Empower Gas Chromatography

Getting Started Guide

NOTICE

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Preface

The *Empower Gas Chromatography Getting Started Guide* describes the basics of how to set up GC instruments with your Empower™ system, how to develop a GC instrument method, and how to use custom fields to enhance your GC data. This guide also covers basic information for troubleshooting your GC systems.

Organization

This guide contains the following:

Chapter 1 briefly describes the GC instruments you control using Empower software. It also contains a suggested reading path, with relevant sections for GC users.

Chapter 2 describes how to connect GC hardware to the Empower system.

Chapter 3 describes how to create a GC instrument method and how to make manual injections.

Chapter 4 contains information to help you troubleshoot your GC system.

Related Documentation

Waters Licenses, Warranties, and Support: Provides software license and warranty information, describes training and extended support, and tells how Waters handles shipments, damages, claims, and returns.

Online Documentation

Empower Help: Describes all Empower windows, menus, menu selections, and dialog boxes for the base software and software options. Also includes reference information and procedures for performing all tasks required to use Empower software. Included as part of the Empower software.

Empower Read Me File: Describes product features and enhancements, helpful tips, installation and/or configuration considerations, and changes since the previous version.

Empower LIMS Help: Describes how to use the Empower LIMS Interface to export results and import worklists.

Empower Toolkit Professional Help: Describes how to use the common-object-model, message-based protocol to communicate with the Empower software from a third-party application.

Printed Documentation for Base Product

Empower Software Getting Started Guide: Provides an introduction to the Empower software. Describes the basics of how to use Empower software to acquire data, develop a processing method, review results, and print a report. Also covers basic information for managing projects and configuring systems.

Empower Software Data Acquisition and Processing Theory Guide: Provides theories pertaining to data acquisition, peak detection and integration, and quantitation of sample components.

Empower System Installation and Configuration Guide: Describes Empower software installation, including the stand-alone Personal workstation, Workgroup configuration, and the Enterprise client/server system. Discusses how to configure the computer and chromatographic instruments as part of the Empower System. Also covers the installation, configuration, and use of acquisition servers such as the LAC/E^{32} module, the busLAC/E™ card, and interface cards used to communicate with serial instruments.

Empower System Upgrade and Configuration Guide: Describes how to add hardware and upgrade the Empower software using an import-and-export upgrade method.

Empower Software System Administrator's Guide: Describes how to administer the Empower Enterprise client/server system and Workgroup configuration.

Empower Software Release Notes: Contains last-minute information about the product. Also provides supplementary information about specific Empower software releases.

Printed Documentation for Software Options

Empower System Suitability Quick Reference Guide: Describes the basics of the Empower System Suitability option and describes the equations used by the System Suitability software.

Empower PDA Software Getting Started Guide: Describes the basics of how to use the Empower PDA option to develop a PDA processing method and to review PDA results.

Empower GPC Software Getting Started Guide: Describes how to use the Empower GPC option to develop a GPC processing method and to review GPC results.

Empower GPCV Software Getting Started Guide: Describes how to use the Empower GPCV option to develop a GPCV processing method and to review GPCV results.

Empower Light Scattering Software Getting Started Guide: Describes how to use the Empower Light Scattering option to develop a light scattering processing method and to review light scattering results.

Empower ZQ Mass Detector Software Getting Started Guide: Describes installation, configuration, calibration, and tuning methods, as well as how to operate the ZQ Mass Detector with Empower software.

Empower Chromatographic Pattern Matching Software Getting Started Guide: Describes how to use the Chromatographic Pattern Matching option to develop a pattern matching processing method and to review pattern matching results.

Empower Dissolution System Software Quick Start Guide: Describes how to operate the Alliance® Dissolution System using Empower software.

Empower Toolkit Programmer's Reference Guide: Describes how to use the common-object-model, message-based protocol to communicate with Empower software from a third-party application.

Waters Integrity System Getting Started Guide: Describes features of the Waters Integrity® System and provides step-by-step tutorials that guide a user through the use of the Empower Mass Spectrometry (MS) option.

Empower AutoArchive Software Installation and Configuration Guide: Describes how to install and configure the Empower AutoArchive option.

Documentation on the Web

Related product information and documentation can be found on the World Wide Web. Our address is http://www.waters.com.

Related Adobe Acrobat Reader Documentation

For detailed information about using Adobe® Acrobat® Reader, see the *Adobe Acrobat Reader Online Guide*. This guide covers procedures such as viewing, navigating, and printing electronic documentation from Adobe Acrobat Reader.

Printing This Electronic Document

Adobe Acrobat Reader lets you easily print pages, page ranges, or the entire document by selecting **File > Print**. For optimum print quantity, Waters recommends that you specify a PostScript® printer driver for your printer. Ideally, use a printer that supports 600 dpi print resolution.

Documentation Conventions

The following conventions can be used in this guide:

Convention	Usage
Purple	Purple text indicates user action such as keys to press, menu selections, and commands. For example, "Click **Next** to go to the next page."
Italic	Italic indicates information that you supply such as variables. It also indicates emphasis and document titles. For example, "Replace *file_name* with the actual name of your file."
`Courier`	Courier indicates examples of source code and system output. For example, "The `SVRMGR>` prompt appears."
`Courier Bold`	Courier bold indicates characters that you type or keys you press in examples of source code. For example, "At the `LSNRCTL>` prompt, enter **`set password oracle`** to access Oracle."
[Underlined Blue](#)	Indicates hypertext cross-references to a specific chapter, section, subsection, or sidehead. Clicking this topic using the hand symbol brings you to this topic within the document. Right-clicking and selecting **Go Back** from the shortcut menu returns you to the originating topic. For example, "Empower software communicates with the GC through an RS-232 card in the GC as described in [Section 2.1, Digital Output Configuration](#)."
Keys	The word *key* refers to a computer key on the keypad or keyboard. *Screen keys* refer to the keys on the instrument located immediately below the screen. For example, "The A/B screen key on the 2414 Detector displays the selected channel."
…	Three periods indicate that more of the same type of item can optionally follow. For example, "You can store *filename1*, *filename2*, … in each folder."
>	A right arrow between menu options indicates you should choose each option in sequence. For example, "Select **File > Exit**" means you should select **File** from the menu bar, then select **Exit** from the File menu.

Notes

Notes call out information that is helpful to the operator. For example:

Note: Record your result before you proceed to the next step.

Attentions

Attentions provide information about preventing damage to the system or equipment. For example:

STOP **Attention:** *To avoid damaging the detector flow cell, do not touch the flow cell window.*

Cautions

Cautions provide information essential to the safety of the operator. For example:

Caution: *To avoid burns, turn off the lamp at least 30 minutes before removing it for replacement or adjustment.*

Caution: *To avoid electrical shock and injury, turn off the detector and unplug the power cord before performing maintenance procedures.*

Caution: *To avoid chemical or electrical hazards, observe safe laboratory practices when operating the system.*

Chapter 1
Empower GC Basics

The Empower™ system is a single- or multisystem computer, linked to a set of chromatographic instruments, that performs acquisition, processing, and management of chromatographic information.

This guide explains how to start using the Empower gas chromatography (GC) option, which works with the Empower system and your GC hardware.

You should be familiar with your GC hardware and the basics of Empower software before you begin to use the system. The documentation set you received with the software contains extensive information about the system.

1.1 GC Instrument Control

You can control the following GC instruments with Empower software using the serial interface:

- Agilent 5890 GC
- Agilent 6890 GC with G1512A Controller
- Agilent 6890 Plus GC
- Agilent 6890N GC
- Agilent 7673 GC Controller or G1512A Controller

These instruments constitute a GC system when connected to Empower software through one of the following devices:

- 8-port serial control card
- I/O distribution box (busLAC/E control; 5890/7673 only)
- busSAT/IN Module (no control; data collection only)

Note: For specific communications information, see the operator's guides for the GC instruments.

5890 GC Control

You can control the 5890 GC with Empower software. However, in some cases, the 5890 GC is shipped with a serial card that is not compatible with Empower software.

The 5890 GC contains one of these serial cards:

- HP 3365 ChemStation Interface HP-IB/RS232, part number 19257A
- Serial RS-232-C interface board, part number 19254A

Only 5890 GCs with part number 19254A are compatible with Empower software. If your 5890 GC contains part number 19257A, there are two options:

- Purchase a new 19254A board (part number 19242-60030) and RS-232 cable (part number 19242-60500) from Agilent.
- Connect the 5890 GC to Empower using only SAT/IN modules.

6890N GC Control

You can control the 6890N GC with Empower software. The GC itself and the injector(s) are controllable from within Empower. Empower control of the instrument requires Agilent firmware version N04.08.

Using a Headspace Analyzer as an Injector

Although headspace analyzers are not directly controlled by Empower, you can use a headspace analyzer as a stand-alone instrument in a Empower system, or you can use a headspace analyzer controlled by its own software running with Empower. In either configuration, the headspace analyzer should run its own method and trigger the start of the run when the sample is introduced.

1.2 General Steps

Figure 1-1 shows the general steps for setting up your GC system, installing Empower, software and making a run. It also shows where you can find detailed information for each step of the process.
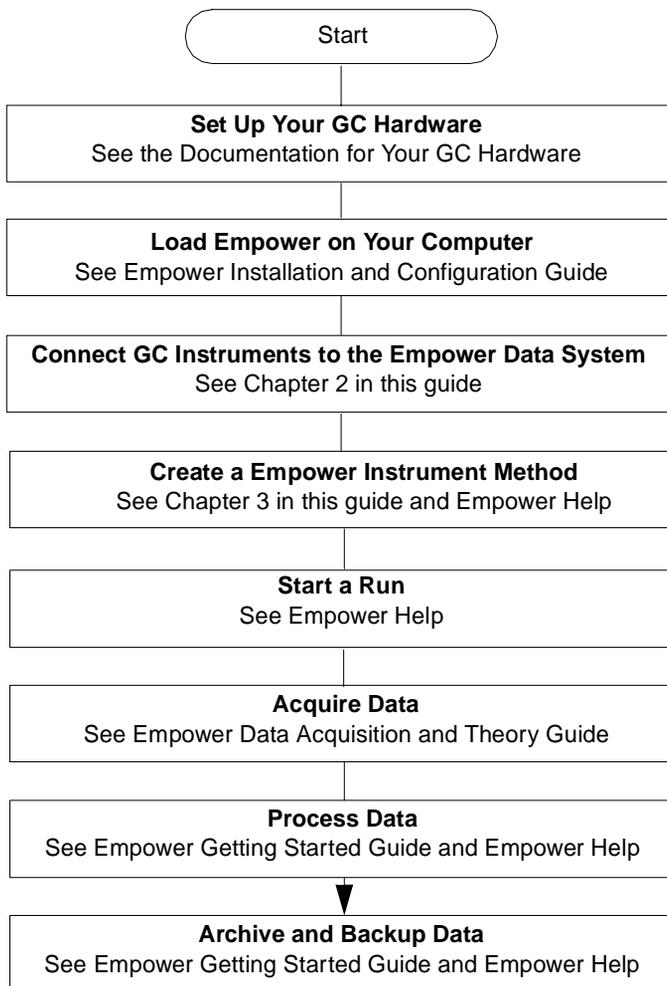
```
                        ┌──────────────────────────┐
                        │          Start           │
                        └──────────────────────────┘
                                     │
        ┌────────────────────────────────────────────────────────┐
        │             Set Up Your GC Hardware                    │
        │        See the Documentation for Your GC Hardware      │
        └────────────────────────────────────────────────────────┘
                                     │
        ┌────────────────────────────────────────────────────────┐
        │             Load Empower on Your Computer              │
        │        See Empower Installation and Configuration Guide │
        └────────────────────────────────────────────────────────┘
                                     │
        ┌────────────────────────────────────────────────────────┐
        │   Connect GC Instruments to the Empower Data System    │
        │             See Chapter 2 in this guide                │
        └────────────────────────────────────────────────────────┘
                                     │
        ┌────────────────────────────────────────────────────────┐
        │          Create a Empower Instrument Method            │
        │     See Chapter 3 in this guide and Empower Help       │
        └────────────────────────────────────────────────────────┘
                                     │
        ┌────────────────────────────────────────────────────────┐
        │                    Start a Run                         │
        │                  See Empower Help                      │
        └────────────────────────────────────────────────────────┘
                                     │
        ┌────────────────────────────────────────────────────────┐
        │                   Acquire Data                         │
        │     See Empower Data Acquisition and Theory Guide      │
        └────────────────────────────────────────────────────────┘
                                     │
        ┌────────────────────────────────────────────────────────┐
        │                   Process Data                         │
        │   See Empower Getting Started Guide and Empower Help   │
        └────────────────────────────────────────────────────────┘
                                     │
                                     ▼
        ┌────────────────────────────────────────────────────────┐
        │               Archive and Backup Data                  │
        │   See Empower Getting Started Guide and Empower Help   │
        └────────────────────────────────────────────────────────┘
```

Figure 1-1 Setting Up Your GC System

Chapter 2
Connecting and Configuring GC Hardware

This chapter describes how to connect gas chromatography hardware for use with Empower software. For information about connecting other hardware components, see the *Empower System Installation and Configuration Guide*.

The gas chromatograph (GC) generates both digital and analog data. When controlled through Empower software, the digital data is collected (see Section 2.1, Digital Output Configuration). You can also collect the analog data using a SAT/IN module with control of the GC through Empower software (see Section 2.2, Analog Output Configuration).

2.1 Digital Output Configuration

Empower software communicates with the GC through an RS-232 card in the GC. One communication port (busLAC/E card for the 5890/7673 or 8-port serial card for all supported GCs) both sends control information to the GC and receives data back from the GC.

The following sections describe these digital output configurations:

- 5890 GC, 7673 Controller, and busLAC/E card
- 5890 GC, 7673 Controller, and 8-port serial card
- 5890 GC, G1512A Controller, and 8-port serial card
- 6890 GC, G1512A Controller, and 8-port serial card
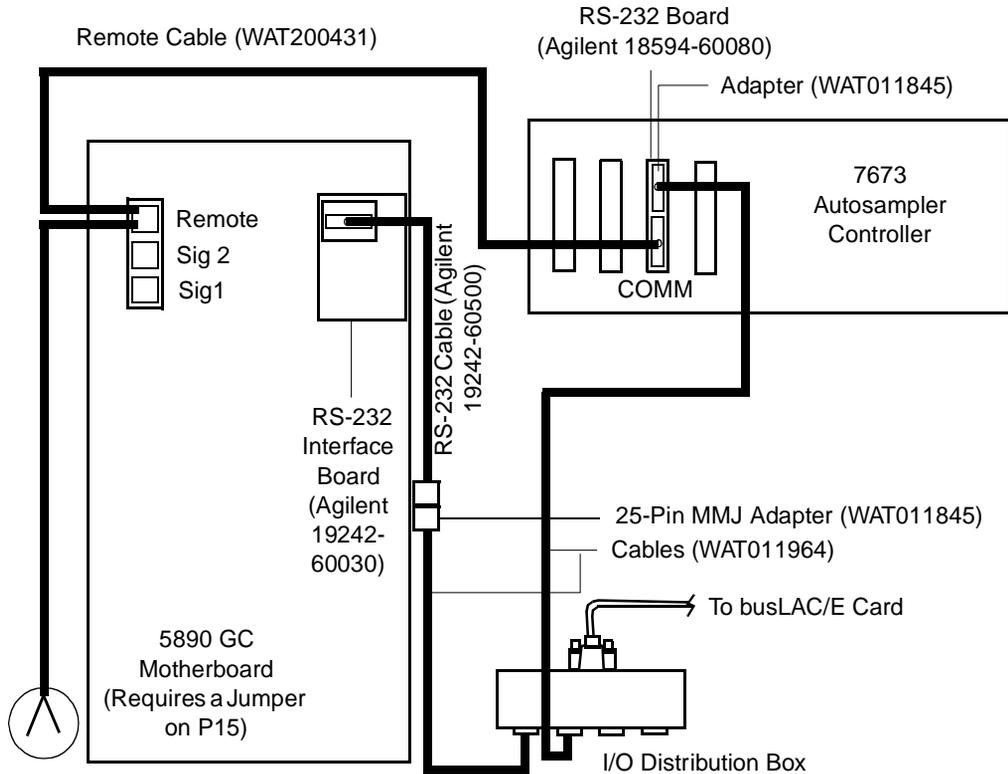- 6890 Plus GC or 6890N GC and 8-port serial card

2.1.1 5890 GC, 7673 Controller, and busLAC/E Card

You can connect a GC system consisting of a 5890 GC and 7673 Controller. Each GC system uses two serial ports on the I/O distribution box (one for each device) to communicate with the busLAC/E card.

To connect the 5890 GC and 7673 Controller to the Empower system:

1. Using RS-232 cables, connect each GC device (5890 and 7673) to separate serial ports in the I/O distribution box (Figure 2-1). In this configuration, two 5890/7673

systems can be supported because each GC and each controller occupies its own I/O distribution box port.

Note: *Do not allow these leads to directly contact each other.*

Figure 2-1 Connecting a 5890 GC and 7673 Controller to a busLAC/E Card

2. Follow the instructions in "Configuring the 5890 GC" on page 18 to configure the 5890 GC.

2.1.2 5890 GC, 7673 Controller, and 8-Port Serial Card

You can also connect a GC system consisting of a 5890 GC and 7673 Controller through an 8-port serial interface card. To connect the 5890 GC and 7673 Controller to the Empower system:

1. Using RS-232 cables, connect each GC device (5890 and 7673) to separate serial ports on the cables extending from the 8-port serial card (Figure 2-2). Each serial card cable is labeled with the corresponding port (1 – 8).

2. When the 5890 and 7673 are controlled through the 8-port serial card, they are referred to as 5890S and 7673S, respectively. Install the 8-port serial card starting at COM address 3 on the computer, so physical port 1 on the serial card gives a Empower instrument address of 3, port 2 gives 4, and so on.
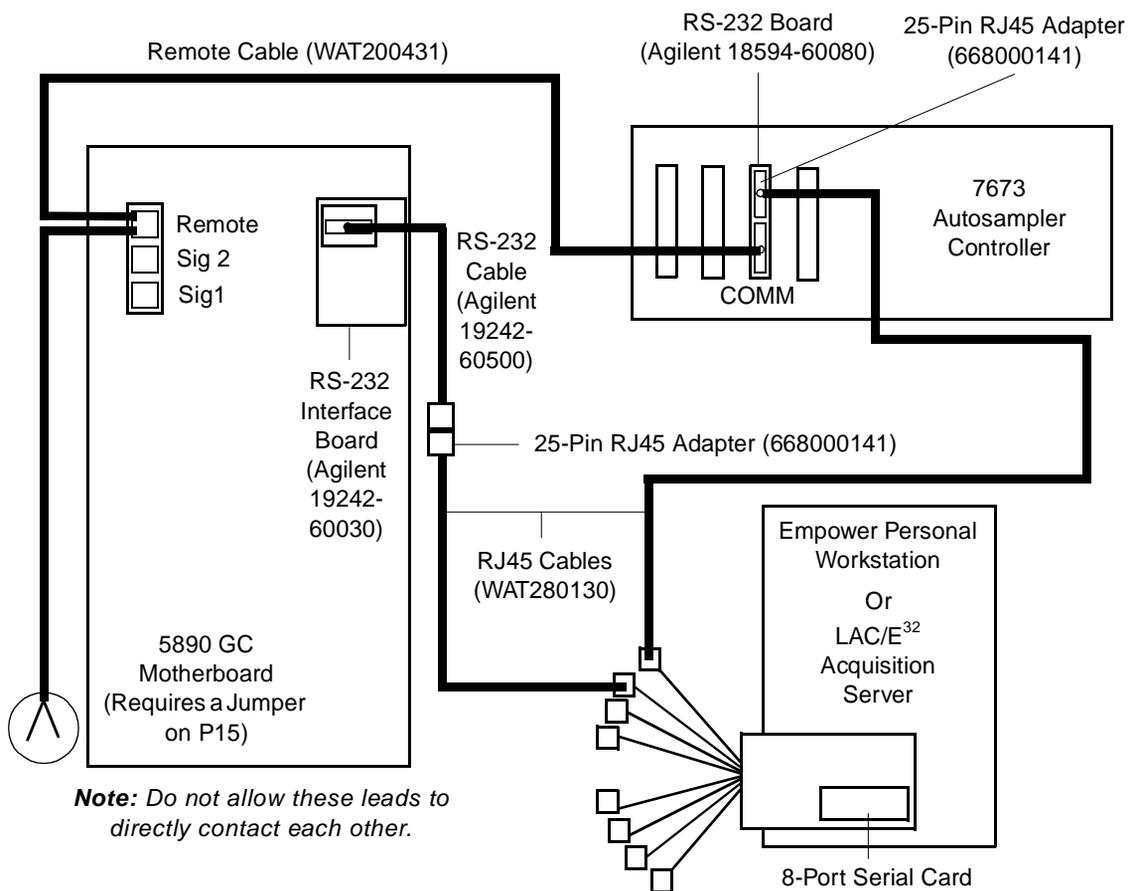

Figure 2-2 Connecting a 5890 GC and 7673 Controller to the Serial Card

3. Follow the instructions in "Configuring the 5890 GC" to configure the 5890 GC.

Configuring the 5890 GC

When you have conneceted the 5890 GC to your Empower system, you must configure the instrument.

1. Power down the 5890 GC and unplug the power cord from the power source.

> ⚠ **Attention:** *To avoid possible electric shock, ensure that the 5890 is powered down and the power cord is disconnected from the power source before proceeding.*

2. Locate the 5890 motherboard.

3. Enable the emulation mode by placing a jumper (part number WAT072940 or equilvalent) on the P15 pins on the 5890 motherboard.

   Note: *If the INET board was previously used, you must provide a jumper to place on the P15 pins.*

4. Power on the 5890 GC and ensure the "Emulation Mode OK" message appears on the front panel.

5. Set the 5890 GC to Local mode by pressing the following on the 5890 keypad:

   a. Press **Clear**.

   b. Press the **.** key.

   c. Press **3**.

   d. Press **Enter** and record the address setting (9, 17 or 9, 31) that appears on the front panel.

   e. Press **Off**. The display should change from Global to Local.

   f. Press **Clear**.

6. If the address recorded in the previous step was X, 17 (where X is any integer) the 5890 GC is properly configured. Otherwise, set the address using this key sequence on the 5890 GC keypad:

   a. Press **Clear**.

   b. Press the **.** key.

   c. Press **3**.

   d. Press **Enter**.

   e. Press **1**.

   f. Press **7**.

   g. Press **Enter**.

   h. Press **Clear**.

7. Repeat the above sequence to ensure that the changes were accepted. When you press Enter, Local Address 9, 17 should appear on the display.

2.1.3 6890 GC, G1512A Controller, and 8-Port Serial Card

The Empower system can communicate with a 6890 GC and a G1512A Controller through the 8-port serial card (Figure 2-3). Each GC system uses one serial port to both send and receive control data.

To connect the 6890 GC to the Empower system, use the RJ45 cable from the 8-port serial card in the LAC/E^{32} Acquisition Server or the Empower Personal workstation to connect to the modem port (9-pin) at the back of the 6890 GC. Follow the instructions in "Configuring the 6890 GC" on page 20 to configure the 6890 GC.
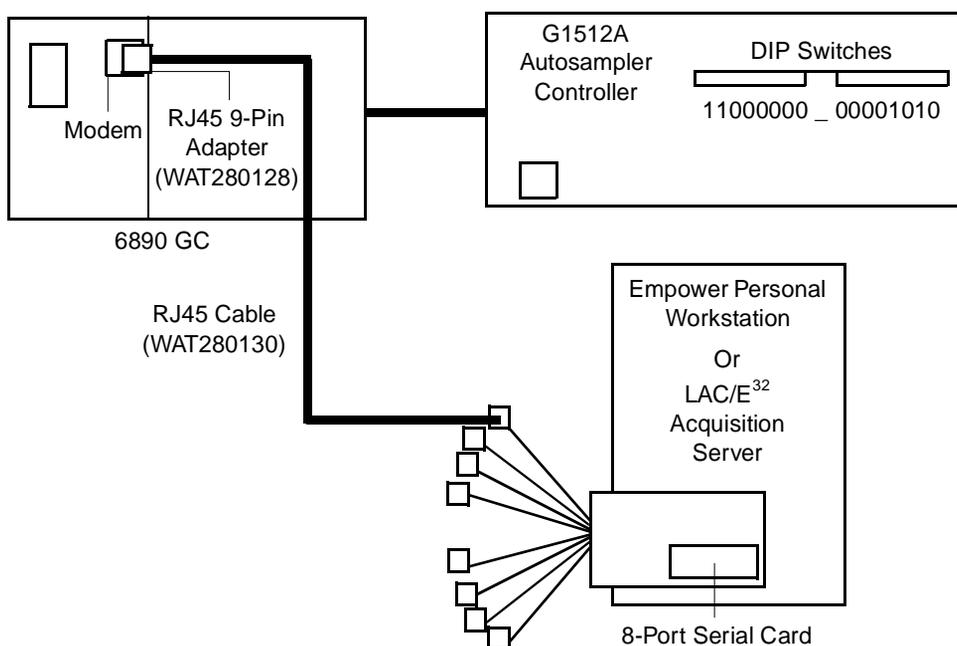
Figure 2-3 Connecting a 6890 GC and G1512A Controller to the Serial Card

2.1.4 6890 Plus GC or 6890N GC and 8-Port Serial Card

The Empower system can communicate with a 6890 Plus GC or a 6890N GC through an 8-port serial card. Each GC system uses one serial port to both send and receive control data.

To connect the 6890 Plus GC or the 6890N GC to the Empower system, use the RJ45 cable from the 8-port serial card in the LAC/E^{32} Acquisition Server or the Empower Personal workstation to connect to the modem port (9-pin) at the back of the 6890 GC (Figure 2-4). Follow the instructions in "Configuring the 6890 GC" to configure the 6890 GC.
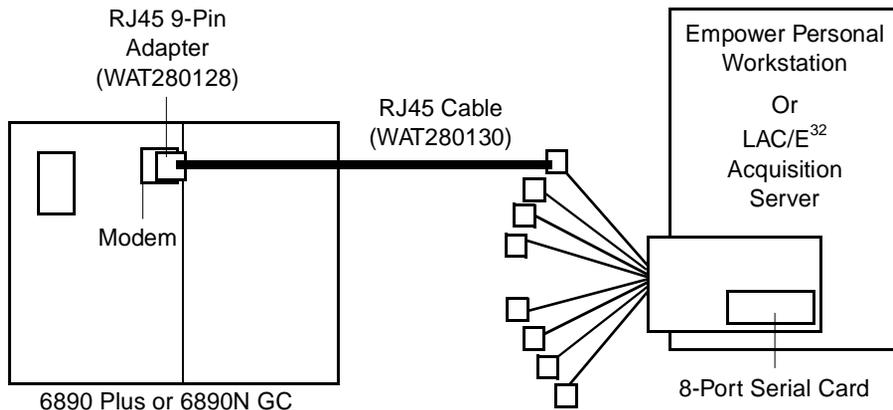

Figure 2-4 Connecting a 6890 Plus GC or 6890N GC to the Serial Card

Configuring the 6890 GC

To complete the 6890 setup, ensure the parameters in the 6890 Communications menu are set as follows:

Parameter	Setting
HPIB	0
Baud Rate	19200
Parity	None
Handshake	None
Data Bits	8
Stop Bits	1
End of Command	Carriage return (Enter)

2.1.5 Additional 6890 Configuration

When you have connected the 6890 GC to your Empower system, you must configure the instrument.

Configuring a GC Column

For a 6890 GC with more than one inlet or detector, a GC column can be installed by connecting it to either the front or back inlet and the front or back detector. After installing a GC column, specify the location of the inlet and detector to which the column is connected. Using the front panel of the 6890 GC, enter this key sequence for column 1:

1. On the 6890 front panel, press **Config**.
2. Press the arrow key until the **Column 1** selection is highlighted, then press **Enter**.
3. Press the arrow key until the **Detector** selection is highlighted, then press **Enter**.
4. Ensure that the detector settings are correct. If not, press **Front** or **Back** to specify the appropriate location.
5. Press **Enter**.

Follow the same procedure to configure column 2.

Enabling Auto Prep Run

Auto Prep Run must be enabled for the 6890 GC to run under software control. To enable the Auto Prep Run feature:

1. On the 6890 front panel, press **Config**.
2. Press the arrow key until the **Instrument** selection is highlighted, then press **Enter**. The panel displays the instrument serial number on line 1 and the Auto Prep Run parameter on line 2.
3. Ensure that the Auto Prep Run parameter is on. If not, press **On**.
4. Press **Enter**.

2.2 Analog Output Configuration

You can use the busSAT/IN Module to convert analog output from the GC detector to digital data for processing by the Empower system. The busSAT/IN Module can reside on the busLAC/E or an 8-port serial card. Figure 2-5 shows a busLAC/E 5890 set up for control through Empower software (digital data) as well as collection of the GC analog data.

The busSAT/IN Module, when used, occupies an additional (third) port on the I/O distribution box. In this configuration, each Empower Personal workstation can support one GC system. As an example, this section describes the 5890/7673 with a SAT/IN through a busLAC/E.

Note: A SAT/IN can also be used to collect analog data from a 5890 GC or a 6890 GC configured on an 8-port serial card.

Figure 2-5 shows the cable connections for a 5890 GC and a 7673 Controller with analog data acquisition through a busSAT/IN Module.
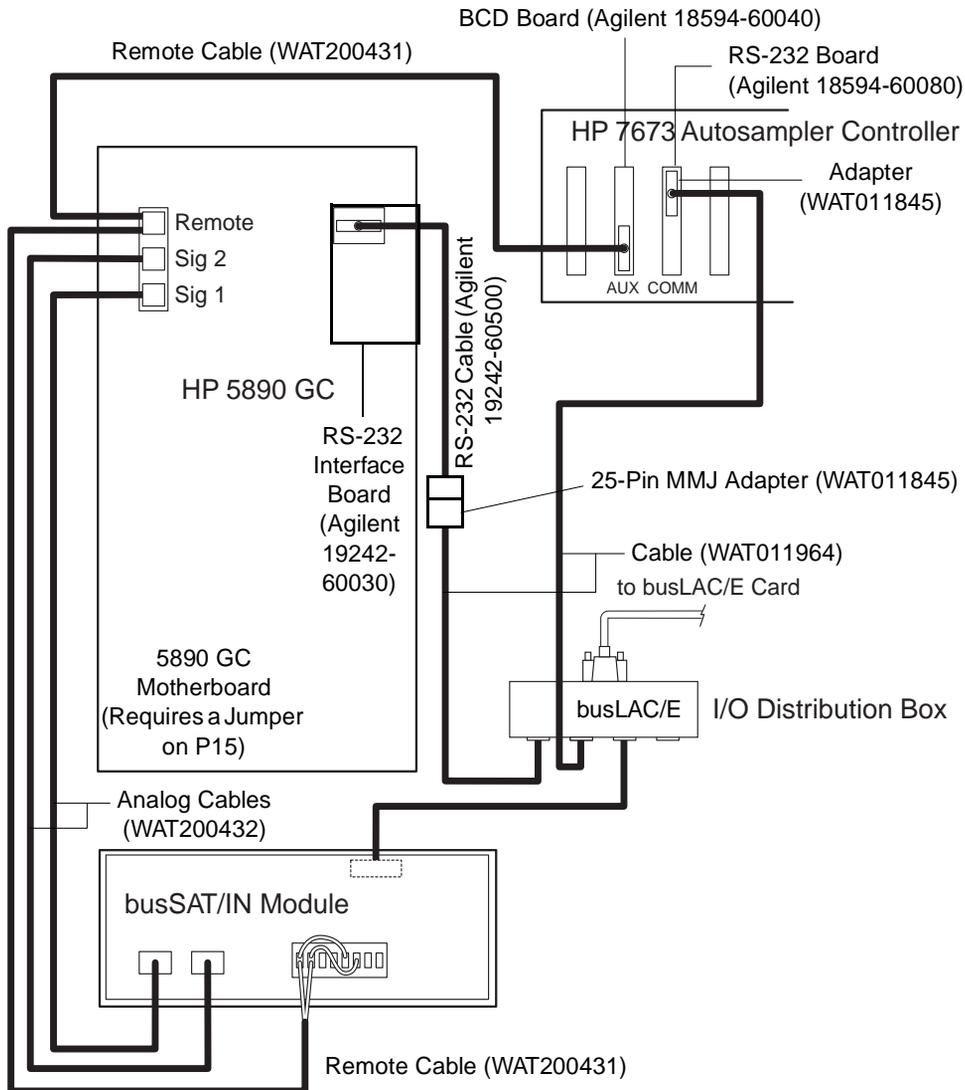

Figure 2-5 Connecting a 5890 GC, 7673 Controller, and busSAT/IN to a busLAC/E Card

Connect inject start trigger cables and analog output cables as follows:

• Connect the inject start trigger cables as indicated in Table 2-1. Both the GC and the busSAT/IN Module require an inject start signal. The controller provides the inject start trigger signal over the remote cable. The GC trigger cable connects to the injector input terminals on the busSAT/IN Module.

- If you are using the analog data output of the GC, connect the analog cables between the GC and the busSAT/IN Module as specified in Table 2-1.

Table 2-1 Analog Data Output Connections

busSAT/IN Module Connection	5890 GC	7673 Controller
CHAN 1 and COM (–)	Signal 1	N/A
CHAN 2 and COM (–)	Signal 2 (if optional board is installed)	N/A
EVENTS CH 1 IN (trigger signal)	REMOTE	Y-cable from REMOTE TTL board

Note: The jumper wires shown on the busSAT/IN Module events connector block are required to allow data collection on both analog channels using one trigger input (see Figure 2-5). Connect the black wire on the trigger cable to the positive (+) terminal on the busSAT/IN Module, and connect the red wire to the negative (–) terminal on the busSAT/IN Module.

2.3 Alternative Setup for a 5890 GC

To interface a 5890 GC and a G1512A Controller to the Empower system, connect the cables as shown in Figure 2-6. This configuration allows the G1512A Controller to emulate a 7673 Controller.

Note: This configuration requires the use of an 8-port serial card.

APG Remote Port Remote Cable
(Agilent G1512-60530)

5890 GC

G1512A Controller

DIP Switches in 7673 Mode
00111101 _ 11111111

Host Comm RS-232 (9-Pin)
Connect with Adapter
(WAT280128) to 8-Port Serial Card
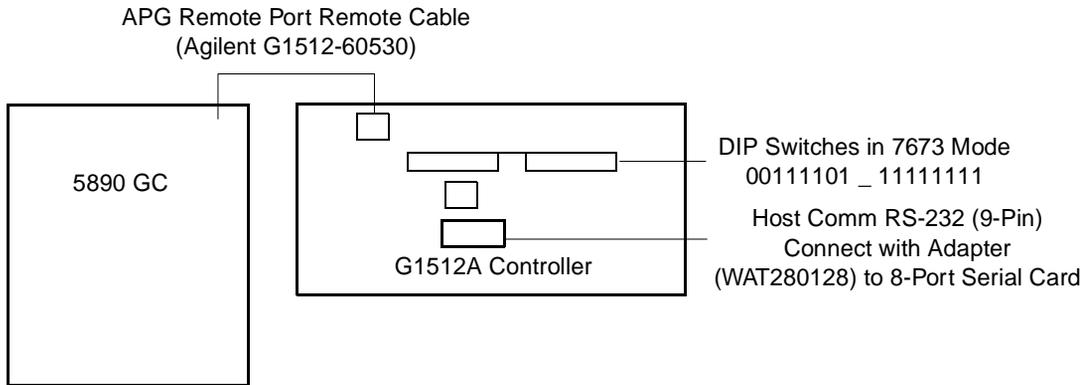
Figure 2-6 Connecting a 5890 GC and G1512A Controller

Chapter 3
Developing Methods Using Wizards

This chapter guides you through acquiring and processing data from a single injection using the Run Samples and wizard features of Empower software.

Before creating a GC instrument method, you must:

- Set up your GC hardware.
- Load Empower on your computer.
- Connect your GC instruments to the Empower data system.
- Create a Empower chromatographic system that includes your GC instruments.

Note: You should be in Run Samples before you begin the tutorial in this chapter. If you are not, see Section 3.2, Accessing Run Samples, in the Empower Software Getting Started Guide *for additional instructions.*

3.1 Creating an Instrument Method

The instrument method instructs Empower software on how to control your chromatographic instrumentation. This method contains parameters such as flow rate, solvent composition, and detector type.

Note: This section is intended to provide an overview of the Instrument Method Editor and tips for creating a GC instrument method. It does not include specific instructions for each parameter displayed in the Instrument Method Editor. For specific instructions and field descriptions, see the Empower Help.

To create an instrument method:

1. In Run Samples with the Single tab displayed, click **Develop Methods** (Figure 3-1).
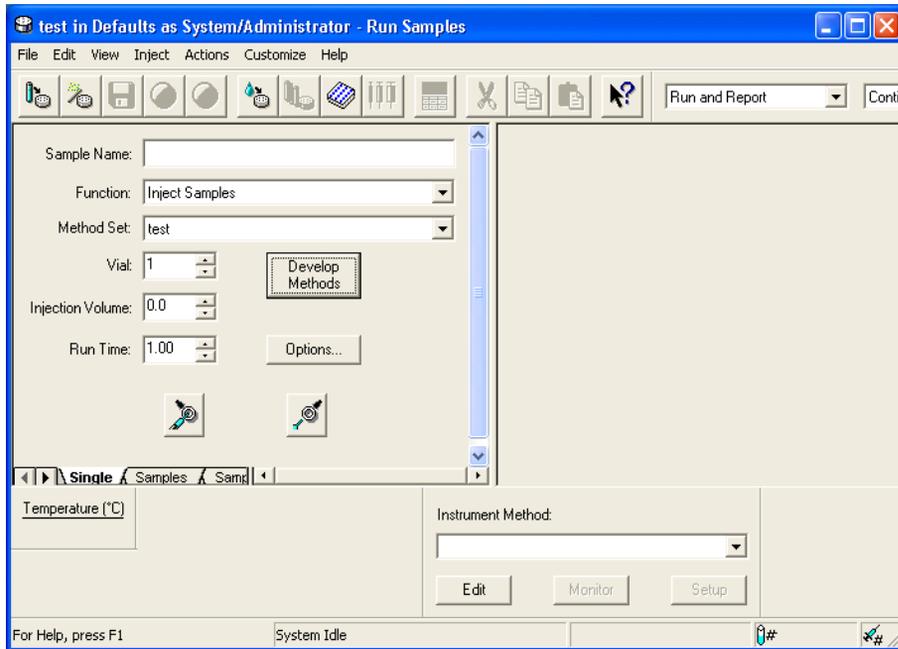
Figure 3-1 Run Samples, Single Tab, Run Only Mode

This activates the New Method Set wizard. The New Method Set : Select Instrument Method page appears (Figure 3-2).
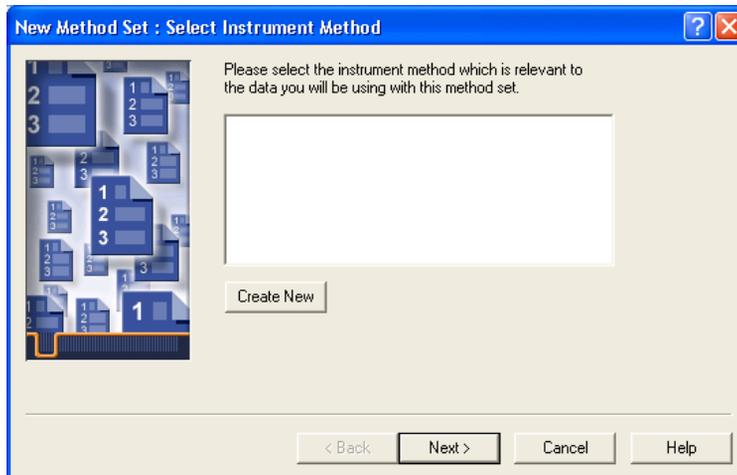

Figure 3-2 New Method Set : Select Instrument Method Page

2. Click **Create New** to create an instrument method. The Instrument Method Editor window appears. Click the **General** tab, if it is not already displayed (<u>Figure 3-3</u>, shown for the 6890 GC).
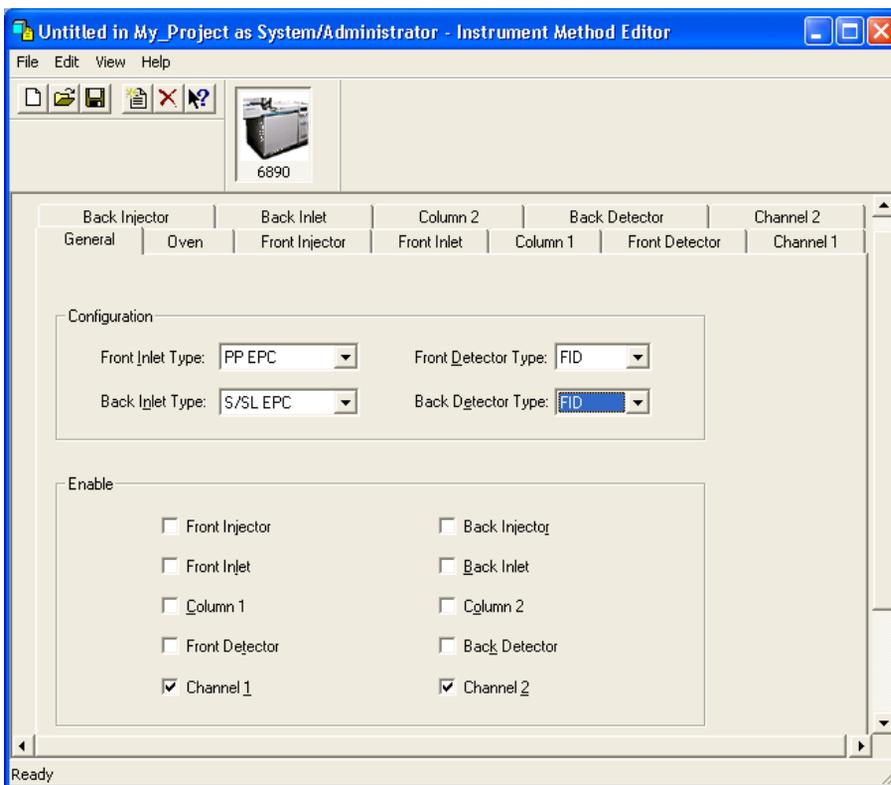
Figure 3-3 Instrument Method Editor, 6890, General Tab

The Instrument Method Editor is one of the few windows that contains property tabs (as opposed to window tabs). These tabs reflect parameter settings for the instrument you select in the Instruments and Active Channels tree pane and differ depending upon the instrument.

Note: The following procedures assume that the chromatographic system you are using for this tutorial includes a 6890 GC. If not, the property tabs that appear will differ from those shown here. Enter the parameter values appropriate to your instrumentation.

3. Go to <u>Section 3.1.1, Setting Instrument Properties</u> to set the instrument properties.

3.1.1 Setting Instrument Properties

1. The Instrument Method Editor lists the instruments in your selected Empower chromatographic system (Figure 3-3). Click the icon for GC (the 6890 in Figure 3-3), then click the **General** tab. The General tab appears.

   Note these considerations in the General tab:

   - The inlets and detectors displayed are scanned from your GC and are informational; do not change them.

   - When creating an instrument method for dual tower operation, you must enable both injectors/inlets (enable injectors A and B in the HP 7673S property tabs), columns, detectors, and channels.

   - Enable the front and/or back detector before you specify detector parameters in the corresponding detector tab. If you specify detector parameters in the detector tab without first enabling the detector, the parameter settings do not take effect.

   - You can simultaneously transmit digital data (RS-232 port on the 5890 GC or 6890 GC) and analog data (Signal 1 and Signal 2 terminals on the 5890 GC or 6890 GC) to an Empower Personal workstation. You need not enable the analog outputs; they are always active. Analog outputs must be converted to digital signals by an A/D converter [typically a busSAT/IN Module or busSAT/IN Module (SAT/IN 2)] before they are transmitted to the Empower Personal workstation. See Chapter 2 for information on connecting your 6890 GC to an Empower Personal workstation through a busSAT/IN Module or busSAT/IN Module (SAT/IN 2).

   - Set the sampling rate for GC data collected through the analog channels in the busSAT/IN Module or the busSAT/IN Module (SAT/IN 2) property tabs, depending on which module is connected to the GC.

3

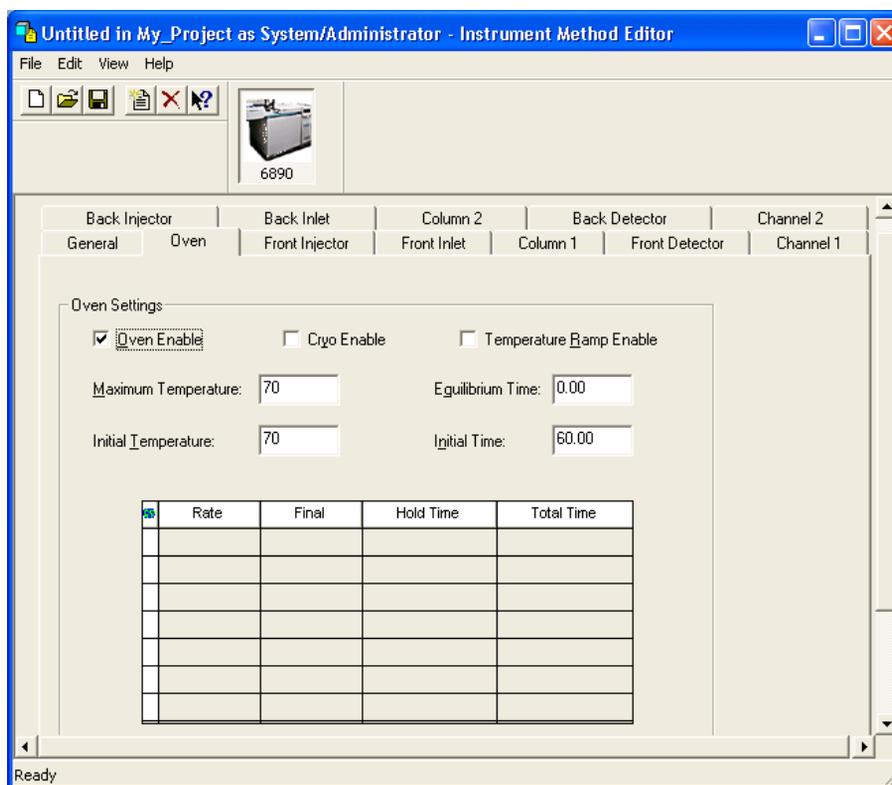2. Click the **Oven** tab (Figure 3-4). The Oven tab appears (Figure 3-4).

Figure 3-4 Instrument Method Editor, 6890, Oven Tab

3. Enter the oven settings appropriate for your selected system. The run time is
    derived from the oven time values. No data is acquired after the oven time expires.

    *Note: The Temperature Ramp Enable check box must be selected to enter ramp
    values in the table.*

4. Click the **Front Injector** tab. The Front Injector tab appears (Figure 3-5).

    *Note: The Back Injector tab is similar. Only the Front Injector properties are
    discussed here.*
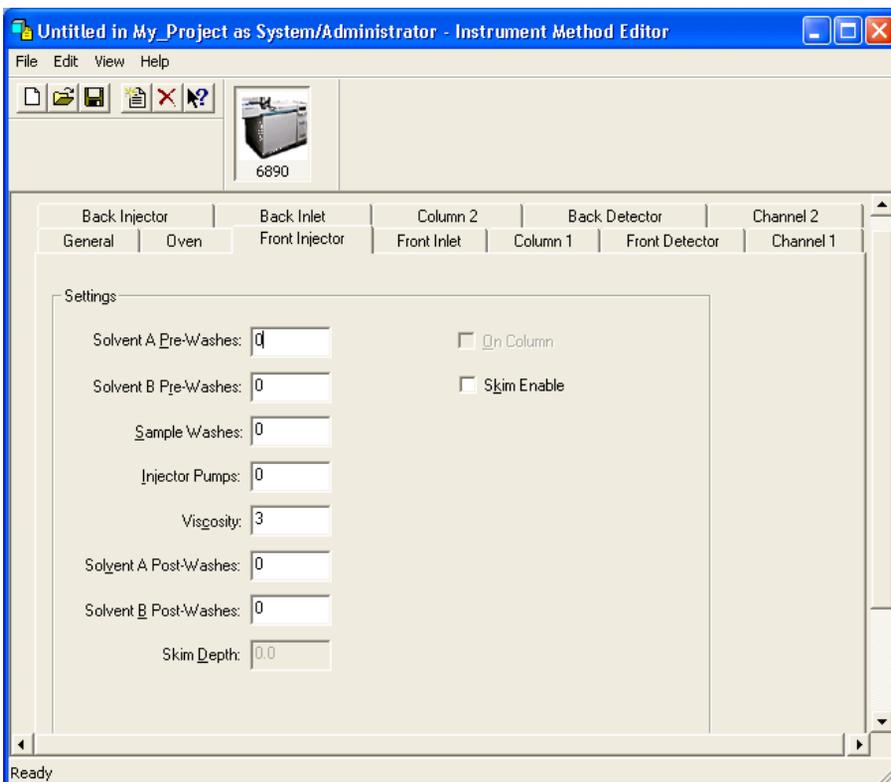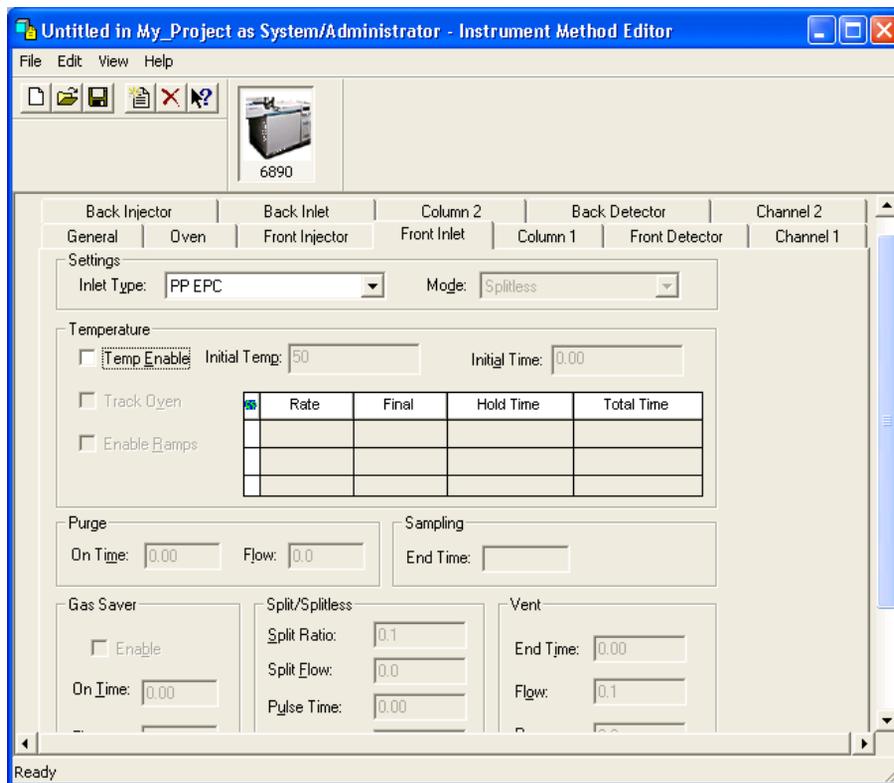
Figure 3-5 Instrument Method Editor, 6890, Front Injector Tab

Note these considerations in the Injector tabs:

- The Skim Enable option is available only for the 6890 Plus GC and the 6890N GC. It is not available for the 6890 GC.

- If your system includes a 6890 GC with these capabilities, you must control them directly from the instrument:

  Waste bottle location

  Slow plunger

  Pre- and post-dwell time

- If you are using a 7673-style injector tower with a 6890 series controller box, you might not be able to use all of the advanced injector functions on this tab, such as pre-washes or skim depth.

- If your 6890 Plus GC or 6890N GC has an installed on-column inlet, all injections are made on-column.

- If your 6890 GC does not have an installed on-column inlet, clear the On-column check box to avoid damaging the column by excessive lowering of the needle.

5. Click the **Column 1** tab. The Column 1 tab appears (Figure 3-6).

   Note: The Column 2 tab is similar. Only the Column 1 properties are discussed here.
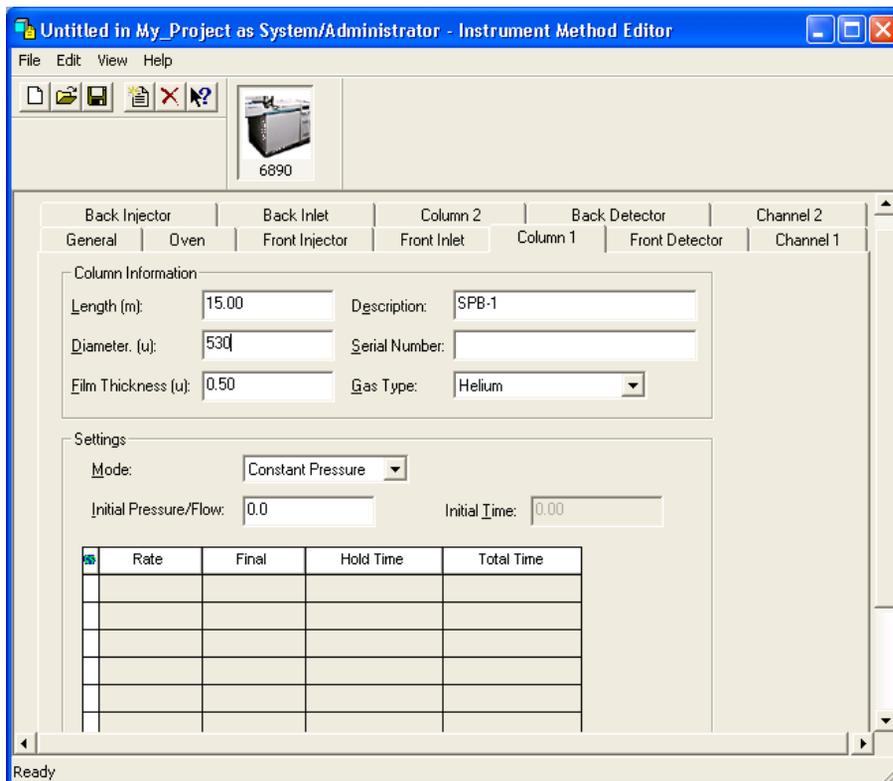
Figure 3-6 Instrument Method Editor, 6890, Column 1 Tab

The Column 1 tab specifies the column mode in which the carrier gas is to be applied during a run. Select one column mode and complete the ramp parameters if necessary.

Note: In the Ramp table, if a flow or pressure program ends before the analytical run ends, the flow or pressure remains at the final value.

Note these considerations in the Column tabs:

- You must define the column dimensions.
- Configure the correct inlet with the correct detector.

- If you are using a capillary column, ensure the make-up gas is on.

- Ensure that the inlets and detectors to be used are present in the instrument and enabled in Empower software.

- If you are using packed columns, the column parameters should be undefined. To do this, enter 0 for the column length or column diameter.

- Ensure the column configurations specify separate inlets. If you are only using one column, the unused column must be configured for a different inlet, even if it is undefined. Failure to do this can produce unusual flow calculations.

- It is possible, and sometimes appropriate, to configure both installed columns to the same inlet.

6. Click the **Front Inlet** tab. The Front Inlet tab appears (Figure 3-7).

   *Note: The Back Inlet tab is similar. Only the Front Inlet properties are discussed here.*

Figure 3-7 Instrument Method Editor, 6890, Front Inlet Tab

7. The inlet type is automatically detected and should not be changed. Choose the appropriate mode for the inlet.

    Note: If the Split option is selected in the Inlet Type field, you can enter a value for either the Split Ratio or the Split Flow, but not both. Empower software automatically calculates the value not entered.

    If the Splitless option is selected, the purge valve options become available. You can enter values for the purge on time (how long after the injection was made) and the flow desired.

    The Gas Saver option reduces the flow of carrier gas into the inlet and out of the split vent after an injection. The Gas Saver option does not alter column head pressure or flow through the column.

Note these considerations in the Inlet tabs:

- To avoid an unstable inlet temperature, set the inlet Initial Temp parameter at least 6 °C higher or lower than the Oven Initial Temperature.
- If an inlet temperature program ends before an oven temperature program ends, the inlet temperature remains at the Final value until the oven program and run end.
- Configure your column before setting the Purge Flow parameter or the Split Ratio or Split Flow parameter.
- If you are using the Gas Saver option, ensure the Gas Saver On Time value is greater than the Purge On Time value.
- Set Gas Saver Flow at least 15 mL/min greater than the maximum column flow.
- Split Ratio and Split Flow parameters relate to each other and the column flow. Split Ratio = Split Flow/Column Flow. When one parameter is specified, Empower automatically calculates the second parameter.

    Note: If you are using a split inlet and have selected Constant Pressure mode on the Column tab, you cannot specify a Split Flow value. You can specify only the Split Ratio value.

8. Click the **Front Detector** tab. The Front Detector tab appears ().

   Note: The Back Detector tab is similar. Only the Front Detector properties are discussed here.
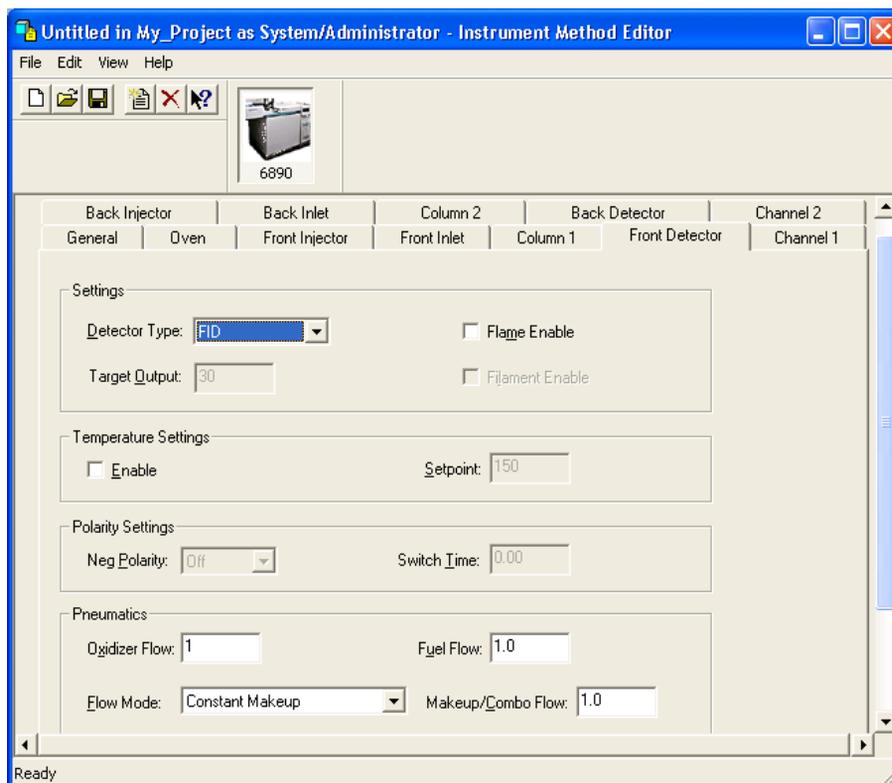
Figure 3-8 Instrument Method Editor, 6890, Front Detector Tab

9. The detector type is automatically detected and should not be changed. Select the appropriate parameters for the detector.

10. Click the **Channel 1** tab. The Channel 1 tab appears (Figure 3-9).

   Note: Only the Channel 1 properties are discussed here. The Channel 2 tab is similar.
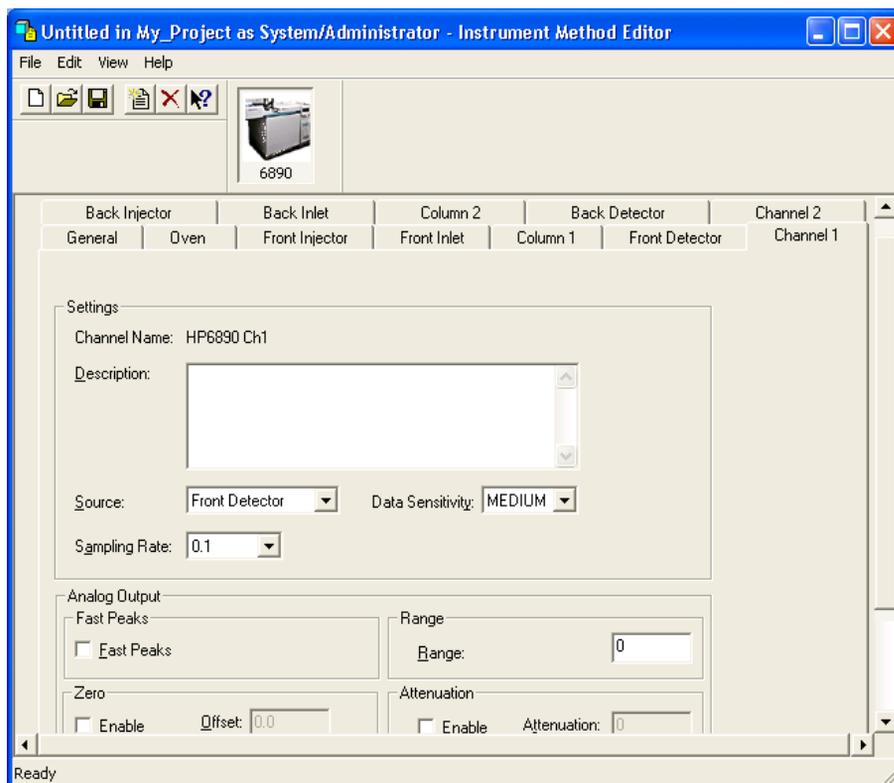
Figure 3-9 Instrument Method Editor, 6890, Channel 1 Tab

Note these considerations in the Channel 1 tab:

• If you are transmitting analog data through a busSAT/IN Module or busSAT/IN Module (SAT/IN 2), you must define all Channel 2 tab parameters. If you enabled the Ch 2 Enable parameter to transmit digital data through the RS-232 port, you must define the Units and Source parameters.

   You set the sampling rate for GC data collected through the analog channels in the busSAT/IN Module or the busSAT/IN Module (SAT/IN 2) property tabs, depending on which module is connected to the GC.

- If your system is configured for dual tower operation, you must specify Front Detector as the Source for Channel 1 (the front detector must be connected to the front injector), and Back Detector as the Source for Channel 2 (the back detector must be connected to the back injector).

- Select a Sampling Rate of 200 points per second for single-channel acquisition only.

- To minimize error, set Range to the lowest possible value, making sure that the peaks of interest do not exceed 1 V. For the analog output of the 6890 GC there is an internal Range setting within the 6890 GC, but it does not affect the signal collected by Empower.

- When choosing a data sensitivity level, remember that higher data sensitivity provides better definition of small features in the chromatogram, but limits the size of large features.

- Go to section <u>Section 3.1.2, Saving the Instrument Method</u> to save the instrument method.

3.1.2 Saving the Instrument Method

1. Click the **Save** tool. The Save current Instrument Method dialog box appears (<u>Figure 3-10</u>).
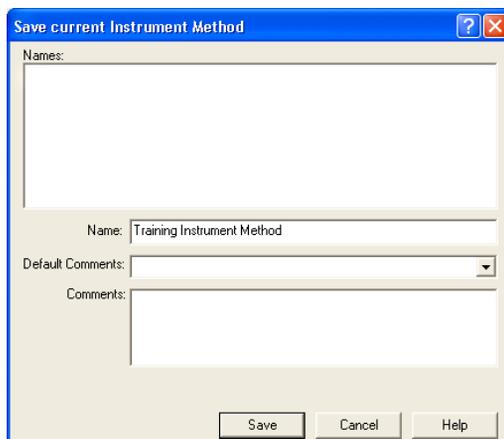
Figure 3-10 Save Current Instrument Method Dialog Box

2. Enter an instrument method name, then click **Save**. The Instrument Method Editor reappears.

3. Close the Instrument Method Editor. The New Method Set : Select Instrument Method page appears (Figure 3-11).
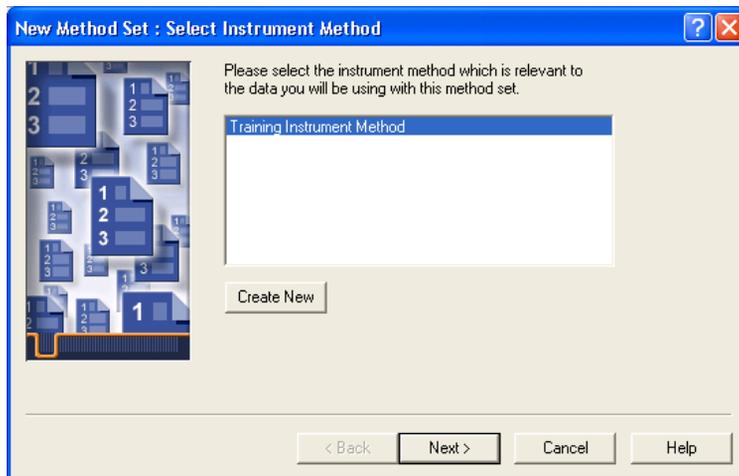
Figure 3-11 New Method Set : Select Instrument Method Page

4. Select the instrument method you created from the Instrument Method list, then click **Next**. The Select Default Methods page appears (Figure 3-12).
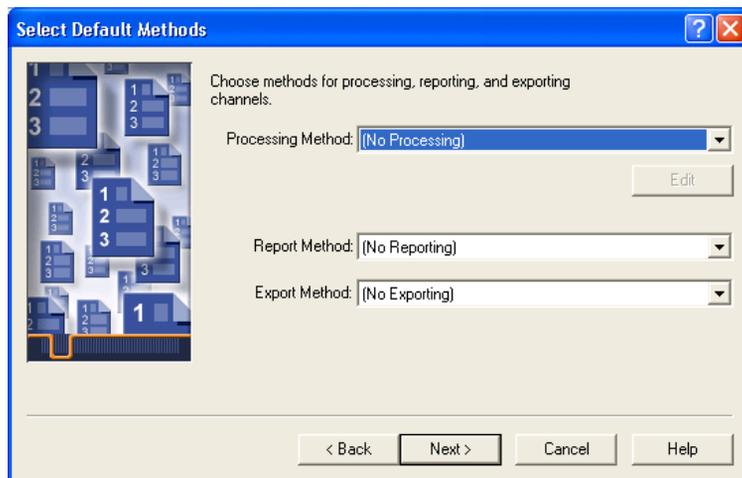
Figure 3-12 New Method Set Wizard, Select Default Methods Page

5. Accept the default settings (no methods), then click **Next**. The Name Method Set page appears (Figure 3-13).
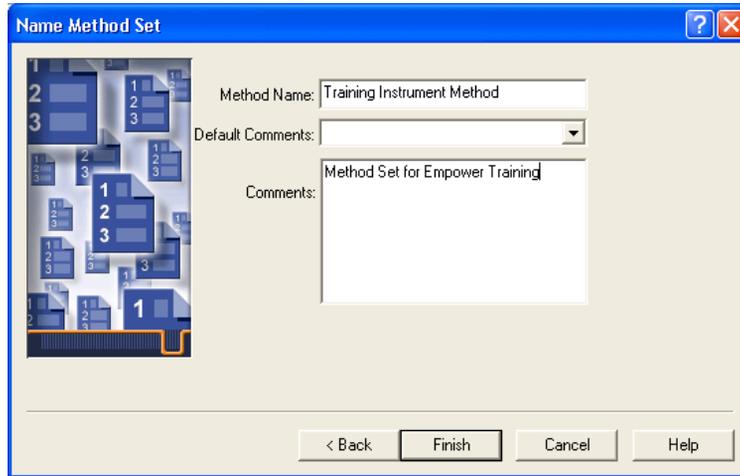
Figure 3-13 New Method Set Wizard, Name Method Set Page

6. Enter a name for the method set, add any comments describing the method set, then click **Finish** to exit.

Note: The Method Name field cannot be blank, and the name cannot be the same as an existing method set.

The Method Set Editor displays the method set entries (Figure 3-14).
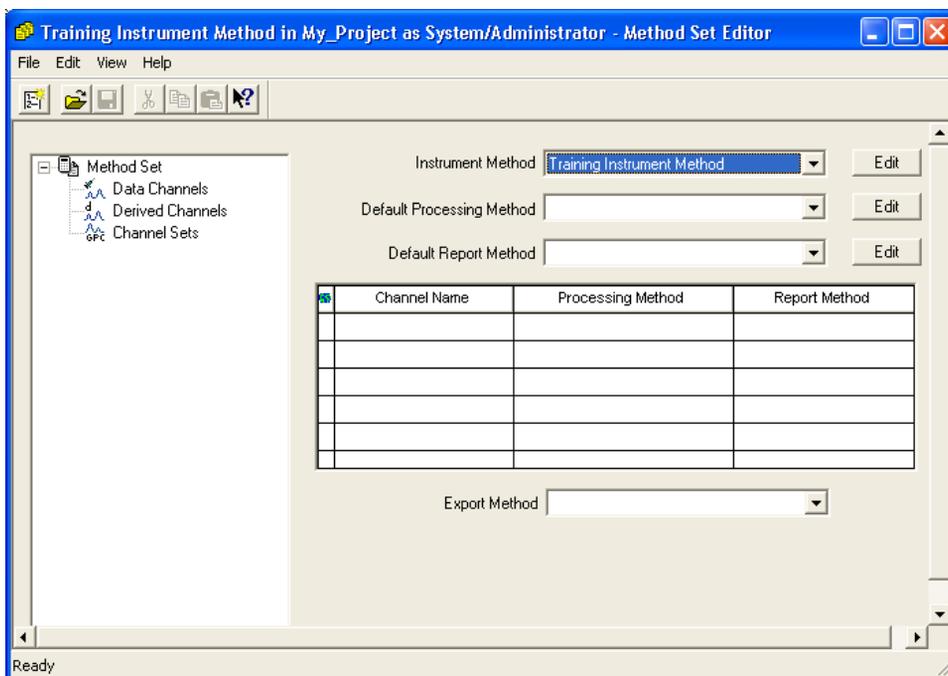
Figure 3-14 Method Set Editor

7. Click the **Close** button. Run Samples reappears with the Single window tab displayed (Figure 3-1).

3.1.3 Injection Volume in Run Samples

The injection volume displayed in Run Samples can be expressed as an actual volume or as the number of plunger steps injected by the GC.

You can specify the syringe size and presence of the nanoliter adapter for the front and back injectors. When you set these parameters, Empower software calculates the actual injection volume. Otherwise, the injection volume shown in the Run Samples window is expressed as a raw value of the number of plunger steps injected.

The actual injection volume for a given number of plunger steps can vary significantly based on your injector configuration. We recommend specifying the injector parameters for your system so that the actual injection volume is displayed in Run Samples. You can set these parameters as defaults or as independant values for samples or single injections.

Figure 3-15 GC Syringe Size Parameters Window

To set default syringe size parameters:

1. In Run Samples, select **Customize > Defaults**. The Run Samples Defaults window appears.

2. Click **GC Syringe Info Define**. The GC Syringe Size Parameters window appears (Figure 3-15).

3. Select **Use parameters to check injection volume**. The syringe fields are activated.

4. For each syringe (front and back injector):

   • Select the syringe size from the Size list.

   • If the injector is equipped with a nanoliter adapter, select the **Nanoliter Adapter** check box.

5. Click **OK** to close the GC Syringe Size Parameters window.

6. Click **OK** to close the Run Samples Defaults window.

You can also set syringe size parameters for a sample set or for a single injection. The sample set and single injection syringe parameters are independant.

To set the syringe size parameters for a sample set or single injection:

1. In Run Samples, click the appropriate tab (**Single** or **Samples**).

2. Select **Edit > GC Sample Set Info**. The GC Syringe Size Parameters window appears (Figure 3-15).

3. Select **Use parameters to check injection volume**. The syringe fields are activated.

4. For each syringe (front and back injector):

- Select the syringe size from the Size list.
- If the injector is equipped with a nanoliter adapter, select the **Nanoliter Adapter** check box.

5. Click **OK**.

3.1.4 Stop Flow Button (5890 and 6890 GCs)

The Stop Flow button in the Run Samples window does not stop the gas flow in the 5890 or 6890 GC. For details on stopping gas flow, see the applicable Agilent documentation.

3.1.5 Vial Capacity and Open Access (6890 GC)

Open Access automatically detects the maximum vial capacity number of the autosampler for an Agilent 6890 GC (100) and uses this value to determine when Open Access must restart the Starting Vial number at 1, as different users submit more samples than the autosampler can handle. Management of the open well position is critical. You must determine when samples have run and either remove them from the carousel or free up well positions.

3.2 Running the GC in Dual Tower Mode

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3.2.1 Using Dual Tower Mode

If your Empower system is connected to a 5890/7673 or 6890 GC in a dual tower configuration, each row in the vial column specifies both the carousel vial number and the tower location (front or back) from which the injection is to be made. For example, an injection from vial number 2 on the front tower appears as F:2 in the vial column row; an injection from vial number 6 on the back tower appears as B:6 in the vial column row.

6890 GC

When sample sets are acquired using a dual tower sample set method, the Empower database stores two channel, two injection, and two vial records for each GC injection. One channel, injection, and vial are stored for the front tower; a second channel, injection, and vial are stored for the back tower.

5890 GC

For dual tower operation, the 5890 GC must be connected to an Empower Personal workstation by a serial card, and must be configured as a 5890S GC. Dual tower operation is not supported if the 5890 GC is connected to an Empower Personal workstation by a busLAC/E interface card.

3.2.2 Creating a Dual Tower Sample Set Method (5890 GC)

To run control samples (which require that Inject Controls functions be added to your sample set method), manually add the desired Inject Controls functions after you finish the Sample Set Method wizard.

3.2.3 Creating Dual Tower Sample Set Methods for Simultaneous Sample Injections (5890 and 6890 GCs)

When creating a dual tower sample set method for a 6890 GC or a 5890/7673, all of the following criteria must be met to simultaneously inject samples from a pair of rows in the sample set method (one row specified from the front tower, and a second row specified from the back tower).

For two rows in the Samples table to be simultaneously injected, they must specify:

- The same method set
- Different vial numbers
- An F: vial designator (for the front tower) and a B: vial designator (for the back tower)
- The same # of Injections (for the two rows only; you do not need to specify the same total number of front and back injections for the sample set method)
- The same Run Time
- The same Data Start time
- The same Next Inject Delay time

3.3 Making Manual Injections

You can use the Empower system to make manual injections with your 6890 GC or 5890 GC.

1. When injecting manually, leave the vial field in Run Samples set to its default value.

2. If you are making a manual injection on a 5890 GC, disconnect the remote cable from its port on the GC.

3. To monitor the baseline and equilibrate, click **Monitor** in the instrument control pane to activate baseline monitoring and equilibrate the system.

   Note: If you are making a manual injection using a 5890 GC, you must click Start after you click Monitor.

The steps for making manual injections are identical for 6890, 6890 Plus, and 6890N GC systems.

1. Remove the autoinjector tower.

2. If the Not Ready light on the 6890 front panel is lit, adjust the gas flow and temperature to put the instrument in a ready state. If the light remains lit, press the **Status** key for further information on the system status.

3. In Empower software, close the Run Samples window.

4. Access Configuration Manager and take the system offline.

5. In the Acquisition Server Properties window, click the **Instruments** tab and click **Scan for Instruments**.

    Note: Complete this step even if there is no busLAC/E installed in the acquisition server. Scanning the acquisition server captures the configuration of attached instruments.

    If your connection to the 6890 GC and configuration of the Equinox serial board are correct, YES appears in the OK? field for instrument type 6890 when you click Scan for Instruments in Acquisition Server Properties.

6. In the Acquisition Server Properties window, scroll to the right to see the instrument firmware revision and other configurations such as inlets, oven, tray, and detectors. Do not proceed until the OK? field for the 6890 says YES and the configuration reported in the Details field matches the actual 6890 configuration. The system is now ready to accept a manual injection.

7. Click **OK** to close the Acquisition Server Properties window.

8. Bring the system online.

9. Open the Run Samples window and enter your sample information in the Single Injection window.

10. In Run Samples, click **Inject**. The 6890 front panel displays the "Ready for Injection" message, then the "Waiting for Injection" message.

11. When the 6890 front panel displays the "Waiting for Injection" message, make the injection at the 6890 system and press **Start** on the 6890 front panel.

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Chapter 4
Troubleshooting the GC System

This chapter provides basic troubleshooting information for your GC system. It focuses on problems between Empower and your GC instruments. See the appropriate operator's guides for information about error messages, diagnostics, and troubleshooting other instruments in your GC system.

Before You Begin

If you work in a validated environment, consult your standard operating procedures before troubleshooting the system.

Rely on your instrument service provider to make internal adjustments to your GC instruments.

STOP *Attention: To avoid problems caused by power surges, line spikes, and/or transient energy fluctuations, use a power supply that is properly grounded and free from power supply variations.*

Caution: Use caution when touching the GC instruments. They could contain hot surfaces.

Contacting Waters

Most problems are relatively easy to correct. If you are unable to correct a problem or a failed condition, call Waters Technical Service at 800 252-4752, *U.S. and Canadian customers only.* Other customers, call your local Waters subsidiary or your local Waters Technical Service Representative, or call Waters corporate headquarters in Milford, Massachusetts (U.S.).

To expedite your request for service or technical support, have the following information available when you call Waters Technical Service:

- System configuration (front inlet, back inlet, front detector, back detector, injectors)
- Detector type
- Problem symptom(s)

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- Method parameters
- Column type
- Operating pressure
- Carrier gas

You might also be asked to provide the firmware versions of your GC instruments.

To check the firmware version on the 5890, 6890, 6890 Plus or the 6890N GC, power on the instrument. The firmware version is displayed on the LCD.

To check the firmware version on the injector towers and controllers:

1. On the instrument keypad, press **Options**.
2. Scroll down to Instrument Status and press **Enter**.
3. Scroll down. The instruments are shown as follows:
   - Smplr:model&firmware
   - F inj:model&firmware
   - B inj:model&firmware

4.1 Gas System Troubleshooting

A poorly functioning gas system can cause problems in your Empower GC system. Before proceeding to Section 4.2, check these gas system components.

Regulators

To check the regulators, set the instrument for a constant pressure of 8 psi. Then use the manifold pressure (on the regulator, not the tank) to adjust the pressure to a constant flow at 8 psi.

Tanks

Ensure there is adequate pressure in the tanks. The lower the pressure in the tank, the more erratic the pressure and flow readings. As a rule, the tank should be replaced when its pressure falls below 100 psi. Follow your standard operating procedure for replacing the tank.

If you are using a split/splitless inlet, consider using the 6890 Gas Saver option, which reduces carrier gas consumption and allows you to reach pressures that may otherwise be difficult to achieve.

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Clogs

Visually inspect the inlet liner and septum and the column for clogs. If necessary, have the person responsible for instrument maintenance remove and reinstall the column. Capillary columns occasionally become clogged with broken pieces. If this is the case, cut off the clogged portion of the column and reinstall it.

Fittings

Check the entire copper assembly to ensure all connections are tight. Do not overtighten the copper connections. If you have to adjust the fittings, tighten them no more than a quarter turn past tight.

Determine the age and condition of the gas scrubbers and the Teflon® tape inside the fittings. If there is no Teflon tape inside the fittings, remake all connections using Teflon tape.

4.2 GC-Specific Troubleshooting

Table 4-1 contains troubleshooting information for Empower controlled GC systems.

Table 4-1 GC Troubleshooting

Symptom	Possible Cause	Corrective Action
Instrument status – "No"	System rescanned before it was taken offline.	Reboot the instrument and the Empower system computer. Take the system offline, then rescan.
	Columns or instruments reconfigured without reconfiguring the Empower system.	Take the system offline, then rescan.
Instrument fail – Inlet not enabled	Two colums configured for same inlet.	Ensure the column configurations specify separate inlets. For single column configurations, the unused column must be configured for an inlet different than that of the used column.
Instrument fail – Bad Method	Instrument method/GC configuration mismatch	Check your Empower instrument method and the instrument configuration to ensure they match.

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Table 4-1 GC Troubleshooting *(Continued)*

Symptom	Possible Cause	Corrective Action
Channel collects wrong data.	Cross-configured systems ***Note:*** *You can only collect two channels of data from one injection if your system is configured for a single tower or for a single injection using dual towers.*	Ensure channel 1 is configured with inlet 1 and channel 2 is configured with inlet 2.
Communication failure.	Incorrect adapter address.	Ensure the Equinox card adapter is configured so that its first port is COM 3. ***Note:*** *Close Run Samples and take the system offline before you rescan the busLAC/E or reconfigure the ports used for the system.*
Instrument status – Always "No"	Incorrect communications parameters.	Reset communication parameters.
	Incorrect 5890 network configuration parameters.	Reset network configuration parameters.
	Incorrect firmware/driver versions.	Check firmware and driver versions and reload if necessary. ***Note:*** *Reloading firmware clears the instrument memory. You must reenter the instrument communication parameters after loading the firmware.*
Instrument status – Always "No" (*continued*)	Incorrect connectors used to connect the Equinox card to the GC.	Ensure the correct connectors (RJ45 - DB9) are used. See the connection diagrams in Chapter 2 for connector uses and part numbers.
Instrument fail – Injector	Injector errors.	Check the injector needle. Check the fault lights. Reboot the instrument and the Empower system computer.
Data buffer overflow	Serial communication limitation.	Ensure that no more than four GCs are connected to one computer *and* that data is not sampled at more than 200 points per second for any one instrument.

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Table 4-1 GC Troubleshooting *(Continued)*

Symptom	Possible Cause	Corrective Action
Instrument failure when setting up the 6890 Plus	Incorrect column dimensions.	Ensure the correct column dimensions are entered in the system.
	Oven temperature not at specified set point.	Ensure the oven temperature has reached the set point. If the error persists, test the conditions on the instrument before running from Empower.
	Inlet or detector not at specified temperature.	Ensure the inlets and detectors have reached the set temperature. If the error persists, test the conditions on the instrument before running from Empower.
	Incorrect instrument method configuration.	Check the instrument method. If you are using a dual tower method, ensure both injectors are configured properly. If you are using a single tower method, uncheck the unused inlet and injector.
	Unused detector enabled.	If you are using only one detector, ensure the unused detector is not enabled.
Instrument failure when setting up the 6890 Plus *(continued)*	Equinox card configured incorrectly.	Check the Devices applet in Control Panel. The Equinox card should be listed as Started, and the startup option should be set to Automatic. If the card is not listed, the driver was not loaded. If the card is listed but fails to start, start it manually by clicking **Start**, then set the startup parameter to **Automatic**.
	Incorrect cable connection (6890 with a G1512A injector controller).	Check the cables that connect the controller to the respective front and back injectors to ensure they are connected correctly.
6890 Plus does not start until the Prep Run button is pressed.	The Auto Prep Run feature is disabled (off).	See the instructions on the front panel and the HP configuration manuals on how to enable the Auto Prep Run feature. This starts the 6890 without pressing the Prep Run button.

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Table 4-1 GC Troubleshooting *(Continued)*

Symptom	Possible Cause	Corrective Action
6890 does not start.	Remote cable connected to 6890 (other than from the G1512).	Disconnect the remote cable to the 6890 GC (other than from the G1512).
	Specified parameters cannot be reached by the instrument.	Enter parameters in the instrument front panel to verify that they work.

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