OPERATION, MAINTENANCE, and TROUBLESHOOTING

L2140-*i*, L2130-*i* or L2120-*i* Analyzer and Peripherals

User's Manual

* This manual excludes information on how to operate and maintain the Induction Module Setup. Please see the "IM-CRDS Setup User's Manual."

* This manual excludes information on how to operate and maintain the Picarro Autosampler. Please see the "Picarro Autosampler | Installation and Operation Manual."

PICARRO

Picarro Analyzer User's Manual

Thank you for purchasing a Picarro product. Your Picarro analyzer is a quality product that has been designed and manufactured to provide reliable performance.

This manual is an important part of your purchase as it will help familiarize you with the analyzer and explain the numerous features that have been designed into it. Please read this manual thoroughly before using your Picarro analyzer.

Please contact Picarro or your authorized Picarro distributor should you have questions regarding specific applications or if you require additional information.

Contact Technical Support:
Email: support@picarro.com
Phone: 408.962.3991
(See "Technical Support" chapter for more information.)

Contact Customer Service:
Email: orders@picarro.com
Phone: 408.962.3992

Picarro, Inc. reserves the right to change or update the contents of this manual and to change the specifications of its products at any time without prior notification. Every effort has been made to keep the information in this document current and accurate as of the date of publication or revision. However, no guarantee is given or implied that this document is error free or that it is accurate with regard to any specification.

Picarro, Inc. has prepared this manual for use by its customers as a guide for the proper installation, operation and/or maintenance of the Picarro analyzer.

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PICARRO

Table of Contents

PICARRO

MUST READ BEFORE USING THE MANUAL

This manual is supplementary to the **INSTALLATION: L2140-*i*, L2130-*i* or L2120-*i* Analyzer and Peripherals User's Manual**, and should be referred to only *after* completing the system installation and reviewing safety notes. This manual describes how to operate, analyze data, maintain, and troubleshoot these configurations.

References to chapters and other files/documents are referenced in bold.

This manual includes various graphic icons to represent important information in the text. See **Conventions** for definitions of graphic icons. For explanations of acronyms, see **Acronyms**.

Picarro water analyzers (L2140-*i*, L2130-*i* or L2120-*i*) can work in many different configurations, allowing a diverse application of the CRDS (Cavity Ring-Down Spectroscopy) technology. This manual includes information on how to operate, analyze data, maintain, and troubleshoot the water analyzer in its many configurations, excluding the Picarro Autosampler Operation (see **Picarro Autosampler: Installation and Operation User's Manual**).

For information on Picarro's chief technology, see **Introduction to Technology**.

To sign up for Picarro's electronic newsletter which showcases research by Picarro customers around the globe, see **Connecting Our Customers.**

Be selective when following the manual by only referring to the sections that refer to the configuration of your interest. To start, find your configuration below, which will link to relevant chapters of the manual.

NAME OF SETUP	SETUP CHAPTER
Dual Mode	See **Operation, Maintenance, and Troubleshooting** | **Dual Mode Setup.** This mode is used for measurement of ambient vapor coupled with automated injection of liquid calibration standards. This setup requires an A0211 high precision vaporizer, an A0912 hardware/software for vapor calibration and an Autosampler. The measurement mode alternates between analyzing ambient vapor and liquid standards based on user defined sequence. The mode uses high precision method for liquid calibration. Each injection cycle takes 9 minutes. Before operating in Dual Mode, set the vaporizer temperature to 110 C°.
IM	See a separate document titled **IM-CRDS Setup User's Manual.** This setup requires an Induction Module and a CRDS analyzer. Used for isotopic analysis of extracted

	water from samples such as soil, plants, or tissues and allows isotopic analysis of the extracted water.
Manual Mode	See **Operation, Maintenance, and Troubleshooting** | **Manual Mode Setup.** The manual mode setup is used for semi-automated measurement of liquid water samples with maximum precision. The setup requires an A0211 high precision vaporizer and A0322 Syringe Guide. User manually injects samples after prompt. The control of the vaporizer and the analysis of liquid samples are automated. Each injection cycle takes 9 minutes.
Picarro Autosampler – High Precision Vaporizer (A0211)	See **Operation, Maintenance, and Troubleshooting** | **Picarro Autosampler - High Precision Vaporizer Setup.** The setup can operate in two measurement modes: High Precision and High Throughput. • High Precision Measurement Mode measures liquid water samples with maximum precision. Liquid samples are automatically injected and analyzed. Each injection cycle takes 9 minutes. • High Throughput Measurement Mode is used for faster measurement of liquid water samples with good precision. Liquid samples are automatically injected and analyzed. Each injection cycle takes 4 minutes. High Precision & High Throughput Coordinator Modes operate in the exact same fashion except that the steps of sample preparation and analysis are faster in the high throughput coordinator mode.
Picarro Autosampler – High Throughput Vaporizer (A0212)	See **Operation, Maintenance, and Troubleshooting** | **Picarro Autosampler - High Throughput Vaporizer Setup.** The setup is used for fastest measurement of liquid water samples with good precision. Liquid samples are automatically injected and analyzed. Each injection cycle takes 4 minutes.
SDM	See **Operation, Maintenance, and Troubleshooting** | **Standard Delivery Module (SDM) Setup.** Used for measurement of ambient vapor coupled with automated injection of liquid calibration standards. Requires A0211 high precision vaporizer and A0101 standards delivery module. Alternates between analyzing ambient vapor from multiple points and a continuous stream of

	vaporized standard. The alternation is based on a user defined sequence. A calibration measurement takes approximately 20 minutes per concentration/standard. Before operating in SDM mode, set the vaporizer temperature to 140°C.

Refer to the **Table of Contents** to find the location of any of the chapters described above.

See **Technical Support** to learn how to streamline technical support from Picarro.

For warranty information, see **Limited Warranty**.

INTRODUCTION TO TECHNOLOGY

Picarro analyzers use time-based, optical absorption spectroscopy of the target gases to determine concentration. They are based on wavelength-scanned cavity ring-down spectroscopy (WS-CRDS), a technology in which light re-circulates many times through the sample, creating a very long effective path length for the light to interact with the sample, thus, enabling excellent detection sensitivity in a compact and rugged instrument.

The Picarro analyzer is comprised of two modules:

Analyzer	The analyzer contains the spectrometer, sample chamber, and a computer with a hard drive to store data. The single analyzer module controls the operation of the system and converts spectroscopic measurements into gas concentration data.
External Vacuum Pump	The diaphragm pump draws the sample gas through the instrument.

CONVENTIONS

Throughout the manual you will see graphic icons representing important information in the text. The purpose of these icons is to provide a visual convention to alert you of a stop in the flow of the manual, where an important note or safety hazard alert is posted.

NOTE	CAUTION	WARNING	REMINDER
			

NOTE is an important procedure of which you should be aware before proceeding.

CAUTION alerts you of a potential danger to equipment or to the user.

WARNING indicates an imminent danger to the user.

REMINDER is a helpful hint to procedures listed in the text.

ACRONYMS

This manual includes various acronyms. For definitions, see below.

Acronym	Definition
AS	Autosampler
cm	centimeters
DIO	Digital Input and Output Between the Analyzer and the Autosampler. DIO Tells the Autosampler to prepare for an injection, and also to do an injection. Additionally, DIO is the place where the autosampler notifies that an injection has been made.
GUI	Graphical User Interface
IM	Induction Module
mm	Millimeters
MCM	Micro-combustion Module
ppm	Parts Per Million
sccm	Standard Cubic Centimeters per Minute
SDM	Standards Delivery Module
WLM Purge Port	Wavelength Monitor Purge Port. The Port on the Analyzer the dry gas connects to. This keeps the spectroscopy accurate.

SAFETY

GENERAL SAFETY

The Picarro analyzer complies with the following safety standards:

CE **IEC EN61010-1:2001 (Safety) and EN61326-1:2006 (EMC)** requirements for electrical equipment for measurement, control and laboratory use.

FDA/CDRH **21 CFR Parts 1040.10-11**

	WARNING: DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE! DO NOT OPERATE IN THE PRESENCE OF FLAMMABLE GASSES OR FUMES.
	WARNING: THE INSTRUMENT IS NOT WATER PROOF, AND IT SHOULD BE KEPT PROTECTED FROM EXPOSURE TO ALL LIQUID WATER.
	CAUTION: The Picarro analyzer contains no user serviceable components except the particulate filter and the vacuum pump. Do not attempt repairs; instead, report all problems to Picarro Customer Service or your local distributor. Please contact Picarro if you have any questions regarding the safe operation of this equipment.
	CAUTION: The inlet gas connector on the back panel of the analyzer, and its immediate vicinity, runs hot during operation of the analyzer. Take care when connecting gas lines or working at the rear of the instrument to wear protective gloves or avoid contact with these surfaces.
	CAUTION: The analyzer contains HOT SURFACES and utilizes HIGH VOLTAGES inside the instrument. There are no user serviceable components except the filter within the analyzer and you should not open the analyzer except to replace the filter. Do not open any enclosures within the analyzer.
	CAUTION: The analyzer is heavy. To avoid injury, please use proper 2-person lifting procedures when moving or installing the equipment.

LASER SAFETY

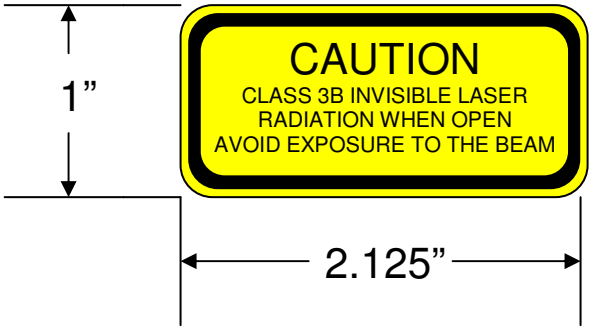
The outside of the Picarro analyzer is classified as a Class 1 Embedded Laser Product, while the inside of the Picarro analyzer is classified as a Class 3B Embedded Laser Product.

	CAUTION: CLASS 3B INVISIBLE LASER RADIATION WHEN OPEN. AVOID EXPOSURE TO THE BEAM.

The lasers inside of the analyzer emit a maximum of 50mW of CW light in the near-infrared. There are no user serviceable components within the analyzer enclosures and so you should not open any of these enclosures within the analyzer. FAILURE TO FOLLOW THIS INSTRUCTION COULD RESULT IN EXPOSURE TO CLASS IIIB LASER RADIATION, which can permanently damage eyes and skin.

SAFETY LABEL

The following label is affixed to the inside of the analyzer.



ADJUSTING INJECTION VOLUME

For best results, liquid sample injections should be provided to the instrument at a concentration of **20,000 ± 1000ppmv (parts per million by volume).** Each liquid injection will be labelled as ”good” in the coordinator if this concentration is between **17,000 - 23,000ppmv**. If the concentration is significantly above/below this range (i.e. <6,500 ppmv or >25,000 ppmv) or if the dry background is >500ppmv, the pulse will not be analyzed and the data will not appear in the coordinator.

To achieve the appropriate injection concentration:

1. Dry nitrogen (<50ppmv water concentration) should be supplied to the instrument at **2.5 ± 0.2psi** (17.2 ± 1.4kPa), supplied at **200sccm (Standard Cubic Centimeters per Minute)**. If Drierite (or similar) is used for the dry air (rather than nitrogen) supply, a measured level of ~**100-200ppmv** will produce satisfactory data. Specifications are guaranteed only with dry nitrogen supply. Dry air can be used but will require a software change to account for the calibration shift from nitrogen. Contact Picarro for details on the software change.
2. Sample injection volume (controlled by Autosampler) should be set at ~**2µL**.

If the resulting concentration peak after the 2nd or 3rd liquid injection is substantially different from 20,000ppmv:

1. **The injection volume may need to be scaled appropriately:** for example, if the resulting concentration peak of an initial ‘test’ injection is 16,000ppmv, then the injection volume needs to be adjusted by the factor 20,000/16,000 = 1.25. To accomplish this, multiply the current injection volume in the Autosampler method by 1.25.
2. **The injection quality may need improvement**. Bad Injections can cause incorrect injection concentrations. Bad injections can be from a clogged needle, damaged vaporizer septum, or incorrect dry gas pressure/flow restriction. For rapid optimization of injection volume use the high throughput coordinator.

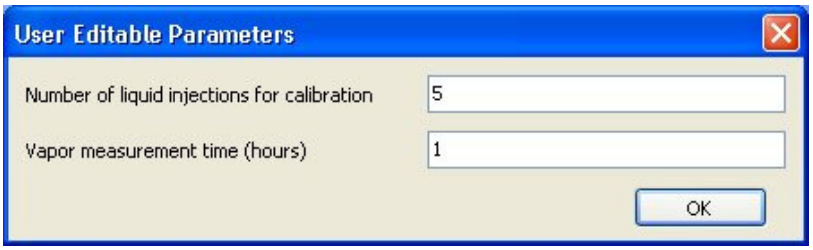
	**Five failed injections will lead to a Time Out:** Every time there is a liquid injection into a vaporizer by the Autosampler, a pulse of water vapor should enter the cavity and be analyzed. If something goes wrong (e.g. syringe breaks), and the pulse analysis fails, the software will try injecting five times in a row. After 5 failed injection pulses, the coordinator will time out. You will need to restart the coordinator to continue the experiment. This is a built-in safety mechanism that helps prevent un-intended sample contamination following multiple pierces of the vial septum.

OPERATION, MAINTENANCE, AND TROUBLESHOOTING

Dual Mode Setup

OPERATION

1) Before continuing, review the important safety notes in **Safety**.
2) Make sure the hardware setup is complete and the system turned on in the correct sequence (see **INSTALLATION | L2140-*i*, L2130-*i* or L2120-*i* Analyzer and Peripherals User's Manual**).
3) Once turned on, the main GUI (Graphical User Interface) of the analyzer will open automatically on the desktop screen. To understand all the functions of the main GUI, see **GUI Functions**. A sequence of start-up messages will also appear in the Status Log Message window of the main GUI. For definition, see **Common Status Log Messages**.
4) Make sure the temperature of the High Precision Vaporizer stabilizes at 110℃ by viewing the read out on the front of the vaporizer.
5) Make sure the Picarro Autosampler has been trained, methods and jobs defined, and samples loaded. See **Picarro Autosampler: Installation, Training, Operation, Maintenance User's Manual**.
6) Double click on the Coordinator Launcher icon on the analyzer's desktop. The coordinator software allows the analyzer to take measurements from multiple samples, and is used to control the sample source and match the corresponding real time read out with the sample source. To learn more about the coordinator software (running the software, loading sample description, functions of the coordinator window), see **Coordinator Window.** Choose and launch an appropriate coordinator mode from the choices in the drop down menu of the coordinator launcher window. The Dual Mode Setup can operate in one coordinator mode.
    - **Dual Mode:** This mode is used for measurement of ambient vapor coupled with automated injection of liquid calibration standards. This setup requires A0211 high precision vaporizer, A0912 hardware/software for vapor calibration and an Autosampler. Each injection cycle takes 9 minutes. Before operating in Dual Mode, set the vaporizer temperature to 110 ℃.
7) Once launched, before the Coordinator window opens up, the User Editable Parameters window will pop up (as shown below):



This allows measurement of liquid isotopic water standards at fixed time intervals during the measurement of the vapor phase to verify calibration. The analyzer will run the parameters specified in a continuous loop until exiting from the program (i.e. measure 5 liquid injections, 1 hour of vapor, 5 liquid injections, 1 hour of vapor, etc). Measurement will always start with liquid injections.

- **If no liquid samples are to be measured** then enter '0' in the field for liquids. It will then measure the vapor continuously.
- **If no vapor samples are to be measured** then enter '0' in the field for vapors. It will then run only the liquid samples specified in the Autosampler job (see later section for details).
- **If the analyzer is already running and these parameters need to be changed** it will require exiting and restarting the Picarro software.

	Analysis of liquid samples requires that both the coordinator software and autosampler job be started.

It is highly recommended to match the 'number of liquid injections for calibration' to the injection count set in the Autosampler job. This ensures one sample vial is analyzed completely before returning to vapor measurements. If two or more liquid calibration standards are used then 'number of liquid injections for calibration' can also be an integer multiple of the injection count set in the Autosampler job**. For example** if eight injections each of two liquid standards are to be run every 6 hours during vapor measurements then enter 16 (8 injections * 2 standards) in the first field and 6 in the second field.

Be sure there are sufficient liquid standards available because once all the liquid samples specified in the Autosampler job have been run and the current vapor measurement is complete, the analyzer will wait indefinitely or until a new Autosampler job is started.

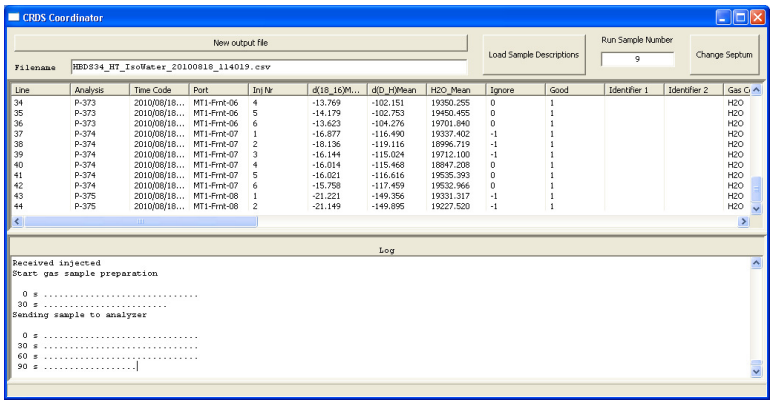
	To calculate the time to complete the autosampler job use the follow formula: Cycle time = number injections * 9 min + vapor measurement time

Assuming 1 standard per cycle, 8 injections, and 6 hours vapor measurement: the total cycle time is 432 minutes and consumes 1 vial. The Picarro Autosampler has a tray for up to 105 vials. Therefore, one full tray of 105 vials will last 432 * 105 = 45360 minutes or 31 days 12 hours. Thus, plan on one tray lasting for one month of measurements when calibrating every 6 hours.

Once the injection number and vapor measurement duration parameters have been entered, and the 'OK' button is clicked, the coordinator window will pop up on your desktop. The different software element will indicate whether liquid or vapor is being measured.

8) Once launched, the coordinator will automatically start collecting data. The data will also be available in the GUI as pulses. To customize pulse analysis or to adjust the peak of pulse data, please see **Pulse Customization.**

Coordinator Launcher Window



Coordinator Window

9) To learn about the other coordinator modes supported by the Picarro water analyzer (but in different setups), see **Coordinator Modes**.

10) To calibrate one's system, see **Calibration**.

11) One may need to adjust the sample injection volume to improve the quality of one's data. See **Adjusting Injection Volume** for more information.

12) When in need of shutting down the system, refer to **Shutdown Procedure** for directions. To transport and store the system optimally, see **Transportation & Storage.**

DATA

13) To learn where to retrieve the data from, and to set the frequency of file archival and automatic deletion of old files, see **Data Files.** To access one's data remotely, see **Remote Data Access.**

14) To configure data file saving details, including which data elements are written to data files, digital data output (via serial port or TCP/IP), remote data delivery (via email), and general GUI properties, click on the Setup Tool icon in the Picarro Utilities folder in the desktop. For more information, see **Setup Tool.**

15) The Picarro Water analyzers allow users to archive data using a highly-compressed, binary "HDF5" or "h5" format. The Data File Viewer program, which comes installed with the hardware, allows one to open and convert h5 files, as well as viewing the h5 files as graphs. For more information, see **Data File Viewer.**

16) The Picarro Water Analyzers come preinstalled with the ChemCorrect software which allows one to screen and quantify contamination in isotopic water samples. To post process data using ChemCorrect Software, see **ChemCorrect: Analysis of Coordinator Files.**

MAINTENANCE

17) With the exception of the particulate filter, the analyzer is not user serviceable. For information on how to change the particulate filter of the analyzer and the vaporizer's injection port septum, see **Service and Maintenance.**

TROUBLESHOOTING

18) For information on troubleshooting the CRDS analyzer or ChemCorrect, see **Troubleshooting.** The Cavity Ring-Down Spectrometer Controller software can be used as a diagnostic tool in troubleshooting the analyzer (see **Cavity Ring-Down Spectrometer Controller**).

19) When in need of a direct help from Picarro, see **Technical Support**. For warranty information, see **Limited Warranty.**

Picarro Autosampler - High Precision Vaporizer Setup

OPERATION

1) Before continuing, review the important safety notes in **Safety.**
2) Make sure the hardware setup is complete and the system is turned on in the correct sequence (**INSTALLATION | L2140-*i*, L2130-*i* or L2120-*i* Analyzer and Peripherals User's Manual**).
3) Once turned on, the main GUI (Graphical User Interface) of the analyzer will open up automatically on the desktop screen. To understand all the functions of the main GUI, see **GUI Functions**. A sequence of start-up messages will also appear in the Status Log Message window of the main GUI. For definition, see **Common Status Log Messages**.
4) Make sure the temperature of the High Precision Vaporizer has stabilized at 110℃ by viewing the read out on the front of the vaporizer.
5) Make sure the Picarro Autosampler has been trained, methods and jobs defined, and samples loaded. See **Picarro Autosampler: Installation, Training, Operation, Maintenance User's Manual**.
6) Double click on the Coordinator Launcher icon in the analyzer's desktop. The coordinator software allows the analyzer to take measurements from multiple samples, and is used to control the sample source and match the corresponding real time read out with the sample source. To learn more about the coordinator software (running the software, loading sample description, functions of the coordinator window), see **Coordinator Window.** Choose and launch an appropriate coordinator mode from the choices in the drop down menu of the coordinator launcher window. The coordinator window will pop up.

   The Picarro Autosampler – High Precision Vaporizer Setup can operate in following coordinator modes.

   For the L2140-*i*:

   - **High Precision:** For interfacing with an autosampler for high precision measurements of $\delta^{18}O$ and δD. This coordinator must be run in either the iH2O N2 mode or the iH2O Air mode. In this mode the coordinate ***will not*** output $\delta^{17}O$ and ^{17}O-excess.
   - **O17 High Precision:** For interfacing with an autosampler for high precision measurements of $\delta^{18}O$, $\delta^{17}O$, δD and ^{17}O-excess. This coordinator must be run in either the iH2O N2 O-17 mode or the iH2O Air O-17 mode. In this mode the coordinate ***will*** output $\delta^{17}O$ and ^{17}O-excess.

For the L2130-*i* and L2120-*i*:

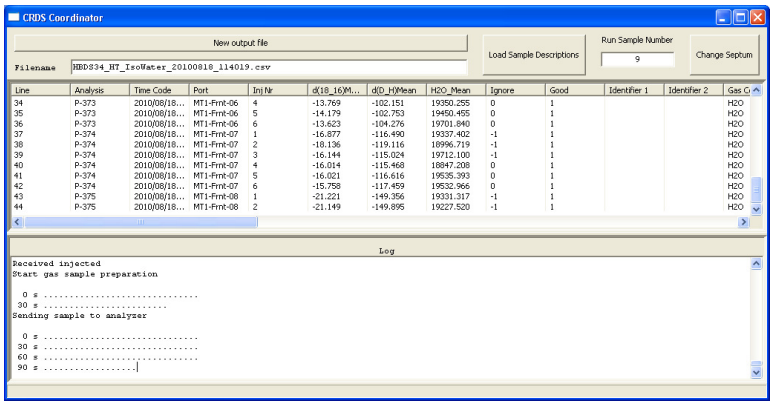
- **High Throughput:** Used for faster measurement of liquid water samples with good precision. Automatically injects and analyzes liquid water samples. Each injection cycle takes 4 minutes.
- **High Precision:** Used to measure liquid water samples with maximum precision. Automatically injects and analyzes liquid samples. Each injection cycle takes 9 minutes.

The High Precision & High Throughput Coordinator Modes operate in exactly the same fashion except that the steps of sample preparation and analysis are faster in the high throughput coordinator.

7) To learn about the other coordinator modes supported by the Picarro water analyzer (but in different setups), see **Coordinator Modes**.

8) Once launched, the coordinator will automatically start collecting data, assuming the Autosampler job has been started. The data will also be available in the GUI as pulses. To customize pulse analysis or to adjust the peak of pulse data, please see **Pulse Customization.**

Coordinator Launcher Window for the L2140-i



Coordinator Window

9) To calibrate one's system, see **Calibration**.

10) While operating, when in need of switching between different measuring modes (for instance between the High Throughput and High Precision mode), see **Switching Between Measurement Modes** for directions.

11) When in need of shutting down the system, refer to **Shutdown Procedure** for directions. To transport and store the system optimally, see **Transportation & Storage.**

DATA

12) To learn where to retrieve the data from, and to set the frequency of file archival and automatic deletion of old files, see **Data Files.** To access one's data remotely, see **Remote Data Access.**

13) To configure data file saving details, including which data elements are written to data files, digital data output (via serial port or TCP/IP), remote data delivery (via email), and general GUI properties, click on the Setup Tool icon in the Picarro Utilities folder in the desktop. For more information, see **Setup Tool.**

14) The Picarro Water analyzers allow users to archive data using a highly-compressed, binary "HDF5" or "h5" format. The Data File Viewer program, which comes installed with the hardware, allows one to open and convert h5 files, as well as viewing the h5 files as graphs. For more information, see **Data File Viewer.**

15) The Picarro Water Analyzers come preinstalled with the ChemCorrect software which allows one to screen and quantify contamination in isotopic water samples. To post process data using ChemCorrect Software, see **ChemCorrect: Analysis of Coordinator Files.**

16) One many need to adjust the sample injection volume to improve the quality of one's data. See **Adjusting Injection Volume** for more information.

MAINTENANCE

17) With the exception of the particulate filter, the analyzer is not user serviceable. For information on how to change the particulate filter of the analyzer and the vaporizer's injection port septum, see **Service and Maintenance.**

TROUBLESHOOTING

18) For information on troubleshooting the CRDS analyzer or ChemCorrect, see **Troubleshooting.** The Cavity Ring-Down Spectrometer Controller software can be used as a diagnostic tool in troubleshooting the analyzer (see **Cavity Ring-Down Spectrometer Controller**).

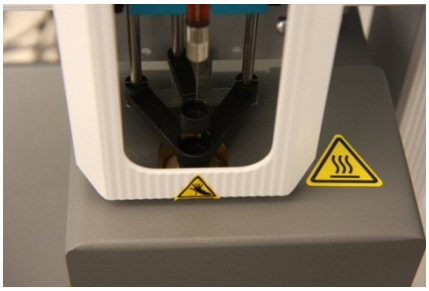
19) When in need of a direct help from Picarro, see **Technical Support**. For warranty information, see **Limited Warranty.**

Picarro Autosampler - High Throughput Vaporizer Setup

OPERATION

1) Before continuing, review the important safety notes in **Safety.**
2) Make sure the hardware setup is complete and the system is turned on in the correct sequence (**INSTALLATION | L2140-*i*, L2130-*i* or L2120-*i* Analyzer and Peripherals User's Manual**).
3) Once turned on, the main GUI (Graphical User Interface) will open up automatically on the desktop screen. To understand all the functions of the main GUI, see **GUI Functions**. A sequence of start-up messages will also appear in the Status Log Messages window of the main GUI. For definition, see **Common Status Log Messages**.
4) Make sure the temperature of the High Precision vaporizer has stabilized to 110℃.
5) Make sure the Picarro Autosampler has been trained, samples loaded, and methods and jobs defined. See **Picarro Autosampler: Installation, Training, Operation, Maintenance User's Manual**.

	**Training the High Throughput Vaporizer:** The Vaporizer needs to be set up properly in order to achieve its best performance. The training of the Vaporizer injection port should be set such that the syringe is trained to the center of the Vaporizer needle guide with an injection depth of 28 mm. See figures below. The injection speed should be set to 50nL/sec, and the sample size should be set to 3.3uL for water with low concentrations of dissolved solids and 3.0uL for water with higher concentrations of dissolved solids.



Autosampler aligned to the injection port of a High Throughput Vaporizer.

6) Double click on the Coordinator Launcher icon in the desktop. The coordinator software allows the analyzer to take measurement from multiple samples, and is

used to control the sample source and match the corresponding real time read out with the sample source. To learn more about the coordinator software (running the software, loading sample description, functions of the coordinator window), see **Coordinator Window.** Choose and launch an appropriate coordinator mode from the choices in the drop down menu. The coordinator window will pop up.

The Picarro Autosampler – High Throughput Vaporizer Setup can operate in only one coordinator mode, and can only be interfaced with the L2130-*i* or L2120-*i*. See description below.

- **A0212 High Throughput**: Used for fastest measurement of liquid water samples with good precision. Automatically injects and analyzes liquid samples. Each injection cycle is less than 2 minutes. See the rest of the Chapter for more information on the Coordinator.

To learn about the other coordinator modes supported by the Picarro water analyzer, see **Coordinator Modes**.

7) Once launched, the coordinator will automatically start collecting data, assuming the Autosampler job has been started. The data will also be available in the GUI as pulses. To customize pulse analysis or to adjust the peak of one's data pulses, see **Pulse Customization.**
8) To load sample description to the coordinator window, please see **Coordinator Window.**
9) For calibration information, see **Calibration**.
10) When in need of shutting down the system, please refer to **Shutdown Procedure**. To transport and store the system safely, please see **Transportation & Storage.**

DATA

11) To learn where to retrieve the data from, and to set the frequency of file archival and automatic deletion of old files, see **Data Files.** To access one's data remotely, see **Remote Data Access.**
12) To configure data file saving details, including which data elements are written to data files, digital data output (via serial port or TCP/IP), remote data delivery (via email), and general GUI properties, please click on the Setup Tool icon in the Picarro Utilities folder in the desktop. For more information, see **Setup Tool.**
13) The Picarro Water analyzers allow users to archive data using a highly-compressed, binary "HDF5" or "h5" format. The Data File Viewer program, which comes installed with the hardware allows one to open and convert h5 files, as well as viewing the h5 files as graphs. For more information, see **Data File Viewer.**
14) The Picarro Water Analyzers come preinstalled with the ChemCorrect software which allows one to screen and quantify contamination in isotopic water samples.

To post process data using the ChemCorrect Software, see **ChemCorrect: Analysis of Coordinator Files.**

15) One many need to adjust the sample injection volume to improve the quality of data. See **Adjusting Injection Volume** for details.

MAINTENANCE

16) With the exception of the particulate filter, the analyzer is not user serviceable. For information on how to change the particulate filter of the analyzer and the vaporizer's injection port septum, see **Service and Maintenance.**

17) To replace the vaporizer liner of the High Throughput Vaporizer, see **Installation** | **Picarro Autosampler – High Throughput Vaporizer (A0212) Setup** chapter of the **INSTALLATION: L2140-*i*, L2130-*i* or L2120-*i* Analyzer and Peripherals User's Manual**.

TROUBLESHOOTING

18) For information on troubleshooting the CRDS analyzer, High Throughput Vaporizer, or ChemCorrect, see **Troubleshooting.** The Cavity Ring-Down Spectrometer Controller software can be used as a diagnostic tool in troubleshooting the analyzer (see **Cavity Ring-Down Spectrometer Controller**).

19) When in need of direct help from Picarro, see **Technical Support.** For warranty information, see **Limited Warranty.**

Manual Mode Setup

OPERATION

1) Before continuing, review the important safety notes in **Safety.**

2) Make sure the hardware setup is complete and the system turned on in the correct sequence (**INSTALLATION | L2140-*i*, L2130-*i* or L2120-*i* Analyzer and Peripherals User's Manual**).

3) Once turned on, the main GUI (Graphical User Interface) of the analyzer will open up automatically on the desktop screen. To understand all the functions of the main GUI, see **GUI Functions**. A sequence of start-up messages will appear in the Status Log Messages window of the main GUI. For definition, see **Common Status Log Messages**.

4) Make sure the temperature of the High Precision Vaporizer has stabilized to 110℃.

5) Double click on the Coordinator Launcher icon on the desktop. The coordinator software allows the analyzer to take measurement from multiple samples, and is used to control the sample source and match the corresponding real time read out with the sample source. To learn more about the coordinator software (running the software, loading sample description, functions of the coordinator window), see **Coordinator Window.** Choose and launch an appropriate coordinator mode from the choices in the drop down menu. The coordinator window will pop up.

   The Manual Mode Setup can operate in one coordinator mode in the **L2130-*i* and L2120-*i***.

   - **Manual Inject:** Used for semi-automated measurement of liquid water samples with maximum precision. Requires A0211 high precision vaporizer and A0322 Syringe Guide. User manually injects samples after prompt. The vaporizer control and the analysis of liquid samples are automated. Each injection cycle takes 9 minutes.

   The Manual Mode Setup can operate in two coordinator modes for the **L2140-*i***.

   - **O17 Manual Inject:** Used for semi-automated measurement of liquid water samples with maximum precision on $\delta^{18}O$, $\delta^{17}O$, δD and ^{17}O-excess. Requires A0211 high precision vaporizer and A0322 Syringe Guide. User manually injects samples after prompt. The vaporizer control and the analysis of liquid samples are automated. Each injection cycle takes 9 minutes.
   - **Manual Inject:** Used for semi-automated measurement of liquid water samples with maximum precision on $\delta^{18}O$ and δD. Requires A0211 high precision vaporizer and A0322 Syringe Guide. User manually injects samples after prompt. The vaporizer control and the analysis of liquid samples are automated. Each injection cycle takes 9 minutes.

To learn about all the other coordinator modes supported by the Picarro water analyzer (in different setups), see **Coordinator Modes**.

6) Once launched, the coordinator will direct the user on when to manually inject samples and it will automatically start collecting data. The data will also be available in the GUI as pulses. To customize pulse analysis or to adjust the peak of one's data pulses, see **Pulse Customization.**

7) The status bars at the bottom of the Coordinator window will allow one to know if the analyzer is ready for a manual injection or not. If ready, the sample description (if preloaded) will appear. If not loaded, a description can be added. Manually inject the sample and then press the Injected button in the lower right corner of the Coordinator window. The coordinator software will prepare the sample in the vaporizer in high precision mode. It will take approximately 9 minutes until it is ready for the next injection.

8) To load sample description, see **Coordinator Window.**

9) On the analyzer's desktop, there are various icons & folders. To learn more, see **Desktop Icons & Folders.**

10) When in need of shutting down the system, see **Shutdown Procedure**. To transport and store the system safely, see **Transportation & Storage**.

11) To calibrate one's system, please see **Calibration**.

DATA

12) To configure data file saving details, including which data elements are written to data files, digital data output (via serial port or TCP/IP), remote data delivery (via email), and general GUI properties, click on the Setup Tool icon in the Picarro Utilities folder in the desktop. For more information, see **Setup Tool.**

13) To learn about different types of data produced by one's system and to set file archival and automatic deletion of old files, see **Data Files.** To access one's data remotely, see **Remote Data Access.**

14) The Picarro Water analyzers allow users to archive data using a highly-compressed, binary "HDF5" or "h5" format. The Data File Viewer program, which comes installed with the hardware allows one to open and convert h5 files, as well as viewing the h5 files as graphs. For more information, see **Data File Viewer.**

15) The Picarro Water Analyzers come preinstalled with the ChemCorrect software which allows one to screen and quantify contamination in isotopic water samples. To post process data using ChemCorrect Software, see **ChemCorrect: Analysis of Coordinator Files.**

16) One many need to adjust the sample injection volume to improve the quality of data. See **Adjusting Injection Volume** for more information.

MAINTENANCE

17) With the exception of the particulate filter, the analyzer is not user serviceable. For information on how to change the particulate filter of the analyzer and the vaporizer's injection port septum, see **Service and Maintenance.**

TROUBLESHOOTING

18) For information on troubleshooting the CRDS analyzer, High Throughput Vaporizer, or ChemCorrect, see **Troubleshooting.** The Cavity Ring-Down Spectrometer Controller software can be used as a diagnostic tool in troubleshooting the analyzer (see **Cavity Ring-Down Spectrometer Controller**).

19) When in need of further help from Picarro, see **Technical Support.** For warranty information, please see **Limited Warranty.**

Standard Delivery Module (SDM) Mode Setup

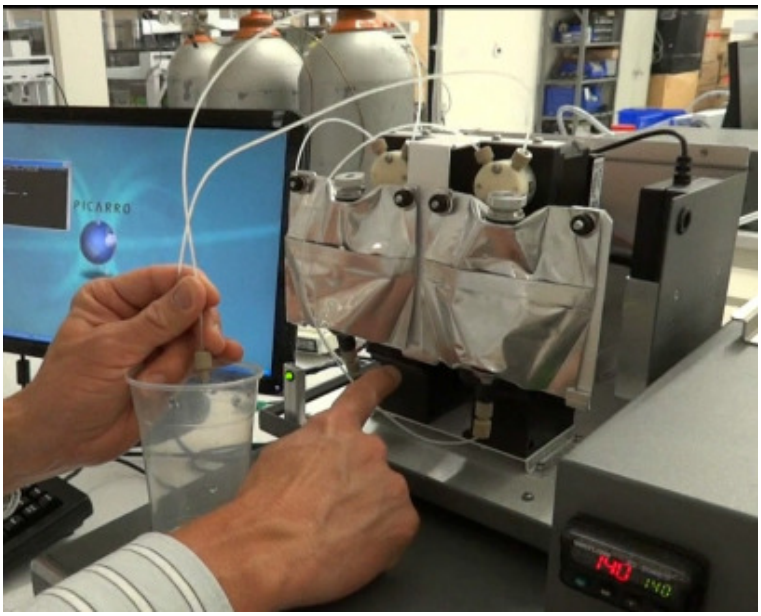
The Standard Delivery Module (SDM) delivers liquid water standard at an extremely slow flow rate (0 to 4.8 microliters per minute) through a needle. For reference, a standard drop of water is about 50 microliters.

The needle tip is held inside the vaporizer and 2 mm away from a tube carrying dry air. The flow rate of air is approximately 300 sccm (standard cubic centimeter per minute). The combination of high temperature, fast dry gas flow, and slow liquid flow allow the delivered standard to evaporate fully as it exits the needle.

Because of the low flow rates all of the fluid connections are very fine (diameters of approximately 100 micrometers). These can clog easily if exposed to dust or mineral rich water.

OPERATION

1) Before continuing, review the important safety notes in **Safety.**
2) Make sure the hardware setup is complete and the system turned on in the correct sequence (**INSTALLATION | L2140-*i*, L2130-*i* or L2120-*i* Analyzer and Peripherals User's Manual**)
3) Once turned on, the main GUI (Graphical User Interface) of the analyzer will open up automatically on the desktop screen. To understand all the functions of the main GUI, see **GUI Functions**. A sequence of start-up messages will also appear in the Status Log Message window of the main GUI. For definition, see **Common Status Log Messages**.
4) **Make sure the temperature of the High Precision Vaporizer has stabilized to 140°C.** Use the up/down buttons on the vaporizer to adjust the set point and allow it to stabilize before proceeding. High temperature is required for proper vaporization since the SDM is not operating in vacuum.
5) Prime the SDM System(see **steps a – e** below):
    a. Point the beige connector ends of the liquid tubing (from right port of pump) into a cup — they will push out a stream of water during the pump priming operation.



Point the beige connector ends of the liquid tubing into a cup.

	Do not connect the beige connector to the vaporizer—a large amount of water will go into the vaporizer and saturate it!!!

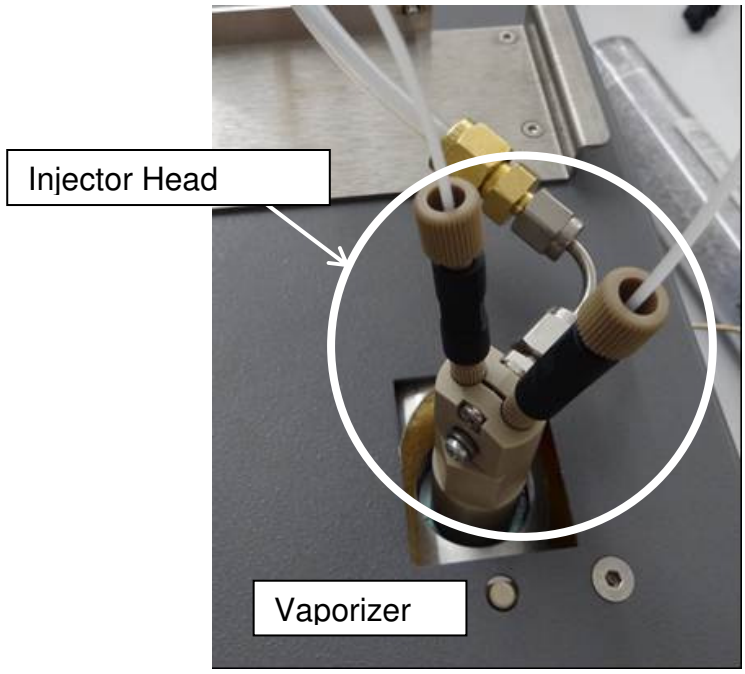
b. On the computer desktop, click on the icon labeled SDM Priming. Verify that both syringe pump 1 and 2 are selected in the Syringe Pump Priming window. Click OK.

c. Each syringe pump will fill and dispense multiple times. The first time this operation is performed with dry tubing, only one to two dispenses may be visible. The dispensed water will be visible as a narrow stream lasting a few seconds. The software window will automatically close within a minute of the last dispense. If tubing lines are used for the first time or have been dried out, the priming should be repeated until each dispense is a strong clean jet of water that is free of bubbles.

	If no water or only a weak trickle is observed by the third dispense, the lines are probably clogged or leaking severely. See troubleshooting in this manual for recommendations.

d. Inspect all three connections of each pump for any leaks. Using a small light source, check both the outside of the connectors as well as the inside for signs of water.

e. Now connect the tubing from each pump to the hex nut on the upper portion of the SDM injector assembly (the two connection points are symmetrically identical). Hold the hex portion of the assembly while tightening in the tubing. It is recommended to mark each hex portion with the number of the connected pump to simplify maintenance and troubleshooting.

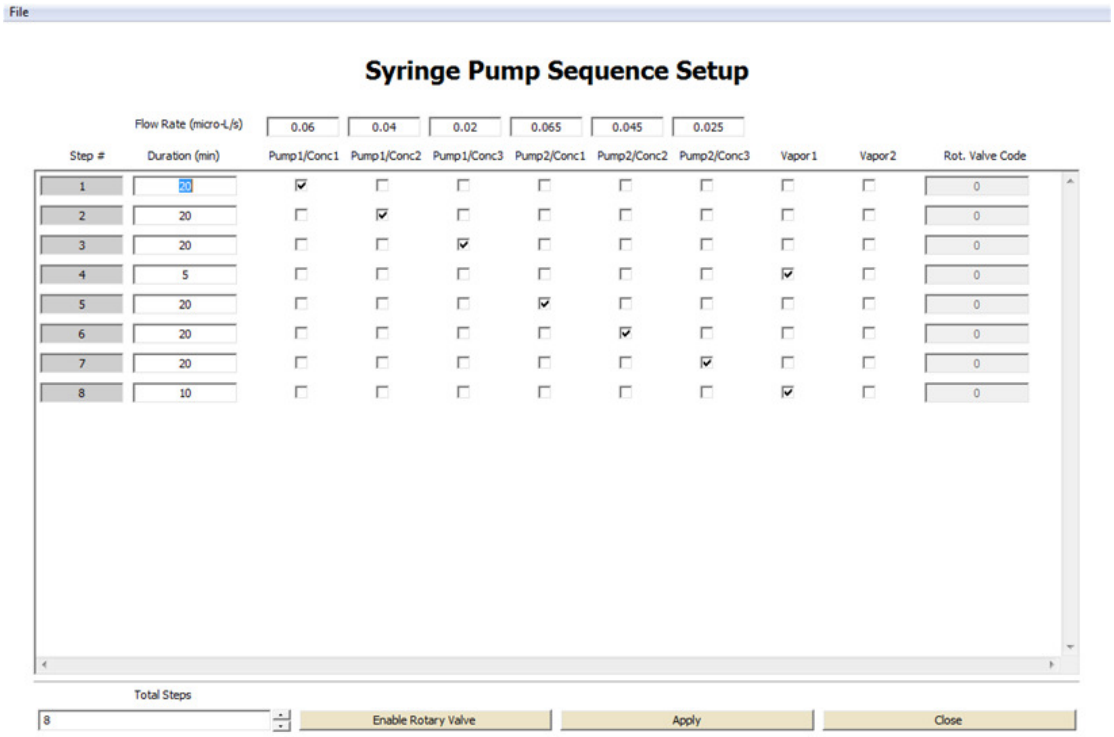


SDM Injector Head Assembly connected to the Vaporizer.

6) Use the Syringe Pumps Sequencer Software to set the frequency, duration, and concentration of standard delivery as well as ambient vapor measurement using the preinstalled software Syringe Pump Sequencer.

7) Click on the SDM Pump Sequencer icon on the desktop to create or load the desired sequence of operation. The sequencer software is used to set the frequency, duration, and concentration of standard delivery as well as ambient vapor measurement. The software supports three concentrations per standards as well as solenoid vapor switching valve (with appropriate valves) and rotary valve switching (for analyzers equipped with two serial ports and appropriate valves.). By specifying Vapor 1 State, Vapor 2 State, or the Rotary Valve Position on the Sequencer Software window, it is possible to sample air from multiple locations for one experiment sequence. Recommended parameters and details of operation are described below. Pump 1 and Pump 2 are on the left and right side of the SDM when looking from the front. Click Apply after entering the parameters.

	In order minimize isotopic memory effects it is recommended to **first run at the higher concentration of a particular water standard, then the lower.** The Picarro analyzer is temperature stabilized and has extremely low drift so calibrations should be run typically every 6-12 hours.



'Syringe Pump Sequence Setup' window

The Concentration of Vapor:	This will be determined by the user programmed liquid flow rate. *A rate of 0.02 microliters/second corresponds to approximately 6000ppmv.* The vapor concentration is a linear function of the liquid flow rate. Rates higher than 0.08 microliters/second (24000ppmv) are prevented by the software in order to prevent accidental saturation of the analyzer. The precision of the isotopic ratio measurement is specified for a vapor concentration of 6000 to 20000ppmv. The precision will suffer significantly below 6000ppmv. Increasing the measurement duration will compensate to some degree. The dry air source, such

	as Drierite® condition air with a 200-300ppmv water concentration, can contribute significantly to the measured isotope rate when operating at standard vapor concentrations below 6000 ppmv. For each step in the sequence only one pump or vapor state is allowed. If enabled, the rotary valve position is always active.
Vapor 1 State:	Allows the analyzer to pull air through the connector labelled Sample 2 on the back of the vaporizer. No power is supplied to any solenoid valve in this state. For analyzers with an additional valve (carrying V4 gas) also connected to the Sample 2, air will be drawn through the NO port of the valve.
Vapor 2 State:	In this state, power is applied to the solenoid valve connected to the wire pair labelled V4. For analyzers with an additional valve (carrying V4 gas) also connected to the Sample 2, V4 gas will be drawn through the NC port of that valve.
Rotary Valve Position:	This is controlled independently of the liquid pumps and solenoid valves. The default value is 0 which is generally not a valid position. This prevents the rotary valve from inadvertently switching to a new position. The common line of the rotary valve can be connected to Sample 2 on the back of the vaporizer. Whenever Vapor 1 is selected in the software, sample will be drawn through the common line and whichever rotary valve position is selected.

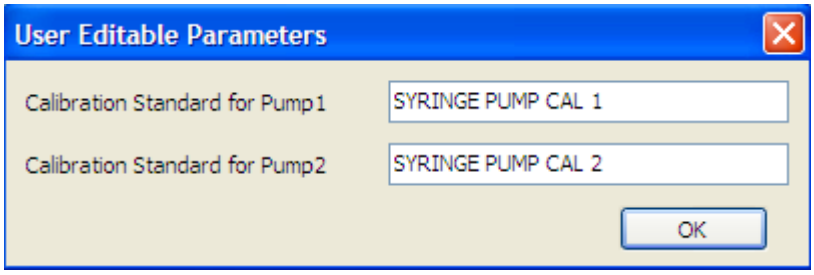
8) Double click on the Coordinator Launcher icon in the analyzer's desktop. The coordinator software allows the analyzer to take measurements from multiple samples, and is used to control the sample source and match the corresponding real time read out with the sample source. To learn more about the coordinator software (running the software, loading sample description, functions of the coordinator window), see **Coordinator Window.** Choose and launch an appropriate coordinator mode from the choices in the drop down menu of the coordinator launcher window. The User Editable Parameters window will pop up. Enter the names of the liquid standards on the window, and the click ok to continue. The SDM Setup can operate in one coordinator mode.

SDM: Used for measurement of ambient vapor coupled with automated injection of liquid calibration standards. Requires A0211 high precision vaporizer and A0101 Standards Delivery Module. Alternates between analyzing ambient vapor from multiple points and a continuous stream of vaporized standard. The alternation is based on user defined sequence. The calibration measurement takes approximately 20 minutes per concentration/standard. Before operating in SDM mode, set the vaporizer temperature to 140 C°.

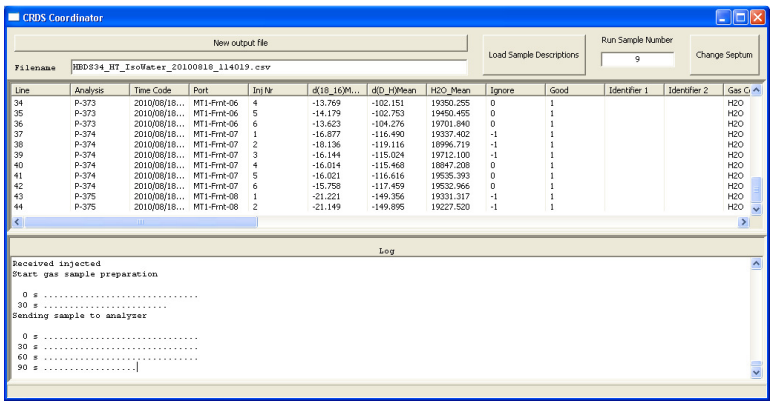
9) To learn about the other coordinator modes supported by the Picarro water analyzer (but in different setups), see **Coordinator Modes**.

10) Once launched, the coordinator will automatically start collecting data. The data will also be available in the GUI as pulses. To customize pulse analysis or to adjust the peak of pulse data, please see **Pulse Customization.**

Coordinator Launcher Window



User Editable Parameters



Coordinator Window

11) After 1-2 hours of operation, inspect all the four connections of each pump for any leaks. Using a small light source, check both the outside of the connectors as well as the inside for signs of water. Very small leaks take a very long time to release enough water to be visible.

12) Put the cover of the SDM back on. Be sure the front and sides of the cover are inside of the tray edge. Be sure the back of the cover is outside of the tray's back wall.

13) The coordinator software will start to run the active sequence that was previously applied using the Syringe pump Sequence Software. The sequence applied in the sequencer software will start and loop indefinitely until the coordinator window is closed. To change the sequence first close the coordinator, open SDM Sequencer, apply the desired sequence, and finally restart the coordinator.

14) By default the data output from the coordinator will be saved in C:\SyringePumpData. The default is to create a single file which can become extremely long for multiple day experiments. The coordinator will automatically create a *.csv file containing the measured values. The .csv file can be read using Notepad++, which is provided on the Picarro CPVU (Computer Power Vacuum Unit).

15) For information on how to post process SDM Data and how to set the output size and location of SDM Data files, see the **Data** section of this chapter.

16) To calibrate one's system, see **Calibration**.

17) One may need to adjust the sample injection volume to improve the quality of one's data. See **Adjusting Injection Volume** for more information.

18) When in need of shutting down the system, refer to **Shutdown Procedure** for directions. To transport and store the system optimally, see **Transportation & Storage.** Also see tips below.

19) SDM FIELD DEPLOYMENT TIP:

    a. Run the SDM in the lab to become fully familiar with its setup and operation before undertaking a field deployment.

b. Plan enough time for setup. Although the SDM sets up quickly it requires 2-4 hours of run time to fully verify performance so it can be left to run unattended. Plan on at least a half day, overnight is ideal. Ideally the SDM can be set up first and allowed to run while other equipment is being set up.

c. Be prepared. The bags should be filled in the laboratory. Extra lines and needles should be packed as well.

d. Don't take shortcuts. The procedures in the manual are based on personal, sometimes painful, experiences gained by engineers and scientists during the development of the SDM. The effort of a proper setup will be rewarded by weeks of smooth unattended operation and good data.

20) **Optional:** When in need of installing a rotary valve control, it should be connected to the COM 2 port back of the analyzer, and the Enable Rotary Valve Control button should be selected in the syringe pump sequencer software in order to make use of this functionality. See **External Valve Sequencer** for more detail.

21) While operating the SDM, please keep in mind the SDM has been pre-programmed with certain operation steps which bring the vaporizer into isotopic equilibrium in a quick and consistent fashion to minimize time required for standards measurement and to simplify data analysis. These steps are in addition to the user entered sequence. There are different situations when this occurs:

Case A: Vapor to Standard Step 1: vapor measurement Step 2: water standard from pump 1 or 2	3.5 minutes before the end of step 1, the SDM delivers 6 microliters of water over 2.5 minutes followed by 1 minute at the user specified rate. The exit valve of the vaporizer vents this standard vapor out to the atmosphere. Once Step 2 starts, the valve connecting vaporizer to analyzer is opened allowing a nearly seamless transition between measuring the ambient vapor and standard vapor. In the event the vapor measurement period is <3.5 minutes, the vapor measurement period is automatically extended (i.e. if the sequence call for a 1 minute vapor measurement then measurement of a standard the actual vapor measurement period will be 4.5 minutes).
Case B: Between Two Standards Step 1: water standard from pump 1 or 2 Step 2: water standard from pump 2 or 1	After step 1 is complete the SDM delivers 6 microliters from the following standard over 2.5 minutes followed by 1 minute at the user specified rate. The standard vapor from this automatic step is sent into the analyzer for measurement. When using the analysis software the 3.5 minute automatic step is skipped over by the analysis software.
Case C: Between Two Concentrations Step 1: pump 1 conc. 1 Step 2: pump 1 conc. 2	Syringe pump is refilled at the start of step 2 and then starts to dispense at the user specified rate.

DATA

22) To post process SDM Data by using the Syringe Pump Data Processor window. The SDM purchase includes data processing software for user's convenience.

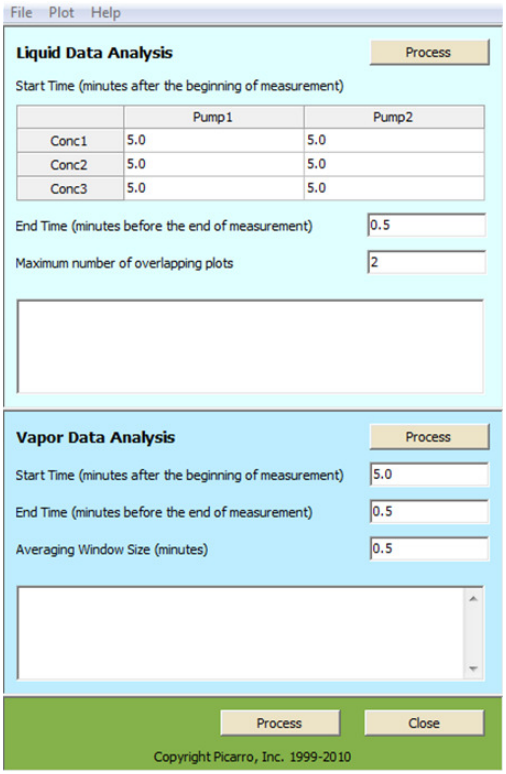
To start the software, double click on the icon SDM Data Processor in the desktop. The Syringe Pump Data Processor window will pop up. See descriptions of the software below. Under the File menu, select Load File and choose the file to be processed. Raw files are stored under C:\SyringePumpData by default.

Once data is processed one or more files are generated. They are all stored in C:\SyringePumpData\ProcessedData by default. The processed data is saved in *.csv format and can be viewed by double clicking on the blue hyperlinks shown in

the Data Processor window. Each hyperlink has text above it describing the contents of the processed file.

High Standard Deviation?

If the reported standard deviations (SD) appear high for any particular standard delivery note the time and view the H_2O concentration for that period. There may be a specific upset such as an air bubble that can be excluded from the data processing by changes in the start/end time. If there is significant oscillation in the water concentration (amplitude >250ppmv) that is an indication of uneven water delivery which is generally caused by loose connections, partially clogged lines/needles, or an air bubble undergoing compression/relaxation as it is pumped through the line.



The Syringe Pump Data Processor Window

Under the Liquid Data Analysis section, select the start time for each pump and the concentration value. • **START TIME:** The start time has a delay relative to the actual start of standard delivery; it prevents non-equilibrium values from being evaluated. Typically a 5 minute delay is sufficient to allow the isotope ratio to reach full equilibrium. For higher concentrations a shorter time will be sufficient, for very low concentrations a longer time will be required. Examine the ∂D value vs. time for each pump and concentration to optimize this parameter further. The ∂D value takes longer to equilibrate than the $\partial^{18}O$ value. • **END TIME:** Select the end time of the evaluation period, it is relative to the end of actual liquid delivery. The default is 0.5 minutes which works well generally. • **MAXIMUM NUMBER OF OVERLAPPING PLOTS:** The maximum number of plots is limited to 4. These are useful for quick visual assessment of the data. **THE PROCESS BUTTON:** The **process button** in the upper right will process the data for liquid data analysis only. The data will automatically have a 30 second moving average applied to it.	Under the **Vapor Data Analysis section** select the start and end times in the same fashion as for the liquid data analysis. Below are explanations for each sub-section. • **START TIME:** The start time delay required for vapor may be significantly larger than for liquid data. This is due to concentration effects as well due to the absence of preconditioning steps for vapor analysis. The averaging window size applies a moving average to the vapor data. • **PROCESS BUTTON:** The button will process the data for vapor data analysis only. • **PROCESS BUTTON:** To process the data for both liquid and vapor, press the process button at the very bottom of the window.

23) To limit the size of the output file and to change the location of the output file, see directions below. By default there is no upper limit on the size of the coordinator file output. When the SDM is run for prolonged periods the size of the generated .csv file will become very large and it will easily exceed the upper limit of records in MS Excel (65536). A new record is generated with each scan reported by the analyzer, the scan time ranges from 5-10 seconds depend upon analyzer configuration.

To limit the size of the output file:

Step 1: Open PicarroSyringePumpCoordinatorV13.ini file

Step 2: Use Notepad++ text editor (right click on file)

Step 3: Under section marked `[FILES]` at line 8 the default will be: `max_num_lines=`

Step 4: If it is left blank after the equals sign then there is no size limit

Step 5: To specify a limit on the number of records enter an integer value after the equal sign. For example: `max_num_lines=2000`

This will limit the file to 2000 records, the coordinator software will automatically create a new file when the 2000 record limit is reached.

To change the location of the output file:

Step 1: Open PicarroSyringePumpCoordinatorV13.ini file

Step 2: Use Notepad++ text editor (right click on file)

Step 3: Under section marked `[FILES]` at line 7 the default will be: `output='C:\SyringePumpData\'`

Step 4: create a new location by changing the value in `' '`.

for example `output='C:\MyDocuments\SyringePumpData\'`

This would save the outputs in a separate directory.

TROUBLESHOOTING

24) For troubleshooting information for the SDM Setup, please see **Troubleshooting | SDM.**

25) When in need of further help from Picarro, see **Technical Support.** For warranty information, please see **Limited Warranty.**

DESKTOP ICONS & FOLDERS

On the Window's desktop, the following icons and folders may be present. The options available will vary depending on the configuration of your analyzer.

1) **Start Instrument:** When clicked, the analyzer will start measuring in the configuration that it was last in when the software/analyzer was shut down.
2) **Coordinator Launcher: Depending on the system's configuration, the coordinator program may or may not be included.** Clicking on this icon will lead you to a window which will allow you to select the appropriate mode for coordinator output, for example using the high precision vaporizer or the standards delivery module.
3) **Picarro Mode Switcher: Depending on the system's configuration, the Mode Switcher Software may or may not be included.** When clicked, you will be led to a window which will allow you to switch between various measurement modes. **For the L2140-*i* this is how you switch between the normal mode for measuring only $\delta^{18}O$ and δD, and the 17O mode for measuring $\delta^{18}O$, $\delta^{17}O$, δD and ^{17}O-excess.**
4) **Picarro Controller:** When clicked, you will be led to a useful diagnostic panel allowing the user to see the analyzer's internal temperatures, pressure, and spectroscopy in real time. This program has user-accessible functions, but cannot change anything related to analyzer functionality and is intended for diagnostics purposes only.
5) **Picarro Utilities Folder:**
    - **Data file Viewer:** When clicked, you will be led to a window which will allow you to convert between *.dat & H5 data files and to make various graphical representations of your data.
    - **Data Recal:** When clicked, you will be led to a window which will allow you to recalibrate your data based on known, certified data.
    - **Setup Tools:** When clicked, you will be led to a window which will allow you to edit various settings for your analyzer (See the "Setup Tools" section of this manual).
6) **PostProcess ChemCorrect:** Depending on the system's configuration, the ChemCorrect Software may or may not be included. This software allows post acquisition analysis of discrete sample data generated by the coordinator.
7) **Diagnostic Folder**
    - **Stop Instrument:** When clicked, you will be led to a window (see below) which will allow you to turn off the analyzer in an emergency event. Upon clicking on this icon, the following window will pop up. Please see **Shutdown**

Procedure chapter of this manual to shut down the analyzer in normal circumstances.

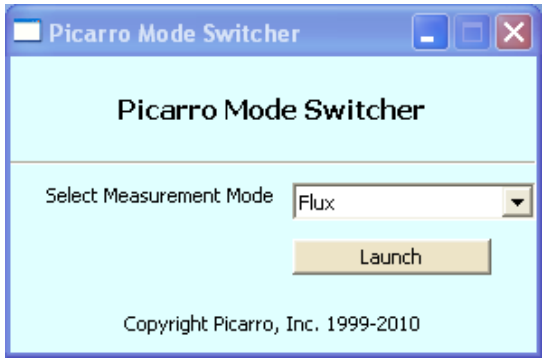
- **For the L2140-*i*, you must stop the instrument using the Stop Instrument icon prior to switching modes.** After double-clicking the Stop Instrument icon, select "Stop software and driver", and then click Stop.

	CAUTION: EXCEEDING GAS INLET PRESSURE OR TEMPERATURE SPECIFICATIONS COULD RESULT IN DAMAGE TO THE INSTRUMENT. In the case of higher input pressure or flow, configuring a sampling bypass manifold system is recommended. Use a 'tee' at the gas inlet and either return the remainder to the main gas stream or exhaust appropriately.
	CAUTION: <u>Do not disconnect</u> the AC power to the analyzer, vacuum line or the AC power to the External Vacuum Pump while analyzer is operating. Damage may be caused by current surges if power is applied while attaching or removing cables.
	CAUTION: Analyzers which include the external valve control option are provided with a cable consisting of five electrical connections intended for controlling solenoid valves (typically 12VDC <1A max). It is important to **electrically isolate the solenoid valves from the analyzer's ground** to avoid electrical interference which could compromise the analyzer's accuracy.

SWITCHING BETWEEN MEASUREMENT MODES

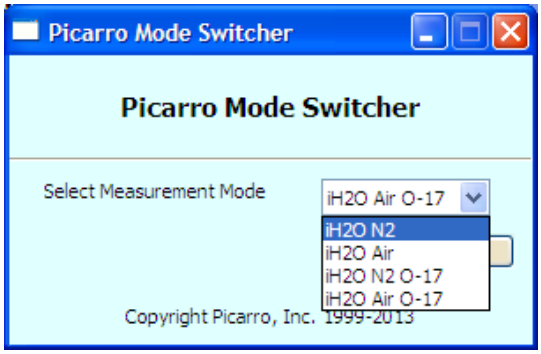
The Picarro Mode Switcher allows users to operate the analyzer in various modes. Switching between measurement modes is accomplished with a few easy steps:

- Activate the user interface by double-clicking the Picarro Mode Switcher icon on the analyzer's deskstop.
- A user interface will appear on the desktop:



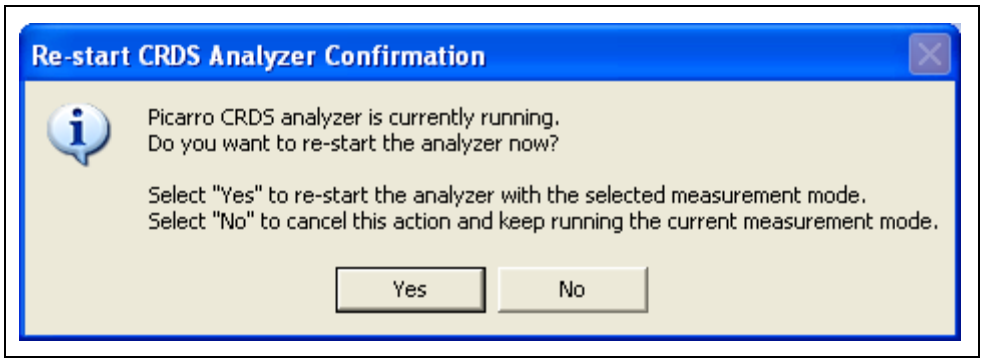
Picarro Mode Switcher Window (example).

- To switch modes, click on the drop-down box menu, select the desired measurement mode, and then click the launch button:



Picarro Mode Switcher. The choices in the drop down menu will vary between analyzers. Above choices are for the L2140-i.

- Confirm your selection when prompted by the confirmation dialog box:



- The analyser software with then re-start in the new measurement mode. There is no need to turn off the vacuum pump during this process.

	For the L2140-i, you must stop the instrument (software and drivers) prior to switching between the normal mode ($\delta^{18}O$ and δD) and the 17O mode (for $\delta^{18}O$, $\delta^{17}O$, δD and ^{17}O-excess). To stop the instrument and switch modes, open the Diagnostic Folder on the desktop. Then double click Stop Instrument. Once the Stop Instrument window has opened, select “Stop software and driver,” and then click stop.

GUI FUNCTIONS

The Picarro analyzer GUI has useful features. See below for more information.

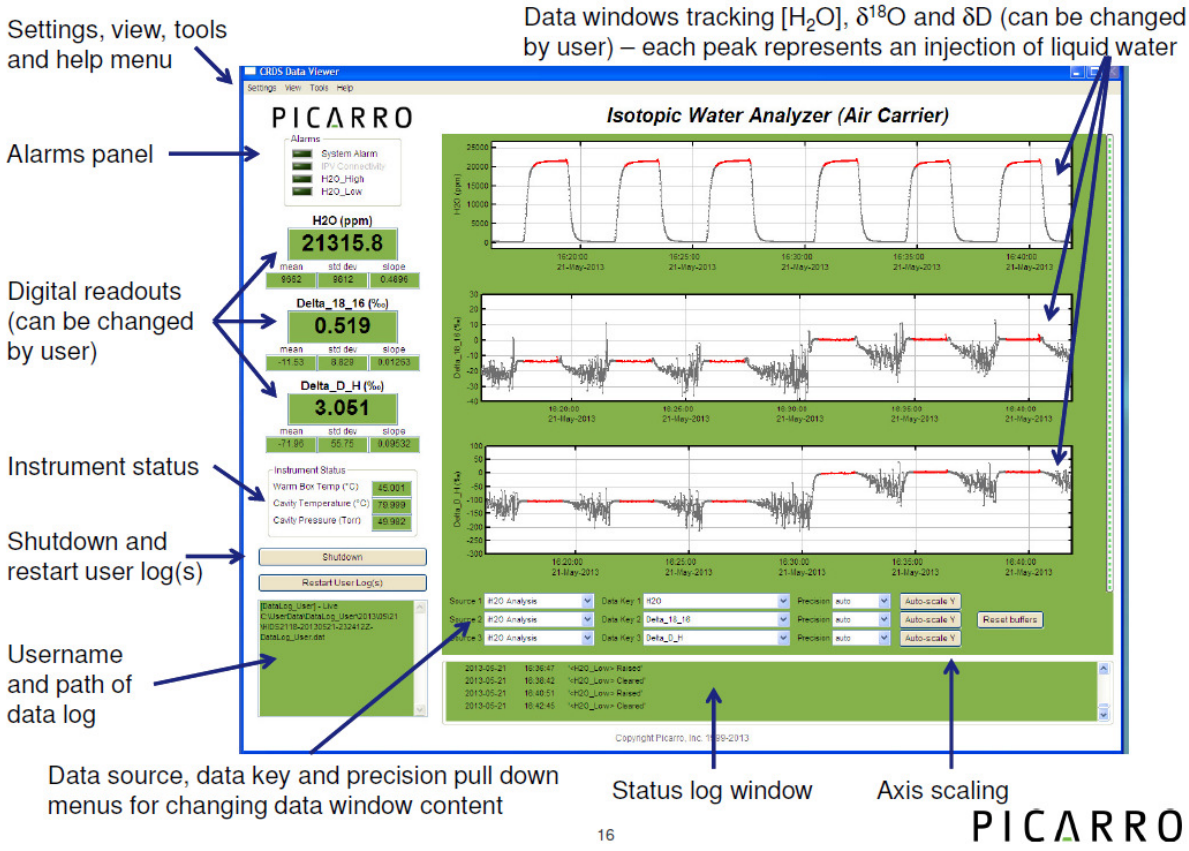


Figure 2 - Layout of the Picarro analyzer GUI, G2000 series. Types of data shown in the main GUI will differ between different analyzer configurations.

Settings, Tools and Help Menus

- **Settings Menu**

  Left clicking on the Settings menu pulls down a menu that has one entry: Change GUI Mode from Standard to Service. This is the access point to a password protected service mode where additional operational and measurement parameters are displayed. Selecting and clicking on this entry opens the Cavity Ring-Down Spectrometer Controller. This is reserved for Picarro service operators only.

- **View Menu**

  This menu item has three entries:

1) Lock/Unlock time axis when zoomed: When locked, forces the two graphs to display the same time scale during zoom.
2) Show/hide statistics: Toggles the measurement statistics display, see Digital Readout section below.
3) Show/hide instrument status: Toggles the instruments status display. See Instrument Status section below.

- **Tools Menu**

  This menu item has three entries:

  1) User Calibration: Opens the user calibration window (default password is "picarro"). The password can be reset in the QuickGui.ini file in the instrument directory: "C:\Picarro\G2000\AppConfig \Config\QuickGUI\" under the section:
  2) [Authorization] UserCalPassword = Picarro Show/Hide Valve
  3) Sequencer GUI: Toggles the display of the external valve sequencer window.

  The calibration slope and intercept can be entered and their effects immediately seen in the data. Please refer to the section at the end of this manual concerning calibration.

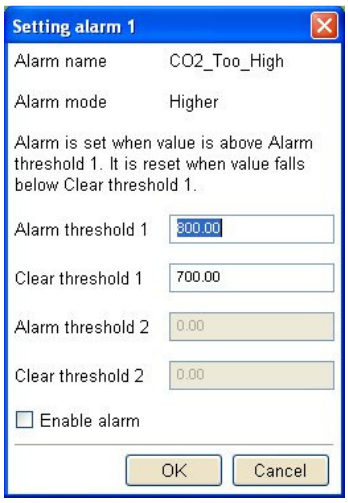
- **Help Menu**

  "About" displays the version number of the instrument.

Alarm Panel

The panel in the upper left-hand corner of the GUI is used to monitor the status of the internal instrument alarms. These indicators are gas concentration alarms (i.e., "CO_2 Too High/Low"). The gas concentration alarm LEDs are off (grayed out) when the respective concentrations are below a certain value, and they are illuminated when the respective concentrations are above/below a certain value.

To view the alarm set point, click on the LED and a dialog box will appear, indicating the alarm setting. The user can either enable the alarm or change the set point.



To change the set point, type the value you wish to set the alarm to and press the “ok” button to confirm. If you do not wish to change the alarm value anymore, press “cancel.” If you do nothing, the dialog box will eventually disappear and the alarm value will remain unchanged.

Digital Readouts

Displays the latest value recorded for the selected Data Key for each Data Window. Changing the Data Key changes the Digital Readout as well as changes the Data Window view. If the ‘Show Statistics’ entry is enabled in the ‘View’ menu, the mean, standard deviation and slope of the data in the graph is dynamically calculated and indicated below the digital concentration readout. These numbers change to reflect statistics of whatever data is in the data window.

Start / Stop Data Log Button

The Analyzer automatically records all data collected on the instrument and saves it for later analysis. These files are called Data.dat files, which are described below in the section called “File Management”. In addition, the user can record a separate data log file. Press this button if you would like the instrument to start recording a separate data file. A dialog box will appear prompting you for a filename and location. Press this button again to stop recording the data file.

Data Log Filename and Path

The filename and path of the active data log is displayed in this pane. The indicator is grayed-out if there is no active data log (i.e., if a new data log has not been started

using the *Start /Stop New Data Log Button*). A new file will be generated at midnight, which will be saved to the same location as the original log file.

Data Window

The data window displays a graph of any stream of data vs. system time, with a format of hh:mm:ss. The user can select which data stream are displayed using combinations from the Data Source and Data Key pull down menus. The precision displayed can be adjusted using the "Precision" menu and Auto-scaling of the 'Y' axis is also also available.

Instrument Status

If these parameters are enabled through the 'Show Instrument Status' entry in the 'View' Menu on the main toolbar digital readouts for Warm Box temperature, Cavity Temperature and Cavity Pressure are displayed to the left of the main trend graphs.

Data Source and Data Key Pull Down Menus

These two menus enable selection of the data stream that is viewed in the *data window*. Data streams available on the GUI are gas concentrations, if '*instrument* Analysis' (where *instrument* represents the system installed) is selected, or if "sensors" is selected, the analyzer's optical cavity pressure or temperature can be viewed as well as the nominal ambient temperature of the analyzer ("DAS temp") and the temperature of the analyzer's electronics chamber, indicated as "warm chamber temp."

Precision Pulldown Menu

Click on this icon to select the precision displayed on the y-axis, between 0 and 4 digits of precision or "auto". The currently selected precision is displayed during operation. This does not affect the precision of the saved data in the data log files or results files.

Status Log Window

This window displays instrument status messages, in the following form: "MM/DD/YYYY hh:mm:ss generic message text." These messages include all messages sent to the front panel display.

Reset Data Buffer Button

Press this button to clear the internal data buffer of the GUI (this clears the current data traces from the graphs). This has the effect of clearing all data in the data window. Pressing this button has no effect on any of the data log files stored by the instrument.

Data Buffer Level Meter

The meter to the right of the *Data Window* indicates how much of the internal memory of the GUI is used to retain historical data collected with the instrument. There is an internal limit of a finite number of points. Once that number of data points is collected, the buffer is full, and old data is removed from the buffer as new data is collected. This buffer affects *only* the data displayed in the *data window*, not the data stored in any files. This buffer is empty upon instrument startup, and can also be emptied by pressing the *reset data buffer button* in the lower-right-hand corner of the GUI.

Graph Zooming

To zoom the graph, simply drag the magnifying glass over the section to be zoomed and click and hold the left mouse button. While holding down the left button, move the mouse to create a box that covers the region of interest. When the box is properly drawn, release the left button and boxed area will automatically scale to fill the data window. To zoom back out, double click on the left button. To autoscale the y-axis of either graph, use the autoscale buttons below the graph. To lock or unlock the time axes of each graph during zooming, select that menu item in the 'View' menu.

COMMON STATUS LOG MESSAGES

Temperature Locked: WB/HB (normal startup)

The system waits for the warm box ("WB" – the temperature-controlled electronics and wavelength monitor chamber) to reach operating temperature. Similarly, the temperature of the hot box ("HB" – the temperature-controlled chamber containing the analyzer's optical cavity and gas handling system) is stabilized. This is typically the longest step in the startup sequence. The duration of this step can range from 5 to 60 minutes, depending on the ambient temperature and how much time has elapsed since the last startup.

Entering Measurement (normal startup)

Spectral scanning has started. Concentration measurements will be available in approximately 30 seconds. The instrument will continue to scan and report concentration measurements until the instrument is shutdown using the procedure below.

Pressure Stabilizing/Locked (normal startup)

The valve control system begins to allow flow through the analyzer and stabilizes the pressure inside the cavity.

Measuring (normal startup)

This is the normal mode of operation after startup has completed.

Pressure High – check vacuum pump (error)

There is unusually high pressure. The pump is either weak or dying or the vacuum hose has a leak.

DATA FILES

During operation, the analyzer generates ASCII format text output file that is updated after each batch of concentration measurement is complete. The analyzer also creates directories to store the data based on the date the data was acquired. After each data file has been closed, it is moved to an archive directory, and a new file is started in the original location. To keep the data files easy to manage and to limit the size of individual files and directories, please see **Setup Tools** in the Utilities folder on your desktop to modify various aspects of data storage.

There are two data directories: UserData and Archived Data.

UserData

This directory contains current and recent data.

- **DataLog_User**: stores data as measurements are made.
    - Location: *C:\UserData\DataLog_User\Year\Month\Day*
    - Naming Convention:
        - Example: *CFHADS2007-20111222-000131-DataLog_User.dat*
        - CFHADS: Instrument Serial Number
        - 20111222: Year, month, and day of when file was started
        - 000131: Hour, minute, and second of when file was started (using a 24 hour clock).
- **DataLog_User_Sync**: same data as DataLog_User, except that the data are evenly spaced in time (0.1 s interval). *This type data is only available when measured in flux mode, and is useful only for Flux G2311-f analyzers.*
    - Location: *C:\UserData\DataLog_User_Sync\Year\Month\Day*
    - Naming Convention:
        - Example: *CFHADS2007-20111222-000131-DataLog_User_Sync.dat*
        - Explanations are as same as for DataLog_User.

Archived_Data

This directory contains past data.

- **DataLog_User_Backup**: archived, older data that is stored in compressed .zip format.
    - Location: *C:\Picarro\G2000\Log\Archive\DataLog_User_Backup\Year\Month\Day*
    - Naming Convention:
        - Example: *DataLog_User_Backup_20111107_005427.zip*
        - 20111107: Year, month, and day of when the file was started.
        - 005427: Hour, minute, and second of when file was started (using a 24 hour clock).
- **DataLog_Private**: complete data file which includes additional parameters beyond the concentration data such as instrument temperatures and pressure, set points, and spectroscopic information. This information is generally not useful to the user, but it can be useful for diagnostic purposes. For more information, please contact Picarro.
    - Location: *C:\Picarro\G2000\Log\Archive\DataLog_Private\Year\Month\Day*

REMOTE DATA ACCESS

The Picarro Serial Communication

The analyzer supports an RS-232 physical command interface, which can be used to control the instrument and to retrieve concentration data. Not all features of the instrument are available on the serial interface. For details on how to use the serial command interface, please see "**Programming Guide**" (included in *.pdf* format on the installation CD) and "**Troubleshooting**" chapter of this manual. This command set may also be used across a TCP/IP interface through an ethernet connection. Please contact Picarro or visit our Community website for further details.

Remote Data Access

Using the *RemoteAccess.ini* file, the analyzer can be configured to automatically:

- Send data from the instrument to a list of e-mail accounts.
- Measure the offset of the host computer system clock from a set of internet timeservers and (optionally) to resynchronize the clock on the basis of this information.

The internet connection need not be permanent; it can be a dial-up connection accessible via a user-supplied USB modem. If a dial-up connection to the internet is employed, it is used only on demand in order to minimize the connection time.

The task of sending data and/or synchronizing the clock on the analyzer is performed using the *C:\Picarro\G2000\HostExe\RemoteAccess.exe* program. This program can be set up to run periodically using the Windows Task Scheduler at a user-configurable frequency.

Each time that the *RemoteAccess.exe* program runs, it appends information to a log file, which keeps a record of the results of the time synchronization and of the files sent by e-mail. The *RemoteAccess.exe* program is configurable by means of an initialization file, which includes information such as the login credentials for the dial-up connection, the e-mail account, and the list of timeservers.

The initialization file is found at:

C:\Picarro\G2000\AppConfig\Config\RemoteAccess\RemoteAccess.ini

It should be placed in the same directory as the executable *RemoteAccess.exe*. The file has one required section named **LOGGING** and three optional sections named **NTP**, **DIALUP**, and **EMAIL**.

LOGGING

The **LOGGING** section has a single key “Logfile” whose value is the path to the log file. Once this log file exceeds 64 kilobytes in length, it is backed up appending a numeric extension to the file name and a new file is open. A total of ten backup log files are kept.

NTP

The **NTP** section controls querying the internet time servers using the SNTP protocol (RFC4330) and the resetting of the clock on the host computer. If the section is not present, time synchronization is not carried out. The keys “Server1,” “Server2,” etc., are used to specify the URLs of the timeservers. As many of these timeservers are interrogated as possible, and the clock offset is computed on using the median of the results obtained from the available servers. If the “UpdateClock” key is set to true (“1”), the offset is applied to the host clock. Otherwise, the offset is recorded, but the host clock is not changed.

EMAIL

The **EMAIL** section controls the sending of the data files as email attachments. If the section is not present, email messages are not sent. The key “Directory” specifies the directory that contains the data files. When the program is run, files in this directory are sent to the specified recipients and the files are deleted. In order to avoid problems with incomplete files, programs that place files into this directory should do so using an atomic operation, such as a rename. The “Server” key is set to the name of an RFC2821-compliant SMTP server that actually sends the email messages.

The “From” key is the email address from which the messages are sent. Note that some SMTP servers check that the source is permitted to send mail while others allow any name in this field. The collection of email addresses to which copies of the email is sent is specified by the keys “To1,” “To2,” etc. The “Subject” key is used to fill the subject field in the email header, and may be set to any string. Depending on the SMTP server, it may be necessary to use authentication before emails can be sent, as described in RFC2554. If such authentication is not needed, the key “UseAuthentication” is set to false (“0”). If this key is set to true (“1”), two additional keys “Username” and “Password” must also be specified for the email account.

DIALUP

The **DIALUP** section is used if a dial-up connection to the Internet needs to be established when the program runs. If the section does not exist, a permanent connection is assumed to be available for carrying out the other tasks specified in the initialization file. The “ConnectionName” key specifies the name of the dial-up connection to use, as listed under “Network Connections” in the Control Panel. The values of the keys “Username,” “Password,” and “Number” are used to make the connection.

Example of "*RemoteAccess.ini*" file

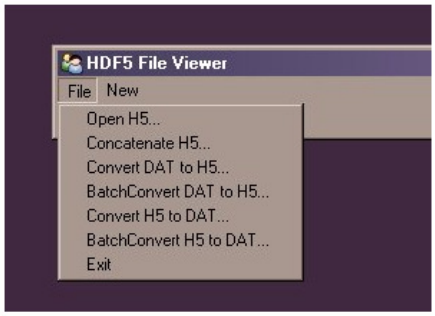
```
[LOGGING]
Logfile=c:/temp/RemoteAccessLog

[NTP]
Server1=time-a.nist.gov
Server2=time-b.nist.gov
Server3=time-a.timefreq.bldrdoc.gov
Server4=time-b.timefreq.bldrdoc.gov
Server5=time-c.timefreq.bldrdoc.gov
Server6=time.nist.gov
Server7=time-nw.nist.gov
UpdateClock=1

[DIALUP]
ConnectionName=Picarro Dialup Access
Username=user
Password=password
Number=14085551212

[EMAIL]
Server=smtp.servername.org
Directory=c:/picarro/mailbox
From=instrument@picarro.com
To1=recipient1@site1.com
To2=recipient2@site2.com
Subject=CRDS data from Silverstone instrument
UseAuthentication=0
```

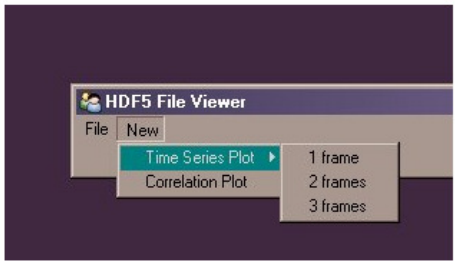
DATA FILE VIEWER

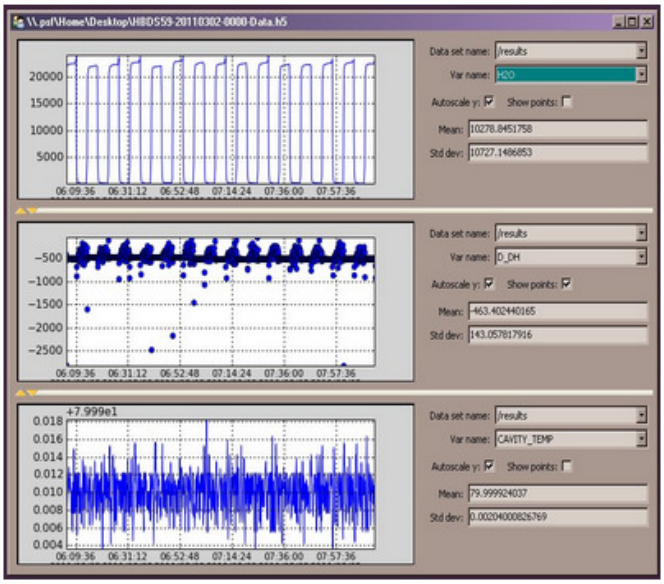
Picarro 2000 series analyzers allow users to archive data using a highly-compressed, binary *.hdf5* or *.h5* format.

Screenshots below show the Data File Viewer program, which can be found in the "Picarro Utilities" folder on the analyzer's desktop. This programs allows you to open *.h5* files, convert *.h5* files to **.dat* files (also convert **.dat* to *.h5*), as well as to do batch conversions. Through this program, multiple *.h5* files can be joined, and then viewed as graphs. In the graph window, you can select any of the data columns in the file, autoscale, zoom, hide/show points, and calculate statistics of data within the graph window.

If you have any questions, please contact Picarro or refer to Picarro Community for more information. http://www.picarro.com/community/







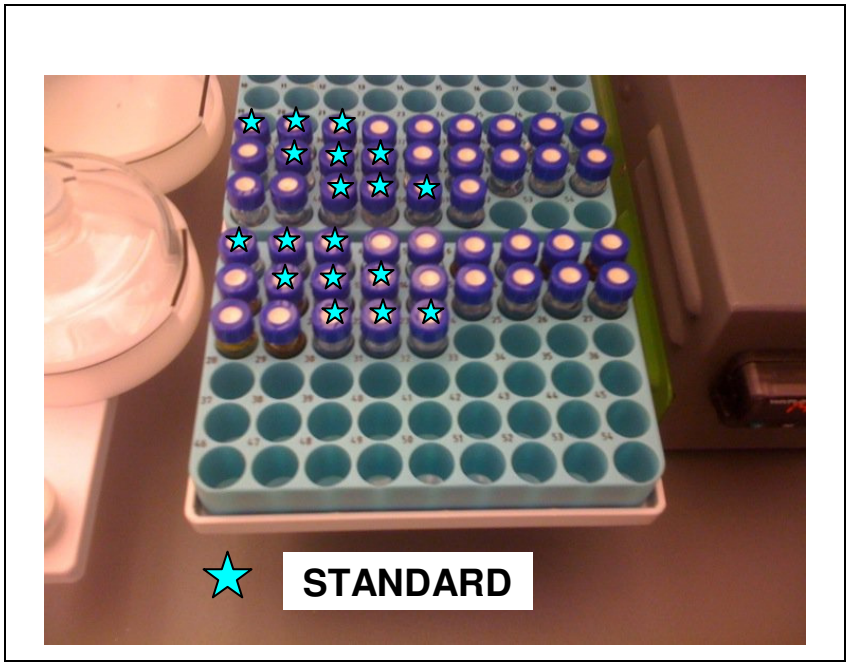
CHEMCORRECT: ANALYSIS OF COORDINATOR FILES

All coordinator output files are analyzed by the same processing programming with the exception of the SDM. Post analysis of the coordinator files is made significantly better and easier if samples are run in the proscribed manner.

Preparing the Tray:

A. Each run needs at least 2 standards (3 is recommended but more is better) with known d18O and dD values. These values create a linear fit, which is used in calibration of the samples.

B. The standards must be run one after another at the beginning of each tray to be analyzed. The post processing software works sequentially and therefore requires the linearity of the known standards before it can correct the unknown values of the samples. It is recommended to include standards in the middle and end of the sample set as controls. An example is shown below, vials with the CYAN stars being the standards:

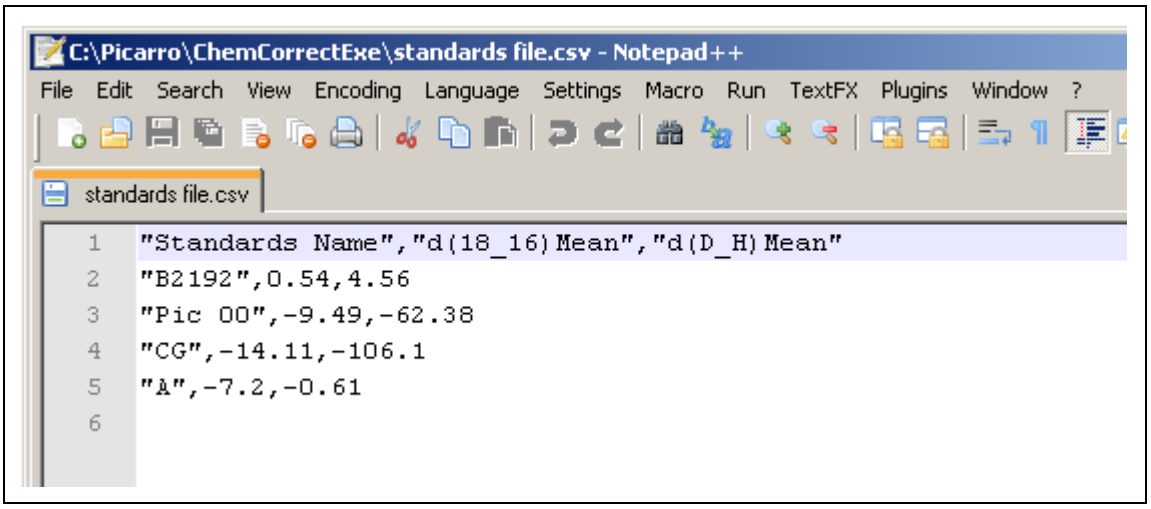


C. Due to memory, first two to three injections of each vial should be ignored. Because of this, a minimum of six injections should be run per vial. The number of injections is set in the control pad of the auto-sampler prior to every run.

Creating a Standard Database File:

A. The application requires a standards file.csv, an instruction file, and a source file (data output from the coordinator software that is in C:\IsotopeData) for the samples to be analyzed. A sample data file along with the standards and instruction files can all be found in the ChemCorrect™ main folder C:\Picarro\ChemCorrectExe

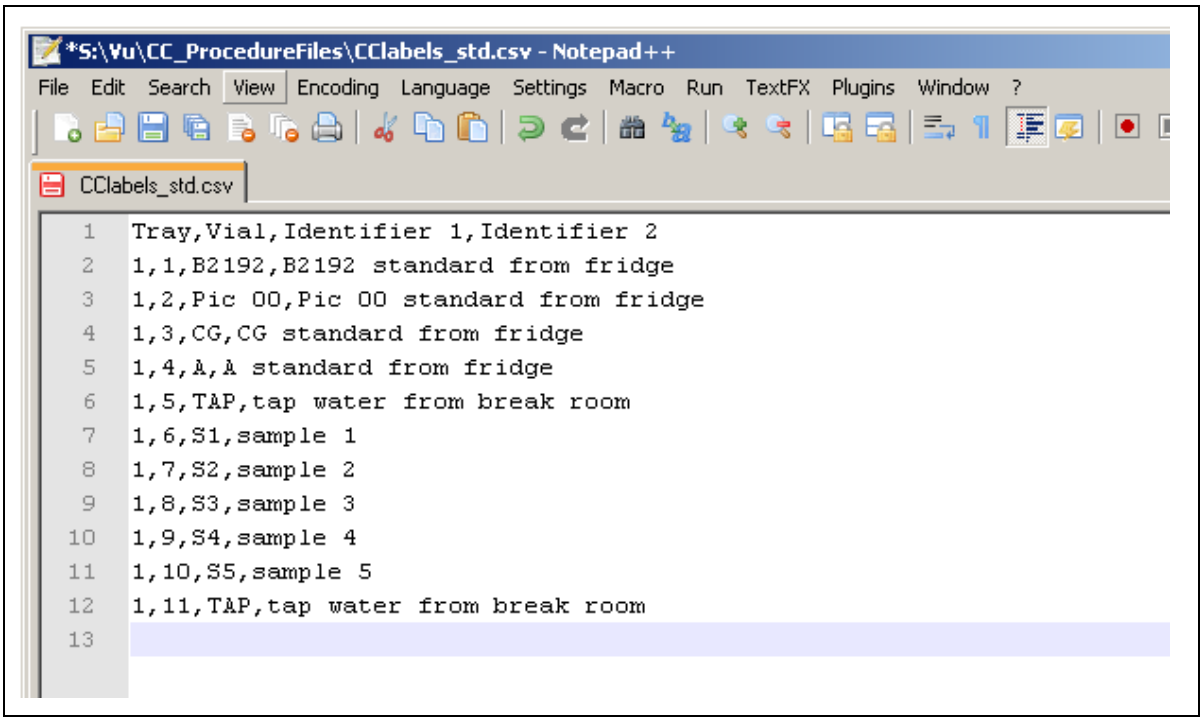
Below is a screenshot of the standards file (to make sure the file format is preserved, please use Notepad++ (The software included in every instrument):



B. The standards.csv file must contain the name, standardized d18O, and dD values of each standard.

NOTE: The names in the standards.csv file must match (case-sensitive) the names in the data file under “Identifier 1” (Column K) of the source file, otherwise they will be treated as samples.

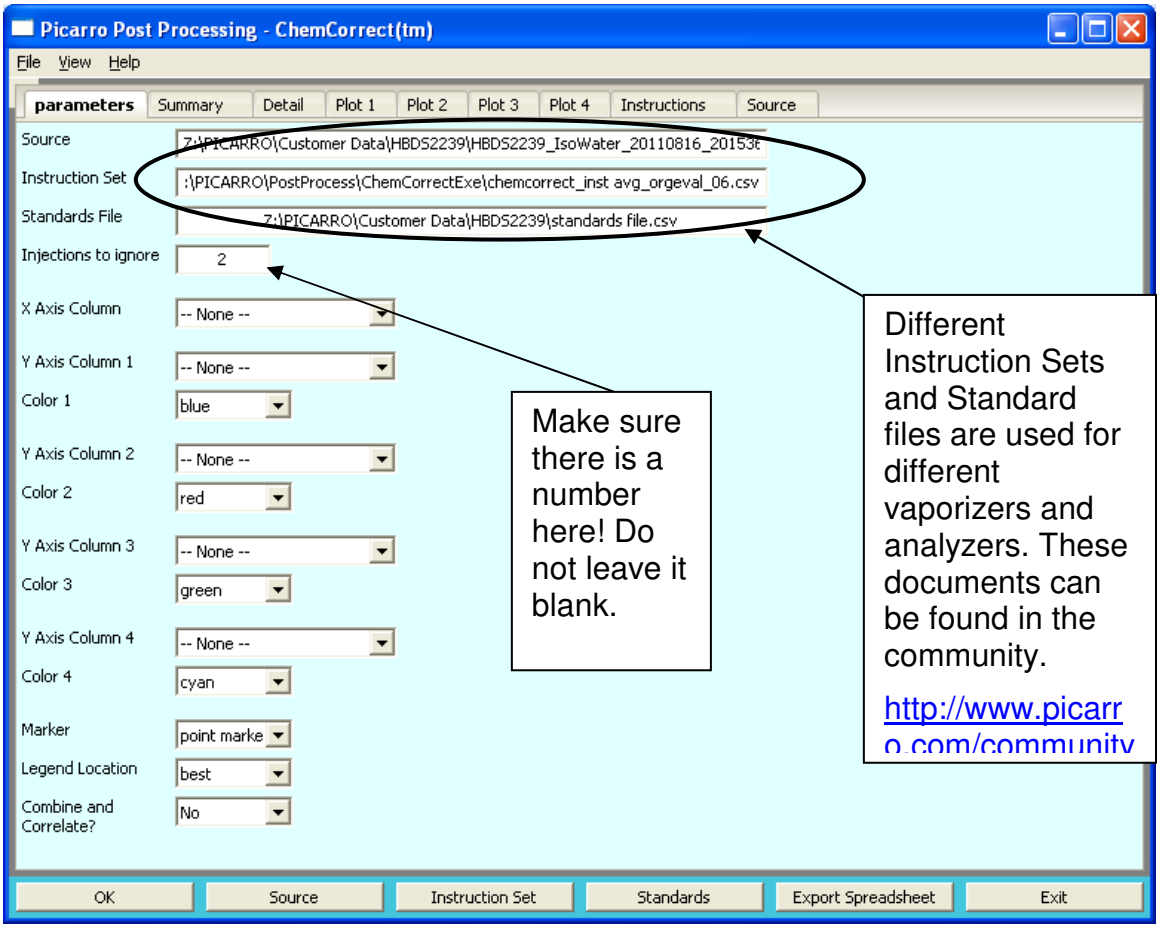
Below is an example of the sample description file that must be loaded into the coordinator. Note the first 4 names under “Identifier 1” are standards, and that those names match ones shown on the above “standards file.csv”



Running the Post Processing:

A. There should be an icon on the desktop, to open, double-click on that icon. If icon not available, the executable file for ChemCorrect™, "chemcorrect.exe," is contained in the main folder. To open it, either double-click "chemcorrect.exe" or right-click it and select "Open."

B. The top 4 boxes on the GUI are the required fields for ChemCorrect™ to operate: the most recent source file name (sometimes empty), instruction file name, standards file (contain a library of the standards' isotope values) and number of injections to be ignored. You have an option to plot additional graphs for other parameters but those are just additional features.



C. To choose a different source file to be analyzed, click the “Source” button at the bottom right. Then use the finder window to locate the desired raw data file and click “Open.”

D. To select a different instruction file than the one displayed, click the “Instruction Set” button. Then use the finder window to locate the desired instruction file and click “Open”. See section K for a list of available instruction sets.

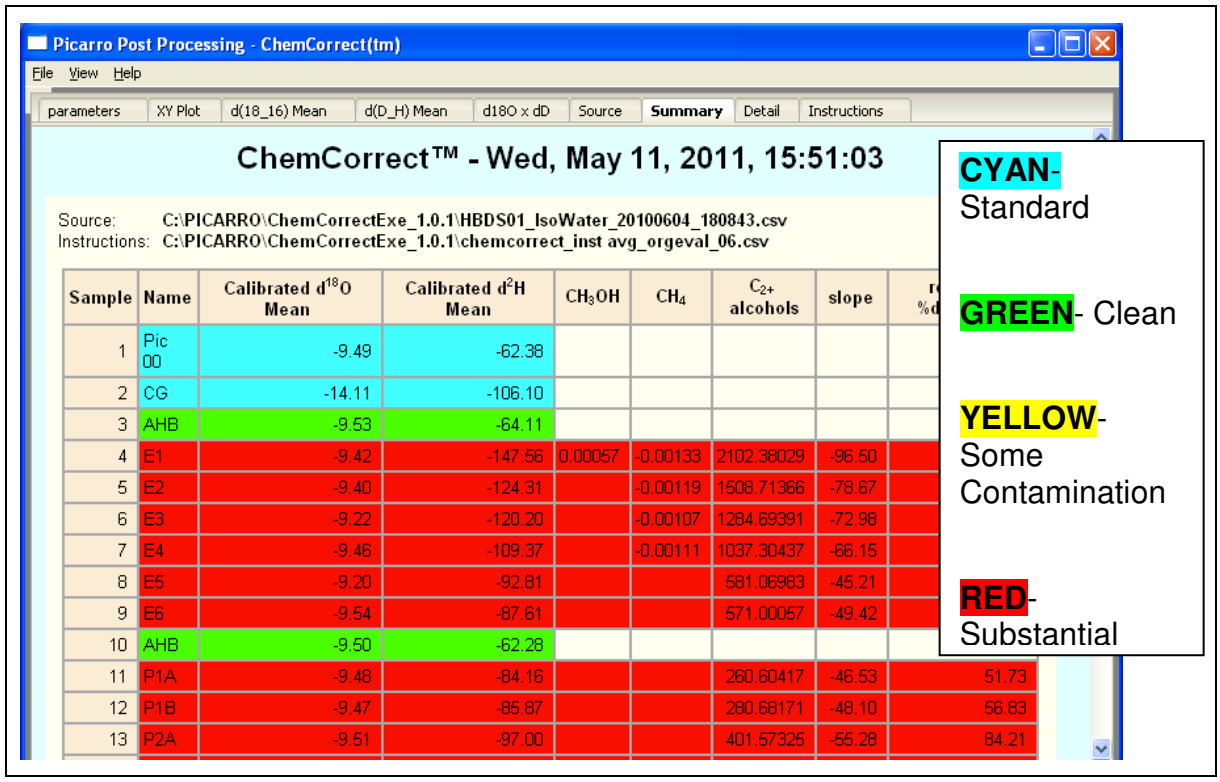
E. To change the number of injections to be ignored, highlight the existing number and type in the preferred one (required 2 but 3 is recommended).

F. When the correct source and instruction files are shown, click the “Ok” button at the bottom of the window to cue ChemCorrect™ to begin analysis.

Example Analysis:

A. Select "HBDS01_IsoWater_20100604_180843.csv" (which Picarro has provided in the main folder) as the source, and "chemcorrect_inst avg_orgeval_06.csv" as the instruction file. Then click "Ok."

B. The first display is called the "Summary." Contained here are: the calibrated isotope values and visual indicators as to the severity of contamination by sample.



Sample	Name	Calibrated $d^{18}O$ Mean	Calibrated $d^{2}H$ Mean	CH_3OH	CH_4	C_{2+} alcohols	slope	
1	Pic 00	-9.49	-62.38					
2	CG	-14.11	-106.10					
3	AHB	-9.53	-64.11					
4	E1	-9.42	-147.56	0.00057	-0.00133	2102.38029	-96.50	
5	E2	-9.40	-124.31		-0.00119	1508.71366	-78.67	
6	E3	-9.22	-120.20		-0.00107	1284.69391	-72.98	
7	E4	-9.46	-109.37		-0.00111	1037.30437	-66.15	
8	E5	-9.20	-92.81			581.06983	-45.21	
9	E6	-9.54	-87.61			571.00057	-49.42	
10	AHB	-9.50	-62.28					
11	P1A	-9.48	-84.16			260.60417	-46.53	51.73
12	P1B	-9.47	-85.87			280.68171	-48.10	56.83
13	P2A	-9.51	-97.00			401.57325	-55.28	84.21

i. The CYAN colored rows are standards.

ii. The GREEN colored rows are samples that have been determined to have little to no contamination.

iii. The YELLOW colored rows are samples that contain trace values of contamination that may slightly shift the isotope values.

iv. The RED colored rows are samples with severe contamination leading to inaccurate dD and d18O readings.

v. A star next to a sample indicates a problem, e.g. missing rows in the source file resulting in an inaccurate calculation.

The color code legend is also available at the end of the summary tab.

C. Red/yellow rows display relative contamination due to methane, methanol, or "other" hydrocarbons in the respective columns on the right.

D. There are other tabs that can be accessed by clicking on them in the top left corner of the window.

   i. Detail- Summons a list of summarized charts by injection and sample chronologically. The un-calibrated and calibrated values, as well as the measurements taken to calibrate the values are included per injection. Below each chart is a summary.

   ii. Source- Displays the original raw data file without any changes or calibration.

   iii. Instructions- Displays the raw instruction file used by ChemCorrect™ as well as comments on the far right of each instruction.

   iv. Additional plots for your convenience.

E. At the bottom of the ChemCorrect™ window are additional buttons "OK", "Export Spreadsheet," and "Exit" buttons.

   i. OK- each time you reloaded the source and instruction sets, you can click "OK" again to process more data without closing and re-opening ChemCorrect™. Once you make your edits, export the result to save your processed data. See below

   ii. Export Spreadsheet- Creates an excel spreadsheet complete with all the information contained in the four tabs in the ChemCorrect™ main window as well as all the data sets and formulas used to calibrate the isotope values.

   iii. Exit- Quits ChemCorrect™.

F. The standards.csv file can be amended if needed, but the format must remain the same. To edit, simply open the file, make the desired changes, and hit save. For the changes to be reflected in ChemCorrect™, hit the "OK" button at the bottom of the ChemCorrect™ GUI.

G. Picarro provides 2 instruction files. Instruction sets are different between different vaporizers (A0211vs A0212 vaporizer) and analyzers (L2130-*i* vs L2120-*i*). The updated versions of these instructions files can always be found in the community. http://www.picarro.com/community/

H. Each instruction file can be edited to perform your required calculations – for more advanced users. In the provided instruction sets, Column C of each provides a description of each operation. To edit an instruction file, follow the guidelines outlined at the bottom of the instruction set file.

	**Important Notes**: it is highly recommended to run the post processing within 7 days of initially acquiring the data. If a sample is flagged as contaminated the post processing software will automatically set aside the associated spectral files. These files can be sent to Picarro for further analysis and spectral library development. Once set aside these files will not be affected by the automatic

	file management software which is running on the analyzer. Due to the large amount of data generated by the analyzer a buffer of 10GB of spectral files are kept, after which point they are erased. This corresponds to approximately 2 weeks of operation. Running the post processing ensures that any spectra associated with contamination are not erased.

PULSE CUSTOMIZATION

Pulse Analysis

There is a delay of a few seconds at both the beginning of the pulse and the end of a pulse where the pulse analysis ignores incoming data. Therefore only the most stable center portion of the pulse is included in the pulse analysis. Although the default settings should be adequate for most uses, one can adjust the delays in the following fashion:

- Edit the `validTimeAfterTrigger` or `validTimeBeforeEnd` fields in the following file:

  C:\Picarro\G2000\AppConfig\Config\Coordinator\Coordinator_Fast_G2000.ini

  line 183: `validTimeAfterTrigger = 14, validTimeBeforeEnd = 10`

- One can similarly adjust the level that triggers a pulse analysis event by changing the 6500 value in the upslope or downslope trigger in the following file:

  C:\Picarro\G2000\AppConfig\Config\Coordinator\Coordinator_Fast_G2000.ini

  line 178: `thres1Pair = [6500, 30000]  #this is the upslope trigger`

  line 179: `thres2Pair = [6500, 30000]  #this is the downslope trigger`

Pulse Peaks

When starting a run it is desirable to have the water concentration of the first few pulse peaks in the 14,000-18,000 ppmv range. This concentration range is a suitable all-purpose range for the concentration, as the pulse analysis software default trigger is set at 6500 ppmv. Only the portion of the peak which is above 6500ppmv will be included in the pulse analysis.

Changing the pulse peak can normally be accomplished by adjusting the dilution gas pressure (starting with a pressure of 3 psi or 0.2 bar):

- Increasing the pressure by a small fraction of a psi should reduce the next pulse's peak concentration.
- Decreasing the pressure should increase the next pulse's peak concentration.

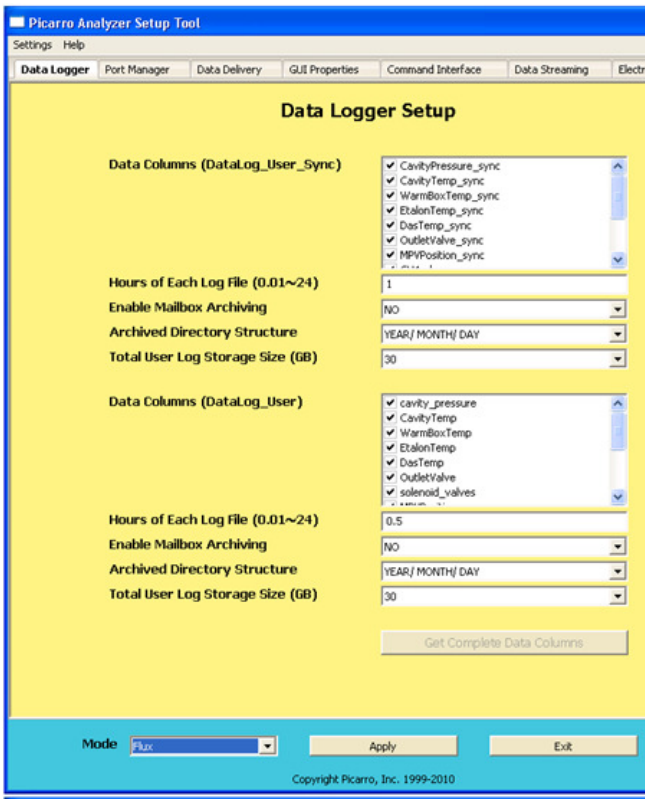
SETUP TOOL

In the desktop folder called Picarro Utilities, the Setup Tool can be launched by double clicking on its icon. The tool allows the user to configure data file saving details, including which data elements are written to data files, digital data output (via serial port or TCP/IP), remote data delivery (via email), and general GUI properties.

Seven tabs of the Setup Tool window are explained in the next pages. If you have any questions about the Setup Tool, please contact Picarro or refer to Picarro Community for further details: http://www.picarro.com/community/

DATA LOGGER tab

This tab allows the user to configure various data file saving details, including which data elements are written to which data files.

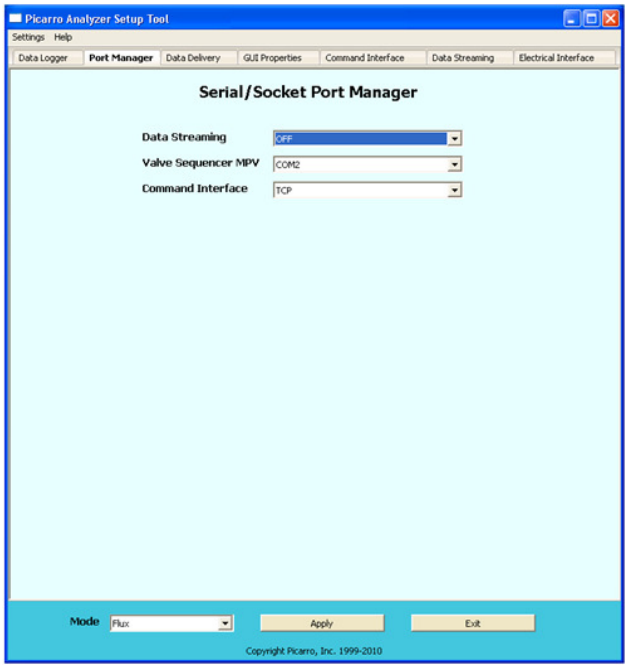


- **Data Columns**: Controls which data elements are written to data files.
- **Hours of Each Log File:** Controls the size of each data document.
- **Enable Mailbox Archiving:** Enables archiving of data in the mailbox folder: *C:\Picarro\G2000\Log\Archive\Data Log_Mailbox*
- **Archived Directory Structure:** Specifies part of naming convention for data documents.
- **Total User Log Storage Size (GB):** Specifies the size of storage allowed for UserData (recent data – see "**Data**" chapter).

After making the appropriate edits, click "Apply" to put changes into effect, and then "Exit" to close the window.

PORT MANAGER tab

This tab prepares the **COMMAND INTERFACE** tab by managing the digital data output/input ports via serial port or TCP/IP.



On this window, specify:

- **Data Streaming** port: COM1, COM2, or Off
- **Valve Sequencer** port: COM1, COM2, or Off
- **Command Interface** port: COM1, COM2, TCP, or Off

Make sure there are no COM port conflicts before clicking “Apply”; otherwise the system will not work.

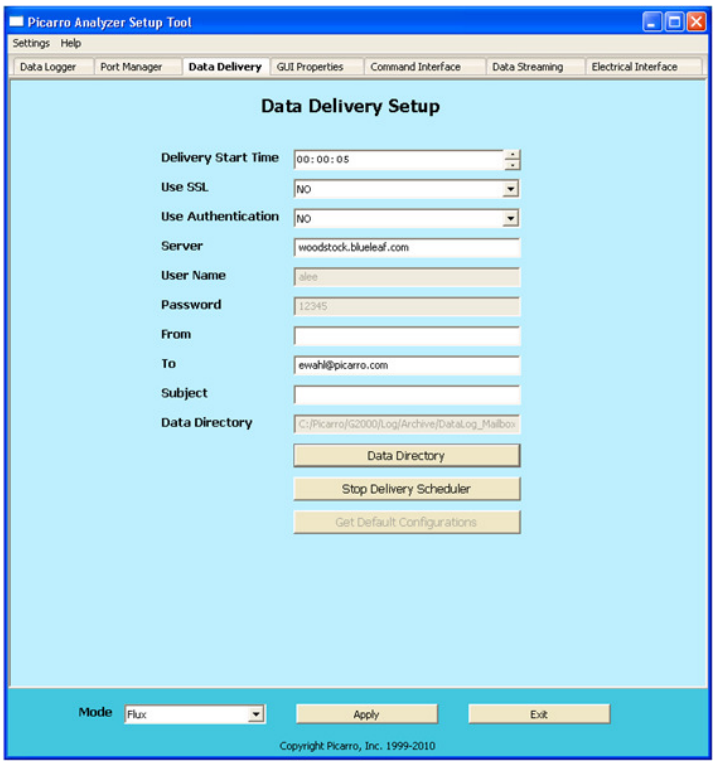
See **External Valve Sequencer** chapter of this manual to learn more about valve sequencer.

After making the appropriate edits, click “Apply” to put changes into effect and then “Exit” to close the window.

Serial Communication: the analyzer supports an RS-232 physical command interface, which can be used to control the instrument and to retrieve concentration data. Not all features of the instrument are available on the serial interface. For details on how to use the serial command interface, please see the “**Programming Guide**” (in *.pdf* format on the installation CD). This command set may also be used across a TCP/IP interface through an ethernet connection.

DATA DELIVERY tab

This tab allows the user to schedule remote data delivery by email.

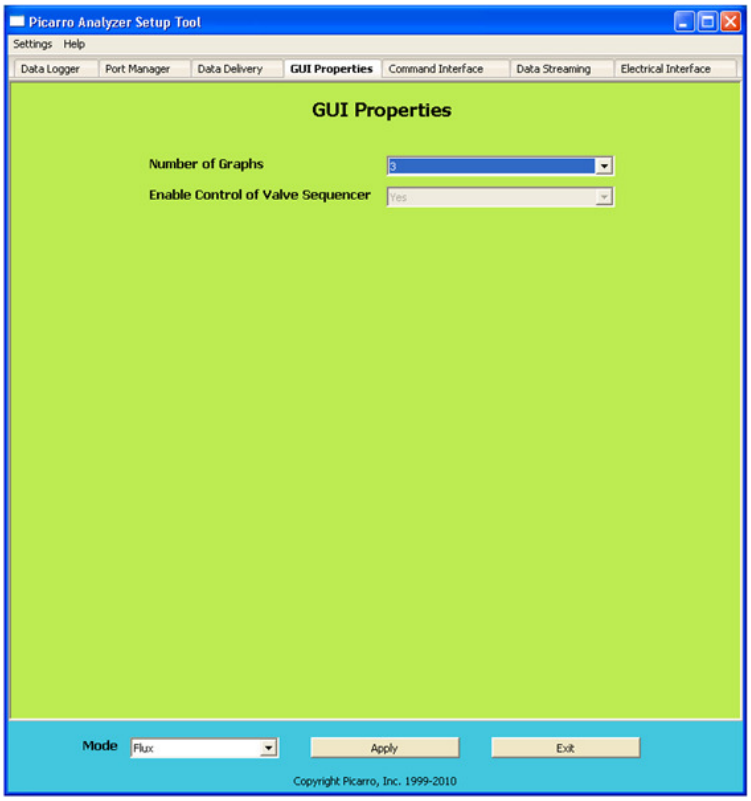


- **Delivery Start Time:** Time of the day when data will be sent.
- **SSL:** Depending on the sender's email server, the sender can activate the Secure Sockets Layer (SSL).
- **Use Authentication**: Turning this on will require the receiver to provide a **username** and a **password** on this window in order to access data.
- **From:** Sender's email.
- **To:** Receiver's email.
- **Subject:** Subject line of the email.
- **Data Directory:** Location of the data you want to email.

After making the appropriate edits, click "Apply" to put changes into effect, and then "Exit" to close the window.

GUI PROPERTIES tab

This tab allows you to set the number of line graphs visible on the main GUI. It also enables the control of the valve sequencer from the main GUI.



To make the "Valve Sequencer" menu item visible under the "Tools" menu of the main GUI:

1. Click on "Settings" of the "Setup Tool" window, and then "Switch to Service" mode.
2. Choose "Yes" next to "Enable Control Valve Sequencer" drop down menu on the "GUI Properties" tab.
3. Click "Apply" to put changes into effect, and then "Exit" to close the window.

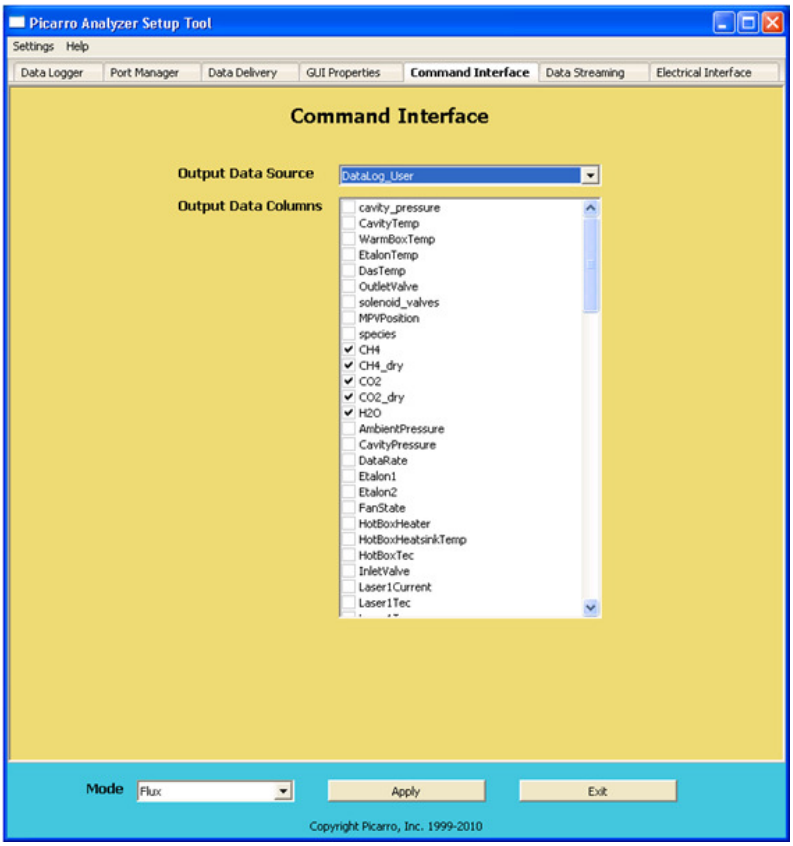
You should now be able to access the "Show/Hide Valve Sequencer GUI" menu from the main GUI under "Tools"

After making the appropriate edits, click "Apply" to put changes into effect, and then "Exit" to close the window.

COMMAND INTERFACE tab

This tab specifies the digital data output that are sent via ports COM or TCP (specified from the **PORT MANAGER** tab).

To pull data, you will need to send commands to the **COMMAND INTERFACE** (see the "**Programming Guide**" in *.pdf* format on the installation CD for commands). This is different from **DATA STREAMING** (see next section of this chapter).



Output Data Source: Two types of recent output data can be specified:

- Datalog_User
- DataLog_User_Sync (relevant only for Flux G2311-f analyzers).

See "**Data**" chapter of this manual for more information.

Output Data Columns: Select the type of data available for the **COMMAND INTERFACE** to access.

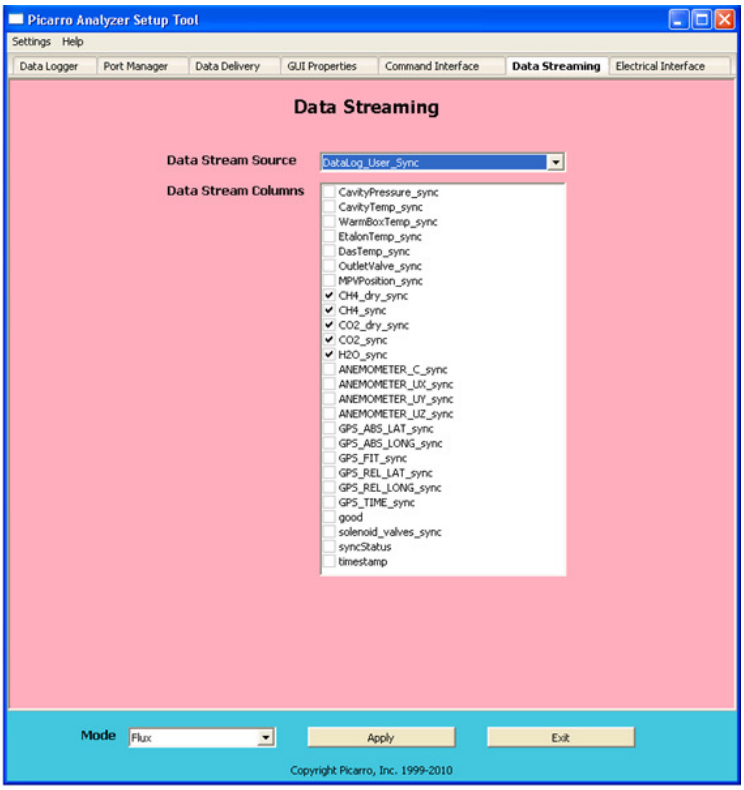
This is setup and initialization only. If a data type is not checked, it cannot be outputted by the **COMMAND INTERFACE** – you will need to return to this tab and mark the desired data type.

After making the appropriate edits, click "Apply" to put changes into effect, and then "Exit" to close the window.

DATA STREAMING tab

This tab specifies the digital data output to send via COM port (specified from the **PORT MANAGER** tab).

DATA STREAMING outputs data continuously, whereas the **COMMAND INTERFACE** needs commands to output data (see previous section of this chapter).



Output Data Source: Two types of recent output data can be specified:

- Datalog_User
- DataLog_User_Sync (relevant only for Flux G2311-f analyzers).

See "**Data**" chapter of this manual for more information.

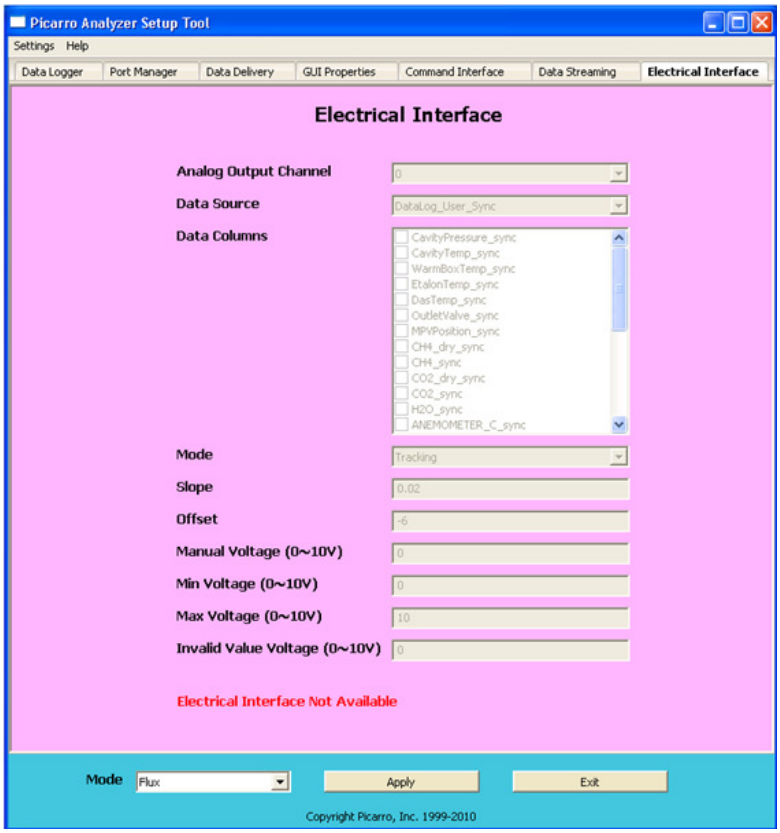
Output Data Columns: Select the type of data available for **DATA STREAMING** to access.

This is setup and initialization only. If a data type is not checked, it cannot be outputted by **DATA STREAMING** – you will need to return to this tab and mark the desired data type.

After making the appropriate edits, click "Apply" to put changes into effect, and then "Exit" to close the window.

ELECTRICAL INTERFACE tab (optional)

This tab is enabled if your analyzer is optionally configured with an Electrical Interface Card (EIC).



The **ELECTRICAL INTERFACE** tab allows customization of each analog output channel.

The EIC provides up to 8 analog signals available to the user for monitoring various measurements results and analyzer parameters.

Note that this tab will be disabled if your analyzer was not configured to work with an analog peripheral.

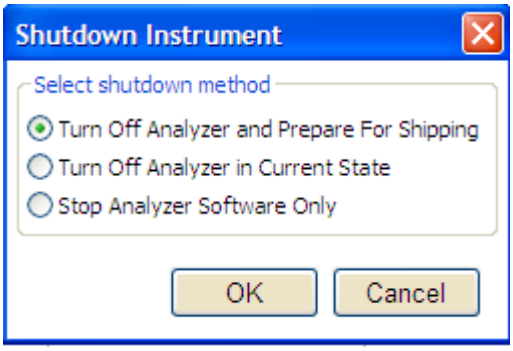
After making the appropriate edits, click “Apply” to put changes into effect, and then “Exit” to close the window.

SHUTDOWN PROCEDURE

Before proceeding to turn off the analyzer, note the following warnings.

	CAUTION: A flow of clean, relatively dry gas should always be directed through the instrument for several minutes prior to shut down. Trapping a high-moisture content gas sample in the cavity can cause condensation damage to the mirrors as the instrument cools from its operating temperature.
	CAUTION FOR ALL USERS: do not turn off the pump or disconnect the vacuum line while the instrument is operating.
	CAUTION FOR G2000 SERIES ANALYZER USERS: If you have trouble turning off the analyzer software, do not kill process(es) in the task manager. Instead, **double-click on the "Stop Instrument"** icon in the “Diagnostics” folder on your desktop.
	CAUTION: If you accidentally over-saturate the instrument with water, it is very important that you do not turn the instrument off. Instead, let the instrument pull either room air or dry air/N_2 through for a few days to dry out the cavity - until the instrument is able to make measurements normally again. If the instrument is turned off right after the accident, water will condense and contaminate the cavity rendering it useless. The cavity repair can be up to 25000USD.

1. To turn off the analyzer, click the "Shutdown" button in the GUI of the analyzer software. This opens a window that offers different shutdown states for the analyzer.



- **Turn Off Analyzer and Prepare for Shipping:** Used for when the analyzer undergoes long storage or transport. This mode prefills the cavity to ambient pressure with a gas prior to shut down. This gas should be clean and dry to

prevent condensation inside the system as it cools down. Five minutes of flow is sufficient. If the instrument is likely to experience low storage temperatures, the gas should be dry enough so as not to cause condensation (<1000 ppmv water concentration, for example, is sufficiently dry). If the instrument will be stored at typical room temperatures, however, the gas need not be particularly dry and the analyzer can be shut down safely after it has been purged for a few minutes with normal room air.

- **Turn Off Analyzer in Current State**: Used when the analyzer will be off for a few hours or overnight and will not be moved. The analyzer gas cell is stored at sub-atmospheric pressure. **If the analyzer is moved in this mode it is possible to damage the gas cell!**
- **Stop Analyzer Software Only**: This mode of turn off is used to perform updates and to set up configuration changes. This does not turn off the analyzer; however, it does turn off the software.
    - To turn the analyzer software back on, use the "**Start Instrument**" or "**Picarro Mode Switcher**" icons on the desktop (see **Desktop Icons and Folders** chapter of this manual).

2. Then turn off the pump(s) and dry gas (only if your system had required it).

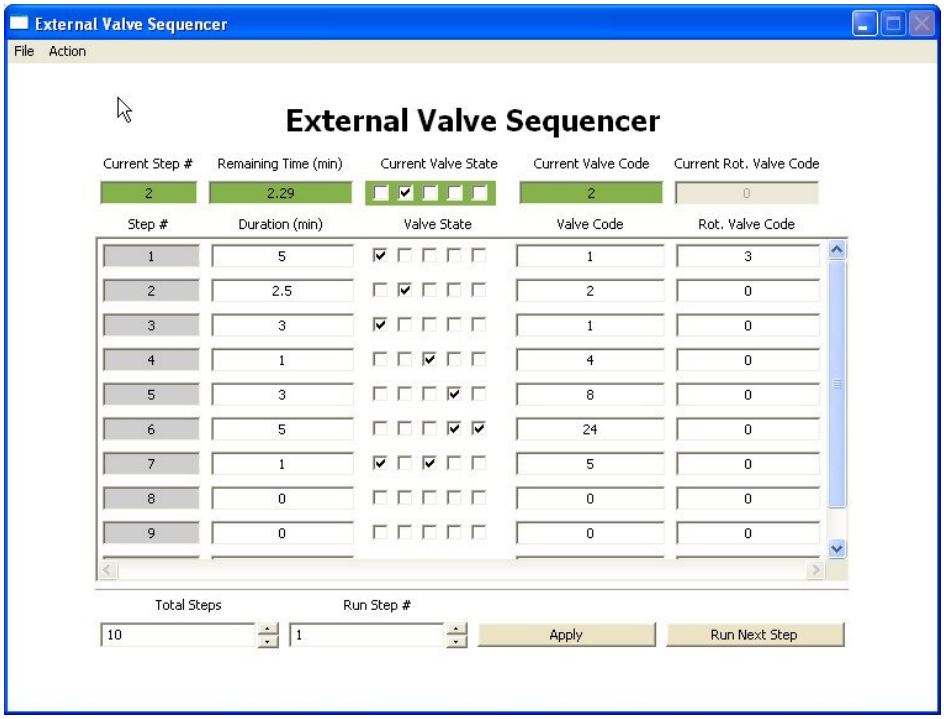
IN CASE OF AN ELECTRICAL POWER OUTAGE

If power to the analyzer is cut off for any reason the analyzer will cease operation. However, when the power is reapplied, the analyzer will restart automatically. the Picarro software tools will properly close out previous files and open new files for data collection so that previously collected data, instrument diagnostics and other parameters recorded up to the time of power outage are retained.

If short power outages will be a routine operating environment, Picarro recommends use of a power conditioning and/or uninterrupted power supply that will work to prevent the more damaging operating system and software corruption problems that can occur with repeated crashes.

EXTERNAL VALVE SEQUENCER

The Picarro valve sequencer window appears as below:



Introduction

The Picarro analyzer can control two types of valves:

- Solenoid valve(s): DC voltage powered valve with normally open (NO) and normally closed (NC) positions. These can be either 2-way or 3-way valves.
- Rotary Selector valve: digitally controlled valve used to send selected flow from one of many inputs (up to 32) into the analyzer

Both types of valves can be simultaneously controlled through a common software interface called the “External Valve Sequencer,” which is available from the Tools menu in the GUI.

Default Configuration

For all models of Picarro analyzers, the rotary valve control is disabled in the factory default setting. The solenoid valve control, however, is ready to use by default for all solenoid valve connectors.

Setting Up Solenoid Valves

Up to six solenoid valves can be controlled by the Valve Sequencer software. Each valve should operate using 12 VDC with a maximum current requirement of 1.5 ampere. This analyzer comes with a cable which can be connected to the solenoid valves.

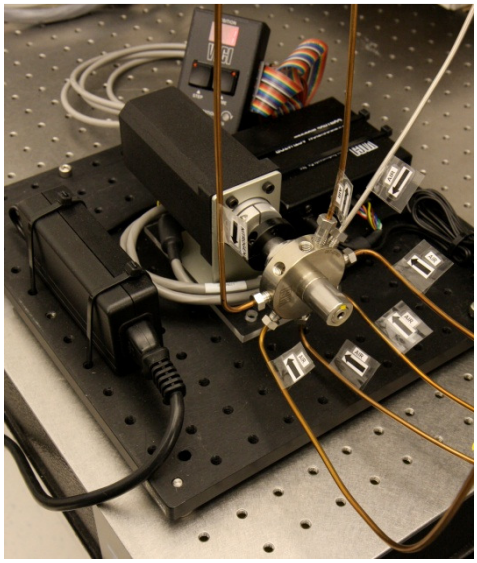
The valve connector cable should be connected to the 15-pin connector at the lower left corner of the analyzer. There are six pairs of wires with connectors labeled V1, V2, … V6 with 2-pin female Molex connectors (Molex#43020-0200) for connection to the solenoid valves. Connect V1 to solenoid valve 1, V2 to solenoid valve 2, etc. for valves wired with matching Molex connectors. Do not connect the solenoid valve to the analyzer ground -- use only the provided electrical connectors.

Setting Up Rotary Selector Valve

A multi-position rotary selector valve can be controlled by the Valve Sequencer software. It is controlled by standard serial commands in the Valco (VICI) protocol. Valco rotary valve models SD, SC, SF, ST, and STF are all supported, but not all configurations will be appropriate due to tube diameter, pressure or materials of construction. This setup will also require a Valco microelectric high torque actuator. A single combination package such as EMT2ST16MWE includes a 16 position, low-pressure ST valve in stainless steel, 1/8” tubing, 2” standoff, and microelectric high torque actuator. Please refer to http://www.vici.com/vval/st_8-1.php#16pos for further options, and consult with Valco directly for more details.

The Valco controller should be installed per manufacturer’s instructions. The 9-pin female connector cable should mate with its corresponding male port (labeled “MPV”) on the analyzer. Please note the 9-pin connector cable is not supplied with the instrument.

The setup will be similar to that in the pictures below:



Valve Sequencer Software

The Valve Sequencer software allows the user to set steps in which solenoid valves are turned on/off and the rotary selector valve is set to a single position. The current step, elapsed duration, and valve states are shown in the top most row of the valve sequencer command window. The duration of each step is set in minutes; for example, 1 minute and 30 seconds corresponds to 1.5 minutes.

Please note the number of steps correlates with the total steps in the sequence. But the count of the steps starts at "0." So, according to the image, the first step of the sequence is designated Current Step "0" and the second step in the sequence is designated Current Step "1." The "Go to First Step" menu item under "Action" restarts the sequence from step 1.

Different sequences can be created and saved in the software. Use the "Sequence File #" field to select which file the sequence will be saved to (0 to 10 are the available choices). Click the up/down arrows to select the desired number.

Configuring a Valve Sequence

Each "step" sets the rotary valve to a single position and activates the indicated solenoid valve(s) for a set period of time. Multiple steps can be carried out in sequential order to switch between different gas sources, flush out a manifold, or other gas handling operation. Create the number of desired steps in the sequence by clicking the up/down arrow for "steps."

For each step select the box for each solenoid valve to be opened. The check mark in the "current valve state" window indicates a solenoid valve is open. Note: In this example, we assume normally closed (NC) valves are used. A check indicates current is flowing to the valve thus powering it open. The positions from left to right correspond to solenoid valves V1…V6.

The rotary selector valve position can be set in the column labeled "Rot. Valve Code." Enter the number that corresponds to the desired valve position. A value of 1 in this field corresponds to position 2 on the Valco valve. Only one rotary position can be selected per step.

Step duration is determined by the value entered in the "duration (min)" field, where the duration of the step is in minutes. If duration values are set to less than 0.1 minutes they may not be carried out correctly.

The "valve code" field is a configuration- dependent, read-only display field that shows the total state of that particular step in a numerical code. Should the most upper right grey box display a value of 512, 256 or be greyed-out, that indicates no rotary selector valve is connected to the instrument, or it is not functioning. For each individual measurement the analyzer makes, the valve codes and rotary valve positions

corresponding to the valve state(s) at that point in time are saved alongside the concentration data.

Once the valve sequence has been programmed, it can be saved using the button "save valve sequence file" — it will be saved under the sequence file number selected.

Loading and Running a Saved Sequence

To load a valve sequence file, select the desired "sequence file number" and press "load valve sequence file." If the user has been running a different sequence from the one that was loaded, the user needs to press "Next Step" to initialize the newly selected sequence.

To run a sequence file press "Enable Sequencer." This button will turn to "Disable Sequencer" once the sequence starts. (The sequencer should be activated if it was disabled but not necessary to change from one sequence to another). The sequence will repeat itself indefinitely until disabled or the software exited. If enabled, the sequence will continue to run after the "close sequencer window" button is pressed.

If desired, the valve sequence can be forwarded to the next step of the sequence by pressing the "run next step" button. To stop the sequencer file, use the "Start/Stop Sequencer" menu item under the "Action" menu. This will leave all valves in their current state. In some situations, it is convenient to program the last step in the sequence to be a safe or default valve state. The sequencer can be advanced to the last step should the user need to put the solenoid or rotary vales into a safe/default state. The "Reset All Valves" de-activates all valves. Using the "Hide Sequencer Interface" closes the window, but if the sequencer is enabled, it will continue to run in the background. To jump to a particular step, increment the "run step 3" and click "Apply."

Both solenoid and rotary valve codes are recorded in columns in the output data files indicating the active valve configuration respective to when data is taken. These codes can be used as event timing flags. For example, if no solenoid valves are present, the codes will be recorded regardless of whether a valve is connected or not.

CALIBRATION

You can use either of the methods below to calibrate your analyzer. Method 1 requires you to make a graph (known standards versus measured standards) to calibrate the analyzer. Method 2 does not require you to make any graph; however, the effect of its calibration is harder to reverse in comparison to Method 1.

METHOD 1: USING THE MAIN GRAPHICS USER INTERFACE (GUI) TO CALIBRATE THE ANALYZER

Since the Picarro analyzer is extremely linear, it is only necessary to use three calibration standards to calibrate each gas or isotopic species (two points define the calibration line and a third intermediate point is used for verification). The exact value of each calibration standard is not of particular importance as long as they span a representative range of values over which the analyzer will typically be operated. It is reasonable to use a concentration of zero for the low calibration value, for example. Although it is not necessary to use more than three standards, additional standards can be used to further constrain the linear calibration coefficients.

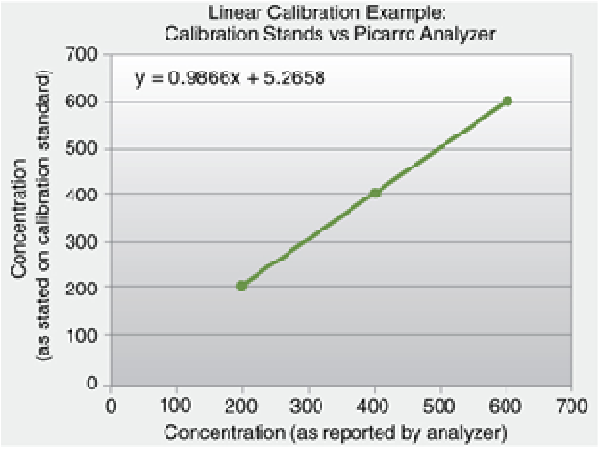
To perform a calibration or verification of calibration:

1. Introduce the first calibration standard into the analyzer for an interval long enough for the analyzer to yield a stable measurement of that sample. The stated concentration of the calibration sample (a calibrated gas bottle, for example) and the value the analyzer reads for that sample are recorded for each calibration standard used.
2. Plot the values to determine the linear relationship between the known calibration values and the analyzer's reported values. It is important to plot the analyzer's reported concentration on the horizontal axis and the gas standards' stated concentrations on the vertical axis.
3. Calculate a linear best-fit equation from the data. The slope and intercept of the best-fit line through these points are the two values that are used to calibrate the analyzer. Determining the linear relationship between the known calibration values and the analyzer's reported concentration enables the calculation of a calibration offset (slope and intercept). This adds a correction term to the analyzer's factory or previous calibration.

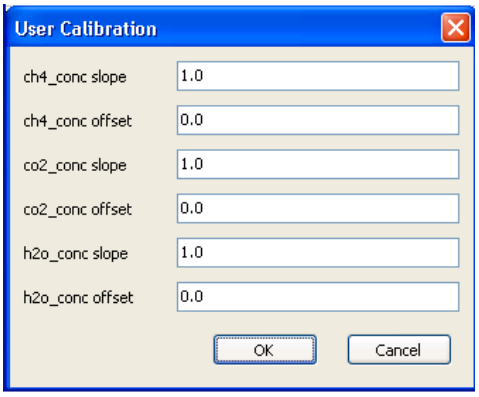
Changing the analyzer's calibration is intended to be done infrequently. Instead of recalibrating frequently to increase the accuracy of the data, users often just verify the calibration by measuring three or more gas standards and use the same regression procedure described here to calculate an offset by which to correct their data offline.

In the calibration example data below, fitting the three standards yields the linear equation y = 0.9866x + 5.2658 where the slope m=0.9866 and the intercept b=5.2658. This equation would be used with x=raw data measured by the analyzer (labelled "CRDS Reported") to give y=corrected data (labelled "Certified" value).

	CRDS Reported Value	Certified Value
Calibration Point #1	200.1	202.7
Calibration Point #2	600.3	597.6
Calibration Point #3	400.0	400.0



These calibration values are inputted into the software by selecting the "User Calibration" from the Tools menu and entering the slope and intercept for each species (see below). This is a password-protected function, with the default password "picarro."



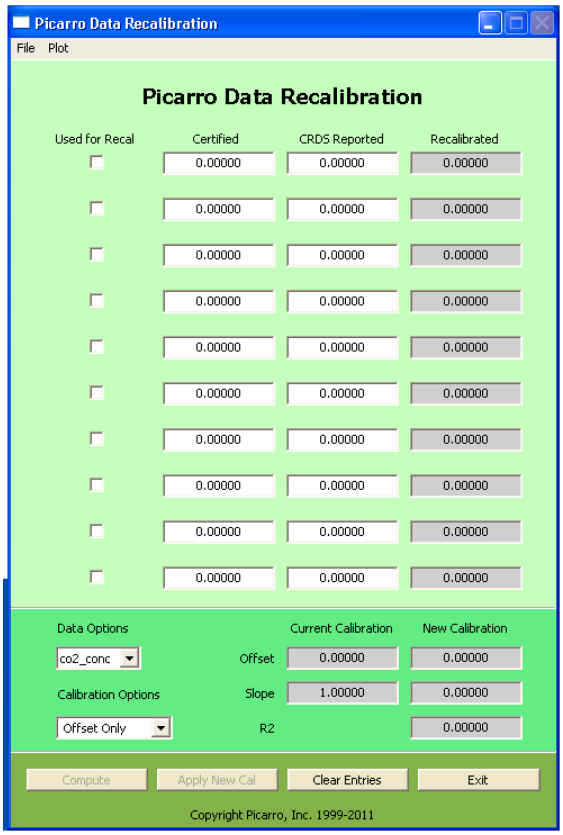
After the calibration is entered, it will take effect immediately after clicking "ok."

To return to the factory calibration, simply set the slope to "1" and the intercept to "0" for each species.

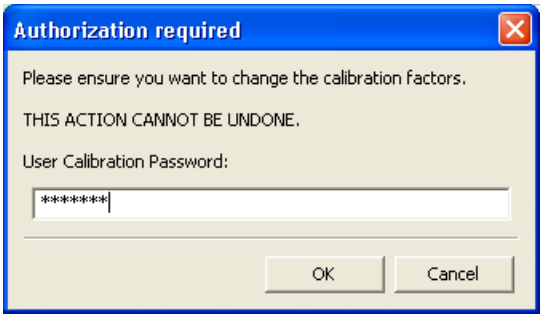
METHOD 2: USING THE "PICARRO DATA RECALIBRATION TOOL" TO CALIBTRATE THE ANALYZER

This tool can be used after you have performed the calibration measurements of standards with your Picarro analyzer.

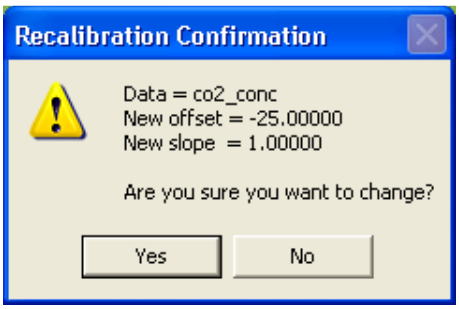
The Picarro Data Recalibration ("Data Recal" icon) software can be found in the "Picarro Utilities" folder in the desktop, and it can be used to recalibrate the data analyzed by Picarro analyzers.



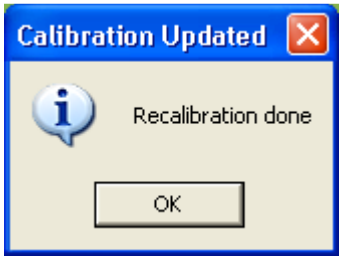
1. Double-click the "Data Recal" icon to pull up the window to the left.
2. Click on "Clear Entries" to reset the values in the "Picarro Data Recalibration" window.
3. Enter data values into the "Certified" (expected ppm values).
4. Enter data values into the "CRDS Reported" (ppm reported by Picarro analyzer) columns.
5. Check the boxes in the "Used for Recal" column that you want the software to base the calibration on.
6. Click the "Compute" button. The recalibrated values will appear in the rightmost column called "Recalibrated".
7. Click "Apply New Cal" if you want to apply the calibration to your future measurements.



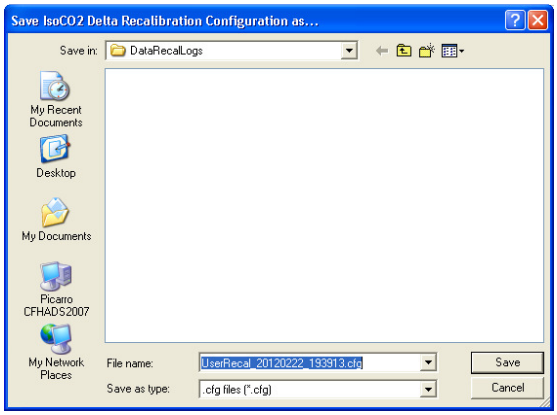
8. The default User Calibration Password is "picarro." Click "OK" to continue. **NOTE: This action cannot be undone from the "Picarro Data Recalibration Window," but it CAN be undone in METHOD 1 in the "User Calibration" window.**



9. Review the values in the window, and click “YES” to confirm.



10. Click “OK” to continue.



11. You now have the option to save your calibration settings. Click “Cancel” if you don’t want to save your new calibration setting.

12. You have now calibrated your analyzer. The next time you do any sample measurements, the measurements will be based on the new calibration setting.

COORDINATOR WINDOW

INTRODUCTION: In order to measure discrete samples or from multiple locations (when switching valves draw in ambient air from different heights. see **Switching Between Measurement Modes** for more information) a separate software window (coordinator) is used to control the sample source and match the corresponding real time read out with the sample source. **Depending on system configuration, coordinator programs may or may not be included.**

This chapter includes the following information:

1) How to run the coordinator software
2) How to read the Coordinator window
3) How to make sample descriptions files for the coordinator

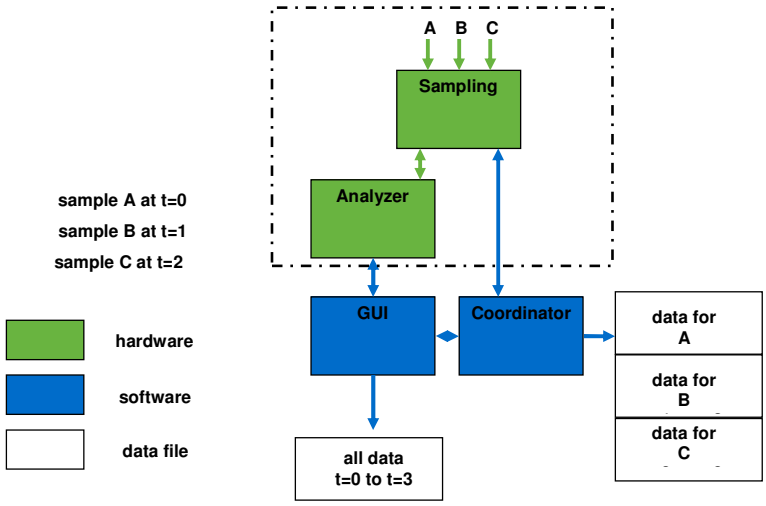


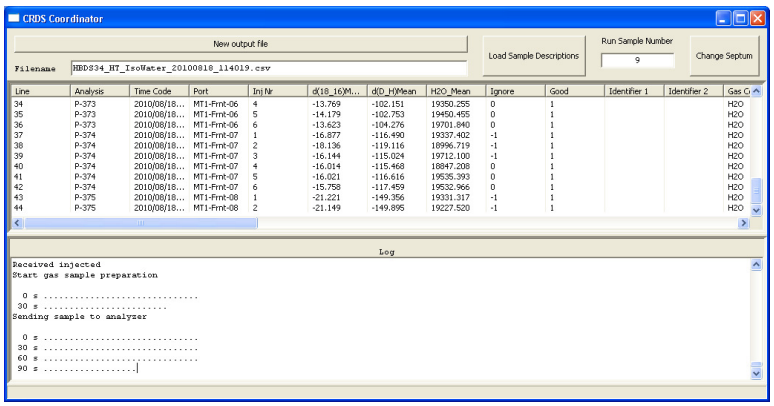
Figure 3 - Overview generalized schematic of Picarro analyzer system hardware, software, and data file generation:

The samples A, B, and C are introduced into the analyzer sequentially by a sampling module, if present. The sampling module could be a set of customer-supplied valves, a valve manifold, a discrete sampling module, or other device. The timing of sample introduction is controlled by the coordinator or valve sequencer software. The analyzer measures continuously and reports the data to the GUI which saves a single file where all data is reported as a function of time. The coordinator gets data from the GUI and creates a single file, and the data is reported as a function of sample.

1) **HOW TO RUN THE COORDINATOR SOFTWARE:**

First, make the required hardware connections for your system of interest. Afterwards, turn on the analyzer and wait for the GUI (Graphical User Interface) of the analyzer's software to open up automatically on your desktop screen. Next, launch the coordinator software by double clicking on the 'Coordinator Launcher' icon on your desktop.

After double clicking on the 'Coordinator Launcher' icon, a window will appear. Choose the appropriate coordinator from the drop down menu, and then click on the 'Launch' button. Make sure that the chosen coordinator is supported by your hardware connections and that samples (or gas from multiple locations) are ready to be analyzed.



Coordinator window. ***The look of the window may vary depending on the configuration of your analyzer.***

After clicking on the "Launch" button, the coordinator window will pop up (depending on the coordinator mode chosen, you may or may not be asked to set parameters for your analysis). From the Coordinator window, you will be able see results from sample analysis, see the current status of your analyzer, and load sample descriptions.

2) **COORDINATOR WINDOW DESCRIPTION**:

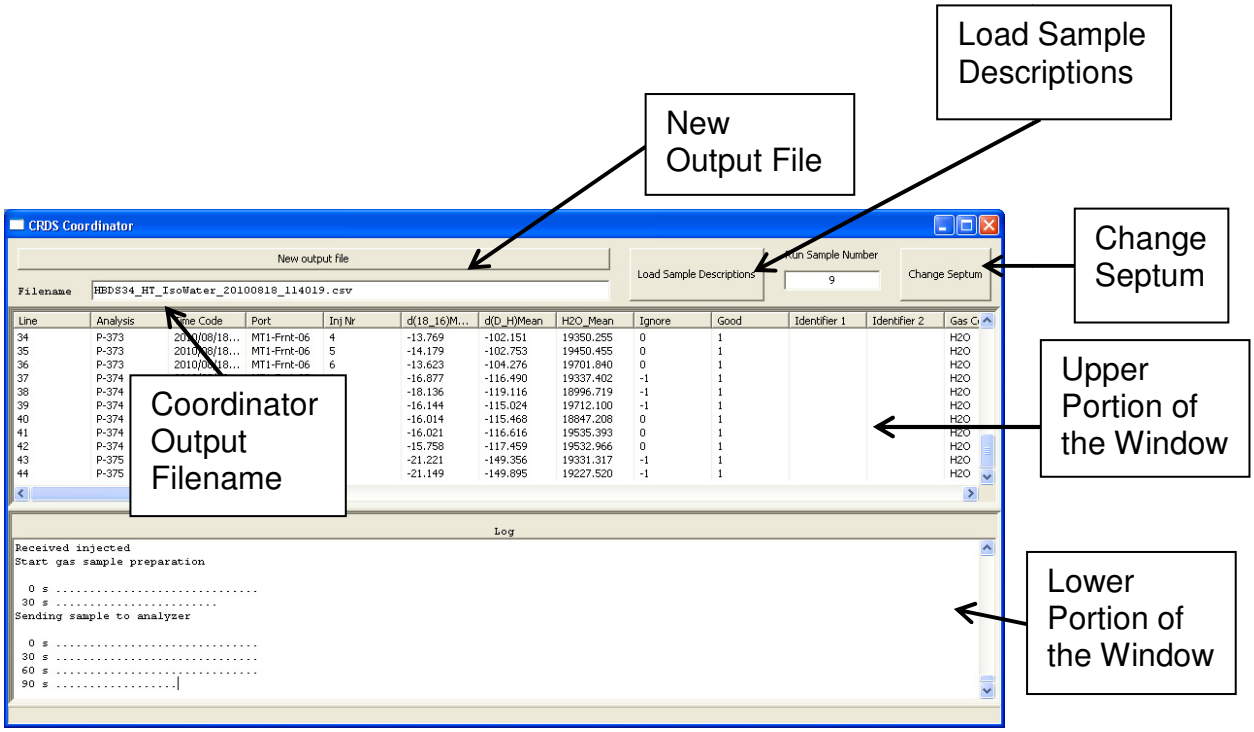
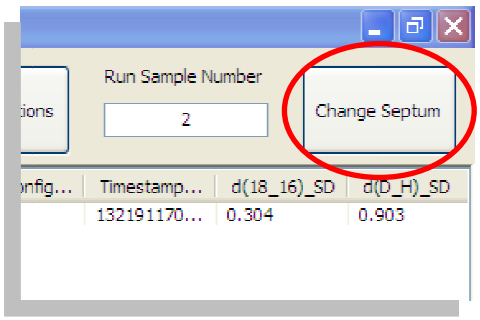


Figure above: Coordinator window

a. CHANGE SEPTUM BUTTON: Used to pause the Autosampler and the vaporizer in the middle of an analysis to physically change the septum on the vaporizer.



b. LOAD SAMPLE DESCRIPTIONS BUTTON: Located around the upper right corner of the Coordinator Window. The button allows the user to include a description for each vial in the data file output on the coordinator window.

In order to load the sample description file, press the button labeled 'Load Sample Descriptions'. If you are using the CTC PAL Autosampler, two file dialog boxes will appear in sequence, the first for the front tray and the second for the rear tray. For the Picarro Autosampler, only one dialog box will appear. Select the sample

description file, and then click to 'Open'. If a certain tray (front or rear) is not being used, use the 'Cancel' button to dismiss the dialog.

c. NEW OUTPUT FILE BUTTON: Clicking on this button will save the data that you see on the coordinator window into a file, and then clear the data from the Coordinator Window.

d. UPPER PORTION OF THE WINDOW: Each row represents the analysis results from a single injection. The types of columns are pre-selected by Picarro to include the most useful values for isotopic water analysis and for diagnostic indications.

   The values for the columns, unless otherwise noted, are the average value for time period of the injection, which was marked in red on the GUI (Graphical User Interface) of the analyzer's Sofrware. Values of the form *_SD are standard deviations for that same time period. The time period is selected by trigger thresholds based on the water vapor concentration. The analyzer is characterized and specified based on the factory default trigger thresholds—it is not recommended to change these values, please contact Picarro if you feel this is necessary.

e. LOWER PORTION OF THE WINDOW (labelled Log): This window displays the action that is currently taking place. For those actions that take some time to complete, a period is displayed each second and a new line is started every thirty seconds to show progress.

f. COORDINATOR OUTPUT FILENAME: Can be seen in the upper left of the Coordinator window. It follows an automated convention of –

   model, serial number, mode, year, month, date, and time. For example

   HBDS34_HT_IsoWater_20100818_114019.csv

   HIDS34_HT_IsoWater_20100818_114019.csv

   This means the coordinator file output was taken using analyzer HBDS34 in high throughput isotopic water analysis starting on 18 August 2010 at 11:40:19 am.

   This means the coordinator file output was taken using analyzer HIDS34 in high throughput isotopic water analysis starting on 18 August 2010 at 11:40:19 am.

3) **HOW TO MAKE THE SAMPLE DESCRIPTION FILE:**

The sample description file should be in CSV (comma separated value) format. Use the supplied NotePad++ software. Write the sample descriptions in the format as shown below.

Tray,Vial,Identifier 1,Identifier 2

1,1,Picarro 00,standard

1,2,Picarro 11, standard

1,3,Picarro 22, standard

1,4,WA 1,first sample from Washington

1,5,WA 2,second sample from Washington

1,6,CA 1, first sample from California

1,7,CA 2, second sample from California

1,8,Picarro 00, standard

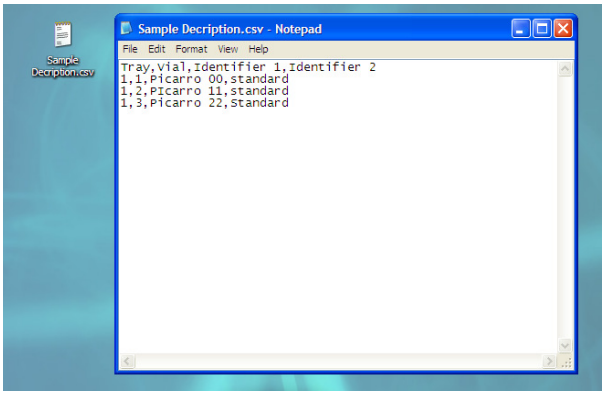
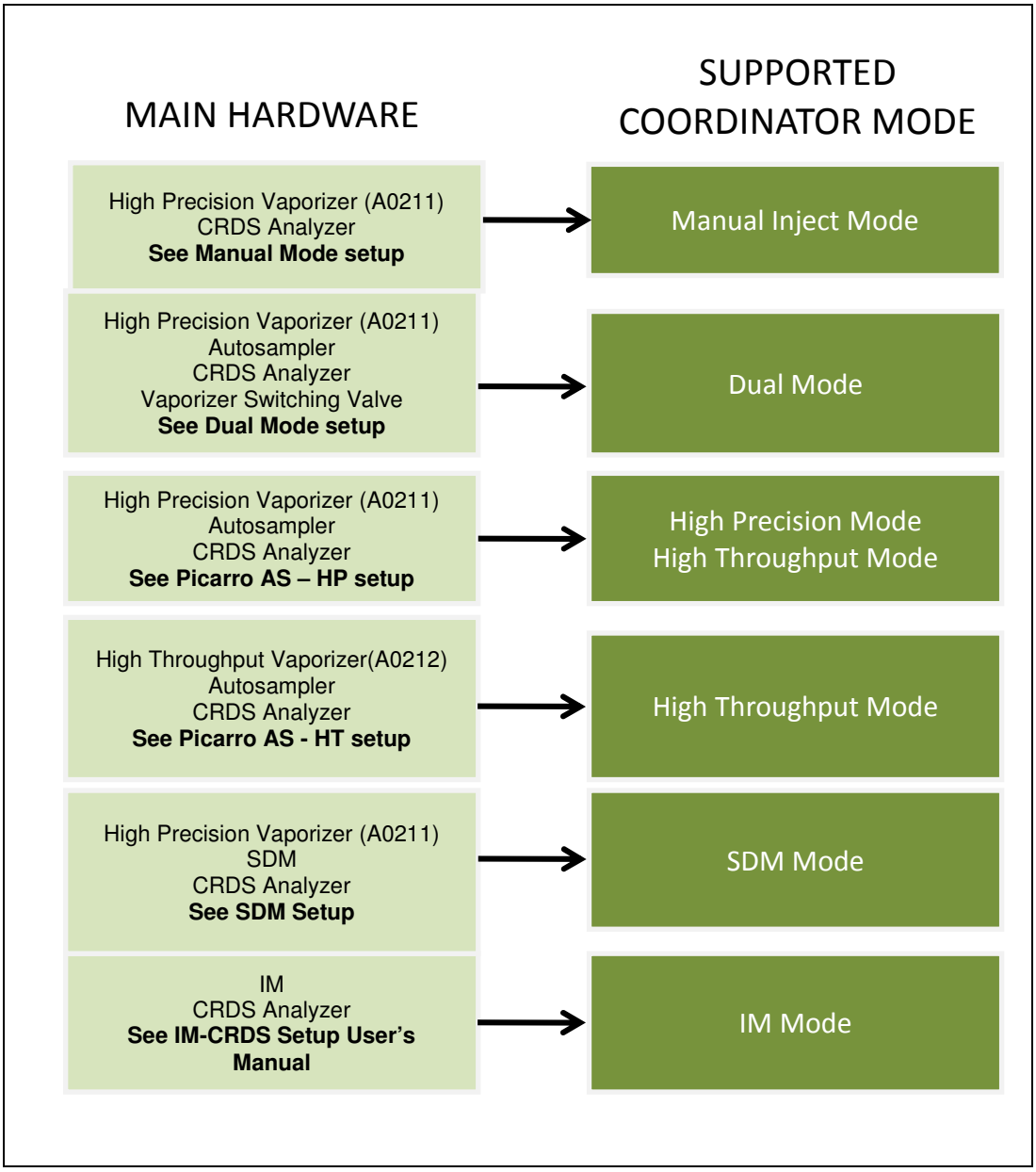


Figure above: An example of a Sample Description CSV files.

After the first line (which should contain the column heading), each line should represent a sample description for the analysis results from a single injection. The lines in the file may be arranged in any order. The capitalization and spacing of the first line must exactly match the provided example. MS Excel can be used if the file is saved in CSV format. It is recommended to generate the file using Windows operating systems (as on the analyzer) as there are differences in CSV format between different operating systems. It is permissible to load the sample description files at any time during the data collection. The output file is rewritten to use the new sample descriptions, so that the most recently loaded descriptions are always used.

COORDINATOR MODES

The CRDS analyzer needs to be equipped with the appropriate hardware to support a coordinator mode. Unless stated otherwise, the chapters below are referenced in the **INSTALLATION | L2140-*i*, L2130-*i*, or L2120-*i* Analyzer and Peripherals User's Manual.**



SHORT DESCRIPTION OF DIFFERENT COORDINATOR MODES:

1. **High Precision:** Used to measure liquid water samples with maximum precision. Automatically injects and analyzes liquid samples. Each injection cycle takes 9 minutes. High Precision & High Throughput Coordinator Modes operate in the exact same fashion except that the steps of sample preparation and analysis are faster in the high throughput coordinator.
2. **High Throughput:** Used for faster measurement of liquid water samples with good precision. Automatically injects and analyzes liquid samples. Each injection cycle takes 4 minutes. High Precision & High Throughput Coordinator Modes operate in the exact same fashion except that the steps of sample preparation and analysis are faster in the high throughput coordinator.
3. **A0212 High Throughput:** Used for fastest measurement of liquid water samples with good precision. Automatically injects and analyzes liquid samples. Each injection cycle is less than 2 minutes. See the rest of the chapter for more information on the Coordinator. High Precision & High Throughput Coordinator Modes operate in the exact same fashion except that the steps of sample preparation and analysis are faster in the high throughput coordinator.
4. **Manual Inject:** Used for semi-automated measurement of liquid water samples with maximum precision. Requires A0211 high precision vaporizer and A0322 Syringe Guide. User manually injects samples after prompt. The vaporizer control and the analysis of liquid samples are automated. Each injection cycle takes 9 minutes.
5. **Dual Liquid/Vapor:** Used for measurement of ambient vapor coupled with automated injection of liquid calibration standards. Requires A0211 high precision vaporizer, A0912 hardware/software for vapor calibration and Autosampler. Alternates between analyzing ambient vapor and liquid standards based on user defined sequence. Uses high precision method for liquid calibration. Each injection cycle takes 9 minutes. Before operating in Dual Mode, set the vaporizer temperature to 110 C°**.**
6. **Standards Delivery Module (SDM):** Used for measurement of ambient vapor coupled with automated injection of liquid calibration standards. Requires A0211 high precision vaporizer and A0101 standards delivery module. Alternates between analyzing ambient vapor from multiple points and a continuous stream of vaporized standard. The alternation is based on user defined sequence. A calibration measurement takes approximately 20 minutes per concentration/standard. Before operating in SDM mode, set the vaporizer temperature to 140 C°**.**
7. **IM CRDS (Induction Module)**: Requires the IM. Used for isotopic analysis of extracted water from samples such as soil, plants, or tissues and allows the isotopic analysis of the extracted water. This requires the Induction Module.

IMPORTANT NOTE: The L2140-i can operate in four instrument modes (iH2O N2, iH2O Air, iH2O N2 O-17 and iH2O air O-17). By default, only the 'High Precision' and 'Manual Inject' coordinator modes will work for the two O-17 instrument modes. If you require additional coordinator modes for 17O, please contact Picarro.

PARTICULATE FILTER (on analyzer)

The advanced, rugged design of Picarro analyzers provides stable, long-term operation with minimal service or maintenance. With the exception of the particulate filter, the analyzer is not user serviceable. Should it appear to malfunction, please refer to the **Troubleshooting** chapter of this manual or contact Picarro.

Particulate filters can become clogged after years of use in dirty environments. The symptoms of a clogged filter include the analyzer reporting “pressure low” or there being no flow into the instrument, causing unusual measurements.

If liquid water is accidentally sucked into the inlet line, it will clog the filter and impede the flow (usually for a few days) until the water evaporates. If this occurs, it is important to NOT turn off the analyzer or replace the filter until the filter is dry. The reason for this is that the increased humidity due to liquid water in the filter can cause condensation on the optics if the analyzer is allowed to cool from its operating temperature. Often, after the filter dries, the analyzer will begin functioning normally, and a filter replacement is not necessary.

There are two in-line, sub-micron particulate filters before the measurement cavity:

- The first filter is user-replaceable and is found immediately following the inlet at the back of the analyzer. Replacement filters can be purchased from Picarro to be installed by the user.
- The second filter, which is directly attached to the cavity, is NOT user-replaceable. **NEVER remove this filter, as it is directly attached to the cavity.**

Tools Required

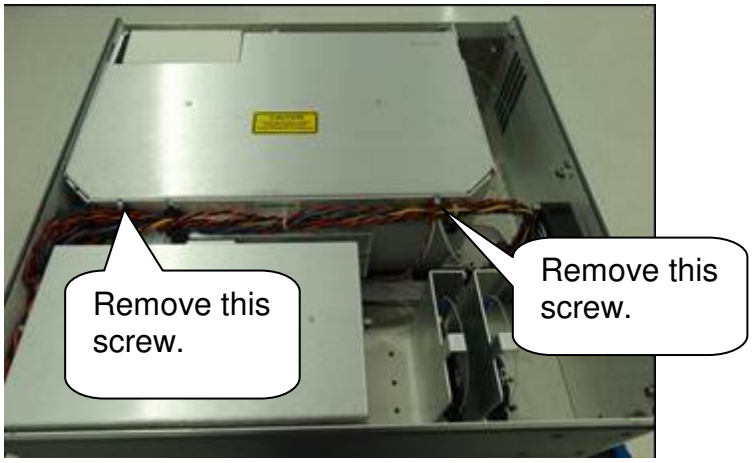
- 1.5mm hex driver
- 9/16” open end wrench
- 5/8” open end wrench
- 11/16” open end wrench

Removing the Old Particulate Filter

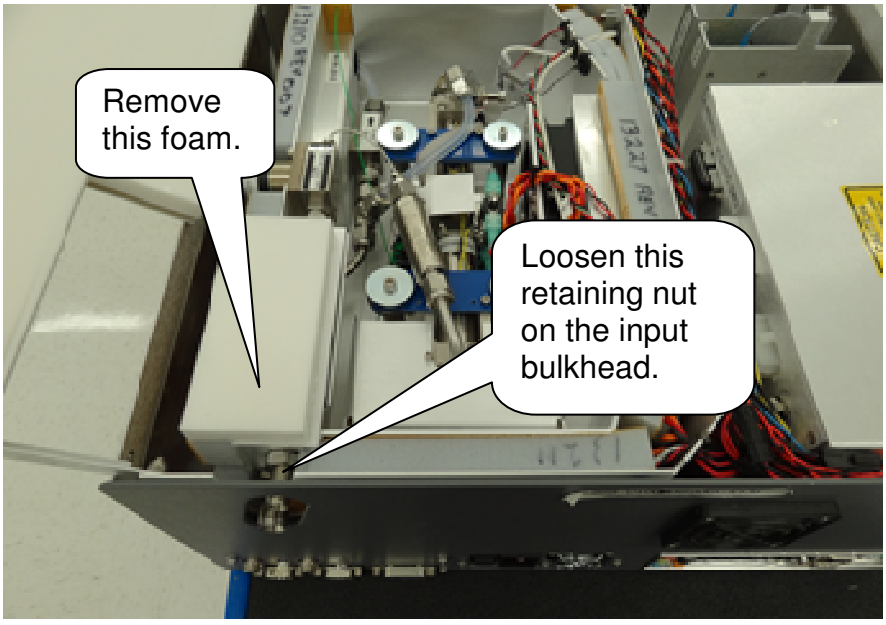
The following procedure is **ONLY** for the **user-serviceable particulate filter** (first filter).

1. Move the analyzer to a clean work environment.

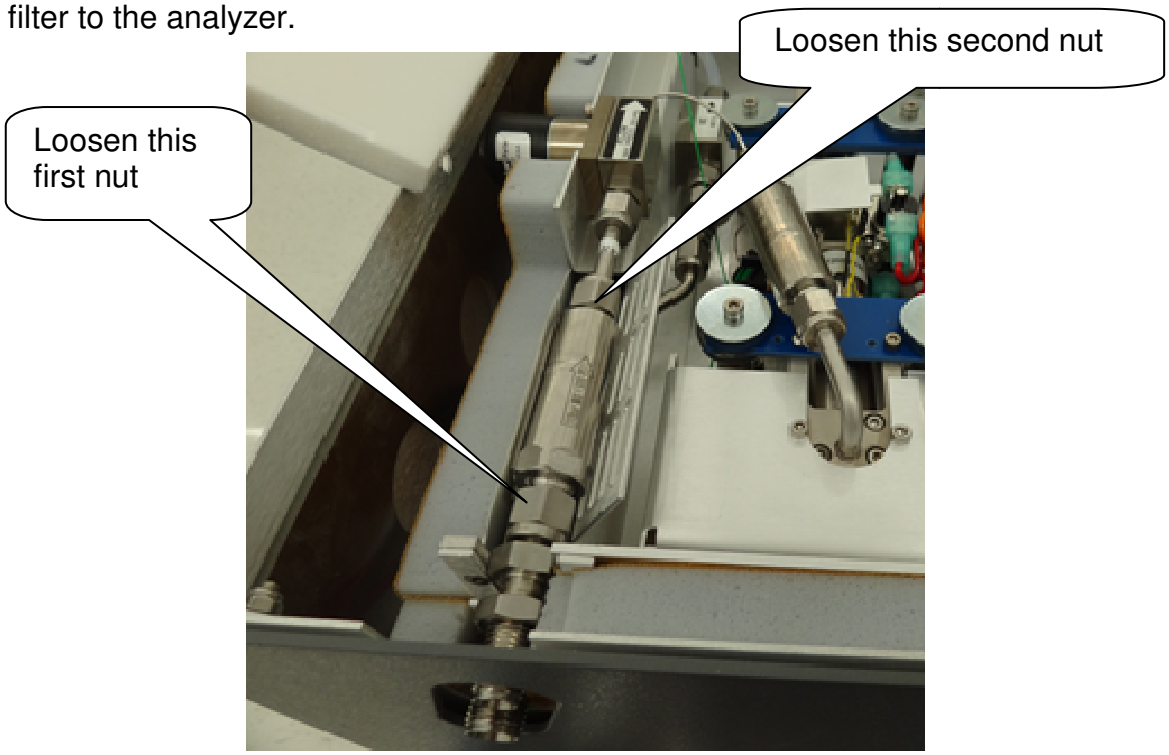
2. Using a 2mm hex driver, remove the top lid of the analyzer by removing six M3x6mm socket flathead screws.
3. Loosen and remove the two screws on the inner long side of the bigger box. Open the lid.

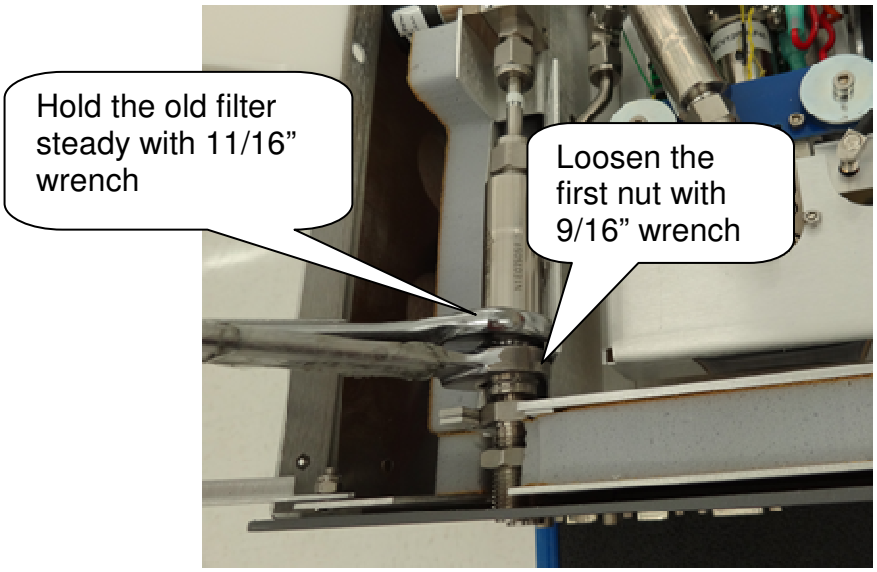


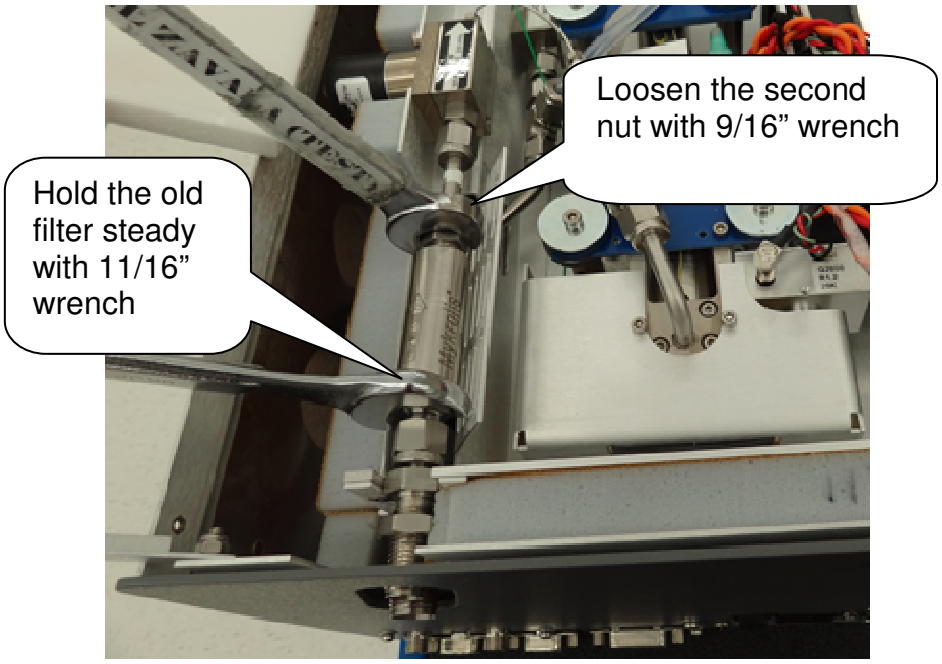
4. Using a 5/8” wrench, loosen the retaining nut on the input bulkhead (about 1 full turn should be enough).
5. Slide the foam towards left side of the analyzer (from the back of the analyzer) to remove it.



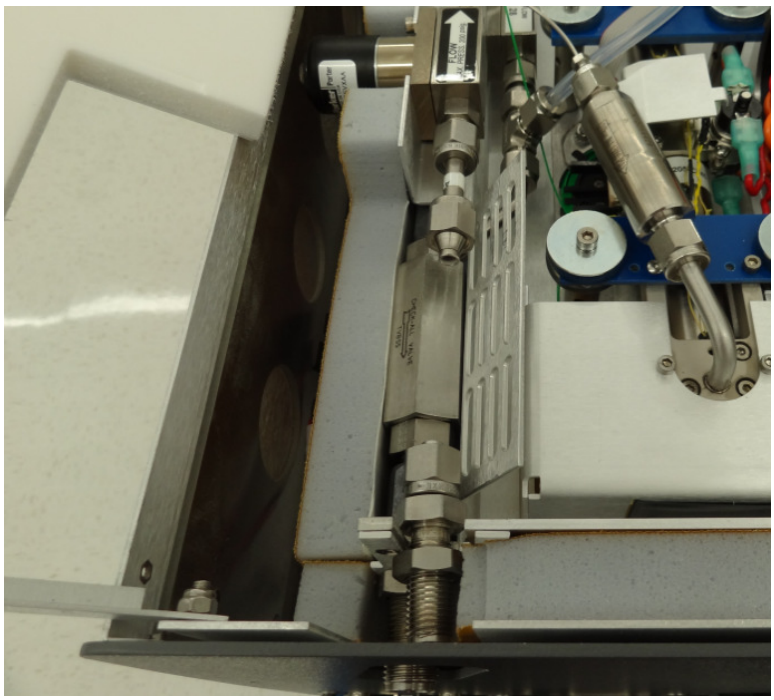
6. Using the 9/16” and 11/16” wrenches, loosen the two nuts that are securing the filter to the analyzer.







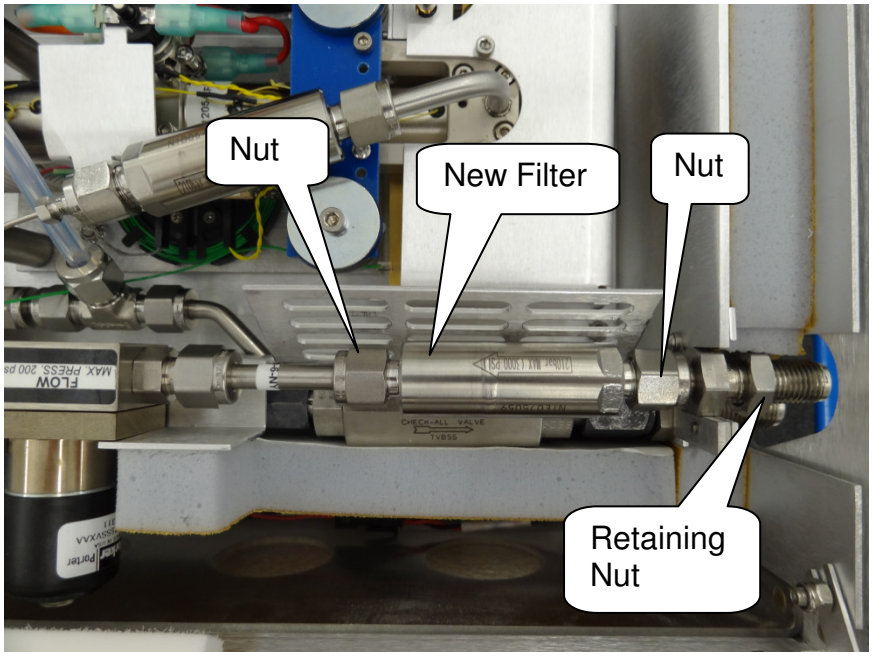
7. Slide the filter slightly towards the back of the analyzer and lift it out.



Installing the New Particulate Filter

	Note: When re-attaching 1/4” Swagelok fittings, the nut should be hand-tightened and then turned an additional 1/8 of a turn using a wrench.

1. Remove the filter from its packaging.
2. Using the 9/16” and 11/16” wrenches, attach it to the two nuts. The arrow on the filter needs to point away from the back of the analyzer.



3. Using a 5/8” wrench, reposition the filter foam cover and tighten the retaining nut on the bulkhead fitting. The metal edge of the filter cover should be under the foam.
4. With a 2mm hex driver, reattach the analyzer’s top with six screws.

INJECTION PORT SEPTUM (on vaporizer)

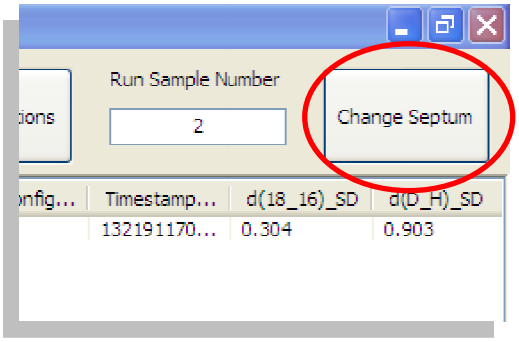
The injector port septum should be replaced every 200-300 injections. The more closely grouped the needle piercings are on the septum, the earlier the septum will need to be replaced. If the septum is not changed, it will be difficult to maintain the vacuum inside the vaporizer, which will degrade the quality of the data.

Tools Required

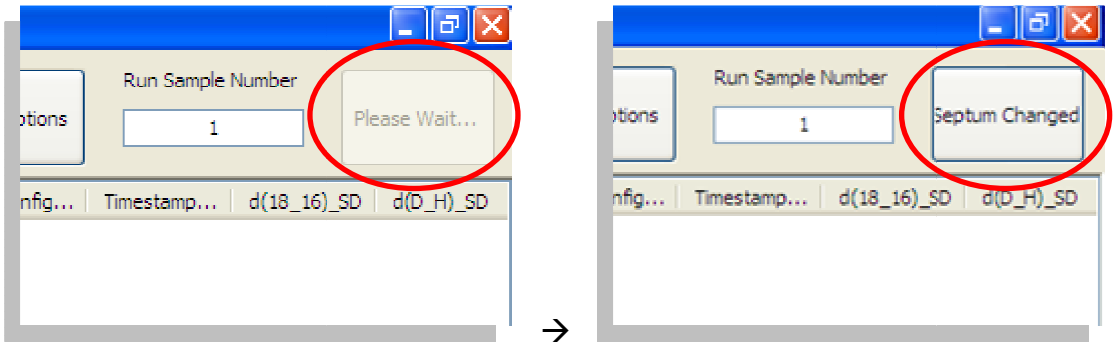
- tweezers
- new septum

Replacing the Septum

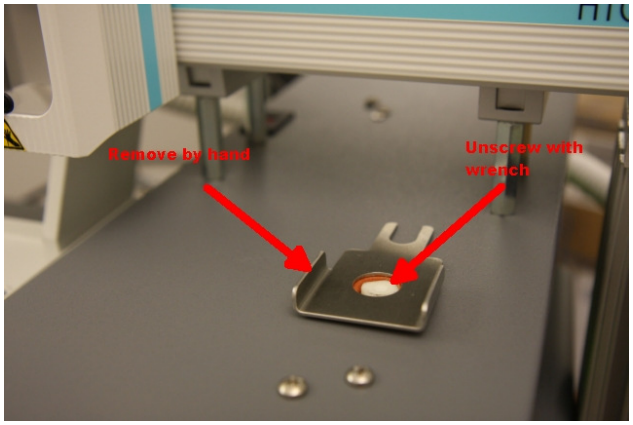
1. Is your autosampler running (i.e., actively injecting samples)?
   - If yes, click the Change Septum button in the Coordinator window. This button is used to pause the autosampler and the vaporizer in the middle of an analysis to physically change the septum on the vaporizer.



   - If no, proceed directly to step 3. If you happen to click on the Change Septum button in the Coordinator window anyway, the software will wait indefinitely. To resolve this:
     - Start a job on the autosampler, or
     - Manually end the Coordinator window
2. Wait for the Change Septum button to change to Septum Changed (see below). This will happen when the current injection analysis is complete.



3. Remove the protective metal cover around the injection port (ensure that the insulation foam stays attached to the cover).



4. Unscrew the cap of the port.

   WARNING: THE BOTTOM OF THE CAP IS VERY HOT!

5. The old septum will usually stick to the port, but if it is in the cap, use tweezers to remove the old septum.

6. Insert a new septum into the cap and screw the cap back onto the port by hand until it comes to a hard stop. This should be finger-tightened only.

   CAUTION: DO NOT OVER-TIGHTEN OR USE A WRENCH, AS THE INJECTOR PORT WILL BE DAMAGED.

7. Replace the metal cover around the injection port.

8. If you had not used the Change Septum Button in the Coordinator window to change the septum, proceed to step 9. Otherwise, click the Septum Changed button. The analyzer will restart the vaporizer purge cycle and then wait for the next sample injection.

9. Done!

TROUBLESHOOTING

Analyzer

The following section lists problems that may be encountered during installation and operation of the analyzer. The corresponding step-by-step procedures provide resolution in most cases. If, after attempting these procedures, the problem remains unresolved, please contact Picarro Technical Support. More troubleshooting information is available on the Community section of our website. Choose from the following symptoms:

Symptom: Power LED on analyzer does not illuminate

Context: Turning on the analyzer by momentarily depressing its front panel power switch should apply power. The green power LED is illuminated when it detects the correct power levels.

- Check that the AC power cord is attached and plugged into a working outlet.
- Check that the rear on-off switch near the AC power cord is in the on position.
- Press and hold the front panel power switch for at least 5 seconds as the analyzer may take several seconds to respond.

Symptom: User interface program does not start

Context: The computer is typically configured to automatically start the instrument and its associated user interface program after booting up. If it does not start automatically, the program may be launched by double-clicking the “Start Instrument” icon on the desktop. Communication problems with the analyzer may occur if the analyzer fails to initialize correctly on power up.

- Shut down the computer using the following procedure only:
    1. Click on the computer’s “Start” menu in the lower left hand corner.

NOTE: Do not simply restart Windows by selecting “Restart” in the drop-down box on Step 3, since this does not cycle the power to the analyzer.

2. Select the red “Shut Down” button.
3. Select “Shut down” in the drop-down box.
4. Wait for the computer and analyzer to turn off completely and the shutdown to complete normally.
5. After a few seconds, restart the computer by momentarily depressing the power button.

Symptom: Sample pressure cannot be controlled to the appropriate value for concentration measurements

Context: Under normal operation, the cavity pressure is automatically locked to the correct value by means of electronically controlled inlet and outlet valves. The message “Pressure Locked” on the front panel display and the user interface indicates that the cavity pressure is at the appropriate value. Should either of the messages “Pressure high” or “Pressure low” be displayed, the cavity pressure is out of its correct operating range.

- The “Pressure low” message indicates that there is insufficient gas available at the inlet of the analyzer. Check the inlet plumbing to the analyzer and ensure that the pressure at the inlet is within the specifications.
- The “Pressure high” message indicates that gas cannot be removed from the analyzer at a sufficient rate. Check the vacuum line between the analyzer and the power vacuum unit for leaks. Failure of the vacuum pump, injecting dilution gas at excessive pressure, or excessive pressure at the inlet can also cause this problem.

Symptom: User interface program “freezes” and does not update graphs as data are collected

Context: The computer may become unresponsive, causing the programs that control the analyzer to stop functioning. The computer and analyzer should be shut down and restarted.

- If the computer responds to the mouse, a normal Windows shutdown may be carried out:
    1. Click on the computer’s “Start” menu in the lower left hand corner.
    2. Select the red “Shut Down” button.
    3. Select “Shut down” in the drop-down box.
    4. Wait for the computer and analyzer to turn off completely and the shutdown to complete normally.

5. After a few seconds, restart the computer by momentarily depressing the power button.

- If the computer does not respond to the mouse:
  1. Hold down the power switch on the front panel for a few seconds until the computer and the instrument power off.
  2. After another few seconds, restart the analyzer by momentarily depressing the power button.

ChemCorrect

The following section lists solutions to a common problem that may be encountered while using the ChemCorrect Sotware. If, after attempting these procedures, the problem remains unresolved, please see **Technical Support**. More troubleshooting information is available at the www.picarro.com/community website.

Symptom: My ChemCorrect Processing Software hung up (froze).

Recommendation: Check that you ran the correct coordinator: Ones with ChemCorrect in the name. The output csv file should contain columns with ORGANIC in the heading.

If the above checked out, the other usual cause is syntax error and/or missing/empty row(s) in the coordinator output file. The below 3 files are user-editable:

Instruction Set: C:\Picarro\ChemCorrectExe\chemcorrect_inst xx.csv

Standard Library: C:\Picarro\ChemCorrectExe\standards file.csv

Coordinator Output csv file or source file: HBDSxx _CC_IsoWater_xx.csv

The instruction set is usually not edited unless you're an avid user. The standards file syntax is not too complicated to follow. The most common errors occur in the coordinator output file. These are the items to check:

The number of injections that you set ChemCorrect Analysis to ignore has to be less than the total injections/sample.

There can't be any empty row or blank value (as a result of broken/bent needle, or sample ran out of liquid). This is not an issue if you have ChemCorrect version 1.2.0 or later.

"Line" column has to be sequential and start at 1

"Time Code" column has to be chronological.

Port number should correspond with the correct sample number.

If you have to edit this source file, use Excel (an exception to all previous warnings to use Notepad++ because it's a lot easier but be careful). When done editing, close the file, when asked "Do you want to save changes...?", click "**yes**", when asked to keep the format, click "**yes**". MS Excel 2007 should work fine and if you have trouble with other versions, let us know.

Sometimes above syntax errors will crash ChemCorrect and you won't be able to run the software, instead an error message pops up with a path to the error log file. If this happens, please report this bug to help us improve our software. The temporary work around is to delete this file "chemcorrect.clt" in the ChemCorrectExe root directory.

Standard Delivery Module (SDM)

The following section lists common problems that may be encountered while operating the SDM (Standard Delivery Module). If, after attempting these procedures, the problem remains unresolved, please see **Technical Support**, or refer to the community site www.picarro.com/community.

Symptom: No communication between software and SDM.

Recommendation: Verify power is on (LED in front). Verify COM 1 of analyzer is connected to SDM. Remove cover and check internal connections.

Symptom: Water vapor concentration is unexpectedly very low (100-300ppmv) during standards measurement.

Recommendation: Check water delivery pathway. Remove cover and disconnect tubing from problematic standard. Run priming software for that pump only (the movement of the syringe pump will be visible by looking from the side of the SDM, there will be 3 cycles). Assuming the pump is working and there is no water then one of the lines is clogged. If there is water then the problem is with the needle. Remove the needle from the injector assembly, connect to tubing and check again.

Symptom: Water vapor concentration is unexpectedly high (20000+ ppmv) during standards measurement.

Recommendation: Verify the air pump is running. Verify there is a flow of about 250 sccm coming out of the vacuum port of the vaporizer. If both are operating correctly, this means excess water entered the vaporizer previously. Please contact Picarro for instructions on how to dry out the vaporizer. If the pump is running and air flow is <250 sccm then the line is leaking before the vaporizer or is blocked. Blockage most likely will occur at the orifice at the pump outlet. The pump inlet is equipped with a filter inlet to prevent particles from entering.

Symptom: Standard deviation of standard isotope ratio exceeds typical values/water concentration during standards delivery shows large oscillations (250+ppmv) or erratic behaviour. Amplitude may be worse for lower concentrations.

Recommendation: Carefully look at tubing for bubbles. Disconnect tubing from needle and run priming—stream should be a strong narrow jet of water free of bubbles. Remove needle from injector assembly and check with microscope/10x magnifying glass for encrustations/blockage if priming jet is strong. If priming jet is weak disconnect and replace tubing. The pump can generate enough pressured to overcome a partial blockage at higher flow rates but not at lower flow rates. So if the same pump shows oscillation only at low flow rates it is very likely the problem is a partial blockage in the fluid pathway.

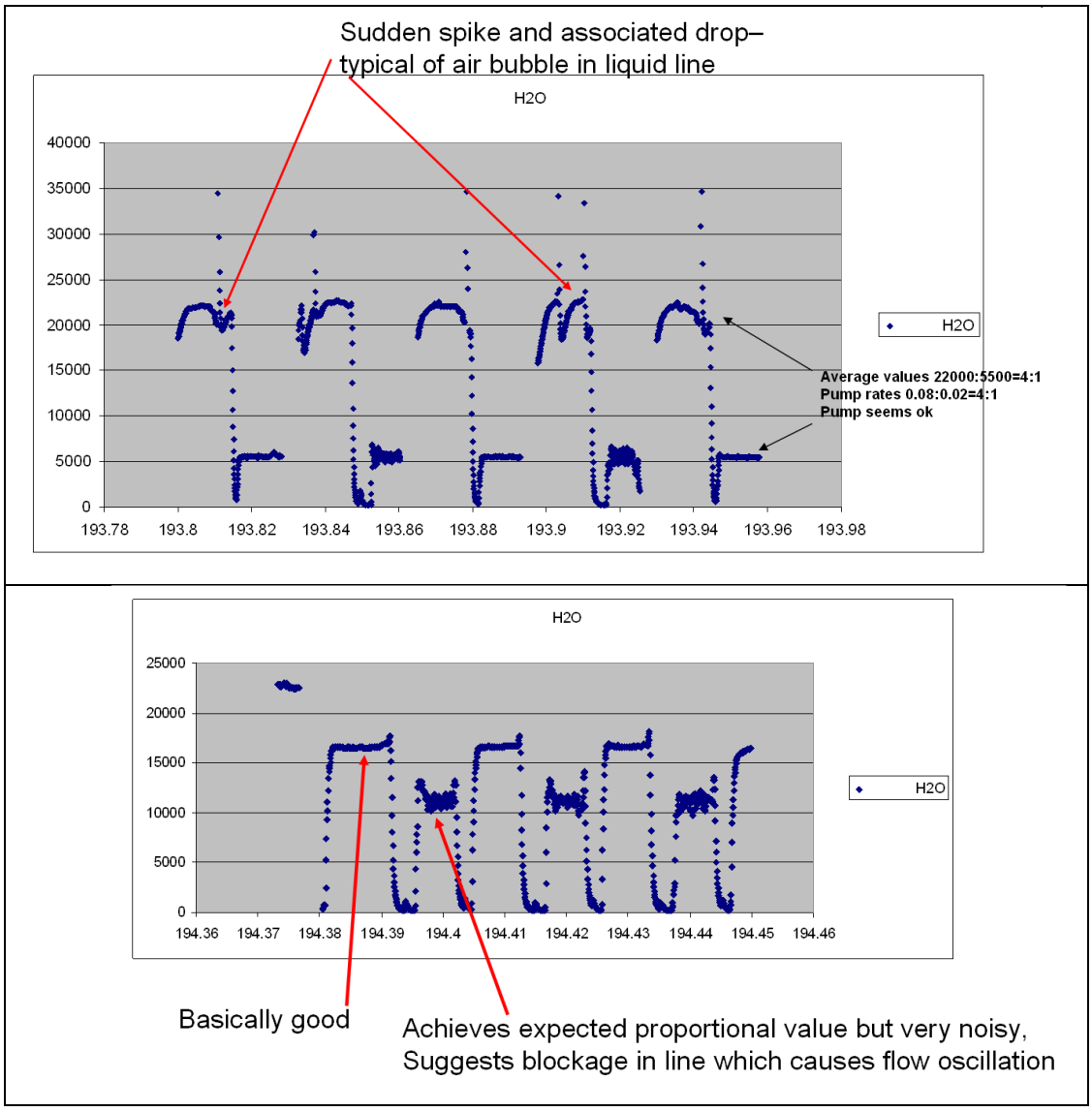
If priming jet contains bubbles and tubing connections are good then "palpate the bag"- i.e. pull at the edges, tap, etc …to detach air bubbles from outlet area so they can rise to the top. Good bag filling and line connection procedure minimizes this problem.

Symptom: Data displayed in coordinator or processed data files does not match column heading.

Recommendation: The analyzer has an earlier configuration file with a different order of columns. Please contact Picarro for assistance.

Symptom: Sudden drop ins in the vapor concentration?

Recommendation: Ensuring a consistent vapor concentration of the standard requires a consistent liquid flow. The presences of air bubbles will not only cause sudden drops in the vapor concentration when an air bubble reaches the needle tip but it will also cause oscillations in liquid flow. This is because the air bubble is compressible and the liquid is pumped by mechanical displacement (syringe) and instead of water flowing the air bubble will undergo compression. This is manifested in strong oscillations in measured vapor concentration followed by a sudden drop when the air bubble finally exits the needle. This is illustrated in the examples below:


Sudden spike and associated drop–
typical of air bubble in liquid line
H2O
40000
35000
30000
25000
20000
15000
10000
5000
0
193.78
193.8
193.82
193.84
193.86
193.88
193.9
193.92
193.94
193.96
193.98
H2O
Average values 22000:5500=4:1
Pump rates 0.08:0.02=4:1
Pump seems ok
H2O
25000
20000
15000
10000
5000
0
194.36
194.37
194.38
194.39
194.4
194.41
194.42
194.43
194.44
194.45
194.46
H2O
Basically good
Achieves expected proportional value but very noisy,
Suggests blockage in line which causes flow oscillation

High Throughput Vaporizer

The following section lists solutions to a common problem that may be encountered while using the ChemCorrect Software. If, after attempting these procedures, the problem remains unresolved, please see **Technical Support**. More troubleshooting information is available on the www.picarro.com/community website.

Symptom: Coordinator stops with an error

Recommendation: This typically happens because the H_2O peak concentration is so far below 12000ppmv (typically below the default value of 6500) that the pulse analysis cannot occur. Check that there is adequate sample and that the syringe is ok or see the "H_2O Peak Concentration is below 12000ppmv" section below.

Symptom: H_2O Peak Concentration is below 12000ppmv

Recommendation: Verify that the autosampler handset's injection speed into the vaporizer is set to 50nL per second and that you are using a 10uL syringe.

Decrease Dilution Gas Pressure in 10% increments between each pulse until resolved.

If the H_2O Peak Concentration is still below 12000ppmv after a number of pressure adjustments, pause the job on the autosampler handset and check whether the sample source is running low on sample. The Vaporizer uses roughly 6.7uL of sample per injection. If there is adequate sample, check that the syringe depth is set to reach below the surface of the sample using the autosampler handset. If everything appears to be correct, manually remove the syringe and check that it is working properly. Note that syringes wear out more rapidly when working with samples that have a large amount of solids, i.e. seawater.

Symptom: H_2O Peak Concentration is above 15000ppmv

Recommendation: Verify that the autosampler handset's injection speed into the vaporizer is set to 50nL per second and you are using a 10uL syringe.

Increase Dilution Gas Pressure in 10% increments between each pulse until resolved.

If the H_2O Peak Concentration is still above 15000ppmv after a number of pressure adjustments, pause the job on the autosampler handset and check whether the glass vaporizer liner is obstructed. The liner is a consumable item upon which solid residue from the sample is deposited during sample vaporization. Over time the liner can become obstructed and will need to be replaced. This failure mode is more pronounced in samples with a large amount of solids, i.e. seawater.

Symptom: H_2O Peak Concentration is noisy on most injections

Recommendation: Some noise in peak concentration is to be expected. If the concentration noise is pronounced, it may be indicative of the vaporizer injection depth not be set deeply enough to allow the syringe to make contact with the heated metal reservoir in the injection liner. Try adding 3mm to the injection depth in the handset; this step can be repeated a couple of times.

Symptom: Syringe breaking or wearing out in a short period

Recommendation: The 10uL syringes are robust when running with water that has few dissolved solids. The autosampler handset does, however, need to be set properly for the syringes not to be damaged. Among the most important settings are the various speeds at which the syringes are filled or injected. It is recommended not to fill or inject the syringes at a speed in excess of 1uL/second for pure water, or greater than 0.5uL/second for water with significant dissolved solids. Please check the autosampler handset settings to verify that these settings are not exceeded. Another important setting is the sample size; syringes should not be filled to more that 3.33uL if injecting pure water, or 3.00uL if using water with significant dissolved solids. (Note the actual volumes are doubled because the autosampler generally is set by default to assume the syringes are 5uL rather than 10uL). When running syringes with significant amounts of dissolved solids the syringe's lifespan will be reduced.

Symptom: Concentration Spikes at the end of the pulse

Recommendation: This is usually indicative of the sample not being fully vaporized before the syringe is removed from the injection port. Try increasing the post injection delay; in many cases a value of 18 seconds is optimal.

Symptom: Pulse time is longer than two minutes

Recommendation: If the setup seems to be otherwise working appropriately then there is nothing specifically wrong if the pulse time is longer than two minutes. Since longer pulses are composed of more measurement points, the pulse integration results might even be slightly improved. However, if you wish to improve throughput you can increase the dilution gas pressure in not more than 10% increments until pulse peak concentrations are closer to 12500ppmv. This should dry out the pulse faster. You can also try reducing the post injection delay; this risk causing concentration spikes at the end of the pulse, so be careful doing this. In any case, values under about 12 seconds are not recommended. It may also be advisable to try reducing the sample volume.

Pulse lengths are typically linearly related to sample volume. Sample volumes in the 2.9uL to 3.33uL range are typical.

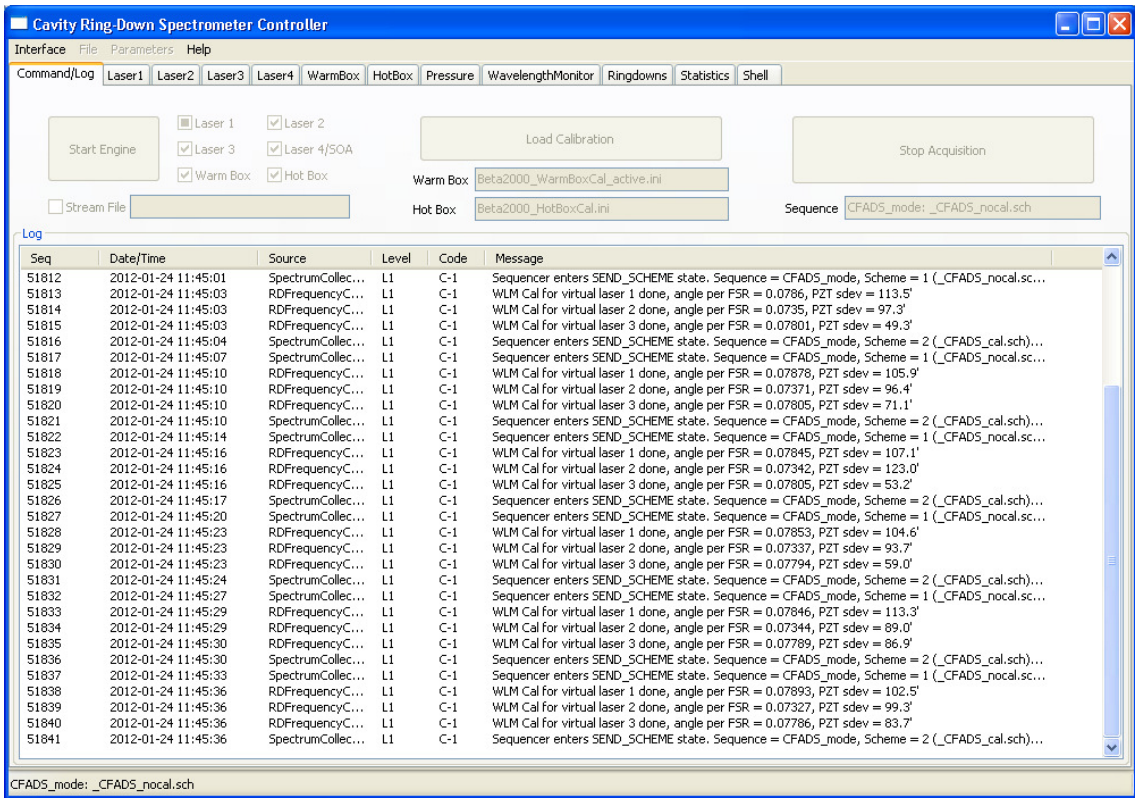
	**Caution:** do not use sample volumes above 3.33uL (for pure water), or 3.0uL (for liquids with significant dissolved solids), as this reduces the syringe life.

Symptom: Poor pulse integration is occurring because noisy measurements at the beginning or end of the pulse are being included in the integration as shown by the red dots for the isotope measurements

Recommendation: In this case, try customizing the pulse analysis as in the section above. Typically, increasing the delay for validTimeAfterTrigger or validTimeBeforeEnd by 2-3 seconds and re-running the coordinator to see if the noisy points have been excluded would be the first thing to try.

CAVITY RING-DOWN SPECTROMETER CONTROLLER

On your desktop, there is an icon labelled “Picarro Controller.” Clicking on this icon will open up a useful diagnostics panel (see image below), allowing the user to see the analyzer’s internal temperatures, pressure, and spectroscopy in real time. This program has user-accessible functions, but cannot change anything related to analyzer functionality and is intended for diagnostics purposes only.



TRANSPORTATION & STORAGE

In the event that the instrument will be transported or stored, the following procedure can be used to prepare the instrument and repack it into the original carton. All original packing materials the analyzer was shipped with should have been retained.

1. Ensure clean dry gas is still attached to the instrument prior to shutting down. This prevents condensation inside the system during storage or shipment.
2. Click the “Shutdown” button on the GUI.
3. Select the “Turn Off Analyzer and Prepare for Shipping” option (see **Shutdown Procedure** chapter of this manual for details).
4. Disconnect the all tubing and electrical connections from the analyzer.
5. To prevent contamination and possible damage to the connector threads, place caps on all gas connections.
6. Place the analyzer in a plastic bag with a packet of desiccant. Seal the bags with tape.
7. Pack the analyzer in the original shipping container ensuring that all of the foam pieces are in place to protect the analyzer during shipping.

	**CAUTION:** When shipping or relocating the analyzer, it is important to protect it from mechanical shocks. Failure to do so can compromise its performance. When shipping the analyzer, use its original packaging only.

LIMITED WARRANTY

Picarro, Inc. warrants its Products to be free from defects in material and workmanship and to perform in the manner and under the conditions specified in the Product specifications for twelve (12) months from shipment.

This warranty is the only warranty made by Picarro with respect to its Products and no person is authorized to bind Picarro for any obligations or liabilities beyond this warranty in connection with its Products. This warranty is made to the original Purchaser only, is nontransferable and may only be modified or amended by a written instrument signed by a duly authorized officer of Picarro. Sub-systems manufactured by other firms, but integrated into Picarro Products, are covered by the original manufacturer's warranty and Picarro makes no warranty, express or implied, regarding such sub-systems. Products or parts thereof which are replaced or repaired under this warranty are warranted only for the remaining, un-expired portion of the original warranty period applicable to the specific Product replaced or repaired. Products or parts thereof which are replaced or repaired outside of this warranty are warranted only for ninety days.

NOTE: DISCLAIMER

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER WRITTEN, ORAL OR IMPLIED, AND SHALL BE THE PURCHASER'S SOLE REMEDY AND PICARRO'S SOLE LIABILITY IN CONTRACT OR OTHERWISE FOR THE PRODUCT. PICARRO EXPRESSLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

The Purchaser's exclusive remedy with respect to any defective Product shall be to have Picarro repair or replace such defective Product or credit the Purchaser's account, whichever Picarro may elect in its sole discretion. If it is found that any Product has been returned which is not defective, the Purchaser will be notified and such Product returned at the Purchaser's expense. In addition, a charge for testing and examination may, at Picarro's sole discretion, be made on any Product so returned.

These remedies are available only if: i) Picarro is notified in writing by the Purchaser promptly upon discovery of a Product defect, and in any event within the warranty period; ii) Picarro's examination of such Product discloses to Picarro's satisfaction that such defects actually exist and the Product has not been repaired, worked on, altered by persons not authorized by Picarro, subject to misuse, negligence or accident, or connected, installed, used or adjusted otherwise than in accordance with the instructions furnished by Picarro.

The following warranty conditions shall apply to all Picarro, Inc. products unless amended by a written instrument signed by a duly authorized officer of Picarro:

ADJUSTMENT – No electrical, mechanical or optical adjustments to the product(s) are permitted.

PARTS AND LABOR - New or factory-built replacements for defective parts will be supplied for twelve (12) months from date of shipment of the product. Replacement parts are warranted for the remaining portion of the original warranty period. There will be no charge for repair of products under warranty where the repair work is done by Picarro, Inc.

NOT COVERED BY THE WARRANTY – Damage to any optical surface from improper handling or cleaning procedures. This applies specifically to those items subjected to excess laser radiation, contaminated environments, extreme temperature or abrasive cleaning. Damage due to ESD, abuse, misuse, improper installation or application, alteration, accident, negligence in use, improper storage, transportation or handling. No warranty shall apply where the original equipment identifications have been removed, defaced, altered or where there is any evidence of alterations, adjustments, removal of protective outer enclosure, any attempt to repair the product by unauthorized personnel or with parts other than those provided by Picarro, Inc.

DAMAGE IN SHIPMENT - Your analyzer should be inspected and tested as soon as it is received. The product is packaged for safe delivery. If the product is damaged in any way, you should immediately file a claim with the carrier or, if insured separately, with the insurance company. Picarro, Inc. will not be responsible for damage sustained in shipment. All Picarro products are F.O.B. origin, shipped from the Picarro factory or Picarro distributor. The price of all Products, unless otherwise specifically stated, is Ex-Works, Santa Clara, CA, as defined by Incoterms, 2010. The cost of normal packaging for shipment is included in the invoiced price. Where Buyer specifies special packaging, a charge will be made to cover any extra expense.

CLAIMS ASSISTANCE - Call Picarro, Inc. Customer Service or your local distributor for assistance. Give our representative the full details of the problem. Helpful information or shipping instructions will be provided. If requested, estimates of the charges for non-warranty or other service work will be supplied before work begins.

RETURN PROCEDURE - Customers must obtain a Return Merchandise Authorization Number from Picarro, Inc. prior to returning units. Products being returned for repair must be shipped in their original shipping cartons to avoid damage.

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TECHNICAL SUPPORT

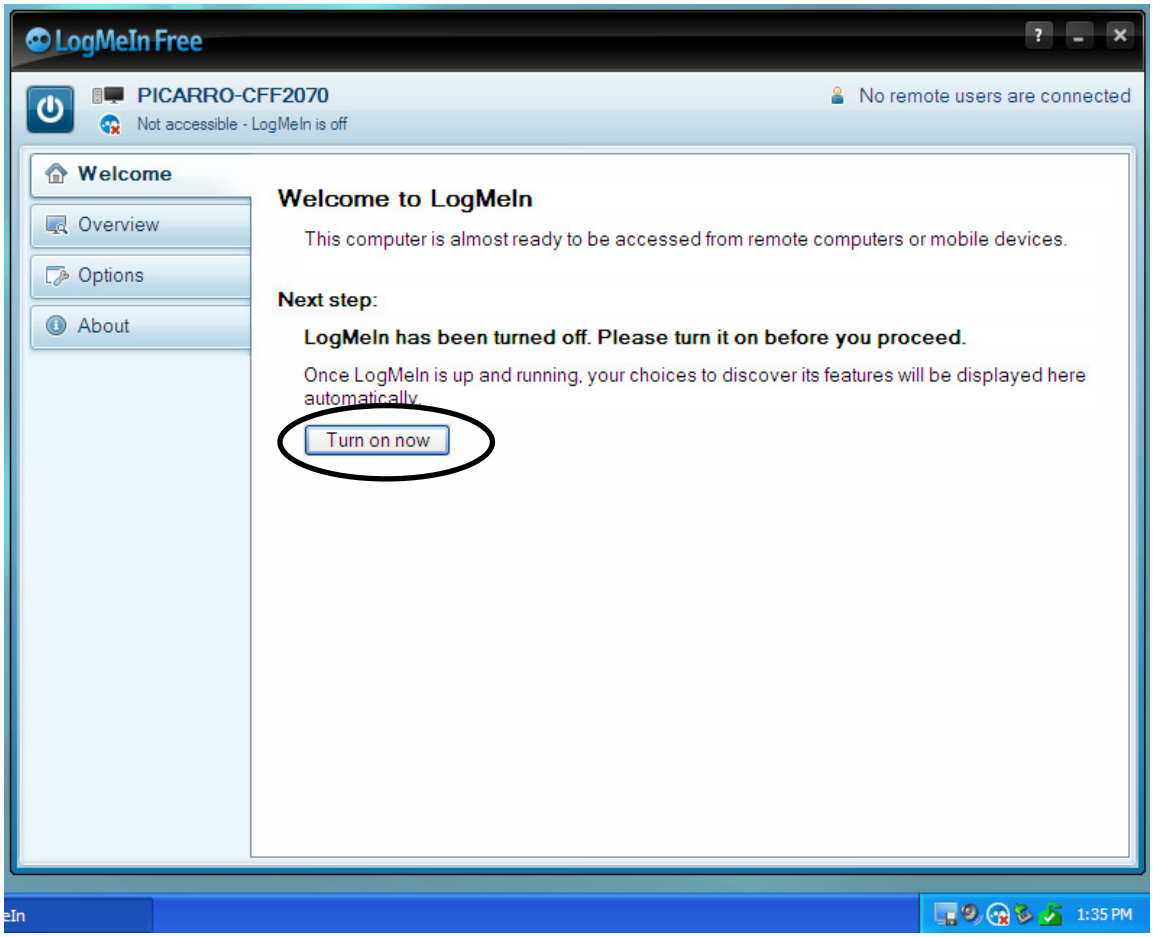
We are committed to helping our customers! Following the steps below will help us get to your problem faster.

- **Visit our popular Community forum at www.picarro.com/community.** It offers a wealth of information with answers to thousands of questions from our customers as well as useful links and updates to operate your analyzer optimally. If this is your first time visiting this forum, you will be asked to login using your username and password, which can be created easily with a special email invitation from Picarro. These invitations are automatically emailed to current customers upon purchase as well as to interested individuals; otherwise, please email us to request an invitation to community.
- **Email us at support@picarro.com.** We will get back to you right away. We highly recommend that you attach data and/or screen shots that you feel might help us diagnose your problem to your email.
    - **Please activate the LogMeIn software before emailing us (see tutorial below).** This activation allows our technical engineers to get access to your analyzer's desktop remotely, allowing us to find and solve your problem quickly. This access can easily be turned off by the user.
- **Call us at 408.392.3991.**

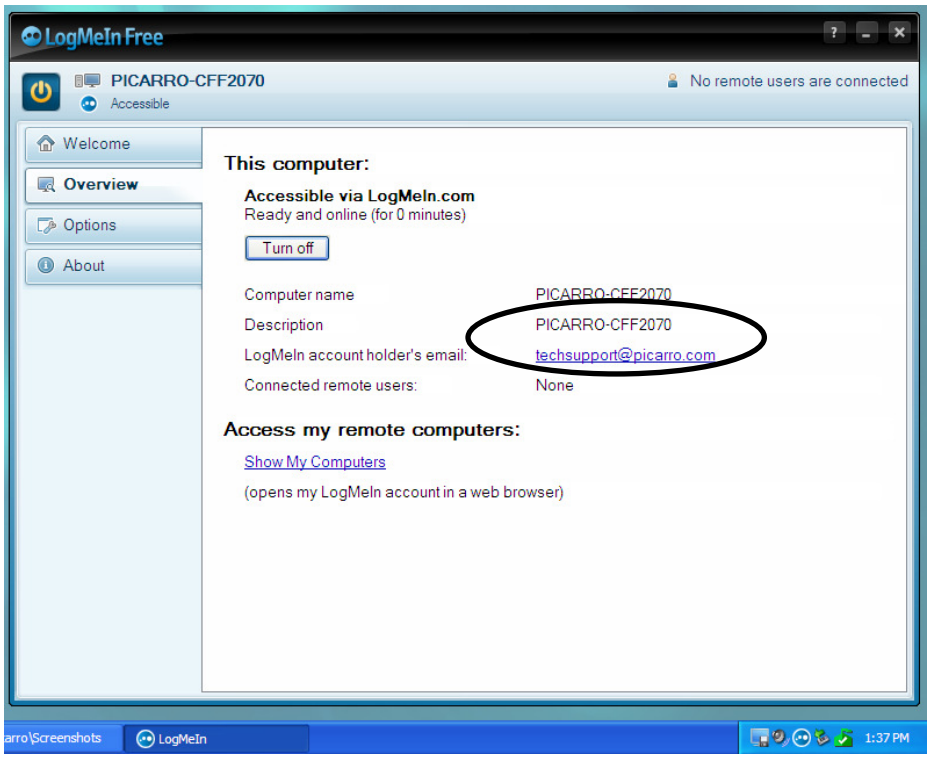
TO ACTIVATE THE LOGMEIN SOFTWARE

1. Click on the “LogMeIn” icon in the Windows task bar at the lower right hand corner. The “LogMeIn Free” window will pop up.

2. Click the “Turn on now” button.



3. Send both the “Description” and “LogMeIn account holder’s email” entries to Picarro, including a description of your problem. The “LogMeIn account holder’s email” shows the account that the instrument is currently on (default is an @picarro.com email).



4. After your problem has been solved, you can turn off Picarro’s access to your desktop by clicking on the “Turn off” button (see screenshot above).

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and learn about the many exciting and inspiring applications of our analyzers.

Picarro's website also offers links to application notes, customer conference presentations, research posters, white papers, datasheets, and so much more. Visit us at http://www.picarro.com.