than 2 A at 24 VDC. Refer to Section 2.17.1 and the documentation for the external device for connection instructions.

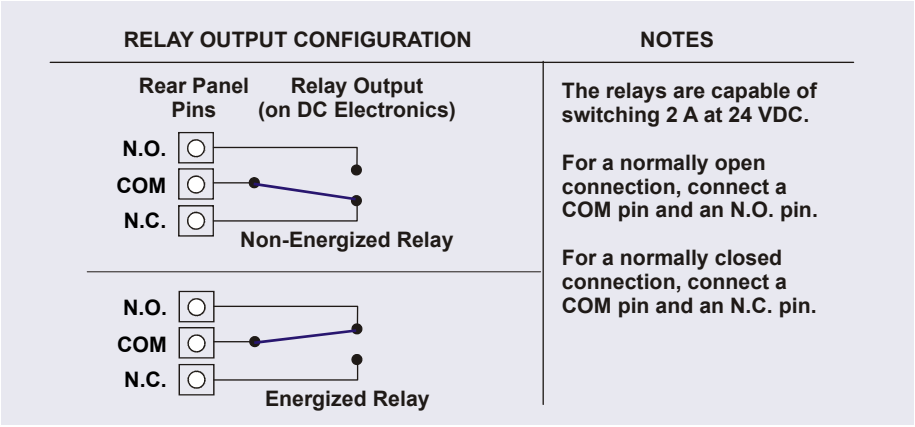


Figure 2-35. *Relay Output Configuration*

You can control the power, relays, and TTL outputs from the DC ePanel in Chromeleon 7 (see Figure 2-36) or the DC Control panel in Chromeleon 6.8.

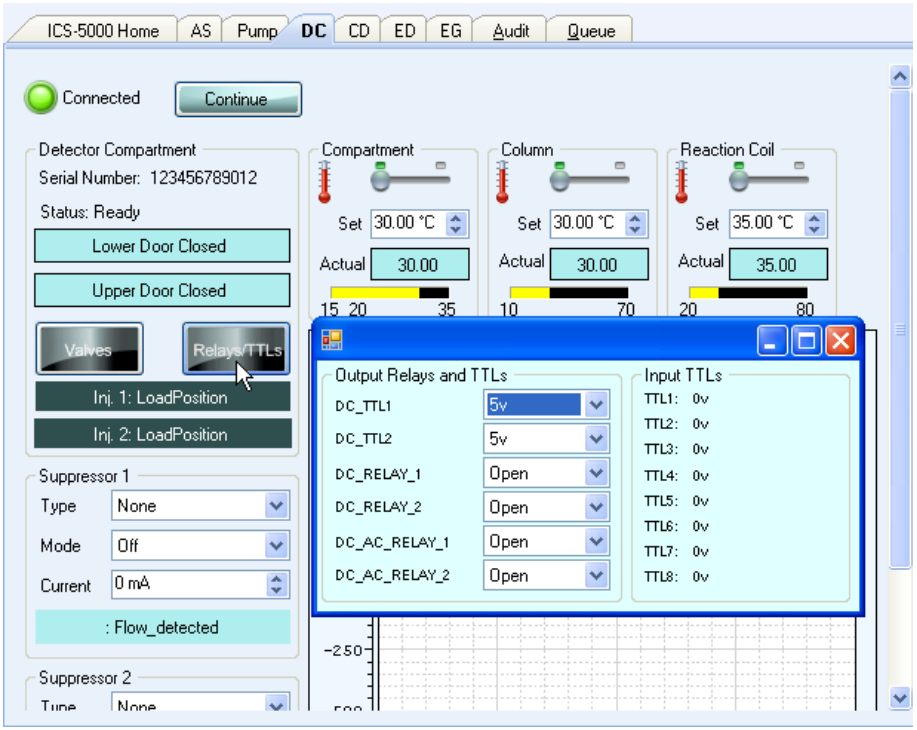


Figure 2-36. *Output Relays and TTL Control on DC ePanel in Chromeleon 7*

NOTE It is possible to change the settings for the power, relays, and TTL outputs while a Chromeleon 7 instrument method or Chromeleon 6.8 program is running.

2.17.4 TTL Inputs

When connected to a controlling device, the TTL inputs can be programmed to perform the following DC functions:

- Injection valves left and right (load/inject)
- AM high-pressure valves A and B (A/B)
- AM low-pressure valves A and B (open/closed)
- DC low-pressure valves A through F on the rear panel (open/closed)

- ED detectors 1 and 2 (on/off)
- CD/ED detectors 1 and 2 auto-offset
- CD/ED detectors 1 and 2 mark
- Suppressors 1 and 2 (on/off)
- Reaction coil heater (on/off)
- A/C relays 1 and 2 (open/closed)

Assigning TTL Input Functions

TTL input control functions are assigned in the Chromeleon 7 Instrument Configuration program or the Chromeleon 6.8 Server Configuration program. You can assign one or more functions to each input.

NOTE If two timebases are sharing the DC, the TTL input functions are shared between the timebases. For example, if TTL input 1 is assigned to control injection valve 1, that function is assigned to both timebases. You do not need to associate a TTL input with a particular timebase.

To select TTL input control functions:

1. Open the Chromeleon 7 Instrument Configuration program or Chromeleon 6.8 Server Configuration program.
2. Double-click the DC icon under the instrument or timebase.

3. Select the **TTL Inputs** tab (see Figure 2-37).

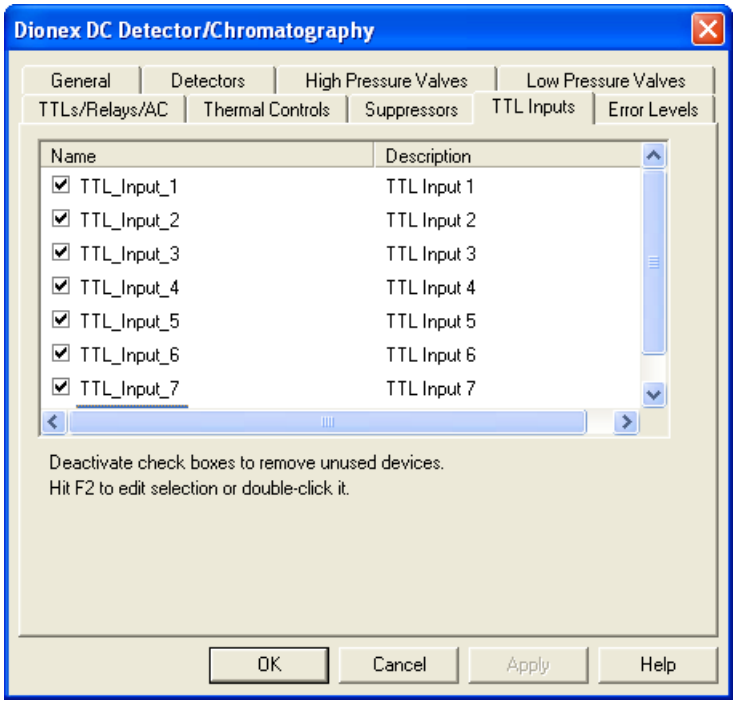


Figure 2-37. *DC Server Configuration Properties: TTL Inputs*

4. Select the name of the input and press the **F2** key (or double-click the name).

The Device Configuration dialog box for the selected input appears.

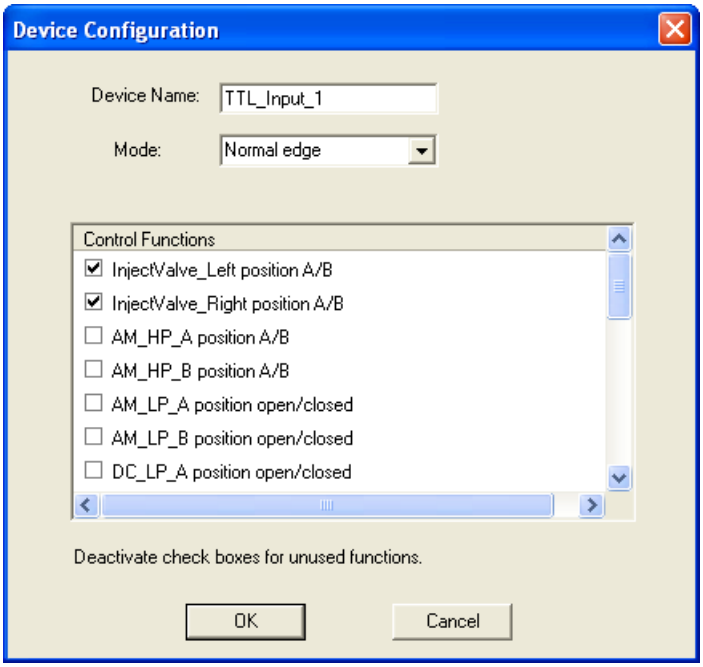
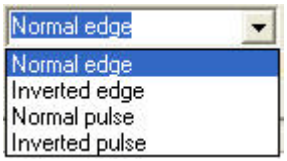


Figure 2-38. *Assign TTL Input Control Functions*

5. In the **Control Functions** list, select the check box of one or more functions to be controlled by this input. When connected to a controlling device, the device can send a signal to the input to trigger the selected functions.
6. By default, several functions are selected. Scroll down the list and disable all unwanted functions.

TTL Input Control Types

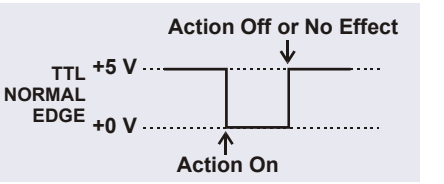


The DC TTL inputs respond to four types of signals to accommodate different controlling devices. The default control type, **Normal Edge**, is compatible with the output signals provided by Dionex modules.

If the device connected to the DC does not send a normal edge signal, select the appropriate control type. Refer to the documentation provided with the

controlling device and the information below to determine the correct type. Select the input control type in the Device Configuration dialog box for each TTL input (see Figure 2-38).

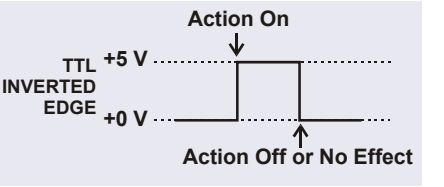
- *Normal Edge*: In normal edge operation, the negative (falling) edge of a signal turns on the function.



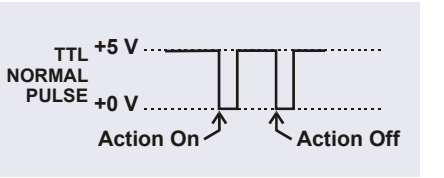
  The action of the positive (rising) edge depends on the function: For on/off or other functions that have two options, the rising edge turns off the function. However, for functions with only one option, the rising edge has no effect.

  For example, for the injection valve position, the falling edge switches the valve to Load and the rising edge switches the valve to Inject. Similarly, for the detector start/stop, the falling edge starts the detector and the rising edge stops it. For the detector mark and offset functions, the falling edge turns on the function and the rising edge has no effect.

- *Inverted Edge*: The inverted edge mode works identically to the normal edge mode except that the positive and negative edges are reversed in function.

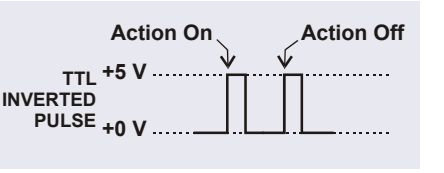


- *Normal Pulse*: In normal pulse operation, the negative (falling) edge of the TTL signal is the active edge and the positive (rising) edge is ignored.



  A pulse width of 50 ms or more is guaranteed to be detected. A pulse width of 4 ms or less is guaranteed to be ignored. The action for pulse widths that are greater than 4 ms and less than 50 ms is undefined.

- *Inverted Pulse*: The inverted pulse mode operates identically to the normal pulse mode except that the positive and negative edges are reversed in function.



Analytical IC

2.18 Automation Manager

The Dionex ICS-5000 Automation Manager (AM) provides a mounting location for various components used for performing matrix elimination, large volume pre-concentration, post-column reagent addition, and other functions.

Each AM consists of a tray on which valves and other components are installed (see Figure 2-39). The tray is installed in the upper compartment of the DC (see Figure 2-21). Connections to other components in the system (pump, injection valve, reagent reservoirs, etc.) depend on the application. Refer to Chapter 3 for the configuration schematic for your application.

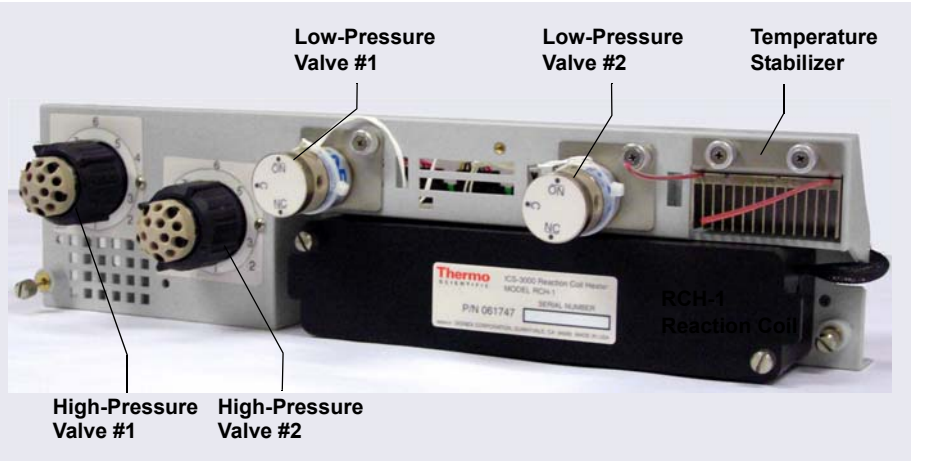


Figure 2-39. *Dionex ICS-5000 Automation Manager*

NOTE Because the AM requires the full width of the DC upper compartment, an IC Cube cannot be installed in the DC when an AM is installed.e AM is available in the following configurations:

Components Included	Part Number
Two 10-port high-pressure valves Two low-pressure 3-way valves	061738
One 10-port high-pressure valve One low-pressure 3-way valve	061736

Figure 2-40. *AM Configurations*

Components Included	Part Number
One 6-port high-pressure valve One low-pressure 3-way valve	061740
AutoPrep configuration: 10-port high-pressure valve AutoPrep sample loop AutoPrep standard loops	066343
AM tray with no valves	061734

Figure 2-40. *AM Configurations (Continued)*

In addition to the configurations described above, you can order the following components separately for installation on an AM:

AM Component	Part Number
High-pressure valve, 6-port	061961
High-pressure valve, 10-port	061962
Low-pressure valve, 3-way	061971
Low-pressure valve, 2-way	061745
RCH-1 Reaction Coil Heater	061746
Temperature stabilizer, standard bore, 0.25 mm (0.010 in) ID	062561
Temperature stabilizer, microbore, 0.125 mm (0.005 in) ID	062562

Figure 2-41. *AM Components Available Separately*

Analytical IC

2.18.1 AM High-Pressure Switching Valves

Up to two high-pressure switching valves can be installed on an AM. Two models are available: 6-port (P/N 061961) and 10-port (P/N 061962). Both models are electrically-activated, two-position valves. Figure 2-42 and Figure 2-43 show the liquid flow path through the valve ports at each valve position.

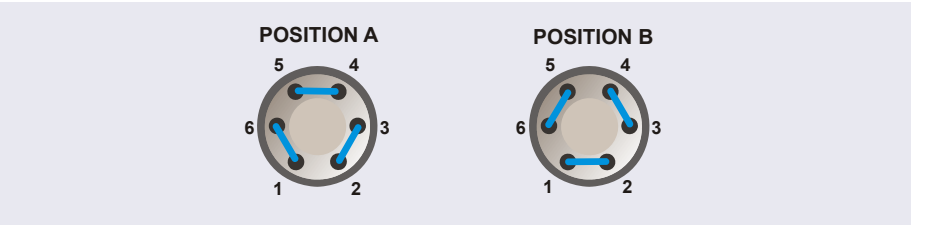


Figure 2-42. *High-Pressure Switching Valve Flow Schematics: 6-Port Valve*

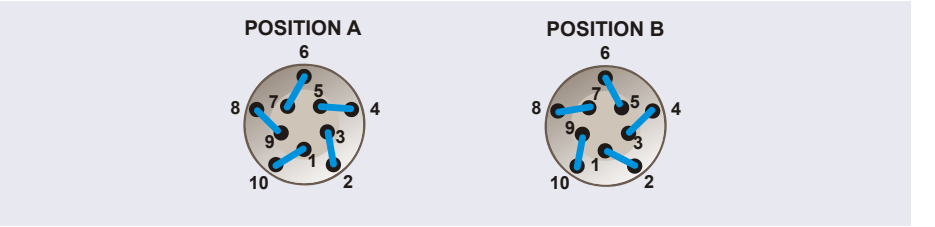


Figure 2-43. *High-Pressure Switching Valve Flow Schematics: 10-Port Valve*

Valve port connections to chromatography components vary, depending on the application. Refer to Chapter 3 for the configuration schematic for your application.

Valves are controlled by Chromeleon (see Section 2.18.3).

Analytical IC

2.18.2 AM Low-Pressure Valves

Up to two low-pressure valves can be mounted on an AM. The valves are either two-way or three-way valves. The two-way valves provide on/off control of liquid flow in one direction, while the three-way valves provide on/off control in two directions (see Figure 2-44).

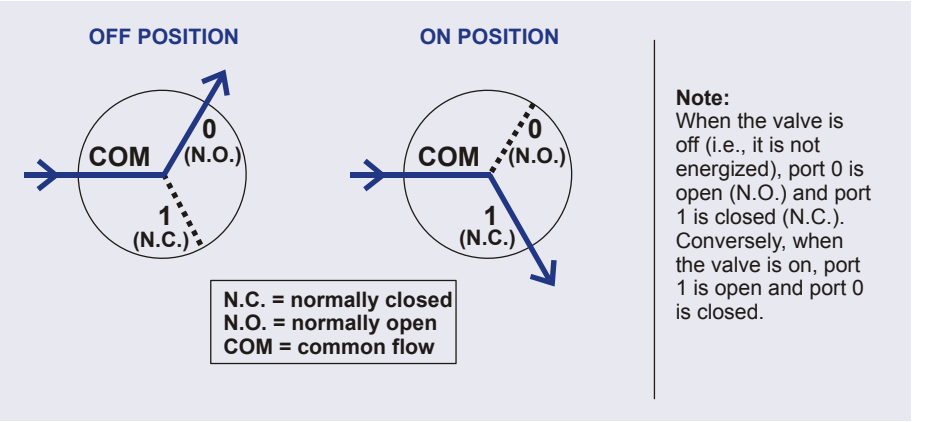


Figure 2-44. *Three-Way Low-Pressure Valve Flow Schematics*

Valve port connections to chromatography components vary, depending on the application. Refer to Chapter 3 for the system flow schematic for your application.

Valves are controlled by Chromeleon (see Section 2.18.3).

Analytical IC

2.18.3 AM High- and Low-Pressure Valve Control

Chromeleon is used to control the high- and low-pressure valves. For automated control, commands for valve control can be included in a Chromeleon 7 instrument method or a Chromeleon 6.8 program. To add AM valve control commands to a Chromeleon 7 instrument method, use the **Script Editor** (see Figure 2-45).

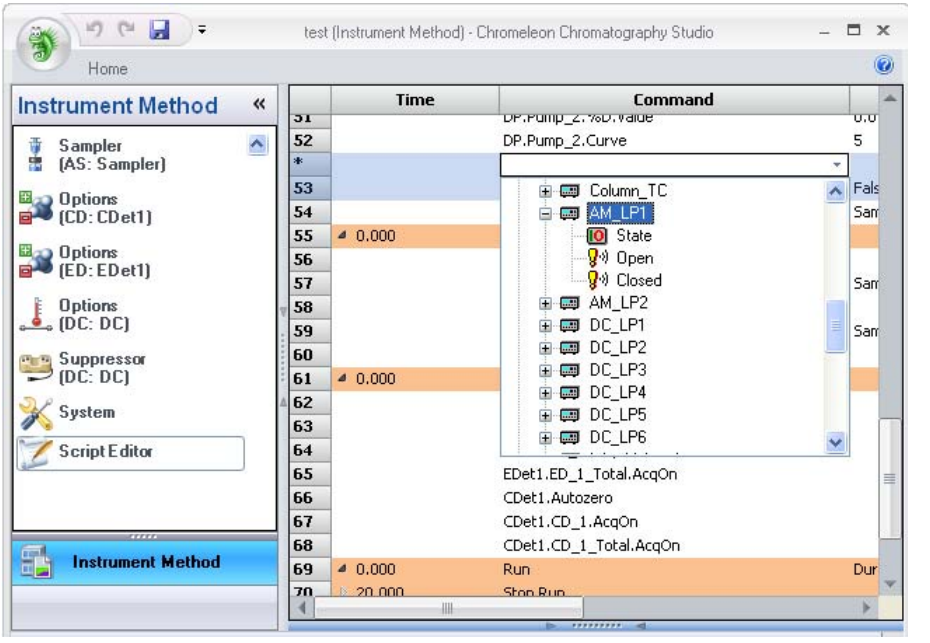


Figure 2-45. *Chromeleon 7 Script Editor*

To add AM valve control commands to a Chromeleon 6.8 program, use the **Relay and State Devices Options** page in the Program Wizard (see Figure 2-46).

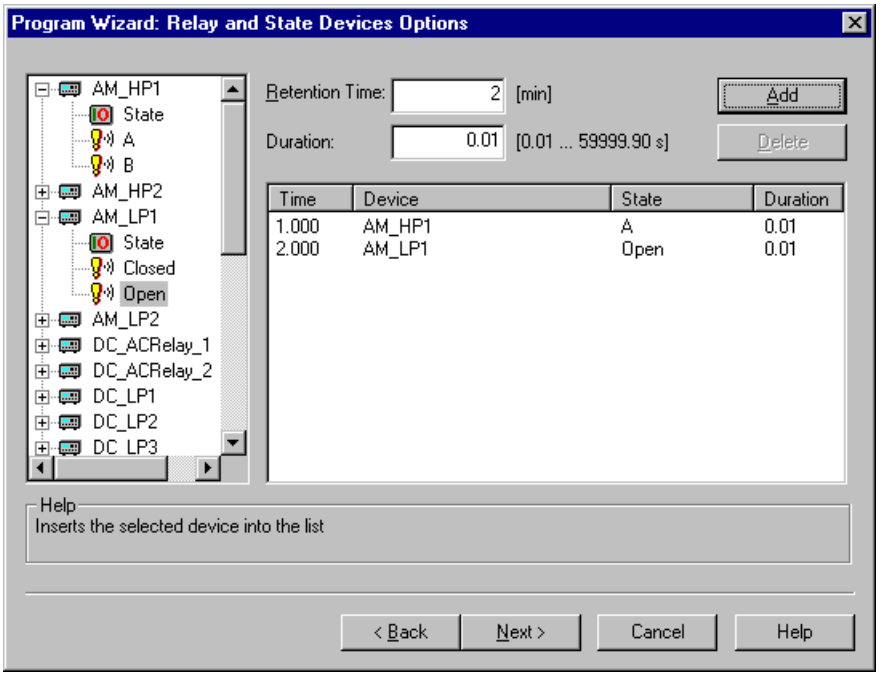


Figure 2-46. *Chromeleon 6.8 Program Wizard Relay and State Devices Options Page*

For manual control of AM valves, execute commands from the DC ePanel in Chromeleon 7 (see Figure 2-47) or the DC Control panel in Chromeleon 6.8.

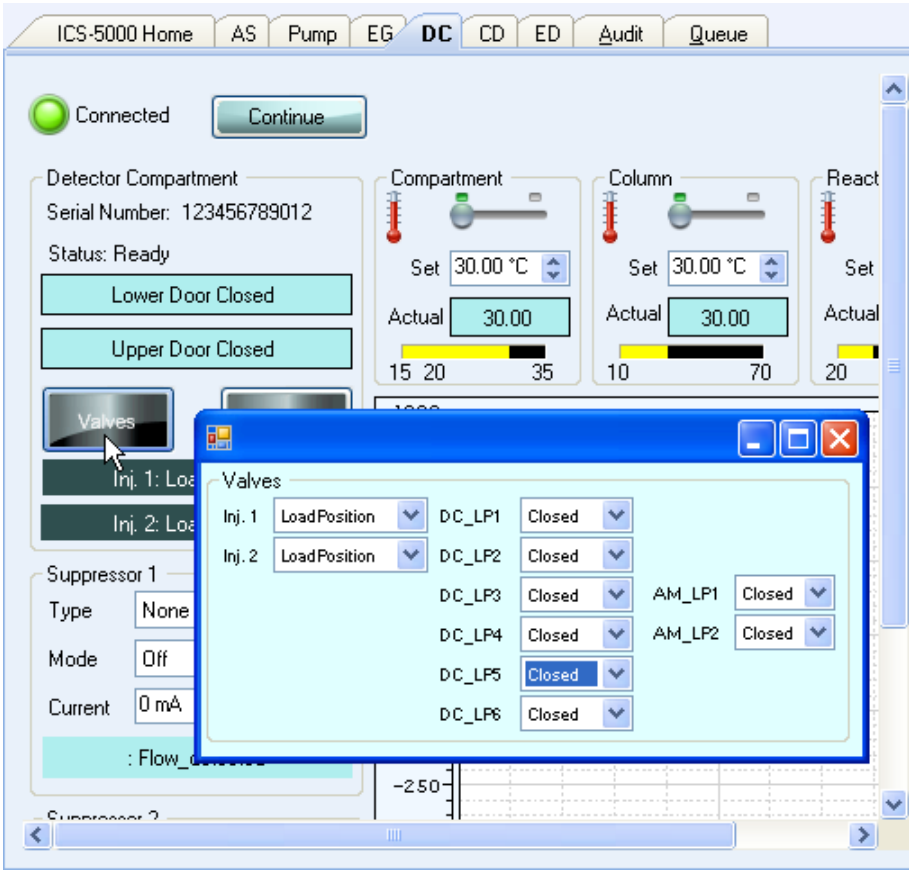


Figure 2-47. *Valve Control on DC ePanel in Chromeleon 7*

Analytical IC

2.18.4 RCH-1 Reaction Coil Heater

The RCH-1 Reaction Coil Heater (P/N 061746) can hold up to two reaction coils. The heater has an operating temperature range of from 5 °C above the temperature of the upper compartment up to 80 °C.

For automated control of the heater, commands can be included in a Chromeleon 7 instrument method (see Figure 2-48) or Chromeleon 6.8 program.

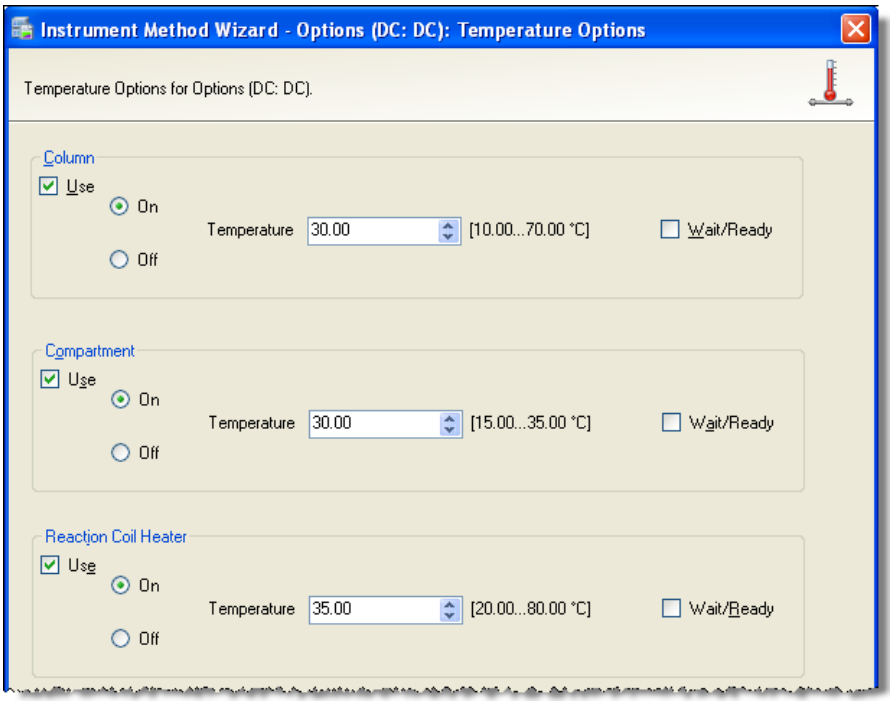


Figure 2-48. *Instrument Wizard DC Options Page in Chromeleon 7*

For direct control of the heater, use the controls on the DC ePanel in Chromeleon 7 or the Control panel in Chromeleon 6.8.

2.19 Electrochemical Detection Modes

The Dionex ICS-5000 Electrochemical Detector can perform the following electrochemical detection modes:

- DC amperometry (see Section 2.19.1)
- Integrated amperometry—includes pulsed amperometric detection (PAD) and integrated pulsed amperometric detection (IPAD) (see Section 2.19.2)
- Cyclic voltammetry (see Section 2.19.3)

2.19.1 DC Amperometric Detection

In DC amperometry, a constant potential is applied to the working electrode. The potential can be entered into a Chromeleon 7 instrument method (see Figure 2-49) or Chromeleon 6.8 program.

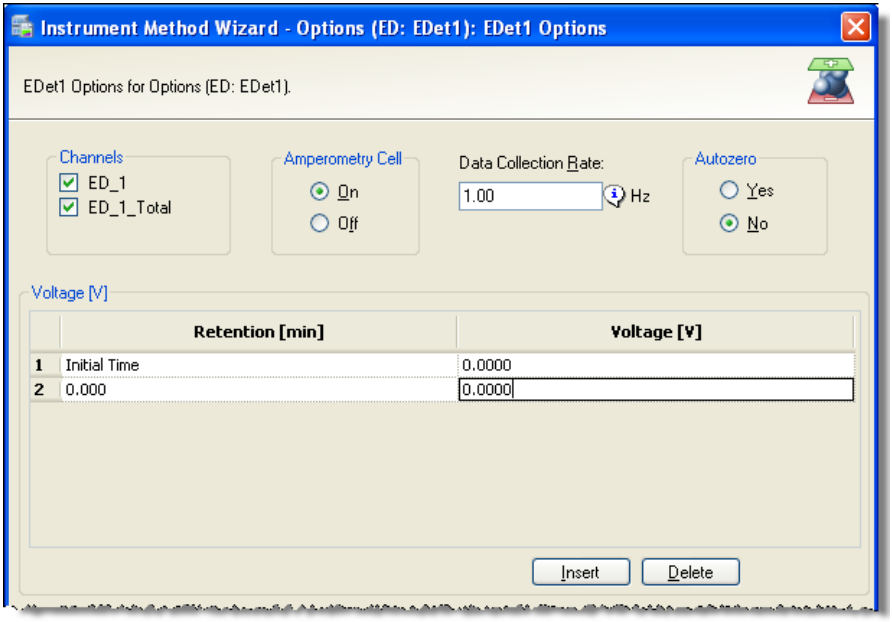


Figure 2-49. *DC Amperometry Instrument Method Wizard Page in Chromeleon 7*

The applied voltage can be changed up to 10 times during the run. The actual number of potential changes allowed depends on the available data storage

capacity, which is determined by the length of the run and the data sampling rate.

For direct control, enter the potentials on the DC ePanel in Chromeleon 7 or the Control panel in Chromeleon 6.8.

2.19.2 Integrated and Pulsed Amperometric Detection

Integrated and pulsed amperometric detection are similar to DC amperometry (see Section 2.19.1) in that molecules are oxidized or reduced at the surface of an electrode. However, with these detection modes, a series of potential changes is repeated over time. By repeatedly pulsing between optimized high positive and negative potentials, the electrode surface is continually regenerated. Current is measured by integration during a portion of the repeating potential vs. time waveform. See Section 2.19.4 for more information about waveforms.

Pulsed Amperometric Detection

In pulsed amperometric detection (PAD), current is integrated at a single constant potential (see Figure 2-50).

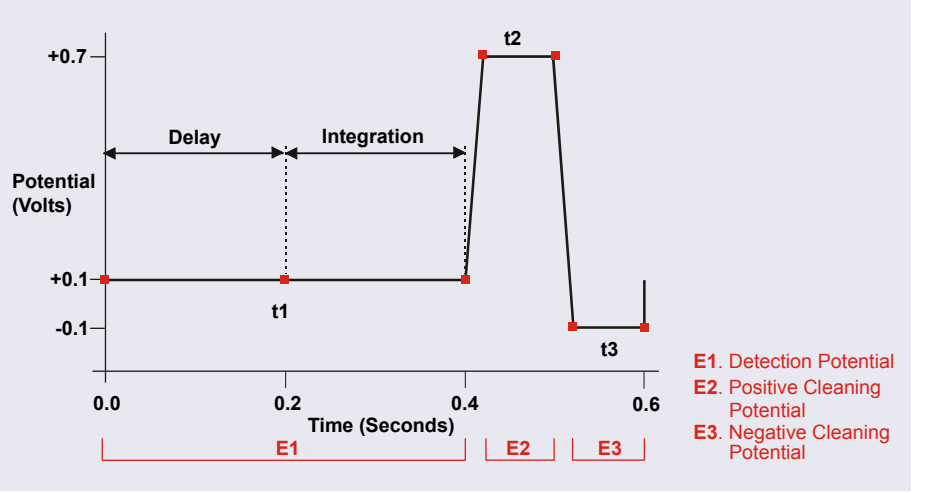


Figure 2-50. *Example Pulsed Amperometry Waveform*

The potentials, labeled E1, E2, and E3, are applied for durations t1, t2, and t3, respectively. At t1, the E1 potential is applied. After a delay, the signal is

measured by integrating the current for a fixed time. Current integrated for a fixed time is charge and the units are coulombs. At t2 and t3, positive and negative cleaning pulses are added to the waveform. This waveform period repeats until the end of data acquisition or until another waveform is specified.

Integrated Pulsed Amperometric Detection

With integrated pulsed amperometric detection (IPAD), current is integrated at two or more potentials (see Figure 2-51).

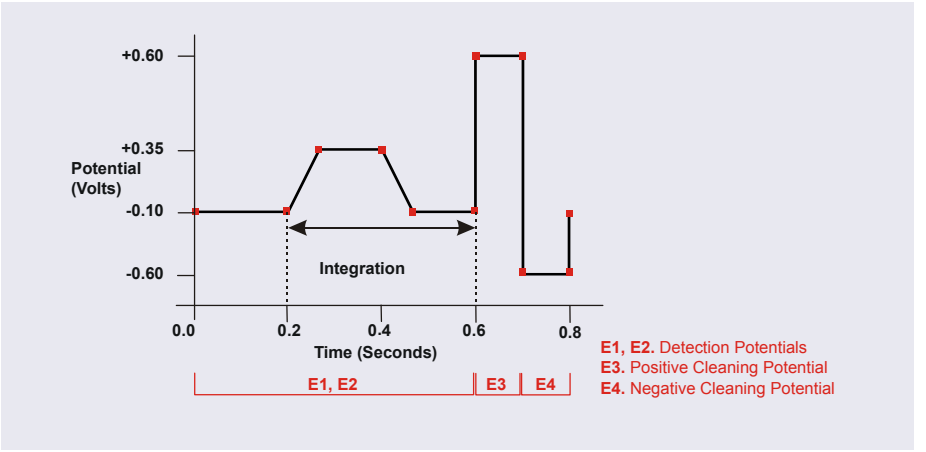


Figure 2-51. *Example Integrated Amperometry Waveform*

With the example waveform shown in Figure 2-51, the current is integrated both while the potential is swept across the metal oxide formation wave and also during the reverse sweep across the oxide reduction wave. This technique minimizes baseline shift and the peak dips that can occur when an eluting analyte's effect on oxide suppression is greater than the detector response from the analyte.

As with pulsed amperometric detection, the waveform period repeats until the end of data acquisition or until another waveform is specified.

2.19.3 Cyclic Voltammetry

The determination of the optimum potentials to use in amperometry begins with an electrochemical technique called voltammetry, in which the current that results from oxidation or reduction reactions is measured against the voltage applied to the system. The applied voltage is changed (scanned) within preset limits.

Chromeleon 6.8 supports cyclic voltammetry. In cyclic voltammetry, the voltage is first scanned in one direction and then reversed so that the voltage at the end of the scan is the same as at the beginning. This results in a triangular waveform (see Section 2.19.4).

In the cyclic voltammetry mode, the detector measures the current at a rate of 1 kHz (i.e., 1000 raw data points per second are collected). The data is compressed before storage to 20 Hz.

2.19.4 Waveforms

A waveform is a series of steps, defined as points on a plot of potential vs. time. Waveforms must be defined for the cyclic voltammetry and integrated amperometry modes.

Cyclic Voltammetry Waveforms

Cyclic voltammetry waveforms are defined by three points, each with a time and a potential. The waveform forms a triangle, with the first point always at time zero and the first and third points always having the same potential.

Figure 2-52 shows an example of a triangular waveform used in cyclic voltammetry.

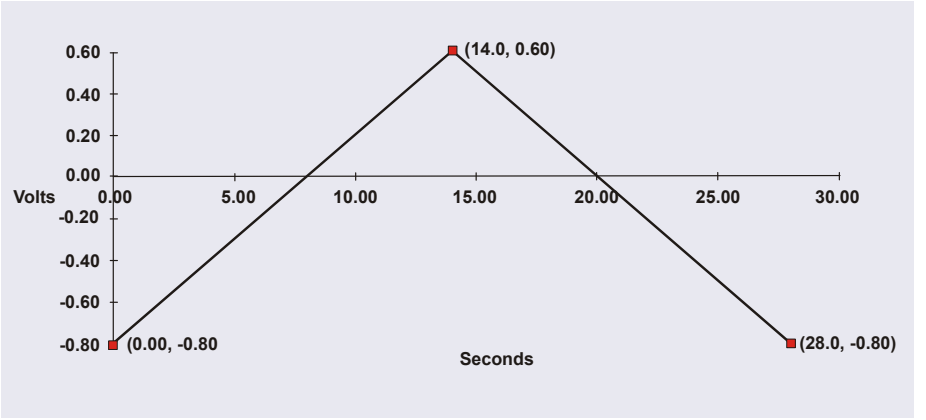


Figure 2-52. *Example Cyclic Voltammetry Waveforms*

In this example, the potential is scanned from -0.80 to +0.60 V and then from +0.60 to -0.80 V. The total time for one waveform period is 28 s. This provides a sweep rate of 0.1 V/s as shown in the equation below.

$$\frac{2 \times \Delta V}{CV\ Cycle\ Time} = Sweep\ Rate$$

$$\frac{2 \times 1.4V}{28s} = 0.1\ \frac{V}{s}$$

Cyclic voltammetry waveforms are defined manually on the Chromeleon 6.8 electrochemical detector Control panel. Click the **CV Mode** button to display the following window.

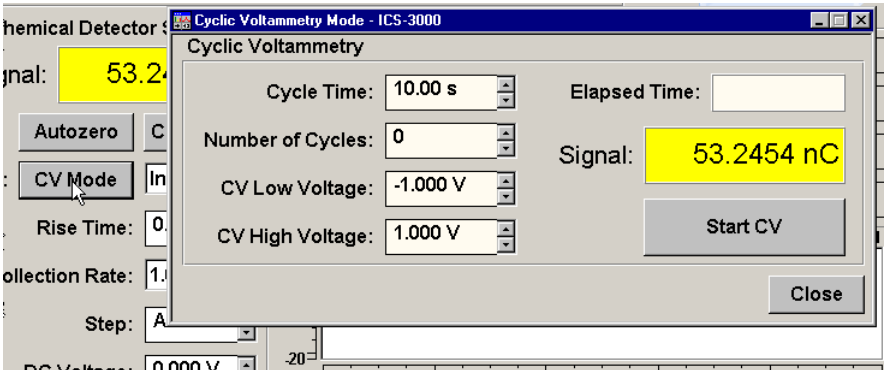


Figure 2-53. *Cyclic Voltammetry Control Panel*

Integrated Amperometry Waveforms

Integrated amperometry waveforms are included in an instrument method in Chromeleon 7 or a program in Chromeleon 6.8. Integrated amperometry waveforms have the following characteristics:

- The duration of one waveform period can be between 0.05 and 2.0 s, with a step resolution of 10 ms. A waveform can have no more than 100 steps.
- The maximum waveform period is 2.0 s. However, for 2D data, because only one data point is generated per waveform period, the effective maximum length of a waveform period depends on the *data collection rate* (the rate at which Chromeleon collects digital data points from the detector). The relationship is as follows:

$$\textit{Data Collection Rate} = 1/\textit{Waveform Period}$$

- Multiple waveforms can be defined for a single run, provided they all have the same cycle duration. Up to 15 waveform changes per run are allowed.
- Each waveform can have only one integration interval. However, 3D amperometric data can be reprocessed after the run with integration intervals at multiple points in the waveform (see Section 2.19.5).
- The integration interval generates one integrated data point per waveform.

Chromeleon provides several pre-programmed waveforms.

You can use a pre-programmed waveform, without modification, or modify it for your application. You can also define a new waveform. Waveforms are defined and modified in the Waveform Editor (see Figure 2-54).

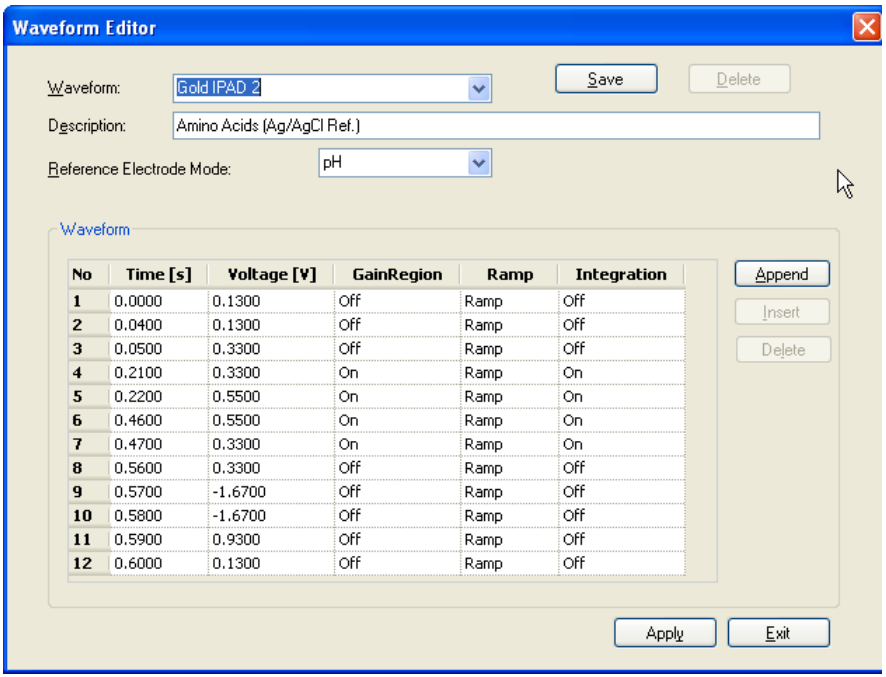


Figure 2-54. *Waveform Editor in Chromeleon 7*

To view the Waveform Editor, click **Edit** on the **ED Options** page in the Instrument Method Wizard (Chromeleon 7) or Program Wizard (Chromeleon 6.8).

Analytical vs. Scanning Waveforms

The pre-programmed analytical waveforms supplied with Chromeleon are designed for quantitative analysis of specific compounds (alcohols, amino acids, carbohydrates, etc.). With analytical waveforms, integration occurs either while a single constant potential is being applied over time (see the example waveform in Figure 2-50) or while a series of stepped potentials is being applied (see the example waveform in Figure 2-51).

With scanning waveforms, integration occurs while the potential is being increased linearly over time (see the example scanning waveform in Figure 2-55). Although scanning waveforms are typically not as useful for quantitative analysis as analytical waveforms, when used to collect 3D amperometric data, scanning waveforms can be optimized to provide characteristic I-t plots (see Section 2.19.5). Comparison of I-t plots of a known substance with an unknown can help to identify unknown peaks or to determine whether a substance is coeluting with another.

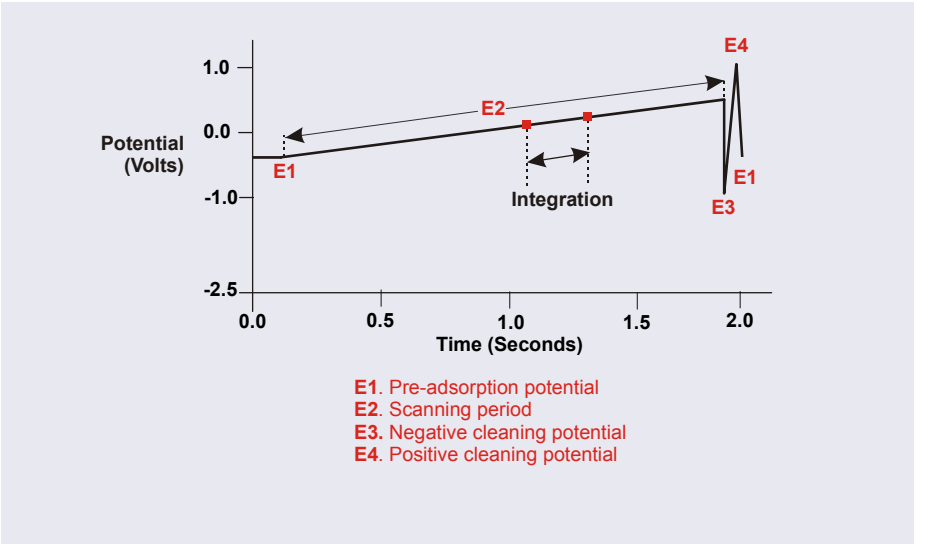


Figure 2-55. *Example Scanning Waveform*

2.19.5 Storing and Reprocessing Amperometry Data

Chromeleon provides storage of 2D and 3D pulsed amperometry and integrated amperometry data. For 2D data, Chromeleon stores the detector's response at each waveform period's integration interval. One integrated data point per waveform period is stored. This allows you to produce a chromatogram similar to the example shown in Figure 2-56. The retention

time (in minutes) is on the x-axis and the detector response (in nanoCoulombs) is on the y-axis.

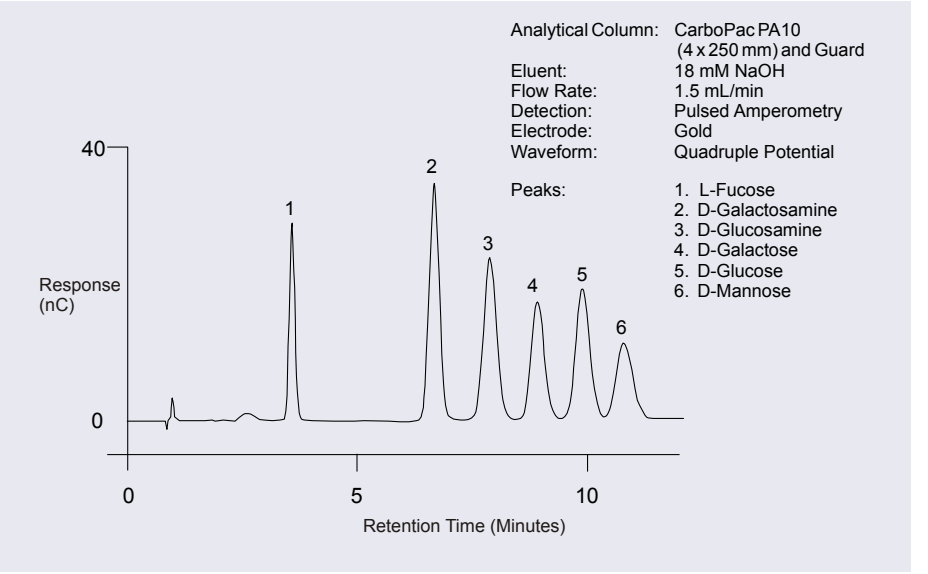


Figure 2-56. *Example Chromatogram for a Pulsed Amperometry Application*

For 3D amperometry data, Chromeleon stores raw data points at a rate of 1 KHz throughout the entire run. Each raw 3D data point is defined by the following attributes: the detector current (1) recorded at a particular waveform time (2) and at a specific retention time (3). As a result, the two-dimensional view of an integrated amperometry chromatogram (retention time vs. integrated current) is extended by a third dimension (waveform time). Thus, data for the entire waveform period—not just the integration intervals—are collected.

Displaying and Reprocessing 3D Data

This section describes how to display and reprocess 3D amperometry data using Chromeleon 6.8. If you are using Chromeleon 7, the features described here are available by displaying the data in a contour plot. For details, refer to the Chromeleon 7 Help.

In Chromeleon 6.8 you can display and reprocess 3D amperometry data in the 3D Amperometry View window (see Figure 2-57). To open the window,

double-click the sample in the Browser to open the chromatogram. On the **View** menu, click **3D-Amperometry**.

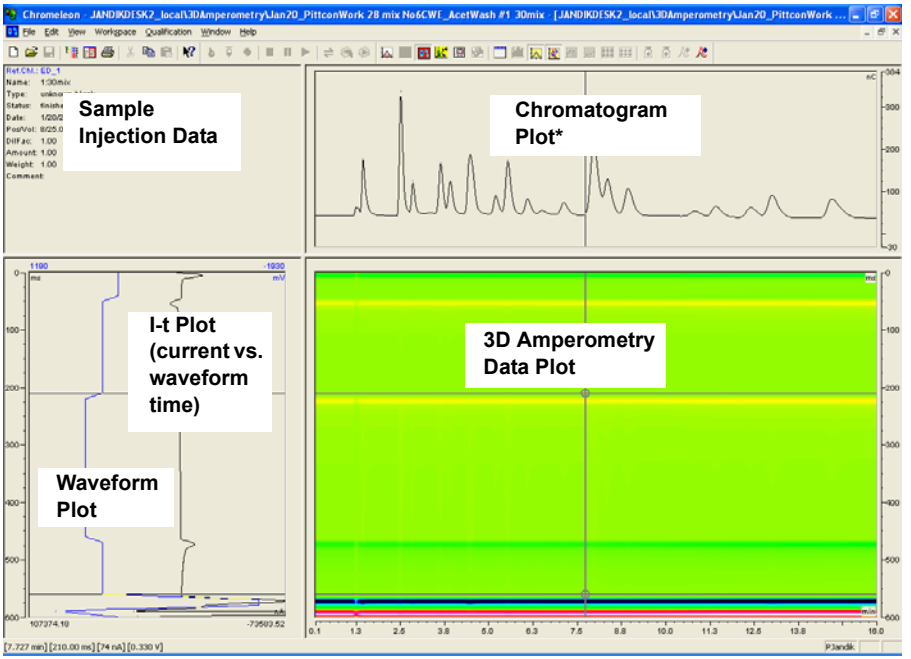


Figure 2-57. *3D Amperometry View Window in Chromeleon 6.8*

*The chromatogram plot shown in Figure 2-57 was obtained by plotting integrated current (charge, nC) vs. retention time.

The window is divided into several display areas:

Sample injection data	Displays information about the sample.
Chromatogram plot	Displays a chromatogram of data selected from the selected integration interval in the 3D amperometry data plot.
3D amperometry data plot	Displays the raw 3D amperometry data.
Waveform/I-t plot	Displays an I-t plot (current vs. waveform time) of selected data and optionally a waveform plot.

In Chromeleon 6.8, the raw 3D amperometry data plot can be viewed as either an Iso or a 3D (wireframe) plot. For both plot types, colors are used to represent the ranges of response values.

The Iso view is the default view for the 3D raw data. This is a top down view of the data (imagine you are looking down on the data from above the plot) (see Figure 2-58). The x-axis is the retention time (min) and the y-axis is the waveform period (ms). The z-axis, which is represented by different colors in the plot, is the response (nA).

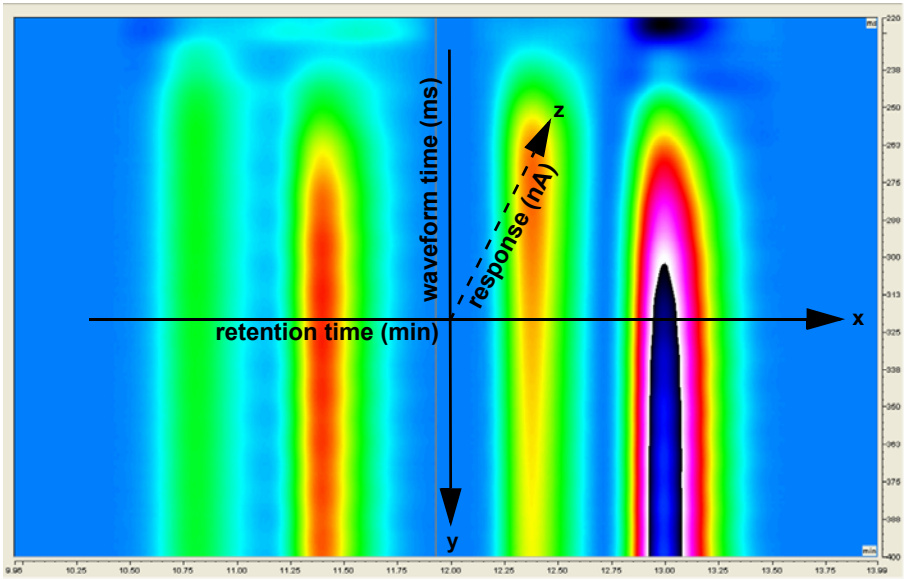


Figure 2-58. *3D Amperometry Data in Chromeleon 6.8: Iso View*

NOTE The 3D data shown in Figures 2-58 and 2-59 were collected using an analytical waveform (see "Analytical vs. Scanning Waveforms" on page 108).

To switch to the 3D plot view, right-click on the Iso plot, select **Decoration** and click the **Iso/3D Plot** tab. The 3D view projects the response values in the third dimension, which allows you to see the height of responses as well as the colors representing different magnitudes of detection signal along the z-axis

(see Figure 2-59). For this view, imagine you are standing in front and slightly to the left of the plot.

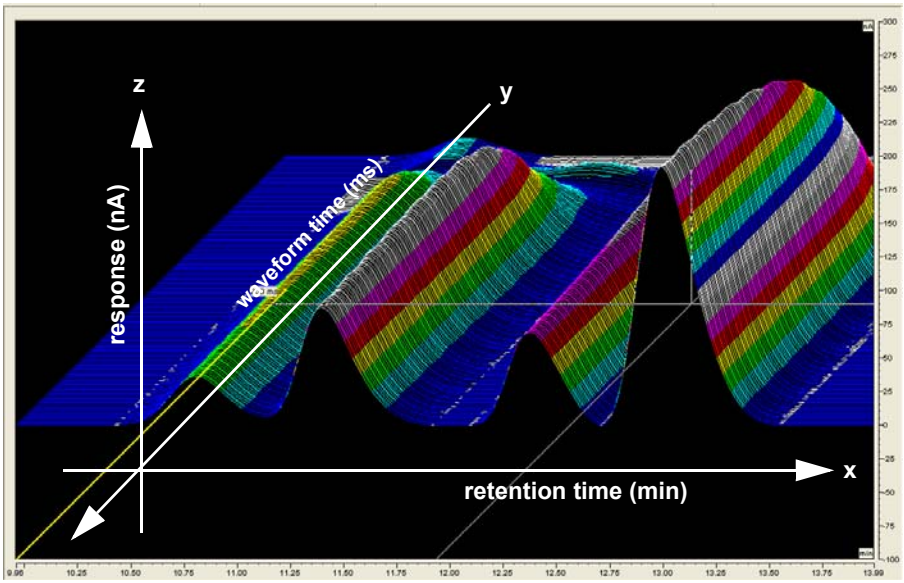


Figure 2-59. *3D Amperometry Data in Chromeleon 6.8: 3D View*

Baseline Correction

Based on the peak recognition algorithm or by peaks obtained with a user drawn base line, Chromeleon can calculate a baseline I-t plot for each data point of a peak. Each I-t plot measured at a given retention time can be corrected by subtracting the calculated baseline I-t plot from the 3D amperometry data. By definition, if baseline correction is enabled, 3D amperometry data is zero unless a peak is present.

TC Description

2.20 TC Front Features

A status bar on the front of the Dionex ICS-5000 Thermal Compartment (TC) includes LEDs (light emitting diodes) that indicate the status of several TC components and functions (see Figure 2-60).

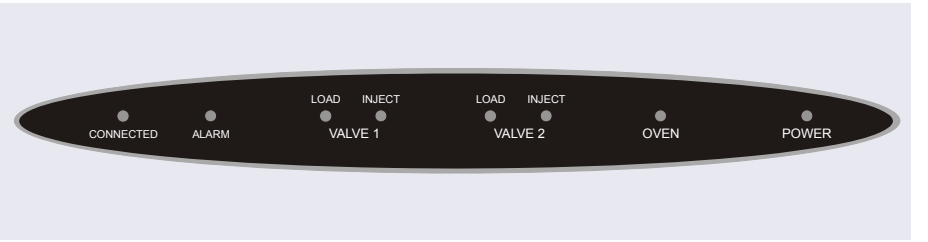


Figure 2-60. *TC Status Bar*

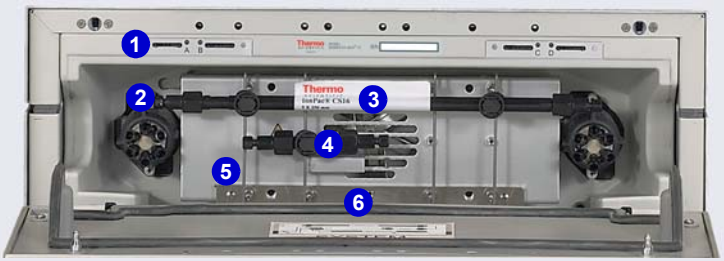
LED Label	If the LED Is On	If the LED Is Flashing
CONNECTED	The TC is connected to a Chromeleon 7 instrument or a Chromeleon 6.8 timebase.	Does not flash.
ALARM	A sensor detected the presence of a gas or humidity leak inside the TC, or a valve or oven error was detected. Check the Chromeleon Audit Trail for the cause.	Does not flash.
VALVE 1 LOAD **VALVE 2 LOAD** **VALVE 1 INJECT** **VALVE 2 INJECT**	Indicates whether the injection valve is in the Load or Inject position.	Valve error. See Section 8.30 for troubleshooting.

LED Label	If the LED Is On	If the LED Is Flashing
OVEN	The TC is at its set temperature.	The TC is transitioning to the set temperature. The TC is not ready for operation. If the LED is flashing **and** the **ALARM** LED is lighted, an oven error has been detected. See Section 8.30 for troubleshooting.
POWER	When the power is on, this LED is lighted. Use the **POWER** button on the front of the TC for routine on/off control. To turn on the TC, press the **POWER** button. To turn off the TC, press and hold the **POWER** button for 2 seconds.	Does not flash.

NOTE The main power switch is on the TC rear panel (see Figure 2-62).

2.21 TC Interior Components

Figure 2-61 illustrates the interior of the TC. The components installed in your TC may vary, depending on your application.



1 Slots for Column ID Chip Cards (A, B, C, and D)
2 Injection Valves
3 Separator Column
4 Guard Column
5 Column Brackets
6 Temperature Stabilizer

Figure 2-61. *TC Interior View (Dual System Configuration Shown)*

Injection Valves

The TC can hold one or two electrically-actuated, high-pressure injection valves. Two valve models are available:

- A 2-position, 6-port Rheodyne TitanHP™ injection valve
- A 2-position, 10-port Rheodyne TitanHP™ injection valve

See Section 2.23 for details about the injection valves.

Column Brackets

The column brackets are installed in the TC at the factory. The TC can hold up to three columns with an inner diameter of 1 to 9 mm and a maximum length of 30 cm (11.8 in). Columns are attached to the brackets with special column clips (P/N 064786; set of six clips).

Temperature Stabilizers (Optional)

Installation of a temperature stabilizer (standard bore, P/N 064548; microbore, P/N 064650) ensures that (a) the temperature of the stationary phase remains constant over the total column length and (b) the column and the eluent have the same temperature during the analysis.

When these conditions are met, the analytical separation is performed at the nominal temperature. This minimizes fronting and tailing of peaks, as well as retention time variations.

Column ID Chip Card Slots

The TC column ID (identification) system lets you store column-specific information on a memory card and read the information at any time. Up to four column ID chip cards can be installed at the same time. The TC is shipped with two column ID chip cards (P/N 5710.1500). An optional Column ID Kit (P/N 066353) containing five chip cards is available.

See Section 2.24 for details about the column ID system.

2.22 TC Rear Panel

Figure 2-62 illustrates the rear panel of the TC.

1 Main Power Switch, Fuse Holder, and Power Receptacle

2 Digital I/O Connectors (2)

3 USB Receptacle ("B" Connector)

4 Drain Port

Figure 2-62. *TC Rear Panel*

Main Power Switch, Fuse Holder, and Power Receptacle

The rear panel power switch is the main power switch for the TC. Turn on the main power switch before initial operation, and leave the switch on unless instructed to turn it off (for example, before performing a service procedure).

NOTE For routine on/off control of the TC, use the **POWER** button on the front of the module. To turn off the TC, press and hold the **POWER** button for 2 seconds.

The fuse holder contains two 2-amp fuses (P/N 954776). For instructions on how to change the fuses, see Section 9.33.

The power cord plugs into the IEC 320 three-prong receptacle.

CAUTION

The power supply cord is used as the main disconnect device. Make sure the socket-outlet is located near the TC and is easily accessible.

Le cordon d'alimentation principal est utilisé comme dispositif principal de débranchement. Veillez à ce que la prise de base soit située/installée près du module et facilement accessible.

Das Netzkabel ist das wichtigste Mittel zur Stromunterbrechung. Stellen Sie sicher, daß sich die Steckdose nahe am Gerät befindet und leicht zugänglich ist.

Digital I/O Connectors

The two 6-pin mini-DIN connectors can be used to exchange digital signals with any external device capable of being controlled through a relay or TTL input. The two connectors are identical in function.

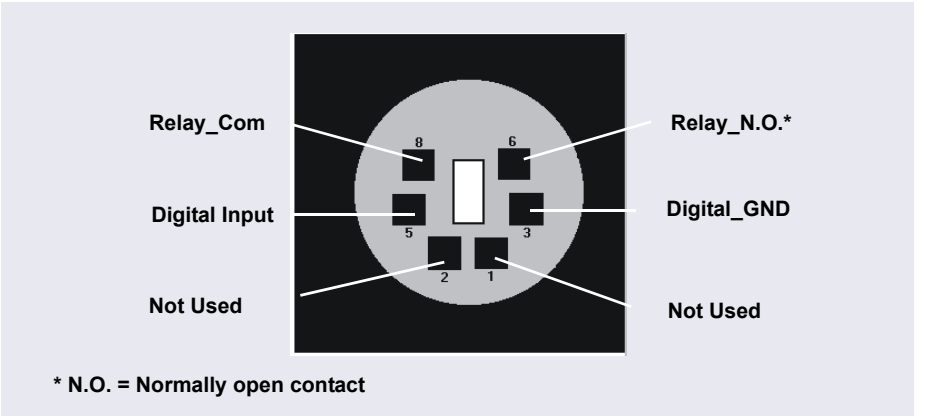


Figure 2-63. *Digital I/O Connector*

When the relay is activated, the connection is between Com and N.O.

Connection	Description
Digital Input <---> Digital_GND	0 to +5 V
Relay_Com <---> Relay_N.O.	Switching voltage: 100 VDC Switching current: 0.25 A Carry current: 1.0 A Switching capacity: 3 W Contact resistance: Max. 150 megohms

Use the 6-pin mini-DIN signal cable (P/N 6000.1004) provided in the TC Ship Kit (P/N 064789) to connect the TC to an external device. For details about the pin assignments, refer to Table 2-5.

Pin	Signal Name	Signal Level	Core Color	Core Label
1	Not occupied	----	Pink	Analog High
2	Not occupied	----	Gray	Analog Low
3	Digital_GND	0 V	Green	Digital GND
5	Digital Input	0 to +5 V	Yellow	Digital Input
6	Relay_N.O.	100 V_{DC}/0.25 A/3 W	Brown	Digital Output
8	Relay_Com	100 V_{DC}/0.25 A/3 W	White	Dig./Out (GND)
			Black	Shield

Table 2-5. *Pin Assignments for the TC Mini-DIN Signal Cable*

USB Receptacle

The USB (Universal Serial Bus) receptacle (“B” type connector) provides a connection to the PC on which Chromeleon is installed. Select one of the following methods to establish the connection:

- Connect the TC directly to the USB receptacle on the PC.
- Connect the TC to the PC through another USB device in the system (for example, the pump).

The TC Ship Kit (P/N 064789) includes a 1 m (3 ft) USB cable (P/N 063246).

Drain Port

The drain port removes any liquid that collects in the drip tray in the bottom of the TC. A clear corrugated drain hose (P/N 055075) is connected to this port during installation. Place the drain hose into a waste container. To maintain a positive siphon, position the waste container below the level of the TC.

IMPORTANT **For correct drainage, make sure the drain hose is not bent, pinched, or elevated at any point. Do not allow the end of the hose to be submerged in waste liquid.**

2.23 Injection Valves

The TC is available in the following configurations:

TC Description	Part Number
TC with no injection valves	074108
TC with one 2-position, 6-port high-pressure injection valve	074109
TC with two 2-position, 6-port high-pressure injection valves	074112
TC with one 2-position, 6-port high-pressure injection valve and one 2-position, 10-port high-pressure injection valve (The 6-port valve is installed on the left side of the module.)	074113

2.23.1 Injection Valve Operation

The 6-port injection valve has two operating positions: Load and Inject. Liquid flows through either the Load or Inject path, depending on the valve position.

Figure 2-64 shows flow schematics for the 6-port valve.

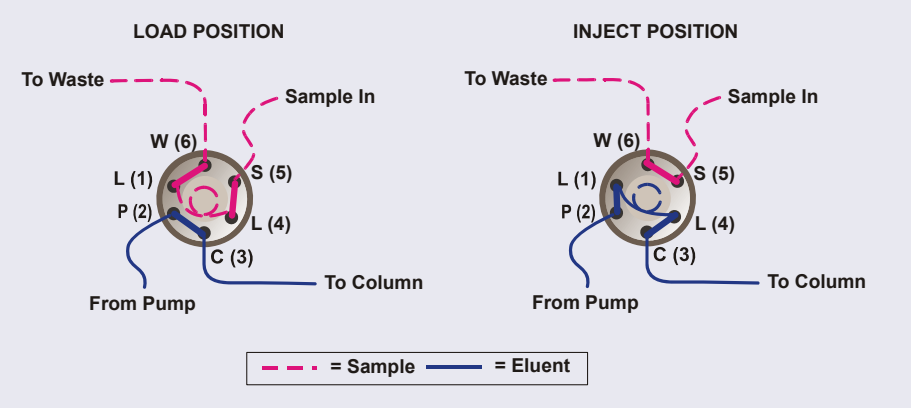


Figure 2-64. *TC Injection Valve Flow Schematics (6-Port Valve)*

- In the Load position, sample is loaded into the sample loop, where it is held until injection. Eluent flows from the pump, through the valve, and to the column, bypassing the sample loop. Sample flows from the syringe

or autosampler line (if installed), through the valve, and into the sample loop. Excess sample flows out to waste.

- In the Inject position, sample is swept to the column for analysis. Eluent flows from the pump, through the sample loop, and on to the column, carrying the contents of the sample loop with it. Section 5.3.1 describes how to inject samples.

The 10-port injection valve has two operating positions: 10_1 and 1_2. Liquid flows through the path between either ports 10 and 1 or ports 1 and 2, depending on the valve position.

Figure 2-65 shows example flow schematics for the 10-port valve when it is connected for an application that uses a concentrator column.

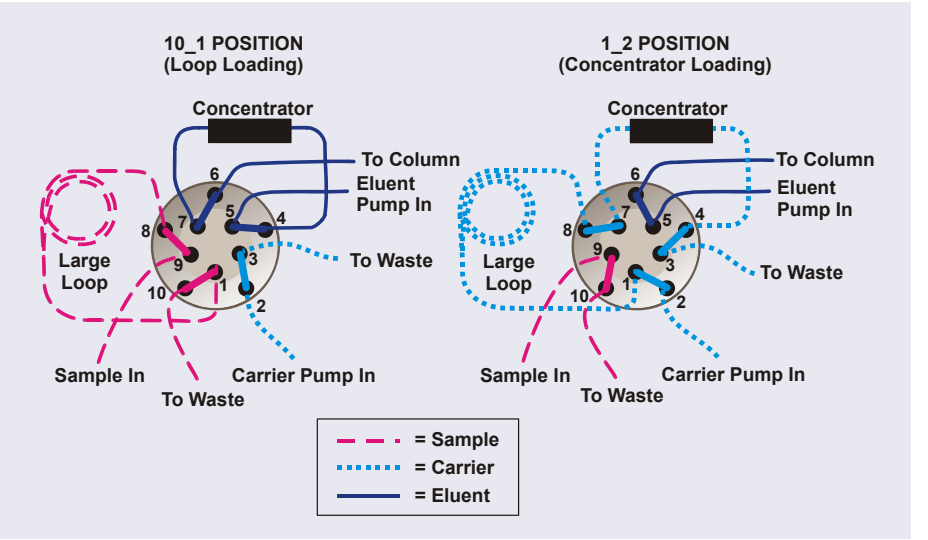


Figure 2-65. *TC Injection Valve Flow Schematics (10-Port Valve) Example Connections: Large Loop to Concentrator*

- In the 10_1 position, sample flows from the syringe or autosampler line, through the valve, and into the sample loop. Excess sample flows out to waste. Eluent flows from the eluent pump, through the valve, through the concentrator column, and to the separator column. If sample was previously loaded onto the concentrator column, it is swept to the separator column for analysis.

- In the 1_2 position, carrier liquid flows through the sample loop and on to the concentrator column, carrying the contents of the sample loop with it. Excess flows out to waste. Eluent flows from the pump, through the valve, and to the separator column, bypassing the concentrator column.

2.23.2 Injection Valve Plumbing

Figure 2-66 shows the injection valve connections for the 6-port valve. The injection valve is plumbed at the factory with all tubing and fittings for connection to the pump, sample loading port, column, and waste. A 25 µL PEEK sample loop (P/N 042857) is installed between ports L (1) and L (4).

Thermo Fisher Scientific offers sample loops in various sizes. If needed, the pre-installed 25 µL loop can be replaced with a loop that has a different sample injection volume.

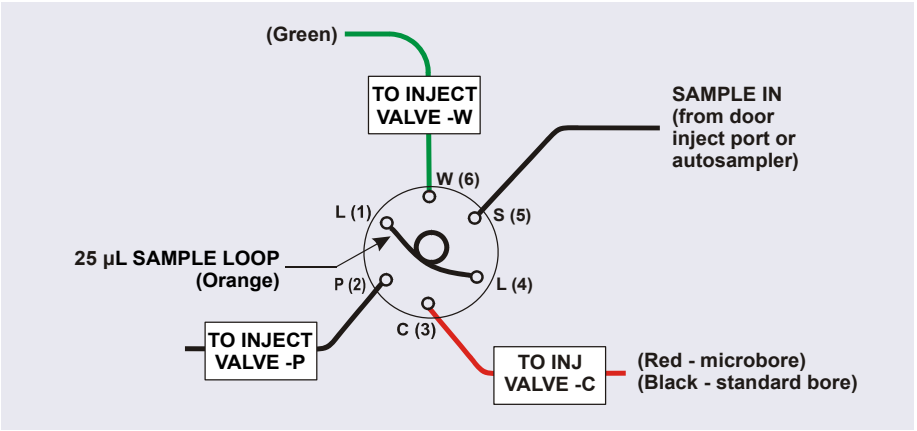


Figure 2-66. *Injection Valve Plumbing (6-Port Valve)*

2.24 Column Identification (ID) System

The electronic column ID system stores column-specific information on a column ID chip card (P/N 5710.1500) that is connected to a column for the column life cycle (see Figure 2-67).

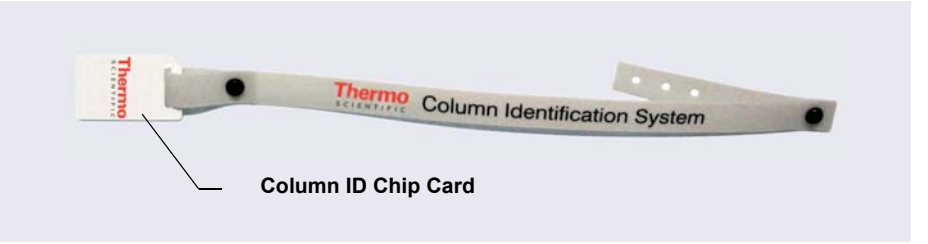


Figure 2-67. *Column ID (Identification) System*

The columns to be monitored are selected in the TC Properties dialog box in the Chromeleon 7 Instrument Configuration program or the Chromeleon 6.8 Server Configuration program. To select column properties (see below) for storage and to review the stored information at any time, use the TC ePanel in Chromeleon 7 or the TC Control panel in Chromeleon 6.8. The properties are also available in the Chromeleon Commands dialog box. Information on the column ID chip card is continuously updated, as long as the column and the chip card are installed in the TC.

Column Properties

Two types of information can be stored on the column ID chip card:

- *Primary column properties* are entered once by the column manufacturer or the user and are never changed during the lifetime of the column. The primary properties are the product ID, serial number, batch/lot number, date of manufacture, and custom information.
- *Secondary column properties* are entered by the user and can be changed whenever required by any Chromeleon user with Expert privileges. Secondary properties include the column manufacturer, diameter, length, particle size, maximum number of injections, pH limits, and upper pressure limit. For a complete list of secondary properties, refer to the Chromeleon Help.

2.25 Gas and Humidity Sensors

The TC contains two sensors to detect any gas or humidity that may accumulate inside the TC. When a certain concentration of gas or humidity is reached (while the door is closed), the following events occur:

- The corresponding sensor is activated.
- The **ALARM** LED on the front of the TC lights (red), and remains red as long as the sensor is exposed to gases or humidity.
- The error is logged in the Chromeleon Audit Trail.
- A beep sounds.

What to do when an alarm occurs:

1. Find and eliminate the leak.
2. If you are using Chromeleon 7: Open the Commands dialog box (press the **F8** key). Select the TC and click the **Commands** tab. Click the **ClearAlarmLED** button.
3. If you are using Chromeleon 6.8: On the TC Control panel, click the **Clear Alarm** button.
4. Ventilate the interior of the TC thoroughly before closing the door and resuming operation.

Adjusting the Sensor Sensitivity

Follow these steps to change the sensitivity setting of the gas or humidity sensor, or to turn off a sensor:

1. Open the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset.
2. Press the **F8** key to open the Commands dialog box.
3. Select the TC.
4. If you are using Chromeleon 7: Click the **Parameters** tab page for the TC, click the **GasLeakSensor** or **HumidityLeakSensor** parameter. Select the new sensitivity setting (or select **Off** to disable the sensor).
5. If you are using Chromeleon 6.8, click the plus sign beside **TC** to display the items underneath. Under **TC_Temp**, select the **GasLeakSensor** or

HumidityLeakSensor parameter. Select the new sensitivity setting (or select **Off** to disable the sensor) and click **Execute**.

2.26 TC Theory of Operation

The fundamental requirement for a thermal compartment intended for chromatography applications is the ability to maintain the preset temperature as precisely as possible. The TC contains advanced electronic circuitry that maintains the selected temperature with a precision of ±0.1 °C.

The TC can be heated from 5 to 85 °C in 0.1 °C increments. An increase in temperature from 20 to 50 °C (or a decrease from 50 to 20 °C) is typically realized in less than 20 minutes. Columns can be warmed up to 85 °C. If the ambient temperature changes during the analysis, increased heating or cooling ensures that the column temperature remains constant.

IMPORTANT **Operating IC columns at temperatures above 70 °C (158 °F) may affect column performance. Before selecting the TC temperature, refer to the column manual for the recommended operating conditions. Column manuals are provided on the Thermo Scientific Reference Library DVD (P/N 053891).**

The thermo-optimized design of the TC reduces the time required to equilibrate the temperature between the column and the eluent. Peltier elements in the TC heat up and cool down the columns. They also help to bring the air and all of the installed components (including the injection valves) to the selected temperature.

If necessary, a temperature stabilizer (standard bore, P/N 064548; microbore, P/N 064650) can be installed in the TC. Installation of a temperature stabilizer ensures that:

- The stationary phase temperature remains constant over the total column length.
- The column and the eluent have the same temperature during the analysis.

Under these conditions, the separation is performed at the nominal temperature. This minimizes fronting and tailing of peaks, as well as retention time variations.

The temperature achieved may vary from the control range, depending on the ambient temperature (see the table below).

Control Range	Achieved Temperatures (Based on Ambient)
5 to 85 °C	Minimum temperature 18 °C below ambient Maximum temperature 70 °C above ambient

For example, if the ambient air temperature in the lab is 30 °C and you set the temperature to 5 °C, the actual temperature achieved will be about 12 °C.

Do not touch any metal parts inside the TC while it is heating up or after it reaches the set point temperature. Wait for the compartment to cool down before servicing any parts.

Ne touchez à aucune des pièces métalliques à l'intérieur du TC pendant qu'il chauffe ou après qu'il ait atteint la température de consigne. Attendez que le compartiment soit refroidi avant de réparer les pièces.

Berühren Sie im TC keine metallischen Teile, während dieses aufgeheizt wird oder nachdem die Solltemperatur erreicht ist. Warten Sie, bis die Kammer abgekühlt ist, ehe Sie Wartungsarbeiten durchführen.

2.26.1 Predictive Performance

The Predictive Performance feature of the TC provides various functions for estimating the lifetime of replaceable parts and for planning and recording service and qualification procedures.

A partial list of the TC Predictive Performance functions is provided below. Refer to the Chromeleon Help for details.

- Monitoring of the total cooling and heating workload performed by the compartment and the total operating hours since initial operation
- Monitoring of the injection valve usage
- Reminders for service and qualification periods, including display of warning messages when limits are approaching or overdue

Predictive Performance commands and parameters are available in the Chromeleon Commands dialog box.

3 • Configurations

3.1 Overview

This chapter provides example component and plumbing drawings for the following Dionex ICS-5000 system configurations:

Dionex ICS-5000 IC System Configuration	See
Capillary IC: Dual RFIC-EG System (CD/CD)	page 130
Capillary IC: Dual RFIC-EG System (CD/ED)	page 131
Hybrid System: Dual RFIC-EG System (CD Analytical/CD Capillary)	page 132
Analytical IC: Single System without EG (CD)	page 133
Analytical IC: Single RFIC-EG System (CD)	page 134
Analytical IC: Dual RFIC-EG System (CD/CD)	page 135
Analytical IC: Dual RFIC-EG System (CD/ED)	page 136
Analytical IC: Single RFIC-EG System with Matrix Elimination Using a DP and a 6-Port Valve	page 137
Analytical IC: Single RFIC-EG System with Matrix Elimination Using an SP and a 10-Port Valve	page 138
Analytical IC: Single RFIC-EG System with Post-Column Reagent Addition (Bromate)	page 139
Analytical IC: Single RFIC-EG System with ED and VP (for Carbohydrate Analysis)	page 140

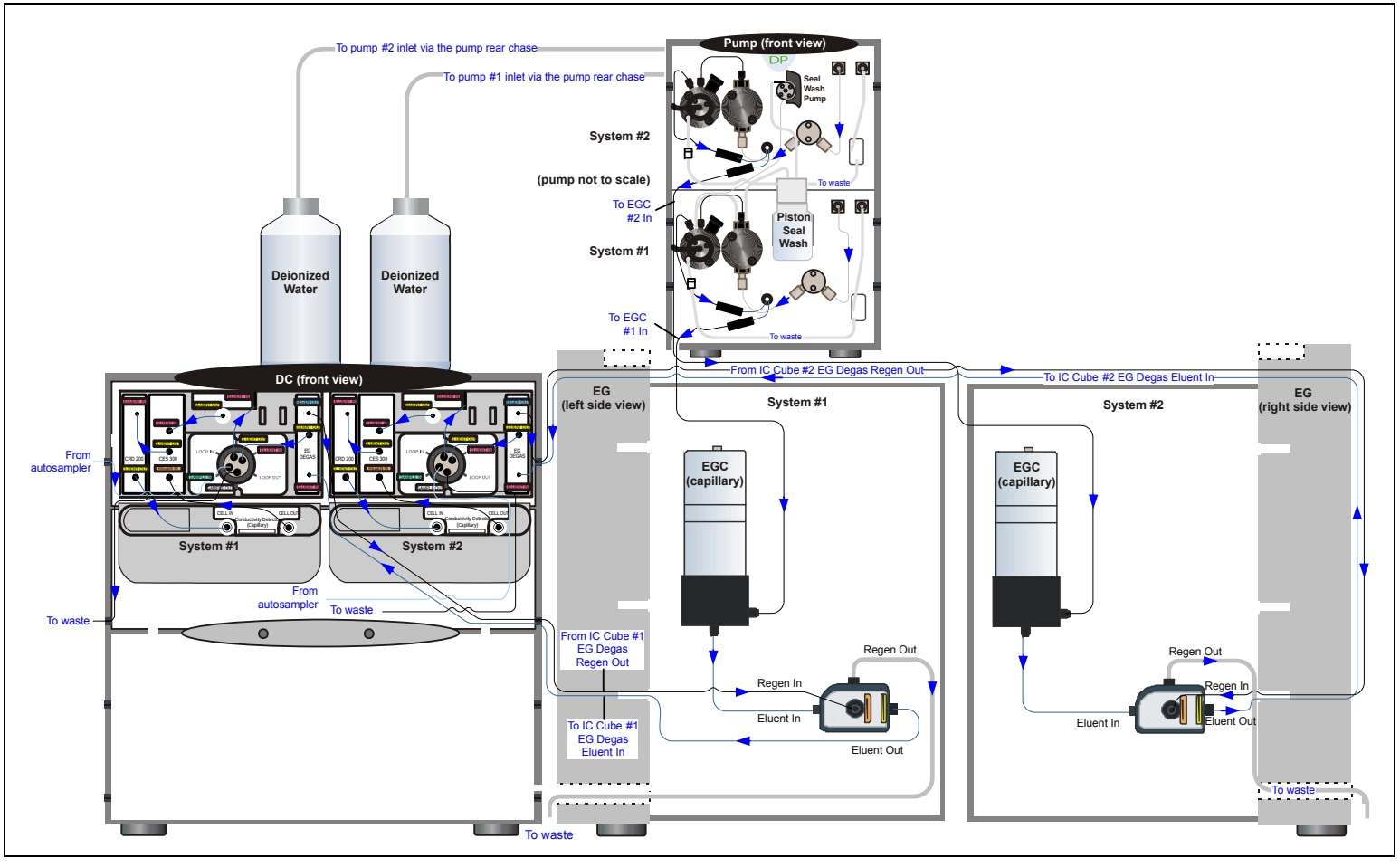


Figure 3-1. *Capillary IC: Dual RFIC-EG System (CD/CD)*

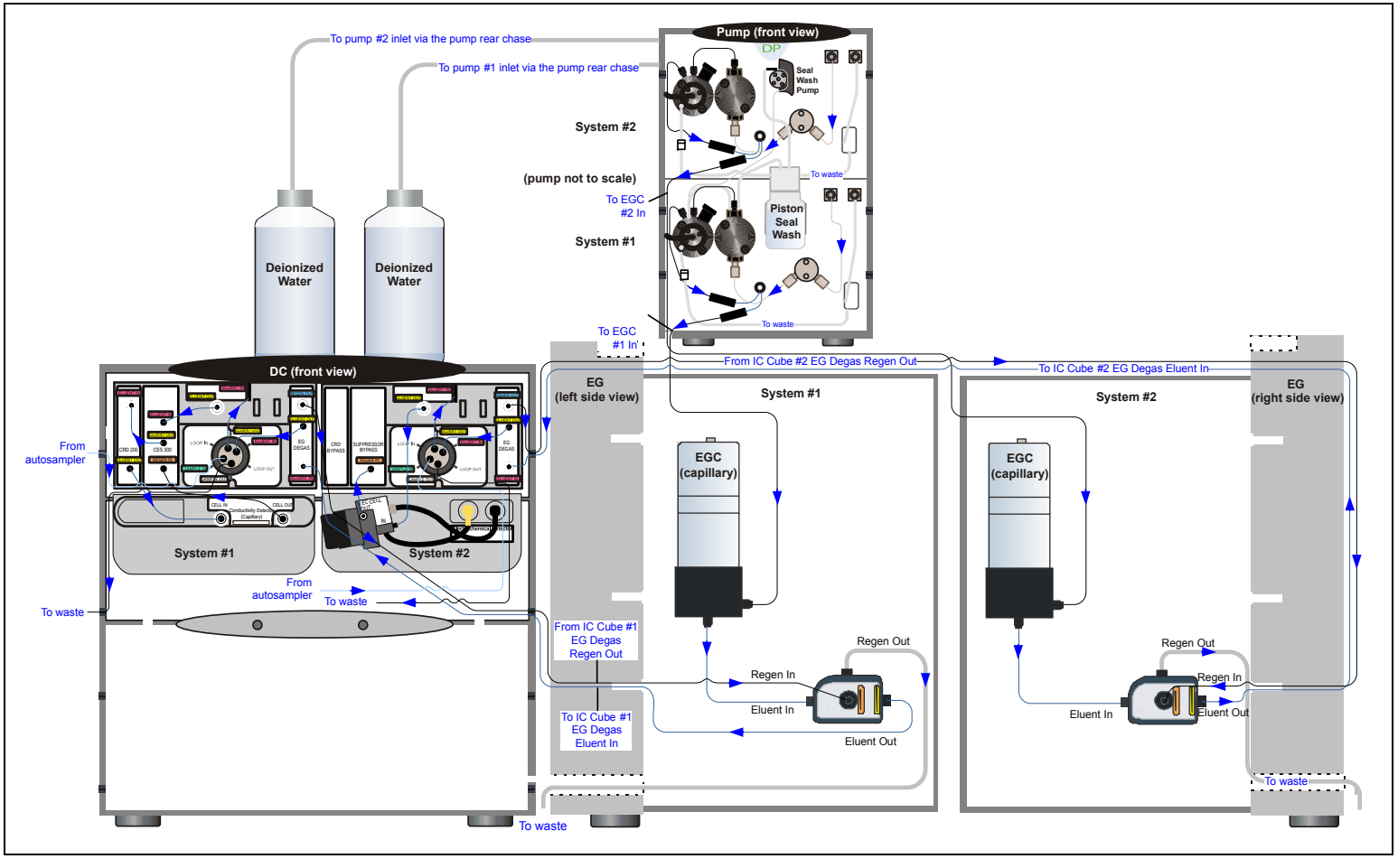


Figure 3-2. *Capillary IC: Dual RFIC-EG System (CD/ED)*

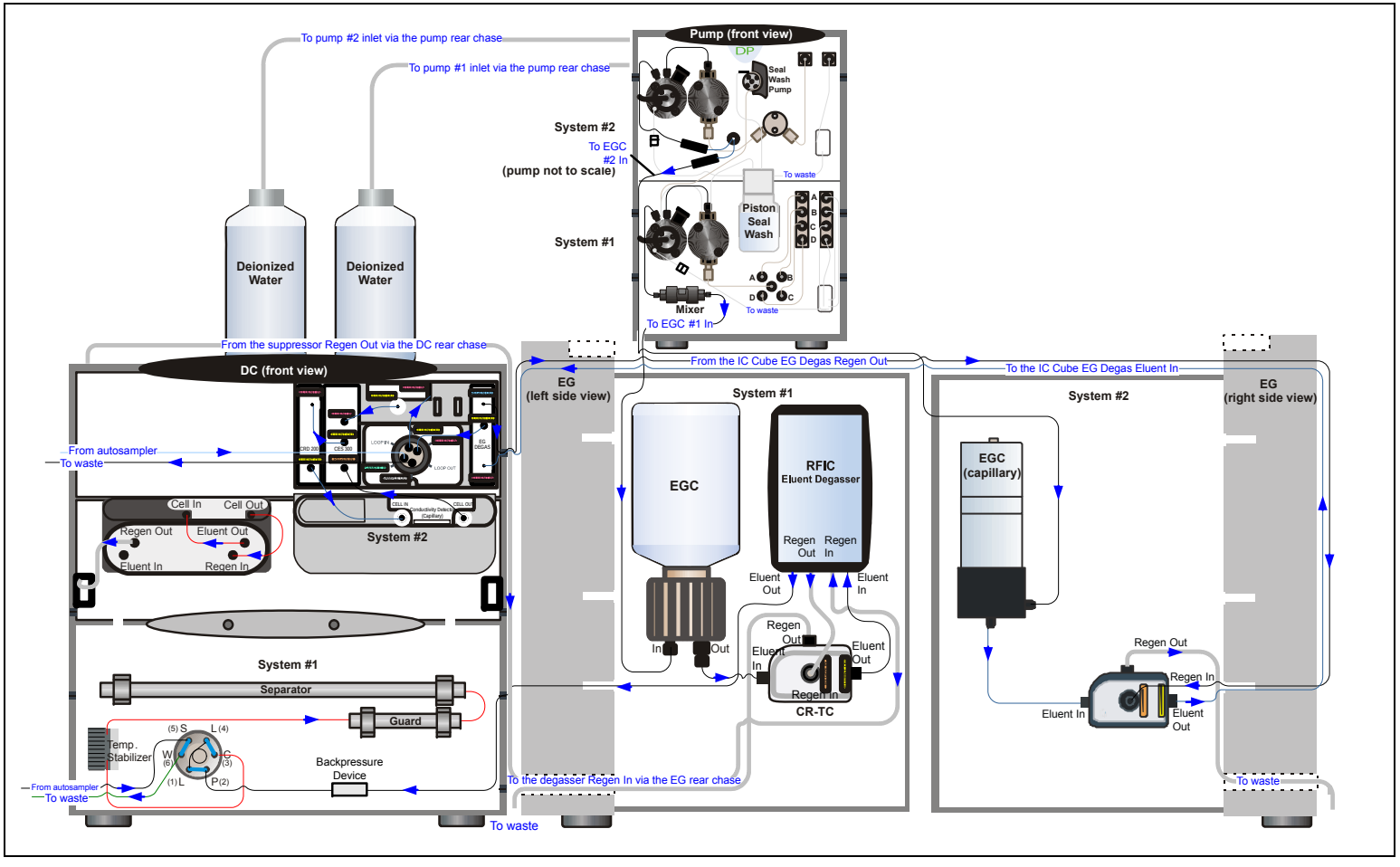


Figure 3-3. *Hybrid System: Dual RFIC-EG System (CD Analytical/CD Capillary)*

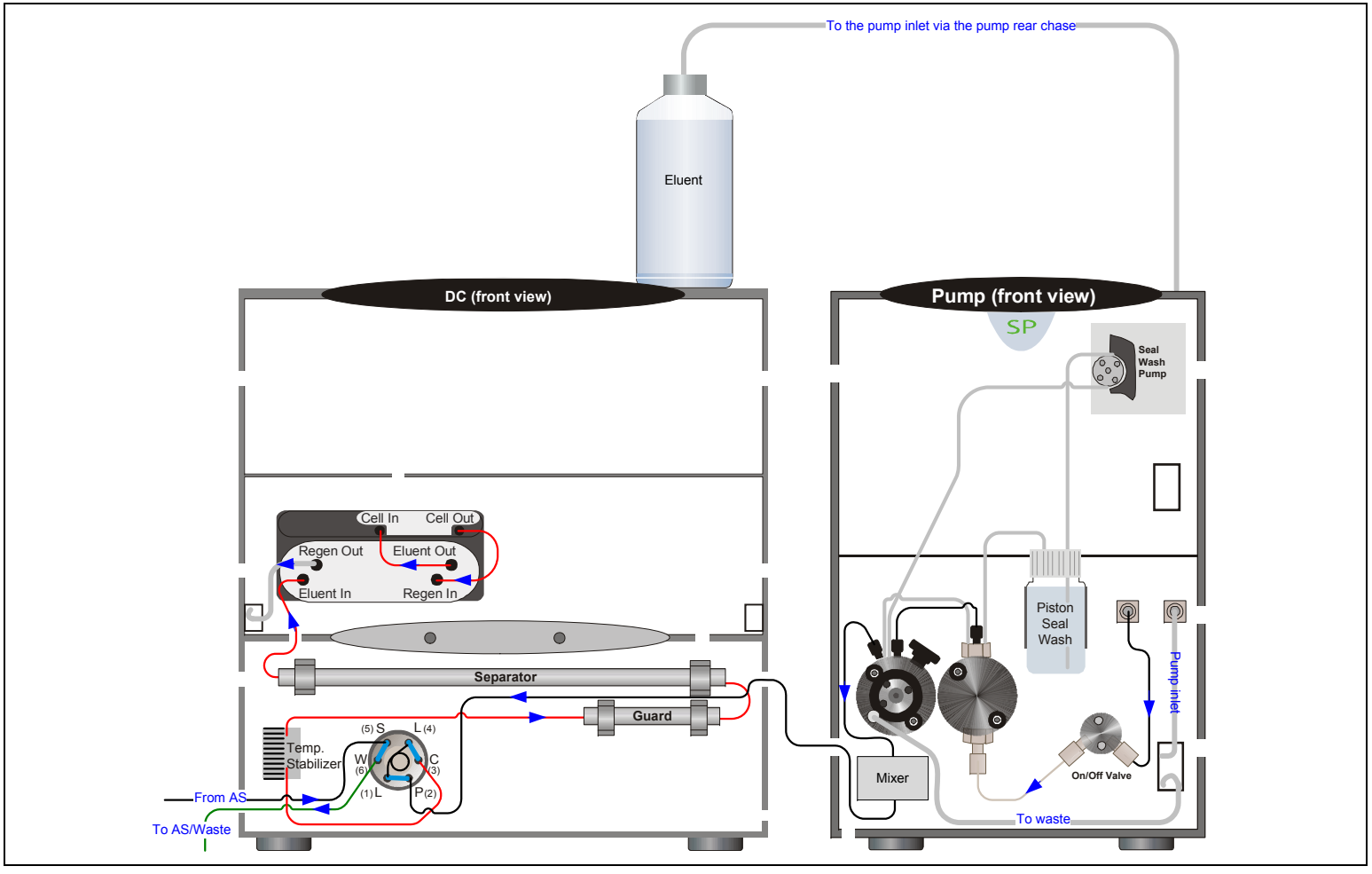


Figure 3-4. *Analytical IC: Single System with no EG (CD)*

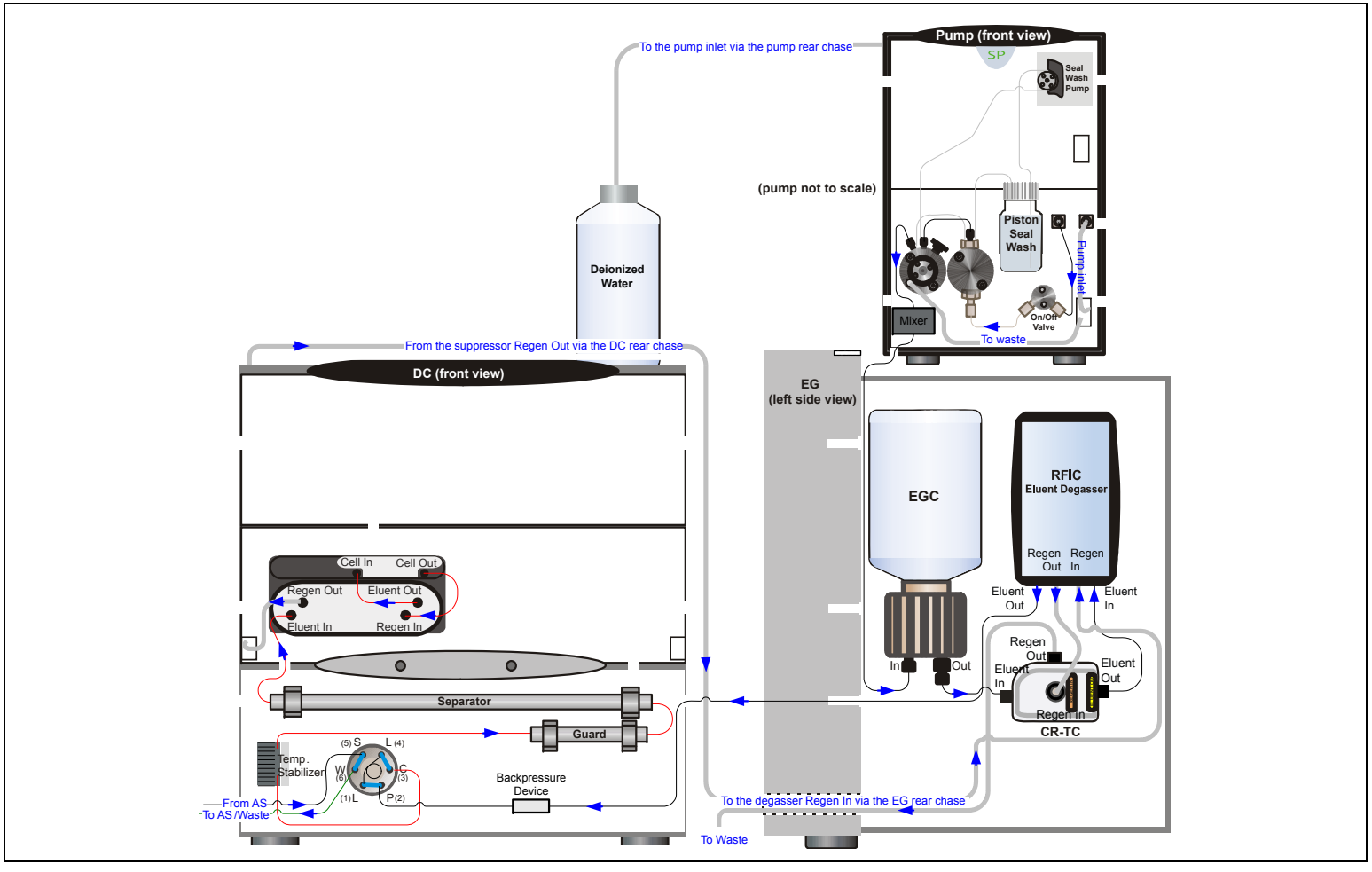


Figure 3-5. *Analytical IC: Single RFIC-EG System (CD)*

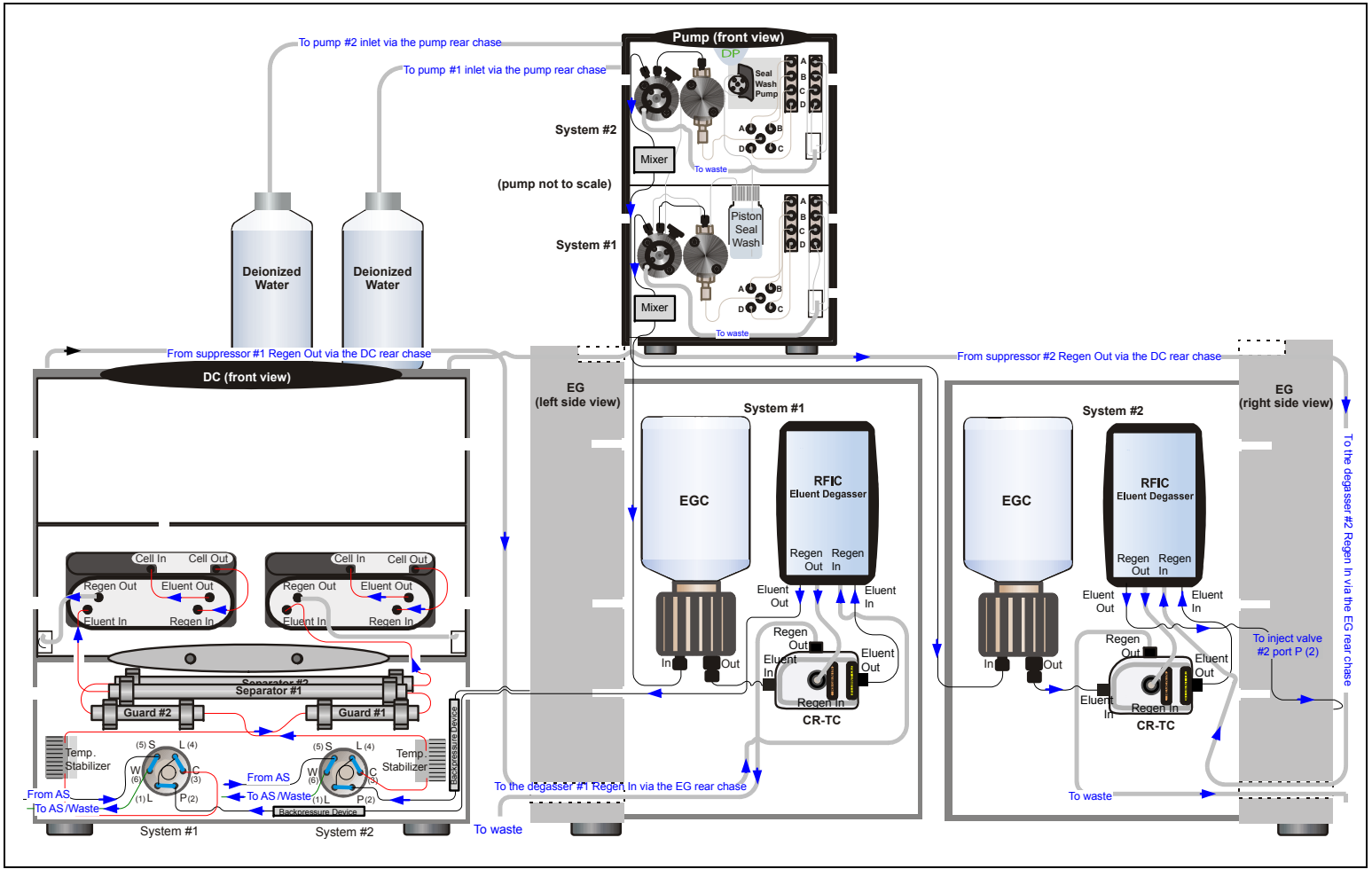


Figure 3-6. *Analytical IC: Dual RFIC-EG System (CD/CD)*

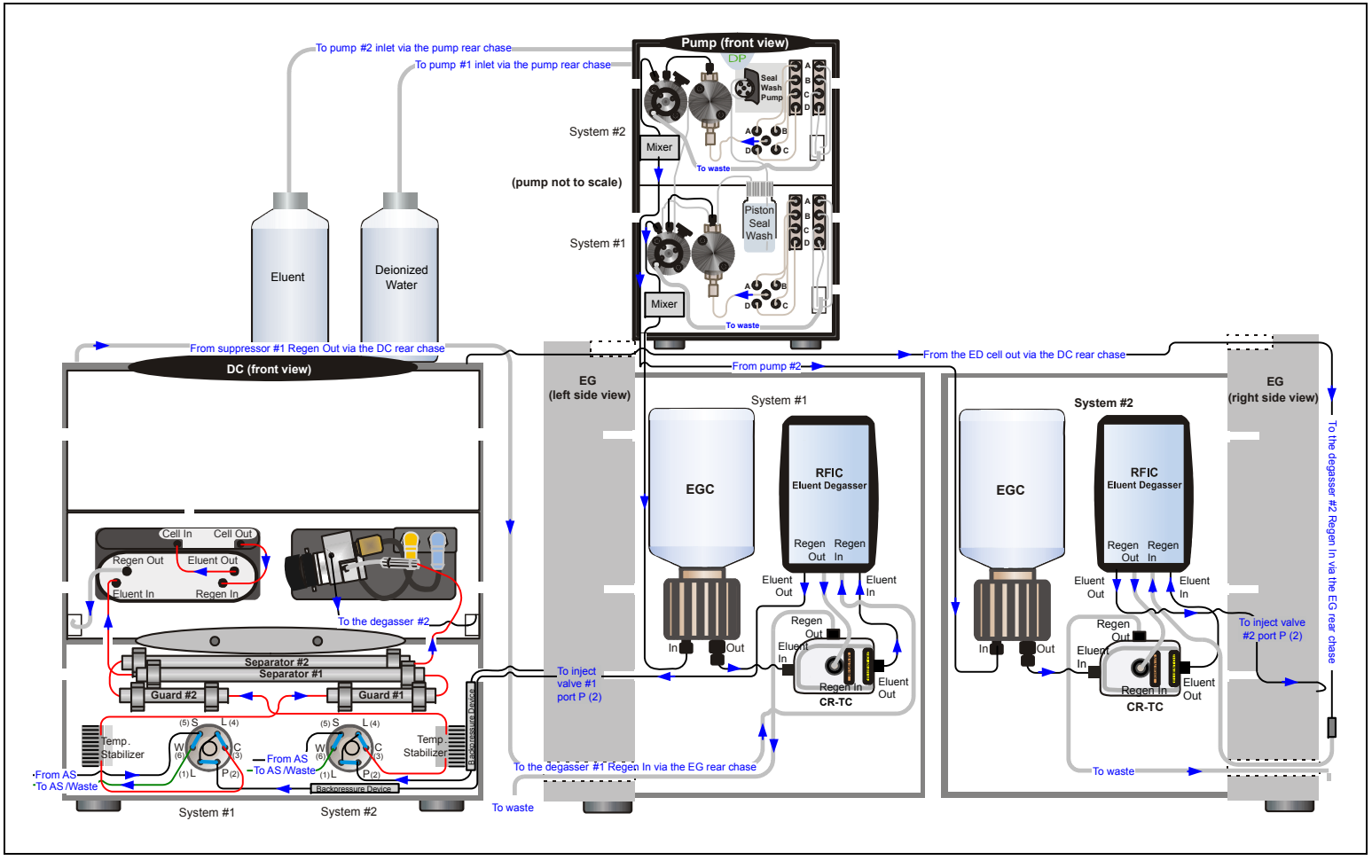


Figure 3-7. *Analytical IC: Dual RFIC-EG System (CD/ED)*

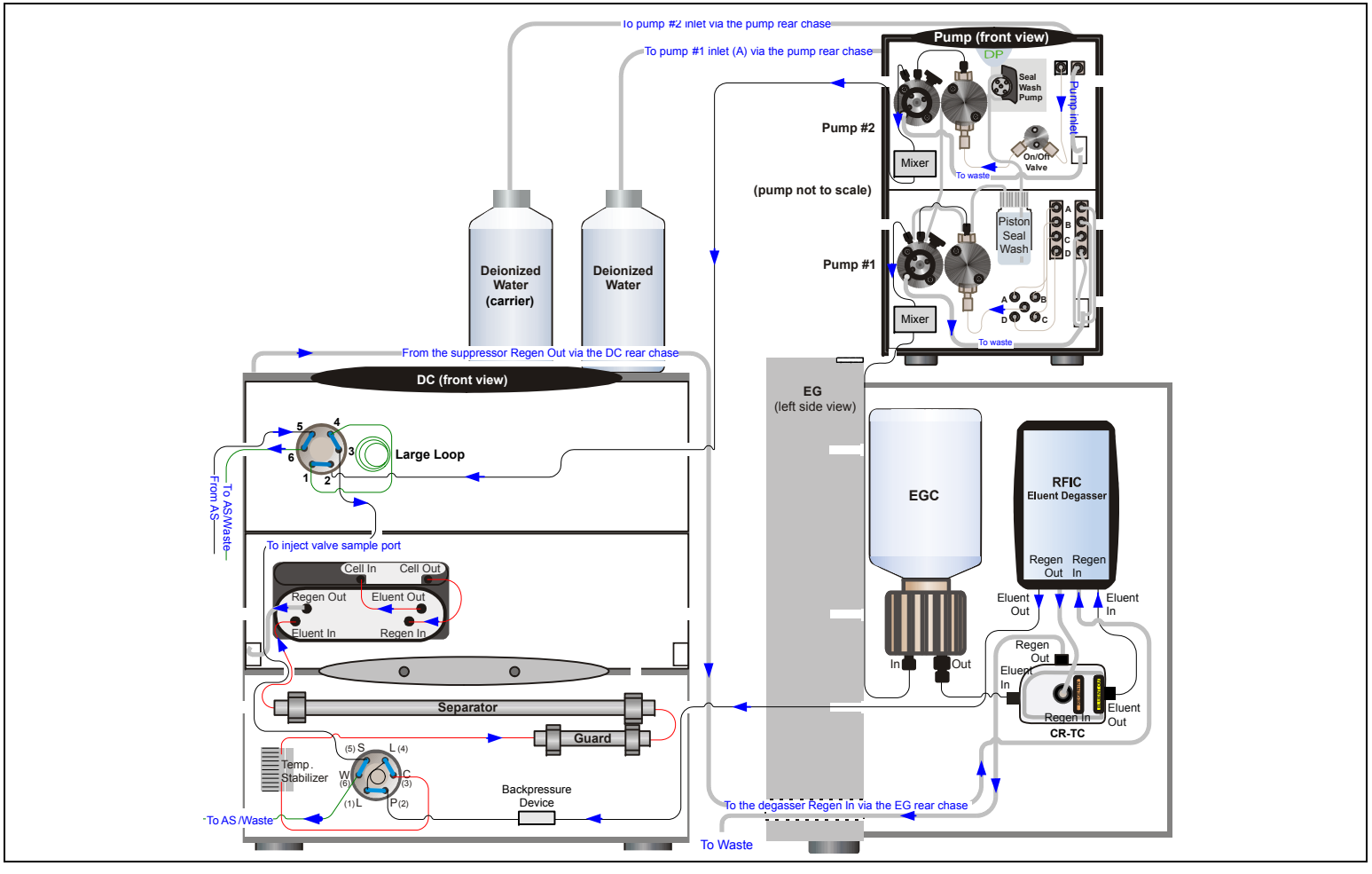


Figure 3-8. *Analytical IC: Single RFIC-EG System with Matrix Elimination Using a DP and a 6-Port Valve*

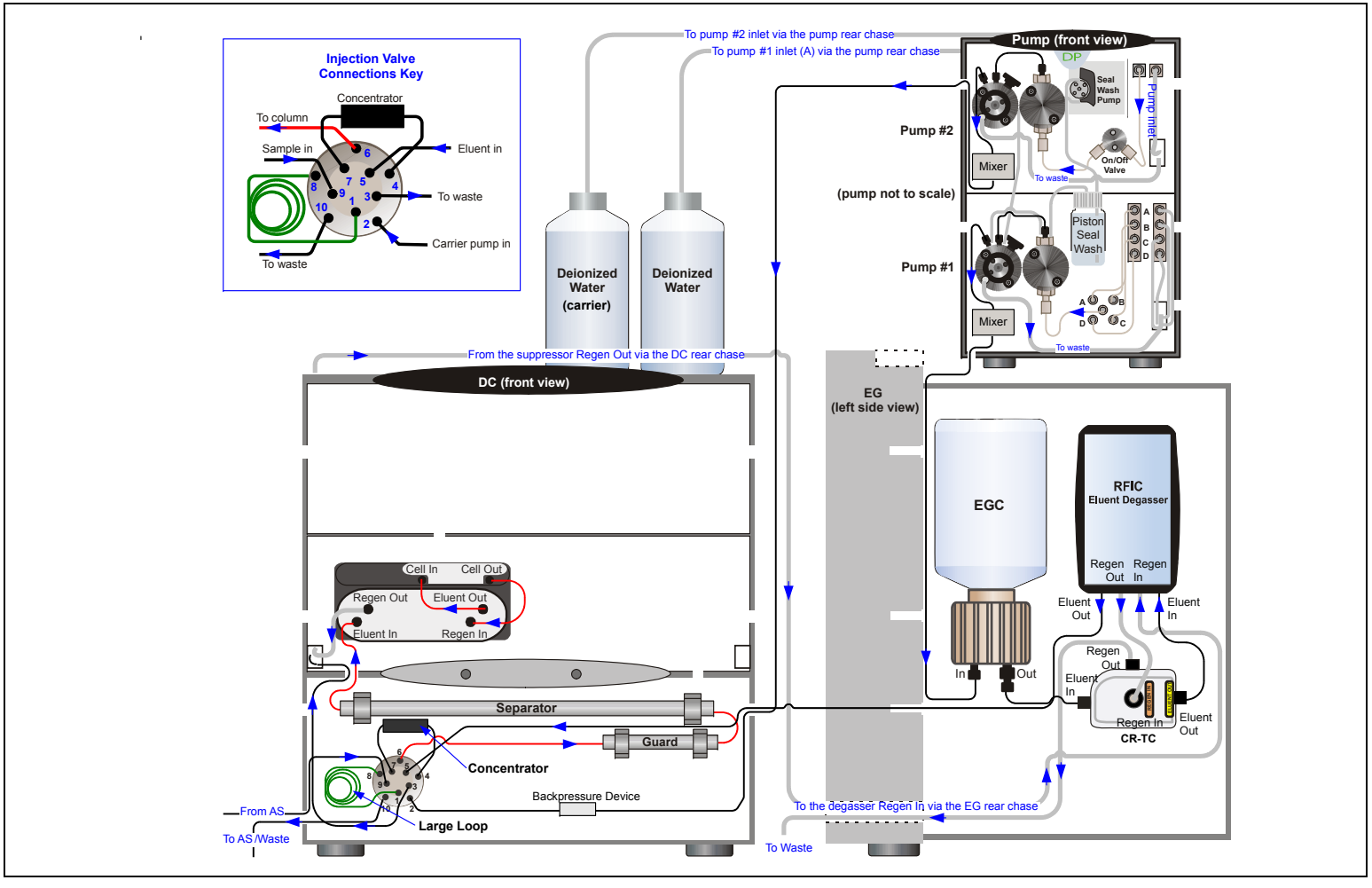


Figure 3-9. *Analytical IC: Single RFIC-EG System with Matrix Elimination Using an SP and a 10-Port Valve*

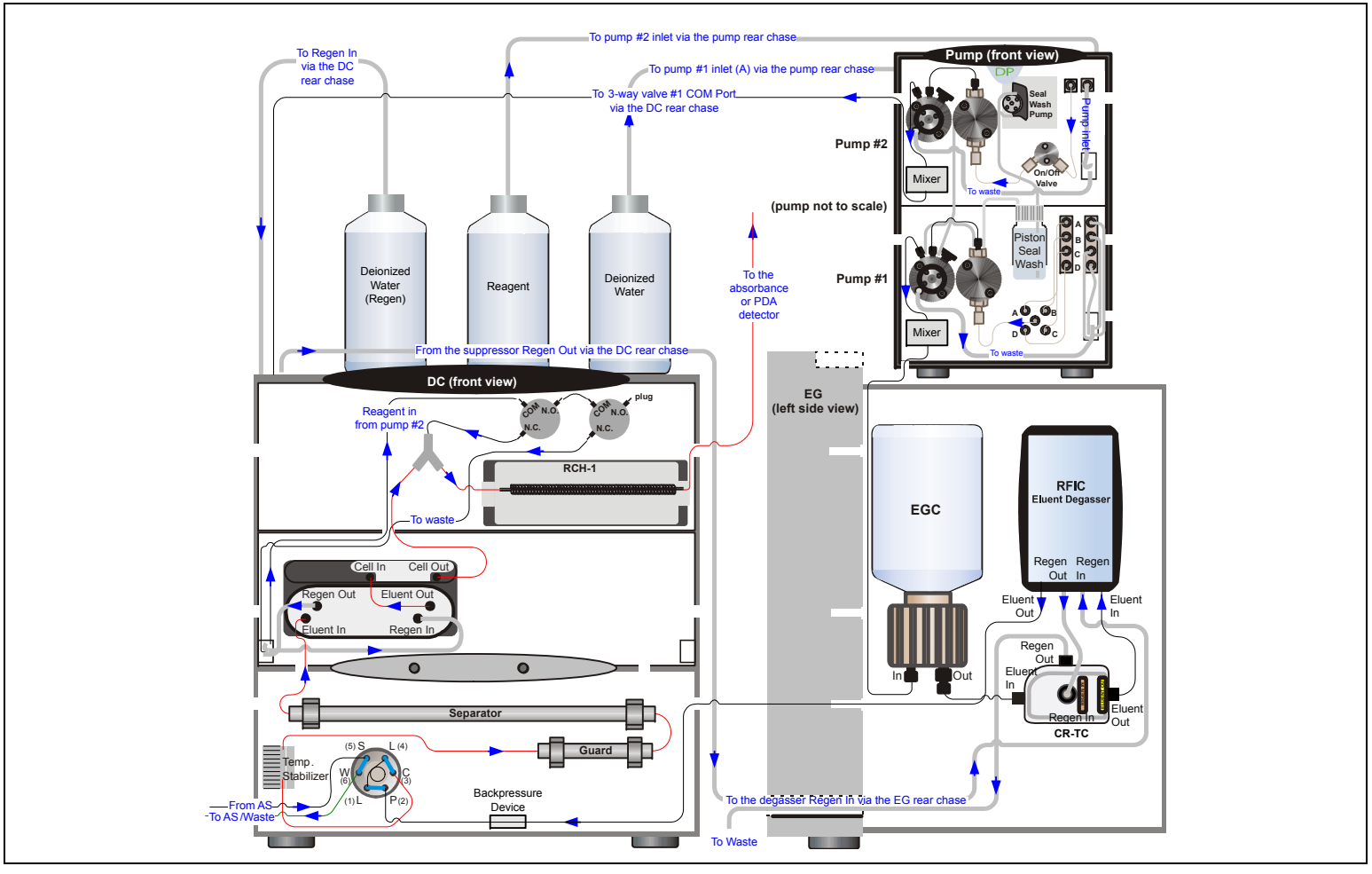


Figure 3-10. *Analytical IC: Single RFIC-EG System with Post-Column Reagent Addition (Bromate)*

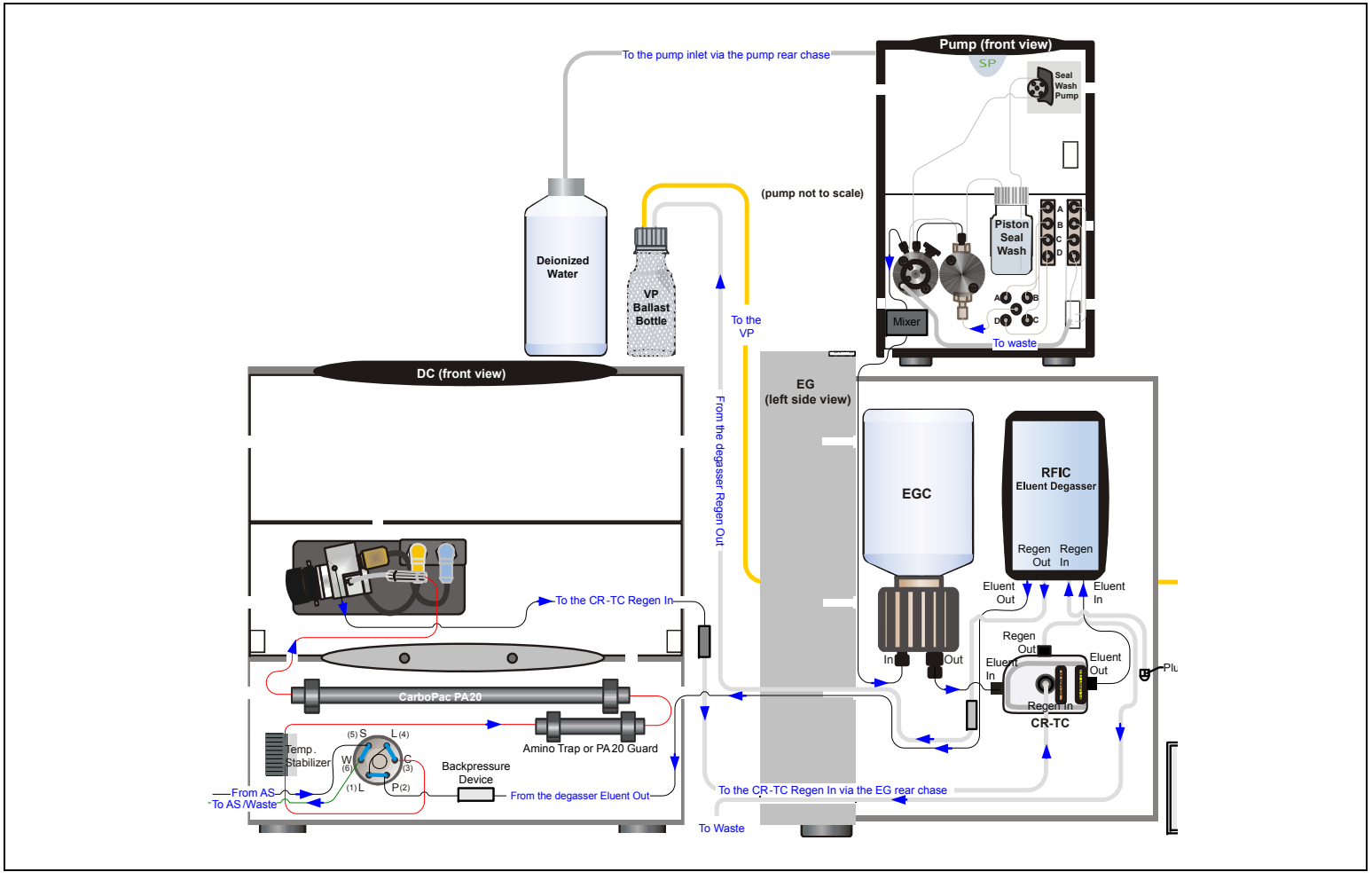


Figure 3-11. *Analytical IC: Single RFIC-EG System with ED and VP (for Carbohydrate Analysis)*

4 • Startup

This section is an overview of the steps required to start up the Dionex ICS-5000 system components and prepare the system to run samples. The operating parameters (flow rate, compartment temperature, suppressor current, etc.) depend on the application you plan to run. Refer to the column manual, as well as the schematics in Chapter 3 of this manual, for the required operating parameters.

NOTE Before beginning operation, be sure to perform any special startup procedures required for the columns, suppressors, etc. Startup procedures are described in the quick start guides and manuals provided on the Thermo Scientific Reference Library DVD (P/N 053891).

4.1 Operating Precautions

4.1.1 EG Operating Precautions

Analytical IC

In an analytical IC system, the EGC requires at least 14 MPa (2000 psi) of system backpressure. This ensures optimal removal of electrolysis gas from the eluent produced by the cartridge.

During system equilibration, monitor the **Current Pressure** reading on the **Pump** panel in Chromeleon; the pressure should remain between 14 and 21 MPa (2000 and 3000 psi). If necessary, increase the system backpressure by installing a backpressure coil between the injection valve and the **ELUENT OUT** port on the EGC. For instructions, refer to Section 9.17.

IMPORTANT **The recommended maximum operating pressure for the EG in an analytical IC system is 21 MPa (3000 psi). Excessive backpressure may rupture the tubing inside the RFIC Eluent Degasser.**

DO NOT CAP THE WASTE CONTAINER: The Dionex ICS-5000 Eluent Generator (EG), Atlas Electrolytic Suppressor, and Self-Regenerating Suppressor (SRS) use an electrolytic process that results in the production of small amounts of oxygen or hydrogen gas. To ensure that the gas is not trapped in a closed container and allowed to concentrate, install a 1.3 cm (0.52 in) ID black gas separator waste tube (P/N 045460) in an uncapped waste container. Connect the Waste, Gas Separator line to the waste tube.

NE FERMEZ PAS LE CONTENEUR DE GAZ RÉSIDUEL: Le Dionex ICS-5000 Eluent Generator (EG), le Atlas Electrolytic Suppressor, et le Self-Regenerating Suppressor (SRS) travaillent avec un proces d´électrolyse, qui produit des petites quantités de gaz d´oxygène ou d´hydrogène. Afin de garantir que le gaz ne soit pas enfermé dans un conteneur fermé et puisse s´y concentrer, connectez un tube noir à gaz résiduel (diamètre intérieur = 1,3 cm; n° de commande 045460) à un conteneur ouvert (non fermé). Connectez le conteneur résiduel au tube résiduel/gaz séparateur (désigné: « Waste, Gas Separator»).

VERSCHLIESSEN SIE DEN ABFALLBEHÄLTER NICHT: Der Dionex ICS-5000 Eluent Generator (EG), Atlas Electrolytic Suppressor und Self-Regenerating Suppressor (SRS) verwenden einen Elektrolyseprozess, wodurch kleine Mengen an Sauerstoff und Wasserstoff entstehen. Führen Sie einen schwarzen Gasabscheiderschlauch (ID = 1,3 cm; Bestell-Nr. 045460) in einen offenen (unverschlossenen) Abfallbehälter, damit sich das Gas nicht in einem geschlossenen Behälter sammelt und aufkonzentriert. Verbinden Sie die mit Waste, Gas Separator bezeichnete Leitung mit dem Abfallschlauch.

If you select a low flow rate that allows the system pressure to drop below 14 MPa (2000 psi) and you do not turn off the EG, the EG will continue to generate eluent at the concentration set for the last step of the last Chromeleon 7 instrument method or Chromeleon 6.8 program.

If this occurs, the eluent concentration will increase in proportion to the decrease in the flow rate. In extreme cases, excessive heat buildup can occur and damage the EGC.

For a complete list of operating precautions for EGCs and CR-TC trap columns, refer to the product manuals. The manuals are provided on the Thermo Scientific Reference Library DVD (P/N 053891).

4.1.2 ED Cell Operating Precautions

To maintain good reproducibility of detection results:

- Prepare all eluents with ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5.
- Avoid contamination of the cell with incompatible eluents.
- Never apply potential to the electrode unless a stream of eluent or water is flowing through the cell.
- Do not allow a pH-Ag/AgCl reference electrode to dry out. Make sure that eluent is pumped continuously through the cell. If the cell will not be used for a short time (less than 2 days), disconnect the tubing from the inlet and outlet fittings and all fitting plugs. For longer shutdowns, see Section 6.4.
- Be careful to keep the polished surface of the ED cell body clean and dry when not in use. The gold, spring-loaded (pogo) contact must also remain clean and dry. If a salt bridge forms, it can cause an electrical short between the working electrode contact and the cell body.
- If the conventional (nondisposable) working electrode becomes discolored or if you notice a degradation in performance (baseline noise, tailing peaks, etc.), polish the electrode as instructed in Section 9.28.4.
- Over the lifetime of the conventional working electrode, the surface may gradually become pitted or receded. Receded electrodes can be repaired by sanding with 600 grit sandpaper. Continue sanding until the metal surface is again flush with the Kel-F electrode block surface. Then, polish the electrode (see Section 9.28.4).
- To help determine when the pH-Ag/AgCl reference electrode needs regenerating or replacing, monitor the pH value displayed on the detector panel in Chromeleon (see page 144).
- To have an alarm displayed in the Audit Trail if the pH exceeds certain values, set pH limits in Chromeleon (see page 145).

To monitor the pH-Ag/AgCl reference electrode pH:

1. At installation, calibrate the pH electrode (see Section 9.28.6).
2. When you run your first chromatographic instrument method or program, note the pH value displayed on the Chromeleon panel (see Figure 4-1).

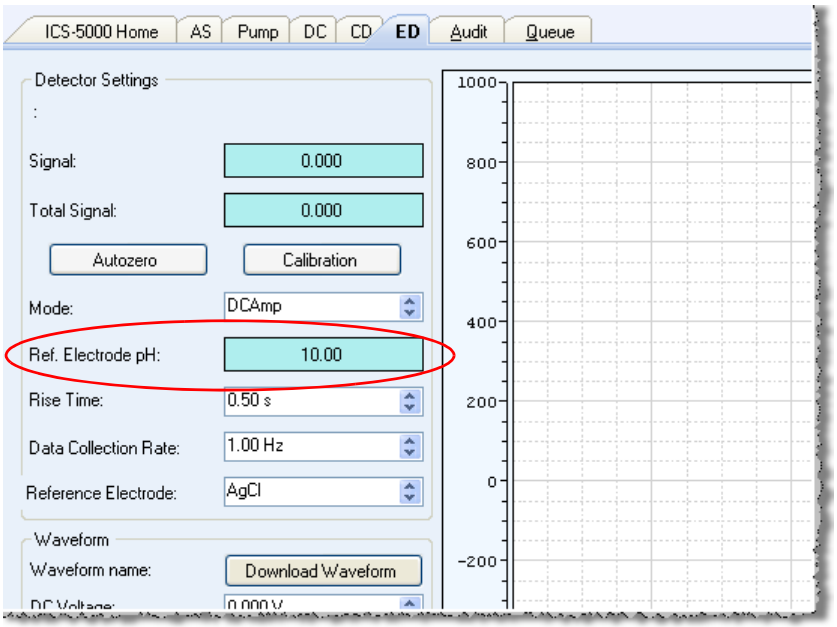


Figure 4-1. *Monitoring the pH-Ag/AgCl Reference Electrode pH*

3. Thereafter, monitor the pH value to determine whether there is a shift in the pH. A shift in the pH reading for the same eluent composition indicates a change in the Ag/AgCl reference potential.

   If the pH value shifts by 0.5 pH unit from the value first observed, check the pH-Ag/AgCl reference electrode (see Section 8.28.6).

To set ED cell pH limits:

You can set upper and lower pH limits in the Chromeleon 7 Instrument Method Wizard (see Figure 4-2) or Chromeleon 6.8 Program Wizard. The Audit Trail displays an alarm if the limits are exceeded.

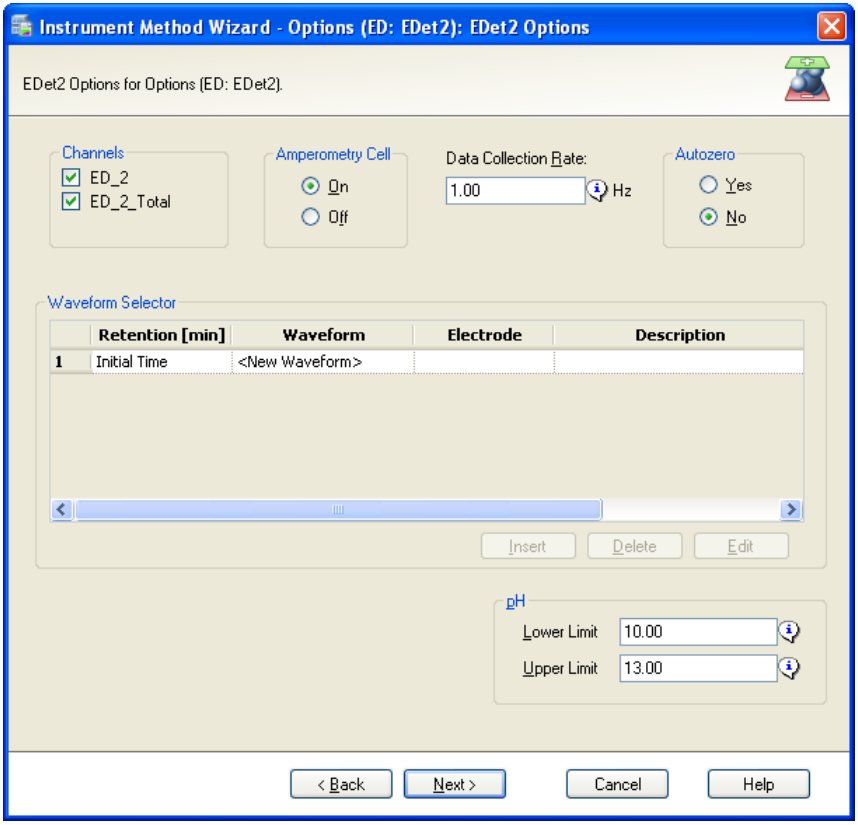


Figure 4-2. *Setting pH Limits in Chromeleon 7*

NOTE To disable the alarm, set the upper limit to 14 and the lower limit to 0.

4.2 System Startup Checklist

- ☐ Prepare the samples (see page 147)
- ☐ Fill the autosampler vials and load the sample tray (see page 149)
- ☐ Start Chromeleon (see page 149)
- ☐ Set up the eluent reservoirs (see page 153)
- ☐ Set up the piston seal wash system (see page 154)
- ☐ Start the pump (see page 157)
- ☐ Set the pressure limits (see page 158)
- ☐ If an EG is installed, start the EG and set the eluent concentration (see page 161)
- ☐ Start the DC (see page 165) or TC (see page 169)
- ☐ Equilibrate the system and verify operational readiness (DC: see page 166; TC: see page 170)

NOTE You can use the Smart Startup feature in Chromeleon to automate system startup and equilibration. Refer to the Chromeleon Help for details.

4.3 Preparing Samples

This section provides basic information about collecting, storing, and preparing samples for analysis.

NOTE Sample preparation can be performed while the system is equilibrating.

4.3.1 Collecting and Storing Samples

Collect samples in high density polyethylene, polystyrene, or polycarbonate containers that have been thoroughly cleaned with ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5. Do not clean containers with strong acids or detergents because these can leave traces of ions on the container walls. The ions may interfere with the analysis.

If samples will not be analyzed on the day they are collected, filter them through clean 0.45 micron filters immediately after collection; otherwise, bacteria in the samples may cause the ionic concentrations to change over time. Refrigerating the samples at 4° C (39° F) will reduce, but not eliminate, bacterial growth.

Analyze samples containing nitrite or sulfite as soon as possible. Nitrite oxidizes to nitrate, and sulfite to sulfate, thus increasing the measured concentrations of these ions in the sample. In general, samples that do not contain nitrite or sulfite can be refrigerated for at least one week with no significant change in anion concentration.

4.3.2 Pretreating Samples

Analyze rainwater, drinking water, and air particulate leach solutions directly with no sample preparation (other than filtering and if required, diluting).

Filter groundwater and wastewater samples through 0.45 micron filters before injection, unless samples were filtered after collection.

A Low-Volume High-Pressure Inline Filter (P/N 074505) is available for removing particulates down to 0.45 micron from samples. Connect the inline filter between the autosampler outlet and the sample inlet port on the injection valve. For details, see the instructions provided with the inline filter.

Before injection, pretreat samples that may contain high concentrations of interfering substances by putting them through Thermo Scientific Dionex OnGuard™ cartridges. Refer to the installation and troubleshooting guide for the Dionex OnGuard cartridge for instructions. The guide is located on the Thermo Scientific Reference Library DVD (P/N 053891).

4.3.3 Diluting Samples

Because the concentrations of ionic species in different samples can vary widely from sample to sample, no single dilution factor can be recommended for all samples of one type. In some cases (for example, many water samples), concentrations are so low that dilution is not necessary.

To dilute the sample, use eluent or ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5. When using carbonate eluents, diluting with eluent minimizes the effect of the water dip at the beginning of the chromatogram. If you dilute the sample with eluent, also use eluent from the same lot to prepare the calibration standards. This is most important for fluoride and chloride, which elute near the water dip.

To improve the accuracy of early eluting peak determinations, such as fluoride, at concentrations below 50 ppb, dilute samples in eluent or spike the samples with concentrated eluent to minimize the water dip. For example, spike a 100 mL sample with 1.0 mL of a 100 X eluent concentrate.

4.3.4 Filling the Autosampler Vials and Loading the Sample Tray

Follow the instructions in the autosampler manual to fill the vials or well plates and load them into the sample tray or carousel. The autosampler manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).

4.4 Starting Chromeleon 7

4.4.1 Starting the Chromeleon 7 Instrument Controller Service

To start the Chromeleon 7 Instrument Controller Service, right-click the Chromeleon tray icon (which is crossed out in red) and click **Start Chromeleon Instrument Controller**. The icon changes to gold to indicate that the Instrument Controller Service is starting. When the Instrument Controller Service is running (idle), the icon changes to gray .

If the Chromeleon Tray Icon is not on the taskbar, click **Start > All Programs > Chromeleon 7 > Services Manager** to open the Services Manager and click **Start Instrument Controller**.

4.4.2 Starting the Chromeleon 7 Client

1. To start the Chromeleon 7 client, click **Start > All Programs > Chromeleon 7 > Chromeleon 7**.
2. To display the Chromeleon 7 ePanel Set, click the **Instruments** category bar on the Console. Click your instrument in the Navigation Pane. Chromeleon 7 connects to the instrument and displays the ePanel Set (see Figure 4-3). The ePanel Set opens to the **Home** panel by default. This panel displays basic status information for each instrument in the system.

In addition, a limited number of device functions can be controlled directly from this panel. You can also access the Audit Trail from here

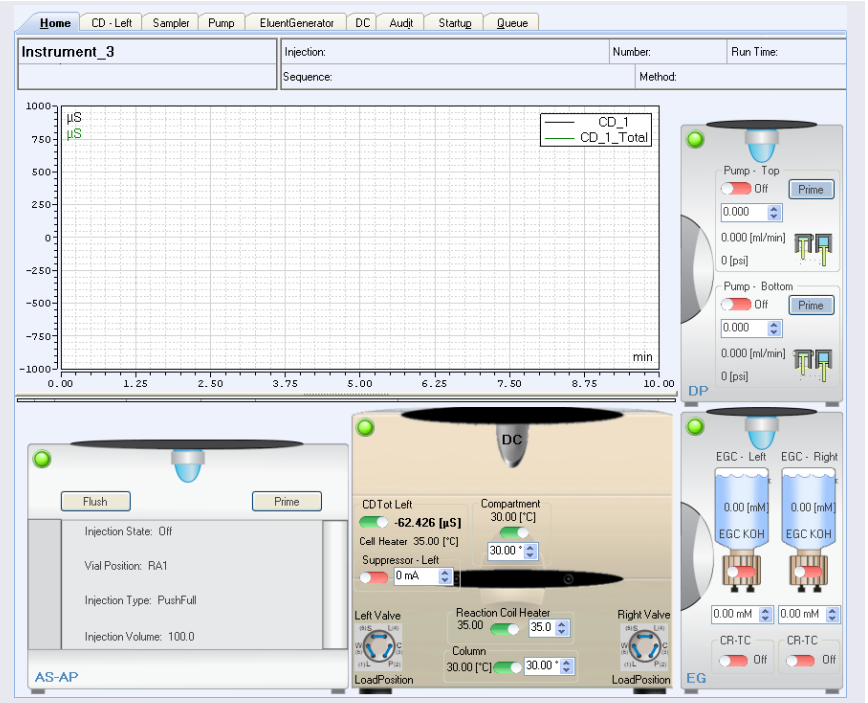


Figure 4-3. *Example Chromeleon 7 ePanel Set*

4.5 Starting Chromeleon 6.8

4.5.1 Starting the Chromeleon 6.8 Server

To start the Chromeleon 6.8 Server, right-click the Chromeleon Server Monitor icon (which is crossed out in red) on the Windows taskbar and click **Start Server**. The icon changes to gold to indicate that the Chromeleon Server is starting. When the Chromeleon Server is running (idle), the icon changes to gray .

If the Server Monitor icon is not on the Windows taskbar, click **Start** > **All Programs** > **Chromeleon** > **Server Monitor** to open the Server Monitor and click **Start**.

4.5.2 Starting the Chromeleon 6.8 Client

1. To start the Chromeleon 6.8 client, click **Start > All Programs > Chromeleon > Chromeleon**.

2. To display the Chromeleon 6.8 panel tabset, click **View > Default Panel Tabset** or click the toolbar button . The panel tabset opens to the **Home** panel by default (see Figure 4-4). This panel displays basic status information for each instrument in the system. In addition, a limited number of device functions can be controlled directly from this panel. You can also access the Audit Trail from here.

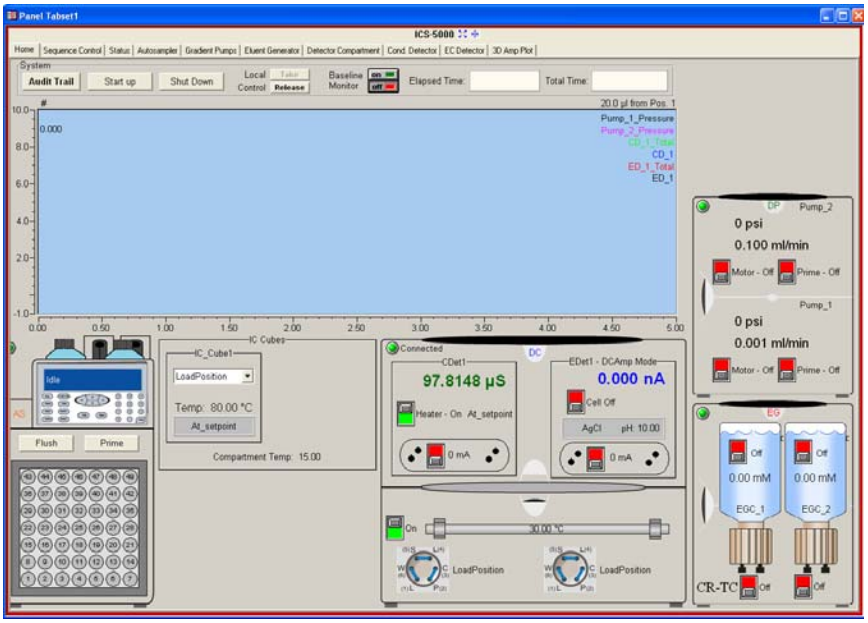


Figure 4-4. *Example Chromeleon 6.8 Panel Tabset*

4.6 Setting Up the Eluent Reservoirs

1. Rinse the eluent reservoirs with ASTM Type I (18 megohm-cm) filtered and deionized water.

   NOTE Always use ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5 to prepare eluent and regenerant or to rinse eluent reservoirs.

2. If an EG is not installed, prepare the eluent for the application. For instructions, refer to the manual for the column. Column manuals are provided on the Thermo Scientific Reference Library DVD (P/N 053891).
3. Fill the reservoirs with prepared eluent or deionized water (if an EG is installed).
4. Locate the end-line filters (P/N 045987) provided in the pump ship kit:

Pump Ship Kit	Part Number
DP Ship Kit Dual Capillary	072112
DP Ship Kit Dual Analytical	062463
DP Ship Kit Capillary and Analytical	072111
SP Ship Kit Capillary or Analytical	063342

   Before installation, thoroughly rinse the end-line filter with ASTM Type I (18 megohm-cm) filtered and deionized water to remove any loose particles.

5. Install an end-line filter on the end of each reservoir's eluent line.
6. Install the reservoir caps, making sure the end of each line extends to the bottom of the reservoir, and that each filter is submerged in liquid. This prevents air from being drawn through the eluent lines. Hand-tighten the caps.

NOTE A High-Pressure Inline Filter (P/N 044105) can be used to remove particulates down to 0.45 micron from eluent. Connect the inline filter between the pump outlet and the eluent inlet port on the injection valve. For details, see the instructions provided with the inline filter.

4.7 Setting Up the Piston Seal Wash System

Replumbing the Seal Wash System (DP only) (Optional)

The standard piston seal wash system is designed for use with only one of the two pumps in a DP module. When the DP is shipped from Thermo Fisher Scientific, the seal wash system is connected to pump 1 (the bottom pump). If you want to connect the seal wash system to pump 2 (the top pump), follow the instructions in this section.

NOTE For users who need to operate a piston seal wash system for both pumps in the DP, Thermo Fisher Scientific offers an External Seal Wash Kit (P/N 063518) or a second seal wash system (P/N 068661).

1. Note the tubing connected from the peristaltic pump to the seal wash tube on the secondary pump head on pump 1 (see Figure 4-5, item 1). Disconnect this tubing from the pump head and connect it to the seal wash tube on the secondary pump head on pump 2.

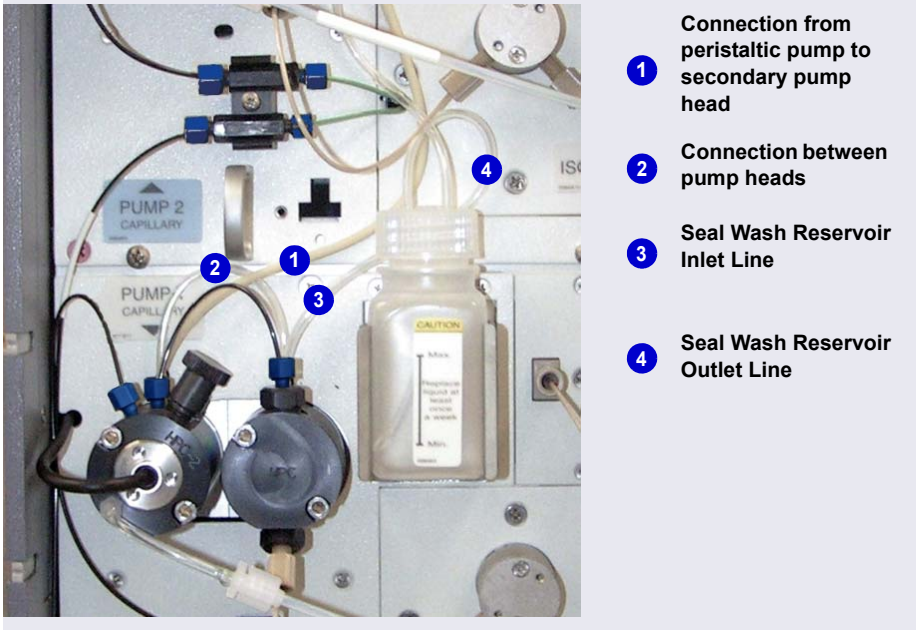


Figure 4-5. *Piston Seal Wash Connections to Pump 1*

2. Disconnect the short piece of tubing between the primary and secondary pump heads on pump 1 (see Figure 4-5, item 2). Connect this tubing to the pump heads on pump 2.
3. Disconnect the seal wash reservoir inlet line from the primary pump head on pump 1 (see Figure 4-5, item 3). Connect the inlet line to the primary pump head on pump 2.
4. When you finish these connections, go to the next section to continue setting up the seal wash system.

Setting Up the Seal Wash System (All pumps)

1. Add ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5 to the seal wash reservoir (P/N 064155).

   The liquid level should be between the **Min.** and **Max.** markers on the reservoir label. **Do not overfill the reservoir.**

2. Place the cap on the reservoir and tighten fingertight.
3. Insert the reservoir into the holder on the component panel.
4. Check that the tubing is engaged in the peristaltic pump (see Figure 4-6). If it is not, lift the lever on the peristaltic pump up and to the right, insert the tubing neatly between the lever and the rotor, and release the lever to secure the tubing.

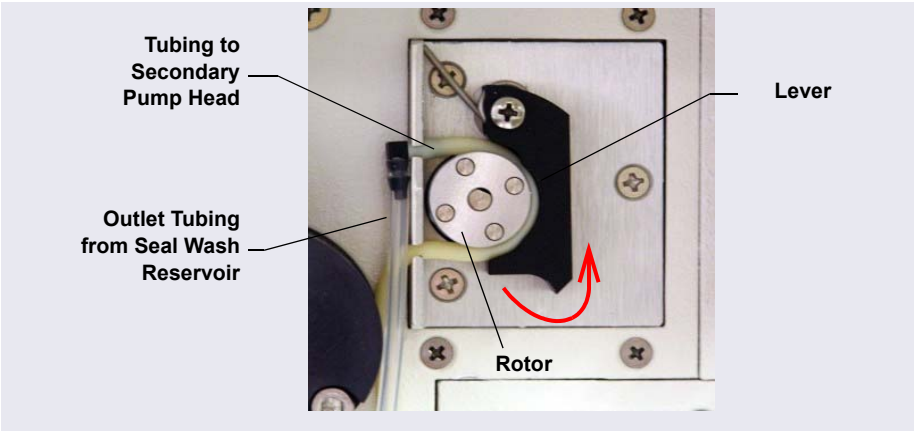


Figure 4-6. *Peristaltic Pump*

5. Follow these steps to activate the piston seal wash function:
   a. Open the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset.
   b. Press the **F8** key to open the Commands dialog box.
   c. Select the pump name.
   d. For Chromeleon 7, click the **Properties** tab on the right pane of the dialog box. For Chromeleon 6.8, scroll through the list of commands and properties under the pump name.

e. Select the **RearSealWashSystem** property and select the **Interval** option.

f. For Chromeleon 6.8, click the **Execute** button.

4.8 Starting the Pump

1. Press the **POWER** button on the front of the DP/SP.
2. If any of the following conditions applies, prime the pump (see Section 9.5) before proceeding:
   - The eluent has been changed.
   - The eluent line is new (empty).
   - The eluent line contains air.
3. On the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset, click the **Pump** tab to display the Pump panel (see Figure 4-7).

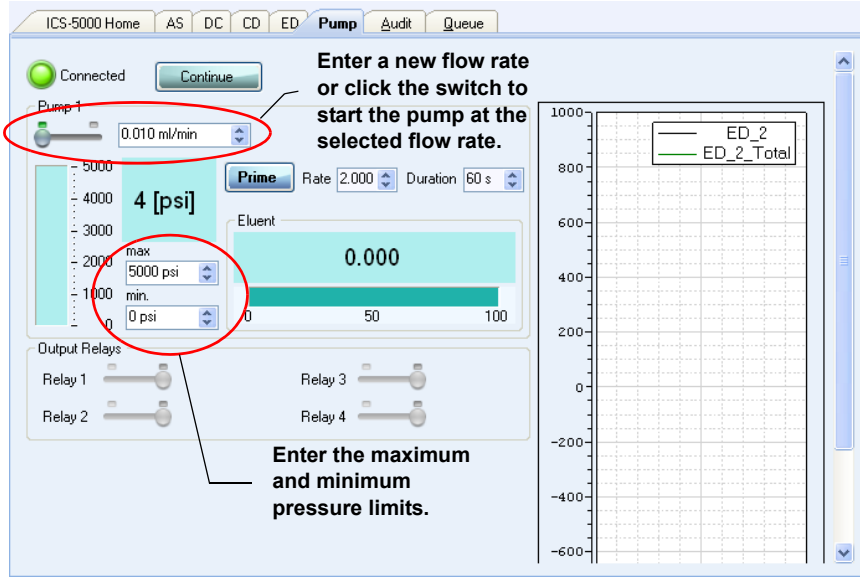


Figure 4-7. *Setting the Pump Flow Rate and Pressure Limits (Chromeleon 7 Version Shown)*

4. Enter the **Flow** rate required for your application. This starts the pump flow, also.

5. If the preferred flow rate is already selected, but the pump flow is off, click the switch to start the pump at the selected flow rate.

   NOTE After starting the pump or changing the flow rate, wait at least 5 minutes (longer for flow rates below 1.0 mL/min) before beginning an analysis. This allows the DP/SP to stabilize the flow rate.

6. Enter the minimum and maximum pressure limits. Setting pressure limits ensures that the DP/SP will automatically stop if a system malfunction occurs. Table 4-1 lists the default pressure limits for capillary and analytical pumps.

Pump Configuration	Default Low Pressure Limit	Default High Pressure Limit
Capillary pump not linked to an EGC	0	41 MPa (6000 psi)[a]
Capillary pump linked to an EGC	1.4 MPa (200 psi)	35 MPa (5000 psi)[b]
Analytical pump not linked to an EGC	0	35 MPa (5000 psi)
Analytical pump linked to an EGC	1.4 MPa (200 psi)	21 MPa (3000 psi)

Table 4-1. *Default Pressure Limits for DP/SP Pumps*

a. Capillary IC pumps shipped before February 17, 2011 were rated for lower operating pressures than the pumps currently being shipped. Refer to the important note on the next page for details.

b. If the installed version of EG degas (capillary) cartridge is not rated for 35 MPa (5000 psi), change the default high pressure limit to 21 MPa (3000 psi). Refer to the important note on the next page for details.

Capillary IC

IMPORTANT

Capillary IC pumps shipped before February 17, 2011 were rated for lower operating pressures than the pumps currently being shipped. The older pumps can be operated at pressures up to 35 MPa (5000 psi) (without RFIC) and up to 21 MPa (3000 psi) (with RFIC). Before operating at pressures above these limits, verify that you have the appropriate pump.

- **HPC** is stamped on the secondary pump heads of the older (lower pressure rated) capillary IC pumps.

- **HPC-2** is stamped on the secondary pump heads of the newer (higher pressure rated) capillary IC pumps.

A Capillary Pump High Pressure Upgrade Kit (P/N 075994) is available for converting a lower pressure rated capillary IC pump to a higher pressure rated pump.

IMPORTANT

If your system includes a capillary pump linked to an EGC, check the label on the EG degas (capillary) cartridge in the IC Cube and verify that 5000 psi is printed on the label (see the figure on the right).

If 5000 psi is not on the label, you must change the high pressure limit to **21 MPa (3000 psi)** or replace the cartridge with an EG degas (capillary) cartridge that is rated for 35 MPa (5000 psi) (P/N 074459).

4.9 Entering the Eluent Concentration

1. Press the **POWER** button on the front of the EG.
2. On the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset, click the **EG** tab to display the EG panel (see Figure 4-8).

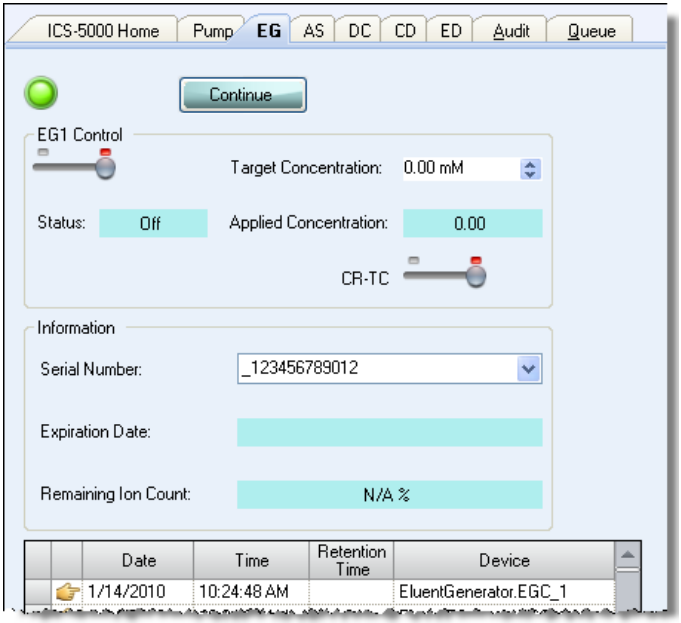


Figure 4-8. *Example EG Panel (Chromeleon 7 Version Shown)*

3. Enter a value in the **Target Concentration** box. For help in selecting an eluent concentration, see Section 4.10.

   If the pump flow is on, entering a new **Target Concentration** value automatically turns on the power to the EGC, also.

4. If the pump flow is off, first turn on the flow and then click the switch under **EG1 Control** (or **EG2 Control**). This turns on the power to the EGC at the selected **Target Concentration** value.
5. If the **CR-TC** switch is off, click the switch to turn on the power to the CR-TC.

4.10 Selecting an Eluent Concentration

The allowable eluent concentration depends on several factors: the flow rate, suppressor type, EGC type, and cartridge configuration. For details, refer to Table 4-2 and Table 4-3.

Single-Cartridge or Independent Dual-Cartridge Configuration

In the single-cartridge configuration, the EG contains one EGC. In the independent dual-cartridge configuration, the EG contains two EGCs operating independently on separate systems (each cartridge is linked to a different DP/SP). For details, refer to the EGC manual. Cartridge manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).

EGC	Eluent Concentration Range
KOH (Capillary)	0.1 to 200 mM at 0.001 to 0.010 mL/min flow 0.1 to X mM at 0.010 to 0.030 mL/min where X = 2/flow
MSA (Capillary)	0.1 to 200 mM at 0.001 to 0.010 mL/min flow 0.1 to X mM at 0.010 to 0.030 mL/min where X = 2/flow
K_2CO_3	0.1 to 15 mM at 0.1 to 1.0 mL/min flow 0.1 to X mM at 1.0 to 2.0 mL/min flow where X = 15/flow
KOH	0.1 to 100 mM at 0.1 to 1.0 mL/min flow 0.1 to X mM at 1.0 to 3.0 mL/min flow where X = 100/flow
LiOH	0.1 to 80 mM at 0.1 to ≤ 1.0 mL/min flow 0.1 to X mM at 1.0 to ≤ 3.0 mL/min flow where X = 80/flow
MSA	0.1 to 100 mM at 0.1 to 1.0 mL/min flow 0.1 to X mM at 1.0 to 3.0 mL/min flow where X = 100/flow
NaOH	0.1 to 100 mM at 0.1 to 1.0 mL/min flow 0.1 to X mM at 1.0 to 3.0 mL/min flow where X = 100/flow

Table 4-2. *Eluent Concentration Ranges for Single-Cartridge and Independent Dual-Cartridge Configurations*

Linked Dual-Cartridge Configuration

In the linked dual-cartridge configuration, the EG contains two EGCs, linked to a single pump. Note that the allowable eluent concentration for a linked cartridge is less than when the cartridge is defined as independent. For details, refer to the EGC manual. EGC manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).

EGCs	Eluent Concentration Range	Comment
K_2CO_3/EPM Electrolytic pH Modifier	0.1 to 15 mM at 0.1 to 1.0 ml/min flow 0.1 to X mM at 1.0 to 2.0 ml/min flow where X = 15/flow	The total of the eluent concentrations from both cartridges (K_2CO_3 and EPM) must not exceed the specified range. The EPM concentration must not exceed 10 mM. See the notes below for additional information.
KOH/KOH KOH/MSA KOH/NaOH MSA/MSA MSA/NaOH NaOH/NaOH	0.1 to 50 mM at 0.1 to 1.0 mL/min flow 0.1 to X mM at 1.0 to 3.0 mL/min flow where X = 50/flow	The eluent concentration range for each cartridge is 50% of the range for an independent cartridge
LiOH/LiOH	0.1 to 40 mM at 0.1 to 1.0 mL/min flow 0.1 to X mM at 1.0 to 3.0 mL/min flow where X = 40/flow	The eluent concentration range for each cartridge is 50% of the range for an single-independent cartridge.
KOH (Capillary)/ MSA (Capillary)	0.1 to 100 mM at 0.001 to 0.01 mL/min 0.1 to X mM at 0.01 to 0.1mL/min where X = 1/flow	The eluent concentration range for each cartridge is 50% of the range for an independent cartridge.

Table 4-3. *Eluent Concentration Ranges for Linked Dual-Cartridge Configurations*

Notes for Generating Carbonate/Bicarbonate Eluent

If an EGC III K_2CO_3 and an EPM III Electrolytic pH Modifier are installed (EGC_1 and EGC_2, respectively):

1. Set **EGC_1 Target Concentration** to the concentration of K_2CO_3 required for your application
2. Set **EGC_2 Target Concentration** to the concentration of $KHCO_3$ required.

The K_2CO_3 cartridge generates the total of the two target concentrations and the EPM modifies the total to achieve the $K_2CO_3/KHCO_3$ eluent mixture that you require.

For example:

For a 3.50 mM K_2CO_3/1.00 mM $KHCO_3$ eluent, set EGC_1 to 3.50 mM and EGC_2 to 1.00 mM.

The K_2CO_3 cartridge generates 4.50 mM K_2CO_3 (indicated in the **Applied Concentration** field for the K_2CO_3 EGC). The EPM modifies the 4.50 mM K_2CO_3 eluent to achieve the required 3.50 mM K_2CO_3/1.00 mM $KHCO_3$ mixture.

4.11 Starting the DC

1. Press the **POWER** button on the front of the DC.
2. On the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset, click the **DC** tab to display the DC panel (see Figure 4-9).

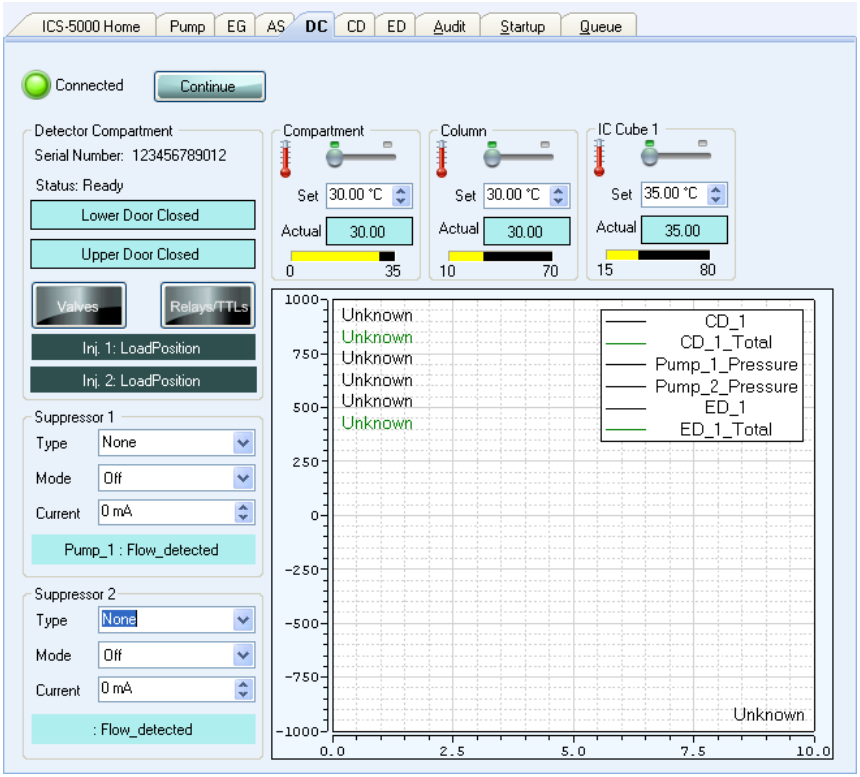


Figure 4-9. *DC Control Panel (Chromeleon 7 Version Shown)*

3. For each of the following temperature control devices installed in the DC—**Compartment**, **Column**, **Reaction Coil**, **IC Cube**—enter the preferred **Set** temperature. This turns on the device, also.

   If the preferred temperature is already selected but the device is off, click the corresponding switch to turn on the device.

4. If a suppressor is installed: Under **Suppressor 1** (or **Suppressor 2**), select the suppressor **Type,** set the **Mode** to **On**, and enter the **Current** required for your application.
5. If a CD is installed: Click the **CD** tab to open the CD panel.
6. Under **Cell Heater**, set the **Cell Heater Mode** to **On** and enter the **Cell Heater Set Point**.

4.12 Equilibrating the System and Verifying Operational Readiness

NOTE You can also use the Smart Startup feature in Chromeleon to automate system startup and equilibration. Refer to the Chromeleon Help for details.

1. On the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset, verify that each device listed below (if installed in your system) is turned on and the selected setting for the device (flow rate, eluent concentration, temperature, and so on) is correct for your application:
   - Pump
   - EGC
   - CR-TC
   - EPM
   - Suppressor
   - Temperature control devices (DC compartment, DC column compartment, IC Cube, CD cell heater, reaction coil heater)
2. Click **Monitor Background** on the toolbar above the Chromeleon 7 ePanel Set or on the Home panel of the Chromeleon 6.8 panel tabset. Chromeleon begins plotting the detector signal and pump pressure readings.
3. View the detector signal and monitor the background. Refer to the column manual for the appropriate background for your application. The column manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).

4. Offset the detector background and zero the reading by clicking the **Autozero** button.
5. Verify that the detector baseline is at the expected reading for your application and is stable. See Section 8.11 for troubleshooting information if the reading is too high. See Section 8.2 for troubleshooting information if the baseline is drifting or is excessively "noisy" (there are large fluctuations in readings).
6. Monitor the DP/SP pressure and make sure it is at the expected reading for the installed column and it is stable.
7. Verify that all installed temperature control devices are at their set points and are stable.

   The system is now ready for operation.

Capillary IC

Because capillary IC systems use low flow rates and consume very little eluent, you can leave a capillary IC system on at all times, allowing it to remain equilibrated and always ready to run the next sample.

4.13 Starting the TC

1. Press the **POWER** button on the front of the TC.
2. On the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset, click the **TC** tab to display the **TC** panel (see Figure 4-10).

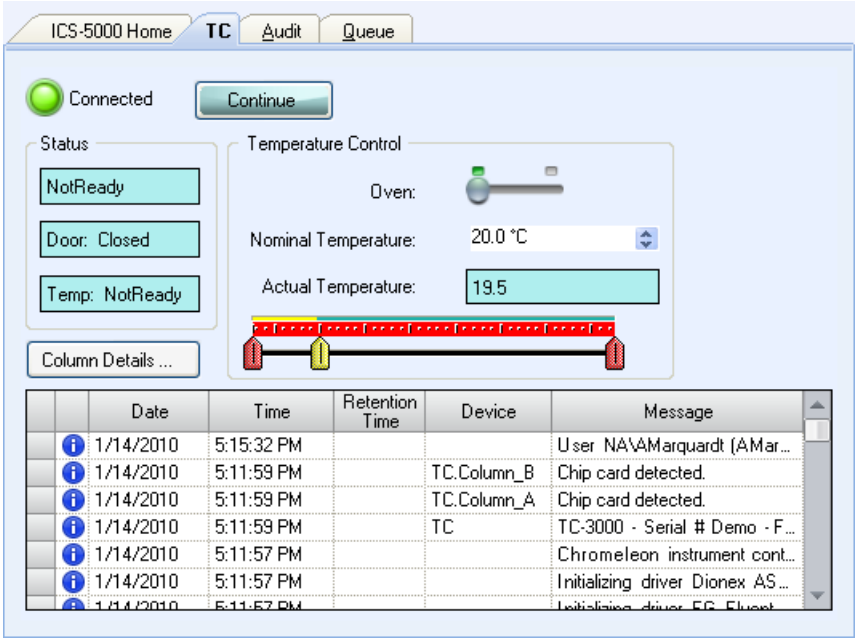


Figure 4-10. *TC Panel (Chromeleon 7 Version Shown)*

3. Click the **Oven** switch (Chromeleon 7) or the **Oven on** button (Chromeleon 6.8) to turn on the oven.
4. Set the temperature required for the application.

4.14 Equilibrating the System and Verifying Operational Readiness

NOTE You can also use the Smart Startup feature in Chromeleon to automate system startup and equilibration. Refer to the Chromeleon Help for details.

1. On the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset, verify that the TC temperature is at its set point and is stable.
2. Monitor the pump pressure; make sure it is at the expected reading for the installed column and is stable.
3. Verify that the detector baseline is at the expected reading for your application and is stable.

   The system is now ready for operation.

5.1 Controlling Modules Directly

When the Thermo Scientific Dionex ICS-5000 Ion Chromatography System is not running automated analyses, you can directly control the system modules by issuing commands from the ePanel Set in Chromeleon 7 or the panel tabset in Chromeleon 6.8. For example, you can turn on the pump flow, set the eluent concentration, or set the compartment temperature.

To display the Chromeleon 7 ePanel Set:

1. On the Console, click the **Instruments** category bar.
2. In the Navigation Pane, click the instrument that you want to control. Chromeleon 7 connects to the instrument and displays the ePanel Set.

To display the Chromeleon 6.8 panel tabset:

1. Click **View** > **Default Panel Tabset** or click the toolbar button .
2. Select the Chromeleon server and click **OK**.
3. If more than one timebase is configured on the server, Chromeleon 6.8 displays a panel tabset for each timebase. Click the **Expand Timebase View** button for the timebase that you want to control.

To issue direct control commands to a module:

1. On the ePanel Set or panel tabset, click the tab for the module.
2. Use the controls (buttons, sliders, etc.) on the panel to issue commands.
3. If the function that you want to perform is not available from the panel, press the **F8** key to open the Commands dialog box. You can access all commands available for the system from this dialog box.

5.2 Analyzing Samples

Figure 5-1 shows the basic steps used to analyze a sample in a chromatography system.

To analyze a sample with a Dionex ICS-5000 system, you add sample injections to a Chromeleon sequence. The sequence determines how the group of injections will be analyzed and the order in which they will be run. A sequence typically includes the following elements:

- A predefined list of commands and parameters for controlling Dionex ICS-5000 modules and acquiring sample data (called an instrument method in Chromeleon 7 or a program in Chromeleon 6.8).
- The chromatographic data acquired for each injection.

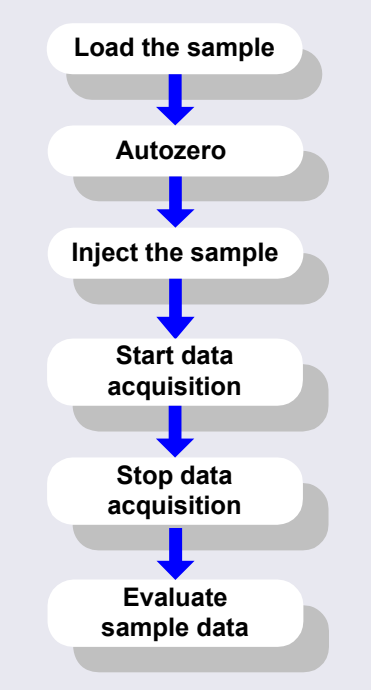


Figure 5-1. *Sample Analysis Overview*

- A predefined set of instructions for evaluating the acquired data (called a processing method in Chromeleon 7 or a quantification method in Chromeleon 6.8).
- Templates for displaying chromatographic data on the screen and for printing reports.

NOTE A Virtual Column Separation Simulator is available in Chromeleon that can help you determine the best operating parameters (column, eluent, flow rate, temperature) for a particular analysis. Refer to the Chromeleon Help for details.

5.2.1 Creating a New Sequence in Chromeleon 7

In Chromeleon 7, two methods are available for creating a new sequence: eWorkflows and the Sequence Wizard.

- eWorkflows provide predefined templates and rules for creating new sequences. If they have been defined for your laboratory, eWorkflows are the preferred method for creating a new sequence.
- If eWorkflows are not available, use the Sequence Wizard.

Using eWorkflows

1. On the Console, click the **eWorkflows** category bar (see Figure 5-2). In the Navigation Pane, click the eWorkflow name.
2. In the work area, click the instrument name and then click **Launch**.

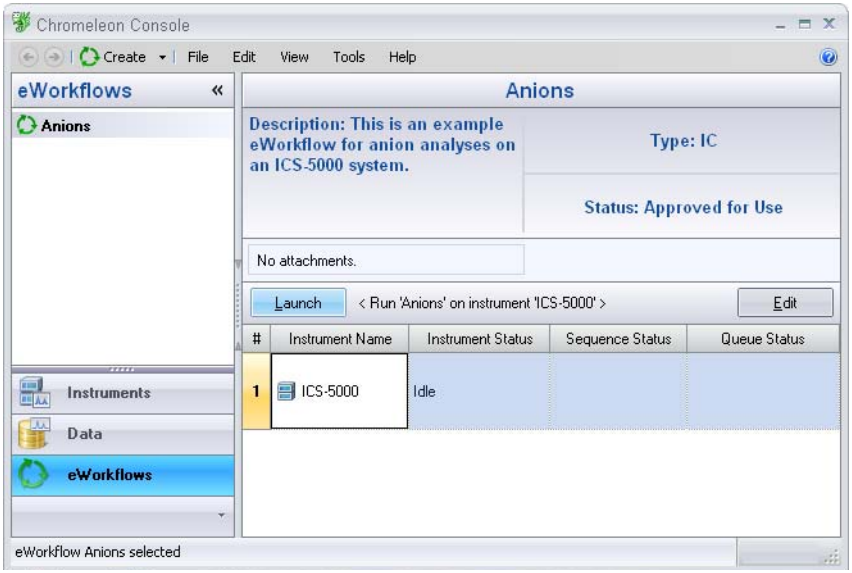
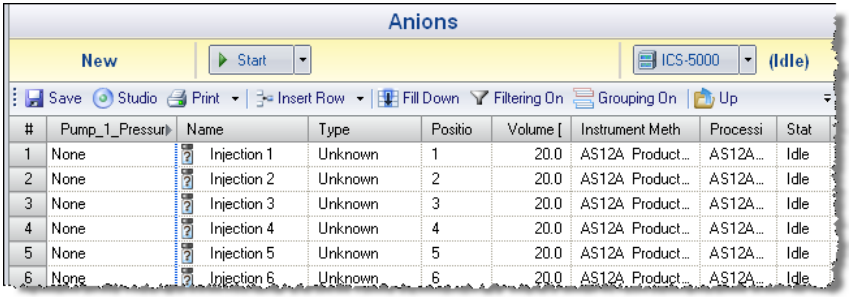


Figure 5-2. *eWorkflow View in Chromeleon 7*

3. The eWorkflow Wizard opens. Complete the steps in the wizard. For details about an eWorkflow Wizard page, click the **Help** icon .

4. After you finish the eWorkflow Wizard, the sequence is displayed in the Console Data view (see Figure 5-3).



#	Pump_1_Pressur	Name	Type	Positio	Volume [	Instrument Meth	Processi	Stat
1	None	Injection 1	Unknown	1	20.0	AS12A Product...	AS12A...	Idle
2	None	Injection 2	Unknown	2	20.0	AS12A Product...	AS12A...	Idle
3	None	Injection 3	Unknown	3	20.0	AS12A Product...	AS12A...	Idle
4	None	Injection 4	Unknown	4	20.0	AS12A Product...	AS12A...	Idle
5	None	Injection 5	Unknown	5	20.0	AS12A Product...	AS12A...	Idle
6	None	Injection 6	Unknown	6	20.0	AS12A Product...	AS12A...	Idle

Figure 5-3. *New Sequence in Chromeleon 7*

Using the Sequence Wizard

1. On the Console menu bar, click the **Create** button.
2. The Sequence Wizard opens. Complete the steps in the wizard, specifying the number of samples and standards that you want, and the instrument method, processing method, and report template to use. For details about a wizard page, click the **Help** icon .

   NOTE If preferred, you can create the sequence first and then specify the methods and report template later. You can also edit other details of the sequence (for example, add or remove samples) after you finish the wizard.

3. After you finish the wizard, the new sequence is displayed in the Console Data view (see Figure 5-3).

5.2.2 Creating a New Sequence in Chromeleon 6.8

In Chromeleon 6.8, two wizards are available to help you create a new sequence: the Sequence Wizard and the Application Wizard.

- If the program and quantification method have already been created, use the Sequence Wizard.
- If you want to create a new program and quantification method, in addition to the sequence, use the Application Wizard.

Using the Sequence Wizard

1. On the **Sequence Control** panel in the Chromeleon 6.8 panel tabset, click **Create Sequence** (see Figure 5-4).

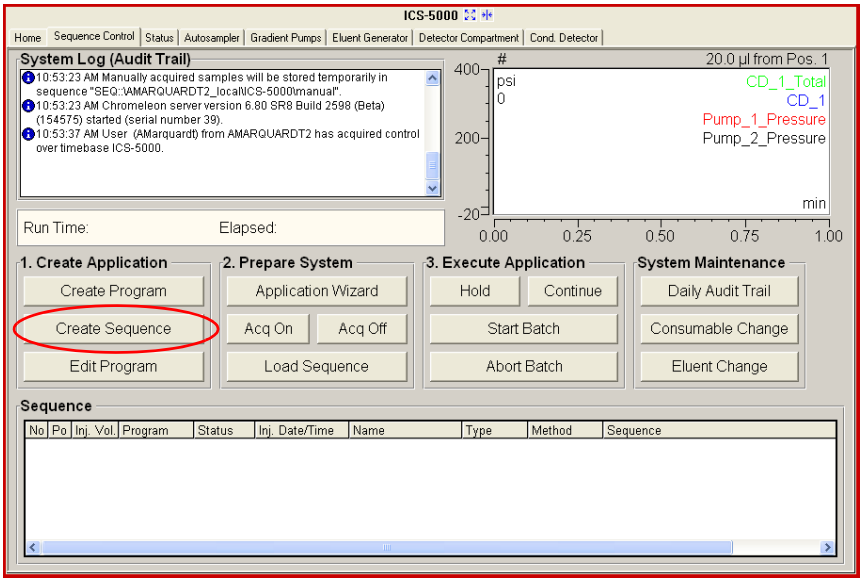


Figure 5-4. *Sequence Control Panel in Chromeleon 6.8*

2. Complete the steps in the Sequence Wizard, specifying the number of samples and standards that you want and the program and quantitation method to use. For help at any time, click the **Help** button on the Sequence Wizard page.

   NOTE If preferred, you can create the sequence first and then specify the program and quantitation method later. You can also edit other details of the sequence (for example, add or remove samples) after you finish the wizard.

3. After you finish the Sequence Wizard, the new sequence is displayed in the Chromeleon 6.8 Browser.

Using the Application Wizard (Chromeleon 6.8 only)

1. Click **Application Wizard** on the **Sequence Control** panel (see Figure 5-4).
2. Select a suppressor type (if used) and then select an application template from the list.

   NOTE Instead of selecting an application template, you can use the Virtual Column Separation Simulator. Refer to the Chromeleon 6.8 Help for details.

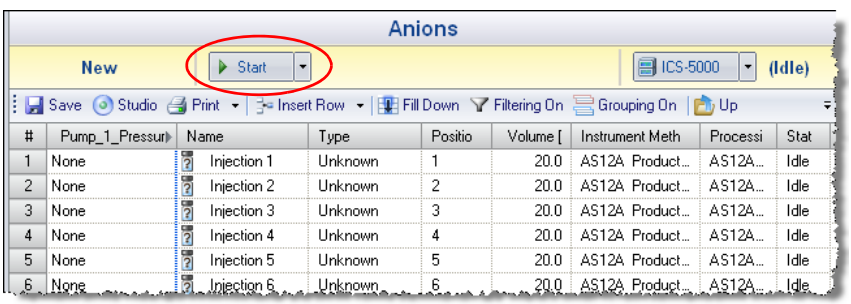
3. Click **Next>** and select the **in a new sequence via Sequence Wizard** option.
4. Click **Next>** to go to the Sequence Wizard.
5. Complete the steps in the Sequence Wizard, specifying the number of samples and standards that you want. For help at any time, click the **Help** button on the Sequence Wizard page.

   After you finish the Sequence Wizard, a sequence is created and displayed in the Chromeleon 6.8 Browser. A program and quantification method appropriate for the selected application are copied to the sequence.

5.2.3 Starting a Sequence

Starting a Sequence in Chromeleon 7

1. Click **Start** on the sequence control bar (see Figure 5-5).



#	Pump_1_Pressur	Name	Type	Positio	Volume [	Instrument Meth	Processi	Stat
1	None	Injection 1	Unknown	1	20.0	AS12A Product...	AS12A...	Idle
2	None	Injection 2	Unknown	2	20.0	AS12A Product...	AS12A...	Idle
3	None	Injection 3	Unknown	3	20.0	AS12A Product...	AS12A...	Idle
4	None	Injection 4	Unknown	4	20.0	AS12A Product...	AS12A...	Idle
5	None	Injection 5	Unknown	5	20.0	AS12A Product...	AS12A...	Idle
6	None	Injection 6	Unknown	6	20.0	AS12A Product...	AS12A...	Idle

Figure 5-5. *Starting a New Sequence in Chromeleon 7*

2. The sequence is appended to the instrument queue and a Ready Check is performed. If the Ready Check passes and the instrument is not currently running another sequence, the sequence is started.

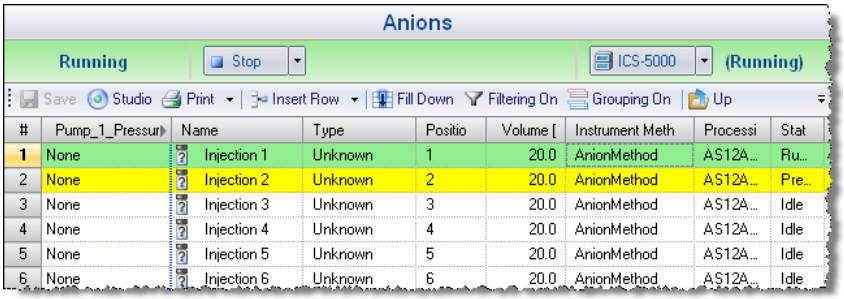


Figure 5-6. *Running Sequence in Chromeleon 7*

Starting a Sequence in Chromeleon 6.8

1. On the **Sequence Control** panel, click **Load Sequence** (see Figure 5-7).
2. Select the sequence from the list and click **Open**. The sequence is added to the **Sequence** table.
3. Click **Start Batch** (see Figure 5-7).

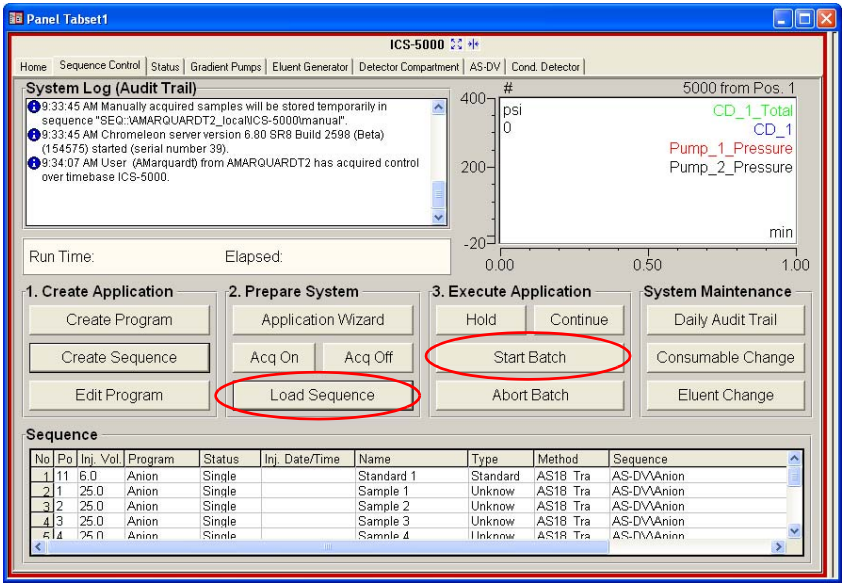


Figure 5-7. *Starting a Sequence in Chromeleon 6.8*

5.3 Loading Samples Into the Sample Loop or Concentrator

Two methods are available for loading samples:

- Loading samples with an autosampler (see Section 5.3.1)
- Loading samples with a syringe through the sample loading ports on the DC front door (see Section 5.3.2)

5.3.1 Loading Samples with an Autosampler

1. Verify that the autosampler output line is connected to the sample port on the DC (or TC) injection valve. Direct the waste line as required for this autosampler model.
2. Prepare and fill the sample vials and place them in the autosampler tray or carousel. Refer to the autosampler manual for detailed instructions. Autosampler manuals are provided on the Thermo Scientific Reference Library DVD (P/N 053891).
3. Create a sequence in Chromeleon that specifies the vials from which to take sample injections and the order in which the injections should be run.
4. Specify a Chromeleon 7 instrument method or Chromeleon 6.8 program that includes the appropriate load and inject commands for the autosampler. See the examples in Section 5.4.

5.3.2 Loading Samples with a Syringe

This section describes two methods for using a syringe to load sample into the DC injection valve sample loop:

- Loading sample with a syringe through the sample loading port on the front of the DC (push method)
- Loading sample with a vacuum syringe through the sample loading port on the front of the DC (pull method)

Loading Samples with a Syringe (Push Method)

1. Verify that a luer adapter fitting is installed on the sample loading port on the front of the DC and that tubing is connecting the sample loading port

to the sample port on the injection valve. If not, refer to Section 9.20 for connection instructions.

2. Fill a syringe with a calibration standard or sample.
3. Insert the syringe into the sample loading port on the front of the DC.
4. Verify that the injection valve is in the Load position. If it is not, switch the valve by clicking the valve control on the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset, or by pressing the **VALVE** button on the front of the DC.
5. Overfill the sample loop with several sample loop volumes. Excess sample will exit through the injection valve waste line.
6. Leave the syringe in the port. This prevents the sample from exiting the loop before injection.
7. Switch the injection valve to the Inject position.

5.3.3 Loading Samples with a Vacuum Syringe (Pull Method)

1. Verify that a luer adapter fitting is installed on the sample loading port on the front of the DC and that tubing is connecting the sample loading port and the injection valve. If this is not the case, refer to Section 9.20 for connection instructions.
2. Disconnect the waste line from the injection valve and replace it with a 25 to 30 cm (10 to 12 in) piece of PEEK or PTFE tubing (see Figure 5-8).
3. Place the free end of the line into the sample.
4. Verify that the injection valve is in the Load position. If it is not, switch the valve by clicking the valve control on the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset, or by pressing the **VALVE** button on the front of the DC.
5. Insert a 5 cc syringe into the sample loading port on the DC front door (see Figure 5-8) and pull out the plunger to draw the sample into the injection valve.

6. Switch the injection valve to the Inject position.

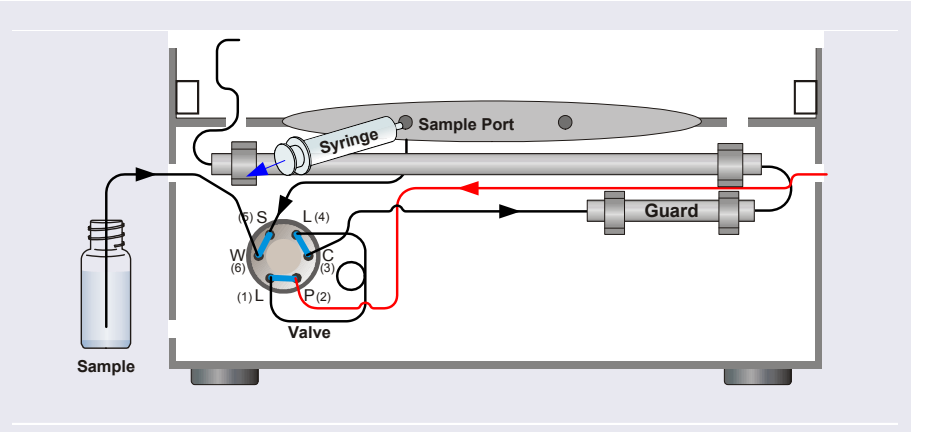


Figure 5-8. *Loading Sample with a Vacuum Syringe (Pull Method)*

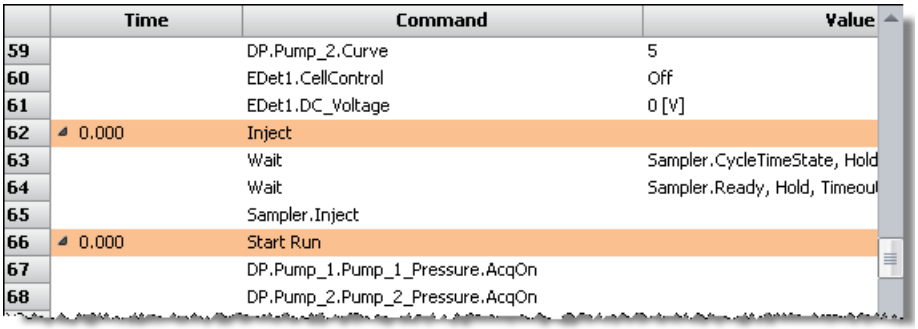
5.4 Autosampler Commands for Loading and Injecting Samples

Commands for loading and injecting a sample using an autosampler are included in a Chromeleon 7 instrument method or Chromeleon 6.8 program. When you create an instrument method or program with the Chromeleon software wizard, the specific autosampler commands required for your model of autosampler and the type of injection to be performed are added automatically.

An Inject command to switch the injection valve to the Inject position is always included. The Inject command occurs at time 0.00. This is when the sample enters the high-pressure side of the system and defines the beginning of a chromatogram. Wait commands to pause the instrument method or program while the autosampler is performing the injection are also included.

For Dionex AS-DV and AS autosamplers, a Load command is required to switch the injection valve to the Load position. A separate Load command is not needed for the Dionex AS-AP.

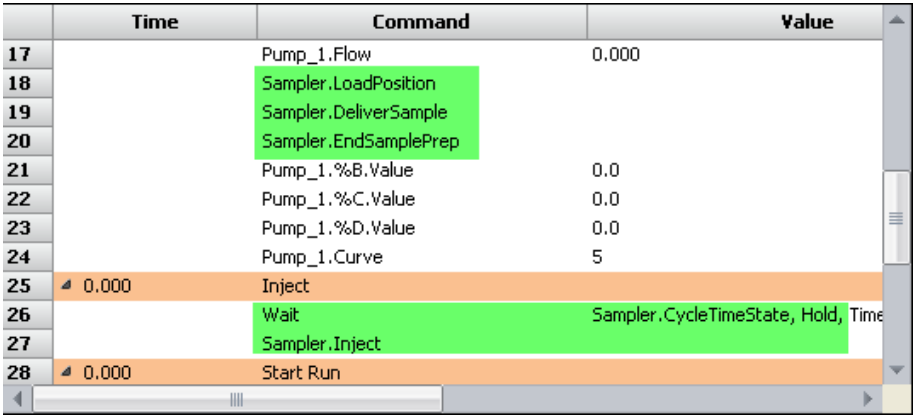
Figure 5-9 shows the basic Chromeleon commands for controlling sample injection with a Dionex AS-AP Autosampler.



	Time	Command	Value
59		DP.Pump_2.Curve	5
60		EDet1.CellControl	Off
61		EDet1.DC_Voltage	0 [V]
62	0.000	Inject	
63		Wait	Sampler.CycleTimeState, Hold
64		Wait	Sampler.Ready, Hold, Timeout
65		Sampler.Inject	
66	0.000	Start Run	
67		DP.Pump_1.Pump_1_Pressure.AcqOn	
68		DP.Pump_2.Pump_2_Pressure.AcqOn	

Figure 5-9. *Commands for Loading and Injecting a Sample with a Dionex AS-AP (Chromeleon 7 Script Editor Shown)*

Figure 5-10 shows the basic Chromeleon commands for controlling sample injection with a Dionex AS-DV Autosampler.



	Time	Command	Value
17		Pump_1.Flow	0.000
18		Sampler.LoadPosition	
19		Sampler.DeliverSample	
20		Sampler.EndSamplePrep	
21		Pump_1.%B.Value	0.0
22		Pump_1.%C.Value	0.0
23		Pump_1.%D.Value	0.0
24		Pump_1.Curve	5
25	0.000	Inject	
26		Wait	Sampler.CycleTimeState, Hold, Time
27		Sampler.Inject	
28	0.000	Start Run	

Figure 5-10. *Commands for Loading and Injecting Sample with a Dionex AS-DV (Chromeleon 7 Script Editor Shown)*

Figure 5-11 shows the basic Chromeleon commands for controlling sample injection with a Dionex AS Autosampler.

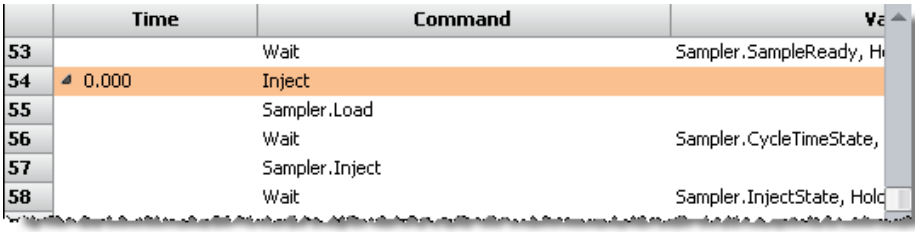


Figure 5-11. *Commands for Loading and Injecting a Sample with a Dionex AS (Chromeleon 7 Script Editor Shown)*

For details about controlling an autosampler, refer to the operator's manual for your autosampler. The manuals are provided on the Thermo Scientific Reference Library DVD (P/N 053891).

ICS-5000 DP/SP

DP/SP Shutdown

If the Dionex ICS-5000 Dual Pump (DP) or Dionex ICS-5000 Single Pump (SP) will not be operated for a period of one week or more, follow the instructions below:

- Fill the pump with methanol (or a similar alcohol, such as 2-propanol or ethanol). If the eluents in the pump are not miscible with water, replace the eluents step-by-step.
- Fill the seal wash reservoir with wash solution (see Section 2.2.5).
- Rinse out buffers. This will reduce the time required for column equilibration when you resume operation.
- Disconnect the tubing from the peristaltic pump on the component panel: lift the lever up and to the right, remove the tubing, and release the lever (see Figure 6-1).

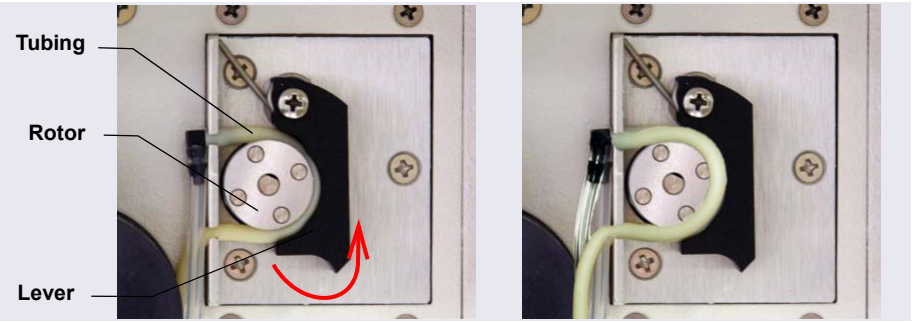


Figure 6-1. *Peristaltic Pump for Seal Wash System*

Before shipping the pump:

- Empty the seal wash reservoir.
- Disconnect the tubing from the peristaltic pump on the component panel: press the lever to the right, remove the tubing, and release the lever (see Figure 6-1).

ICS-5000 EG

EG Shutdown

6.1 Short-term Shutdown

If the shutdown is for 3 months or less, follow the instructions below.

To prepare the EG for the shutdown:

1. Turn off the EG, including all consumables installed in the EG (the CR-TC, suppressor, etc.).
2. Verify that the current to the EGC and the suppressor is off.

IMPORTANT **Supplying power to the EGC when there is no eluent flow can severely damage the cartridge.**

3. Store the EGC in the EG during the shutdown.

To restart the EG:

1. Select the parameters for the analysis on the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset. For EG startup information, see Section 4.9.

Analytical IC

2. In an analytical IC system, if the EG has been shut down for more than 3 to 4 days, hydrate the suppressor as instructed in the product manual. Suppressor manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).
3. Let the system equilibrate before collecting data.

6.2 Long-term Shutdown

If the shutdown is for 3 months or more, follow the instructions below.

To prepare the EG for the shutdown:

1. Turn off the EG, including all consumables installed in the EG (the CR-TC, suppressor, etc.).

2. Verify that the current to the EGC and the suppressor is off.

IMPORTANT **Supplying power to the EGC when there is no eluent flow can severely damage the cartridge.**

3. If you plan to store the EGC in the EG, no further action is required.

   If you plan to store the cartridge outside the EG (for example, in the original shipping container), follow the instructions in Section 9.14.1, to remove the EGC from the EG, and the instructions in Section 9.14.3, to store the EGC.

To restart the EG:

1. Select the parameters for the analysis on the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset. For EG startup information, see Section 4.9.
2. Condition the EGC. For instructions, see "Conditioning the Capillary EGC" on page 343 or "Conditioning the Analytical EGC" on page 348.
3. Hydrate the CR-TC (see "Installing and Flushing the New CR-TC" on page 350).
4. Hydrate the suppressor as instructed in the product manual. Suppressor manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).
5. Let the system equilibrate before collecting data.

Before shipping the EG:

1. Follow the instructions in Section 9.14.1, to remove the EGC from the EG.
2. Plug all fittings. Tighten the vent fitting (capillary EGC) or cap the vent port (analytical EGC). This will prevent the evaporation of water in the electrolyte reservoir.

IMPORTANT **Make sure the EGC packaging conforms to hazardous material shipping requirements. Refer to the Material Safety Data Sheet (MSDS) shipped with the EGC for the chemical description.**

6.3 Consumables Storage

The columns, suppressors, and other consumable items used with a Dionex ICS-5000 system have various short- and long-term storage requirements. Refer to the manuals for the individual products for instructions. These manuals are provided on the Thermo Scientific Reference Library DVD (P/N 053891).

6.4 ED Cell Storage

6.4.1 Short-term Storage of the ED Cell

If the cell will not be used for a short period of time (less than 2 days), disconnect the tubing from the inlet and outlet fittings and all fitting plugs.

NOTE If the pH-Ag/AgCl reference electrode remains in the cell but eluent is not being pumped through the cell, the pH-Ag/AgCl reference electrode frit may partially dry out. If this occurs, regenerate the electrode by soaking it in a solution containing 1 M KCl and 1 M HCl.

6.4.2 Long-term Storage of the pH-Ag/AgCl Reference Electrode

If the cell will not be used for 2 days or more, remove the pH-Ag/AgCl reference electrode and store it in a solution of saturated KCl, as instructed in the procedure below.

1. Prepare a saturated solution of KCl in ASTM filtered, Type I (18 megohm-cm) deionized water that meets the specifications listed in Section 1.5.
2. Locate the cap in which the electrode was shipped and fill it two-thirds full with the prepared KCl solution.
3. Remove the pH-Ag/AgCl reference electrode from the cell.
4. Insert the electrode into the cap and screw on the cap (see Figure 6-2).

5. Make sure there is no air bubble in the cap. Add more KCl solution if needed.

Figure 6-2. *pH-Ag/AgCl Reference Electrode in Storage Cap*

TC Shutdown

6.5 Consumables Storage

The columns and other consumable items used with a Dionex ICS-5000 system have various short- and long-term storage requirements. Refer to the manuals for the individual products for instructions. These manuals are provided on the Thermo Scientific Reference Library DVD (P/N 053891).

6.6 Short-term Shutdown

Before a TC shutdown of less than one week, no special procedure is required.

6.7 Long-term Shutdown

Before interrupting TC operation for more than one week or before shipping the TC, rinse the fluid connections with deionized water.

7 • Maintenance

This section describes routine maintenance procedures for the Dionex ICS-5000 system that users may perform. All other maintenance procedures must be performed by Thermo Fisher Scientific personnel.

For information about maintenance procedures for the EGC, CR-TC trap column, or suppressor, refer to the appropriate product manual. These manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).

7.1 System Maintenance Checklists

7.1.1 Daily Maintenance

- ☐ Check for leaks.
- ☐ Wipe up liquid spills.
- ☐ Check eluent reservoirs for microbial growth; clean reservoirs and replace eluent as needed.

Analytical IC
- ☐ Check eluent reservoir levels and refill as needed.

Analytical IC
- ☐ Check waste containers and empty as needed.

For detailed daily maintenance instructions for each module, see:

DP/SP	page 195
EG	page 197
DC	page 199
TC	page 201

7.1.2 Weekly Maintenance

- ☐ Check end-line filters on eluent lines. When end-line filters are new, they are pure white. Replace filters if they become discolored, if bacterial

buildup is evident, or if eluent flow is blocked. See Section 4.6 for instructions.

- ☐ Check for plugged or blocked tubing connections.
- ☐ Check eluent reservoir levels and refill as needed. (Capillary IC)
- ☐ Check waste containers and empty as needed. (Capillary IC)

For detailed weekly maintenance instructions for each module, see:

DP/SP	page 195
EG	page 197
DC	page 199
TC	page 201

7.1.3 Periodic Maintenance

- ☐ Clean eluent reservoirs (when making fresh eluent or as needed) (see Section 9.4).
- ☐ (Optional) Have Thermo Fisher Scientific perform the performance qualification (PQ) procedure for IC systems.

For detailed periodic maintenance instructions for each module, see:

DP/SP	page 196
DC	page 199
TC	page 201

NOTE There are no periodic maintenance instructions for the EG.

7.1.4 Annual Maintenance

- ☐ Thermo Fisher Scientific recommends performing preventive maintenance on each module annually. Preventive Maintenance Kits contain all the required parts for these procedures. The following kits are available:

  DP/SP Preventive Maintenance Kits

  - ICS-5000 Analytical Pump Preventive Maintenance Kit (P/N 075038)

- ICS-5000 Capillary Pump Preventive Maintenance Kit (P/N 075039)

DC/TC Preventive Maintenance Kits

- 0.4 µL Internal Loop High-Pressure Valve Preventive Maintenance Kit (P/N 075040)
- 6-Port High-Pressure Valve Preventive Maintenance Kit (P/N 075041)
- 10-Port High-Pressure Valve Preventive Maintenance Kit (P/N 075042)

NOTE There is no Preventive Maintenance Kit for the EG.

ICS-5000 DP/SP

DP/SP Routine Maintenance

This section describes routine maintenance procedures that users may perform for the Dionex ICS-5000 Dual Pump (DP) or Dionex ICS-5000 Single Pump (SP). All other maintenance procedures must be performed by Thermo Fisher Scientific personnel.

7.2 DP/SP Daily Maintenance

- Check for leaks at the following locations: the eluent proportioning valves (gradient pump only), vacuum degas chambers, and eluent reservoirs. Tighten or replace any leaking fittings.
- Wipe up liquid spills and rinse dried reagents off pump components with deionized water. Dry the leak sensor thoroughly; if the sensor is not dry, it will remain activated and continue to report a leak to the Audit Trail.
- Check the liquid level in the seal wash reservoir. The liquid level should remain between the **Min.** and **Max.** markers on the reservoir label.
- Check eluent reservoirs for microbial growth; clean reservoirs and replace eluent as needed. Rinse each eluent reservoir thoroughly (inside and out) with ASTM filtered, Type I (18 megohm-cm) deionized water that meets the specifications listed in Section 1.5. Dry with clean, particulate-free air. If a reservoir still appears dirty, or if there is a slimy film on the interior, clean the reservoir as instructed in Section 9.4.

Analytical IC

- Check the liquid level in each eluent reservoir and refill as required.

7.3 DP/SP Weekly Maintenance

- The end-line filters (P/N 045987) on the eluent lines may need to be replaced weekly, depending on water quality and eluent conditions. For example, replace the filters weekly when using an EGC to generate carbonate/bicarbonate eluent.

  When the end-line filters are new, they are pure white. Replace the filters whenever they become discolored, if bacterial buildup is evident, or if eluent flow is blocked.

NOTE It is especially important to regularly replace end-line filters when using aqueous eluents. Aqueous eluents may contaminate the filters with bacteria or algae, causing cause flow restrictions to the pump.

End-line filters are provided in the pump ship kit.

Pump Ship Kit	Part Number
DP Ship Kit Dual Capillary	072112
DP Ship Kit Dual Analytical	062463
DP Ship Kit Capillary and Analytical	072111
SP Ship Kit Capillary or Analytical	063342

Before installation, thoroughly rinse the end-line filter with ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5 to remove any loose particles.

- Replace the seal wash solution. ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5 is appropriate for most applications.
- Check the tubing connected to the peristaltic pump. If the tubing is blocked or crimped, replace it (see Section 9.9).

Capillary IC
- Check the liquid level in each eluent reservoir and refill as required.

7.4 DP/SP Periodic Maintenance

- Make fresh eluent as needed.
- Replace piston seals every 6 to 12 months (see Section 9.7).

Capillary IC
- Clean eluent reservoirs every 3 months with methanol or isopropyl alcohol, as instructed in Section 9.4.

7.5 DP/SP Annual Maintenance

Thermo Fisher Scientific recommends performing preventive maintenance annually. The following kits are available:

- ICS-5000 Analytical Pump Preventive Maintenance Kit (P/N 075038)
- ICS-5000 Capillary Pump Preventive Maintenance Kit (P/N 075039)

EG Routine Maintenance

This section describes routine maintenance procedures for the Dionex ICS-5000 Eluent Generator (EG) that users may perform. All other maintenance procedures must be performed by Thermo Fisher Scientific personnel.

For information about maintenance procedures for the EGC, CR-TC trap column, or suppressor, refer to the appropriate product manual. These manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).

7.6 EG Daily Maintenance

- Locate and repair leaks inside the EG (see Section 9.13) and wipe up liquid. Rinse dried eluents off components with deionized water.
- Rinse the EG drip tray with deionized water (to prevent formation of salt crystals) and dry the drip tray thoroughly. Rinse and dry the leak sensor, also; if the sensor is not dry, it will remain activated and continue to report a leak to the Audit Trail.
- Check the waste container and empty as needed.

7.7 EG Weekly Maintenance

- Check all lines for crimping. Move (or reroute) pinched lines and replace damaged lines (see Section 9.12). For help in isolating the cause of a tubing restriction, see Section 9.13.
- Monitor the system backpressure. A gradual increase in backpressure can indicate clogging of the EGC inlet frit from particulates in the eluent water.

7.8 EG Annual Maintenance

- Check the expiration date and remaining lifetime of the EGC on the EG ePanel in Chromeleon 7 or the Control panel in Chromeleon 6.8.

ICS-5000 DC

DC Routine Maintenance

This section describes routine maintenance procedures for the Dionex ICS-5000 Detector/Chromatography Module (DC) that users may perform. All other maintenance procedures must be performed by Thermo Fisher Scientific personnel.

7.9 DC Daily Maintenance

- Check the DC components for leaks or spills. Wipe up spills. Isolate and repair leaks (see Section 8.26). Rinse off any dried eluent with ASTM filtered, Type I (18 megohm-cm) deionized water that meets the specifications listed in Section 1.5.
- Check the waste container and empty as needed.

NOTE If you are using an electrochemical detector, also see the special maintenance considerations that are described in Section 4.1.2.

7.10 DC Weekly Maintenance

- Check liquid lines for crimping or discoloration. Relocate any pinched lines. Replace damaged lines.
- Check for excess condensation inside the DC. Condensation may build up when the DC is operated in a highly humid environment and the majority of the applications are run at cold temperatures. To remove condensation, run the DC at its maximum temperature for at least 48 hours.

7.11 DC Periodic Maintenance

- Inspect the door seal for signs of damage. A defective seal impairs the performance of the instrument. If the seal is defective, contact Technical Support for Dionex products.

7.12 DC Annual Maintenance

Thermo Fisher Scientific recommends performing preventive maintenance annually. The following kits are available:

- 0.4 µL Internal Loop High-Pressure Valve Preventive Maintenance Kit (P/N 075040)
- 6-Port High-Pressure Valve Preventive Maintenance Kit (P/N 075041)
- 10-Port High-Pressure Valve Preventive Maintenance Kit (P/N 075042)

TC Routine Maintenance

This section describes routine maintenance procedures for the Dionex ICS-5000 Thermal Compartment (TC) that users may perform. All other maintenance procedures must be performed by Thermo Fisher Scientific personnel.

7.13 TC Daily Maintenance

- Check the TC components for leaks or spills. Wipe up spills. Isolate and repair leaks (see Section 8.31). Rinse off any dried eluent with ASTM filtered, Type I (18 megohm-cm) deionized water that meets the specifications listed in Section 1.5.
- Check the liquid level in the waste container and empty as needed.

Neutralize acidic and caustic wastes before disposal. Dispose of all wastes in accordance with local regulations.

Neutralisez les déchets acides ou caustiques avant de les jeter. Jetez les déchets aux règlements locaux.

Neutralisieren Sie säurehaltige und ätzende Abfälle vor ihrer Entsorgung. Entsorgen Sie alle Abfälle entsprechend den lokalen Bestimmungen.

7.14 TC Weekly Maintenance

- Check liquid lines for crimping or discoloration. Relocate any pinched lines. Replace damaged lines.

7.15 TC Periodic Maintenance

- Clean the interior of the TC, using a lint-free cloth. Use paper to absorb any liquid inside the module. The cleaner the module, the more effective the sensors are at detecting excessive gas or humidity.

- Check for excess condensation inside the TC. Condensation may build up when the TC is operated in a highly humid environment and the majority of applications are run at cold temperatures. To remove condensation, run the TC at its maximum temperature for at least 72 hours.

IMPORTANT **Some IC columns should not be operated at temperatures above 70 °C (158 °F). Remove all columns from the TC before beginning the maintenance procedure above.**

- Inspect the door seal for signs of damage. A defective seal impairs the performance of the instrument. If the seal is defective, contact Technical Support for Dionex products.

7.16 TC Annual Maintenance

- Thermo Fisher Scientific recommends performing preventive maintenance annually. The following kits are available:
  - 6-Port High-Pressure Valve Preventive Maintenance Kit (P/N 075041)
  - 10-Port High-Pressure Valve Preventive Maintenance Kit (P/N 075042)

8 • Troubleshooting

This chapter is a guide to troubleshooting minor issues that may arise during operation of the Dionex ICS-5000 system. Turn to the section of this chapter that best describes the operating problem or symptom that has been observed. Each section lists possible causes of the problem or symptom in order of probability. A systematic troubleshooting approach is the most effective way to determine the root cause.

If you are unable to resolve a problem by following the instructions here, contact Technical Support for Dionex products. In the U.S. and Canada, call 1-800-346-6390. Outside the U.S. and Canada, call the nearest Thermo Fisher Scientific office. Please have this chapter at hand when talking with Technical Support personnel.

8.1 Audit Trail Error Messages

The instrument control firmware installed in each Dionex ICS-5000 module periodically checks the status of certain parameters. If a problem is detected, it is reported to Chromeleon and logged in the Audit Trail. Each error message is preceded by an icon that identifies the seriousness of the underlying problem (see the table below). For most modules (except for the TC), you can change the severity level assigned to a problem whenever appropriate.

Icon	Default Severity Level	Description
	Warning	A message is displayed in the Audit Trail, but the current run is not interrupted.
	Error	A message is displayed in the Audit Trail, and the system attempts to correct the problem (sometimes by using an alternative parameter). An Error never interrupts the current analysis; however, if it occurs during the Ready Check, the analysis will not be started.
	Abort	A message is displayed in the Audit Trail, and the running batch is aborted.

8.1.1 DP/SP Error Messages

Table 8-1 lists the most frequently observed DP/SP-related error messages and their default severity levels. For troubleshooting assistance, refer to the page indicated in the table.

DP/SP-Related Audit Trail Error Message	Default Severity Level	See
A program with this name already exists.	Abort	page 227
Abnormal drive current for x.x seconds.	Warning	page 227
Camshaft index too early.	Abort	page 228
Camshaft index too late.	Abort	page 228
Camshaft sensor always alight.	Abort	page 228
Camshaft sensor missing or dark.	Abort	page 228
Degasser malfunction.	Warning	page 228
Excessive drive current. Camshaft x.x.	Abort	page 229
Invalid flow value.	Abort	page 229
Leak detected. Flow stopped.	Abort	page 229
Left-hand pump block carryover pressure is too high.	Abort	page 230
Motor malfunction.	Abort	page 230
Motor position error. The motor is overloaded.	Abort	page 230
Pressure fallen below lower limit.	Abort	page 231
Relay 4 is configured for inject synchronization. Please change pump configuration.	Abort	page 232
Right-hand pump block carryover pressure is too high.	Abort	page 230
The maximum purge pressure was exceeded.	Abort	page 232
The pressure in the left-hand working cylinder exceeded the safety limit.	Abort	page 233
The pressure in the right-hand working cylinder exceeded the safety limit.	Abort	page 233

Table 8-1. *DP/SP Error Messages*

DP/SP-Related Audit Trail Error Message	Default Severity Level	See
The system pressure exceeded the safety limit.	Abort	page 233
This function cannot be adjusted by the user.	Abort	page 234
Upper pressure limit exceeded.	Abort	page 234

Table 8-1. *DP/SP Error Messages (Continued)*

8.1.2 EG Error Messages

Table 8-2 lists the EG-related error messages and their default severity levels. For troubleshooting assistance, refer to the page indicated in the table.

EG-Related Audit Trail Error Message	Default Severity Level	See
Concentration out of range! The maximum value at time %1 is %2.	Error	page 241
Concentration out of range! The maximum value is %1.	Error	page 241
CR-TC1 open circuit. CR-TC2 open circuit.	Abort	page 241
CR-TC1 over current. CR-TC2 over current.	Abort	page 242
CR-TC1 stopped because EGC1 OFF. CR-TC2 stopped because EGC2 OFF.	Abort	page 242
CR-TC1 stopped due to zero flow. CR-TC2 stopped due to zero flow.	Abort	page 243
The CR-TC mode is off for a virtual pump.	Abort	page 243
CR-TC mode will be turned off for invalid flow. Flow range for analytical EGC: 0.100 - 3.000 mL/min, capillary EGC: 0.001 - 0.100 mL/min.	Abort	page 243
Current linked pump is capillary. Please install a capillary EGC.	Abort	page 244

Table 8-2. *EG Error Messages*

EG-Related Audit Trail Error Message	Default Severity Level	See
Current linked pump is analytical. Please install an analytical EGC.	Abort	page 244
EG1 cartridge disconnected. EG2 cartridge disconnected.	Abort	page 244
EG1 invalid activation date. EG2 invalid activation date.	Abort	page 245
EG1 invalid concentration. EG2 invalid concentration.	Abort	page 245
EG1 invalid flow. EG2 invalid flow.	Abort	page 245
EG1 invalid flow rate-concentration. EG2 invalid flow rate-concentration.	Abort	page 246
EG1 invalid ion count. EG2 invalid ion count.	Abort	page 246
EG1 invalid serial number. EG2 invalid serial number.	Abort	page 247
EG1 over current. EG2 over current.	Abort	page 247
EG1 over power. EG2 over power.	Abort	page 248
EG1 over voltage. EG2 over voltage.	Abort	page 248
EG1 wrong cartridge error. EG2 wrong cartridge error.	Abort	page 249
The EG mode is off due to pump pressure alarm or leak.	Abort	page 249
The EG mode is off for a virtual pump.	Warning	page 249
EG mode will be turned off for invalid flow.	Warning	page 249

Table 8-2. *EG Error Messages (Continued)*

EG-Related Audit Trail Error Message	Default Severity Level	See
EG mode will be turned off for invalid flow. Flow range for analytical EGC: 0.100 - 3.000 mL/min, capillary EGC: 0.001 - 0.100 mL/min.	Abort	page 250
EGC-1 is not linked to a compatible pump. EGC-2 is not linked to a compatible pump.	Warning	page 250
EGC cannot be used due to invalid ion count.	Abort (can't be changed)	page 251
EGC is either not installed or invalid cartridge number. Please install a capillary EGC.	Abort	page 251
EGC is either not installed or invalid cartridge number. Please install an analytical EGC.	Abort	page 251
EGC is either not installed or invalid cartridge number. Please install an EGC.	Abort	page 252
Leak sensor wet.	Warning	page 252
pH modifier must be used with a different type of cartridge.	Error	page 252
Pump is disconnected. The EG mode is off.	Warning	page 253

Table 8-2. *EG Error Messages (Continued)*

8.1.3 DC Error Messages

Table 8-3 lists the DC-related error messages and their default severity levels. For troubleshooting assistance, refer to the page indicated in the table.

DC-Related Audit Trail Error Message	Default Severity Level	See
CD cell option disconnected.	Abort	page 259
CD cell over safe temperature.	Abort	page 260
Column temperature open circuit.	Abort	page 260
Column over safe temperature.	Abort	page 260
Column temperature calibration error.	Warning	page 261

Table 8-3. *DC Error Messages*

DC-Related Audit Trail Error Message	Default Severity Level	See
Compartment temperature open circuit.	Abort	page 261
Compartment over safe temperature.	Abort	page 261
Compartment temperature calibration error.	Warning	page 261
ED cell current exceeds limits error.	Warning	page 261
ED cell option disconnected.	Abort	page 262
ED cell working electrode disconnected.	Abort	page 263
ED pH offset calibration failed.	Warning	page 263
ED pH slope calibration failed.	Warning	page 264
ED reference electrode disconnected.	Warning	page 264
High pressure valve 1 error. High pressure valve 2 error. High pressure valve 3 error. High pressure valve 4 error.	Abort	page 265
IC Cube 1 heater over safe temperature. IC Cube 2 heater over safe temperature.	Error	page 266
Lower door opened.	Warning	page 267
Lower leak sensor wet.	Warning	page 267
Reaction coil open circuit.	Abort	page 267
Reaction coil over safe temperature.	Abort	page 268
Suppressor over-current.	Abort	page 268
Suppressor over-power.	Abort	page 268
Suppressor over-voltage.	Abort	page 269
Suppressor stopped for flow rate.	Warning	page 269
Upper door opened.	Warning	page 269

Table 8-3. *DC Error Messages (Continued)*

8.1.4 TC Error Messages

Table 8-4 lists the TC-related error messages and their default severity levels. For troubleshooting assistance, refer to the page indicated in the table.

TC-Related Audit Trail Error Message	Default Severity Level	See
AcqOff without previous AcqOn.	Error	page 275
Acquisition is still on at program end.	Error	page 275
All samples scheduled for run on timebases x need to specify the same value for property (nominal) Temperature.	Error	page 275
All samples scheduled for run on timebases x need to specify the same value for property TempCtrl.	Error	page 275
All samples scheduled for run on timebases x need to specify the same value for property y.	Error	page 276
Can't execute “Disconnect” command during data acquisition.	Warning	page 276
Can't execute “Standby” command during data acquisition.	Warning	page 276
Can't find download image TC3000.HEX.	Abort	page 276
Can't start acquisition at negative retention times.	Error	page 277
Can't start acquisition: The server configuration does not fulfill the license conditions.	Abort	page 277
Can’t start TC firmware. A firmware download may be necessary.	Abort	page 277
Can't use device “x” as a source of the column pressure. Please check the property “SystemPressure” for a valid device name. The device must have the “Pressure” property available.	Error	page 278

Table 8-4. *TC Error Messages*

TC-Related Audit Trail Error Message	Default Severity Level	See
Can't use device "x" as a source of the column pressure. Please check the property "y" for a valid device name. The device must have the "Pressure" property available.	Error	page 278
Card data checksum error.	Error	page 279
Command is not available in demo mode.	Abort	page 279
Communication error: x.	Abort	page 279
Communication time-out.	Abort	page 280
Configuration doesn't match. X not installed.	Warning	page 280
Configuration mismatch (x — CM uses y, Column Compartment uses z). Please use the Server Configuration program to check the installation.	Abort	page 280
Current flow is out of limits defined for the column.	Warning	page 280
Current pressure is out of limits defined for the column.	Warning	page 281
Current temperature is out of limits defined for the column.	Warning	page 281
Data buffer overrun.	Abort	page 281
Device control feature is not available! Please check key code and CM Features (see "About Chromeleon..." in the client's Help menu).	Abort	page 282
Device is not remote.	Abort	page 282
Device not found on the USB.	Abort	page 283
Either the current date is later than the expiration date for x or the program or batch will end later than 24 hours before the expiration time for y.	Warning	page 283
Error deleting flash memory.	Abort	page 283
Error during storing of the card data to the chip card.	Error	page 284

Table 8-4. *TC Error Messages (Continued)*

TC-Related Audit Trail Error Message	Default Severity Level	See
Error finishing download.	Abort	page 277
Error programming flash memory.	Abort	page 284
Executing this command will reset associated counter values stored in the module.	Warning	page 284
Firmware download failed.	Abort	page 285
Firmware download in progress. Please wait.	Error	page 285
Gas leak detected.	Error	page 285
Humidity leak detected.	Error	page 285
Illegal parameter.	Abort	page 286
Invalid date/time format. Either use “DD MMM YYYY” or “current [+ [Nyear[s]] [Nmonth[s]] [Nday[s]]].” Examples: “31 Dec 1999,” “current + 1year 6months.”	Error	page 286
Invalid enumerated value.	Warning	page 286
Next qualification of this module is due in x day(s) (due date is [date]).	Warning	page 286
Next qualification of this module is overdue (due date was [date]).	Warning	page 287
Next qualification of this module is overdue (due date was [date]). Module may no longer be used.	Error	page 287
Next qualification of this module was due on [date]. Allowing x more grace day(s).	Warning	page 287
Next service of this module is due in x day(s) (due date is [date]).	Warning	page 287
Next service of this module is overdue (due date was [date]).	Warning	page 287
No chip card in the reader for the column x.	Error	page 288
No response from x for x seconds.	Warning	page 288
No response from x for x seconds. Device disconnected.	Abort	page 288

Table 8-4. *TC Error Messages (Continued)*

TC-Related Audit Trail Error Message	Default Severity Level	See
Operating columns above 70 °C could affect column performance. Verify recommended column operating conditions before setting temperature above 70 °C.	Warning	page 289
Parameter x value exceeded its allowed range. Set to closest valid value y.	Warning	page 289
Primary property "x" is already assigned and cannot be changed.	Error	page 290
Properties cannot be changed. A chip card has not been inserted properly. Check the CardState property for all cards and reinsert those indicating "BusBlocked."	Error	page 290
Properties cannot be changed if the compartment door is open.	Error	page 290
Properties cannot be changed—there is no card in the card reader.	Error	page 291
Raw data file x cannot be created.	Warning	page 291
Raw data file x cannot be created. Continuing with network failure protection.	Warning	page 291
Raw data file x cannot be written.	Warning	page 291
Raw data file x cannot be written. Continuing with network failure protection.	Warning	page 291
Starting data acquisition manually will overwrite any data which has been acquired so far.	Warning	page 292
TC—Firmware download failed.	Abort	page 277
TC is not remote.	Abort	page 282
The command can format only chip cards with an invalid data structure.	Error	page 292
The communication interface is closed. Reconnect the instrument.	Error	page 292
The compartment door is open; a batch or a program may need to wait until the door has been closed. Please close the door.	Warning	page 293

Table 8-4. *TC Error Messages (Continued)*

TC-Related Audit Trail Error Message	Default Severity Level	See
The counter [name] (value: x) has exceeded its limit (y). Module should no longer be used. Replace the [name].	Warning	page 293
The data format stored on the chip card is unsupported (format version x).	Error	page 293
The injections limit for the column has been exceeded.	Warning	page 294
The injections limit will be exceeded for the column x.	Warning	page 294
The nominal temperature must be set within the current limits.	Error	page 294
The nominal temperature value is out of range defined by the active column ID.	Error	page 294
The oven is not fully operable yet. Check the values of “Standby,” “Ready,” “Door,” and “CardState.”	Error	page 294
The primary column ID property “x” will be changed. The property can't be changed in the future.	Warning	page 295
The upper limit must be higher than the lower limit.	Error	page 295
The Warning threshold must be higher than the Limit threshold.	Error	page 296
The Warning threshold must be lower than the Limit threshold.	Error	page 296
There was already an AcqOff command for this channel before.	Warning	page 296
There was already an AcqOn command for this channel before.	Warning	page 296
This function cannot be adjusted by the user.	Abort	page 297
This operation may affect the oven's operation on timebase x, which is currently running a batch.	Warning	page 297

Table 8-4. *TC Error Messages (Continued)*

TC-Related Audit Trail Error Message	Default Severity Level	See
Two AcqOn commands for the same channel. The second chromatogram will overwrite the first.	Error	page 296
Unknown error code.	Warning	page 297
Unknown format of the card data.	Error	page 297
USB/LAN communication error. Please check communication cable and instrument's power.	Abort	page 283
Value for [name] parameter is not within valid range. Value passed (x) will be substituted by y.	Warning	page 289
Value x replaced by valid table entry y.	Warning	page 289
X position error.	Abort	page 298
You do not have the privilege to approve the module's qualification.	Error	page 298
You do not have the privilege to change the performance limits.	Error	page 298
You do not have the privilege to change the qualification intervals.	Error	page 298

Table 8-4. *TC Error Messages (Continued)*

8.2 Noisy Baseline

- **Eluent is contaminated**

  1. Clean all eluent reservoirs thoroughly (inside and out) with ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5. Dry with clean, particulate-free air. If a reservoir still appears dirty, or if there is a slimy film on the interior, follow the cleaning instructions in Section 9.4.
  2. Flush the system with ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5.
  3. Replace all end-line filters (P/N 045987). See Section 4.6 for instructions.
  4. Prepare new stock solution.

5. Prepare fresh eluent. To ensure eluent purity, prepare all eluents with spectro-grade eluents, reagent-grade chemicals, and ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5.

- **DP/SP not properly primed**

  Prime the pump (see Section 9.5).

- **Piston seal is damaged**

  If the piston seal is damaged, it allows liquid leaks. Leaks are usually visible, and thus easily detected. If necessary, replace the piston seal (see Section 9.7).

- **Inadequate system or cell backpressure**

  Add backpressure tubing to the cell outlet (see Section 9.27.4) or to the pump (if no column is installed).

Analytical IC

- **(Analytical EG only) System backpressure is below 14 MPa (2000 psi)**

  The optimal system backpressure is 16 MPa (2300 psi) in an analytical IC system with an EG installed,. Low system backpressure may cause high baseline noise as the eluent concentration increases in the gradient. To correct this, install a backpressure coil in the EG after the RFIC Eluent Degasser (see Section 9.17).

- **Flow system leak ahead of cell**

  Check all fittings and liquid lines for leaks. Tighten or, if necessary, replace all liquid line connections (see Section 9.19).

- **Rapid changes in ambient temperature**

  Make sure the column is installed in a thermostatically controlled compartment and the compartment door is closed.

- **Insufficient system equilibration following changes to operating parameters; especially apparent when operating at high sensitivities**

  Allow a longer system equilibration time (up to 2 hours) before starting operation.

Noisy Baseline: CD Only

- **Incorrect suppressor operating conditions**

  Refer to the suppressor manual for troubleshooting information. Suppressor manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).

- **Cell above or below temperature**

  Contact Technical Support for Dionex products for assistance.

- **Detector electronics not functioning correctly**

  Run the detector dummy cell diagnostics from the Wellness panel (see Section 9.27).

- **Inappropriate suppressor operating conditions**

  Refer to the suppressor manual for the correct operating conditions. Suppressor manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).

- **Temperature compensation setting not optimized**

  Optimize the selected setting (see Section 2.14).

Analytical IC

- **Trapped gases in cell**

  Release any trapped gases in the cell by loosening the lines to and from the cell and then retightening them. Also loosen and retighten the fittings to and from the suppressor eluent ports.

Analytical IC

- **Inadequate system backpressure**

  In an analytical IC system, add backpressure tubing to the cell outlet (see Section 9.27.4).

Noisy Baseline: ED Only

- **(DC Amperometry and Integrated Amperometry modes) Air bubbles trapped inside cell**

  While wearing gloves and eye protection and with the pump running and all plumbing connected, generate a slight temporary backpressure by putting your finger over the end of the cell outlet tubing for 2 to

3 seconds. Repeat two or three times. If the baseline does not improve, check the other causes of baseline instability described in this section.

IMPORTANT **Do not block the end of the cell outlet tubing for longer than the recommended 2 to 3 seconds. Doing so creates high backpressure, which can break the pH-Ag/AgCl reference electrode glass membrane.**

NOTE To prevent air from becoming trapped in the cell in the future, increase the backpressure on the cell by connecting backpressure tubing to the cell outlet. The backpressure limit for the ED cell is 690 kPa (100 psi). Do not exceed this limit.

- **(DC Amperometry and Integrated Amperometry modes) Frequent, random spikes in the baseline**

  The pH-Ag/AgCl reference electrode diaphragm is plugged. First, try regenerating the pH-Ag/AgCl reference electrode frit by soaking the electrode in a solution of 1 M KCl plus 1 M HCl. If this does not eliminate the spiking, replace the electrode (P/N 061879).

- **(DC Amperometry and Integrated Amperometry modes) Regular baseline oscillation on high-sensitivity ranges**

Analytical IC

Reconnect the short length of titanium tubing to the cell inlet (see Figure 2-30).

- **(DC Amperometry and Integrated Amperometry modes) Dirty or pitted conventional (nondisposable) working electrode**

  Polish the working electrode (see Section 9.28.4). If you are using a disposable electrode, replace it.

- **(Integrated Amperometry mode) Regular baseline oscillations**

  1. Check the pump pressure plot to verify that the pump is working properly.
  2. Air bubbles may be trapped inside the cell. While wearing gloves and eye protection, generate a slight temporary backpressure by putting your finger over the end of the cell outlet tubing for 2 to 3 seconds.

Repeat two or three times. If the baseline does not improve, check the other causes of baseline instability described in this section.

IMPORTANT **Do not block the end of the cell outlet tubing for longer than the recommended 2 to 3 seconds. Doing so creates high backpressure, which can break the pH-Ag/AgCl reference electrode glass membrane.**

NOTE To prevent air from becoming trapped in the cell in the future, increase the backpressure on the cell by connecting backpressure tubing to the cell outlet. The backpressure limit for the ED cell is 690 kPa (100 psi). Do not exceed this limit.

3. The water used to prepare the eluent may contain trace contaminants. Remake the eluent, using ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5.

8.3 Poor Retention Time Reproducibility

- **Liquid leaks**

  1. Check for leaks from the piston seals. Replace the piston seal on any head with a leak (see Section 9.7).
  2. Check for leaks throughout the remainder of the system, including the check valves, injection valve, and columns. Tighten or replace fittings as needed.

- **DP/SP not primed**

  Prime the pump (see Section 9.5).

- **Liquid lines incompletely flushed after an eluent change**

  Attach a 10 cc syringe (P/N 054578) to the waste port on the priming valve. Open the priming valve (turn the knob one-half turn counterclockwise). Draw at least 20 mL of the new eluent through the liquid lines before operation.

- **Inoperative eluent proportioning valve (gradient pump only)**

  The proportioning valve assembly should be replaced. Contact Technical Support for Dionex products for assistance.

- **Inoperative check valves**

  Replace the check valve cartridges (see Section 9.6).

- **Insufficient mixing (gradient pump only)**

  The static mixer may be dirty or contaminated. Flush with IPA (isopropyl alcohol). If this does not eliminate the problem, install a new mixer (GM-3, P/N 042126; GM-4, P/N 049135).

- **Eluent is contaminated**

  1. Clean all eluent reservoirs thoroughly (inside and out) with ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5. Dry with clean, particulate-free air. If a reservoir still appears dirty, or if there is a slimy film on the interior, follow the cleaning instructions in Section 9.4.
  2. Flush the system with ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5.
  3. Replace all end-line filters (P/N 045987). See Section 4.6 for instructions.
  4. Prepare new stock solution.
  5. Prepare fresh eluent. To ensure eluent purity, prepare all eluents with electrochemical-grade chemicals, and ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5.

- **Problem unrelated to the pump**

  1. The eluent concentration may be wrong, or the eluent may have been prepared with impure chemicals/eluents or water. To ensure eluent purity, prepare all eluents with spectro-grade eluents, reagent-grade chemicals, and ASTM Type I (or better) filtered and deionized water that meets the specifications listed in Section 1.5.
  2. The column may be the source of the problem. Refer to the column manual for troubleshooting assistance. Column manuals are provided on the Thermo Scientific Reference Library DVD (P/N 053891).
  3. The injection valve may be the source of the problem. Rebuild the injection valve (see Section 9.22).

8.4 Peak Retention Times Are Too Early

- **Eluent concentration setting is too high**

  The correct eluent concentration setting depends on several factors (the flow rate, EGC type, etc.). Refer to Section 4.9 for a list of valid concentration ranges for the cartridges, and then edit the program as required.

- **DP/SP flow rate is too low**

  Increase the DP/SP flow rate.

- **Inoperative eluent proportioning valve (gradient pump only)**

  The proportioning valve assembly should be replaced. Contact Technical Support for Dionex products for assistance.

8.5 Peak Retention Times Are Too Late

- **Eluent concentration setting is too low**

  The correct eluent concentration setting depends on several factors (the flow rate, EGC type, etc.). Refer to Section 4.9 for a list of valid concentration ranges for the cartridges, and then edit the program as required.

- **DP/SP flow rate is too high**

  Decrease the DP/SP flow rate.

- **Inoperative eluent proportioning valve (gradient pump only)**

  The proportioning valve assembly should be replaced. Contact Technical Support for Dionex products for assistance.

8.6 No Peaks

- **EG power is not turned on**

  1. Check that the **POWER** button on the front of the EG is turned on.
  2. Check that the EG main power switch (on the rear panel) is turned on.

3. Check that the main power cord is plugged into both the EG rear panel connector and the power source. Check that the wall outlet has power.

- **Injection valve is not actuating or the sample loop is plugged**

  1. Test the valve by manually switching the position from the DC ePanel in Chromeleon 7 or Control panel in Chromeleon 6.8.
  2. Check the sample loop for blockage. Clean or replace the loop if needed.

- **Detector not properly installed**

  CD: An electronics connector on the back of the detector plugs into a receptacle on the detector compartment. Push on the detector to make certain the connector is securely connected (see Figure 8-1).

- **ED:** Verify that the signal cables from the cell are connected to the detector block. In addition, an electronics connector on the back of the detector plugs into a receptacle on the detector compartment. Push on the detector to make certain the connector is securely connected (see Figure 8-1).

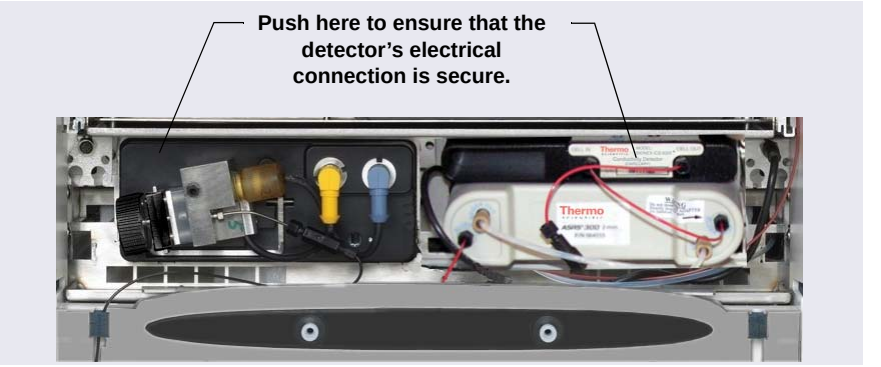


Figure 8-1. *Detector Connection*

ED Only

- **Cell is off**

  Turn on the cell from the detector ePanel (in Chromeleon 7) or Control panel (in Chromeleon 6.8).

8.7 Tailing Peaks

- **Excess tubing void volumes**

  Check tubing connections for void volumes.

Analytical IC

- **(CD) Long tubing lengths connecting**

  Minimize all tubing lengths between the injection valve and the detector.

- **(DC Amperometry and Integrated Amperometry modes) Dirty or pitted conventional (nondisposable) working electrode**

  Clean the working electrode with water and dry with pressurized air or nitrogen.

  Polish the working electrode (see Section 9.28.4). If you are using a disposable electrode, replace it.

Capillary IC

- **Capillary tubing fittings incorrectly installed**

  Incorrectly installed fittings on capillary tubing can increase void volumes, causing chromatograms with tailing peaks (see Figure 8-2).

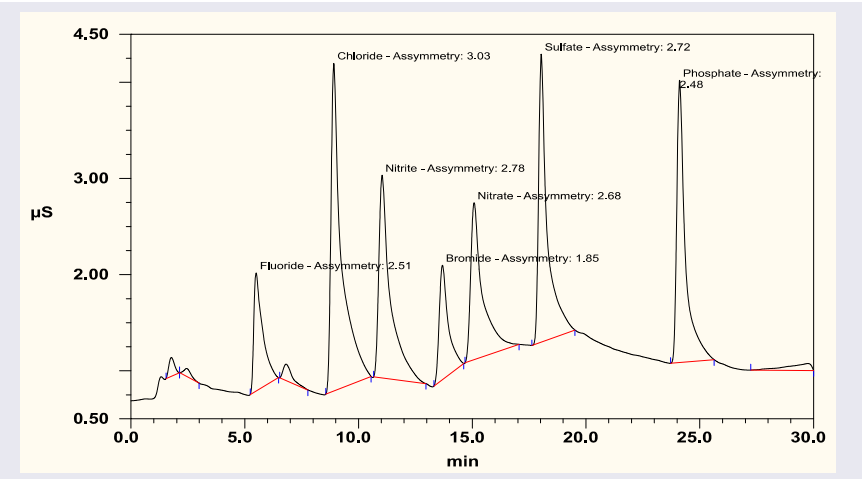


Figure 8-2. *Tailing Peaks Caused by Incorrectly Installed Capillary Tubing Fittings*

To correctly install fittings on capillary tubing, follow the instructions in Section 9.1.

8.8 Low System Backpressure

- **Loose fitting**

  Make sure there are no liquid leaks in the flow system. Check tubing connections throughout the system (including the check valves, injection valves, and columns) and tighten or replace fittings as needed.

Analytical IC

- **RFIC Eluent Degasser tubing is ruptured**

  If flow from the EG waste line is normal but there is no flow through the columns, the tubing assembly inside the RFIC Eluent Degasser has ruptured. Replace the degasser (see Section 9.16).

- **Internal EGC leak (from membrane barrier)**

  Leakage from the membrane barrier may trip the DP/SP low pressure limit and shut down the pump. If all other causes of the low system pressure have been eliminated, replace the EGC (see Section 9.14).

NOTE The EG leak sensor cannot immediately detect leakage from the membrane barrier because these leaks exit the EG through the vent line.

8.9 High System Backpressure

- **Restriction in the system plumbing**

  1. Begin pumping eluent through the system (including the columns) at the flow rate normally used.
  2. Work backward through the system, beginning at the flow cell exit. One at a time, loosen each fitting and observe the pressure. The connection at which the pressure drops abnormally indicates the point of restriction. If the EGC is the source of the high backpressure, replace the outlet frit as instructed in the EGC manual. The manual is on the Thermo Scientific Reference Library DVD (P/N 053891).
  3. If the restriction has caused such high pressure that the system cannot be operated, you must work forward through the system, adding parts one at a time until an abnormal pressure increase (and hence, the restriction) is found.

- **TC temperature stabilizer is blocked**

  Rinse the temperature stabilizer and the temperature stabilizer inlet line, using an appropriate solvent. If necessary, replace the temperature stabilizer (standard bore, P/N 064548; microbore, P/N 064650).

8.10 Low Detector Output

- **Insufficient sample injected**

  Increase the injection size or concentration.

ED Only

- **Working electrode fouled**

  1. If a disposable working electrode is being used, replace the electrode.
  2. For conventional (nondisposable) electrodes, clean the working electrode with ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5. Dry with pressurized air or nitrogen. If the electrode is pitted, polish the electrode (see Section 9.28.4).
  3. Check the value of the reference potential shift (see "Using a Digital Voltmeter to Determine Reference Potential Shift" on page 274). If the value fluctuates by more than 30 mV, electrode passivation may occur because potentials that are too high are being applied. Recalibrate the pH-Ag/AgCl reference electrode (see Section 9.28.6). If the problem persists, replace the pH-Ag/AgCl reference electrode (see Section 9.28.5).

Analog Output Option

- **Analog output range set too high**

  Select a more sensitive analog output range.

8.11 High Background

- **CR-TC is contaminated**

  Clean the trap column as instructed in the CR-TC manual. The manual is included on the Thermo Scientific Reference Library DVD (P/N 053891).

- **Wrong eluent**

  Check that you are using the correct eluent for your application. For ED detectors, verify that the pH readout is correct for your eluent.

- **Background signal not offset from detector signal**

  Before injecting sample, allow the background signal to equilibrate, and then press **Autozero** on the detector ePanel in Chromeleon 7 or Control panel in Chromeleon 6.8.

CD Only

- **Background not suppressed by suppressor**

  Verify that the suppressor is turned on and the current is set to the correct value. Refer to the suppressor manual for additional troubleshooting guidance. Suppressor manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).

- **Regenerant fails to suppress background**

  Use a higher regenerant flow rate. Refer to the suppressor manual for the suggested regenerant flow rate for your application.

ED Only

- **(Integrated Amperometry mode) Excessive number or length of integration intervals and/or incorrect potential for the integration**

  Verify that the length and potential of the integration interval is correct (refer to the column manual for the settings required for your application). Column manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).

- **(DC Amperometry and Integrated Amperometry modes) Amperometric detection cell working electrode shorted to counter electrode**

  Clean the working electrode with water and dry with pressurized air or nitrogen.

  Remove any precipitate on the counter electrode by cleaning the spot directly opposite the working electrode with a lint-free tissue.

- **(DC Amperometry and Integrated Amperometry modes)—Leak between gasket and electrode, or between gasket and cell body**

  Remove any precipitate with water and a lint-free tissue and then install a new gasket (see Section 9.28.3).

  Turn the yoke knob (see Figure 9-53) a full 360 degrees to completely engage the knob.

8.12 Troubleshooting DP/SP Error Messages

If any of the following alarm conditions occurs, a message is displayed in the Chromeleon Audit Trail.

A program with this name already exists.

This error occurs if you attempt to save a modified Chromeleon 7 instrument method or Chromeleon 6.8 program under the name of an existing instrument method or program.

To troubleshoot:

Enter a new name for the modified instrument method or program *or* select **Save** to save your changes under the existing instrument method or program name.

Abnormal drive current for x.x seconds.

If this error occurs, the tubing between the pump heads may be blocked or the fitting may be overtightened.

To troubleshoot:

Inspect the tubing for blockage or crimping and replace if needed (see Section 9.3). Be careful to not overtighten fittings. If the message appears again, contact Technical Support for Dionex products for assistance.

Camshaft index too early.

-or-

Camshaft index too late.

This error is caused by an internal error in the pump drive mechanism.

To troubleshoot:

Turn off the DP/SP power for 30 seconds and then turn it on again. If the error message appears again, contact Technical Support for Dionex products for assistance.

Camshaft sensor always alight.

-or-

Camshaft sensor missing or dark.

This error is caused by an internal error in the pump drive mechanism.

To troubleshoot:

Turn off the DP/SP power for 30 seconds and then turn it on again. If the error message appears again, contact Technical Support for Dionex products for assistance.

Degasser malfunction.

The vacuum degassing module monitors the vacuum system continuously. If a problem is detected, this error occurs.

To troubleshoot:

1. Check all tubing connections to the vacuum degassing module for leakage; tighten loose fitting connections. Be careful not to overtighten fittings.
2. Turn off the DP/SP power for 30 seconds and then restart the pump.
3. If the message appears again, the vacuum degassing module should be replaced. Contact Technical Support for Dionex products for assistance.

Excessive drive current. Camshaft x.x.

This error occurs if the drive current is above the allowed value. When this message appears, the DP/SP stops running.

To troubleshoot:

One or more tubing connections may be plugged, blocked, or crimped. Check all tubing connections and replace as needed (see Section 9.3). Be careful not to overtighten fittings.

Invalid flow value.

This error occurs if you enter an invalid value for the DP/SP flow rate in Chromeleon.

To troubleshoot:

Select a flow rate within the DP/SP flow rate range. For the flow rate range for each type of DP/SP, refer to Section 1.5.

Leak detected.

This error occurs if the DP/SP leak sensor detects a liquid leak inside the enclosure. When this error occurs, the pump stops running.

To troubleshoot:

To find and eliminate the source of the leak, see Section 8.15.

Left-hand pump block carryover pressure is too high.

-or-

Right-hand pump block carryover pressure is too high.

This error occurs if the pressure in the primary pump head exceeds the maximum allowed. ("Right-hand" refers to the bottom pump; "left-hand" refers to the top pump in a dual-pump module.)

To troubleshoot:

1. Make sure that the tubing between the pump heads and the tubing leading to the priming/outlet block is not plugged or blocked. Replace tubing connections as needed (see Section 9.3). Be careful not to overtighten fittings.
2. Inspect the outlet check valve for blockage. Replace the check valve cartridge if needed (see Section 9.6).

Motor malfunction.

This error occurs if an internal error in the pump drive mechanism occurs.

To troubleshoot:

Turn off the DP/SP power for 30 seconds, and then turn on the power again. If the error message appears again, contact Technical Support for Dionex products for assistance.

Motor position error. The motor is overloaded.

This error occurs if the pump motor is overloaded.

To troubleshoot:

1. One or more tubing connections may be plugged or blocked. Check all tubing connections and replace as needed (see Section 9.3). Be careful not to overtighten fittings.
2. If the "Upper pressure limit exceeded message" is also displayed, refer to page 234 for additional troubleshooting steps.

Pressure fallen below lower limit.

This error occurs if the DP/SP pressure falls below the low pressure limit specified in Chromeleon.

To troubleshoot:

1. The eluent supply may be depleted. Check the **Eluent Level Display** on the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset to verify that eluent is present in the selected channel. If the eluent reservoir is empty, refill it (or select a channel that does have eluent). Prime the pump before resuming operation (see Section 9.5).
2. Check all eluent lines for air bubbles. If air is trapped in a line, replace the end-line filter (P/N 045987). See Section 4.6 for instructions. Verify that the end of each filter extends to the bottom of the reservoir and is submerged in eluent. Prime the pump (see Section 9.5).
3. Eluents may be insufficiently degassed. Check the vacuum degassing module.
4. Check all tubing connections for leaks; tighten loose fitting connections. Be careful not to overtighten fittings.
5. Make sure the priming valve is closed (see Figure 2-3). To close the valve, turn the knob clockwise until closed. Tighten no more than fingertight.

IMPORTANT **Do not use any tools to tighten the priming valve! Overtightening may destroy the cap seal. Open or close the priming valve only when the system pressure is down.**

6. A check valve may be defective. Replace the check valve cartridges (see Section 9.6) and then prime the pump (see Section 9.5).

Relay 4 is configured for inject synchronization. Please change pump configuration.

This error occurs if you attempt to use relay 4 as a standard relay in a Chromeleon 7 instrument method or Chromeleon 6.8 program, but the relay has been set to synchronize the gradient with the autosampler sample injection.

To troubleshoot:

Define the relay as a standard relay *or* specify a different relay for use in the program.

The maximum purge pressure was exceeded.

If the DP/SP pressure exceeds 5 MPa (725 psi) during priming, this error occurs and the priming process is aborted.

To troubleshoot:

1. Verify that the priming valve is open. (To open the valve, turn the knob one-half turn counterclockwise.)
2. Check fittings for overtightening. Check tubing for crimping and replace it as necessary (see Section 9.3). Be careful not to overtighten fittings.

The pressure in the left-hand working cylinder exceeded the safety limit.

-or-

The pressure in the right-hand working cylinder exceeded the safety limit.

-or-

The system pressure exceeded the safety limit.

This error may be caused by a blockage in the system or by a problem with the column. ("Right-hand" refers to the bottom pump; "left-hand" refers to the top pump in a dual-pump module.)

To troubleshoot:

1. Check all tubing connections for signs of blockage; replace as needed (see Section 9.3). Be careful not to overtighten fittings.
2. To determine the source of the high backpressure, isolate segments of the flow path:
   a. Remove the pump outlet tubing at the injection valve.
   b. Press the **POWER** button on the front of the DP/SP to turn on the pump.
   c. On the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset, set the **Flow** rate to 0.01 mL/min for a capillary IC system or 1.0 mL/min for an analytical IC system and record the backpressure.
   d. Disconnect all components after the injection valve.
   e. One at a time, reconnect each component of the flow path. If reconnecting a component causes an abnormal increase in backpressure, replace the component. Replace as many components as necessary to resume operation at the standard operating backpressure.
3. As columns age, their backpressure increases. It may be necessary to compensate for this by increasing the high pressure limit. If the column is the source of the high backpressure, clean the column. (Refer to the column manual provided on the Thermo Scientific Reference Library DVD (P/N 053891) for instructions.) If this does not eliminate the problem, replace the column.

4. Observe a run to see whether the high pressure limit is triggered when injection occurs; if it is, the injection valve may be the source of the blockage (i.e., the rotor seal or stator may need to be replaced). Contact Technical Support for Dionex products for assistance.

This function cannot be adjusted by the user.

This error occurs if you attempt to change a parameter that users are not allowed to adjust.

To troubleshoot:

Only Thermo Fisher Scientific Service Representatives can change this parameter.

Upper pressure limit exceeded.

This error occurs if the upper pressure limit specified in the program is exceeded. The running batch is aborted (default) and this message appears.

To troubleshoot:

1. Inspect the tubing for blockage or crimping; replace as needed (see Section 9.3). Be careful not to overtighten fittings.
2. To determine the source of the high backpressure, isolate segments of the flow path:
   a. Remove the pump outlet tubing at the injection valve.
   b. Press the **POWER** button on the front of the DP/SP to turn on the pump.
   c. On the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset, set the **Flow** rate to 0.01 mL/min for a capillary IC system or 1.0 mL/min for an analytical IC system and record the backpressure.
   d. Disconnect all components after the injection valve.
   e. One at a time, reconnect each component of the flow path. If reconnecting a component causes an abnormal increase in backpressure, replace the component. Replace as many components

as necessary to resume operation at the standard operating backpressure.

3. As columns age, their backpressure increases. It may be necessary to compensate for this by increasing the high pressure limit. If the column is the source of the high backpressure, clean the column. (Refer to the column manual provided on the Thermo Scientific Reference Library DVD (P/N 053891) for instructions.) If this does not eliminate the problem, replace the column.
4. Observe a run to see whether the high pressure limit is triggered when injection occurs; if it is, the injection valve may be the source of the blockage (i.e., the rotor seal or stator may need to be replaced). Contact Technical Support for Dionex products for assistance.

8.13 DP/SP Does Not Start

- **Power is off**

  Check that the main power switch on the DP/SP rear panel is turned on.

  Press the **POWER** button on the front of the DP/SP to turn on the pump.

- **Flow rate is set to zero**

  Select a **Flow** rate on the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset.

- **While being primed, pump starts briefly and an alarm sounds**

  If the high pressure limit was tripped:

  1. Check that the priming valve on the secondary pump head is opened (see Figure 2-3). To open the valve, turn the knob one-half turn counterclockwise.
  2. Check fittings for overtightening. Check tubing for crimping and replace it as necessary (see Section 9.3). Be careful not to overtighten fittings.

If the low pressure limit was tripped:

1. Verify that the **Minimum Pressure** setting is set to the correct value.
2. Make sure there are no liquid leaks in the flow system. To find and eliminate the source of a leak, see Section 8.15.

If an Audit Trail error message is displayed, refer to the troubleshooting steps listed for the particular message.

8.14 DP/SP Stops

- **Instrument method or program (or other remote input) instructed the pump to stop**

  If no error message is displayed in the Audit Trail, the DP/SP was probably instructed to stop by the Chromeleon 7 instrument method, the Chromeleon 6.8 program, or other remote signal source. If you do not want the pump to stop, take the appropriate preventive action (edit the instrument method, the program, or the settings of the other remote signal source).

- **Low pressure limit was tripped**

  Refer to the troubleshooting steps for the Audit Trail message "Pressure fallen below lower limit." on page 231.

- **High pressure limit was tripped**

  Refer to the troubleshooting steps for the Audit Trail message "The system pressure exceeded the safety limit." on page 233.

- **Electrical connections incorrectly installed**

  The electrical cables may not be properly installed. Contact Technical Support for Dionex products for assistance.

  NOTE The Thermo Scientific Dionex ICS-5000 Ion Chromatography System electronics components cannot be serviced by the user.

8.15 DP/SP Liquid Leaks/Leak Alarm

NOTE After eliminating the source of a leak, always dry the leak sensor thoroughly. If the leak sensor is not dry, it will remain activated and will continue to report a leak to the Audit Trail.

- **Defective piston seal**

  Check the pump heads for leaks. If there is any leakage, tighten the fitting connections just enough to stop the leak. Dry the components. If the pump head continues to leak, replace the piston seal (see Section 9.7).

- **Leaking check valve**

  If the leaking check valve is securely tightened but allows leaks despite this, the valve is defective. Replace both check valve cartridges (see Section 9.6).

  If the leaking check valve is loose, follow these steps to tighten it:

  1. Turn off the pump.
  2. Loosen the check valve enough to allow it to turn freely.
  3. Tighten the check valve fingertight, and then tighten it one-quarter turn with a 1/2-inch wrench.
  4. If the check valve continues to leak, tighten it an additional one-quarter turn with the 1/2-inch wrench.
  5. If the check valve continues to leak, it is defective. Replace both check valve cartridges (see Section 9.6).

- **Eluent proportioning valve leaks (gradient pump only)**

  Tighten loose fittings. If there are no loose fittings, the proportioning valve assembly should be replaced. Contact Technical Support for Dionex products for assistance.

- **Priming valve knob leaks**

  If leaks occur when the priming valve knob is open, close the knob *completely* and then open it one-half to three-quarters turn. If this does not stop the leakage, replace the seal in the priming valve knob (see Section 9.10).

  If leaks occurs when the priming valve knob is closed, either the pump head or the knob is damaged and should be replaced. Contact Technical Support for Dionex products for assistance.

- **Excessive system backpressure**

  If system backpressure is substantially higher than the normal operating backpressure for the currently configured system (including the column), tubing may be plugged or overtightened. Refer to the troubleshooting steps for the Audit Trail message "The system pressure exceeded the safety limit." on page 233.

8.16 Vacuum Degassing Module Low Vacuum

- **Leak in the vacuum degassing module**

  Check all tubing connections for leakage; tighten loose fitting connections.

8.17 Vacuum Degassing Module Does Not Run

- **Electrical connections incorrectly installed**

  There may be a problem with the connections from the vacuum degassing module to the CPU board. Contact Technical Support for Dionex products for assistance.

  NOTE The Thermo Scientific Dionex ICS-5000 Ion Chromatography System electronics components cannot be serviced by the user.

8.18 DP/SP Digital I/O Port Inoperative

- **TTL input-related error**

  1. The TTL input mode must match the signal type output by the device connected to the pump. Check the user's manual for the device to verify that the correct signal type is selected.
  2. A programming error occurred in the device sending the signal. Refer to the user's manual for the device for troubleshooting assistance.

- **TTL/Relay output-related error**

  1. A programming error occurred in the device sending the signal. Refer to the user's manual for the device for troubleshooting assistance.
  2. The device being triggered may require a TTL, not a relay. Connect the device to a pump TTL output.

EG Troubleshooting

8.19 Troubleshooting EG Error Messages

If any of the following alarm conditions occurs, a message is displayed in the Chromeleon Audit Trail.

Concentration out of range! The maximum value is %1.

-or-

Concentration out of range! The maximum value at time %1 is %2.

The allowable eluent concentration depends on the flow rate and the EGC type. This message appears if the selected eluent concentration is out-of-range for the flow rate. The time indicated in the message refers to the time specified in the Chromeleon 7 instrument method or Chromeleon 6.8 program.

To troubleshoot:

Check the information in Section 4.10 to verify that the selected concentration is within the accepted range for the cartridge type and flow rate. Adjust the flow rate or concentration as needed.

CR-TC1 open circuit.

-or-

CR-TC2 open circuit.

To troubleshoot:

1. Check that the CR-TC is correctly plugged into the EG. Push the CR-TC electrical cable firmly into the **CR-TC 1** (or **CR-TC 2**) bulkhead connector. Twist the ring on the cable connector fingertight to secure it.
2. If the error persists, the CR-TC may be faulty. Replace the CR-TC (see Section 9.15).

CR-TC1 over current.

-or-

CR-TC2 over current.

This error occurs when the current applied to the CR-TC exceeds the maximum current allowed. (The CR-TC current is automatically turned off to prevent damage to the CR-TC.) This error may also occur if liquid flow to the CR-TC is interrupted.

To troubleshoot:

1. Check the CR-TC cable connection to the electrical bulkhead (see Figure 2-10).
2. Refer to Section 8.23 to determine why liquid flow stopped.
3. If the error message appears again, contact Technical Support for Dionex products for assistance. The CR-TC control electronics may have malfunctioned.

NOTE The Thermo Scientific Dionex ICS-5000 Ion Chromatography System electronics components cannot be serviced by the user.

CR-TC1 stopped because EGC1 OFF.

-or-

CR-TC2 stopped because EGC1 OFF.

This error occurs if you attempt to turn on the CR-TC when the EGC is turned off. The CR-TC current is automatically turned off to prevent damage to the CR-TC.

To troubleshoot:

Verify that the pump flow and the EGC are on before turning on the CR-TC.

CR-TC1 stopped due to zero flow.

-or-

CR-TC2 stopped due to zero flow.

This error occurs if you turn off the pump flow while the EGC current (and CR-TC) are on. The CR-TC current is automatically turned off to prevent damage to the CR-TC.

To troubleshoot:

If the pump stopped unexpectedly, follow the troubleshooting steps in Section 8.23.

The CR-TC mode is off for a virtual pump.

This error occurs when a “live” EG is linked to a virtual pump and you try to turn on the CR-TC. The mode is automatically turned off to ensure that the EG does not operate when there is no flow.

CR-TC mode will be turned off for invalid flow. Flow range for analytical EGC: 0.100 – 3.000 mL/min, capillary EGC: 0.001 – 0.100 mL/min.

This error occurs when the flow to the CR-TC is out of range or there is no pumped linked to the EGC.

To troubleshoot:

1. Set the flow rate to a value within the allowed range. Refer to Appendix A for flow rate specifications.
2. Check the EGC configuration properties in the Chromeleon 7 Instrument Controller Service or the Chromeleon 6.8 Server Configuration program to verify that the pump and EGC are linked.

Current linked pump is capillary. Please install a capillary EGC.

-or-

Current linked pump is analytical. Please install an analytical EGC.

This error occurs if the type of pump linked to the EGC does not match the EGC type. A capillary EGC can only be used with a capillary pump and an analytical EGC can only be used with an analytical pump.

To troubleshoot:

1. Install the correct type of EGC for the pump type.
2. For a hybrid system (a dual system with both an analytical and a capillary pump), check the EGC configuration properties in the Chromeleon 7 Instrument Controller Service or the Chromeleon 6.8 Server Configuration program to verify that the correct pump is linked to the EGC.

EG1 cartridge disconnected.

-or-

EG2 cartridge disconnected.

This error occurs if Chromeleon sends a command to set an EG parameter when the EGC is disconnected.

To troubleshoot:

1. Make sure the EGC cable is securely plugged into the EG (see Figure 2-10) and the locking ring is tightened.
2. If the error message appears again, contact Technical Support for Dionex products for assistance. The EGC control electronics may have malfunctioned.

NOTE The Thermo Scientific Dionex ICS-5000 Ion Chromatography System electronics components cannot be serviced by the user.

EG1 invalid activation date.

-or-

EG2 invalid activation date.

This error occurs if the activation date for the EGC is not a valid date. This may indicate a problem with the memory chip in the EGC.

To troubleshoot:

1. Make sure the EGC cable is securely plugged into the EG (see Figure 2-10) and the locking ring is tightened.
2. If the error message appears again, contact Technical Support for Dionex products for assistance.

EG1 invalid concentration.

-or-

EG2 invalid concentration.

This error occurs if the eluent concentration is outside the range allowed by the EG. This may indicate corrupted memory or a problem in the EG instrument control firmware.

To troubleshoot:

Contact Technical Support for Dionex products for assistance.

NOTE The Thermo Scientific Dionex ICS-5000 Ion Chromatography System electronics components and instrument control firmware cannot be serviced by the user.

EG1 invalid flow.

-or-

EG2 invalid flow.

This error occurs if the flow rate is set to a value the EG does not support.

To troubleshoot:

Set the flow rate to a value within the allowed range. Refer to Appendix A for flow rate specifications.

EG1 invalid flow rate-concentration.

-or-

EG2 invalid flow rate-concentration.

This error occurs if the selected concentration is too high for the current flow rate.

To troubleshoot:

Set the flow rate to a value within the allowed range. The allowable eluent concentration for a particular application depends on several factors: the flow rate, suppressor type, EGC type, and cartridge configuration. For details, refer to Section 4.9.

EG1 invalid ion count.

-or-

EG2 invalid ion count.

This error occurs if the ion count reported by the EGC is invalid. This may indicate a problem with the memory chip in the EGC.

To troubleshoot:

1. Make sure the EGC cable is securely plugged into the EG (see Figure 2-10) and the locking ring is tightened.
2. If the error message appears again, contact Technical Support for Dionex products for assistance.

EG1 invalid serial number.

-or-

EG2 invalid serial number.

This error occurs if the serial number reported by the EGC is invalid. This may indicate a problem with the memory chip in the EGC.

To troubleshoot:

1. Make sure the EGC cable is securely plugged into the EG (see Figure 2-10) and the locking ring is tightened.
2. If the error message appears again, contact Technical Support for Dionex products for assistance.

EG1 over current.

-or-

EG2 over current.

This error occurs when the current applied to the EGC exceeds the maximum current allowed. (The EGC current is automatically turned off to prevent damage to the cartridge.) This error may also occur if the liquid flow to the cartridge is interrupted.

To troubleshoot:

1. Make sure the EGC cable is securely plugged into the EG (see Figure 2-10) and the locking ring is tightened.
2. Refer to Section 8.23 to determine why there is no flow.
3. If the error message appears again, contact Technical Support for Dionex products for assistance. The cartridge control electronics may have malfunctioned.

NOTE The Thermo Scientific Dionex ICS-5000 Ion Chromatography System electronics components cannot be serviced by the user.

EG1 over power.

-or-

EG2 over power.

This error occurs when, in order to maintain the selected current, the power supply is required to supply a higher voltage than the EGC can support.

To troubleshoot:

Replace the EGC (see Section 9.14).

EG1 over voltage.

-or-

EG2 over voltage.

This error occurs when the current applied to the EGC exceeds the maximum current allowed. (The EGC current is automatically turned off to prevent damage to the cartridge.) This error may also occur if the liquid flow to the cartridge is interrupted.

To troubleshoot:

1. Refer to Section 8.23 to determine why there is no flow.
2. If the error message appears again, contact Technical Support for Dionex products for assistance. The EGC control electronics may have malfunctioned.

NOTE The Thermo Scientific Dionex ICS-5000 Ion Chromatography System electronics components cannot be serviced by the user.

EG1 wrong cartridge error.

-or-

EG2 wrong cartridge error.

This error occurs when an EGC is plugged into the EG that is not one of the supported types.

To troubleshoot:

Refer to Table 2-2 for a list of the supported EGC types for capillary and analytical IC systems.

The EG mode is off due to pump pressure alarm or leak.

This error occurs if the pump flow is turned off because of a pump pressure alarm or leak. The EG is automatically turned off to prevent damage to the EG.

To troubleshoot:

Check the troubleshooting information for the pump in Section 8.14 and Section 8.15.

The EG mode is off for a virtual pump.

This error occurs when a “live” EG is linked to a virtual pump and you try to turn on the EGC. To prevent damage to the EGC, the mode is automatically turned off to ensure that the EG does not operate when there is no flow.

EG mode will be turned off for invalid flow.

This error occurs when the flow to the EG is out of range or there is no pumped linked to the EG.

To troubleshoot:

1. Set the flow rate to a value within the allowed range. Refer to Appendix A for flow rate specifications.

2. Check the EGC configuration properties in the Chromeleon 7 Instrument Controller Service or the Chromeleon 6.8 Server Configuration program to verify that the pump and EGC are linked.

EG mode will be turned off for invalid flow. Flow range for analytical EGC: 0.100 – 3.000 mL/min, capillary EGC: 0.001 – 0.100 mL/min.

This error occurs when the flow to the EGC is out of range or there is no pumped linked to the EGC.

To troubleshoot:

1. Set the flow rate to a value within the allowed range. Refer to Appendix A for flow rate specifications.
2. Check the EGC configuration properties in the Chromeleon 7 Instrument Controller Service or the Chromeleon 6.8 Server Configuration program to verify that the pump and EGC are linked.

EGC-1 is not linked to a compatible pump.

-or-

EGC-2 is not linked to a compatible pump.

This error occurs if the type of pump linked to the EGC does not match the EGC type. A capillary EGC can only be used with a capillary pump and an analytical EGC can only be used with an analytical pump.

To troubleshoot:

1. Install the correct type of EGC for the pump type.
2. For a hybrid system (a dual system with both an analytical and a capillary pump), check the EGC configuration properties in the Chromeleon 7 Instrument Controller Service or the Chromeleon 6.8 Server Configuration program to verify that the correct pump is linked to the EGC.

EGC cannot be used due to invalid ion count.

This error occurs if the ion count reported by the EGC is invalid. This may indicate a problem with the memory chip in the EGC.

To troubleshoot:

1. Make sure the EGC cable is securely plugged into the EG (see Figure 2-10) and the locking ring is tightened.
2. If the error message appears again, contact Technical Support for Dionex products for assistance.

EGC is either not installed or invalid cartridge number. Please install a capillary EGC.

This error occurs if no EGC cartridge is connected to the EG or an analytical EGC is connected to a capillary IC system.

To troubleshoot:

1. Verify that a capillary EGC is installed.
2. Verify that the EGC cable is securely plugged into the EG (see Figure 2-10) and the locking ring is tightened.

EGC is either not installed or invalid cartridge number. Please install an analytical EGC.

This error occurs if no EGC cartridge is connected to the EG or a capillary EGC is connected to an analytical IC system.

To troubleshoot:

1. Verify that an analytical EGC is installed.
2. Verify that the EGC cable is securely plugged into the EG (see Figure 2-10) and the locking ring is tightened.

EGC is either not installed or invalid cartridge number. Please install an EGC.

This error occurs if no EGC cartridge is connected to the EG or the cartridge serial number is not valid for the type of IC system.

To troubleshoot:

1. Verify that an EGC of the correct type (capillary or analytical) is installed.
2. Verify that the EGC cable is securely plugged into the EG (see Figure 2-10) and the locking ring is tightened.

Leak sensor wet.

This error occurs when liquid accumulates in the drip tray in the bottom of the EG.

To troubleshoot:

1. Locate the source of the leak by visually inspecting the tubing, fittings, and components in the EG.
2. Tighten fittings (or replace tubing and fittings) as required (see Section 9.12). Refer to Section 8.22 for detailed troubleshooting of various types of leaks.
3. After fixing the leak, dry the drip tray and leak sensor thoroughly to prevent the leak sensor from triggering additional error messages.

pH modifier must be used with a different type of cartridge.

This error occurs if you attempt to configure an EPM III Electrolytic pH Modifier with an incompatible type of EGC.

To troubleshoot:

Verify that the EPM III is paired with an EGC III K_2CO_3. The EPM III cannot be used with any other cartridge type.

Pump is disconnected. The EG mode and CR-TC modes are turned off.

This error occurs if the pump linked to the EG is disconnected from Chromeleon. To prevent damage to the EGC and CR-TC, the modes are automatically turned off to ensure that the EG does not operate when there is no flow.

8.20 EG ALARM LED Is Lighted

- **Leaking fitting**

  Locate the source of the leak. Tighten or replace liquid line connections as needed (see Section 9.12).

- **Blocked or improperly installed waste line**

  Check the EG waste lines to be sure they are not crimped or otherwise blocked. Make sure the lines are not elevated at any point after they exit the EG.

- **EGC leaks**

  Replace the EGC (see Section 9.14).

- **RFIC Eluent Degasser leaks**

  Replace the RFIC Eluent Degasser (see Section 9.16).

- **EGC electrical connection is open**

  1. Tug gently on the EGC electrical cable; the locking connector should hold the cable in place (see Figure 2-10).
  2. If the electrical cable is fully seated but the problem persists, the cartridge is defective and must be replaced (see Section 9.14).

- **EGC input electrical connection has shorted out**

  Replace the EGC (see Section 9.14).

- **Electrical error**

  The EG current and/or voltage may have become unstable. Contact Technical Support for Dionex products for assistance.

  NOTE The Thermo Scientific Dionex ICS-5000 Ion Chromatography System electronics components cannot be serviced by the user.

8.21 EG POWER LED Fails to Light

- **No power**

  Check that the **POWER** button on the front of the EG is turned on.

  Check that the EG main power switch (on the rear panel) is turned on.

  Check that the main power cord is plugged into both the EG rear panel connector and the power source. Check that the wall outlet has power.

  If the **POWER** LED still fails to light, contact Technical Support for Dionex products for assistance.

8.22 Liquid Leaks in the EG

- **Leaking fitting**

  Locate the source of the leak. Tighten or replace liquid line connections as needed (see Section 9.12).

- **Blocked or improperly installed waste line**

  Check the EG waste lines to be sure they are not crimped or otherwise blocked. Make sure the lines are not elevated at any point after they exit the EG.

- **EGC leaks**

  Replace the EGC (see Section 9.14).

Analytical IC

- **(Analytical IC only) RFIC Eluent Degasser leaks**

  Replace the analytical IC system RFIC Eluent Degasser (see Section 9.16).

8.23 No Flow

- **DP/SP power is off**

  Turning off the DP/SP automatically turns off the EG and the suppressor. Current to the CR-TC is automatically turned on and off when the EG power is turned on and off.

  Check that the power to the DP/SP is turned on. Prime the pump (see Section 9.5) and resume operation.

- **DP/SP pressure limit tripped**

  Verify that the **Current Pressure** reading on the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset is between the high and low limits displayed on the panel. For details, see Section 4.8.

  NOTE The analytical EGC requires at least 14 MPa (2000 psi) of backpressure for optimal removal of electrolysis gas from the eluent produced by the cartridge. A system backpressure of 16 MPa (2300 psi) is ideal.

Analytical IC

- **(Analytical IC only) RFIC Eluent Degasser tubing is ruptured**

  If flow from the EG waste line is normal but there is no flow through the columns, the tubing assembly inside the analytical IC system RFIC Eluent Degasser has ruptured. Replace the degasser (see Section 9.16).

8.24 EG Stops Operation

- **DP/SP power is off**

  Turning off the DP/SP automatically turns off the EG and the suppressor. Current to the CR-TC is automatically turned on and off when the EG power is turned on and off.

  Check that the power to the DP/SP is turned on. Prime the pump (see Section 9.5) and resume operation.

- **DP/SP pressure limit tripped**

  Verify that the **Current Pressure** reading on the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset is between the high and low limits displayed on the panel. For details, see Section 4.8.

  NOTE The analytical EGC requires at least 14 MPa (2000 psi) of backpressure for optimal removal of electrolysis gas from the eluent produced by the cartridge. A system backpressure of 16 MPa (2300 psi) is ideal.

- **DP/SP flow rate is too low or too high**

  For a capillary IC system, select a flow rate between 0.001 and 0.100 mL/min. For an analytical IC system, select a flow rate between 0.100 and 3.000 mL/min.

- **Electrical error detected (ALARM LED is lighted)**

  To prevent damage to the EGCs, the DP/SP automatically turns off electrical power to the cartridge when excessive current or voltage is detected. Contact Technical Support for Dionex products for assistance.

  NOTE The Thermo Scientific Dionex ICS-5000 Ion Chromatography System electronics components cannot be serviced by the user.

- **EGC is expended**

  Replace the cartridge (see Section 9.14).

- **No communication with Chromeleon**

  1. Check that the **POWER** button on the front of the EG is turned on.

2. Check that the EG main power switch (on the rear panel) is turned on.
3. Check that the main power cord is plugged into both the EG rear panel connector and the power source. Check that the wall outlet has power.
4. Check the USB connections. The EG should be connected to the DP/SP (or other Dionex ICS-5000 module) via a USB cable (P/N 960777). In addition, one module in the system must be connected to the PC on which Chromeleon is installed.
5. Check that the EG is configured in Chromeleon and is assigned to an instrument (Chromeleon 7) or timebase (Chromeleon 6.8).

8.25 Troubleshooting DC Error Messages

If any of the following alarm conditions occurs, a message is displayed in the Chromeleon Audit Trail.

CD cell option disconnected.

To troubleshoot:

1. Check the detector connection: An electronics connector on the back of the detector plugs into a receptacle on the detector compartment. Push on the upper part of the detector (see Figure 8-3) to make certain the connector is securely connected.
2. If the error persists, there may be a problem in the detector electronics. Contact Technical Support for Dionex products for assistance.

NOTE The Thermo Scientific Dionex ICS-5000 Ion Chromatography System electronics components cannot be serviced by the user.

Figure 8-3. *Conductivity Detector Connection*

CD cell over safe temperature.

This error occurs when the temperature of the conductivity detector is higher than the maximum allowed. This error may occur if the Thermo Scientific Dionex ICS-5000 Ion Chromatography System is operating in an environment in which the temperature is greater than 40 °C (104 °F).

To troubleshoot:

1. Refer to Appendix A for environmental specifications.
2. Verify that the compartment setpoint is at least 5 °C less than the CD cell setpoint.
3. Check the suppressor current setting. Running the suppressor at a higher current than is recommended for the application can cause heat-up of the CD cell.

Column temperature open circuit.

This error may indicate a problem in the detector electronics. Contact Technical Support for Dionex products for assistance.

Column over safe temperature.

This error occurs when the temperature of the column compartment exceeds the maximum allowed. This error may occur if the Thermo Scientific Dionex ICS-5000 Ion Chromatography System is operating in an environment in which the temperature is greater than 40 °C (104 °F).

To troubleshoot:

Refer to Appendix A for environmental specifications.

Column temperature calibration error.

To troubleshoot:

Repeat the calibration procedure. Follow the instructions provided in the DC Temperature Calibration Kit (P/N 063782). If the error appears again, contact Technical Support for Dionex products for assistance.

Compartment temperature open circuit.

This error may indicate a problem in the detector electronics. Contact Technical Support for Dionex products for assistance.

Compartment over safe temperature.

This error occurs when the temperature of the DC lower compartment is higher than the maximum allowed. This error may occur if the Thermo Scientific Dionex ICS-5000 Ion Chromatography System is operating in an environment in which the temperature is greater than 40 °C (104 °F).

To troubleshoot:

Refer to Appendix A for environmental specifications.

Compartment temperature calibration error.

To troubleshoot:

Repeat the calibration procedure, following the instructions provided in the DC Temperature Calibration Kit (P/N 063782). If the error appears again, contact Technical Support for Dionex products for assistance.

ED cell current exceeds limits error.

This error can have multiple causes (for example, a cell potential that is too high for a given salt concentration, a cell potential that is too high because the reference mode is incorrect, injection of excessive amounts of electroactive

analytes, a damaged or incorrectly installed cell gasket, or an electrical short between two of the three electrodes).

To troubleshoot:

1. Turn off the cell voltage. Excessive currents can change or even damage the working electrode.
2. Turn off the pump flow.
3. Disassemble the cell (see Section 9.28.3) and check for evidence of liquid and salt bridges that can cause shorts. Rinse the cell surface and dry it with a clean, lint-free towel. Replace the cell gasket.
4. Verify that the correct electrode material, waveform potentials, and reference mode are selected for the application being run.
5. Restart the flow and select DC amperometry mode. Apply cell potential in steps increasing toward the detection potential (the potential of the integration period in integrated amperometric detection). If the current becomes excessive again, try a new working electrode or another cell, if available.

ED cell option disconnected.

This error indicates that the electrochemical detector is unplugged.

To troubleshoot:

1. Check the detector connections: Verify that the signal cable from the cell is connected to the appropriate connector on the detector block (see Figure 8-4). Also, push firmly on the detector to ensure the electronics

connector on the back of the detector is securely connected to the receptacle on the detector compartment.

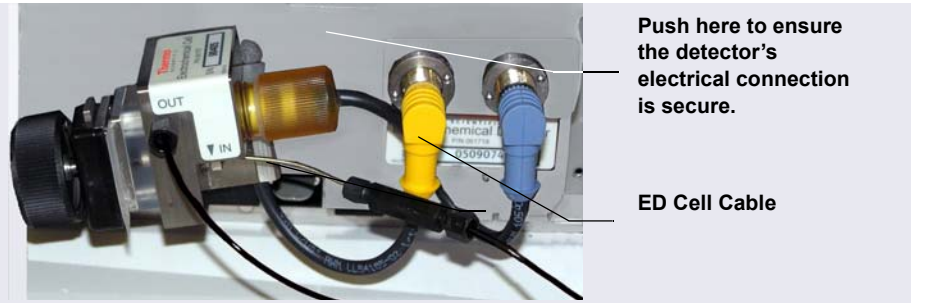


Figure 8-4. *Electrochemical Detector Connection (Analytical Cell Shown)*

2. If the error appears again, contact Technical Support for Dionex products for assistance. The detector electronics may have malfunctioned.

NOTE The Thermo Scientific Dionex ICS-5000 Ion Chromatography System electronics components cannot be serviced by the user.

ED cell working electrode disconnected.

This error occurs when the cable on the working electrode is disconnected from the cell electronics.

To troubleshoot:

Check the cable connection: Verify that the signal cable from the working electrode is connected to the detector block (see Figure 8-4).

ED pH offset calibration failed.

This error occurs when the pH reading differs by more than 1.0 pH unit from 7.0, which is the value specified for offset calibration. This can be caused by too large a change in the Ag/AgCl reference potential or by a damaged glass membrane in the pH sensing part of the reference electrode

To troubleshoot:

1. Check the buffer selection.
2. Verify that the electrode is properly immersed in the calibration buffer.
3. Repeat the calibration procedure (see Section 9.28.6). If the error recurs, repeat the calibration at least one more time.
4. If the error recurs after repeating the calibration at least two times, replace the Ag/AgCl reference electrode (see Section 9.28.5).

ED pH slope calibration failed.

This error occurs when the pH sensing glass membrane of the Ag/AgCl reference electrode is broken or otherwise affected, causing the calibration slope to deviate by more than ±10% from the theoretical slope of 59 mV/pH unit at 25 °C.

To troubleshoot:

1. Make sure the calibration temperature is as close as possible to 25 °C.
2. Verify that the correct buffer is being used and that the electrode is properly immersed in the calibration buffer.
3. Repeat the calibration procedure (see Section 9.28.6). If the error recurs, repeat the calibration at least one more time.
4. If the error recurs after repeating the calibration at least two times, replace the Ag/AgCl reference electrode (see Section 9.28.5).

ED reference electrode disconnected.

To troubleshoot:

Check the cable connection: Verify that the signal cable from the working electrode is connected to the detector block (see Figure 8-4).

High pressure valve 1 error.

-or-

High pressure valve 2 error.

-or-

High pressure valve 3 error.

-or-

High pressure valve 4 error.

This error occurs if a high-pressure valve fails to switch position within 1 second of being toggled. High-pressure valves 1 and 2 are the valves installed in the DC lower compartment (see Figure 8-5). High-pressure valves 3 and 4 are the valves installed on either the IC Cubes or the AM in the upper compartment (see Figure 8-6).

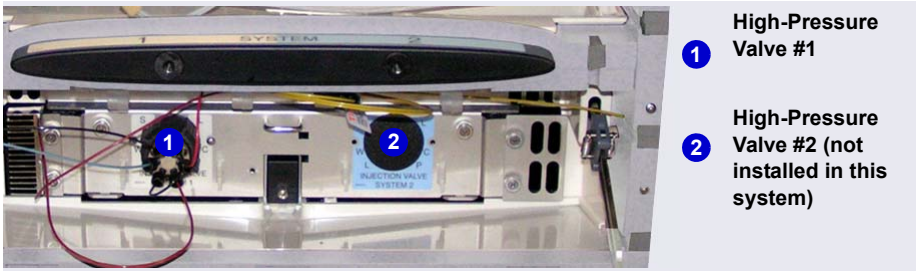


Figure 8-5. *High-Pressure Valves #1 and #2 (In DC Lower Compartment)*

Figure 8-6. *High-Pressure Valves #3 and #4 (On IC Cubes)*

Figure 8-7. *High-Pressure Valves #3 and #4 (On AM)*

To troubleshoot:

1. If a sequence is being executed, terminate the sequence by selecting **Stop** on the Chromeleon 7 ePanel or Chromeleon 6.8 Control panel.
2. Turn off the Thermo Scientific Dionex ICS-5000 Ion Chromatography System power briefly by pressing the **POWER** button on the front of each module. Then press each button again to restart the system.
3. Try to toggle the valve from Load to Inject by pressing the **Load** and **Inject** buttons on the front of the DC.
4. If the problem persists, contact Technical Support for Dionex products for assistance.

IC Cube 1 heater over safe temperature.

-or-

IC Cube 2 heater over safe temperature.

This error occurs when the temperature of the IC Cube heater exceeds the maximum allowed. This error may occur if the Thermo Scientific Dionex ICS-5000 Ion Chromatography System is operating in an environment in which the temperature is greater than 40 °C (104 °F).

To troubleshoot:

Refer to Appendix A for environmental specifications.

Lower door opened.

This message occurs when the door to the lower compartment is opened during a run.

To troubleshoot:

1. Verify that the door is fully closed.
2. Check for—and remove—any obstruction.
3. If the door is fully closed and the error persists, contact Technical Support for Dionex products for assistance.

Lower leak sensor wet.

The leak sensor is installed in the drip tray at the bottom of the column compartment (see Figure 9-33). If liquid accumulates in the tray, the sensor signals the problem and this error message appears.

To troubleshoot:

1. Locate the source of the leak by visually inspecting the tubing, fittings, and components.
2. Tighten fittings or replace tubing and fittings as required. Refer to Section 8.26 for detailed troubleshooting of various types of leaks.
3. After fixing the leak, dry the drip tray thoroughly to prevent the leak sensor from triggering additional error messages.

Reaction coil open circuit.

This error occurs when the reaction coil heater is unplugged from the DC.

To troubleshoot:

1. Check that the reaction coil heater is correctly plugged into the component panel.
2. If the error persists, the heater may be faulty. Replace the heater (P/N 061746).

Reaction coil over safe temperature.

This error occurs when the temperature of the DC upper compartment is higher than the maximum allowed. This error may occur if the Thermo Scientific Dionex ICS-5000 Ion Chromatography System is operating in an environment in which the temperature is greater than 40 °C (104 °F).

To troubleshoot:

Refer to Appendix A for environmental specifications.

Suppressor over-current.

This error may be caused by a depleted or dirty suppressor or by a malfunction in the suppressor controller electronics.

To troubleshoot:

1. Follow the instructions in the suppressor manual to regenerate the suppressor. Suppressor manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).
2. Follow the instructions in the suppressor manual to clean the suppressor.
3. If you suspect a malfunction in the suppressor controller, contact Technical Support for Dionex products for assistance.

NOTE The Thermo Scientific Dionex ICS-5000 Ion Chromatography System electronics components cannot be serviced by the user.

Suppressor over-power.

This error appears when, in order to maintain the selected current, the Thermo Scientific Dionex ICS-5000 Ion Chromatography System is required to apply a higher voltage than the suppressor can support.

To troubleshoot:

1. Reduce the flow rate.

2. Rehydrate the suppressor. Refer to the suppressor manual for instructions. Suppressor manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).
3. If the error persists, replace the suppressor (see Section 9.27.2).

Suppressor over-voltage.

This error appears if you turn on the suppressor and the system cannot establish a connection with the suppressor.

To troubleshoot:

1. Check the suppressor cable connection.
2. If the error persists, replace the suppressor (see Section 9.27.2).

Suppressor stopped for flow rate.

This message occurs if the pump flow stops while the suppressor is on. The suppressor is automatically turned off to prevent damage to the suppressor.

To troubleshoot:

If the pump stopped unexpectedly, see Section 8.14 for pump troubleshooting information.

Upper door opened.

This message occurs when the door to the upper compartment is opened during a run.

To troubleshoot:

1. Verify that the door is fully closed.
2. Check for—and remove—any obstruction.
3. If the door is fully closed and the error persists, contact Technical Support for Dionex products for assistance.

8.26 Liquid Leaks from DC Components

- **Leaking fitting**

  Locate the source of the leak. Tighten or, if necessary, replace the liquid line connection (see Section 9.19).

- **Broken liquid line**

  Replace the line and fittings with the same length and internal diameter tubing (see Section 9.19).

- **Blocked or improperly installed line**

  Make sure the lines are not crimped or otherwise blocked. Also, if the blocked line is a waste line, make sure it is not elevated at any point after it exits the DC. If a line is blocked, replace it (see Section 9.19).

- **Leaking injection valve**

  1. Make sure the liquid line connections to the transducer are tight. Replace any damaged fittings (see Section 9.19).
  2. If the leak is from behind the valve stator, the rotor seal may be scratched. Rebuild the injection valve (see Section 9.22).

- **Leaking cell**

  1. Check the waste lines for blockage; trapped particles can plug the lines and cause a restriction and/or leak. If necessary, clear the waste lines by reversing the direction of flow.
  2. Make sure the plumbing downstream from the cell is clear; a blockage may overpressurize the cell and cause it to leak. If the problem continues, Contact Technical Support for Dionex products for assistance.

Leaking suppressor

Refer to the suppressor manual for troubleshooting procedures. Suppressor manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).

8.27 VALVE Button Not Working

The **VALVE 1** and **VALVE 2** buttons on the front of the DC must be enabled in Chromeleon 6.8 or Chromeleon 7 in order to use them to manually switch the inject valves. To enable a button, open the Commands dialog box and select the **Valve1Button** (or **Valve2Button**) command in the list of commands for the DC.

8.28 ED Cell Troubleshooting

8.28.1 ED Cell pH Readout Always 7.0

The pH reading of the pH-Ag/AgCl reference electrode is displayed on the Chromeleon 7 **ED** ePanel or the Chromeleon 6.8 **EC Detector** panel.

- **Disconnected pH-Ag/AgCl reference electrode**

  Verify that the reference electrode cable is securely connected (see Figure 8-8).

Figure 8-8. *ED Cell Electrical Connections*

- **Reference electrode short circuit**

  Replace the reference electrode (see Section 9.28.5).

- **pH-Ag/AgCl reference electrode glass membrane broken or cracked**

  Replace the pH-Ag/AgCl reference electrode (see Section 9.28.5).

8.28.2 Cannot Set ED Cell pH Readout to 7.0

The pH reading of the pH-Ag/AgCl reference electrode is displayed on the ED ePanel in Chromeleon 7 or the EC Detector Control panel in Chromeleon 6.8.

- **Inaccurate calibration buffer**

  Use a pH meter to check the pH of the buffer.

- **Dry pH-Ag/AgCl reference electrode**

  1. Soak the pH-Ag/AgCl reference electrode in a solution containing 1 M KCl and 1 M HCl long enough to restore the electrode potential to within 30 mV when compared to an unexposed Ag/AgCl reference electrode. To test the pH-Ag/AgCl reference electrode potential, see "Using a Digital Voltmeter to Determine Reference Potential Shift" on page 274.
  2. Replace the pH-Ag/AgCl reference electrode (see Section 9.28.5).

  To prevent a pH-Ag/AgCl reference electrode from drying out, make sure that eluent is being pumped continuously through the cell. If the cell will not be used for a short time (less than 2 days), disconnect the tubing from the inlet and outlet fittings and all fitting plugs. For longer shutdowns, remove the electrode from the cell and store it in its storage bottle filled with saturated KCl solution. See Section 4.1.2 for detailed instructions.

8.28.3 Shift in ED Cell pH Readout

The pH readout is considered to have shifted if it is 0.5 pH units or more different from the value observed when the pH-Ag/AgCl reference electrode was new.

- **Faulty pH-Ag/AgCl reference electrode**

  1. Check the electrode by following the instructions in Section 8.28.6.
  2. Regenerate the electrode by soaking in a solution containing 1 M KCl and 1 M HCl long enough to restore the electrode potential to within 30 mV when compared to an unexposed Ag/AgCl reference electrode. To test the pH-Ag/AgCl reference electrode potential, see "Using a Digital Voltmeter to Determine Reference Potential Shift" on page 274.

3. If soaking does not fix the problem, replace the electrode (see Section 9.28.5).

8.28.4 No ED Cell pH Readout or Intermittent Readout

The pH reading is displayed on the ED ePanel in Chromeleon 7 or the EC Detector Control panel in Chromeleon 6.8.

- **PdH reference electrode selected**

  Select the AgCl reference electrode mode on the ED ePanel in Chromeleon 7 or the EC Detector Control panel in Chromeleon 6.8, or in the Chromeleon 7 instrument method or the Chromeleon 6.8 program.

- **Disconnected reference electrode**

  Verify that the reference electrode cable is securely connected (see Figure 8-8).

- **Uncalibrated pH-Ag/AgCl reference electrode**

  Calibrate the pH-Ag/AgCl reference electrode (see Section 9.28.6).

- **Dry pH-Ag/AgCl reference electrode**

  1. Soak the pH-Ag/AgCl reference electrode in a solution containing 1 M KCl and 1 M HCl long enough to restore the electrode potential to <30 mV when compared to an unexposed Ag/AgCl reference electrode. To test the electrode potential, see "Using a Digital Voltmeter to Determine Reference Potential Shift" on page 274.
  2. If soaking the pH-Ag/AgCl reference electrode does not fix the problem, replace the electrode (see Section 9.28.5).

  To prevent a pH-Ag/AgCl reference electrode from drying out, make sure that eluent is being pumped continuously through the cell. If the cell will not be used for a short time (less than 2 days), disconnect the tubing from the inlet and outlet fittings and all fitting plugs. For longer shutdowns, remove the electrode from the cell and store it in its storage bottle filled with saturated KCl solution. See Section 4.1.2 for detailed instructions.

- **Contaminated pH-Ag/AgCl reference electrode**

  Replace the pH-Ag/AgCl reference electrode (see Section 9.28.5).

8.28.5 Leak in pH-Ag/AgCl Reference Electrode Compartment

- **Defective pH-Ag/AgCl reference electrode O-ring**

  Replace the pH-Ag/AgCl reference electrode O-ring (see Section 9.28.7).

8.28.6 Shift in Ag/AgCl Reference Potential

- **Faulty pH-Ag/AgCl reference electrode**

  A shift in reference potential causes a shift in the effective potential applied to the working electrode. For example, when using an electrode with a shift of 50 mV, an applied potential of 0.1 V, is equivalent to an applied potential of 0.15 V for a new pH-Ag/AgCl reference electrode with no shift.

  Following the steps below, measure the pH-Ag/AgCl reference electrode potential shift by comparing it to the potential shift of an unexposed electrode. A spare pH-Ag/AgCl reference electrode (P/N 061879) stored in 3 M KCl can be kept on hand for this purpose.

Using a Digital Voltmeter to Determine Reference Potential Shift

1. For each pH-Ag/AgCl reference electrode (the unexposed electrode and the electrode being tested), use a straightened paper clip or short piece of wire of a suitable diameter to connect the voltmeter's voltage inputs to pin 1 on the reference electrode's cable connector.

   To identify the cable connector pins, refer to *Product Information Update for the Electrochemical Detector* (PIU_ED_1). The document is included on the Thermo Scientific Reference Library DVD (P/N 053891).

2. Immerse both electrodes in a solution of 0.1 M KCl.

3. Read the potential difference (in mV) between the unexposed electrode and the electrode being tested. If it is greater than 30 mV, try regenerating the electrode by soaking it in a solution containing 1 M KCl and 1 M HCl. If this does not reduce the potential shift, replace the electrode (see Section 9.28.7).

8.29 Troubleshooting TC Error Messages

If any of the following alarm conditions occurs, a message is displayed in the Chromeleon Audit Trail.

AcqOff without previous AcqOn.

This error occurs if the Chromeleon 7 instrument method or Chromeleon 6.8 program contains an **AcqOff** command, but no **AcqOn** command.

To troubleshoot:

Every program should include one **AcqOn** command. Enter the **AcqOn** command after the first injection.

Acquisition is still on at program end.

This error occurs if a Chromeleon 7 instrument method or Chromeleon 6.8 program does not include a command that ends data acquisition.

To troubleshoot:

The **AcqOn** command must be paired with an **AcqOff** command. Enter the **AcqOff** command at the appropriate point in the program.

All samples scheduled for run on timebases x need to specify the same value for property (nominal) Temperature.

-or-

All samples scheduled for run on timebases x need to specify the same value for property TempCtrl.

-or-

All samples scheduled for run on timebases x need to specify the same value for property y.

When a TC is shared by two timebases, the same values must be selected for certain parameters. If the Chromeleon Ready Check detects a discrepancy, this error occurs and batch processing cannot be started.

To troubleshoot:

Find and eliminate any discrepancies in the parameter settings. For example, all samples must turn on **TempCtrl** or all samples must turn off **TempCtrl**.

Can't execute "Disconnect" command during data acquisition.

-or-

Can't execute "Standby" command during data acquisition.

Selecting the **Disconnect** or **Standby** command during data acquisition will stop data transmission and cause data acquisition to stall. If you attempt to issue one of these commands during data acquisition, this error occurs.

To troubleshoot:

Wait until data acquisition is completed before attempting to issue either of these commands.

Can't find download image TC3000.HEX.

TC3000.HEX is the version of the TC instrument control firmware file that should be available in the \Bin directory of your Chromeleon installation. This error occurs if the file is missing.

To troubleshoot:

Select **Tools > Instrument Qualification** (Chromeleon 7) or **Qualification > Chromeleon 6.8 IQ** (Chromeleon 6.8) to run the Chromeleon IQ and diagnose the problem. When you eliminate the source of the error, rerun the Setup program.

Can't start acquisition at negative retention times.

This error occurs if you attempt to execute the **AcqOn** command while retention times are negative.

To troubleshoot:

Wait until the retention time value is positive.

Can't start acquisition: The server configuration does not fulfill the license conditions.

Operation of the TC requires the appropriate version of Chromeleon plus a Timebase Class 1 license. This error occurs if you attempt to start data acquisition when these requirements are not met.

To troubleshoot:

Contact your local Dionex products representative at Thermo Fisher Scientific to obtain the appropriate software version and/license.

Can't start TC firmware. A firmware download may be necessary.

-or-

Error finishing download.

-or-

TC—Firmware download failed.

If the TC firmware cannot be started after a firmware download or if Chromeleon is unable to successfully download firmware to the TC, the appropriate message (shown above) is displayed.

To troubleshoot:

1. Press the **POWER** button on the front of the TC to turn off the power; after 30 seconds, press the button again to turn on the power.
2. Download new firmware to the TC as follows:
   a. Insert the CD containing the new firmware version into the CD drive.

b. Start the Chromeleon 7 Instrument Configuration Manager or the Chromeleon 6.8 Server Configuration program.

c. In the instrument or timebase, right-click the TC for which you want to update the firmware and select **Properties** on the context menu.

d. On the **General** tab page in the Properties dialog box, click **Firmware Download** to display a file open dialog box.

e. Select the file (the extension is .fmw) containing the new firmware version and click **Open** to begin the download. Audit Trail messages will inform you of the status of the download.

3. If the error occurs again, contact Technical Support for Dionex products for assistance. The firmware cannot be serviced by the user.

Can't use device "x" as a source of the column pressure. Please check the property "SystemPressure" for a valid device name. The device must have the "Pressure" property available.

-or-

Can't use device "x" as a source of the column pressure. Please check the property "y" for a valid device name. The device must have the "Pressure" property available.

This error occurs if the device selected to monitor the system pressure is ineligible to do so.

To troubleshoot:

1. Open the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset.
2. Press the **F8** key to open the Commands dialog box.
3. Under TC, select the column name, and select the **SystemPressure** command.
4. Enter the name of the pump currently delivering flow for this column.
5. For Chromeleon 6.8, click **Execute**.

Card data checksum error.

This error indicates that the column ID chip card memory is corrupted.

To troubleshoot:

Replace the column ID chip card (see Section 9.30).

Command is not available in demo mode.

This error occurs if you attempt to issue a command that is not available when the TC is in demo (or simulation) mode.

To troubleshoot:

If a TC is present and connected, disable the demo mode:

1. Start the Chromeleon 7 Instrument Configuration Manager or the Chromeleon 6.8 Server Configuration program.
2. In the instrument or timebase, right-click the TC and select **Properties**.
3. On the **General** tab page, clear the **Simulation Mode** or **Demo Mode** check box.
4. If the TC does not appear in the Module address box, click **Browse** and select the TC. Click **OK**.

Communication error: x.

This error occurs if there is a communication failure between the TC and the PC on which Chromeleon is installed.

To troubleshoot:

1. Check the USB connections.
2. Check the connection from the TC to the power supply.
3. If you cannot identify the cause of the error, contact Technical Support for Dionex products for assistance.

Communication time-out.

This error occurs if a TC firmware command is not executed within the time allotted for its completion.

To troubleshoot:

1. Check the USB connections.
2. Check the connection from the TC to the power supply.
3. If you cannot identify the cause of the error, contact Technical Support for Dionex products for assistance.

Configuration doesn't match. X not installed.

-or-

Configuration mismatch (x - CM uses y, Column Compartment uses z). Please use the Server Configuration program to check the installation.

This error occurs if there is a discrepancy between the TC properties and the actual configuration.

To troubleshoot:

1. Start the Chromeleon 7 Instrument Configuration Manager or the Chromeleon 6.8 Server Configuration program.
2. In the instrument or timebase, right-click the TC and select **Properties**.
3. Correct any discrepancies in the Properties dialog box.

Current flow is out of limits defined for the column.

This error occurs if the current flow rate exceeds the value specified by the **Column_x.FlowRate_UpperLimit** command.

To troubleshoot:

Select a valid flow rate.

Current pressure is out of limits defined for the column.

This error occurs if the current pressure reading is outside the range specified by the **Column_x.Pressure_UpperLimit** and **Column_x.Pressure_LowerLimit** commands.

To troubleshoot:

- Find and eliminate any liquid leaks or blockages in tubing connections (see Section 8.31). Adjust the flow rate accordingly.

Current temperature is out of limits defined for the column.

This error occurs if the current temperature reading is outside the range specified by the **Column_x.Temp_UpperLimit** and **Column_x.Temp_LowerLimit** commands.

To troubleshoot:

Select a valid temperature setting.

Data buffer overrun.

This error occurs in Chromeleon 6.8 if the system cannot write incoming data to disk fast enough.

To troubleshoot:

Increase the buffer size:

1. Start the Chromeleon 7 Instrument Configuration Manager or the Chromeleon 6.8 Server Configuration program.
2. Right-click the computer name and select **Properties** on the menu.
3. Click the **Advanced** tab and enter a new value (in seconds) in the **Buffer** field. Click **OK**.
4. If the error occurs again, contact Technical Support for Dionex products for assistance.

Device control feature is not available! Please check key code and CM Features (see "About Chromeleon..." on the client's Help menu).

This error occurs if you attempt to select or define a feature that is not available for your TC.

To troubleshoot:

Select **Help > About Chromeleon...** to open the About Chromeleon screen.

- For Chromeleon 7, click **Details** to view all license features you purchased (devices controlled, number of timebases, and other software options).
- For Chromeleon 6.8, the license features you purchased are listed on the About Chromeleon screen and labeled **On**.

If necessary, upgrade your software by acquiring the corresponding licenses. Contact your local Dionex products representative at Thermo Fisher Scientific for assistance.

Device is not remote.

-or-

TC is not remote.

If you try to issue certain commands (for example, **Column_x** and **InjectValve_x** commands) when the TC is not under Chromeleon control, the appropriate message (shown above) is displayed.

To troubleshoot:

Select the **Connect** command to connect the TC to the Chromeleon server. Check the Audit Trail for messages indicating whether the module was successfully connected.

Device not found on the USB.

-or-

USB/LAN communication error. Please check communication cable and instrument's power.

This error occurs if there is a problem with the connection between the TC and the Chromeleon server or with the power supply.

To troubleshoot:

1. Check the USB connections.
2. Check the connection from the TC to the power supply.
3. If you cannot identify the cause of the error, contact Technical Support for Dionex products for assistance.

Either the current date is later than the expiration date for x or the program or batch will end later than 24 hours before the expiration time for x.

Chromeleon compares the current date with the column expiration date during injection or before beginning batch processing. This error occurs if the expiration date has already passed or if batch processing is scheduled to start less than 24 hours before the expiration date.

To troubleshoot:

Replace the column.

Error deleting flash memory.

This error occurs if, during a firmware download, the existing firmware cannot be erased from memory.

To troubleshoot:

Flash memory cannot be serviced by the user. Contact Technical Support for Dionex products for assistance.

Error during storing of the card data to the chip card.

This error occurs if the column ID chip card is installed incorrectly, or is defective.

To troubleshoot:

When the chip card is properly installed, the Dionex logo on the card faces up and the LED on the memory slot is green. If this error occurs when the chip card is properly installed, it indicates that the card is defective and should be replaced (for instructions, refer to Section 9.30).

Error programming flash memory.

This error occurs if, during a firmware download, the new firmware cannot be programmed into memory.

To troubleshoot:

Flash memory cannot be serviced by the user. Contact Technical Support for Dionex products for assistance.

Executing this command will reset associated counter values stored in the module.

This error occurs when you select a command (**RotorSealChanged**, for example) that updates information stored in the TC. To prevent information from being inadvertently changed, Chromeleon requests confirmation before executing the command.

To troubleshoot:

If you want to execute this command, click **Execute**; otherwise, click **Cancel**.

Firmware download in progress. Please wait.

This error occurs if you attempt to issue a command while firmware is being downloaded to the TC.

To troubleshoot:

Wait until the firmware download is complete. Audit Trail messages will inform you of the status of the download.

Gas leak detected.

This error occurs if the gas sensor detects an increased concentration of gas inside the TC.

To troubleshoot:

1. Find and eliminate the leak.
2. If you are using Chromeleon 7: Open the Commands dialog box (press the **F8** key). Select the TC and click the **Commands** tab. Click the **ClearAlarmLED** button.
3. If you are using Chromeleon 6.8: On the TC Control panel, click the **Clear Alarm** button.
4. Ventilate the interior of the TC thoroughly before closing the door and resuming operation.

Humidity leak detected.

This error occurs if the humidity sensor detects an increased concentration of humidity inside the TC.

To troubleshoot:

1. Find and eliminate the leak.
2. If you are using Chromeleon 7: Open the Commands dialog box (press the **F8** key). Select the TC and click the **Commands** tab. Click the **ClearAlarmLED** button.

3. If you are using Chromeleon 6.8: On the TC Control panel, click the **Clear Alarm** button.
4. Ventilate the interior of the TC thoroughly before closing the door and resuming operation.

Illegal parameter.

This error occurs if you enter a parameter that is not valid for the TC.

To troubleshoot:

Select a valid parameter.

Invalid date/time format. Either use "DD MMM YYYY" or "current [+ [Nyear[s]] [Nmonth[s]] [Nday[s]]]." Examples: "31 Dec 1999," "current + 1 year 6 months."

This error occurs if you enter the date associated with an event in an invalid format.

To troubleshoot:

Enter the date in the format specified in the message.

Invalid enumerated value.

This error occurs if you attempt to enter an invalid value for a property, rather than selecting a value from the drop-down list box in the Commands dialog box.

To troubleshoot:

Select a valid option from the drop-down list box available for this property.

Next qualification of this module is due in x day(s) (due date is [date]).

-or-

Next qualification of this module is overdue (due date was [date]).

-or-

Next qualification of this module was due on [date]. Allowing x more grace day(s).

-or-

Next qualification of this module is overdue (due date was [date]). Module may no longer be used.

Chromeleon monitors the date on which qualification was last performed and displays an appropriate message (shown above) at the following times: when the due date for the next qualification is approaching; when the due date is overdue, but the TC can still be used; and when the due date is overdue and the TC can no longer be used.

The **Qualification.WarningPeriod** property determines the number of days before the due date that the warning is first displayed. The **Qualification.GracePeriod** property determines for how many days after the due date you can continue using the TC without performing the qualification.

To troubleshoot:

Contact Technical Support for Dionex products to schedule an Operational Qualification and Performance Qualification.

Next service of this module is due in x day(s) (due date is [date]).

-or-

Next service of this module is overdue (due date was [date]).

Chromeleon monitors the date on which service was last performed and display an appropriate message (shown above) at the following times: when the due date for the next service is approaching and when the due date is overdue. The **Service.WarningPeriod** property determines the number of days before the due date that the warning is first displayed.

To troubleshoot:

Contact Technical Support for Dionex products for information about performing annual preventive maintenance.

No chip card in the reader for the column x.

This error occurs if a column ID chip card is not installed for the column identified in the message.

To troubleshoot:

Install a column ID chip card for the column (see Section 9.30). Or, if you do not want to store information about this column, follow the steps below to disable this option.

1. In the Chromeleon 7 Instrument Configuration Manager or the Chromeleon 6.8 Server Configuration program, right-click the TC and select **Properties** on the context menu.
2. Select the **Components** tab in the Properties dialog box. Clear the check mark beside the column name and click **OK**.

No response from x for x seconds.

-or-

No response from x for x seconds. Device disconnected.

This error occurs if there is a communication failure between the TC and the PC on which Chromeleon is installed.

To troubleshoot:

1. Check the USB connections.
2. Check the connection from the TC to the power supply.
3. If you cannot identify the cause of the error, contact Technical Support for Dionex products for assistance.

Operating columns above 70 °C could affect column performance. Verify recommended column operating conditions before setting temperature above 70 °C.

This error occurs if you select a TC temperature setting above 70 °C (158 °F).

To troubleshoot:

Refer to the column manual for the recommended operating conditions. Column manuals are provided on the Thermo Scientific Reference Library DVD (P/N 053891).

Parameter x value exceeded its allowed range. Set to closest valid value x.

-or-

Value for [name] parameter is not within valid range. Value passed (x) will be substituted by y.

-or-

Value x replaced by valid table entry y.

If you select a value outside the allowable range for certain parameters, Chromeleon ignores the setting, replaces it with the closest valid setting, and this error occurs.

To troubleshoot:

No immediate action is required. In future, specify a valid setting for the parameter.

Primary property "x" is already assigned and cannot be changed.

This error occurs if you attempt to change one of the primary column properties (batch or lot number, date of manufacture, etc.) used for column identification.

To troubleshoot:

Once a primary column property has been assigned, it cannot be changed. As an alternative, consider changing a secondary column property. For a list of primary and secondary properties, refer to the Chromeleon Help.

Properties cannot be changed. A chip card has not been inserted properly. Check the CardState property for all cards and reinsert those indicating "BusBlocked."

This error occurs if you attempt to change column ID properties when at least one column ID chip card is inserted incorrectly.

To troubleshoot:

1. Open the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset.
2. Press the **F8** key to open the Commands dialog box.
3. Under TC, select the column name and select the **CardState** property. If the status is **BusBlocked**, remove the card from the card slot and reinsert it.

When the card is properly installed, the Dionex logo on the card faces up and the LED on the memory slot is green.

Properties cannot be changed if the compartment door is open.

This error occurs if you attempt to change column ID properties when the TC door is open (or is not fully closed).

To troubleshoot:

1. Verify that the door is fully closed.
2. If the door is not fully closed, check for—and remove—any obstruction.

3. If the door is fully closed but the error persists, contact Technical Support for Dionex products for assistance.

Properties cannot be changed—there is no card in the card reader.

This error occurs if you attempt to change column ID properties for a column for which no chip card is installed.

To troubleshoot:

Insert a column ID chip card into the appropriate slot (see Section 9.30).

Raw data file x cannot be created.

-or-

Raw data file x cannot be created. Continuing with network failure protection.

-or-

Raw data file x cannot be written.

-or-

Raw data file x cannot be written. Continuing with network failure protection.

If a network failure prevents Chromeleon from creating or writing to a raw data file, the corresponding error occurs.

To troubleshoot:

Wait until batch processing is complete; then, reboot the PC and restart the Chromeleon server.

Starting data acquisition manually will overwrite any data which has been acquired so far.

This error occurs if you attempt to start data acquisition manually while a batch is already running.

To troubleshoot:

To retain the data already acquired, cancel manual data acquisition; otherwise, go ahead and start data acquisition.

The command can format only chip cards with an invalid data structure.

This error occurs if you select the **FormatChipCard** command for a column ID chip card that is not defective.

To troubleshoot:

Cancel the command. Do not attempt to reinitialize a chip card unless it contains invalid or corrupted data.

The communication interface is closed. Reconnect the instrument.

This error occurs if there is a communication failure between the TC and the PC on which Chromeleon is installed.

To troubleshoot:

1. Check the USB connections.
2. Check the connection from the TC to the power supply.
3. If you cannot identify the cause of the error, contact Technical Support for Dionex products for assistance.

The compartment door is open; a batch or a program may need to wait until the door has been closed. Please close the door.

This error occurs if you attempt to operate the TC when the door is open (or not fully closed).

To troubleshoot:

1. Verify that the door is fully closed.
2. If the door is not fully closed, check for—and remove—any obstruction.
3. If the door is fully closed but the error persists, contact Technical Support for Dionex products for assistance.

The counter [name] (value: x) has exceeded its limit (y). Module should no longer be used. Replace the [name].

This error occurs if the number of hours a TC part has been in use exceeds the lifetime set by the **OperationTime.Limit** property.

To troubleshoot:

Replace the part identified in the message before resuming operation.

The data format stored on the chip card is unsupported (format version x).

This error occurs if the column ID chip card data is inadvertently saved in an invalid format.

To troubleshoot:

1. To reinitialize the chip card, open the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset.
2. Press the **F8** key to open the Commands dialog box.
3. Under TC, select the column name and select the **FormatChipCard** command.
4. For Chromeleon 6.8, click **Execute**.

The injections limit for the column has been exceeded.

-or-

The injections limit will be exceeded for the column x.

Chromeleon monitors the number of injections done with each column and display an appropriate message (shown above) at the following times: when the injections limit is about to be exceeded or has been exceeded.

To troubleshoot:

Replace the column.

The nominal temperature must be set within the current limits.

This error occurs if the selected TC temperature setting is outside the range specified by the **Temperature.LowerLimit** and **Temperature.UpperLimit** commands.

To troubleshoot:

Select a valid temperature setting.

The nominal temperature value is out of range defined by the active column ID.

This error occurs if the selected TC temperature setting is outside the range specified by the **Column_x.Temp_LowerLimit** and **Column_x.Temp_ UpperLimit** commands.

To troubleshoot:

Select a valid temperature setting.

The oven is not fully operable yet. Check the values of "Standby," "Ready," "Door," and "CardState."

Each time the TC power is turned on, the firmware runs a series of self-diagnostics in which the status of the main components is checked. This error occurs if a component is not ready for operation.

To troubleshoot:

1. Open the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset.
2. Press the **F8** key to open the Commands dialog box.
3. Check the status of each property listed in the error message. The table below indicates the status required for operation.

Command	Status
CardState	OK
Door	Closed
Ready	Ready
Standby	NoStandby

4. When you identify the component that is not ready for operation, find and eliminate the cause of the problem.

The primary column ID property “x” will be changed. The property can't be changed in the future.

This error occurs when you modify a primary column property (batch or lot number, date of manufacture, etc.). To prevent any unintended changes, Chromeleon requests confirmation before saving the new property.

To troubleshoot:

If you are sure that the proposed change is correct, go ahead and save it.

The upper limit must be higher than the lower limit.

This error occurs if the value entered for a parameter’s upper limit (for example, **TC_Temp.Signal.UpperLimit**) is less than the lower limit for the parameter.

To troubleshoot:

Increase the value of the upper limit setting.

The Warning threshold must be higher than the Limit threshold.

This error occurs if the **Warning** value selected for a Predictive Performance command (for example, **LeftRotorSealSwitches**) is lower than the **Limit** value. Chromeleon issues a warning message in the Audit Trail when the **Warning** value is reached and an error message when the **Limit** value is reached.

To troubleshoot:

Select a **Warning** value that is higher than the **Limit** value.

The Warning threshold must be lower than the Limit threshold.

This error occurs if the **Warning** value selected for a parameter is higher than the **Limit** value. Chromeleon issues a warning message in the Audit Trail when the **Warning** value is reached and an error message when the **Limit** value is reached.

To troubleshoot:

Select a **Warning** value that is lower than the **Limit** value.

There was already an AcqOff command for this channel before.

-or-

There was already an AcqOn command for this channel before.

-or-

Two AcqOn commands for the same channel. The second chromatogram will overwrite the first.

A Chromeleon 7 instrument method or Chromeleon 6.8 program can include no more than one command to start or terminate data acquisition for a channel; if multiple commands are present, the appropriate message (shown above) appears.

To troubleshoot:

Remove the duplicate commands from the instrument method or program.

This function cannot be adjusted by the user.

This error occurs if you attempt to change the setting for a read-only parameter.

To troubleshoot:

Do not attempt to reset read-only parameters.

This operation may affect the oven's operation on timebase x, which is currently running a batch.

If batch processing is in progress when you attempt to change a property (such as **Temperature** or **TempCtrl**) that affects the entire TC, this error occurs.

To troubleshoot:

To avoid disrupting operation, cancel the command.

Unknown error code.

This error occurs if Chromeleon does not recognize the error code sent by the TC firmware.

To troubleshoot:

The firmware cannot be serviced by the user. Contact Technical Support for Dionex products for assistance.

Unknown format of the card data.

This error occurs if Chromeleon does not recognize the format of data stored on the column ID chip card.

To troubleshoot:

1. Open the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset.
2. Press the **F8** key to open the Commands dialog box.

3. Under TC, select the column name and select the **FormatChipCard** command.
4. For Chromeleon 6.8, click **Execute**.
5. If the error occurs again, insert a new column ID chip card (see Section 9.30).

X position error.

This error occurs if a TC injection valve fails to switch position within the time allotted.

To troubleshoot:

1. If a sequence is being executed, terminate the sequence by clicking **Abort Batch** on the **Sequence Control** panel.
2. Press the **POWER** button on the front of the TC to turn off the power; after 30 seconds, press the button again to turn on the power.
3. Try to toggle the injection valve from Load to Inject by clicking the **Load** and **Inject** buttons on the TC ePanel or Control panel.
4. If the error occurs again, contact Technical Support for Dionex products for assistance.

You do not have the privilege to approve the module's qualification.

-or-

You do not have the privilege to change the performance limits.

-or-

You do not have the privilege to change the qualification intervals.

In controlled environments, users are not allowed to perform certain operations unless they have been granted the appropriate privileges. If you attempt to do so, the appropriate message (shown above) is displayed.

To troubleshoot:

The Chromeleon 6.8 administrator assigns various privileges to individual users or to user groups. Contact the administrator if you need one or more of the above privileges assigned to you.

8.30 TC ALARM LED Is Lighted

If the **ALARM** LED lights (red), check the Chromeleon Audit Trail for the cause.

- **Gas leak inside the TC**
  1. Find and eliminate the leak.
  2. If you are using Chromeleon 7: Open the Commands dialog box (press the **F8** key). Select the TC and click the **Commands** tab. Click the **ClearAlarmLED** button.
  3. If you are using Chromeleon 6.8: On the TC Control panel, click the **Clear Alarm** button.
  4. Ventilate the interior of the TC thoroughly before closing the door and resuming operation.
- **Humidity leak inside the TC**
  1. Find and eliminate the leak.
  2. If you are using Chromeleon 7: Open the Commands dialog box (press the **F8** key). Select the TC and click the **Commands** tab. Click the **ClearAlarmLED** button.
  3. If you are using Chromeleon 6.8: On the TC Control panel, click the **Clear Alarm** button.
  4. Ventilate the interior of the TC thoroughly before closing the door and resuming operation.
- **Failure of a mechanical component**

  If a **VALVE** LED is flashing, a mechanical component in the TC injection valve has failed. Replace the injection valve "pod" (see Section 9.32).

  If you are using Chromeleon 7: Open the Commands dialog box (press the **F8** key). Select the TC and click the **Commands** tab. Click the

ClearAlarmLED button. If you are using Chromeleon 6.8: On the TC Control panel, click the **Clear Alarm** button.

If the **OVEN** LED is flashing, a mechanical component in the TC has failed. These parts are not user-serviceable. Contact Technical Support for Dionex products for assistance.

8.31 Liquid Leaks from TC Components

- **Leaking fitting**

  Locate the source of the leak. Tighten or, if necessary, replace the liquid line connection (see Section 9.29).

- **Broken liquid line**

  Replace the line with tubing of the same length and internal diameter (see Section 9.29).

- **Blocked or improperly installed line**

  Make sure the lines are not crimped or otherwise blocked. Also, make sure the waste line is not elevated at any point after it exits the TC. If a line is blocked, replace it (see Section 9.29).

- **Leaking injection valve**

  1. Make sure the liquid line connections to the valve are tight. Replace any damaged fittings (see Section 9.29).
  2. Liquid leaks from behind the valve stator may indicate a scratched rotor seal. Rebuild the injection valve (see Section 9.31).

- **Leaking temperature stabilizer**

  1. Tighten the fittings on the temperature stabilizer inlet and outlet.
  2. If tightening the fittings does not eliminate the leak, excessive system backpressure may be the source of the problem. Follow the troubleshooting steps in Section 8.9 to reduce the backpressure.

8.32 TC Temperature Does Not Increase

If the temperature fails to increase as expected, although the temperature set point has not been reached, follow the troubleshooting steps below.

- **Front door not closed**

  Verify that the TC door is fully closed. If it is, check the door seal for signs of damage. If the seal is damaged, contact Technical Support for Dionex products for assistance.

- **Column tubing connections incorrectly oriented**

  Column tubing connections that are incorrectly oriented can open a small path for ambient air into the TC. Check that the tubing connections are at a 90-degree angle in relation to the door seal.

- **Ventilation slots on TC are obstructed**

  Make sure the ventilation slots are not obstructed in any way. Allow at least 6 cm (2.4 in) behind the TC for ventilation.

- **Ambient temperature is too high**

  Reduce the ambient temperature (for example, ventilate the lab in which the TC is installed).

8.33 TC Temperature Stabilizer Not Operating Properly

- **Temperature stabilizer installed incorrectly**

  Remove the temperature stabilizer and install it correctly. Make sure there is good thermal contact between the temperature stabilizer and the thermal element. For detailed instructions, refer to *Thermo Scientific Dionex ICS-5000 Ion Chromatography System Installation Instructions* (Document No. 065343).

- **TC calibration is incorrect**

  The TC cannot be calibrated by the user. Contact Technical Support for Dionex products for assistance.

- **Defective temperature stabilizer**

  Replace the temperature stabilizer (standard bore, P/N 064548; microbore, P/N 064650).

9 • Service

This chapter describes Thermo Scientific Dionex ICS-5000 Ion Chromatography System service and repair procedures that users may perform. All procedures not included here, including electronics-related repair procedures, must be performed by Thermo Fisher Scientific personnel. For assistance, contact Technical Support for Dionex products. In the U.S. and Canada, call 1-800-346-6390. Outside the U.S. and Canada, call the nearest Thermo Fisher Scientific office.

Before replacing any part, refer to the troubleshooting information in Chapter 8 to correctly identify the cause of the problem.

IMPORTANT **Substituting non-Dionex/Thermo Fisher Scientific parts may impair a module's performance, thereby voiding the product warranty. Refer to the warranty statement in the Dionex Terms and Conditions for more information.**

Capillary IC

9.1 Connecting Capillary Tubing

When connecting precision cut 0.062 mm (0.0025 in) ID blue PEEK tubing (capillary tubing) to a port, make sure the ferrule and fitting bolt are at least 2 mm (0.1 in) from the end of the tubing before you insert the tubing into the port. Do not position the ferrule and fitting bolt flush with the end of the tubing.

Figure 9-1 illustrates the correct and incorrect placement of the ferrule and fitting bolt on the tubing.

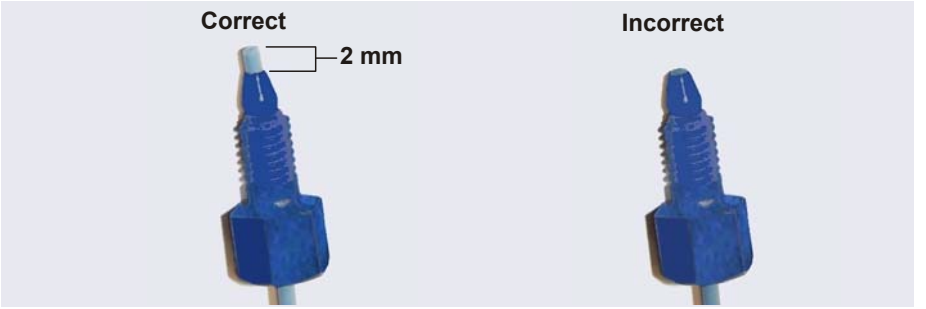
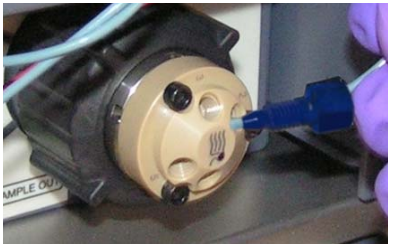


Figure 9-1. *Correct and Incorrect Ferrule and Fitting Bolt Placement for Capillary Tubing Connections (High-Pressure Fitting and Ferrule Shown)*

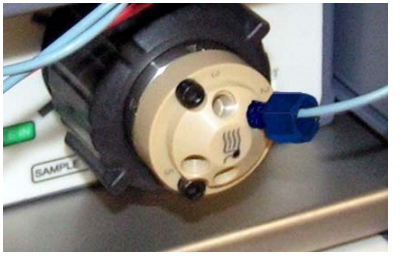
Follow the steps below to install capillary tube fittings:

1. Install the fitting bolt and ferrule onto the tubing. Position the ferrule at least 2 mm (0.1 in) from the end of the tubing (see Figure 9-1).

2. Insert the tubing into the port until it stops.



3. While maintaining pressure on the tubing to keep it in place in the port, tighten the fitting bolt fingertight.
4. If you are installing a high-pressure fitting (blue bolt and ferrule), follow the instructions below to tighten the fitting.



Capillary IC

9.2 Tightening Guidelines for High-Pressure Fittings

Follow these guidelines when tightening a high-pressure fitting bolt (P/N 074449) and high-pressure ferrule (P/N 074373):

1. First, use your fingers to tighten the fitting bolt as tight as you can. Then, use a wrench to tighten the fitting an additional 3/4 turn (270 degrees).
2. If leaks occur, replace the fitting bolt, ferrule, and tubing.

ICS-5000 DP/SP

DP/SP Service

9.3 Replacing Tubing and Fittings

The DP/SP is plumbed with the tubing and fittings listed below.

Tubing Size and Type	Color	P/N	Used to connect…
Pump outlet tubing assembly: 0.25 mm (0.010 in) ID PEEK, 86 cm (34 in)	Black	068658	Pulse damper outlet (capillary pumps) or static valve outlet (standard bore analytical pumps) to EGC inlet or injection valve
0.125 mm (0.005 in) ID PEEK, 86 cm (34 in)	Red	044221 (1 in)	Microbore analytical pumps only: Static valve outlet to EGC inlet or injection valve
0.25 mm (0.010 in) ID PEEK, 10 cm (4 in)	Black	042690 (1 in)	Primary and secondary pump heads
0.51 mm (0.020 in) ID PEEK, 13 cm (5 in)	Orange	042855 (1 in)	Microbore systems only: Proportioning/eluent valve to inlet check valve
1.02 mm (0.040 in) ID PEEK, 13 cm (5 in)	Tan	054410 (1 in)	Standard bore systems only: Proportioning/eluent valve to inlet check valve
0.159 cm (0.0625 in) ID PharMed®	Yellow	063268 (1 in)	Peristaltic pump to primary pump head
0.15 cm (0.060 in) ID Tygon® 2075 tubing	Colorless	064079 (1 in)	• Peristaltic pump to seal wash reservoir • Between pump heads for seal wash
1.58 mm (0.062 in) ID PTFE	Colorless	014157 (1 in)	• Eluent reservoirs • Vacuum degassing assembly
1.58 mm (0.062 in) ID polyurethane	Colorless	047203 (1 in)	Secondary pump head to waste

Table 9-1. *DP/SPTubing and Fittings*

Tubing Size and Type	Color	P/N	Used to connect…
10 mm (0.39 in) ID polyethylene	Colorless	055075	Drip tray drain hose
1/16 in fitting bolt 1/16 in ferrule	Tan Tan	052230 062511	Inlet check valve fitting
1/8 in fitting bolt 1/8 in ferrule	Tan Yellow	052267 048949	Eluent reservoir fittings
High-pressure 10-32 fitting bolt	Blue	074449	Capillary pumps only: Pulse damper to EGC or injection valve
High-pressure 10-32 ferrule, double-cone	Blue	074373	Use with high-pressure fitting bolts
10-32 fitting bolt 10-32 ferrule, double-cone	Black Tan	043275 043276	All other tubing fittings

Table 9-1. *DP/SPTubing and Fittings (Continued)*

Notes

- For tightening requirements for the 10-32 fitting bolt (P/N 043275) and ferrule (P/N 043276), refer to *Installation of Dionex Liquid Line Fittings* (Document No. 031432). The manual is on the Thermo Scientific Reference Library DVD (P/N 053891).
- For tightening requirements for the high-pressure fitting bolt (P/N 074449) and ferrule (P/N 074373), see Section 9.2.
- Use a tubing cutter to cut tubing to the required length. Make sure the cut is at a right angle to the length of the tubing and there are no nicks or burrs on the end. A tubing cutter (P/N 049584) is included in the DC Ship Kit (P/N 072011). Refer to the instructions provided with the cutter.

9.4 Cleaning Eluent Reservoirs

Before preparing new eluent, all eluent reservoirs should be rinsed thoroughly (inside and out) with ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5. If a reservoir still appears dirty, or has a slimy film on the inside, clean it as instructed below.

Capillary IC

Clean reservoirs in a capillary IC system every 3 months, as instructed below.

1. Dispose of any remaining chemicals according to municipal regulations.
2. Rinse the reservoir (inside and out) with ASTM Type I (18 megohm-cm) filtered and deionized water.
3. Rinse the inside of the reservoir with isopropyl alcohol or methanol.
4. If algae or bacteria have left a slimy film on the reservoir, use an algicide or disinfectant (dilute hydrogen peroxide, etc.).
5. Rinse cleaning chemicals out of the reservoir with ASTM Type I (18 megohm-cm) filtered and deionized water.
6. Dry the reservoir with clean, particulate-free air.

9.5 Priming the DP/SP

The pump should be primed if the eluent has been changed, the eluent line is new (empty), or the eluent line contains air. This section describes two methods for priming the pump:

- To prime the pump with the **PUMP PRIME** button, see Section 9.5.1.
- To prime the pump from the **Pump** panel in Chromeleon, see Section 9.5.2.

Although a 10 cc syringe (P/N 054578) can be used with either priming procedure, using a syringe only if eluent lines are 100% empty or if the pump is dry is recommended.

9.5.1 Priming with the PUMP PRIME Button

1. On the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset, click the **Pump** tab.
2. **Gradient pump only:** Enter 100% for the channel (A, B, C, or D) to be primed.
3. Set the priming flow rate to the desired rate. The default rate for a capillary IC pump is 3.0 mL/min. The default rate for an analytical IC pump is 6.0 mL/min.
4. Disconnect the DP/SP from the software by clicking **Connected** on the **Pump** panel.

   NOTE When the pump is connected to Chromeleon, the **PUMP PRIME** buttons are disabled.

5. Open the priming valve on the secondary pump head (see Figure 9-2) by turning it one-half turn counterclockwise.

   NOTE If the priming valve is opened too much, air is drawn through the valve and air bubbles can be seen exiting the waste line.

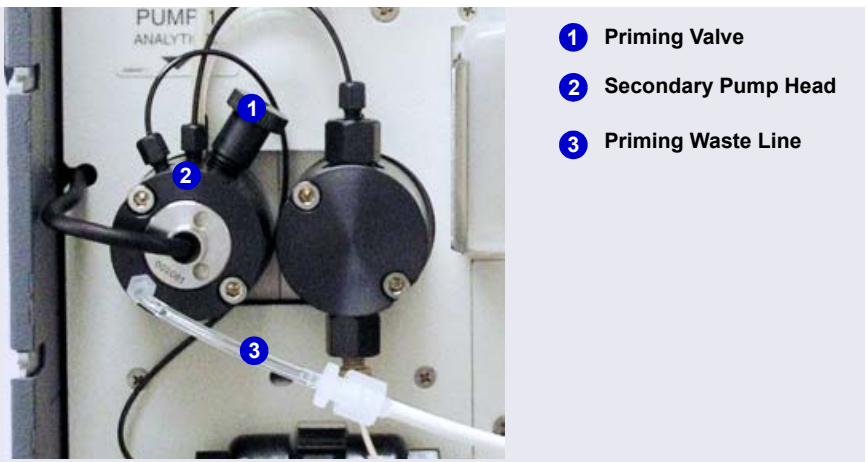


Figure 9-2. *DP/SP Priming Valve*

6. Press **PUMP PRIME 1** (or **PUMP PRIME 2**) on the front of the DP/SP. The pump will begin pumping at the priming flow rate selected on the Chromeleon panel.
7. Prime the pump until all air is purged and no air bubbles can be seen exiting the waste line.
8. **Gradient pump only:** To prime additional eluent lines, select another eluent channel and repeat the priming procedure.
9. After priming all eluent lines, press **PUMP PRIME 1** (or **PUMP PRIME 2**) to stop priming and return to the flow rate last selected.
10. Close the priming valve by turning it clockwise. **Do not overtighten the priming valve.**

IMPORTANT **Do not use any tools to tighten the priming valve! Overtightening may destroy the cap seal. Open or close the priming valve only when the system pressure is down.**

11. Reconnect the pump to the software by clicking **Connected** on the **Pump** panel.

9.5.2 Priming from the Chromeleon Panel

1. Open the priming valve on the secondary pump head (see Figure 9-2) by turning it one-half turn counterclockwise.

   NOTE If the priming valve is opened too much, air is drawn through the valve and air bubbles can be seen exiting the waste line.

2. On the Chromeleon 7 ePanel Set or the Chromeleon 6.8 panel tabset, click the **Pump** tab.
3. **Gradient pump only:** Enter 100% for the channel (A, B, C, or D) to be primed.
4. Set the priming flow rate to the desired rate. The default rate for a capillary IC pump is 3.0 mL/min. The default rate for an analytical IC pump is 6.0 mL/min.
5. Click the **Prime** button on the **Pump** panel. A warning message asks you to verify that the purge (priming) valve is open. Click **Execute despite warnings** (Chromeleon 7) or **OK** (Chromeleon 6.8). Priming starts.

6. Prime the pump until all air is purged and no air bubbles can be seen exiting the waste line. Click the **Prime** button to stop priming.

   NOTE Priming will stop automatically after the number of seconds specified in the **Duration** box have elapsed. You can set the duration to a preferred value.

7. **Gradient pump only:** To prime additional eluent lines, select another eluent channel and repeat the priming procedure.
8. Close the priming valve by turning it clockwise. **Do not overtighten the priming valve.**

IMPORTANT **Do not use any tools to tighten the priming valve! Overtightening may destroy the cap seal. Open or close the priming valve only when the system pressure is down.**

9. Enter the flow rate required for your application.
10. **Gradient pump only:** Enter the required proportions of eluents A, B, C, and D on the **Pump** panel.
11. Turn on the pump flow.

    NOTE After starting the pump, wait at least 5 minutes (longer for flow rates below 1.0 mL/min) before beginning an analysis. This allows the DP/SP to stabilize the flow rate.

9.6 Replacing the Check Valves

A dirty check valve causes erratic flow rates and pressures; in addition, it may cause the pump to lose prime and/or be difficult to reprime. If a check valve leaks or is dirty, it should be replaced.

Capillary IC pumps and analytical IC pumps use different check valves. Verify that you have the correct check valve assembly for your pump type (see Table 9-2).

Pump Type	Check Valve Assembly	Part Number
Capillary IC	Inlet	044541
	Outlet	044540
Analytical IC	Inlet	045722
	Outlet	045721

Table 9-2. *DP/SP Check Valve Assemblies*

Before beginning, locate the 1/2-inch wrench (P/N 062336) in your pump ship kit:

Pump Ship Kit	Part Number
DP Ship Kit Dual Capillary	072112
DP Ship Kit Dual Analytical	062463
DP Ship Kit Capillary and Analytical	072111
SP Ship Kit Capillary or Analytical	063342

Additional items:

- Cleanroom gloves (lint-free, particle-free, and oil-free)
- 0.2 micron filtered, Class 10, isopropyl alcohol (IPA)
- 0.2 micron filtered, canned air duster (ITW Chemtronics Ultrajet® or equivalent)

9.6.1 Removing the Check Valves

1. Turn off the pump flow.
2. Begin monitoring the **Current Pressure** reading on the **Pump** panel on the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset. When the system pressure reaches zero, do the following:
   - Disconnect the pump from the software by clicking **Connected** on the **Pump** panel.
   - Press the **POWER** button on the front of the DP/SP for 2 seconds to turn off the pump.
3. Open the DP/SP door to access the mechanical components.
4. Five red Phillips screws are installed on the component mounting panel before shipment from the factory. Remove these screws, if present.
5. Use the handles on the component mounting panel to pull the panel forward until it reaches the stop.
6. To prevent contamination of pump parts, wear cleanroom gloves while disassembling the pump head.

IMPORTANT **Never disassemble the pump head with bare hands. Even minute particles of dust, dirt, etc., on the check valves or piston can contaminate the inside of the pump head and result in poor pump performance.**

7. The check valves are installed in the primary pump head (see Figure 9-3).

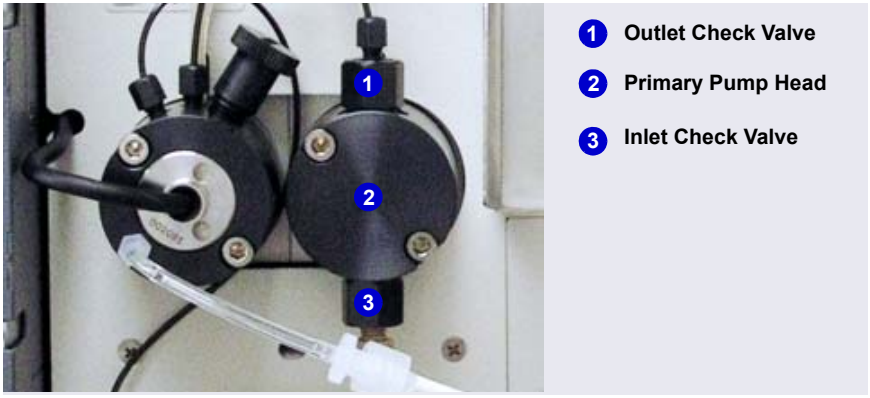
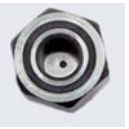


Figure 9-3. *DP/SP Check Valves*

8. Disconnect the tubing connections from the inlet and outlet check valves.
9. Loosen both check valve assemblies using the 1/2-inch wrench (P/N 062336).
10. Remove both check valve assemblies from the pump head.

9.6.2 Installing the New Check Valves

1. The *inlet* check valve assembly housing has a 1/4-28 port.



Inspect the new inlet check valve assembly to verify that the double-hole end of the cartridge (see Figure 9-4) is visible.

If the double-hole end is not visible, remove the cartridge from the housing and install it correctly.

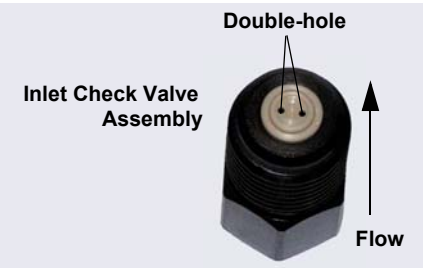


Figure 9-4. *Inlet Check Valve Assembly*

2. The *outlet* check valve assembly housing has a smaller, 10-32 port.

Inspect the new outlet check valve assembly to verify that the single-hole end of the cartridge is visible (see Figure 9-5).

If the single-hole end is not visible, remove the cartridge from the housing and install it correctly.

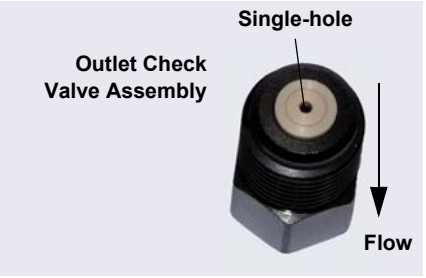


Figure 9-5. *Outlet Check Valve Assembly*

NOTE The pump cannot operate properly unless the cartridges are installed in their respective housings in the correct orientation. Liquid enters through the check valve in the large single hole and exits through the small double holes.

3. Before installing the inlet and outlet check valves, rinse the bottom of the check valve ports in the pump head with isopropyl alcohol and blow them clean using a 0.2 micron filtered, canned air duster. Inspect the bottom of each port for any particulate matter. If necessary, rinse and dry again until they are clean.
4. Install the inlet check valve assembly on the *bottom* of the primary pump head. Install the outlet check valve assembly on the *top* of the pump head.
5. Tighten the check valves fingertight, and then use the 1/2-inch wrench to tighten an additional one-quarter to one-half turn.

IMPORTANT **Overtightening may damage the pump head and check valve housing and crush the check valve seats.**

6. Push the component mounting panel back into the enclosure. Close the DP/SP door.
7. Press the **POWER** button on the front of the DP/SP to turn on the pump.
8. Reconnect the pump to the software by clicking **Connected** on the **Pump** panel.

9.7 Replacing Piston Seals

A defective piston seal allows leakage past the piston. This may cause unstable flow rates and baseline noise; in addition, it may make it difficult to prime the pump.

The piston seal replacement procedure consists of:

- Removing the pump head and piston (Section 9.7.1)
- Cleaning the piston (Section 9.7.2)
- Removing the main piston seal (Section 9.7.3)
- Removing the piston seal wash seal (Section 9.7.4)
- Installing new seals (Section 9.7.5)
- Reinstalling the piston and pump head (Section 9.7.6)

NOTE Capillary IC pumps and analytical IC pumps use different main piston seals and piston seal wash seals. Before continuing, verify that you have the correct seal for your pump type. Part numbers are shown on Figure 9-6 and Figure 9-7.

Before beginning, locate the following items in your pump ship kit:

- 3.0 mm hex key (P/N 062338)
- 10-32 fitting plugs (P/N 042772)
- 10 cc syringe (P/N 054578)
- Seal insertion tool (P/N 063675)

Pump Ship Kit	Part Number
DP Ship Kit Dual Capillary	072112
DP Ship Kit Dual Analytical	062463
DP Ship Kit Capillary and Analytical	072111
SP Ship Kit Capillary or Analytical	063342

Additional items:

- Cleanroom gloves (lint-free, particle-free, and oil-free)
- Small beaker
- ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5
- Methanol (optional)
- 0.2 micron filtered, Class 10, isopropyl alcohol (IPA)
- Lint-free paper towels (KIMWIPES® or equivalent)
- Large flat-blade screwdriver
- 0.2 micron filtered, canned air duster (ITW Chemtronics Ultrajet or equivalent)

9.7.1 Removing the Pump Head and Piston

1. Turn off the pump flow.
2. Begin monitoring the **Current Pressure** reading on the **Pump** panel on the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset. When the system pressure reaches zero, do the following:
   - Disconnect the pump from the software by clicking **Connected** on the **Pump** panel.
   - Press the **POWER** button on the front of the DP/SP for 2 seconds to turn off the pump.
3. Open the DP/SP door to access the mechanical components.
4. Five red Phillips screws are installed on the component mounting panel before shipment from the factory. Remove these screws, if present.
5. Use the handles on the component mounting panel to pull the panel forward until it reaches the stop.

6. To prevent contamination of pump parts, wear cleanroom gloves while disassembling and reassembling the pump head.

IMPORTANT **Never disassemble the pump head with bare hands. Even minute particles of dust, dirt, etc., on the check valves or piston can contaminate the inside of the pump head and result in poor pump performance.**

7. Disconnect all tubing connections to the pump head with the defective piston seal.
8. The primary and secondary pump heads have different components. When disassembling a pump head, refer to Figure 9-6 for a primary pump head or Figure 9-7 for a secondary pump head.

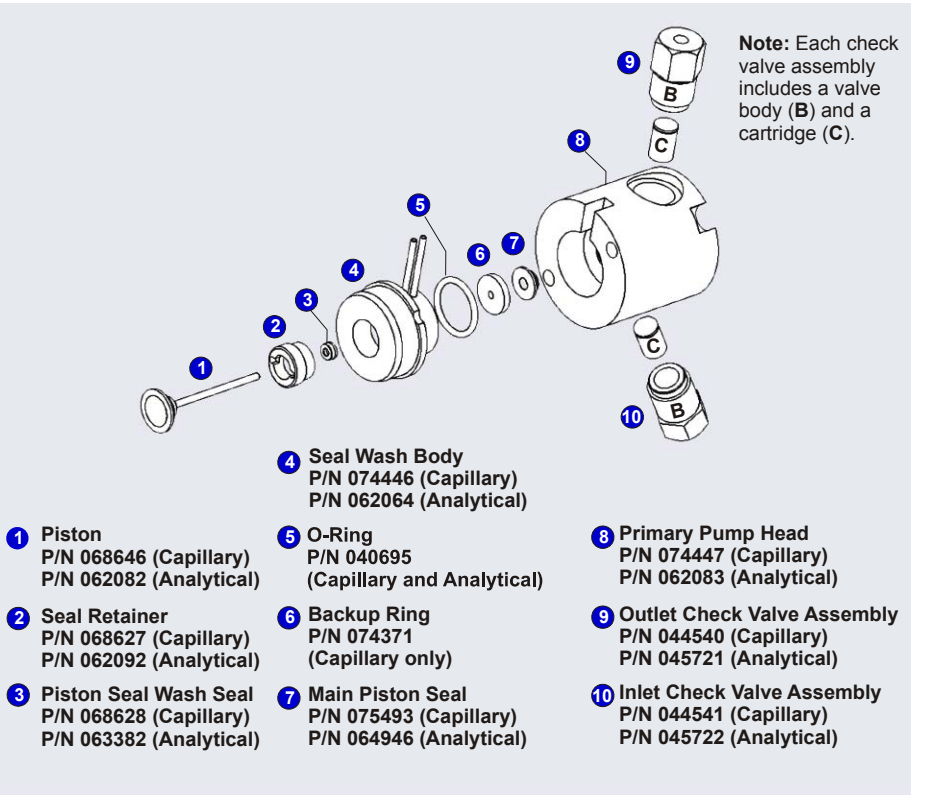


Figure 9-6. *DP/SP Pump: Primary Pump Head Assembly*

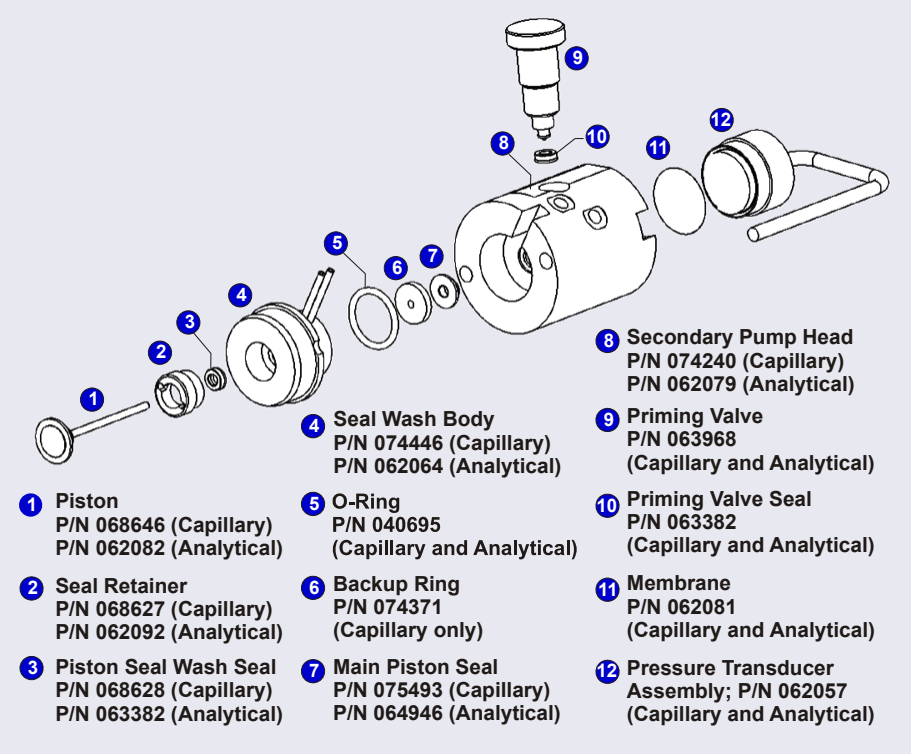


Figure 9-7. *DP/SP: Secondary Pump Head Assembly*

9. Using a 3.0 mm hex key (P/N 062338), loosen the two screws on the pump head with the defective seal. Remove the screws, and then carefully remove the head and place it on a clean surface.

10. Remove the seal wash body from the pump head. Or, if the seal wash body was not removed with the pump head in Step 9, pull it straight out of the pump mechanism now.

11. Pull the piston out of the pump mechanism.

    NOTE A magnet secures the piston in place. If the magnetic force makes the piston difficult to remove, tilt the piston to one side and then pull it out of the pump mechanism.

9.7.2 Cleaning the Piston

1. Place the piston in a beaker containing either ASTM Type I (18 megohm-cm) filtered and deionized water or methanol. Sonicate for several minutes.
2. After cleaning, rinse the piston thoroughly with ASTM Type I (18 megohm-cm) filtered and deionized water. Dry it with a lint-free paper towel.
3. Inspect the piston for signs of damage. If the piston is scratched or scored, replace it (see Section 9.8).

IMPORTANT **Even minute scratches or particles of dust, dirt, etc. on the check valves or piston can contaminate the inside of the pump head and result in poor pump performance.**

9.7.3 Removing the Main Piston Seal

1. If this is the *primary* pump head, insert a 10-32 fitting plug (P/N 042772) into the 10-32 outlet hole of the check valve nut.
2. If this is the *secondary* pump head, insert a 10-32 fitting plug (P/N 042772) into both the 10-32 inlet and outlet holes.
3. Using a 10 cc syringe (P/N 054578), inject a few drops of ASTM Type I (18 megohm-cm) filtered and deionized water through the main piston seal and into the piston cavity in the pump head.
4. Reinsert the piston approximately 3 mm (0.125 in) into the piston seal and press gently. The seal should pop out of the head and onto the piston.

IMPORTANT **Do not use a sharp tool (such as tweezers) to remove the piston seal. This will scratch the inside of the pump housing; these scratches will prevent a proper seal and cause leakage.**

5. If the piston seal was not removed in Step 4, follow these steps:
   a. Verify that the 10-32 fitting plugs in the inlet and outlet holes are tightened enough to prevent any leaks from the pump head.
   b. Fill the piston cavity with water and check for bubbles.
   c. If there are no bubbles, repeat Step 4.

9.7.4 Removing the Piston Seal Wash Seal

1. Remove the O-ring (P/N 040695) from the seal wash body. If this is a capillary pump, also remove the backup ring.
2. Follow these steps to remove the piston seal wash seal from the seal wash body:
   a. Using a large flat-blade screwdriver, remove the retainer (P/N 062092) for the seal from the seal wash body.
   b. Insert the piston into the seal wash body *from the O-ring side* and gently push the seal out of the retainer.

IMPORTANT **Do not use a sharp tool (such as tweezers) to remove the piston seal wash seal. This may scratch the seal and the inside of the pump housing; scratches will prevent a proper seal and cause leakage.**

9.7.5 Installing the Piston Seals and O-Ring

1. Follow these steps to reassemble the seal wash body:
   a. Place the seal wash body on a clean work surface.
   b. Slide the new seal wash seal, with the open side of the seal facing upward, onto the seal insertion tool (P/N 063675) (see Figure 9-8).

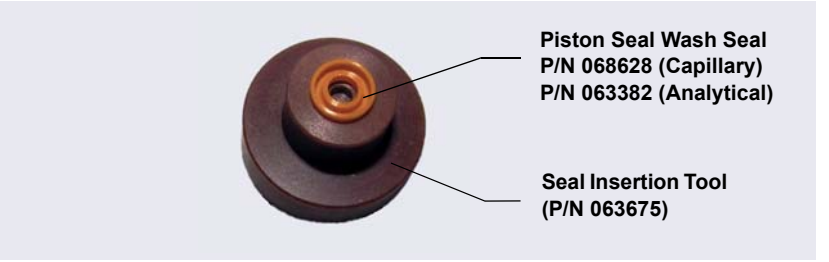


Figure 9-8. *Piston Seal Wash Seal and Seal Insertion Tool*

   c. Insert this end of the tool partway into the seal wash body. Make sure the tool is centered and does not rock back and forth. Then, press firmly on the tool and the seal wash body until they snap together.
   d. Remove the seal insertion tool from the seal wash body.

e. The seal wash seal is now partially installed. To complete the seal installation, place the retainer in the seal wash body and use the large flat-blade screwdriver to tighten the retainer.

f. Place the new O-ring (P/N 040695) on the seal wash body.

NOTE When replacing a piston seal, always replace the O-ring, also. This will prevent leaks.

g. If this is a capillary IC pump, place the new backup ring (P/N 074371) on the seal wash body.

2. Rinse the new main piston seal (P/N 075493, for capillary pump; P/N 064946, for analytical pump) with isopropyl alcohol (IPA) or dip it into a container of IPA. (The seal is easier to install when it is moist.)
3. Insert the piston through the seal wash assembly, and then through the new main piston seal.
4. Make sure the piston seal is centered.

IMPORTANT **If the piston seal is not centered, applying pressure to it in Step 7 will damage the seal and make it unusable.**

5. Place the front of the pump head, flat side down, on a clean work surface.

   Make sure the open side of the piston seal faces away from the retainer for the seal wash seal.
6. Using IPA, rinse inside the pump head cavity where the seal will be installed. Blow inside the cavity to dry it using the 0.2 micron filtered, canned air duster. Inspect the cavity for any particulate matter. If necessary, rinse and dry again, until the cavity is clean. Fill the cavity with ASTM Type I (18 megohm-cm) filtered and deionized water.
7. Place the components on the pump head and *gently* press the housing until the piston seal snaps into place.

   When pressing the seal in place, ensure that the piston is free to move out, to relieve the pressure in the pump head during seal installation.

IMPORTANT **Do not use a sharp tool (such as tweezers) to install the piston seal. This will scratch the seal and the inside of the pump housing; these scratches will prevent a proper seal and cause leakage.**

8. Remove the 10-32 fitting plugs from the pump head.

9.7.6 Reinstalling the Piston and Pump Head

1. Slide the piston *partway* into the pump head; approximately 6 mm (1/4 in) of the sapphire part of the piston should extend from the head.
2. Place the pump head back on the pump.
3. Reinstall the screws in the pump head. Using the 3.0 mm hex key (P/N 062338), tighten the screws just until they come into contact with the pump head. Then, tighten the screws another one-quarter to one-half turn, one-eighth of a turn at a time.
4. Reconnect all tubing connections to the pump head. Tighten connections fingertight, and then tighten an additional one-quarter turn only.
5. Push the component mounting panel back into the enclosure. Close the DP/SP door.
6. Press the **POWER** button on the front of the DP/SP to turn on the pump.
7. Reconnect the pump to the software by clicking **Connected** on the **Pump** panel.
8. Turn on the pump flow.

9.8 Replacing the Piston

If a new piston seal leaks (assuming that the pump head is tight), it indicates that the piston is dirty, scratched, or broken, and should be replaced.

The piston replacement procedure consists of:

- Removing the pump head and the old piston (see Section 9.8.1)
- Reinstalling a new piston (see Section 9.8.2)
- Reinstalling the pump head (see Section 9.8.3)

NOTE Capillary IC pumps and analytical IC pumps use different pistons. Before continuing, verify that you have the correct piston for your pump type: P/N 068646 (for capillary), P/N 062082 (for analytical).

Before beginning, locate the 3.0 mm hex key (P/N 062338) in your pump ship kit:

Pump Ship Kit	Part Number
DP Ship Kit Dual Capillary	072112
DP Ship Kit Dual Analytical	062463
DP Ship Kit Capillary and Analytical	072111
SP Ship Kit Capillary or Analytical	063342

Additional items:

- Cleanroom gloves (lint-free, particle-free, and oil-free)
- ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5

9.8.1 Removing the Pump Head and Piston

When disassembling and reassembling the pump head, refer to Figure 9-6 (primary pump head) or Figure 9-7 (secondary pump head).

1. Turn off the pump flow.
2. Begin monitoring the **Current Pressure** reading on the **Pump** panel on the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset. When the system pressure reaches zero, do the following:
   - Disconnect the pump from the software by clicking **Connected** on the **Pump** panel.
   - Press the **POWER** button on the front of the DP/SP for 2 seconds to turn off the pump.
3. Open the DP/SP door to access the mechanical components.
4. Five red Phillips screws are installed on the component mounting panel before shipment from the factory. Remove these screws, if present.
5. Use the handles on the component mounting panel to pull the panel forward until it reaches the stop.

6. To prevent contamination of pump parts, wear cleanroom gloves while disassembling the pump head.

IMPORTANT **Never disassemble the pump head with bare hands. Even minute particles of dust, dirt, etc., on the check valves or piston can contaminate the inside of the pump head and result in poor pump performance.**

7. Disconnect all tubing connections to the pump head with the damaged piston.
8. Using a 3.0 mm hex key (P/N 062338), loosen the Allen screws on the pump head with the damaged piston. Remove the Allen screws, and then carefully remove the head and place it on a clean surface.
9. If the piston was not removed with the pump head in Step 8, remove the piston now by pulling it straight out of the pump mechanism.

   NOTE A magnet secures the piston in place. If the magnetic force makes the piston difficult to remove, tilt the piston to one side and then pull it out of the pump mechanism.

10. If the piston is broken, be sure to remove all broken pieces. If necessary, flush the pump head with ASTM Type I (18 megohm-cm) filtered and deionized water.

9.8.2 Reinstalling the New Piston

Slide the new piston (P/N 068646, for capillary; P/N 062082, for analytical) *partway* into the pump head; approximately 6 mm (1/4 in) of the sapphire part of the piston should extend from the head.

9.8.3 Reinstalling the Pump Head

1. Place the pump head back on the pump.
2. Reinstall the screws in the pump head. Using the 3.0 mm hex key (P/N 062338), tighten the screws just until they come into contact with the pump head. Then, tighten the screws another one-quarter to one-half turn, one-eighth of a turn at a time.

3. Reconnect all tubing connections to the pump head. Tighten connections fingertight, and then tighten an additional one-quarter turn only.
4. Push the component mounting panel back into the enclosure, using the handle in the center of the panel. Close the DP/SP door.
5. Press the **POWER** button on the front of the DP/SP to turn on the pump.
6. Reconnect the pump to the software by clicking **Connected** on the **Pump** panel.
7. Turn on the pump flow.

9.9 Replacing the Piston Seal Wash Tubing

Check the piston seal wash tubing weekly for crimping or blockage and replace as needed.

1. Turn off the pump flow.
2. Five red Phillips screws are installed on the component mounting panel before shipment from the factory. Remove these screws, if present.
3. Open the DP/SP door and then use the handles on the component mounting panel to pull the panel forward until it reaches the stop.
4. Remove the old tubing from the peristaltic pump (see Figure 9-9) as follows:
    a. Lift the lever up and to the right and hold it in that position with one hand.
    b. With your other hand, pull the PharMed tubing away from the rotor and out of the lower notch on the left side of the mounting plate.
    c. Release the lever.

d. Pull on the fitting slightly to remove the PharMed tubing from the upper notch on the pump mounting plate.

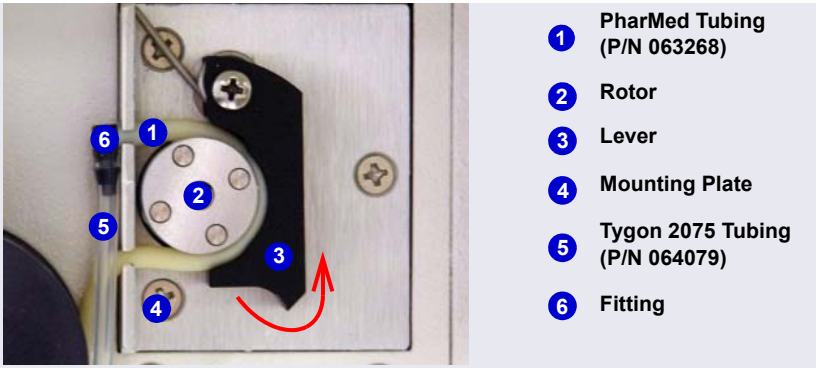


Figure 9-9. *Peristaltic Pump for Seal Wash System*

5. Pull off the PharMed and Tygon 2075 tubing from the fitting. Save the fitting.
6. Pull off all seal wash tubing from the seal wash reservoir and the primary and secondary pump heads(see Figure 9-10).
7. Cut three new pieces of Tygon 2075 tubing (0.15 cm (0.060 in) ID; P/N 064079) and one piece of PharMed tubing (0.159 cm (0.0625 in) ID; P/N 063268) to the same lengths as the tubing just removed. The tubing is included in the pump ship kit:

Pump Ship Kit	Part Number
DP Ship Kit Dual Capillary	072112
DP Ship Kit Dual Analytical	062463
DP Ship Kit Capillary and Analytical	072111
SP Ship Kit Capillary or Analytical	063342

8. Connect the new tubing pieces to the seal wash reservoir and pump heads (see Figure 9-10).
9. Push the tubing onto the fitting that was removed in Step 5.
10. Connect the PharMed tubing to the peristaltic pump as follows:
    a. Push the tubing into the lower notch on the pump mounting plate.
    b. Lift the lever to the right and hold it in that position with one hand.
    c. With your other hand, wind the tubing around the rotor.
    d. Release the lever.

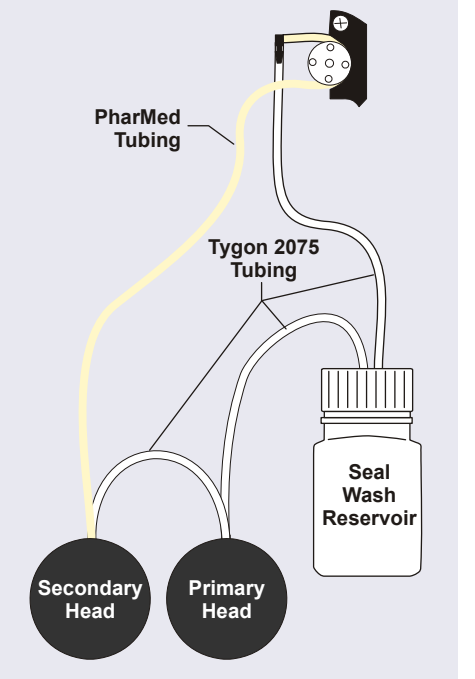


Figure 9-10. *Piston Seal Wash Tubing Connections*

    e. Pull on the fitting slightly to slide the tubing into the upper notch.
    f. Make sure there is no slack in the tubing. If necessary, lift the lever again, adjust the tubing around the rotor and through the lower notch to remove any slack, and release the lever.
11. Push the component mounting panel back into the enclosure. Close the DP/SP door.
12. Turn on the pump flow.

9.10 Replacing the DP/SP Priming Valve Knob Seal

Replace the seal in the priming valve knob if there is leakage around the valve threads when the valve is open or if the waste port leaks when the valve is closed.

1. Turn off the pump flow.
2. Begin monitoring the **Current Pressure** reading on the **Pump** panel on the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset. When the system pressure reaches zero, do the following:
   - Disconnect the pump from the software by clicking **Connected** on the **Pump** panel.
   - Press the **POWER** button on the front of the DP/SP for 2 seconds to turn off the pump.
3. Open the front door of the DP/SP.
4. Five red Phillips screws are installed on the component mounting panel before shipment from the factory. Remove these screws, if present.
5. Use the handles on the component mounting panel to pull the panel forward until it reaches the stop.
6. The priming valve knob is located on the secondary pump head (see Figure 9-11). To remove the knob, turn it counterclockwise all the way and then pull it straight off the pump head.

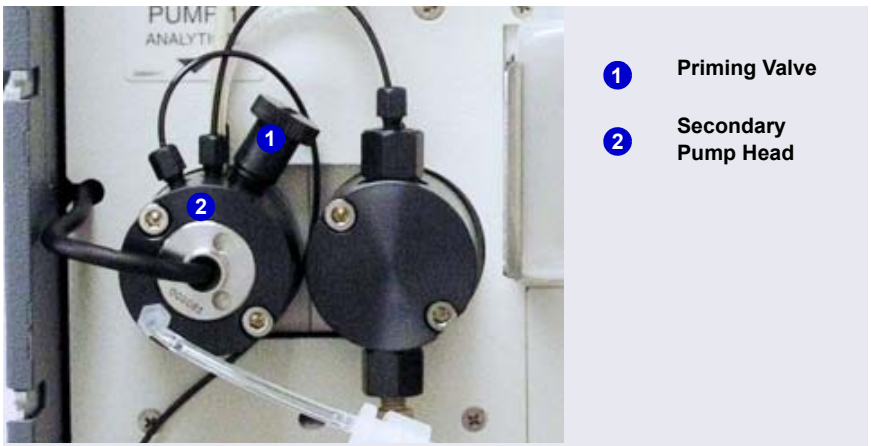


Figure 9-11. *DP/SP Priming Valve*

7. Pull the old seal off the end of the priming valve knob.
8. Hold the new seal (P/N 063382) with the groove in the priming valve seal facing away from the knob (see Figure 9-12). Carefully slide the seal onto the knob; avoid scratching or nicking the sides.

IMPORTANT **Do not use a sharp tool (such as tweezers) to install the seal. This may scratch the seal and the surface of the priming valve knob. These scratches will prevent a proper seal and cause leakage.**

Figure 9-12. *Replacing the Priming Valve Seal*

9. Insert the priming valve knob into the secondary pump head, turn the knob clockwise, and tighten fingertight.
10. Push the component mounting panel back into the enclosure. Close the DP/SP door.
11. Press the **POWER** button on the front of the DP/SP to turn on the pump.
12. Reconnect the pump to the software by clicking **Connected** on the **Pump** panel.
13. Turn on the pump flow.

9.11 Changing the DP/SP Main Power Fuses

1. Turn off the pump flow.
2. Begin monitoring the **Current Pressure** reading on the **Pump** panel on the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset. When the system pressure reaches zero, do the following:
   - Disconnect the pump from the software by clicking **Connected** on the **Pump** panel.

- Press the **POWER** button on the front of the DP/SP for 2 seconds to turn off the pump.

3. Turn off the main power switch on the rear panel of the pump (see Figure 2-7).
4. Disconnect the main power cord from both its source and from the rear panel of the pump.

HIGH VOLTAGE—Disconnect the main power cord from its source and also from the rear panel of the pump.

HAUTE TENSION—Débranchez le cordon d'alimentation principal de sa source et du panneau arrière du pump.

HOCHSPANNUNG—Ziehen Sie das Netzkabel aus der Steckdose und der Netzbuchse auf der Rückseite der Pumpe.

5. The fuse cartridge is located next to the main power switch (see Figure 9-13). Use a small screwdriver to remove the fuse cartridge.
6. Replace the two fuses with new 2 A IEC 60127-2 slow-blow fuses (P/N 954773). Thermo Fisher Scientific recommends always replacing *both* fuses.
7. Reinstall the fuse cartridge.
8. Reconnect the main power cord to its source and to the DP/SP.

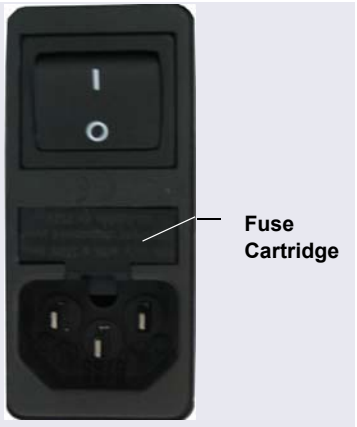


Figure 9-13. *DP/SP Fuse Cartridge*

9. Turn on the main power switch.
10. Press the **POWER** button on the front of the DP/SP to turn on the pump.
11. Reconnect the pump to the software by clicking **Connected** on the **Pump** panel.
12. Turn on the pump flow.

9.12 Replacing Tubing and Fittings

Capillary IC

9.12.1 Tubing and Fittings for Capillary IC EG Channels

Table 9-4 lists the tubing and fittings used to plumb an EG channel for capillary IC.

Tubing/Fitting Size and Type	Color	P/N	Use to connect...
Tubing assembly, precision cut, 0.062 mm (0.0025 in) ID PEEK, 61 cm (24 in)	Blue	072203	CR-TC **ELUENT OUT** to EG degas **ELUENT IN**
Tubing assembly, precision cut, 0.062 mm (0.0025 in) ID PEEK, 18 cm (7 in)	Blue	072204	CR-TC **ELUENT IN** to EGC **OUT**
Tubing assembly, 0.25 m (0.010 in) ID PEEK, 64 cm (25 in)	Black	072224	EG degas **REGEN OUT** to CR-TC **REGEN IN**
Tubing assembly, 1.58 mm (0.062 in) ID ETFE, 2.1 m (7 ft)	Clear	072225	CR-TC **REGEN OUT** to waste
10 mm (0.39 in) ID polyethylene	Colorless	055075	Drip tray drain hose
High-pressure 10-32 fitting bolt	Blue	074449	Use high-pressure fittings for: • Pump outlet to EGC **IN** • EGC **OUT** to CR-TC **ELUENT IN** • CR-TC **ELUENT OUT** to EG degas **ELUENT IN**
High-pressure 10-32 ferrule, double-cone	Blue	074372	Use with high-pressure fitting bolts

Table 9-3. *Tubing and Fittings for a Capillary IC EG Channel*

Tubing/Fitting Size and Type	Color	P/N	Use to connect...
10-32 fitting bolt 10-32 ferrule, double-cone	Black	043275 043276	All other tubing connections

Table 9-3. *Tubing and Fittings for a Capillary IC EG Channel*

Capillary IC

Notes for capillary IC channels:

- Do not cut the 0.062 mm (0.0025 in) ID blue PEEK tubing used for capillary IC connections. This tubing must be cut at the factory using a specialized precision cutter. This ensures good chromatographic results. If you need to replace any tubing of this type, order the appropriate precision cut tubing assembly listed in Table 9-3.
- When replacing capillary tubing, make sure the ferrule and fitting bolt are at least 2 mm (0.1 in) from the end of the tubing before you insert the tubing into the port. Do not position the ferrule and fitting bolt flush with the end of the tubing. For detailed connection instructions, see Section 9.1.
- For tightening requirements for the high-pressure fitting bolt (P/N 074449) and ferrule (P/N 074373), see Section 9.2.
- For tightening requirements for the 10-32 fitting bolt (P/N 043275) and ferrule (P/N 043276), refer to *Installation of Dionex Liquid Line Fittings* (Document No. 031432). The manual is on the Thermo Scientific Reference Library DVD (P/N 053891).

Analytical IC 9.12.2 Tubing and Fittings for Analytical IC EG Channels

Table 9-4 lists the tubing and fittings used to plumb an EG channel for analytical IC.

Tubing/Fitting Size and Type	Color	P/N	Used to connect...
0.25 mm (0.010 in) ID PEEK tubing	Black	042690 (1 in)	• EGC to pump • EGC to CR-TC • RFIC Eluent Degasser to injection valve • RFIC Eluent Degasser to eluent reservoir
1.6 mm (0.062 in) ID PTFE tubing	Colorless	014157 (1 in)	• RFIC Eluent Degasser **REGEN IN** to CR-TC • RFIC Eluent Degasser **REGEN OUT** to waste
1.58 mm (0.062 in) ID polyurethane tubing	Colorless	047203	EGC gas vent line
10 mm (0.39 in) ID polyethylene tubing	Colorless	055075	Drip tray drain hose
1/8 in fitting bolt 1/8 in ferrule	Tan Yellow	052267 048949	The suppressor **REGEN OUT** port and the eluent reservoirs
10-32 fitting bolt 10-32 ferrule, double-cone	Black Tan	043275 043276	All other tubing connections

Table 9-4. *Tubing and Fittings for an Analytical IC EG Channel*

Analytical IC **Notes for analytical IC channels:**

- For ferrule fitting tightening requirements, refer to *Installation of Dionex Liquid Line Fittings* (Document No. 031432). The manual is on the Thermo Scientific Reference Library DVD (P/N 053891).
- For an analytical IC channel, use a tubing cutter to cut tubing to the required length. Make sure the cut is at a right angle to the length of the tubing and there are no nicks or burrs on the end. A tubing cutter (P/N 049584) is included in the DC Ship Kit (P/N 072011). Refer to the instructions provided with the cutter.

9.13 Isolating a Restriction in the Liquid Lines

A restriction in the liquid plumbing will cause excessive system backpressure.

1. Begin pumping eluent through the system (including the columns) at the flow rate normally used.
2. Work backward through the system, beginning at the flow cell exit. One at a time, loosen each fitting and observe the pressure. The connection at which the pressure drops abnormally indicates the point of restriction. If the EGC is the source of the high backpressure, replace the outlet frit as instructed in the EGC manual. The manual is included on the Thermo Scientific Reference Library DVD (P/N 053891).
3. If the restriction has caused such high pressure that the system cannot be operated, you must work forward through the system, adding parts one at a time, until an abnormal pressure increase (and hence, the restriction) is found.

9.14 Replacing the EGC

Replace the EGC when the cartridge is expended or when it leaks. Refer to Table 2-2 for a list of the EGC models that can be used with the Dionex ICS-5000 Eluent Generator.

Analytical IC

Analytical IC systems require EGC III cartridges. Previous versions of EGC are not compatible with the Dionex ICS-5000 Eluent Generator.

The EGC replacement procedure consists of:

- Removing the old EGC (see Section 9.14.1)
- Disposing of the old EGC (see Section 9.14.2)
- Installing and conditioning a new capillary EGC (see Section 9.14.4)

  –or–

- Installing and conditioning a new analytical EGC (see Section 9.14.5)

The EGC contains one of the following: a corrosive base (KOH, LiOH, or NaOH), a corrosive acid (MSA), or a concentrated K_2CO_3 solution. Wear protective eyewear and gloves when handling the cartridge.

MISE EN GARDE

La cartouche d'EGC contient un de ce qui suit: une base corrosive (KOH, LiOH, ou NaOH), un acide corrosif (MSA), ou une solution concentrée de K_2CO_3. Porter des lunettes et des gants protectives en manipulant la cartouche.

VORSICHT

Die EGC-Kartusche enthält eine korrodierende Base (KOH, LiOH oder NaOH), eine korrodierende Säure (MSA) oder eine konzentrierte K_2CO_3-Lösung. Tragen Sie daher beim Umgang mit Kartusche eine Schutzbrille und Handschuhe.

9.14.1 Removing the Old EGC

1. Turn off the pump flow. (This turns off the power to the EGC and the suppressor, also.)
2. Open the front door of the EG.
3. Pull the tray forward until it reaches the stop.
4. Twist the ring on the EGC electrical cable counter-clockwise to loosen it, and then pull the cable straight out of the **EGC 1** (or **EGC 2**) bulkhead connector (see Figure 9-14).

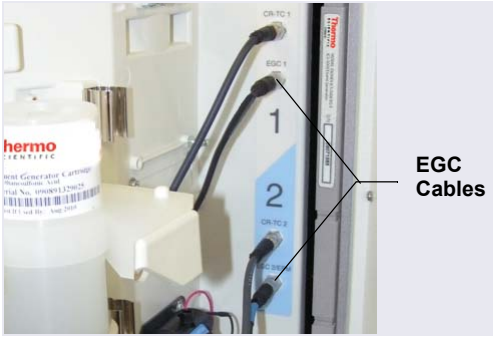


Figure 9-14. *EGC Cables*

5. Close or cap the EGC vent opening to prevent leakage when you turn over the cartridge in Step 7.

Capillary IC

If you are removing a capillary EGC, tighten the vent fitting on the top of the EGC (see Figure 9-15).

Figure 9-15. *Capillary EGC Vent Fitting*

Analytical IC

If you are removing an analytical EGC:

a. Remove the **VENT** line from the EGC by unscrewing the 10-32 luer adapter (see Figure 9-16).

NOTE If necessary, use a wrench to hold the luer adapter in place while unscrewing the vent line.

Figure 9-16. *Analytical EGC Vent Line*

b. Locate the 10-32 plug (P/N 053981) removed from the EGC vent opening during installation. Install the plug into the vent opening.

6. Lift the EGC straight up and off the cartridge holder.

7. Turn the EGC upside down and place it on the EG drip tray (see Figure 9-17). This is the "service position" for the cartridge.

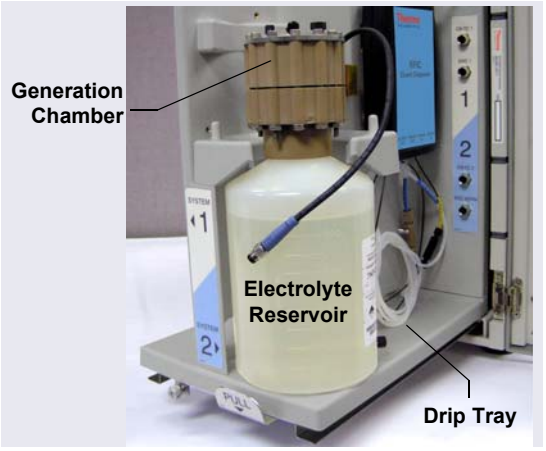


Figure 9-17. *EGC in the Service Position (Analytical Version Shown)*

8. Disconnect the **EGC IN** and **EGC OUT** lines from the **INLET** and **OUTLET** ports on the EGC.

9.14.2 Disposing of the Old EGC

If the EGC is expended, follow these steps to dispose of it:

1. Hold the cartridge with the eluent generation chamber on top. Unscrew the eluent generation chamber from the electrolyte reservoir and pour the remaining electrolyte solution into an appropriate hazardous waste container.

   NOTE Refer to the Material Safety Data Sheet (MSDS) shipped with the EGC for the chemical description.

2. Rinse the electrolyte reservoir and membranes *three times* with ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5. Rinsing should render the reservoir and membranes nonhazardous; however, check your local, state, and federal regulatory agency regulations for proper disposal.

9.14.3 Storing an Old EGC

If the EGC is not expended, follow these steps to prepare the cartridge for storage:

1. Plug all fittings. Tighten the vent fitting (capillary EGC) or cap the vent port (analytical EGC). This will prevent the evaporation of water in the electrolyte reservoir.
2. Store the cartridge in an upright position (with the electrolyte reservoir at top) at 4 to 40°C (39 to 104°F) until its next use. The original shipping container is ideal for storage. Before resuming operation, condition the cartridge. For instructions, see Section 9.14.4 (for a capillary EGC) or Section 9.14.5 (for an analytical EGC).

Capillary IC If you are replacing a capillary EGC, go on to Section 9.14.4.

Analytical IC If you are replacing an analytical EGC, go on to Section 9.14.5.

Capillary IC

9.14.4 Installing and Conditioning a New Capillary EGC

Figure 9-18 shows the EG flow schematic for a capillary IC system. Refer to this figure when performing EGC and CR-TC service procedures in a capillary IC system.

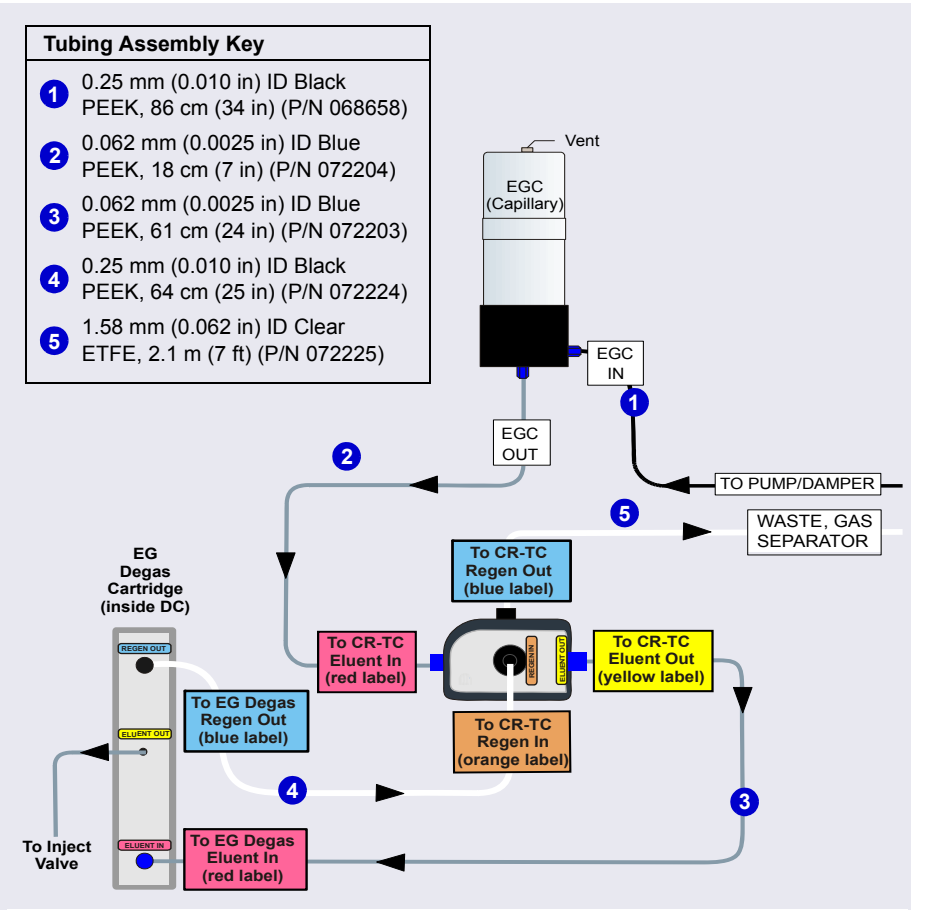


Figure 9-18. *EG Flow Schematic Example for Capillary IC Systems*

Capillary IC

Flushing the Capillary EGC

1. Remove the new EGC from the shipping container.

NOTE Save the shipping container; it may be required for storage or disposal of the EGC.

2. Verify that the vent fitting on top of the EGC is tightened.
3. Turn the cartridge upside down and place it on the EG drip tray.
4. Remove the plugs from the **INLET** and **OUTLET** fittings on the eluent generation chamber.
5. Locate the 38 cm (15 in) piece of 0.025 mm (0.001 in) ID tan PEEK tubing (P/N 074582) in the EG Ship Kit (P/N 072047).
6. Connect this line to the EGC **INLET** port and connect the other end to the **EGC IN** line from the pump pulse damper (see Figure 9-19). This is a temporary connection, to provide backpressure during the EGC setup procedure.
7. Connect a piece of 0.25 mm (0.010 in) ID black PEEK tubing to the EGC **OUTLET** port. Direct the other end of the tubing to waste. This is a temporary connection.

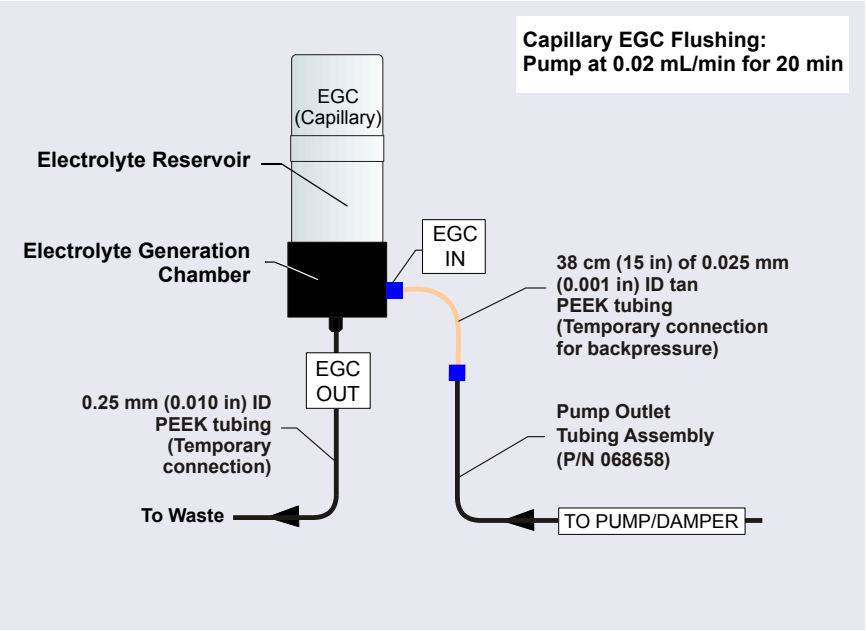


Figure 9-19. *Flow Schematic for Flushing the Capillary EGC*

8. Slide the EGC (with the electrolyte reservoir on top) into the cartridge holder (see Figure 9-20).

Figure 9-20. *Capillary EGC Installed on Holder*

9. Push the EGC electrical cable firmly into the **EGC 1** (or **EGC 2**) bulkhead connector (see Figure 9-14). Twist the ring on the cable connector fingertight to secure it.
10. Unscrew the fitting on the top of the EGC a few turns to vent the EGC.

IMPORTANT **To ensure proper ventilation, always loosen the fitting on the top of the capillary EGC before operation.**

11. On the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset, select the following settings:
    a. **DC** panel: Verify that the suppressor **Mode** is off.
    b. **EG** panel: Verify that the CR-TC is off.

IMPORTANT **To avoid damaging the suppressor and CR-TC, always turn them off before flushing the EGC. The pump flow is on during flushing; however, no flow reaches the suppressor or CR-TC.**

    c. **Pump** panel: Set the flow rate to 0.02 mL/min. This turns on the pump flow, also.
12. Flush the capillary EGC for 20 minutes and then turn off the pump flow.
13. Disconnect the temporary tubing from the EGC **OUTLET** port.

Capillary IC

Conditioning the Capillary EGC

1. Use a high-pressure (blue) fitting bolt and ferrule to connect the **EGC OUT** line from the **ELUENT IN** port of the CR-TC to the EGC **OUTLET** port (see Figure 9-21).
2. Disconnect the lines from the **ELUENT OUT** and **REGEN IN** port of the CR-TC.
3. Connect a piece of 0.25 mm (0.010 in) ID PEEK tubing between the ports. This is a temporary connection.

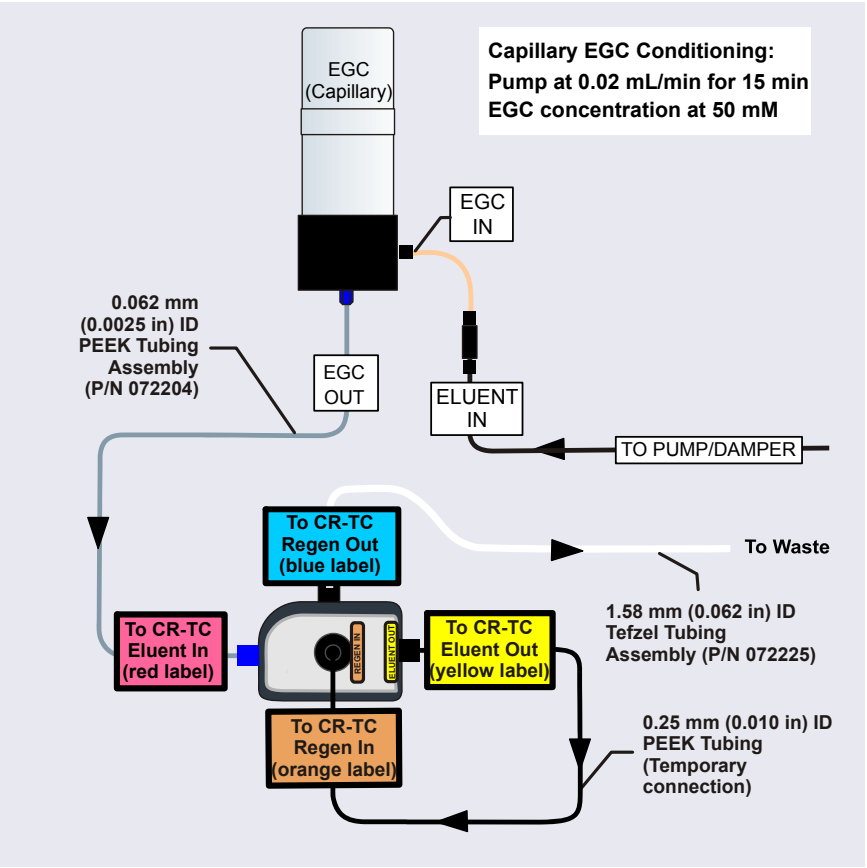


Figure 9-21. *Flow Schematic for Conditioning the Capillary EGC*

4. Verify that the suppressor **Mode** is off.

5. Set the pump flow rate to 0.02 mL/min.

IMPORTANT **To avoid damaging the suppressor, always turn it off before conditioning the EGC. The pump flow is on during conditioning; however, no flow reaches the suppressor.**

6. Set the EGC concentration to 50 mM and turn on the EGC and CR-TC power.
7. Condition the EGC for 15 minutes.
8. Turn off the EGC and CR-TC power.
9. Turn off the pump flow.
10. Remove the backpressure tubing from the **EGC IN** line.
11. Use a high-pressure (blue) fitting to connect the **EGC IN** line to the EGC **INLET** port.
12. Disconnect the temporary tubing from the **ELUENT OUT** and **REGEN IN** ports of the CR-TC.
13. Reconnect the lines to the **ELUENT OUT** and **REGEN IN** ports of the CR-TC that were disconnected in Step 2.

9.14.5 Installing and Conditioning a New Analytical EGC

Analytical IC

Figure 9-22 shows the EG flow schematic for an analytical IC system. Refer to this figure when performing EGC and CR-TC service procedures in an analytical IC system.

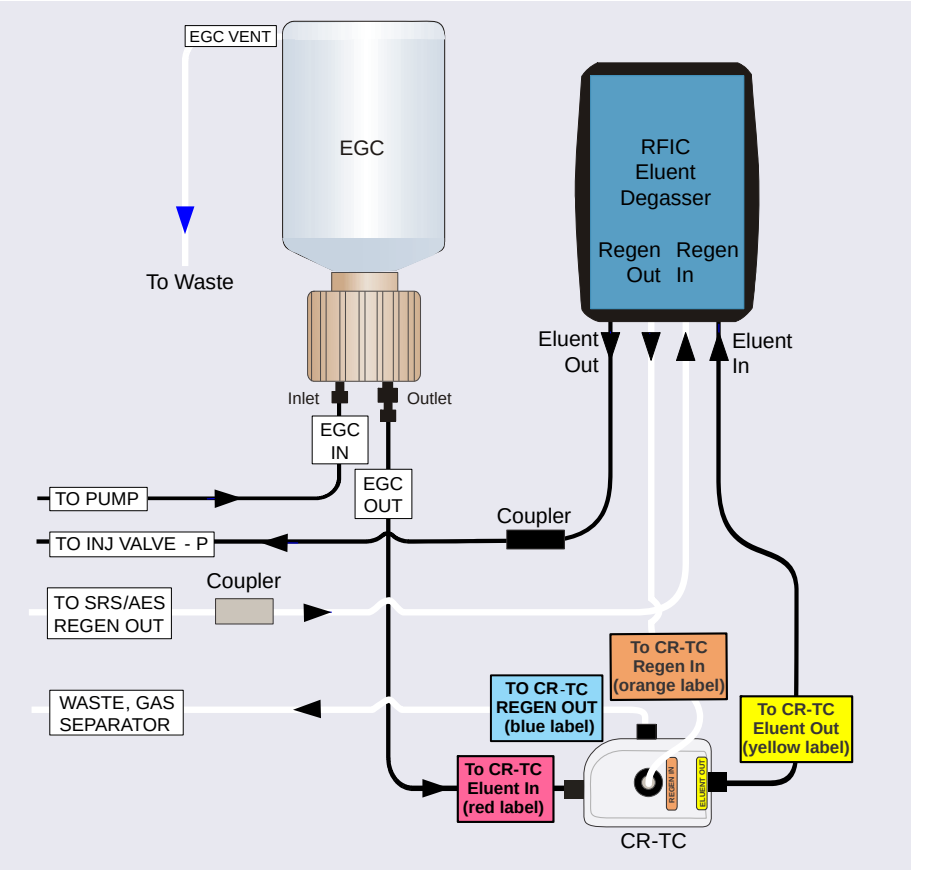


Figure 9-22. *EG Flow Schematic Example for Analytical IC Systems*

Installing the Analytical EGC

1. Remove the new EGC from the shipping container.

   NOTE Save the shipping container; it may be required for storage or disposal of the EGC.

2. Verify that a plug is installed in the vent port. This will prevent leakage from the vent opening when you turn over the cartridge.
3. Turn the cartridge upside down and place it on the EG drip tray in the service position (see Figure 9-17).
4. Remove the plugs from the **INLET** and **OUTLET** fittings on the eluent generation chamber.
5. Connect the **EGC IN** line from the pump to the EGC **INLET** port.
6. Locate the yellow 0.5 mL/min, 7 MPa (1000 psi) backpressure coil (P/N 053765) in the EG Ship Kit (P/N 072047).
7. Connect one end of the backpressure coil to the EGC **OUTLET** port (see Figure 9-23); leave the other end of the coil unconnected. This is a temporary connection.

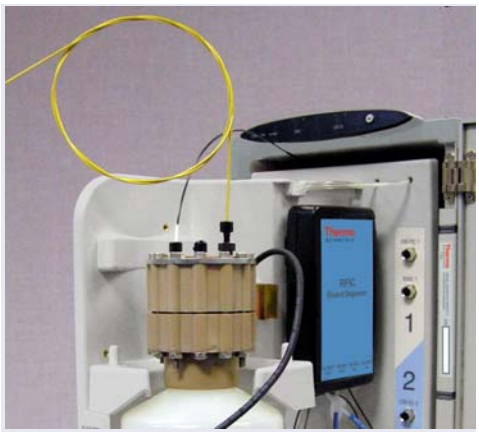


Figure 9-23. *Analytical EGC Outlet Connection for Conditioning Procedure*

8. While holding the EGC right-side up (with the electrolyte reservoir on top), shake the cartridge vigorously and tap it with the palm of your hand 10 to 15 times. Make sure any bubbles trapped in the eluent generation chamber are dislodged.

9. Slide the EGC (with the electrolyte reservoir on top) into the holder in the EG (see Figure 9-24).

Figure 9-24. *Analytical EGC Installed on Holder*

10. Push the EGC electrical cable firmly into the **EGC 1** (or **EGC 2**) bulkhead connector (see Figure 9-14). Twist the ring on the cable connector fingertight to secure it.
11. Remove the 10-32 plug from the EGC vent opening. Install a 10-32 luer adapter in the vent opening.
12. Connect the luer adapter and **VENT** line removed from the old cartridge to the vent opening in the new cartridge (see Figure 9-16).
13. Place the 10-32 plug removed from the vent opening in a safe place for storage. The 10-32 plug is required for shipping or storing the cartridge.

IMPORTANT **To ensure proper ventilation, always connect the vent line to the analytical EGC before operation.**

Analytical IC Conditioning the Analytical EGC

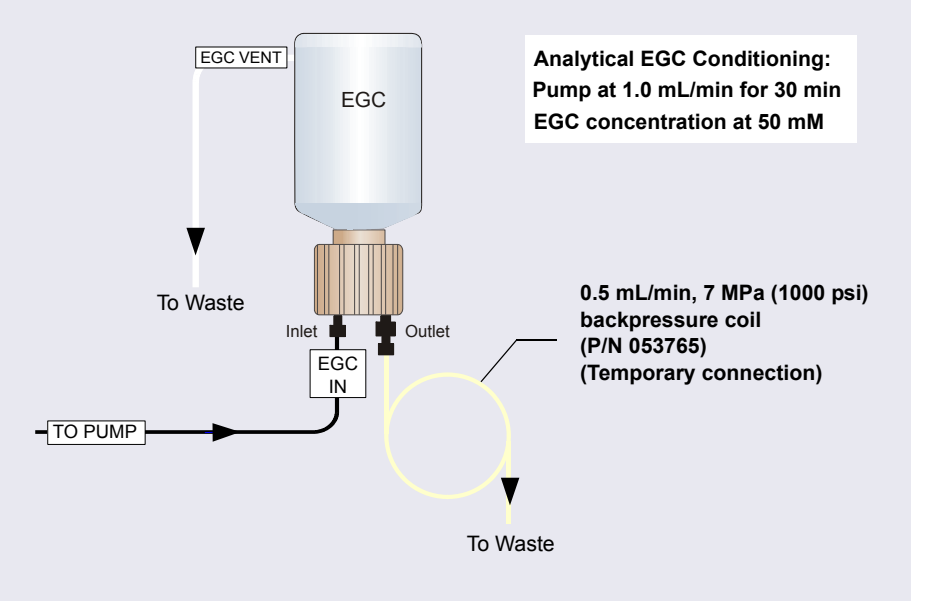


Figure 9-25. *Flow Schematic for Conditioning an Analytical EGC*

1. Set a small temporary waste container (for example, a beaker) next to the EG. Direct the yellow backpressure coil from the EGC **OUTLET** port to the waste container. The backpressure must be at least 1.4 MPa (200 psi).
2. On the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset, select the following settings:
   a. **DC** panel: Verify that the suppressor **Mode** is off.
   b. **EG** panel: Verify that the CR-TC is off.

IMPORTANT **To avoid damaging the suppressor and CR-TC, always turn them off before conditioning the EGC. The pump flow is on during conditioning; however, no flow reaches the suppressor or CR-TC.**

   c. **Pump** panel:
      - **Gradient pump only:** Select the correct eluent channel (A, B, C, or D).
      - **All pumps:** Set the flow rate to 1.0 mL/min. This turns on the pump flow, also.

d. **EG** panel: Enter 50 mM in the **Target Concentration** field. This turns on the power to the EGC, also.

e. Condition the analytical EGC for 30 minutes.

3. Turn off the EGC and CR-TC power.
4. Turn off the pump flow.

Analytical IC

Completing the Analytical EGC Installation

1. Twist the ring on the EGC electrical cable counterclockwise to loosen it, and then pull the cable straight out of the **EGC 1** (or **EGC 2**) bulkhead connector.
2. Remove the backpressure tubing from the waste container and remove the waste container.
3. Replace the 10-32 plug in the EGC vent opening.
4. Lift the EGC out of the holder, turn it upside down, and place it on the drip tray in the service position (see Figure 9-17).
5. Disconnect the backpressure coil from the EGC **OUTLET** port.
6. Connect the **EGC OUT** line to the **OUTLET** port.
7. Turn the EGC right-side up, and check for bubbles in the eluent generation chamber. If necessary, shake and tap the cartridge to remove bubbles.
8. Install the EGC in the holder. Remove the 10-32 plug from the vent opening and reinstall the luer adapter and vent line.
9. Reconnect the EGC electrical cable.

9.15 Replacing the CR-TC

The CR-TC replacement procedure consists of:

- Removing the old CR-TC (see Section 9.14.1)
- Installing and hydrating the new CR-TC (see Section 9.15.2)
- Completing the plumbing for the new CR-TC (see Section 9.15.3)

Refer to Figure 9-18 for a flow schematic of the EG and CR-TC for capillary IC and to Figure 9-22 for analytical IC.

9.15.1 Removing the Old CR-TC

1. Turn off the pump flow. (This turns off the power to the EGC and the suppressor, also.)
2. Open the front door of the EG.
3. Push down on the slide release latch and pull the tray forward until it reaches the stop.
4. Pull the CR-TC off the ball studs on the component mounting panel.
5. Disconnect the liquid lines from the four ports on the CR-TC.
6. Twist the ring on the CR-TC electrical cable counterclockwise to loosen it, and then pull the cable straight out of the **CR-TC 1** (or **CR-TC 2**) bulkhead connector.
7. Remove the CR-TC from the EG.

9.15.2 Installing and Flushing the New CR-TC

1. Remove the plugs from the ports on the new CR-TC.

Capillary IC

2. If you are installing a CR-TC in a capillary IC system:
   a. Connect a piece of 0.25 mm (0.010 in) ID PEEK tubing between the **ELUENT OUT** and **REGEN IN** ports of the CR-TC (see Figure 9-26). This is a temporary connection.
   b. Locate the 38 cm (15 in) piece of 0.025 mm (0.001 in) ID tan PEEK tubing (P/N 074582) in the EG Ship Kit (P/N 072047).
   c. Connect this line to the EGC **INLET** port and connect the other end to the **EGC IN** line from the pump pulse damper (see Figure 9-19). This is a temporary connection, to provide backpressure.

d. Connect the **EGC OUT** line to the CR-TC **ELUENT IN** port and connect the waste line to the CR-TC **REGEN OUT** port.

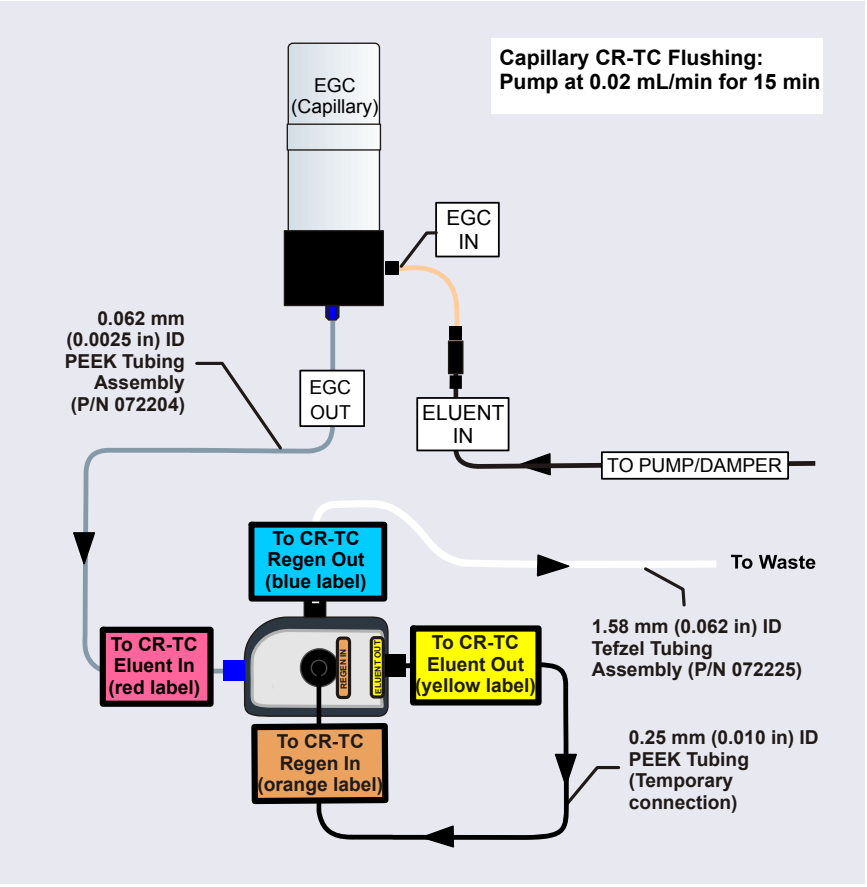


Figure 9-26. *Plumbing for Hydrating a Capillary CR-TC*

Analytical IC

3. If you are installing a CR-TC in an analytical IC system:

   a. Locate the CR-TC Hydration Tubing Kit (P/N 063487) provided in the EG Ship Kit.

b. Refer to Figure 9-27 to plumb the four ports on the CR-TC.

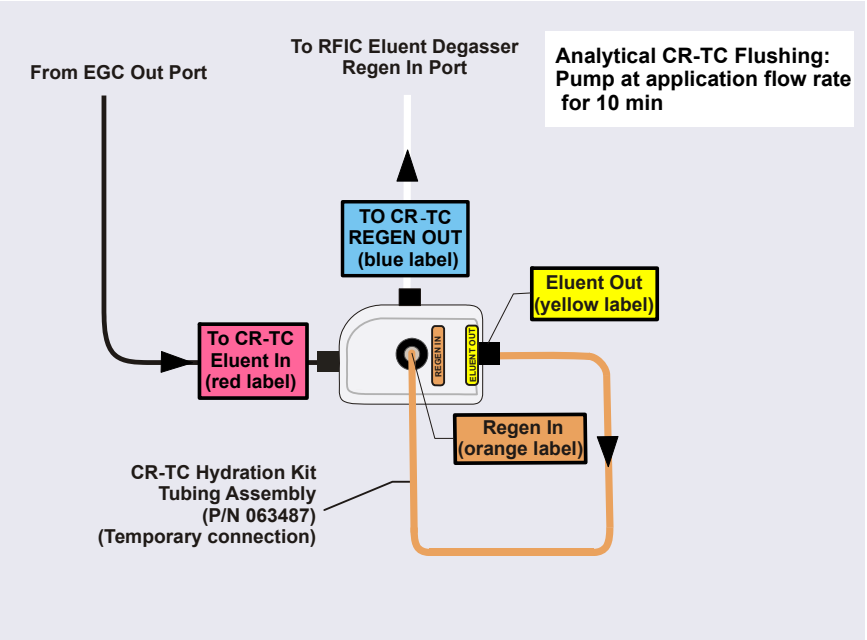


Figure 9-27. *Plumbing for Hydrating an Analytical CR-TC*

4. On the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset, select the following settings:

   a. **DC** panel: Verify that the suppressor **Mode** is off.

IMPORTANT **To avoid damaging the suppressor, always turn off the suppressor before hydrating the CR-TC. The pump flow is on during conditioning; however, no flow reaches the suppressor.**

   b. **Pump** panel:

   - **Gradient pump only:** Select the correct eluent channel (A, B, C, or D).
   - **Analytical pumps:** Set the flow rate recommended for your application. This turns on the pump flow, also. Allow the pump to run for at least 10 minutes.
   - **Capillary pumps:** Set the flow rate to 0.02 mL/min. This turns on the pump flow, also. Allow the pump to run for 15 minutes.

5. Turn off the pump flow.
6. Disconnect the temporary tubing from the **ELUENT OUT** and **REGEN IN** ports on the CR-TC.

Capillary IC

7. If you are installing a CR-TC in an analytical IC system, remove the backpressure tubing from the **EGC IN** line and use a high-pressure (blue) fitting to connect the **EGC IN** line to the EGC **INLET** port.

9.15.3 Completing the New CR-TC Plumbing

1. Connect the regen out and eluent in lines from the eluent degasser to their respective ports on the CR-TC. Refer to Figure 9-28 for a capillary IC system or Figure 9-29 for an analytical IC system.

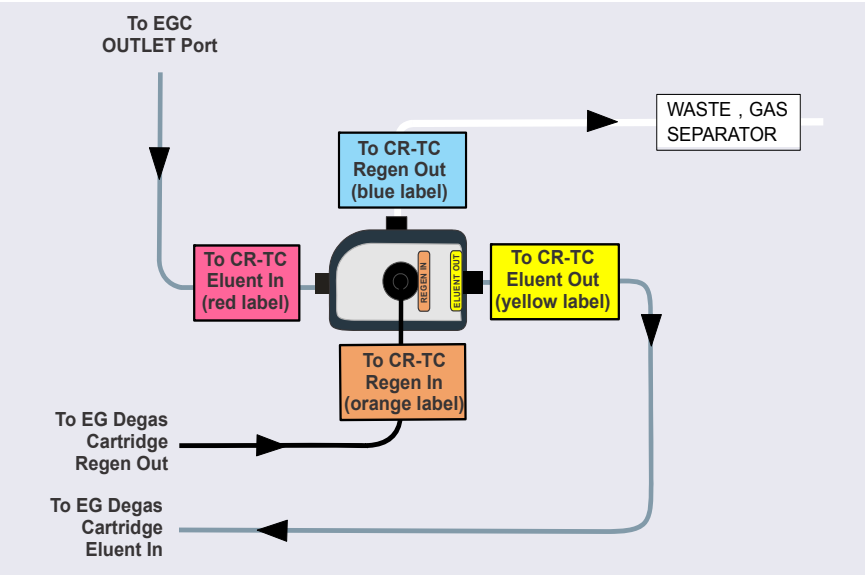


Figure 9-28. *Capillary CR-TC Plumbing Diagram: Installation Completed*

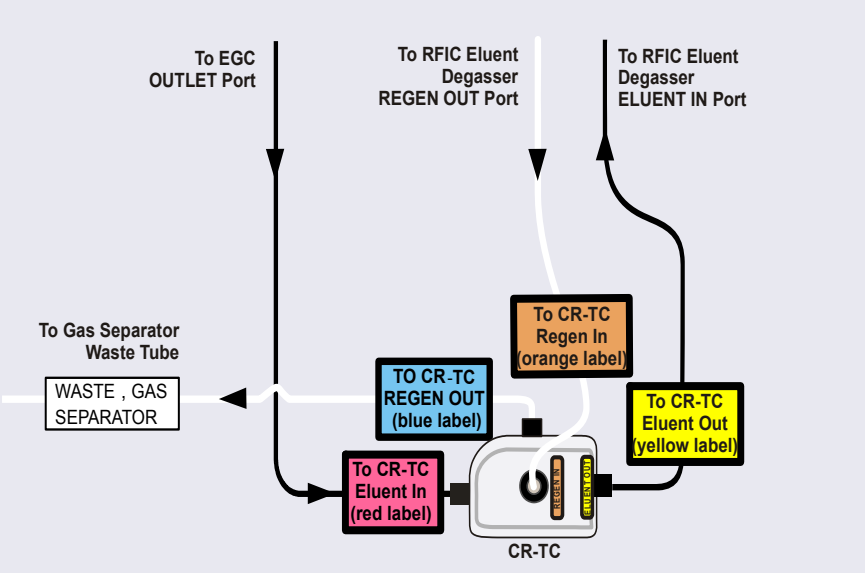


Figure 9-29. *Analytical CR-TC Plumbing Diagram: Installation Completed*

2. Check that no liquid lines are caught under the CR-TC. Align the two mounting holes on the CR-TC back plate with the ball studs on the mounting plate, and then push the CR-TC firmly onto the mounting ball studs. The CR-TC clicks into place when properly installed.
3. Push the CR-TC electrical cable firmly into the **CR-TC 1** (or **CR-TC 2**) bulkhead connector. Twist the ring on the cable connector fingertight to secure it.
4. Push the tray into the module until it locks into place. Close the EG door.

Analytical IC 9.16 Replacing the RFIC Eluent Degasser

1. Turn off the pump flow.
2. Open the front door of the EG.
3. Push down on the slide release latch and pull the tray forward until it reaches the stop.
4. Grasp the degasser by the sides and pull it straight off the ball studs that secure it to the component mounting panel. Dispose of the degasser.
5. Disconnect the four lines connected to the RFIC Eluent Degasser fittings (**ELUENT OUT**, **REGEN OUT**, **REGEN IN**, and **ELUENT IN**).
6. Connect the four lines that were disconnected in Step 5 to the new RFIC Eluent Degasser (P/N 062137).
7. Align the two mounting holes on the back plate of the new RFIC Eluent Degasser with the ball studs on the component mounting panel. Push the degasser firmly onto the mounting ball studs. The degasser clicks into place when properly installed.
8. Push the tray into the module until it locks into place. Close the EG door.

Analytical IC 9.17 Installing a Backpressure Coil

In an analytical IC system, the EGC requires at least 14 MPa (2000 psi) of system backpressure; this ensures optimal removal of electrolysis gas from the eluent produced by the cartridge.

During system equilibration, monitor the pressure and verify that it is between 14 and 21 MPa (2000 and 3000 psi). A system backpressure of 16 MPa (2300 psi) is optimal.

If the backpressure is too low, install a backpressure coil (see Table 9-5) between the injection valve and the **OUTLET** port on the EGC. Connect one end of the backpressure coil to Port P (2) on the injection valve; connect the other end to the **TO INJ VALVE IN - P** line.

The EG Ship Kit (P/N 072047) includes four backpressure coils (see Table 9-5).

Part Number	Backpressure Coil Description	Flow Rate	Approximate Backpressure Added
053762	4 mm ID	2.0 mL/min	3.5 MPa (500 psi)
		1.0 mL/min	1.75 MPa (250 psi)
053763	4 mm ID	2.0 mL/min	7 MPa (1000 psi)
		1.0 mL/min	3.5 MPa (500 psi)
053764	2 mm ID	0.50 mL/min	3.5 MPa (500 psi)
		0.25 mL/min	1.75 MPa (250 psi)
053765	2 mm ID	0.50 mL/min	7 MPa (1000 psi)
		0.25 mL/min	3.5 MPa (500 psi)

Table 9-5. *EG Backpressure Coils*

9.18 Changing the EG Main Power Fuses

1. Press the **POWER** button on the front of the EG for 2 seconds to turn off the power.
2. Turn off the main power switch on the EG rear panel (see Figure 2-12).
3. Disconnect the main power cord from both its source and from the EG rear panel.

DANGER

HIGH VOLTAGE—Disconnect the main power cord from its source and also from the rear panel of the EG.

DANGER

HAUTE TENSION—Débranchez le cordon d'alimentation principal de sa source et du panneau arrière du EG.

ACHTUNG

HOCHSPANNUNG—Ziehen Sie das Netzkabel aus der Steckdose und der Netzbuchse auf der Rückseite des EG.

4. The fuse drawer is located above the main power switch (see Figure 9-30). A small tab locks the fuse drawer in place. Using a small screwdriver, press the tab *in* and *then up* to release the fuse drawer.
5. Pull the fuse drawer out of the rear panel and remove the old fuses.
6. Replace the two fuses with new 2 A IEC 60127-2 slow-blow fuses (P/N 954773). Thermo Fisher Scientific recommends always replacing *both* fuses.

Figure 9-30. *EG Fuse Drawer*

7. Insert the fuse drawer into the rear panel and press until the drawer snaps into place.
8. Reconnect the main power cord and turn on the power.

9.19 Replacing Tubing and Fittings

Capillary IC

9.19.1 Tubing and Fittings for Capillary IC Systems

Table 9-6 lists tubing and fittings used to plumb a DC system for capillary IC.

Tubing Size and Type	Color	P/N	Used to connect…
IC Cube Tubing Kit	N/A	072186	See Table 9-7
AS needle seal assembly, 46 cm (18 in), with 10-32 ferrule fitting	White	057301	AS normal and concentrate modes only: Injection valve to the AS inject port
0.25 mm (0.010 in) ID PEEK tubing, 50 cm (20 in)	Black	042690 (1 in)	AS sequential modes only: Injection valve to AS diverter valve
ED Cell Inlet Tubing Kit	N/A	074221	ED cell inlet to column outlet
10-32 fitting bolt 10-32 ferrule, double-cone	Black Tan	043275 043276	• Suppressor eluent out CRD eluent in • CD cell inlet and outlet • ED cell outlet • Injection valve sample in and sample out

Table 9-6. *Tubing and Fittings for a Capillary IC DC System*

Capillary IC

Table 9-7 lists the tubing and fittings in the IC Cube Tubing Kit (P/N 072186)

Part	Length/ Quantity	Part Number	Used To Connect...
Precision cut 0.062 mm (0.0025 in) ID PEEK tubing, blue	65 mm (2.56 in)	072188	50 mm guard column outlet to 250 mm separator column inlet
Precision cut 0.062 mm (0.0025 in) ID PEEK tubing, blue, labeled **VALVE PORT 3**	115 mm (4.53 in)	072189	Guard column inlet to injection valve
Precision cut 0.062 mm (0.0025 in) ID PEEK tubing, blue	75 mm (2.93 in)	074603	35 mm guard column outlet to 150 mm separator column inlet
Precision cut 0.062 mm (0.0025 in) ID PEEK tubing, blue, labeled **VALVE PORT 3**	210 mm (8.27 in)	072187	Separator column inlet to injection valve (if a guard column is not present)
0.25 mm (0.010 in) ID PEEK tubing, black	610 mm (24 in)	042690	EG degas cartridge **REGEN OUT** to waste (if an EG is not present)
0.125 mm (0.005 in) ID PEEK tubing, red	610 mm (24 in)	044221	Inject valve waste to AS waste
High-pressure 10-32 fitting bolt, blue	7	074449	• EG degas cartridge **ELUENT OUT** to injection valve • Injection valve to guard or separator column • Guard column to separator column • Separator column to suppressor
High-pressure 10-32 ferrule, double-cone, blue	7	074373	Use with high-pressure fitting bolts

Table 9-7. *Contents of the IC Cube Tubing Kit (P/N 072186)*

Capillary IC

Notes for Capillary IC systems:

- The 0.062 mm (0.0025 in) ID blue PEEK tubing (capillary tubing) used for IC Cube connections is cut at the factory using a specialized precision cutter. If you need to replace any of this type of tubing, order an IC Cube Tubing Kit (P/N 072186) or the individual tubing listed in Table 9-7.
- When replacing capillary tubing, make sure the ferrule and fitting bolt are at least 2 mm (0.1 in) from the end of the tubing before you insert the tubing into the port. Do not position the ferrule and fitting bolt flush with the end of the tubing. For detailed connection instructions, see Section 9.1
- Except for capillary tubing, you can use a tubing cutter to cut tubing to the required length. Make sure the cut is at a right angle to the length of the tubing and there are no nicks or burrs on the end. A tubing cutter (P/N 049584) is included in the DC Ship Kit (P/N 072011). Refer to the instructions provided with the cutter.
- For tightening requirements for the high-pressure fitting bolt (P/N 074449) and ferrule (P/N 074373), see Section 9.2.
- For tightening requirements for the 10-32 fitting bolt (P/N 043275) and ferrule (P/N 043276), refer to *Installation of Dionex Liquid Line Fittings* (Document No. 031432). The manual is on the Thermo Scientific Reference Library DVD (P/N 053891).

Analytical IC

9.19.2 Tubing and Fittings for Analytical IC Systems

Table 9-8 lists the tubing and fittings used to plumb a DC system for analytical IC.

Tubing Size and Type	Color	P/N	Used to connect...
0.75 mm (0.030 in) ID PEEK	Green	044777 (1 in)	Injection valve to waste
AS needle seal assembly, 46 cm (18 in), with 10-32 ferrule fitting	White	057301 (1 in)	AS normal and concentrate modes only: Injection valve to the AS inject port
0.33 mm (0.013 in) ID, PEEK	Light Blue	049714 (1 in)	AS sequential modes only: Injection valve to AS diverter valve
0.51 mm (0.020 in) ID, PEEK	Orange	042855 (1 in)	AS simultaneous mode only: Each injection valve to the AS simultaneous injection tee
1.58 mm (0.062 in) ID PTFE	Colorless	014157 (1 in)	Suppressor **REGEN OUT**
0.125 mm (0.005 in) ID PEEK	Red	044221 (1 in)	Microbore systems: Connections between other system components
0.25 mm (0.010 in) ID PEEK	Black	042690 (1 in)	Standard bore systems: Connections between other system components
1/8 in fitting bolt 1/8 in ferrule	Tan Yellow	052267 048949	Suppressor **REGEN OUT** fitting
10-32 Fitting bolt 10-32 Ferrule, double-cone	Black Tan	043275 043276	All other tubing fittings

Table 9-8. *Tubing and Fittings for an Analytical IC DC System*

Analytical IC

Notes for analytical IC systems:

- Use a tubing cutter to cut tubing to the required length. Make sure the cut is at a right angle to the length of the tubing and there are no nicks or burrs

on the end. A tubing cutter (P/N 049584) is included in the DC Ship Kit (P/N 072011). Refer to the instructions provided with the cutter.

- For tightening requirements, refer to *Installation of Dionex Liquid Line Fittings* (Document No. 031432). The manual is on the Thermo Scientific Reference Library DVD (P/N 053891).

9.20 Connecting a Sample Loading Port to the Injection Valve

1. For each sample loading port to be connected, locate the following items in the DC Ship Kit (P/N 072011):
   - One 1/4-28 fitting (P/N 052230) and ferrule (P/N 052231)
   - One 10-32 fitting (P/N 062980) and ferrule (P/N 062978)
   - 0.75 mm (0.030 in) ID green PEEK tubing (P/N 052304)
   - One luer adapter fitting (P/N 024305)
2. Locate the metal release tab under the sample loading port on the front of the DC (see Figure 9-31). Press up on the tab to release the port and pull the port out the front of the DC.

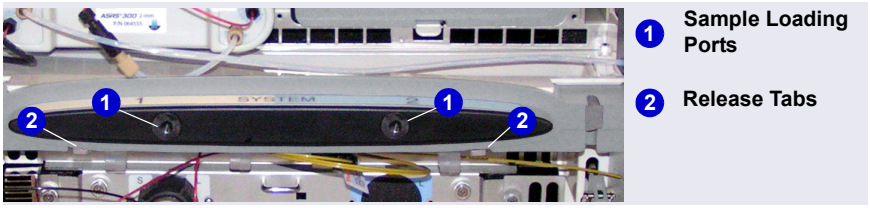


Figure 9-31. *DC Sample Loading Ports and Release Tabs*

3. Remove the fitting plug from the rear of the port.

4. Attach the luer adapter fitting to the front of the port (see Figure 9-32).

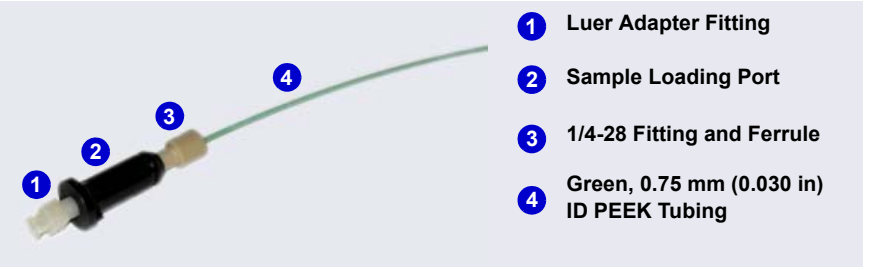


Figure 9-32. *Sample Loading Port Connection*

5. Cut a length of green, 0.75 mm (0.030 in) ID PEEK tubing. The tubing will be used to connect the sample loading port and the sample port on the valve.
6. Attach a 1/4-28 fitting and ferrule to one end of this tubing and connect it to the rear of the sample loading port.
7. Thread the free end of the tubing through the sample loading port opening on the DC. Insert the port into the opening and turn it until it snaps into place.
8. Attach a 10-32 fitting and ferrule to the free end of the tubing and connect it to sample port **S (5)** on the injection valve.

9.21 Replacing the Leak Sensor

1. Turn off the pump flow from the ePanel in Chromeleon 7 or the Control panel in Chromeleon 6.8, or press **PUMP FLOW** on the front of the pump.
2. Press the **POWER** button on the front of the DC to turn off the DC.

To avoid injury, wait for the DC to cool down before opening the door or performing any maintenance or service procedures.

Afin d'éviter toute brûlure, laisser refroidir le DC avant d'ouvrir la porte ou d'effectuer des opérations de maintenance.

VORSICHT

Um Verletzungen zu vermeiden, warten Sie bitte, bis der DC abgekühlt ist, ehe Sie die Tür öffnen bzw. Wartungs oder Servicearbeiten durchführen.

3. Open the DC lower door.
4. Loosen the screw on the front of the leak sensor (P/N 062437) (see Figure 9-33). **Note:** The screw remains attached to the sensor.

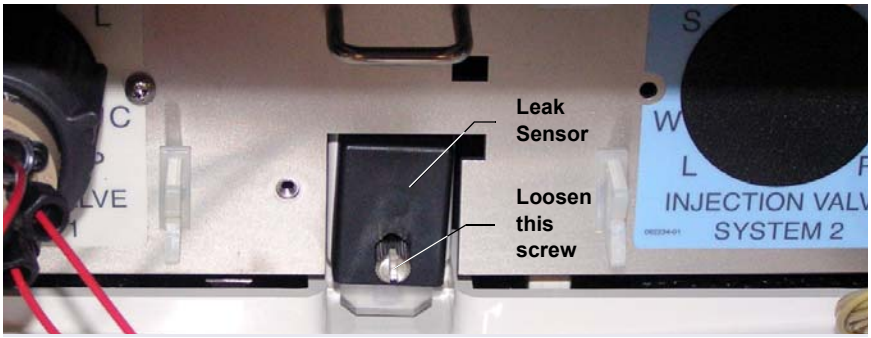


Figure 9-33. *Leak Sensor*

5. Pull out the leak sensor from the component panel and continue pulling until the attached cable is also out of the opening.
6. The cable attached to the leak sensor connects to a cable inside the DC. Continue pulling the cable until the connectors for the two cables are outside the panel (see Figure 9-34).
7. Disconnect the two cables.

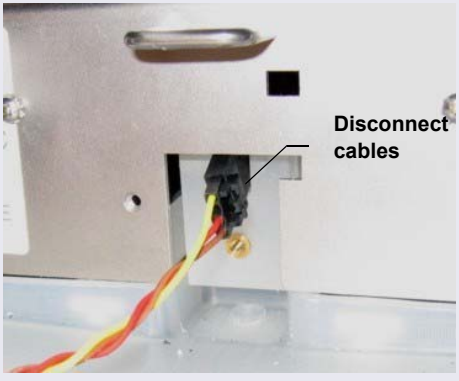


Figure 9-34. *Leak Sensor Cable*

8. Connect the cable from the new leak sensor to the DC cable.
9. Feed the cables back inside the DC. Align the leak sensor with the component panel opening and fingertighten the screw.
10. Make sure the leak sensor does not touch the bottom of the drip tray.

9.22 Rebuilding a High-Pressure (Injection) Valve

Thermo Fisher Scientific recommends rebuilding the injection valve annually. The Injection Valve Rebuild Kit (P/N 074698; 4-port valve; P/N 057896, 6-port valve; P/N 061759, 10-port valve) contains all required replacement parts. This procedure also applies to high-pressure valves installed in a Dionex ICS-5000 Automation Manager.

NOTE Substitution of non-Dionex/Thermo Fisher Scientific parts may impair valve performance and void the product warranty.

NOTE If you prefer, you can replace the high-pressure valve "pod," instead of rebuilding the valve. Replacing the pod is easier and faster than rebuilding the valve.

1. Turn off the pump flow.
2. Press the **POWER** button on the front of the DC for 2 seconds to turn off the DC.

To avoid injury, wait for the DC to cool down before opening the door or performing any maintenance or service procedures.

Afin d'éviter toute brûlure, laisser refroidir le DC avant d'ouvrir la porte ou d'effectuer des opérations de maintenance.

Um Verletzungen zu vermeiden, warten Sie bitte, bis der DC abgekühlt ist, ehe Sie die Tür öffnen bzw. Wartungs oder Servicearbeiten durchführen.

3. Open the DC door.
4. Disconnect each liquid line connected to the valve.
5. Follow the instructions provided in the Rebuild Kit to replace the rotor seal, isolation seal, and stator face.
6. Reconnect all liquid lines to the injection valve.

7. Turn on the power to the DC.
8. Turn on the pump flow. Check for leaks from the valve. Tighten fittings as required. For tightening requirements, refer to *Installation of Dionex Liquid Line Fittings* (Document No. 031432). The manual is on the Thermo Scientific Reference Library DVD (P/N 053891).
9. Close the door.

9.23 Replacing a High-Pressure (Injection) Valve Pod

This procedure describes how to replace the mechanical parts (the "pod") of a high-pressure valve (P/N 074699, 4-port; P/N 061947, 6-port; P/N 061948, 10-port).

NOTE If the valve electronics require service, contact Thermo Fisher Scientific. Electronics-related repair procedures must be performed by Thermo Fisher Scientific personnel.

NOTE Substitution of non-Dionex/Thermo Fisher Scientific parts may impair valve performance and void the product warranty.

1. Turn off the pump flow.

To avoid injury, wait for the DC to cool down before opening the door or performing any maintenance or service procedures.

Afin d'éviter toute brûlure, laisser refroidir le DC avant d'ouvrir la porte ou d'effectuer des opérations de maintenance.

Um Verletzungen zu vermeiden, warten Sie bitte, bis der DC abgekühlt ist, ehe Sie die Tür öffnen bzw. Wartungs oder Servicearbeiten durchführen.

2. Press the **POWER** button on the front of the DC for 2 seconds to turn off the DC.
3. Open the DC door.

4. Disconnect each liquid line connected to the valve.
5. Unscrew the locking ring on the outside of the valve (see Figure 9-35) and remove the ring.

Figure 9-35. *Unscrew the Locking Ring (Valve in IC Cube Shown)*

6. Grasp the front of the valve pod and pull out firmly to remove it from the DC or AM.
7. Align the slots in the new pod with the runner in the valve holder on the DC or AM (see Figure 9-36). Valve pods are keyed to fit only one way (one slot is narrower than the other). Verify that the slots are aligned with their matching runners.

8. Also verify that the two splines on the pod align with the matching splines inside the valve holder (see Figure 9-36). If necessary, twist the end of the pod to adjust the position of the splines.

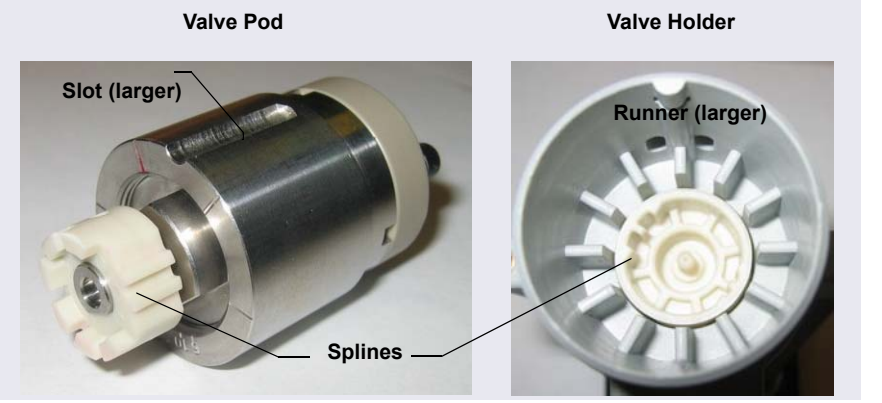


Figure 9-36. *High-Pressure Valve Pod and Pod Holder*

9. Push the pod into the holder until it clicks into place. Replace the black locking ring.
10. Reconnect all liquid lines to the valve.
11. Turn on the pump flow. Check for leaks from the valve. Tighten fittings as required. For tightening requirements, refer to *Installation of Dionex Liquid Line Fittings* (Document No. 031432). The manual is on the Thermo Scientific Reference Library DVD (P/N 053891).
12. Close the door.

9.24 Installing or Replacing an I/O Option Board

1. Press the **POWER** button on the front of the DC for 2 seconds to turn off the power.
2. Turn off the main power switch on the DC rear panel (see Figure 2-31).

3. Disconnect the main power cord from both its source and from the DC rear panel.

DANGER

HIGH VOLTAGE—Disconnect the main power cord from its source and also from the rear panel of the DC.

DANGER

HAUTE TENSION—Débranchez le cordon d'alimentation principal de sa source et du panneau arrière du DC.

ACHTUNG

HOCHSPANNUNG—Ziehen Sie das Netzkabel aus der Steckdose und der Netzbuchse auf der Rückseite des DC.

4. On the DC rear panel, remove the two screws that attach the I/O option cover plate or the existing I/O option board to the rear panel (see Figure 9-37). Save the screws.

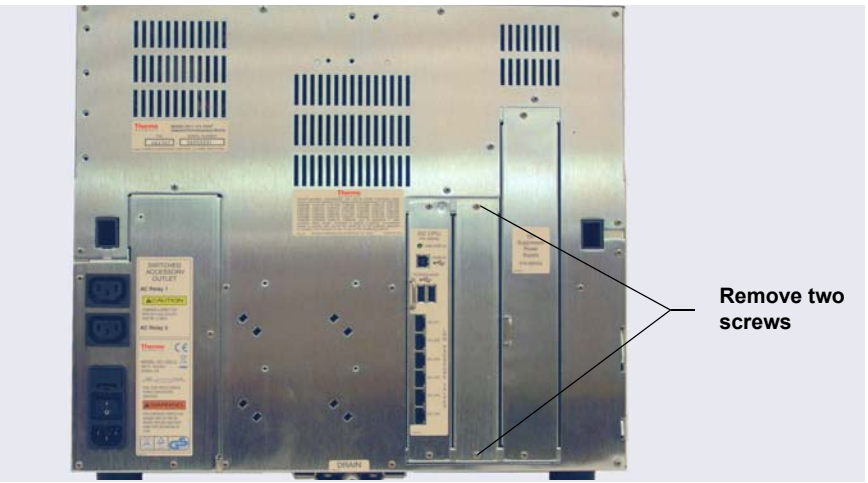


Figure 9-37. *DC Rear Panel: Removing the I/O Option Cover Plate*

5. Slide the new I/O option board (P/N 062201) into the rear panel opening and press firmly to connect the board to the DC motherboard.
6. Replace the two screws.

Figure 9-38 shows the I/O option installed.

Figure 9-38. *DC Rear Panel: I/O Option Installed*

7. Reconnect the main power cord and turn on the power.

9.25 Changing the DC Main Power Fuses

1. Press the **POWER** button on the front of the DC for 2 seconds to turn off the power.
2. Turn off the main power switch on the DC rear panel (see Figure 2-31).
3. Disconnect the main power cord from both its source and from the DC rear panel.

DANGER

HIGH VOLTAGE—Disconnect the main power cord from its source and also from the rear panel of the DC.

DANGER

HAUTE TENSION—Débranchez le cordon d'alimentation principal de sa source et du panneau arrière du DC.

ACHTUNG

HOCHSPANNUNG—Ziehen Sie das Netzkabel aus der Steckdose und der Netzbuchse auf der Rückseite des DC.

4. The fuse drawer is located above the main power switch (see Figure 9-39). A small tab locks the fuse drawer in place. Using a small screwdriver, press the tab *in* and *then up* to release the fuse drawer.
5. Pull the fuse drawer out of the rear panel and remove the old fuses.
6. Replace the two fuses with new 10 A IEC 60127-2 slow-blow fuses (P/N 954772). Thermo Fisher Scientific recommends always replacing *both* fuses.

Figure 9-39. *DC Fuse Drawer*

7. Insert the fuse drawer into the rear panel and press until the drawer snaps into place.
8. Reconnect the main power cord and turn on the power.

9.26 IC Cube Service Procedures

9.26.1 Replacing an IC Cube Cartridge

1. Turn off the pump flow.
2. Press the **POWER** button on the front of the DC for 2 seconds to turn off the DC power.

To avoid injury, wait for the DC to cool down before opening the door or performing any maintenance or service procedures.

Afin d'éviter toute brûlure, laisser refroidir le DC avant d'ouvrir la porte ou d'effectuer des opérations de maintenance.

Um Verletzungen zu vermeiden, warten Sie bitte, bis der DC abgekühlt ist, ehe Sie die Tür öffnen bzw. Wartungs-oder Servicearbeiten durchführen.

3. Open the DC upper door.
4. Disconnect each liquid line connected to the IC Cube cartridge to be replaced.
5. Loosen the two thumbscrews on the cartridge (see Figure 9-40) and pull the cartridge out of the IC Cube.
6. Slide the new cartridge into the IC Cube. Push the cartridge firmly into the IC Cube and then tighten the thumbscrews.

Figure 9-40. *Capillary Cartridge Thumbscrews (EG Degas Cartridge Shown)*

7. If you are installing a suppressor or CRD cartridge, hydrate them before use. Refer to the instructions in the suppressor or CRD manual. The manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891)
8. Reconnect the liquid lines that were disconnected in Step 4.

9.26.2 Replacing Capillary Columns

1. Turn off the pump flow.
2. Open the DC upper door.
3. Disconnect the line from the **ELUENT OUT** port of the injection valve and the line from the **ELUENT OUT** fitting on the column cartridge (see Figure 9-41).

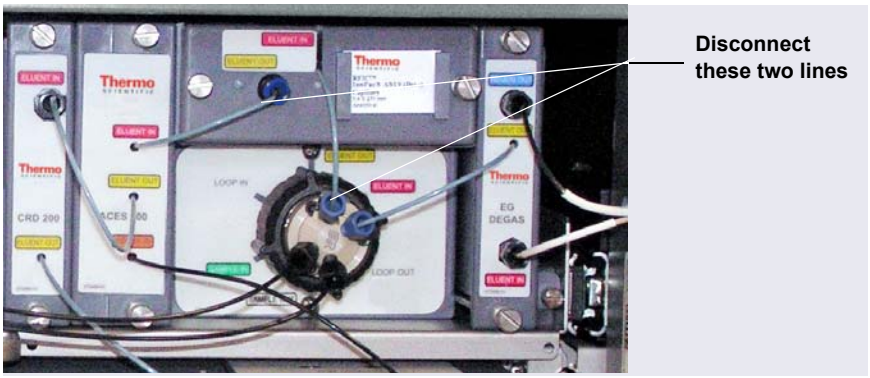


Figure 9-41. *Disconnect Capillary Cartridge Eluent Lines*

4. Loosen the two thumbscrews on the column cartridge and pull the cartridge out of the IC Cube.

5. Lift the lid of the column cartridge to open it. Figure 9-42 shows the column cartridge when a capillary guard column and a capillary separator column are installed.

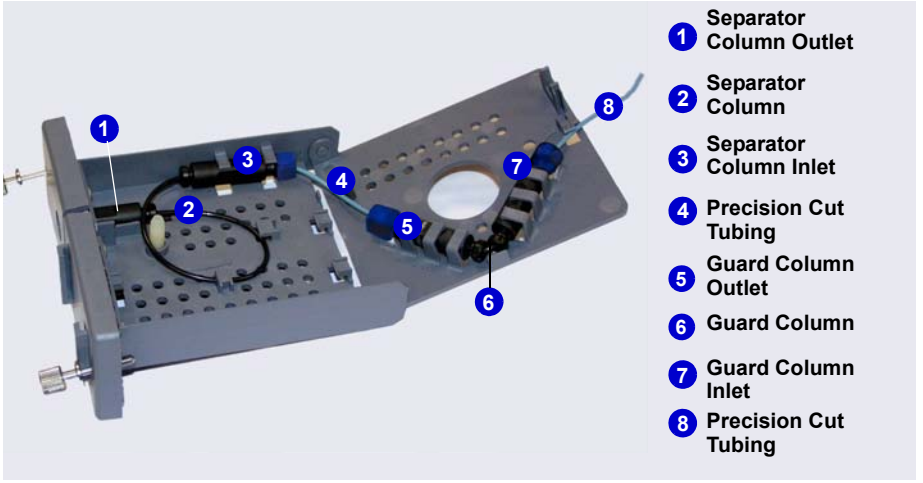


Figure 9-42. *Separator and Guard Columns Installed in Column Cartridge*

Figure 9-43 shows the column cartridge when only a capillary separator column is installed

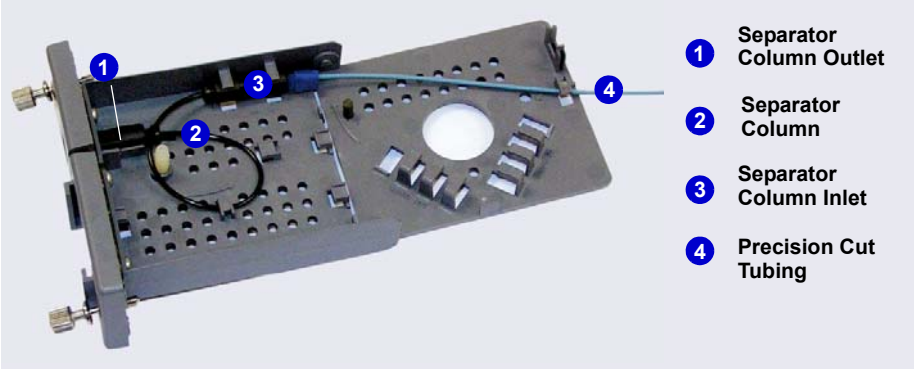


Figure 9-43. *Separator Column Only Installed in Column Cartridge*

6. Remove the guard column (if present) and separator column from the column clips. Lift up the separator column outlet fitting (see Figure 9-44) slightly to free it from the clips and then slide it out of the cartridge.
7. Remove the columns from the cartridge.
8. Disconnect the tubing from the columns. Save the tubing.

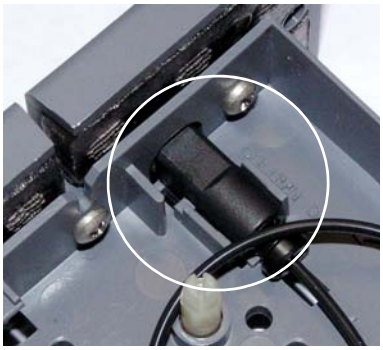


Figure 9-44. *Separator Column Outlet Fitting*

NOTE Do not cut the tubing that you removed from the columns and do not substitute different tubing. To ensure good chromatographic results, capillary tubing is cut at the factory using a specialized precision cutter. If you need to replace the tubing or to install a different length tubing (to accommodate a new column configuration), order an IC Cube Tubing Kit (P/N 072186).

9. Before installing the new separator column, tear off the column label and slide it into the holder on the front of the cartridge (see Figure 9-48).
10. If the new column configuration is the same as the previous, connect the precision cut tubing that you removed in Step 8 to the new columns.

If you are changing the column configuration, refer to the following figures for the precision cut tubing required for your configuration:

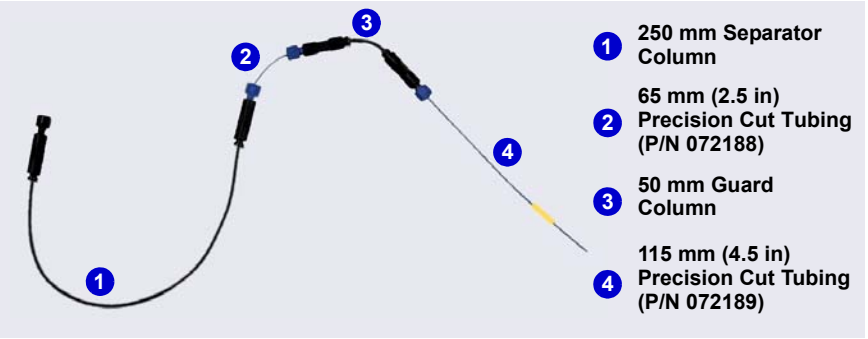


Figure 9-45. *Tubing Connections for 250 mm Separator Column and 50 mm Guard Column*

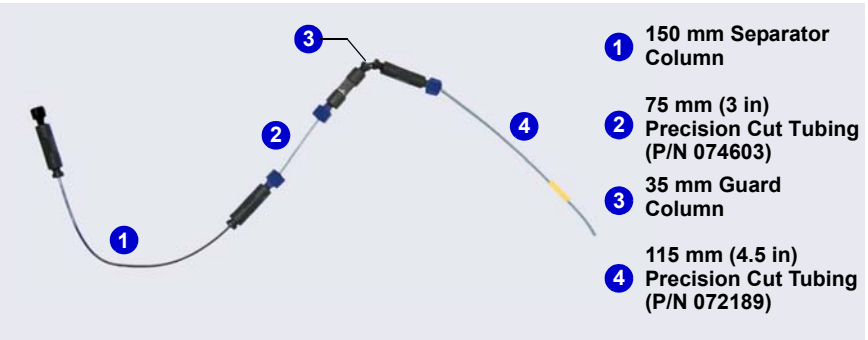


Figure 9-46. *Tubing Connections for 150 mm Separator Column and 35 mm Guard Column*

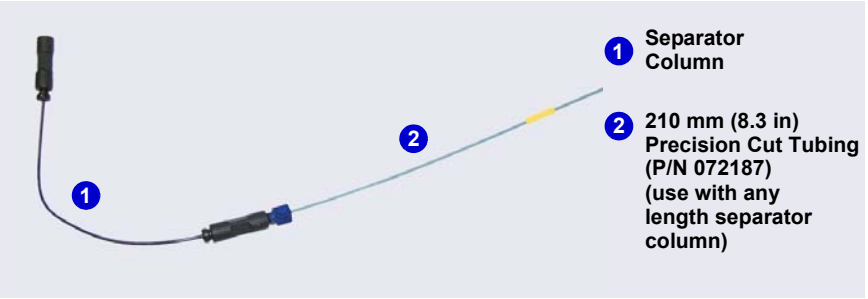


Figure 9-47. *Tubing Connections for Separator Column Only*

11. Remove the fitting plug from the outlet fitting on the separator column. Orient the fitting with a flat side up and push the fitting into the opening at the front of the column cartridge until it stops (see Figure 9-44).
12. Coil the separator column tubing inside the cartridge as shown in Figure 9-42 or Figure 9-43. Secure the column and the inlet fitting in the clips on the column cartridge.
13. Secure the inlet and outlet fittings on the guard column (if used) in the column clips on the lid of the column cartridge.
14. Route the column inlet tubing from the guard column (if used) or the separator column through the clip on the top edge of the cartridge lid.
15. Close the lid (you should hear a click) and route the tubing into the slot on the front of the column cartridge (see Figure 9-48).

NOTE If the columns are installed correctly, the cartridge lid snaps closed easily. If the lid does not close easily, do not force it. Open the lid and verify that the columns and tubing are installed correctly and secured in the clips.

Figure 9-48. *Column Cartridge Closed*

16. Slide the column cartridge into the IC Cube column oven and tighten the two thumbscrews.
17. Turn on the pump flow.
18. Wait until liquid is flowing out of the **Eluent Out** port (3) of the injection valve.

19. Connect the tubing from the **Eluent In** port of the column cartridge to the **Eluent Out** port (3) of the injection valve.
20. Wait until liquid is flowing out of the **Eluent Out** port of the column cartridge.
21. Reconnect the line to the **Eluent Out** fitting on the column cartridge that was disconnected in Step 3 (see Figure 9-41).
22. Close the DC upper door.

9.27 CD Service Procedures

9.27.1 Calibrating the CD Cell

NOTE Do not use this procedure to calibrate a new cell. New cells are calibrated at the factory.

Items Needed	Description
1.0 mM KCl solution	Prepare by dissolving 0.07456 g of reagent-grade KCl in 1 liter of 18 megohm-cm DI water.
Backpressure tubing to provide at least 7 MPa (1000 psi)	Use 0.25 mm (0.010 in) ID black PEEK tubing (P/N 042690).

1. On the Chromeleon 7 ePanel Set, click the **CD** tab. On the Chromeleon 6.8 panel tabset, click the **CD** tab.

2. Under **Detector Settings**, click **Calibration**. The Wellness panel opens (see Figure 9-49).

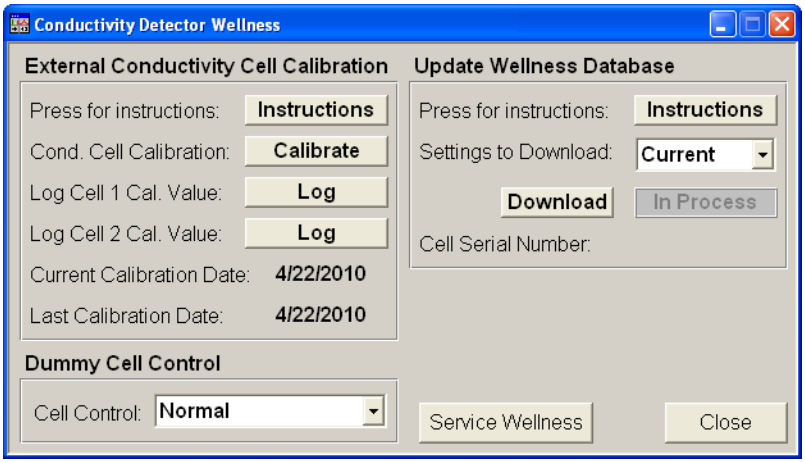


Figure 9-49. *Wellness Panel: Dionex ICS-5000 Conductivity Detector (Chromeleon 6.8 Version Shown)*

3. On the Wellness panel under **External Conductivity Cell Calibration**, click **Instructions** for a summary of the procedure (described in detail in this section).
4. Disconnect the pump output line from the injection valve.
5. Disconnect the line from the suppressor **ELUENT OUT** port to the cell inlet and connect the pump output line directly to the cell inlet.
6. Verify that backpressure at the pump is at least 7 MPa (1000 psi) at 0.01 mL/min (for capillary) or 1.00 mL/min (for analytical).
7. Set the cell heater to 35 °C. Allow the cell to reach this temperature (the LED stops blinking).
8. Begin pumping 1.0 mM KCl through the cell at 0.01 mL/min (for capillary) or 1.0 mL/min (for analytical).
9. Wait until the total conductivity reading stabilizes (15 to 30 minutes).
10. On the Wellness panel, click **Calibrate**.

    After calibration, the conductivity reading should be 147.00 ± 2 µS. If this is not the case, repeat the calibration.
11. To record the new calibration value in the Audit Trail, click **Log**.

12. Flush the KCl solution from the system by pumping ASTM Type I (18 megohm-cm) filtered and deionized water through the cell. When the conductivity drops to less than 1 µS/cm, stop the pump.
13. Reconnect the pump to the injection valve and reconnect the line from the suppressor to the cell inlet.

Analytical IC

9.27.2 Replacing an Analytical Suppressor

Refer to the suppressor manual for guidance about when to replace a suppressor and for instructions on preparing a new suppressor before initial use. Suppressor manuals are included on the Thermo Scientific Reference Library DVD (P/N 053891).

1. Stop the pump flow.
2. Press the **POWER** button on the front of the DC for 2 seconds to turn off the DC.

To avoid injury, wait for the DC to cool down before opening the door or performing any maintenance or service procedures.

Afin d'éviter toute brûlure, laisser refroidir le DC avant d'ouvrir la porte ou d'effectuer des opérations de maintenance.

Um Verletzungen zu vermeiden, warten Sie bitte, bis der DC abgekühlt ist, ehe Sie die Tür öffnen bzw. Wartungs oder Servicearbeiten durchführen.

3. Open the DC upper door.
4. Disconnect the four liquid lines from the suppressor (see Figure 9-50).

5. Unplug the suppressor cable from the detector.

Figure 9-50. *Disconnecting the Suppressor Liquid Lines and Cable*

6. Remove the suppressor from the detector by sliding it to the left a few millimeters to detach it from the mounting tabs on the detector. Then, pull the suppressor toward you.
7. Orient the new suppressor with the **ELUENT IN** and **REGEN OUT** ports on the bottom (see Figure 9-50). Press the suppressor against the back of the detector and then slide it to the right to secure it onto the mounting tabs. Pull out slightly on the center of the suppressor to verify that it is securely fastened.
8. Reconnect the four liquid lines to the new suppressor.
9. Plug in the suppressor cable.
10. Close the DC door.
11. Turn on the DC power and restart the pump flow.

9.27.3 Replacing a CD

1. Stop the pump flow.
2. Press the **POWER** button on the front of the DC for 2 seconds to turn off the DC.

3. Open the DC upper door and disconnect the tubing from the CD **CELL IN** and **CELL OUT** ports (see Figure 9-51).

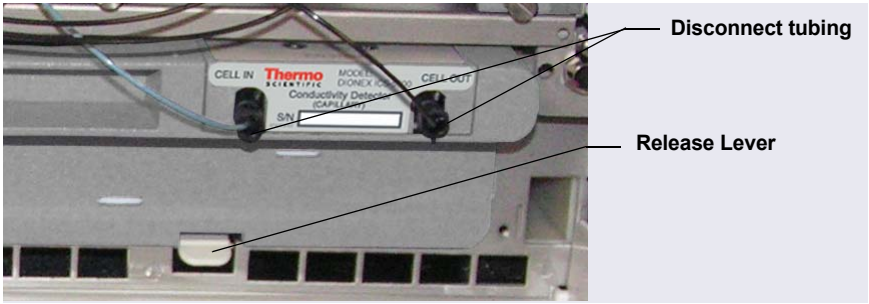


Figure 9-51. *Disconnecting the CD Liquid Lines (Capillary CD shown)*

Analytical IC

4. For an analytical CD, remove the suppressor from the detector. For instructions, refer to Section 9.27.2.
5. Press the release lever located below the detector (see Figure 9-51). The detector pops out slightly from the DC compartment. Grasp the top of the detector and pull outward to remove the detector from the compartment. **Do not pull from the CELL IN and CELL OUT fittings**.
6. Note the electrical plug on the back of the detector and the receptacle on the inside of the DC.
7. Push the new detector into the opening in the DC and press firmly to ensure the electrical connection is secure.
8. Reconnect the cell inlet and outlet lines.
9. Reinstall the suppressor (see Section 9.27.2).
10. Turn on the DC power and restart the pump flow.

Analytical IC

9.27.4 Removing Trapped Air from the Conductivity Cell

Air bubbles in the cell can cause pulsations of the baseline, random noise, and low readings. Air may result from outgassing of the eluent. In an analytical IC system follow the steps below to remove trapped air from the cell. These steps are not required for a conductivity cell in a capillary IC system.

1. Connect enough backpressure tubing to the cell outlet to shrink bubbles and allow them to pass more easily through the cell. Refer to Table 9-9 for the appropriate type and number of backpressure tubing coils required.

Suppressor Type	Column Format	Flow Rate (mL/min)	Backpressure Coils
Dionex AES	2 mm	0.25 to 0.50	2 red*
	3 mm	0.50 to 1.00	2 red
	4 mm	1.00 to 2.00	1 red
Dionex SRS or Dionex MMS	2 mm or 3 mm	<0.25	2 red
	2 mm or 3 mm	0.25 to 0.50	1 red
*The red coil (P/N 045878) consists of 0.125 mm (0.005 in) ID PEEK tubing with fittings.			

Table 9-9. *Backpressure Coil Requirements*

Table 9-10 lists the correct pressure range for each type of suppressor.

Suppressor Type	Pressure Range
Dionex AES	0.14 to 0.70 MPa (20 to 100 psi)
Dionex SRS or Dionex MMS	≤ 0.28 MPa (40 psi)

Table 9-10. *Suppressor Operating Pressure Ranges*

2. To verify that the required amount of backpressure is being generated, follow the instructions in *Backpressure Coil Pressure Test for Dionex Suppressors* (Document No. 031759), the flier shipped with the suppressor. The instructions are also in the suppressor manual on the Thermo Scientific Reference Library DVD (P/N 053891).
3. If a bubble is still trapped in the cell, try these techniques to remove it:
   - Loosen and then tighten the cell outlet fitting.
   - Temporarily disconnect the backpressure coil from the suppressor **REGEN IN** port and then plug and unplug the end of the tubing with your fingertip two or three times to create a pressure difference.

9.28 ED Service Procedures

9.28.1 Disconnecting the ED Cell

Before performing an ED cell service procedure, follow these instructions to disconnect the cell.

1. Turn off the cell voltage from the Chromeleon 7 ePanel Set or Chromeleon 6.8 panel tabset.
2. Stop the pump flow.
3. Disconnect the cell inlet and outlet lines from the ED cell and disconnect the two electrical cables (see Figure 9-52).

NOTE For a capillary IC system, disconnect the cell inlet line from the **ELUENT OUT** port of the IC Cube column cartridge.

Figure 9-52. *Disconnecting the ED Cell (Cell Configured for Analytical IC Shown)*

4. Grasp the cell by the cell body and pull straight out to remove it from the detector.

9.28.2 Replacing an ED Cell Disposable Working Electrode Gasket

For installation instructions for disposable working electrodes, refer to the installation guide shipped with the electrodes (see below) or to *Product Manual for Disposable Electrodes* (Document No. 065040), which is included on the Thermo Scientific Reference Library DVD (P/N 053891).

- *Disposable Silver Electrode Installation Guide for ED* (Document No. 065137)
- *Disposable Platinum Electrode Installation Guide for ED* (Document No. 065139)
- *Disposable Gold Electrode Installation Guide* (Document No. 065191)

IMPORTANT **When you install a disposable electrode, make sure that you install the correct gasket for your system.**

- **For a capillary system, use a 0.001-in PTFE gasket (P/N 072117, Pkg. of 2).**
- **For an analytical system with a gold, silver, or platinum disposable electrode, use a 0.002-in PTFE gasket (P/N 069141, Pkg. of 4).**
- **For an analytical system with a carbon disposable electrode, use a 0.001-in Ultem gasket (P/N 069339).**

9.28.3 Replacing an ED Cell Conventional Working Electrode Gasket

When to Replace the Gasket

Replace the gasket if there is a leak between the gasket and electrode, or between the gasket and cell body.

Items Needed

- ED cell gasket for conventional working electrodes (P/N 045972)
- Gloves
- Blunt-end tweezers

ED Cell Gasket Replacement Procedure

NOTE Always wear gloves when handling the ED cell. Never touch the electrode surface.

1. Follow the instructions in Section 9.28.1, to turn off the cell voltage, stop the pump flow, and disconnect the cell from the detector.
2. Loosen the yoke knob on the yoke block by unscrewing it two to three turns (see Figure 9-53).

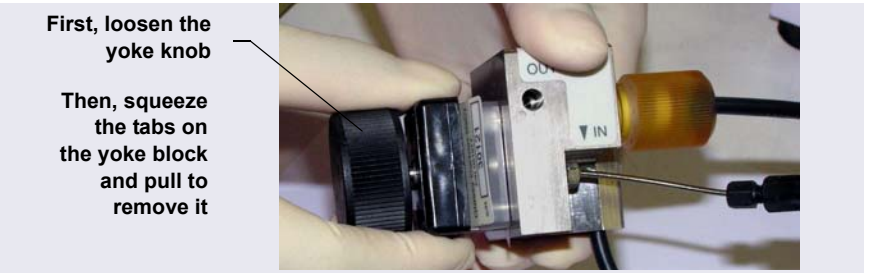


Figure 9-53. *Disassembling the ED Cell (Cell Configured for Analytical IC Shown)*

3. Squeeze the tabs on the sides of the yoke block and pull the block and knob off the working electrode (see Figure 9-53).

NOTE Handle the cell gasket and the inside surfaces of the cell carefully to prevent scratches which may subsequently cause leaks.

4. Carefully separate the parts (see Figure 9-54).

Figure 9-54. *ED Cell Components*

5. Use tweezers to remove the old cell gasket from the cell body (see Figure 9-55).

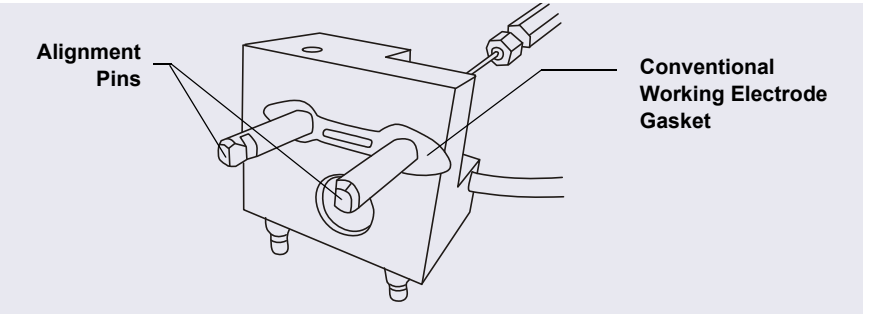


Figure 9-55. *ED Cell Gasket for Conventional Working Electrodes*

6. Rinse the surface of the cell with ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5.
7. Clean the polished surface of the cell with a clean, damp lint-free tissue.
8. Install the new gasket over the alignment pins on the cell body. When correctly installed, one end of the gasket extends beyond the cell body, to facilitate gasket installation and removal.
9. Verify that the gasket is flat against the cell body and is not wrinkled.

10. Reinstall the working electrode block and the yoke knob and block. Fingertighten the yoke knob by turning it a full 360 degrees.

    NOTE It is not possible to overtighten the yoke knob. Once the knob clicks into place, it does not tighten any further. The yoke knob ensures constant pressure is applied to the cell.

11. Orient the cell assembly with the yoke knob on the left and push the cell onto its mounting location in the DC compartment.
12. Reconnect the cell's inlet and outlet lines.
13. Reconnect the electrical cables.
14. Start the pump flow.
15. Wait until the pump pressure has stabilized (30 to 60 seconds) and then turn on the cell voltage.

9.28.4 Polishing an ED Cell Conventional Working Electrode

These instructions are for conventional (nondisposable) working electrodes only. **Do not polish disposable electrodes**.

When to Polish the Working Electrode

- **Do not polish new conventional working electrodes before installation.**
- After an electrode has been used for a period of time, a layer of contamination may build up. When this occurs, the electrode must be polished.
- After the working electrode is polished and installed, background signal and analyte sensitivity require several hours to stabilize. Once stabilized, do not polish the electrode unless you observe a loss of signal or severe electrode recession.

Items Needed

- Polishing kit (P/N 036313) shipped with the electrode. The kit contains polishing pads (P/N 036321), a bottle of fine polishing compound (P/N 036318), and a bottle of coarse polishing compound (P/N 036319).

- Gloves
- Tweezers

Working Electrode Polishing Procedure

NOTE To avoid electrode fouling, always wear gloves when handling electrodes.

1. Follow the instructions in Section 9.28.3, Step 1 through Step 4, to remove the working electrode from the cell.
2. Prepare the polishing pads:
   a. Designate a pad for use with the coarse polishing compound.
   b. Designate another pad for fine polishing compound; also designate the working electrode type with which it will be used.

      NOTE Do not use the same fine polishing pad to polish more than one type of working electrode; this can contaminate the electrode surface with microparticles from the other working electrodes.

   c. Designate a pad that will not be used with polishing compound. This pad is for removal of particles after polishing (see Step 5).
   d. Moisten the suede side of the polishing pad slightly with water and place the pad on a smooth, flat surface, with the suede side facing up.
3. Polish the electrode:
   - If you are polishing the electrode before initial installation, use only the fine polishing compound.
   - If you are polishing the electrode because of degradation of performance, such as increased baseline noise or tailing peaks, first use the coarse polishing compound. Then, repeat with the fine compound.

   a. Sprinkle about one-half gram of polishing compound in the center of the suede side of the polishing pad. Add enough ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5 to make a thick paste.

b. Using the working electrode block, spread the paste evenly over the pad. Then, applying firm pressure in a figure eight motion, polish the surface of the electrode block for about one minute. If the pad dries out while polishing, add water sparingly. However, **never** allow the polishing compound to dry on the electrode.

c. Use ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5 to rinse off all traces of polishing compound from the electrode block. An ultrasonic cleaner is effective for thoroughly cleaning the electrode block. Carefully rinse the surface of the block with ASTM Type I (18 megohm-cm) filtered and deionized water.

4. If you used the coarse polishing compound in Step 3, repeat the step with the fine compound.
5. Using a moist piece of polishing cloth (with no polishing compound added), rub the polished surface free of residual polishing compound particles.
6. Inspect the surface of the working electrode to make sure that it is clean. Repeat Step 5, if necessary.

   NOTE The polishing pads are reusable. Do not rinse the polishing compound from the pads. After initial use, add only enough polishing compound to maintain the coating on the pad.

7. Replace the working electrode block and yoke knob. Fingertighten the knob by turning it a full 360 degrees.

   NOTE It is not possible to overtighten the yoke knob. Once the knob clicks into place, it does not tighten any further. The yoke knob ensures constant pressure is applied to the cell.

8. Orient the cell assembly with the yoke knob on the left and push the cell onto its mounting location in the DC compartment.
9. Reconnect the cell's inlet and outlet lines.
10. Reconnect the electrical cables.
11. Start the pump flow.

12. Wait until the pump pressure has stabilized (30 to 60 seconds) and then turn on the cell voltage.
13. Reapply the electrode potential. The baseline will drift for more than 1 hour as the cell re-equilibrates. Peak area values may require up to 12 hours to stabilize.

9.28.5 Replacing a pH-Ag/AgCl Reference Electrode

When to Replace a pH-Ag/AgCl Reference Electrode

Replace the pH-Ag/AgCl reference electrode if performance problems occur that are not corrected by regenerating the electrode. Performance problems can include no pH readouts, a shift in Ag/AgCl reference potential or incorrect readouts, baseline spikes, or a decreased response even with a freshly polished working electrode. The pH-Ag/AgCl reference electrode typically lasts from 3 months to 1 year, depending on use.

NOTE To regenerate a pH-Ag/AgCl reference electrode, soak it in a solution of 1 M KCl and 1 M HCl.

Items Needed

- pH-Ag/AgCl reference electrode (P/N 061879)

pH-Ag/AgCl Reference Electrode Replacement Procedure

1. Follow the instructions in Section 9.28.1 to turn off the cell voltage, stop the pump flow, and disconnect the cell from the detector.

2. Unscrew the pH-Ag/AgCl reference electrode and remove it from the cell body (see Figure 9-56).

Figure 9-56. *Removing the pH-Ag/AgCl Reference Electrode (Cell Configured for Analytical IC Shown)*

3. Unscrew the storage cap from the new pH-Ag/AgCl reference electrode (see Figure 9-57). Save the cap.

IMPORTANT **Always store the electrode in the storage cap filled with saturated KCl solution when the cell is not in use. This prevents the pH-Ag/AgCl reference electrode membrane from drying out and damaging the electrode. See Section 6.4 for storage instructions.**

Figure 9-57. *pH-Ag/AgCl Reference Electrode in Storage Cap*

4. Rinse the new electrode thoroughly in ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5 to remove any precipitated salt.
5. Calibrate the pH-Ag/AgCl reference electrode (see Section 9.28.6).

9.28.6 Calibrating the pH-Ag/AgCl Reference Electrode

When to Calibrate

- Calibrate after installing a new pH-Ag/AgCl reference electrode.

Items Needed

- A buffer solution with a pH of 7.00
- A second buffer solution with a different pH (typically one that matches the pH of the eluent used in your application; in most cases, this is either pH 10 or pH 4)

pH-Ag/AgCl Reference Electrode Calibration Procedure

1. Complete the following if you are calibrating an electrode that is currently in use:
   a. Follow the instructions in Section 9.28.1 to turn off the cell voltage, stop the pump flow, and disconnect the cell from the detector.
   b. Unscrew the pH-Ag/AgCl reference electrode and remove it from the cell body (see Figure 9-56).
   c. To remove any precipitated salt, rinse the pH-Ag/AgCl reference electrode thoroughly in ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5.
2. With the pH-Ag/AgCl reference electrode removed from the cell, connect the cell and electrode electrical cables to the detector.
3. On the Chromeleon 7 ePanel Set, click the **ED** tab; on the Chromeleon 6.8 panel tabset, click the **EC Detector** tab.

4. Click the **Calibration** button. The Wellness panel opens, see Figure 9-58.

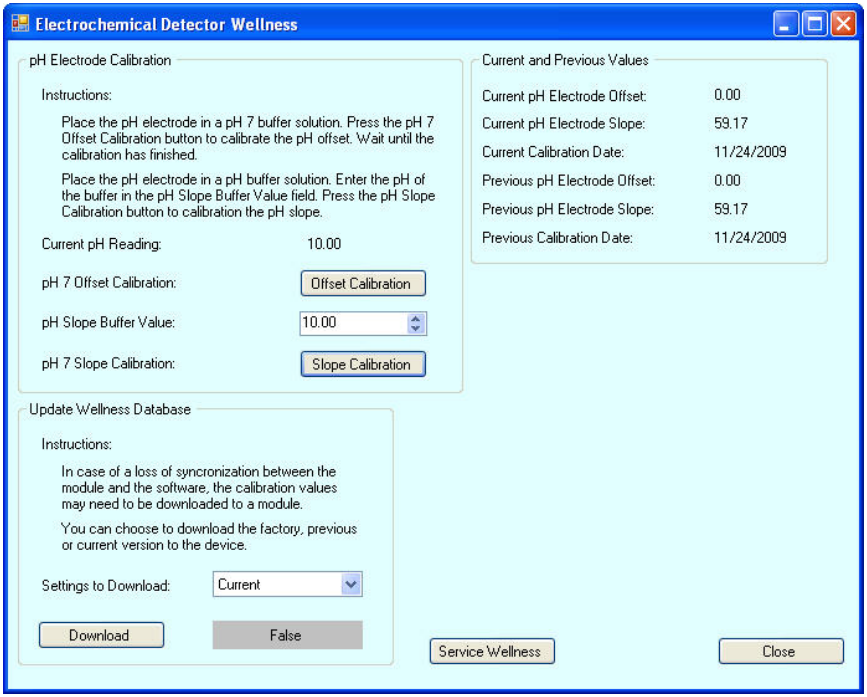


Figure 9-58. *Wellness Panel: Dionex ICS-5000 Electrochemical Detector (Chromeleon 7 Version Shown)*

5. Follow the instructions on the panel to calibrate the electrode.
6. Disconnect the pH-Ag/AgCl reference electrode cable and the cell cable.
7. Grasp the cell body and pull straight out to remove the cell from the detector.

Capillary IC If you are installing the pH-Ag/AgCl reference electrode in a capillary IC system, go on to page 396.

Analytical IC If you are installing the pH-Ag/AgCl reference electrode in an analytical IC system, go on to page 398.

Capillary IC

Installing the pH-Ag/AgCl Reference Electrode in the Cell for a Capillary IC System

1. To avoid any hydraulic pressure buildup when inserting the pH-Ag/AgCl reference electrode into the cell, make sure that fitting plugs are not installed on the cell inlet and outlet fittings.
2. Use a sharp tool (for example, the tip of a safety pin or a straight pin) to remove the pH-Ag/AgCl reference electrode O-ring (see Figure 9-59).

Figure 9-59. *pH-Ag/AgCl Reference Electrode O-Ring*

3. Using tweezers, install the reference electrode gasket for capillary IC (P/N 072162) into the bottom of the reference electrode well (see Figure 9-60).

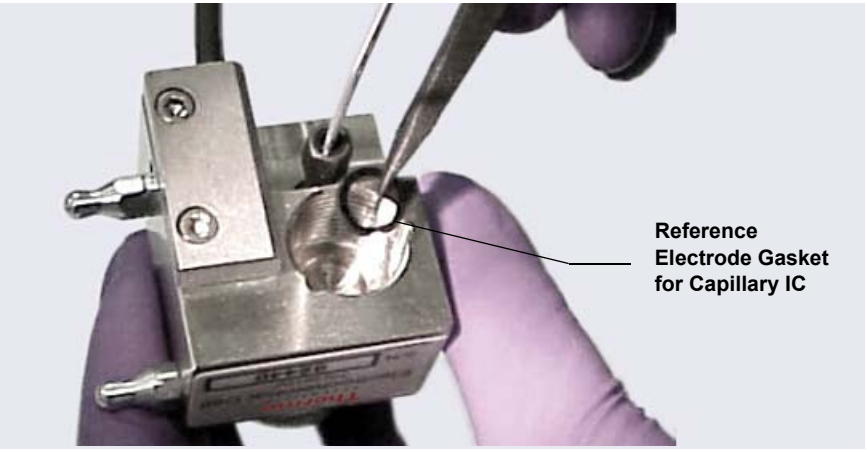


Figure 9-60. *Reference Electrode Gasket for Capillary IC*

4. Make sure the gasket is centered in the bottom of the well and that it does not block the inlet and outlet of the well. The inlet and outlet are small round openings in the bottom of the well (see Figure 9-61).

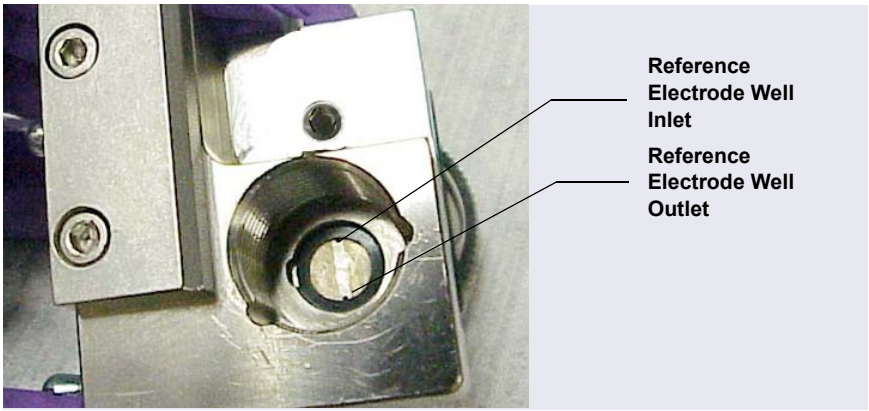


Figure 9-61. *Reference Electrode Well with Reference Electrode Gasket for Capillary IC Installed*

5. Verify that the reference electrode O-ring has been removed and the reference electrode gasket is correctly installed in the bottom of the well.
6. Screw the pH-Ag/AgCl reference electrode into the reference electrode well and tighten it fingertight (see Figure 9-62).

Figure 9-62. *Installing the pH-Ag/AgCl Reference Electrode In the Reference Electrode Well*

7. Orient the cell assembly with the yoke knob on the left and then push the cell onto its mounting location on the ED.
8. Connect the reference electrode cable and the cell cable.
9. Reconnect the cell inlet and outlet lines.

10. Start the pump flow.
11. Turn on the DC power.
12. Wait until the pump pressure has stabilized (30 to 60 seconds) and then turn on the cell voltage.

Analytical IC

Installing the pH-Ag/AgCl Reference Electrode in the Cell for an Analytical IC System

1. To avoid any hydraulic pressure buildup when inserting the reference electrode into the cell, make sure that fitting plugs are not installed on the cell inlet and outlet fittings.
2. Verify that the pH-Ag/AgCl reference electrode O-ring is present (see Figure 9-63) and then screw the pH-Ag/AgCl reference electrode into the reference electrode well and tighten it fingertight (see Figure 9-62).

Figure 9-63. *pH-Ag/AgCl reference electrode O-Ring*

3. Orient the cell assembly with the yoke knob on the left (see Figure 9-52) and push the cell onto its mounting location in the DC compartment.
4. Reconnect the cell inlet and outlet lines.
5. Start the pump flow.
6. Turn on the DC power.
7. Wait until the pump pressure has stabilized (30 to 60 seconds) and then turn on the cell voltage.

9.28.7 Replacing the pH-Ag/AgCl Reference Electrode O-Ring

1. Follow the instructions in Section 9.28.1, to turn off the cell voltage, stop the pump flow, and disconnect the cell from the detector.
2. Unscrew the pH-Ag/AgCl reference electrode and remove it from the cell body (see Figure 9-64).

Figure 9-64. *Removing the pH-Ag/AgCl Reference Electrode (Cell Configured for Analytical IC Shown)*

3. To remove any precipitated salt, rinse the pH-Ag/AgCl reference electrode thoroughly in ASTM Type I (18 megohm-cm) filtered and deionized water that meets the specifications listed in Section 1.5.
4. Use a sharp tool (for example, the tip of a safety pin or a straight pin) to remove the pH-Ag/AgCl reference electrode O-ring (see Figure 9-65).

Figure 9-65. *Removing the pH-Ag/AgCl Reference Electrode O-Ring*

5. Slide the new O-ring (P/N 014067) onto the electrode.

6. To avoid any hydraulic pressure buildup when inserting the pH-Ag/AgCl reference electrode, make sure that fitting plugs are not installed on the cell inlet and outlet fittings.
7. Screw the pH-Ag/AgCl reference electrode into the cell body and tighten fingertight.
8. Orient the cell assembly with the yoke knob on the left and push the cell onto its mounting location in the DC compartment (see Figure 9-52).
9. Reconnect the two cables and the liquid lines.
10. Start the pump flow.
11. Wait until the pump pressure has stabilized (30 to 60 seconds) and then turn on the cell voltage.

9.28.8 Replacing a PdH Reference Electrode

When to Replace a PdH Reference Electrode

Replace the PdH reference electrode if its sensing surface is damaged or if the electrode no longer seals properly. Replace the PdH electrode if performance has degraded (for example, lower response, higher background, or spikes).

The PdH reference electrode typically lasts several years, depending on use.

Items Needed

- PdH reference electrode (P/N 072075)
- Tweezers
- Wrench

PdH Reference Electrode Replacement Procedure

1. Follow the instructions in Section 9.28.1 to turn off the cell voltage, stop the pump flow, and disconnect the cell from the detector.

2. Use a wrench to unscrew the PdH reference electrode nut and then remove the nut from the reference electrode well (see Figure 9-66).

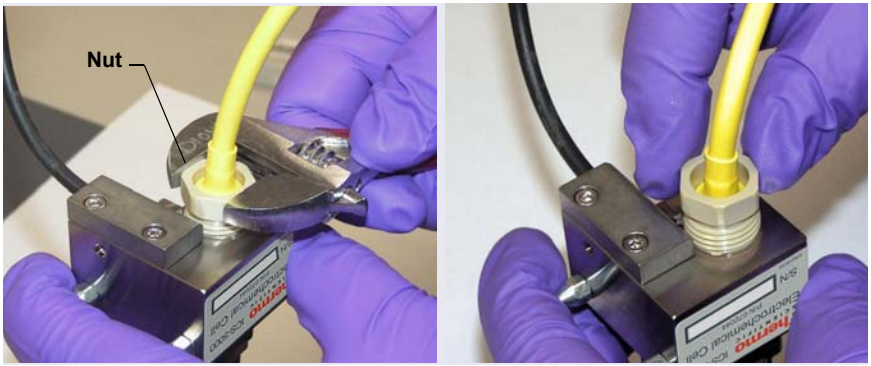


Figure 9-66. *Unscrewing the PdH Reference Electrode Nut*

3. Pull the reference electrode out of the well (see Figure 9-67).

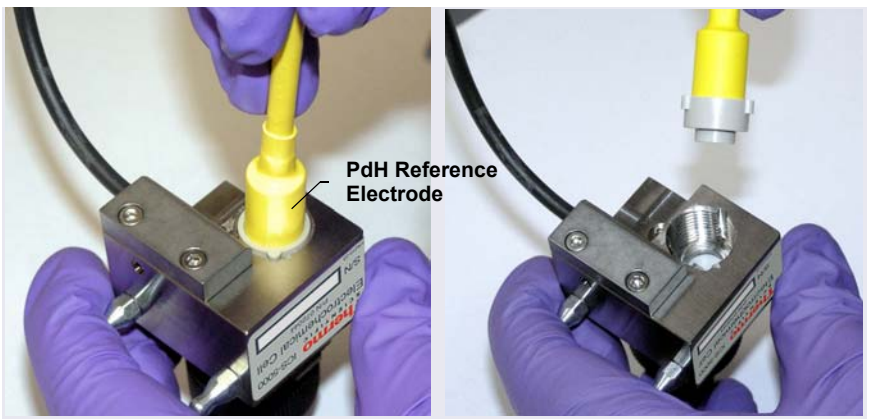


Figure 9-67. *Removing the PdH Reference Electrode from the Reference Electrode Well*

4. Using tweezers, remove the PdH reference electrode gasket from the well (see Figure 9-68).

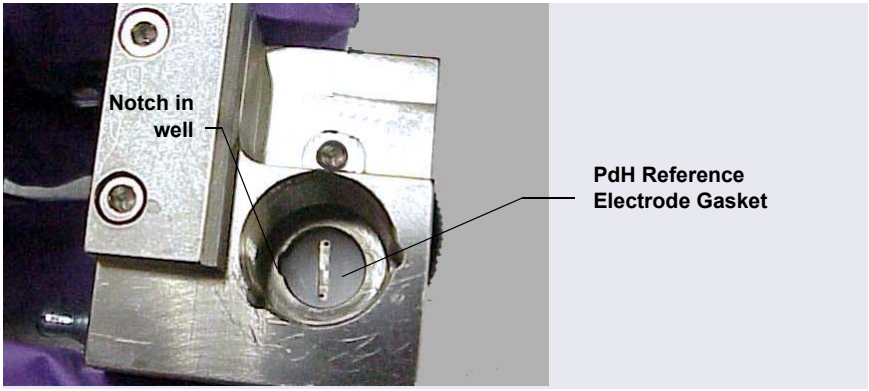


Figure 9-68. *Removing the PdH Reference Electrode Gasket*

5. Using tweezers, grasp the new PdH reference electrode gasket (P/N 072214) on its edge (see Figure 9-69). To avoid deforming the gasket cutout, do not place the tweezer tips on the cutout.

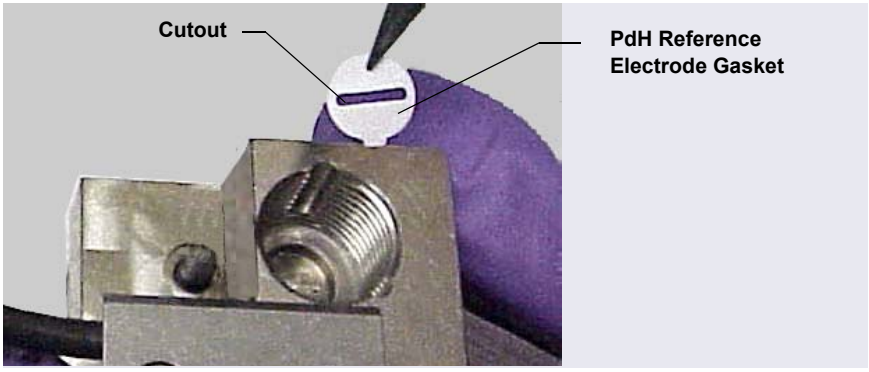


Figure 9-69. *Installing the PdH Reference Electrode Gasket*

6. Align the gasket so that the notched edge of the gasket aligns with the corresponding notch in the reference electrode well and press the gasket into the well.

7. To avoid any hydraulic pressure buildup when inserting the reference electrode into the cell, make sure that fitting plugs are not installed on the cell inlet and outlet fittings.
8. Align the fitting on the end of the PdH reference electrode so that the knobs on the fitting align with the grooves in the reference electrode well (see Figure 9-70).
9. Insert the fitting into the well.

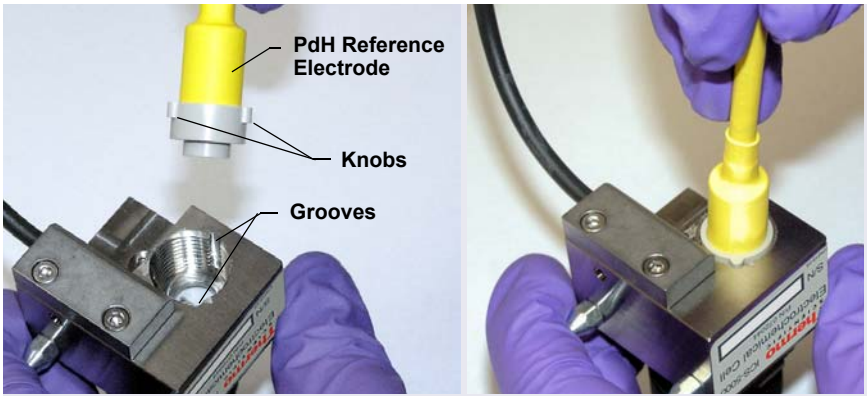


Figure 9-70. *Inserting the PdH Reference Electrode Fitting into the Reference Electrode Well*

10. Screw the nut on the PdH reference electrode into the reference electrode well and tighten it fingertight (see Figure 9-71). After fingertightening, use a wrench to tighten the nut an additional 20 to 30 degrees.

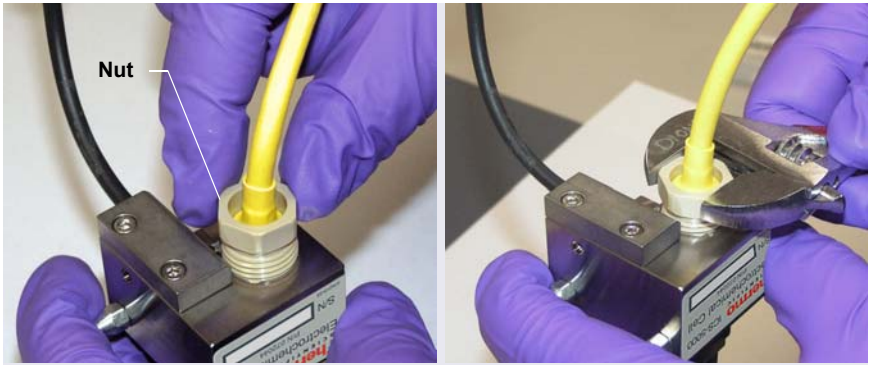


Figure 9-71. *Installing the PdH Reference Electrode Nut*

11. Orient the cell assembly with the yoke knob on the left and then push the cell onto its mounting location on the ED.
12. Connect the reference electrode cable and the cell cable.
13. Reconnect the cell inlet and outlet fittings.
14. Condition the PdH reference electrode (refer to the instructions below).

Conditioning the PdH Reference Electrode

Condition the PdH reference electrode after plumbing the cell:

1. On the Chromeleon 7ePanel Set or Chromeleon 6.8 panel tabset, select the following settings:
    a. **Pump** panel: Set the pump flow rate to 0.01 mL/min. This turns on the pump flow, also.
    b. **EG** panel: Enter 100 mM in the **Target Concentration** field. This turns on the power to the EGC, also.
    c. Verify that eluent is exiting the cell.
    d. **ED** panel: Set the reference electrode mode to **PdH**.
    e. Select DC amperometry mode, set the cell voltage to 0.000 V, and turn on the cell voltage. Switch to integrated amperometry mode and select the PdH-referenced carbohydrate waveform.
2. Condition the electrode for 1 hour at these settings.
3. Turn off the pump flow. This turns off the EGC power and the cell voltage.

9.28.9 Replacing an ED Detector

1. Turn off the pump flow.
2. Press the **POWER** button on the front of the DC for 2 seconds to turn off the DC.
3. Open the DC upper door and disconnect the cell inlet and outlet lines.
4. Disconnect the reference electrode cable and the cell cable.
5. Grasp the cell body and pull straight out to remove the cell from the detector.

6. Press the release lever located below the detector. The detector pops out slightly from the DC compartment. Grasp the detector and pull outward to remove the detector from the compartment.
7. Note the electrical plug on the back of the detector and the receptacle on the inside of the DC.
8. Push the new detector into the opening in the DC and press firmly to ensure the electrical connection is secure.
9. Reinstall the cell and reconnect the cell inlet and outlet lines and the cables.

NOTE If you are installing an ED detector in a system that previously was set up for conductivity detection, remove the suppressor cartridge from the IC Cube and replace it with a suppressor bypass cartridge (P/N 072055). For IC Cube cartridge installation instructions, see Section 9.26.1.

To avoid injury, wait for the TC to cool down before opening the door or performing any maintenance or service procedures.

Afin d'éviter toute brûlure, laisser refroidir le compartiment thermique avant d'ouvrir la porte ou d'effectuer des opérations de maintenance.

Um Verletzungen zu vermeiden, warten Sie bitte, bis der TC abgekühlt ist, ehe Sie die Tür öffnen bzw. Wartungs oder Servicearbeiten durchführen.

9.29 Replacing Tubing and Fittings

The TC is plumbed with the tubing and fittings listed below.

Tubing Size and Type	Color	P/N	Used For
0.125 mm (0.005 in) ID PEEK	Black	052310	Standard bore system connections
0.25 mm (0.010 in) ID PEEK	Red	052306	Microbore system connections
10 mm (0.39 in) ID polyethylene	Colorless	055075	Waste line

Use double-cone 10-32 ferrule fittings (P/N 043276) and 10-32 bolts (P/N 043275) for all tubing connections. For tightening requirements, refer to *Installation of Dionex Liquid Line Fittings* (Document No. 031432). The manual is on the Thermo Scientific Reference Library DVD (P/N 053891).

Use a tubing cutter to cut tubing to the required length. Make sure the cut is at a right angle to the length of the tubing and there are no nicks or burrs on the end.

9.30 Setting Up the Column ID System

The TC Ship Kit (P/N 064789) includes two column ID chip cards (P/N 5710. 1500). The optional Column ID Kit (P/N 066353) includes five chip cards.

These are the main steps required to implement the column ID system:

- Specify the column you want to monitor.
- Install a column ID chip card for the column.
- Close the TC door and select the column properties to be monitored.

To select the column to be monitored:

1. Start the Chromeleon 7 Instrument Configuration program or the Chromeleon 6.8 Server Configuration program.
2. Under the instrument or timebase, right-click the TC and select **Properties** on the context menu.
3. In the TC Properties dialog box, select the **Components** tab to display the **Components** tab page (see Figure 9-72).

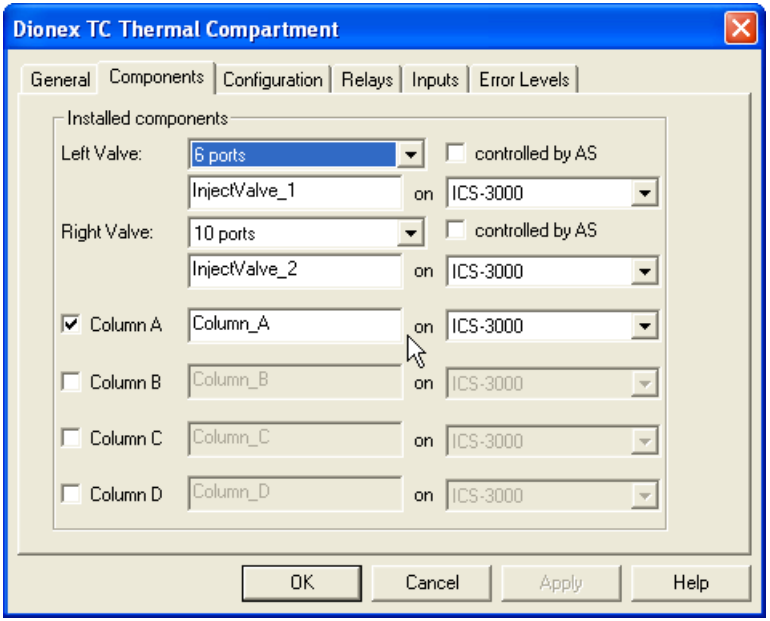


Figure 9-72. *TC Properties Dialog Box: Components Tab Page*

4. Select the check box for the column to be monitored (**A**, **B**, **C**, or **D**) and click **OK**.

To install a column ID chip card:

1. To attach a column ID chip card to the column, wrap the strap around the column, insert the rivet into one of the holes on the strap, and press to secure the strap to the column (see Figure 9-73).

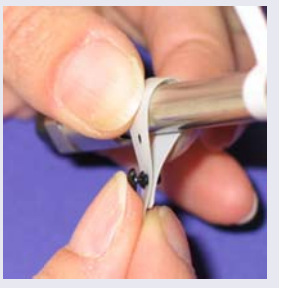


Figure 9-73. *Attaching the Column ID System to the Column*

2. Insert the chip card (with the Dionex logo facing up) into the appropriate card reader (A, B, C, or D) along the top of the compartment (see Figure 9-74).

   When the chip card is installed correctly, the LED next to the slot is green.

Figure 9-74. *Inserting a Column ID Chip Card*

3. Install a chip card for any other columns to be monitored.

To select the column properties to be monitored:

1. Close the TC door, if it is open. (You cannot select column properties unless the door is closed.)
2. On the TC Control panel, click the **Column Details...** button.

   This opens the Column Details screen.
3. For each column, specify the properties the column ID system will monitor. When you finish, click **Close**.

9.31 Rebuilding an Injection Valve

Thermo Fisher Scientific recommends rebuilding the TC injection valve annually. The Injection Valve Rebuild Kit (P/N 057896, 6-port valve; P/N 061759, 10-port valve) contains all required replacement parts.

NOTE Substitution of non-Dionex/Thermo Fisher Scientific parts may impair valve performance and void the product warranty.

NOTE If you prefer, you can replace the injection valve "pod," instead of rebuilding the valve. Replacing the pod is easier and faster than rebuilding the valve.

1. Turn off the pump flow.
2. Press the **POWER** button on the front of the TC to turn off the power.

To avoid injury, wait for the TC to cool down before opening the door or performing any maintenance or service procedures.

Afin d'éviter toute brûlure, laisser refroidir le compartiment thermique avant d'ouvrir la porte ou d'effectuer des opérations de maintenance.

Um Verletzungen zu vermeiden, warten Sie bitte, bis der TC abgekühlt ist, ehe Sie die Tür öffnen bzw. Wartungs oder Servicearbeiten durchführen.

3. Open the TC door.
4. Disconnect each liquid line connected to the injection valve.
5. Follow the instructions provided in the Rebuild Kit to replace the rotor seal, isolation seal, and stator face.

6. Reconnect all liquid lines to the injection valve (see Figure 9-75).

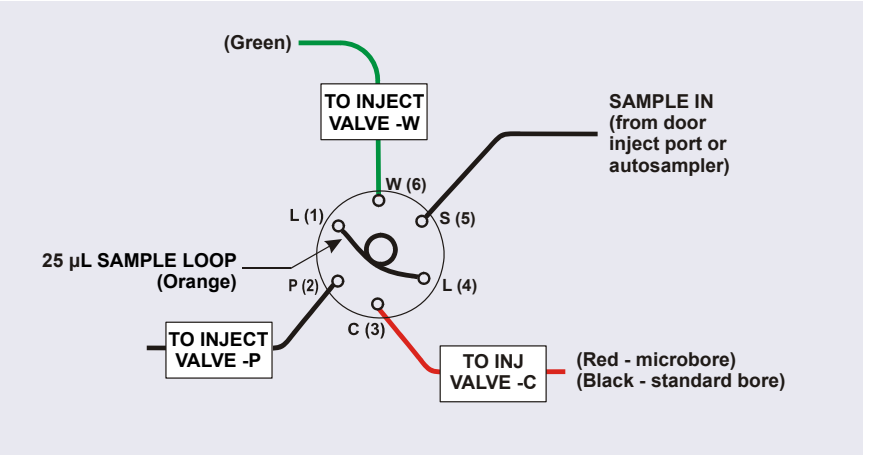


Figure 9-75. *Injection Valve Plumbing (6-Port Valve)*

7. Turn on the power to the TC.
8. Turn on the pump flow. Check for leaks from the valve. Tighten fittings as required (see Section 9.29).
9. Close the TC door.

9.32 Replacing an Injection Valve Pod

This procedure describes how to replace the mechanical part (the “pod”) of the TC injection valve.

NOTE If the valve electronics require service, contact Thermo Fisher Scientific. Electronics-related repair procedures must be performed by Thermo Fisher Scientific personnel.

NOTE Substitution of non-Dionex/Thermo Fisher Scientific parts may impair valve performance and void the product warranty.

1. Turn off the pump flow from the Control panel in Chromeleon 6.8 or Chromeleon 7 or press **PUMP FLOW** on the front of the pump.

CAUTION

To avoid injury, wait for the TC to cool down before opening the door or performing any maintenance or service procedures.

MISE EN GARDE

Afin d'éviter toute brûlure, laisser refroidir le compartiment thermique avant d'ouvrir la porte ou d'effectuer des opérations de maintenance.

VORSICHT

Um Verletzungen zu vermeiden, warten Sie bitte, bis der TC abgekühlt ist, ehe Sie die Tür öffnen bzw. Wartungs-oder Servicearbeiten durchführen.

2. Open the TC door.
3. Disconnect each liquid line connected to the valve.
4. Unscrew the black locking ring on the front of the valve (see Figure 9-76) and remove the ring.
5. Grasp the front of the valve pod and pull out firmly to remove it from the TC.

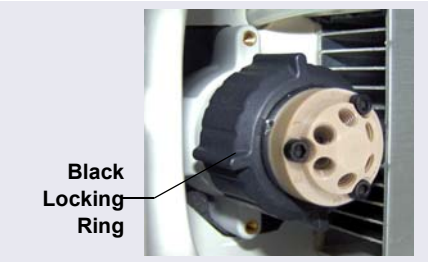


Figure 9-76. *Unscrewing the Locking Ring*

6. Check that the new pod has the correct number of ports for the injection valve being serviced.
7. Align the slots in the new pod with the runner in the valve holder in the TC (see Figure 9-77). Valve pods are keyed to fit only one way (one slot is narrower than the other). Verify that the slots are aligned with their matching runners.

8. Also verify that the two splines on the pod align with the matching splines inside the valve holder (see Figure 9-77). If necessary, twist the end of the pod to adjust the position of the splines.

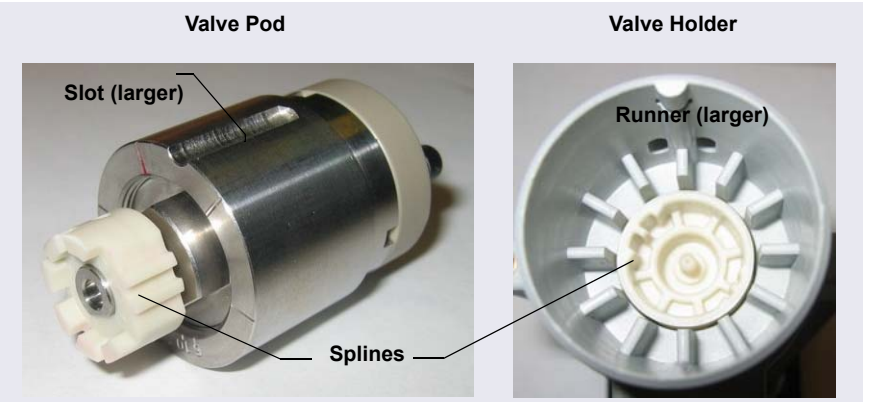


Figure 9-77. *Injection Valve Pod and Pod Holder*

9. Push the pod into the holder until it clicks into place. Replace the black locking ring.
10. Reconnect all liquid lines to the valve.
11. Turn on the pump flow. Check for leaks from the valve. Tighten fittings as required (see Section 9.29).
12. Close the TC door.

9.33 Changing the Main Power Fuses

1. Press the **POWER** button on the front of the TC for 2 seconds to turn off the power.
2. Disconnect the main power cord from both its source and from the TC rear panel.

DANGER

HIGH VOLTAGE—Disconnect the main power cord from its source and also from the rear panel of the TC.

DANGER

HAUTE TENSION—Débranchez le cordon d'alimentation principal de sa source et du panneau arrière du TC.

ACHTUNG

HOCHSPANNUNG—Ziehen Sie das Netzkabel aus der Steckdose und der Netzbuchse auf der Rückseite des TC.

3. The fuse cartridge is located next to the main power switch (see Figure 9-78). Use a small screwdriver to remove the fuse cartridge.

Figure 9-78. *TC Fuse Cartridge*

4. Replace the two fuses with new 2 A IEC 60127-2 time lag fuses (P/N 954776). Thermo Fisher Scientific recommends always replacing *both* fuses.
5. Reinstall the fuse cartridge.
6. Reconnect the main power cord and turn on the power.

ICS-5000 DP/SP

DP/SP Specifications

ICS-5000 SP Single Pump and DP Dual Pump Specifications	
Type	Dual-piston (in series), microprocessor controlled, constant stroke, variable speed, patented Isokinetic Eluent Precompression
Construction	Chemically inert, metal-free PEEK pump heads and flow path; compatible with aqueous eluents from pH 0–14 and reversed-phase solvents
Pressure Range	0–35 MPa (0–5000 psi) (Analytical) 0–41 MPa (0–6000 psi) (Capillary)
Flow Rate Range	• 0.000–10.000 mL/min with settable flow increments at 0.001 mL/min (Analytical) • 0.001–3.000 mL/min with settable flow increments at 0.0001 mL/min (Capillary)
Flow Rate Precision	<0.1% (Analytical)
Flow Rate Accuracy	<0.1% (Analytical) at 14 MPa (2000 psi)
Pressure Ripple	< 1.0% (Analytical) at 1.0 mL/min typical < 0.2% (with damper) at 10 µL/min at 14 MPa (2000 psi)
Pressure	None required
Vacuum Degasser	Integrated, optional 1 channel for isocratic pump or 4 channel for quaternary pump
Piston Seal Wash	Standard, automatic operation
Gradient Formation	Quaternary low pressure (Analytical only) or electrolytic eluent generation at high pressure (Analytical and Capillary)
RFIC-EG Gradients	0.1–100 mM (Analytical) 0.1–200 mM (Capillary)

ICS-5000 SP Single Pump and DP Dual Pump Specifications (Continued)	
Gradient Profiles	Any combination of an unlimited number of linear, convex, and concave positive and negative gradient profiles
Gradient Proportioning Accuracy and Precision (Analytical only)	±0.5% at 2 mL/min
Gradient Mixing (Analytical only)	Passive mixers for 2 mm and 4 mm ID columns, optional
Eluent Generation	Optional eluent generation (RFIC-EG)
Eluent On/Off Valve	Electrically actuated, standard
Leak Sensor	Optical, standard
System Software	
Software	Chromeleon Chromatography Management Software, supports Microsoft Windows® XP or Vista
Automated Procedure Wizards	Yes, standard feature
System Smart Startup and Shutdown	Yes, standard feature
System Wellness and Predictive Performance	Yes, standard feature
Application Templates	Yes, standard feature
Automation Support of 3rd Party Instruments	Yes, fully controls over 300 different instruments from more than 30 manufacturers, including GC, HPLC, and MS
Customizable System Control Panels	Yes, standard feature
Signal Channels	Pump pressure
Data Trending Plots	Yes, all device numerical parameters
System Status Virtual Channels	Yes, standard feature
Power Failure Protection	Yes, standard feature

ICS-5000 SP Single Pump and DP Dual Pump Specifications (Continued)	
System Trigger Commands and Conditionals	Yes, standard feature
Daily Audit Trail	Yes, standard feature
Sample Audit Trail	Yes, standard feature
System Calibration Storage	Yes, factory, present, and previous. Completely user selectable
Customized Reporting	Yes, standard feature with unlimited report workbooks
GLP Compliance	Yes, optional
Electrical	
Main Power Requirements	90–264 VAC, 47–63 Hz (Auto-sensing power supply; no manual voltage or frequency adjustment required) Typical input power: 28 W Maximum line draw: 1.2 A at 110 VAC
Fuse Requirements	Two IEC 60127-2 slow-blow fuses (P/N 954773) rated at 2 A, 250 V
Physical	
Dimensions (h × w × d)	36 × 21 × 48 cm (14 × 8.25 × 19 in.)
Weight	SP: 20.4 kg (45 lb) DP: 24.1 kg (55 lb)
Flow Path	All polymeric (PEEK), anion or cation configurations
Environmental	
Operating Temperature	4–40 °C (40–104 °F)
Operating Humidity	5–95% relative humidity (noncondensing)

ICS-5000 EG

EG Specifications

ICS-5000 EG Eluent Generator Specifications	
Minimum and Maximum Eluent Concentrations	0.1–100 mM (Analytical) 0.1–200 mM (Capillary)
Flow Rates	0.100–3.000 mL/min (Analytical) 0.001–0.030 mL/min (Capillary)
Eluent Types (Analytical)	KOH, LiOH, NaOH Carbonate Carbonate/Bicarbonate Carbonate with pH modifier MSA
Eluent Types (Capillary)	KOH MSA
Maximum Operating Pressure	21 MPa (3000 psi) (Analytical) 35 MPa (5000 psi) (Capillary)
Maximum Solvent Concentration (Analytical and Capillary)	Cations: None Anions: 25% methanol
Gradient Profiles	Standard, any combination of an unlimited number of linear, convex, and concave positive and negative gradient profiles
Number of Cartridges Supported	Two–dual cartridge support
RFIC Eluent Degasser (Analytical Only)	Eluent degasser housed in the EG module
System Software	
Software	Chromeleon Chromatography Data System, supports Microsoft Windows XP and Vista
Automated Procedure Wizards	Yes, standard feature
System Smart Startup and Shutdown	Yes, standard feature
System Wellness and Predictive Performance	Yes, standard feature

ICS-5000 EG Eluent Generator Specifications (Continued)	
Application Templates	Yes, standard feature
Automation Support of Third-Party Instruments	Yes, fully controls over 300 different instruments including GC, HPLC, and MS from more than 30 manufacturers.
Customizable System Control Panels	Yes, standard feature
Signal Channels	Eluent concentration
Data Trending Plots	Device numerical parameters plotted
System Status Virtual Channels	Yes, standard feature
Power Failure Protection	Yes, standard feature
System Trigger Commands and Conditionals	Yes, standard feature
Daily Audit Trail	Yes, standard feature
Sample Audit Trail	Yes, standard feature
Eluent Cartridge Information Storage	Yes, serial number and expiration date
Customized Reporting	Yes, standard feature with unlimited report workbooks
GLP Compliance	Yes, optional package provides security system, modification history, and electronic signatures
Electrical	
Main Power Requirements	90–264 VAC, 47–63 Hz (Auto-sensing power supply; no manual voltage or frequency adjustment required) Typical input power: 18 W Maximum line draw: 1 A at 110 VAC
Fuse Requirements	Two IEC 60127-2 slow-blow fuses (P/N 954773) rated at 2 A, 250 V

ICS-5000 EG Eluent Generator Specifications (Continued)	
Physical	
Dimensions (h × w × d)	41 × 23 × 56 cm (16 × 8.75 × 21.5 in.)
Weight	25 kg (40 lb) (without optional items)
Flow Path	All polymeric (PEEK), anion or cation configurations
Environmental	
Operating Temperature	4–40 °C (40–104 °F)
Operating Humidity	5–95% relative humidity (noncondensing)

ICS-5000 ER Eluent Regeneration Specifications (Analytical IC Only)	
Eluents	Carbonate and carbonate/bicarbonate combinations up to 20 mM MSA up to 34 mM
Flow Rates	1.00–2.00 mL/min
Continuous Operation with 4 L of Eluent	Up to 28 days or 2000 samples, typically
Always On, Always Ready Capable	Yes, standard feature
Remains Fully Calibrated for Extended Periods of Time (≤28 Days)	Yes, standard feature. Results are traceable to a single calibration
System Wellness	Consumables usage monitoring for predictive maintenance
Maximum Operating Pressure	21 MPa (3000 psi)
Operating Temperature Range	4–40 °C

ICS-5000 DC

DC Specifications

Dionex ICS-5000 DC Detector/Chromatography Compartment Specifications	
Dual Temperature Zone Model: Independent Temperature Control of Each Zone	Upper Zone Temperature Range: 10–40 °C (minimum temperature: ambient -20 °C) (maximum temperature: ambient +20 °C) Lower Zone Temperature Range: 10–70 °C (minimum temperature: ambient -15 °C) (maximum temperature: ambient +50 °C) Temperature Accuracy: ±0.5 °C Temperature Stability: ±0.2 °C Temperature Precision: ±0.2 °C
Lower Zone (Analytical)	Injection Valves: Up to two 6- or 10-port valves (upgradeable, field installable) Up to two column sets 1–9 mm diameter Maximum Column Length: 250 mm plus 50 mm guard column Precolumn Heat Exchangers: two (2 mm or 4 mm column ID version)
Automation Manager: (Optional, Analytical Only)	Injection Valves: Up to two high-pressure valves, either 6- or 10-port, 2-position Low Pressure Valves: Up to two inert, 2- or 3-way Reaction Coil Heater (RCH): Holds two reaction coils RCH Temperature Range: 5 °C above upper zone, 80 °C maximum AutoPrep Kit: Dual loop with sample pre-concentration All valves and heater upgradeable and field installable
Capillary IC Cube: (Optional – but required for capillary chemistries)	One or two IC Cube modules hold the following: Injection Valves: Up to two (one per cube) high-pressure valves, 4-port, 2-position EG Degasser Column and Guard Carbonate Removal Device Capillary Suppressor (See Suppressor section) IC Cubes and cartridges are customer installable, with pre-formed tubing and color-coded labeling Capillary column heater, 15 to 80 °C

Dionex ICS-5000 DC Detector/Chromatography Compartment Specifications	
Flow Path	Plumbing configurations for 4 mm, 2 mm, and 0.4 mm columns, fully inert, PEEK
Detectors	Any combination of two conductivity or electrochemical detectors, upgradeable and field installable. Dual detectors can be operated simultaneously or independently. Optional remote operation up to 3 m from instrument
Analog Signal Output	Two analog output channels, two 24 V relays, two TTL Out and eight TTL In lines, upgradeable and field installable, optional
Leak Detection	Optical leak sensor standard
Application Control Automation	Yes, standard. All DC modules come equipped with two switched AC controllers built-in to automate external devices and the ability to control up to six low-pressure 2-way or 3-way valves for fluidic automation
Suppression	
Non -suppressed conductivity	Yes, supported
Suppressor wear parts	None. No valves, pumps, peristaltic pump tubin,g or inline filters required
Chemical Suppression	2 mm and 4 mm anion and cation membrane suppression available
Displacement Chemical Suppression	2 mm and 4 mm anion and cation membrane suppression available
Electrolytic Suppression, Self-Regenerating.	0.4 mm (with optional IC Cube), 2 mm and 4 mm anion and cation. Membrane and MonoDisc suppression bed types available. Membrane for capillary (0.4 mm) suppressor.
Electrolytic Suppression, Self-Regenerating, External Water Mode	0.4 mm (with optional IC Cube), 2 mm and 4 mm anion and cation. Membrane and MonoDisc suppression bed types available for 2 mm and 4 mm. Membrane for capillary (0.4 mm) suppressor.
Salt Converter	Available in 2 mm and 4 mm versions
AMMS-ICE	Available in 2 mm and 4 mm versions

Dionex ICS-5000 DC Detector/Chromatography Compartment Specifications	
Carbonic Acid Removal for Anions	ASRS and AMMS plus CRD 300 for 2 mm and 4 mm versions, CRD (0.4 mm) for capillary suppressors
Suppression Capacities	Anion SRS 300 (4 mm): 200 µeq/min Cation SRS 300 (4 mm): 110 µeq/min Anion SRS 300 (2 mm): 50 µeq/min Cation SRS 300 (2 mm): 37.5 µeq/min Anion MMS 300 (4 mm): 150 µeq/min Cation MMS 300 (4 mm): 150 µeq/min Anion MMS 300 (2 mm): 37.5 µeq/min Cation MMS 300 (2 mm): 37.5 µeq/min Anion AES: 25 µeq/min Cation AES: 25 µeq/min AMMS-ICE: N/A Anion CES (0.4 mm): 2 µeq/min Cation CES (0.4 mm): 1.5 µeq/min
Suppressor Void Volumes	SRS 300 (4 mm): <50 µL SRS 300 (2 mm): <15 µL MMS 300 (4 mm): <50 µL MMS 300 (2 mm): <15 µL AMMS-ICE 300 (4 mm): <50 µL AMMS-ICE 300 (2 mm): <15 µL AES (Anion or Cation): <35 µL Anion CES (0.4 mm): <1.0 µL Cation CES (0.4 mm):<1.0 µL
System Software	
Software	Chromeleon Chromatography Data System, requires Microsoft Windows XP or Vista
Automated Procedure Wizards	Yes, standard feature
System Smart Startup and Shutdown	Yes, standard feature
System Wellness and Predictive Performance	Yes, standard feature
Application Templates	Yes, standard feature

Dionex ICS-5000 DC Detector/Chromatography Compartment Specifications	
Automation Support of Third-Party Instruments	Yes, fully controls over 300 different instruments from more than 30 manufacturers, including GC, HPLC, and MS.
Customizable System Control Panels	Yes, standard feature
Signal Channels	Detector signals, detector background signals, temperatures
Data Trending Plots	Yes, all device numerical parameters plotted
System Status Virtual Channels	Yes, standard feature
Power Failure Protection	Yes, standard feature
System Trigger Commands and Conditionals	Yes, standard feature
Daily Audit Trail	Yes, standard feature
Sample Audit Trail	Yes, standard feature
System Calibration Storage	Yes, factory, current, and previous. Completely user selectable
Customized Reporting	Yes, standard feature with unlimited report workbooks
GLP Compliance	Yes, optional
Electrical	
Main Power Requirements	90–265 VAC, 47–63 Hz (Auto-sensing power supply; no manual voltage or frequency adjustment required) Typical input power: 200 W Maximum line draw: 9.2 A at 110 VAC
Fuse Requirements	Two IEC 60127-2 slow-blow fuses (P/N 954772) rated at 10 A, 250 V

Dionex ICS-5000 DC Detector/Chromatography Compartment Specifications	
Physical Specifications	
Dimensions (h × w × d):	44.5 × 42 × 57 cm (17.5 × 16.5 × 22.5 in)
Weight	38 kg (84 lb)
Flow Path	All polymeric (PEEK), anion or cation configurations
Environmental	
Operating Temperature	4–40 °C (40–104 °F)
Operating Humidity	5– 95% relative humidity (noncondensing)

Dionex ICS-5000 Conductivity Detector Specifications	
Electronics Type	Microprocessor controlled digital signal processing, autoranging
Cell Drive	8 kHz square wave
Linearity	1%
Resolution	0.00238 nS/cm
Output Range	Digital Signal Range: 0–15,000 µS/cm, Analog Signal Range: 0–15,000 µS/cm
Noise, Wet	<0.2 nS at 23 µS/cm background <0.1 nS at 1 µS/cm background
Filter	Rise times 0 to 10 s, programmable
Sampling Rate	1 to 100 Hz, user settable or automatic
Cell Temperature	5 °C above DC upper zone temperature to 60 °C maximum. User settable, working range is identical to settable range.
Cell Temperature Stability	<0.001 °C
Cell Temperature Compensation	Default 1.7% per °C; programmable from 0–3% per °C
Flow Cell Maximum Pressure	10 MPa (1500 psi)
Flow Cell Volume	0.7 µL (Analytical), 0.02 µL (Capillary)

Dionex ICS-5000 Conductivity Detector Specifications (Continued)	
Cell Electrodes	Passivated 316 stainless steel. Compatible with MSA
Cell Body	Chemically inert polymeric material
Heat Exchanger	Inert, tortuous-path for low axial dispersion
System Software	
Software	Chromeleon Chromatography Data System, requires Microsoft Windows XP or Vista
Automated Procedure Wizards	Yes, standard feature
System Smart Startup and Shutdown	Yes, standard feature
System Wellness and Predictive Performance	Yes, standard feature
Application Templates	Yes, standard feature
Automation Support of Third-Party Instruments	Yes, fully controls over 300 different instruments from more than 30 manufacturers, including GC, HPLC, and MS
Customizable System Control Panels	Yes, standard feature
Signal Channels	Conductivity, Total Conductivity
Data Trending	Yes, all device numerical parameters plotted
System Status Virtual Channels	Yes, standard feature
Power Failure Protection	Yes, standard feature
System Trigger Commands and Conditionals	Yes, standard feature
Daily Audit Trail	Yes, standard feature
Sample Audit Trail	Yes, standard feature
System Calibration Storage	Yes, factory, present, and previous. Completely user selectable
Customized Reporting	Yes, standard feature with unlimited report workbooks

Dionex ICS-5000 Conductivity Detector Specifications (Continued)	
GLP Compliance	Yes, optional
Physical	
Dimensions (h x w x d)	6.9 × 16.7 × 9.9 cm (2.7 × 6.5 × 3.9 in)
Weight	400 g (1.6 lb.)

ICS-5000 ED Electrochemical Detector Specifications	
Electronics Type	Microprocessor controlled digital signal processing
Electronic Noise (Wet Noise) (Capillary and Analytical)	IPAD (Au electrode) < 50 pC @ 10 mM KOH, DC Amperometry (GC) < 10 pA @ catecholamine eluent
Potential Range	-2.0 to 2.0 V in 0.001 V increments
Signal Range: Digital and Analog	Integrated amperometry: 50 pC to 200 µC DC amperometry: 5 pA to 74 µA
Filter	0–10 s response time, user settable
Control Mode	Local or remote control using relay closures or TTL, or control using Chromeleon via DC module
Cell Body	Titanium body with narrow bore PEEK inlet tubing for capillary format, titanium inlet tubing for analytical format. Compatible with 0.2–0.6 mm ID columns (PEEK inlet), 2– 7 mm ID columns (titanium inlet)
Working Electrodes	Conventional: gold, glassy carbon, platinum, and silver Disposable: gold, platinum, carbon and silver
Reference Electrode	pH-Ag/AgCl combination, one piece design (Analytical and Capillary) PdH combination, one piece design (Capillary only)
Autoranging	Yes
Analog Output	User selectable full scale of 10, 100, or 1000 mV
Cell Volume @ Working Electrode	<0.2 µL

ICS-5000 ED Electrochemical Detector Specifications (Continued)	
Maximum Cell Operating Pressure	0.7 MPa (100 psi)
System Software	
Software	Chromeleon Chromatography Data System, requires Microsoft Windows XP or Vista
Detection Modes	DC amperometry, pulsed amperometry, and integrated amperometry Detection modes include use of multiple waveforms and multiple integration times to optimize detection conditions for individual analytes Integrated amperometry mode—unlimited changes to the waveform profile's number of segments, duration of each segment, and voltage applied at each segment
3-D Amperometry	Three-dimensional display of the raw integrated amperometry data set, with crosshairs on an isoamperometric plot used to select slices of the plot along the applied voltage axis (to render a chromatogram) and along the time axis (to render a voltammogram)
Automated Procedure Wizards	Yes, standard feature
System Smart Startup and Shutdown	Yes, standard feature
System Wellness and Predictive Performance	Yes, standard feature
Application Templates	Yes, standard feature
Automation Support of Third-Party Instruments	Yes, fully controls over 300 different instruments from more than 30 manufacturers, including GC, HPLC, and MS
Customizable System Control Panels	Yes, standard feature
Signal Channels	Electrochemical and total electrochemical signals
Data Trending Plots	Yes, all device numerical parameters plotted

ICS-5000 ED Electrochemical Detector Specifications (Continued)	
System Status Virtual Channels	Yes, standard feature
Power Failure Protection	Yes, standard feature
System Trigger Commands and Conditionals	Yes, standard feature
Daily Audit Trail	Yes, standard feature
Sample Audit Trail	Yes, standard feature
System Calibration Storage	Yes, factory, present, and previous. Completely user selectable
Customized Reporting	Yes, standard feature with unlimited report workbooks
GLP Compliance	Yes, optional
Physical	
Dimensions (h x w x d)	6.9 × 16.7 × 9.9 cm (2.7 × 6.5 × 3.9 in)
Weight	400 g (1.6 lb.)

TC Specifications

ICS-5000 TC Thermal Compartment Specifications	
Temperature Range	5–85 °C (max. 18 °C below ambient) in 0.1 °C increments
Temperature Performance	Accuracy: ±0.5 °C Stability: ±0.1 °C Precision: ±0.1 °C
Heat-up/Cool-down Time	Typically 15 min 20 °C to 50 °C and 50 °C to 20 °C
High-Pressure Valve Types	6-port, 2-position Rheodyne PEEK (injection) valve 10-port, 2-position Rheodyne PEEK (switching) valve
Column Capacity	Three column sets; 1–9 mm
Maximum Column Length	300 mm + 50 mm guard column
Precolumn Heat Exchangers (optional)	Two low delay volume exchangers
Leak Detection	Humidity and vapor sensors
TTL and Relay Inputs and Outputs	Two digital inputs/outputs Two relay outputs
Control	Chromeleon Chromatography Data System
Computer Connection	USB
Electrical	
Main Power Requirements	90–264 VAC, 47–63 Hz (Auto-sensing power supply; no manual voltage or frequency adjustment required) Power limit: 150 W
Fuse Requirements	Two IEC 60127-2 time lag fuses (P/N 954776) rated at 2 A, 250 V
Physical	
Dimensions	17.4 × 44.4 × 50.3 cm (6.8 × 17.5 × 19.8 in.)
Weight	15.4 kg (34 lb)

ICS-5000 TC Thermal Compartment Specifications (Continued)	
Environmental	
Operating Temperature	10–35 °C (50–95 °F)
Operating Humidity	5–80% relative (noncondensing)

ICS-5000 DP/SP

DP/SP Reordering Information

Part Number	Item
Pump Head Components	
074447 (capillary) 062083 (analytical)	Primary pump head
074240 (capillary) 062079 (analytical)	Secondary pump head
044541 (capillary) 045722 (analytical)	Inlet check valve assembly (for primary pump head) (includes inlet nut and 1/8 in cartridge)
044520 (capillary) 045721 (analytical)	Outlet check valve assembly (for primary pump head) (includes outlet nut and 1/8 in cartridge)
075493 (capillary) 064946 (analytical)	Main piston seal
074371	Backup ring (for capillary pumps)
040695	O-ring (for capillary or analytical pump)
074446 (capillary) 062064 (analytical)	Seal wash body
068628 (capillary) 063382 (analytical)	Piston seal wash seal
068627 (capillary) 062092 (analytical)	Retainer for piston seal wash seal
068646 (capillary) 062082 (analytical)	Piston
063968	Priming valve for secondary pump head (for capillary or analytical pump)
063382	Priming valve knob seal for secondary pump head (for capillary or analytical pump)

Part Number	Item
Piston Seal Wash System	
064155	Piston seal wash reservoir
063268	PharMed tubing, 0.159 cm (0.0625 in) ID **Note:** Order 12 in of tubing for replacement of piston seal wash tubing.
064079	Tygon 2075 tubing, 0.15 cm (0.060 in) ID **Note:** Order 12 in of tubing for replacement of piston seal wash tubing.
063518	External Seal Wash Kit
Eluent Storage and Delivery	
072059	EO without reservoirs
072057	Dionex ICS-5000 Eluent Organizer with 2 2-liter reservoirs
072058	Dionex ICS-5000 Eluent Organizer with 4 2-liter reservoirs
063291	Eluent reservoir (plastic), 1-liter
062510	Eluent reservoir (plastic), 2-liter
063292	Eluent reservoir (plastic), 4-liter
074423	EO Regulator Accessory and Stand
064792	TC/VWD/PDA Regulator Bracket Kit
074422	Regulator
045987	Filter, end-line
044105	Filter, high-pressure inline
Miscellaneous	
042126	GM-3 Gradient Mixer
049135	GM-4 Gradient Mixer
043276	Ferrule fitting, 10-32 double-cone
0643275	Fitting bolt, 10-32 (for double-cone ferrule fitting)
062511	Ferrule fitting, 1/16 in
052230	Fitting bolt, 1/16 in
042772	Plug

Part Number	Item
054578	Syringe, 10 cc
954773	Fuse, IEC 60127-2 slow-blow; rated at 2 A, 250 V
063246	USB cable, 1 m (3 ft) long
005.9001A	Cinch connector, 2-pin
Maintenance Kits	
075038	ICS-5000 Analytical Pump Preventive Maintenance Kit
075039	ICS-5000 Capillary Pump Preventive Maintenance Kit

EG Reordering Information

Part Number	Item
Consumables for Capillary EG	
072076	EGC KOH (Capillary)
072077	EGC MSA (Capillary)
072078	CR-ATC (Capillary)
072079	CR-CTC (Capillary)
Consumables for Analytical EG	
074536	EGC III K_2CO_3
074532	EGC III KOH
074534	EGC III LiOH
074535	EGC III MSA
074533	EGC III NaOH
060477	CR-ATC
060478	CR-CTC
080135	EPM III Electrolytic pH Modifier
061686	EGC-CO_3 Mixer (4 mm)
063443	EGC-CO_3 Mixer (2 mm)
Precision Cut Tubing for Capillary EG	
072203	0.062 mm (0.0025 in) ID PEEK, 61 cm (24 in); CR-TC **ELUENT OUT** to EG Degas **ELUENT IN**
072204	0.062 mm (0.0025 in) ID PEEK, 18 cm (7 in); CR-TC **ELUENT IN** to EGC **OUT**
Backpressure Coils	
053762	Backpressure coil, 2.0 mL/min, 500 psi, 4 mm
053763	Backpressure coil, 2.0 mL/min, 1000 psi, 4 mm
053764	Backpressure coil, 0.5 mL/min, 500 psi, 2 mm
053765	Backpressure coil, 0.5 mL/min, 1000 psi, 2 mm

Part Number	Item
Miscellaneous	
074459	EG degas cartridge (for capillary IC systems). Can be used with system pressures up to 35 MPa (5000 psi).
074218	RFIC Eluent Degasser (f5or analytical IC systems)
954773	Fuse, IEC 60127-2 slow-blow; rated at 2 A, 250 V
063246	USB cable, 1 m (3 ft) long
043276	Ferrule fitting, 10-32 double-cone
043275	Fitting bolt, 10-32 (for double-cone ferrule fitting)
046985	Mini-screwdriver

DC Reordering Information

Part Number	Item
Valves and Accessories	
074525	High-pressure (injection), 4-port
061961	High-pressure (injection or switching valve), 6-port
061962	High-pressure (injection or switching valve), 10-port
061971	Low-pressure valve, 3-way
061745	Low-pressure valve, 2-way
042949	Sample loop, 10 µL
042857	Sample loop, 25 µL
044105	Filter, high-pressure inline (for sample filtering)
024305	Luer adapter fitting, 1/4-28 (for manual injections)
016388	Syringe, 1 cc (for manual injections)
074698	Valve rebuild kit, 4-port
057896	Valve rebuild kit, 6-port
061759	Valve rebuild kit, 10-port
IC Cube and Accessories for Capillary IC	
072000	Dionex IC Cube
072186	IC Cube tubing kit (includes precision cut tubing for column connections)
074459	EG degas cartridge (capillary). Can be used with system pressures up to 35 MPa (5000 psi).
072052	ACES 300 Anion Capillary Electrolytic Suppressor
072053	CCES 300 Cation Capillary Electrolytic Suppressor
072055	Suppressor bypass cartridge
072054	CRD 200 Carbonate Removal Device (Capillary)
072056	CRD bypass cartridge

Part Number	Item
Conductivity Detector for Capillary IC	
072041	Dionex ICS-5000 Conductivity Detector (Capillary)
Conductivity Detector and Accessories for Analytical IC	
061716	Dionex ICS-5000 Conductivity Detector (Analytical)
056116	AAES Anion Atlas Electrolytic Suppressor
056118	CAES Cation Atlas Electrolytic Suppressor
064555	ASRS 300 2 mm Anion Self-Regenerating Suppressor
064556	CSRS 300 4 mm Cation Self-Regenerating Suppressor
064557	CSRS 300 2 mm Cation Self-Regenerating Suppressor
045460	Suppressor gas separator waste tube
045877	Backpressure coil for 4 mm suppressor
045878	Backpressure coil for 2 mm suppressor
Electrochemical Detector and Accessories for Capillary and Analytical IC	
072042	Dionex ICS-5000 Electrochemical Detector (ED) (without cell)
072044	ED cell
061879	pH-Ag/AgCl reference electrode
014067	O-ring for pH-Ag/AgCl reference electrode (for analytical)
072162	Gasket for pH-Ag/AgCl reference electrode (for capillary)
072075	PdH reference electrode
072214	Gasket for PdH reference electrode
061749	ED gold conventional working electrode, with gasket and polishing kit
061751	ED platinum conventional working electrode, with gasket and polishing kit
061753	ED glassy carbon conventional working electrode, with gasket and polishing kit
061755	ED silver conventional working electrode, with gasket and polishing kit
045972	Gasket, PTFE, 0.001 in (for conventional working electrode)

Part Number	Item
063722	ED AAA gold working electrode, with gasket and polishing kit
060082	Gold AAA-Direct disposable working electrodes (6 electrodes, with 2 gaskets)
060139	Gold carbohydrate disposable working electrodes (polyester substrate) (6 electrodes, with 2 gaskets)
066480	Gold carbohydrate disposable working electrodes (PTFE substrate) (6 electrodes, with 2 gaskets)
064440	Platinum disposable working electrodes (6 electrodes, with 2 gaskets)
063003	Silver disposable working electrodes (6 electrodes, with 2 gaskets)
069336	Carbon disposable working electrodes (6 electrodes, with 2 gaskets)
060141	Gaskets for disposable working electrodes, PTFE, 0.002-in (4 gaskets) (for analytical systems)
069339	Gasket for carbon disposable working electrodes, ULTEM, 0.001-in (for analytical systems)
072117	Gasket for disposable working electrodes, PTFE, 0.001 in (2 gaskets) (for capillary systems)
062158	ED cell polypropylene support block (for use with disposable electrodes)
036313	Polishing kit
036319	Coarse polishing compound
036318	Fine polishing compound
036321	Polishing pads
Automation Manager	
061738	Dionex ICS-5000 Automation Manager, two 10-port high-pressure valves, two low-pressure 3-way valves
061736	Dionex ICS-5000 Automation Manager, one 10-port high-pressure valve, one low-pressure 3-way valve
061740	Dionex ICS-5000 Automation Manager, one 6-port high-pressure valve, one low-pressure 3-way valve

Part Number	Item
061734	Dionex ICS-5000 Automation Manager, tray with no valves
061746	RCH-1 Reaction Coil Heater
062561	Temperature stabilizer, standard bore, 0.25 mm (0.010 in) ID
062562	Temperature stabilizer, microbore, 0.125 mm (0.005 in) ID
Analog Output/Relay/TTL	
062201	I/O option
923686	Connector plug, 12-position
043598	Twisted pair of wires
Miscellaneous	
954772	Fuse, IEC 60127-2 slow-blow; rated at 10 A, 250 V
960777	USB cable, 1.8 m (6 ft) long
062437	Leak sensor
043276	Ferrule fitting, 10-32 double-cone
043275	Fitting bolt, 10-32 (for double-cone ferrule fitting)
044105	Filter, high-pressure inline
Maintenance Kits	
075040	0.4 µL Internal Loop High-Pressure Valve Preventive Maintenance Kit
075041	6-Port High-Pressure Valve Preventive Maintenance Kit
075042	10-Port High-Pressure Valve Preventive Maintenance Kit

TC Reordering Information

Part Number	Item
Valves and Accessories	
057896	Injection Valve Rebuild Kit for 6-port valve (includes valve seal, hexagon wrench, and instructions)
061759	Injection Valve Rebuild Kit for 10-port valve (includes valve seal, hexagon wrench, and instructions)
061961	Injection valve head (including seal) for 2-position, 6-port valve
061962	Injection valve head (including seal) for 2-position, 10-port valve
042857	Sample loop, 25 µL
Consumables	
6710.1505	Column ID Kit (includes five column ID chip cards)
064786	Column Clips Kit (includes six column clips)
064548	Temperature stabilizer, standard bore, 0.25 mm (0.010 in) ID
064650	Temperature stabilizer, microbore, 0.125 mm (0.005 in) ID
Miscellaneous	
954776	Fuse, IEC 60127-2 time lag, rated at 2 A (two fuses required)
063246	USB cable, 1 m (3 ft)
6000.1004	6-pin mini-DIN signal cable, 5 m (16.4 ft)
064792	TC/VWD/PDA Regulator Bracket Kit
Maintenance Kit	
075041	6-Port High-Pressure Valve Preventive Maintenance Kit
075042	10-Port High-Pressure Valve Preventive Maintenance Kit

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