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Picarro L1102-i Isotopic Liquid Water and Water Vapor Analyzer

User's Guide

PICARRO INC.

Picarro Analyzer User's Guide

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.

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Picarro L1102-i Analyzer User's Guide
Rev. 3/16/09

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INTRODUCTION

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 three components:

CPVU The **C**omputer **P**ower **V**acuum **U**nit

Contains a Windows-based PC and converts AC power into DC power to drive the analyzer, and contains a diaphragm pump to draw the sample gas through the instrument.

DAS The **D**ata **A**cquisition **S**ystem

Contains the spectrometer and sample chamber, and sends spectroscopic information to the control computer.

Controls the operation of the system, and converts spectroscopic data into gas concentration data.

Vaporizer

Contains a cylindrical chamber and a temperature controller to flash evaporate the liquid water injected into it. The resulting water vapor is passed to the analyzer through the tube connecting the vaporizer to the DAS.

Autosampler

Takes liquid samples from vials and injects into the vaporizer.

Vacuum pump

Contains a diaphragm pump that evacuates the vaporizer to remove traces of the old water sample in preparation of receiving the new sample.

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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 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.

The conventions are listed as follows, showing the picture you will see.

NOTE	CAUTION	WARNING	REMINDER
			

This manual was designed to be easy to read and understand. If you have any questions or suggestions, please let us know.

This manual contains information you need to safely install, operate, and maintain your analyzer.

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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: DO NOT OPERATE IN A WET ENVIRONMENT.

NOTE: The Picarro Analyzer contains no user serviceable components except the particulate filter in the DAS and the vacuum pump in the CPVU. 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. Refer to the appropriate section within this document relating to pump and filter replacement procedures.

CAUTION: The inlet gas connector on the back panel of the DAS, 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 so you should not open the analyzer except to replace the filter. Do not open any enclosures within the analyzer.

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NOTE: Although the analyzer components are can be optionally configured for rack mounting, they require supports in the rack, such as a shelf or side L-brackets, and cannot be safely supported by the front panel bolts alone. Please refer to the section on installation for details.

CAUTION: Some of the analyzer components are heavy. To avoid injury, please use proper lifting procedure when moving or installing the equipment.

Laser Safety

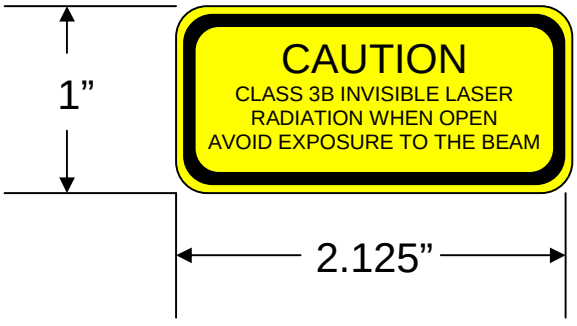
The Picarro Analyzer is classified as a Class 1 Embedded Laser Product

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

There are lasers used inside the analyzer, emitting 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 Labels

The following label is affixed to the main lid of the DAS unit.



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GETTING STARTED

UNPACKING

All Picarro products are inspected and tested prior to shipment from the factory. In the event that there is damage to the shipping containers (holes or crushing, etc.) insist that a representative of your shipping carrier is present while you unpack the contents. Damage caused by shipping is the responsibility of the shipping carrier and all claims must be routed through their claims department.

CAREFULLY unpack the contents from the boxes. The shipment should contain the following:

- 1 – 19" DAS module - includes all of the data acquisition, control, and communications hardware and firmware to perform all gas handling, spectral collection and reporting to the computer
- 1 – 19" CPVU module – contains Windows-based computer, power supply and vacuum pump units that provide all DC power to the DAS, and the vacuum required for sample gas sequencing into and out of the DAS
- 1 – Flexible tubing – with 3/8" Swagelok fitting on each end to connect the vacuum pump in the CPVU to the DAS
- 1 - Vaporizer module - includes the vaporizer with tubing that connects the vaporizer to the DAS inlet
- 1 – Vacuum pump module – contains a diaphragm pump in its housing with tubing to connect the pump to the vaporizer
- 1 – Autosampler – contains the components of an autosampler including its own power supply, cables and software CD
- 1 – USB Cable – connects the DAS with the computer
- 1 – Digital I/O Cable – connects the autosampler to the CPVU
- 1 – Valve Cable – connects the vaporizer to the DAS
- 2 – A/C power cables (North America only)
- 1 - Software CD
- 1 – Certificate of compliance
- 1 – User Manual

- 3 – Fuses, 10A(2ea) 2A(1ea), 250V, time delay, 5x20mm

If any of these items is missing, contact Picarro for a replacement. Inspect each item to assure it is not damaged.

It is recommended that you keep the shipping packages, at least until the analyzer has been installed and verified as being fully operational.

For analysis of liquid samples, it is necessary for the user to provide a dry gas supply (ideally nitrogen with a water content <50-100ppmv) and pressure regulator capable of supplying gas at 2.5psi.

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INSTALLATION

*This section describes the setup and installation of the Picarro Analyzer for use in **liquid mode**. The steps for switching between **liquid mode** and **vapor mode** are listed at the end of this section. Please read and understand this section thoroughly before proceeding with the installation.*

The Picarro Analyzer consists of five modules, the DAS, PVU, Vaporizer, Vacuum pump and Autosampler. The a power connection cable provides electrical connection between the DAS and CPVU modules, with the flexible tubing providing the gas flow. A USB cable provides the communication interface between the DAS and the computer. A Digital I/O cable and a RS-232 cable provide the communication interface between the CPVU and Autosampler. A cable connects the vaporizer to the DAS for controlling the valves in the vaporizer.

The analyzer is controlled and monitored via the interactive graphical user interface (GUI). A computer monitor, keyboard and mouse are required to use the interactive GUI interface.

Thermal Considerations

CAUTION: It is imperative that the analyzer have adequate ventilation and/or cooling to maintain the ambient temperature below 35˚C when operating. Failure to provide adequate airflow and/or cooling to the analyzer will result in overheating of the analyzer causing a shutdown and possibly causing damage to the analyzer.

Thermal Specifications	Min	Max	Description
Ambient Operating Temperature	10°C	35°C	Worst-case environmental limits (unless otherwise specified)

NOTE: A fan on the front face of the analyzer draws air through the analyzer where it then exits from the rear panel. Adequate clearance must be provided at the front and rear panels of the analyzer to ensure proper airflow. Take care to ensure that this warm air is exhausted from any enclosure in which the analyzer is mounted.

CAUTION: Allow analyzer to equalize to room temperature before starting the installation process.

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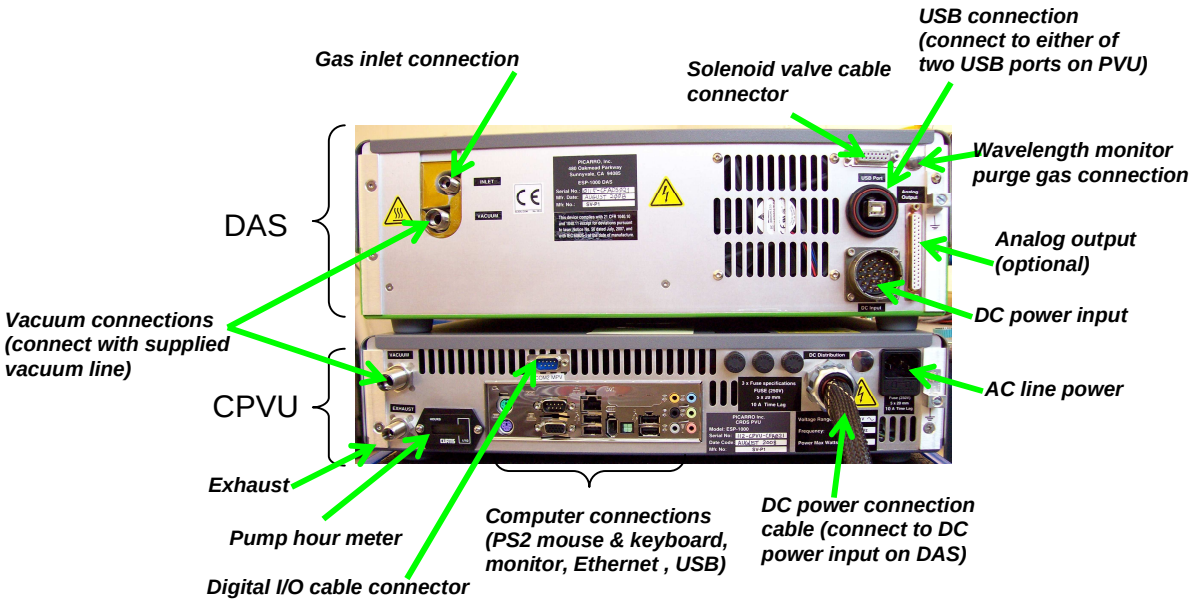
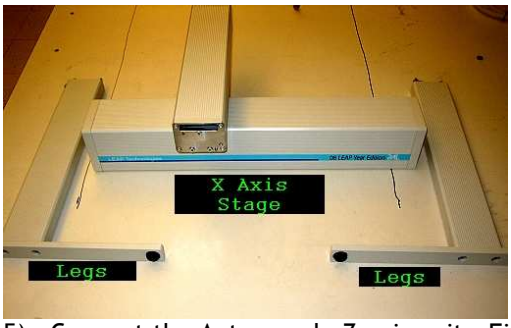


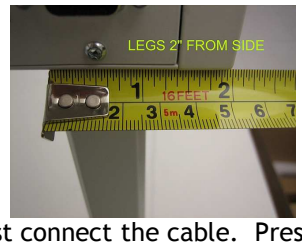
Installation and Start-up Procedure

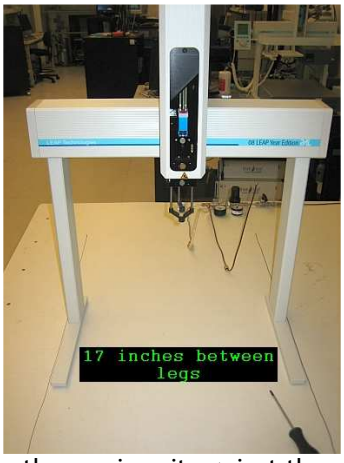
1) Remove the DAS and CPVU from bags.
2) Place the CPVU in a 19" rack or on a bench top.

Warning: The Analyzer cannot support itself using the front panel alone. The instrument *must* be supported by a shelf or rails in the rack.

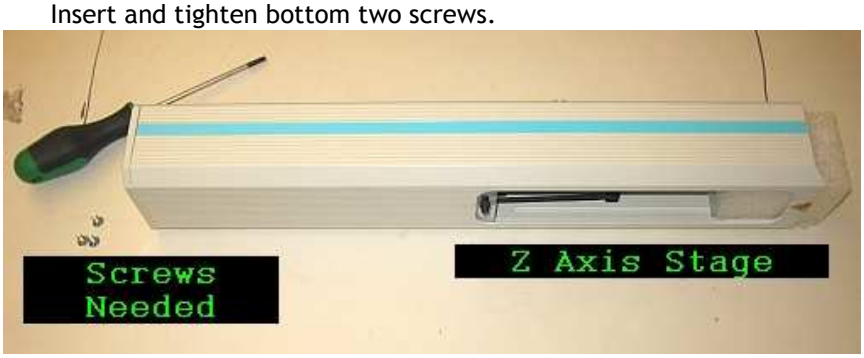
3) Place the DAS on top of the CPVU.
4) Connect the Autosampler vertical legs to the X axis unit. Use a T20 Torx driver to tighten the screws. The distance between the legs must be 17 inches to accommodate the Picarro analyzer.



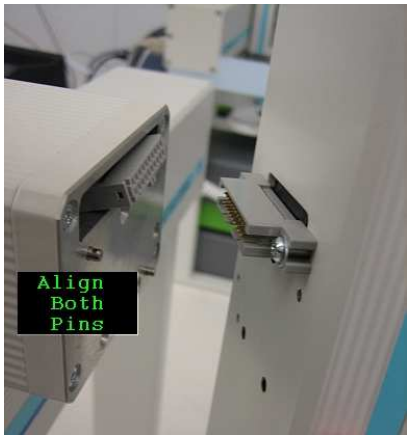




5) Connect the Autosample Z axis unit. First connect the cable. Press the z axis unit against the X axis by aligning the 2 pins. Push up the black plate, align top center opening with the threaded hole, insert and tighten screw. The black plate has magnets which usually pull away the screw, either insert quickly or put some paper on the torx tip which helps hold the screw. Insert and tighten bottom two screws.

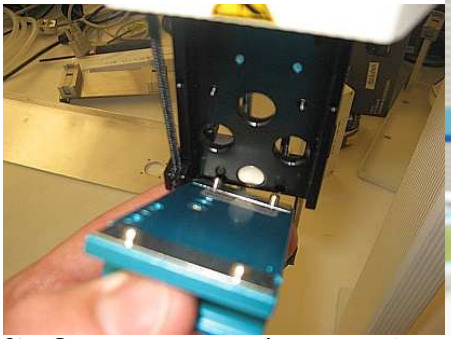


6)

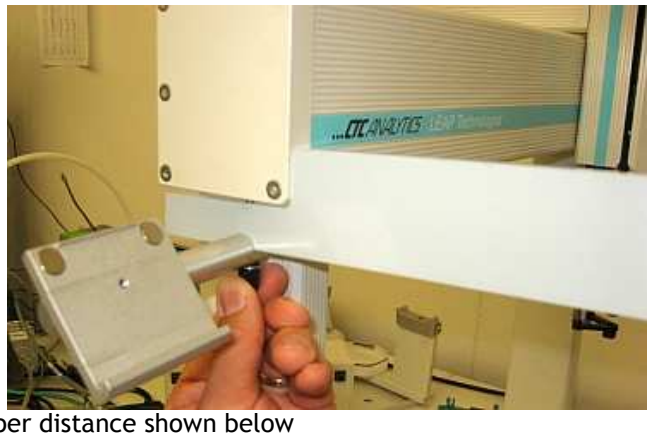


7) 

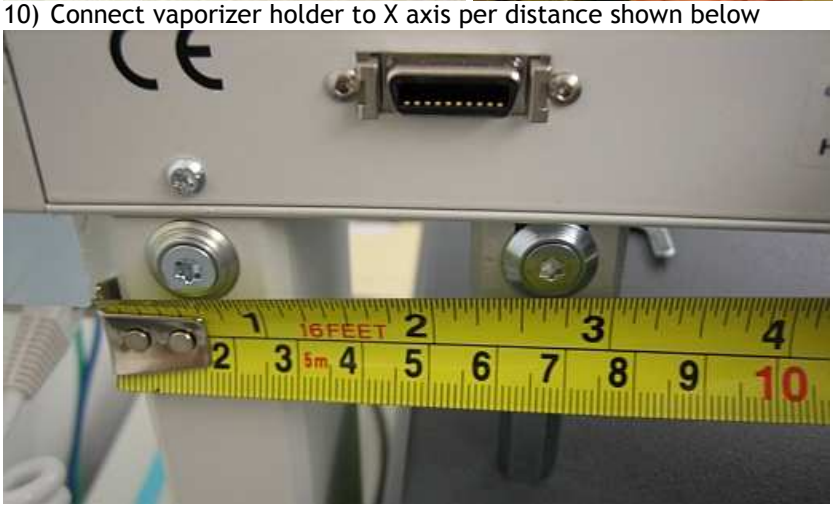

8) Attach blue syringe plate to black back plate. It attaches magnetically and is aligned by 4 pins




9) Connect autosampler protective guard (plexiglass C shaped item) to both ends of x axis, tighten by hand. Keypad stand should be connected on left side with longer screw.



10) Connect vaporizer holder to X axis per distance shown below



11) Connect wash station and tray holder to X axis per distance shown in photographs. The wash station is on the outside edge, the tray holder is towards the middle.

12) Place the autosampler around the DAS and PVU such that the autosampler legs hug the sides of the DAS.
13) Make the electrical connections at the back of the autosampler. 'Serial 1' on the autosampler connects to female DB-9 on the CPVU. 'Interface' on the autosampler connects to 'DIO' on the CPVU. 'Serial 3' connects to the keypad. Power cable attaches flat side up.

14) Attach the vaporizer to the autosampler using the clamps on the vaporizer.
15) Autosampler assembly is now complete. You MUST complete the Autosampler training procedure (described in section 3 of this manual) before loading a syringe and operating the Autosampler.

16) Unpack the accessories. (Vacuum tube, AC power cable, locking USB cable, manual, certificate of compliance, and software CD).
17) Remove caps from DAS inlet and vacuum ports.
18) Remove caps from CPVU vacuum and exhaust port and from vaporizer vacuum and inlet ports.
19) Attach gas line between the DAS vacuum port and CPVU vacuum port. (Hand tighten the nut, then an additional 1/8th turn with a 11/16" wrench.)

CAUTION: The back panel of the DAS in the vicinity of the inlet port can be very hot.

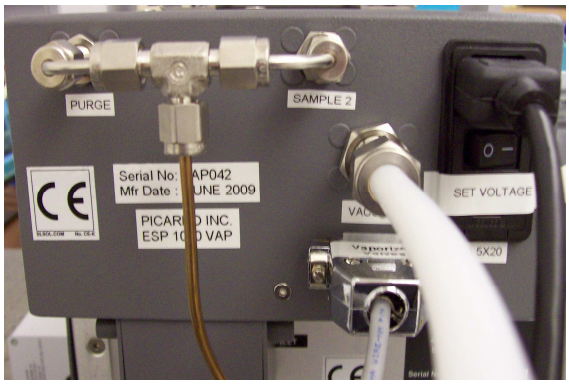
20) Attach the gas line to the vaporizer inlet ports.
21) Attach gas line to the wavelength monitor purge port.
22) **The gas supplied to the vaporizer inlet port and the wavelength monitor purge should be at a pressure of 2.5 ± 0.5 psig from a user-supplied gas supply and regulator.**
23) Attach the external vacuum pump to the vaporizer vacuum port.

24) Attach the DC Power Connection Cable to the DAS. Align keys and insert connector. It is keyed to only connect one way, with the largest key on the top. Turn collar clockwise while pushing in until fully latched (about ¼ turn).

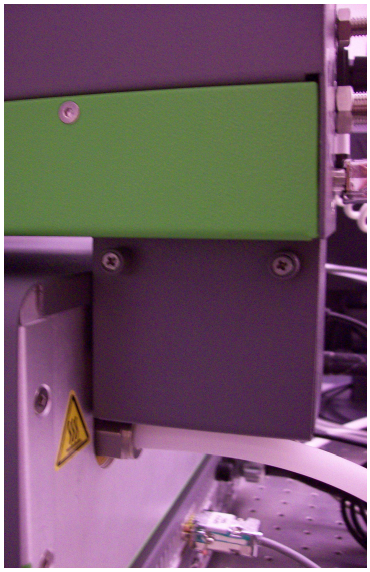
Note: The analyzer can be controlled and monitored via either the interactive graphical user interface (GUI) or the RS-232 command interface. A computer monitor, keyboard and mouse are required if the interactive GUI interface is desired. It is recommended that at least the initial installation be done using the GUI.

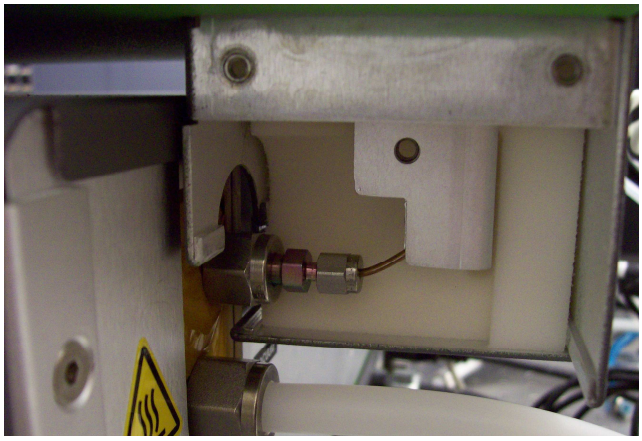
25) If desired, attach a tube to the CPVU port labeled "Exhaust" and the safe place to vent the mixture of sample and dilution gases (typically, this is not necessary).

Pictures showing the connections on the back of the vaporizer:



Pictures showing the connection between the DAS inlet port and the vaporizer:





26) Attach the valve cable between the vaporizer and DAS.
27) Set the red switch on the vaporizer to 115V or 220V based on the A/C power supply specifications and plug the vaporizer into line power. There is no on/off switch on the vaporizer, so it will heat any time it is supplied AC power. If the analyzer is not being used to measure liquid samples, it is reasonable to unplug the vaporizer AC power even if the analyzer is running to conserve heater lifetime and electrical power.
28) Align the DAS+CPVU and the autosampler relative to each other such that the 1/16th inch tube hanging from the vaporizer can be connected to the inlet port on the DAS. Do not bend the tube to achieve this. If the tube is not horizontally aligned with the DAS inlet port, then move the position of the vaporizer on the autosampler by loosening the clamps and retightening them after alignment.
29) If the vaporizer temperature setpoint is not already indicated at 140°C, turn up the temperature of the vaporizer to 140°C using the up arrow key on the temperature controller interface on the front of the vaporizer.
30) Set the position of various 'objects' (vaporizer injection port, waste port and tray holder) for the autosampler using instructions given in section 3 of this manual.
31) Install a 5 uL syringe onto the autosampler syringe guide using instructions given in section 3 of this manual.
32) Install the trays in the tray holder of the autosampler with vials containing samples.
33) Start up the instrument by pressing the circular button on the PVU and turn the autosampler ON. Turn on the external vacuum pump. Power up the vaporizer by connecting it to an A/C power supply.

Warning: Do not connect a USB hub or other USB devices to the computer because it can interfere with the operation of the analyzer. Copying data to a USB flash drive is acceptable, however.

Warning: WHEN CONNECTING THE USB CABLE TO THE DAS, MAKE SURE THE WHITE ARROW ON THE CABLE IS ORIENTED CORRECTLY – THE ARROW SHOULD BE ON TOP, AS SHOWN IN THE PHOTOS BELOW:

Note: Do not supply power to the CPVU until all other system connections have been made.

34) Computer setup
    a. Attach a mouse, keyboard and a display to the computer connections on the back of the CPVU.
    b. Plug the USB cable into the DAS USB Port by aligning the white arrow on the cable connector with the matching arrow on the DAS connector. The cable should insert easily. Screw down the locking nut on the connector. Plug the other end into an open USB port on the computer.
    c. With some configurations, the analyzer will start a few seconds after AC power is supplied. The analyzer will start automatically if all connections in previous sections were made correctly.

35) The software to operate the instrument will automatically start after the operating system has loaded.
36) The user interface will appear a few seconds after the instrument software starts (see the following figure on the following page).

Picture showing analyzer fully set up and connected to dry gas supply:

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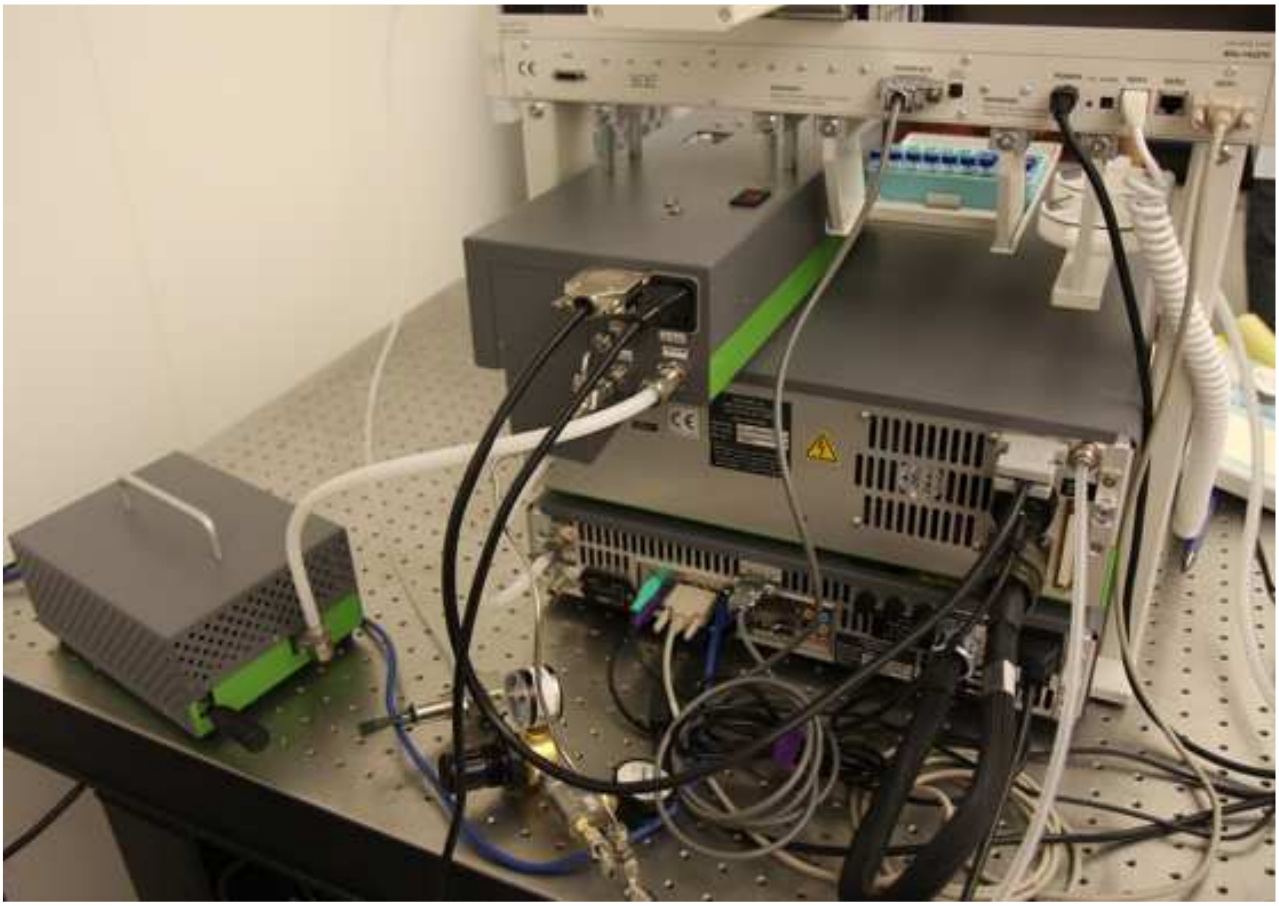

Picture showing mechanical connections between autosampler and vaporizer:

*Note: **As the instrument is starting up, it is normal for there to be a delay in reporting data**. This can take several minutes depending on how long it takes for the internal temperature to reach its operating point, and it is normal during this time for some concentration readings to be negative or constant. Additionally, the data selection pulldown menu will not be populated with the appropriate items until data is actually being reported in the graph. This typically lasts less than 30 minutes, but depending on ambient temperature, the analyzer can take up to 1 hour to warm up and stabilize.*

Note: The indicated concentration values on the LCD of the DAS may not exactly match those on the GUI since they may not be calculated with the same time averaging applied.

37) The status log section of the user interface describes the state of the instrument as it becomes ready to make measurements. The instrument status is also displayed on the DAS front panel. The sequence of steps the instrument goes through are:
    a. **Starting up**: The computer has started communication with the instrument.
    b. **Loading calibration:** The instrument is loading the calibration data needed to operate.
    c. **Waiting: Temperature WB:** The system is waiting for the warm box to reach operating temperature. 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.
    d. **Starting gas flow:** The pump has been started, and the gas flow is being started.
    e. **Pressure Locked:** The cavity pressure has successfully locked to the operating pressure.
    f. **WLM Calibration:** A calibration of the wavelength monitor is in progress.
    g. **Waiting: Temperature HB:** The system is waiting for the cavity temperature to reach its operating temperature.
    h. **Loading: scan config:** The system is loading the spectral scanning profiles.
    i. **Starting fitter:** The spectral analysis program has started.
    j. **Starting scanning:** 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.

CAUTION: The inlet bulkhead connector can be extremely hot when the instrument is operating, or after it has been shut down. Take care when connecting gas lines or working at the rear of the instrument to wear protective gloves or avoid contact with these surfaces. FAILURE TO FOLLOW THIS INSTRUCTION COULD RESULT IN BURNS.

38) Note: this step applies to ambient air measurements only: A sample gas line can now be attached to the "Sample 2" gas inlet on the vaporizer. **The sample gas supplied to the instrument should be near atmospheric pressure and should not exceed 2.5psi (~17KPa) relative to atmosphere.** Typically, the sample gas is delivered to the instrument via a short segment of tubing attached to a tee in a higher flow gas stream. In this manner, the instrument draws the amount of flow it requires, and the delivery plumbing can be flushed at a much faster rate of flow. The instrument is designed for atmospheric input pressure; if the delivered sample gas pressure is too high then the instrument may not be able to maintain the

gas at the measurement pressure. If the sample gas pressure is too low then the flow rate though the instrument will be lower then needed to achieve the instrument response.

Note: The instrument measures the sample that is delivered through the vaporizer to the gas inlet on the DAS. For example, if the flow rate of gas at the input port is slow, then the measurement response will also be slow. The measurement is only as good as the sample you give it!

CAUTION: EXCEEDING INLET GAS PRESSURE OR TEMPERATURE SPECIFICATIONS COULD RESULT IN DAMAGE TO THE INSTRUMENT. In the case of higher input pressure or flow, configuring a sampling flow by system is recommended. Use a 'tee' at the gas inlet and either return the remainder to the main gas stream or exhaust appropriately.

CAUTION: **Do not disconnect** the DC Power Connection Cable, USB cable, vacuum line between the DAS and CPVU modules, or the AC power to the CPVU while the analyzer is operating. Damage may be caused by current surges if power is applied while attaching or removing cables.

CAUTION: The **voltage switch** on the **vaporizer** must be set to the appropriate mains voltage. If it is set incorrectly, the symptoms will be as follows: On 220V mains, a switch setting of 110V will blow the vaporizer fuse. On 110V mains, a switch setting of 220V will result in the vaporizer heating up much more slowly than normal.

CAUTION: It is recommended that all AC electrical connections be made to a common power strip so as to avoid potential ground loops which could interfere with proper operation or potentially cause measurement noise.

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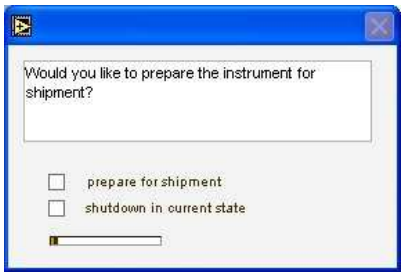
Shutdown Procedure

CAUTION: A flow of clean, dry gas should always be directed through the instrument for several minutes prior to shutdown. 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



Note: There are two different shutdown states for the Analyzer. The most commonly-used mode is a quick shutdown procedure ("shutdown in current state") to be used when the instrument will be off overnight or for a few days. If the instrument will be unused for a longer period of time, or requires transport, a different procedure ("prepare for shipment") is used. The main difference between the two shutdown states is that in the first case, the analyzer gas cell is stored at sub-atmospheric pressure, whereas the second mode prefills the cavity with a clean dry gas prior to shutdown. The instrument should always be supplied dry gas before shutting down in either mode.

1) Prior to shutting down the instrument, dry gas should be attached to the gas inlet port while the instrument is operating. This prevents condensation inside the system as it cools down to ambient. The water level in the gas sample can be checked during normal operation by selecting "H2O_CONC_(%v)" from the plot selection pull down menu. A minute or two of flow should be sufficient. If the instrument is likely to experience low storage temperatures, the gas should be dry enough so as not to cause condensation (<100ppmv 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.
2) Press the "Shutdown" button
    a. Choose from "prepare for shipment" and "shutdown in current state"
        i. "prepare for shipment" will flow gas into the cavity until it reaches a pressure near atmospheric. It will then close the valves and shutdown the software.
        ii. "shutdown in current state" will stop the gas flow and shutdown the software.
    b. You are prompted to confirm the shutdown. Selecting the ok check box will initiate the shutdown procedure. Selecting cancel will abort the shutdown.
3) If "prepare for shipment" is chosen then the cavity pressure will increase until it reaches near atmospheric pressure. The status log, and the front panel display, will indicate the cavity pressure as it is filled.

4) The instrument software will then close. The instrument front panel display will say "Shutdown: turn power off".
5) From the start menu choose "Turn off computer" and select "Turn Off". When the computer is shutdown the instrument automatically powers off.
6) Unplug the vaporizer – the vaporizer is on any time it is supplied power.

Note: It is recommended that the vaporizer be unplugged if the instrument is not being used for longer than a day. The analyzer can, however, remain running, with the only drawback being that running hours will accumulate on the vacuum pumps.

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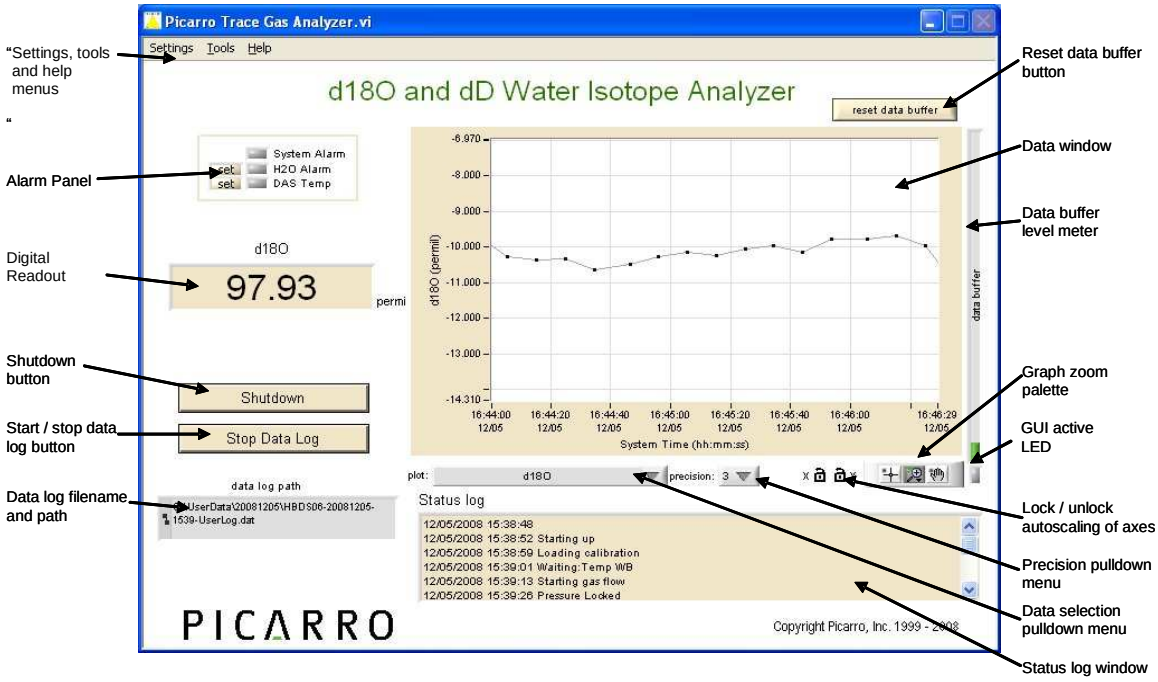
OPERATING INSTRUCTIONS

Graphical User Interface (GUI)



The Analyzer Graphical User Interface (GUI) is the primary means by which the user interacts with the Analyzer. With the GUI, the user can monitor the concentration data, start and stop log files, set and monitor alarm levels, and shutdown the instrument. The different features of this GUI are described in the sections below.

"Settings" Menu

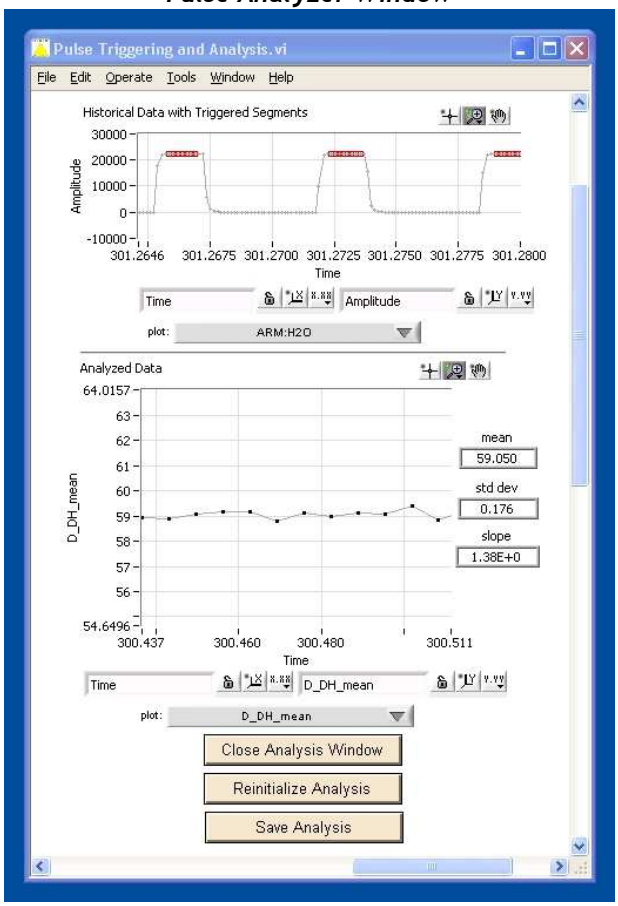
"Set Data Log interval": allows for changes to the logging interval (i.e. how often data is saved to the output files: 1, 2, 5, 10 which corresponds to 1 of 1 lines (all lines), 1 of 2 lines (ever other), 1 of 5 lines, etc.). This is useful to reduce the amount of data that is saved to the log files.
"Set Data Log Columns": allow for the selection of the data that is to be saved to the -userlog.dat file.
"Change GUI mode": Used to enter a service mode where more operational and measurement parameters are available to be displayed. This list will typically include instrument temperature, gas concentrations and valve settings.

"Tools" Menu

"Show/Hide Statistics": allows users to see mathematical statistics in the digital display which are calculated from the data in the window. By scrolling or zooming into certain parts of the data, the statistics will be automatically recalculated for only that data that appears in the graph window.

"Pulse Analyzer Window": allow users to see the analysis of the samples injected into the system. Each injection of the sample is seen as a square pulse of H2O concentration and the pulse analyzer window shows the mathematical statistics of this pulse. By scrolling or zooming into certain parts of the data, the statistics will be automatically recalculated for only that data that appears in the graph window.

Pulse Analyzer Window



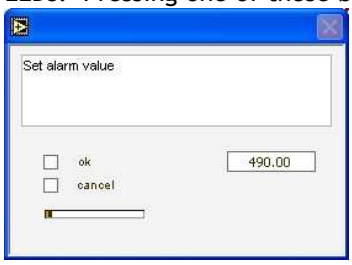
"Help" Menu

Selecting the "About GUI…" menu item brings up a timed dialog screen displaying the version numbers 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 "system alarm," and other gas concentration alarms, such as "H_2O Alarm" depending on instrument configuration. The "system alarm" LED is off (gray) during normal operation, and on (red) when there is an internal system error. For a description of what problems can trigger this system alarm, please contact Picarro. The other gas concentration alarm LEDs are off (gray) when the respective concentrations are below a certain value, and they are on (high) when the respective concentrations are above a certain value. To view the alarm set point, move the mouse pointer above the LED and a pop-up will appear indicating the alarm setting:

To change the alarm set point from the GUI, press the "set" buttons immediately to the left of the LEDs. Pressing one of these buttons will bring up the following timed dialog box:



Type the value you wish to set the alarm to and press the "ok" button, or press "cancel" if you do not wish to change the alarm value. If you do nothing, the dialog box will disappear and the alarm value will remain unchanged.

Shutdown Button

Use this button to shutdown the instrument. For a complete description of this procedure, see Chapter 6, Getting Started.

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 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 indicator. 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.

Results Filename and Path

The filename and path of the latest results file is displayed in this indicator. A new file and filename is generated after each startup and every midnight if the instrument is running.

Reset Data Buffer Button

Press this button to clear the internal data buffer of the GUI. 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 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 is displayed using the *Data selection pulldown menu*.

Concentration Reading

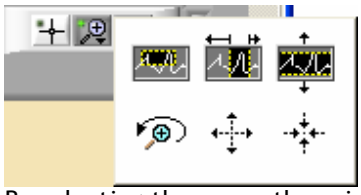
Depending on which data stream is selected using the *Data selection pulldown* menu, the latest value for the various gas concentrations can be found in the yellow-tinted indicator just below the *Alarm Panel*.

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 8,000 points, or ~11 hours worth of data. Once 8,000 data points are 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 data collected in the *data -UserLlog.dat* and *-Data.dat* files. This buffer is empty upon instrument startup, and can also be emptied by pressing the *reset data buffer button* in the upper-right-hand corner of the GUI.

Graph Zoom Palette

The Graph Zoom Palette is made up of three icons. The left-most icon,  , has no effect on the operation of the GUI other than to change the shape of the cursor on the data window to a plus sign. The middle icon,  , brings up a dialog box allowing the user to zoom in or out on the data window:



By selecting the upper three icons, and then clicking and dragging on the *data window,* the user can zoom in on a portion of the graph. By selecting the two icons in the lower right and lower middle, the user can zoom out or zoom in on the data by left-clicking and holding on the *data window*. The icon in the lower left allows the user to undo the last zoom action.

Note: The zooming functions on the *Graph Zoom Palette* require one or both of the axes on the l*ock or unlock autoscaling of axes* to be in the unlocked position.

GUI active LED

This small LED blinks when the GUI is active.

Lock / Unlock Autoscaling of Axes

These two icons just to the left of the graph Palette,  , are used to control whether the data in the *data window* is autoscaled. If a lock icon is displayed, then the graph axes are continually adjusted to include all data in the data buffer. Conversely, if the icon is unlocked, the graph axis is fixed and will not change regardless of data in the buffer. The zooming functions on the *Graph Zoom Palette* require one or both of the axes to be in the unlocked position.

Precision Pulldown menu

Click on this icon to select the precision displayed on the y-axis, between 0 and 4 digits of precision. 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.

Data Selection Pulldown menu

Click on this icon to select the data stream that is viewed in the *data window*. Data streams available on the GUI are listed in the following section describing data 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 DAS front panel display.

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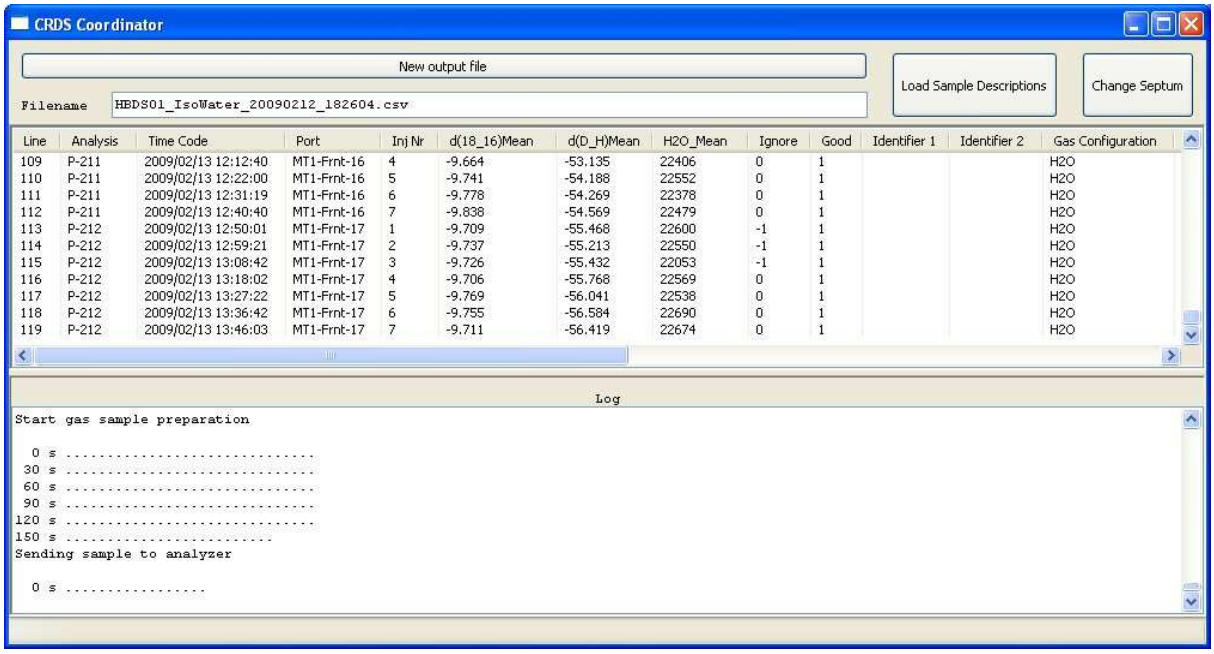
Coordinator

Making measurements from liquid water samples involves the control and sequencing of several components that comprise the instrument. These components are the autosampler, which handles the liquid samples; the vaporizer, which converts these samples into vapor, and the cavity ring down analyzer, which determines the composition of the vapor sample. The coordinator is a program that allows these components to work together, and that assembles the data into an output file that can be imported into a spreadsheet or other analysis program.



Double-clicking the coordinator icon on the desktop starts the program. This should be done after the instrument has warmed up and started to display data on the graphical user interface. The actions of the coordinator are determined by the contents of a configuration file, usually named `coordinator.ini`, which is specified in the shortcut that starts the program. The user should not alter the configuration file without consulting Picarro.

Once the coordinator starts, it opens an output file, whose name is displayed in the text box labeled `Filename`. This is a comma-separated value (.csv) file, whose name is generated from the date and time at which the file was first opened. As data are collected, they are appended to that file. By default, the file is placed in the directory `c:\IsotopeData`. A new output file may be specified by clicking on the `New output file` button. A dialog will appear with a suggested directory and file name, but these may be overridden as desired.

After the coordinator has started, the autosampler keypad is used to initiate a job or queue of jobs. This is done by selecting the job(s) in question and pressing the Start button. The autosampler runs through its pre-programmed sequence of steps, pausing as necessary before processing a new sample, or injecting a sample into the vaporizer in response to signals from the coordinator.

The user interface of the coordinator is divided into two main sub-windows. In the lower sub-window labeled Log, the action that is currently taking place is displayed. 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. In the upper sub-window, the data that are written to the output file are displayed, as they are collected. As may be seen from the figure, these consist of the date and time, the tray name, sample (vial) and job number of each injection together with the results of the spectroscopic analysis of that sample. The format of the output file will be described in more detail in a later section.

It is often useful to provide a textual description of the contents of each vial loaded into the autosampler, so that these descriptions may be included together with the other results in the output file. If this feature is required, it is necessary to produce sample description files, one for each tray. Such files are simple comma-separated text files as shown in the example. Each line consists of a vial number, separated by a comma from its description. The lines in the file may be arranged in any order.

Example of a sample description file:

Tray	Vial	Identifier 1	Identifier 2
1	1	V-SMOW	std
1	2	GISP	std
1	3	SLAP	std

In order to load the sample description files, press the button labeled “Load Sample Descriptions”. Two file dialog boxes will appear in sequence, the first for the front tray and the second for the rear tray. Select the name of the sample description file, and press “Open”, if a tray is not used, use the “Cancel” button to dismiss the dialog.

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.

The injection port septum may be changed before or after running a job. Should it be necessary to change the septum during a job, it is desirable to ensure that this is done at an appropriate point within the cycle, so that no data are lost, and so that the vaporizer valves can be placed in the appropriate states. Press the "Change Septum" button during operation. The button will be disabled, and the label will change to "Please wait…". At the appropriate point in the cycle, the status bar will flash "CHANGE SEPTUM: Press 'Septum Changed' when complete", and the button caption will change to "Septum Changed". At this time, the septum may be changed. After this has been done, pressing the "Septum Changed" button will stop the flashing message and resume the job. If the Coordinator is not running a job, then pressing the CHANGE SEPTUM will have no effect. **Depending on when during a sequence the CHANGE SEPTUM button is pressed, it can take up to 10 minutes for the analyzer to finish one injection cycle and allow the septum to be changed.**

Valve Display

A set of solenoid valves within the vaporizer housing are used to direct dry carrier gas into and out of the vaporizer, and to connect the analyzer either to the vaporizer, or to the dry gas source. These valves are sequenced automatically under the control of the instrument software. If the user wishes to monitor the operation of these valves during the measurement, a valve display utility is available. Double-click on the icon in order to start the utility. A simple GUI appears, showing the current states of the valves in check-boxes.

File Management

Note: The Analyzer processes concentration measurements in batches. Each batch, consisting of multiple individual concentration measurements, is processed in approximately ten seconds. These results then appear as a group on the GUI.

During operation, the Analyzer generates two output files that are updated after each batch of concentration measurements is complete. The user output file is named CFADS##-yyyymmdd-hhmm-UserLog.dat where "CFADS##" or similar is the instrument serial number.

The file name is generated from the instrument serial number, the date, and the time when the instrument was started. For example:

CFADS01-20070127-1029-UserLog.dat

CFADS01 is the instrument serial number

20070127 is the date, 1/27/2007, in format yyyymmdd (to allow easy chronological sorting of data files).

1029 is the time the file was started, 10:29 am, formatted as hhmm using a 24 hour clock.

During data acquisition, the analyzer creates directories in which to store the data, based on the date the data were acquired. The default location for these files is C:\UserData\ *The date of acquisition*, for example, the *20070205* data are stored in the subdirectory "C:\UserData\20070205\ ".

To keep the data files easy to manage and to limit the size of individual files and directories, the software automatically generates new files each time the instrument is powered up and also at midnight each night. When new files are created at midnight, their file name will contain the new date and a time of 00:00. For example if the system was started at 10:29 am on 2/5/2007 it would create a file named C:\UserData\20070205\CFADS01-20070205-1029-UserLog.dat. Then at midnight a new file will be created C:\UserData\20070206\CFADS01-20070206-0000-UserLog.dat.

File Archiver

The analyzer automatically zips and archives old files. The file archival is for the individual spectra files and the files placed in c:\Picarro\Results. The files in C:\UserData are not archived or deleted by the system, and so it is up to the user to manage them. The -Scan.dat, -Results.dat, -Logs.dat and –Mailbox.dat are archived once a day just after midnight to C:\Picarro\Archive. The first three are deleted after they are copied to the archive directory. The mailbox file is copied to the directory C:\Mailbox, where it is deleted after it is sent (if it is sent). The Archiver manages the Archive directory according to the configuration file C:\picarro\host\archiver.ini. Each file type is set up, in general, to zip and archive 1GB of that file type using a FIFO (first-in-first-out) protocol.

File Eraser

The analyzer is setup by default to remove very old and temporary files as described in the FileEraser.ini file in the C:\Picarro\Host directory. This describes the various paths and file extensions subject to routine deletion after the number of elapsed hours specified by each entry's "delete_time_hrs." The "runtime_interval_hrs" specifies how often this program is automatically run. Additional directories can be added to this ini file by following the existing format.

Coordinator Application output file details

The comma separated value output files from the coordinator are organized as columns, with the column heading appearing as the first row. The columns and their descriptions follow:

Line: line number

Analysis: unique identifier

Time Code: the date and time of the injection expressed as a string of the form YYYY/MM/DD HH:MM:SS

Port: code indicating tray and vial numbers in the form: tray# - vial #

Inj Nr: injection number

d(18_16)Mean: Mean O18 to O16 isotopic ratio over the pulse, expressed in delta.

d(D_H)Mean: Mean Deuterium to hydrogen isotopic ratio over the pulse, expressed in delta.

H2O_Mean: Mean water concentration over the pulse, expressed in ppmv.

Ignore: set to ignore first 3 injections of a sample (-1 = ignore, 0 = use)

Good: Flag that is 1 for good data, and 0 for bad data (bad is triggered by too much or too little water in an injection, yielding a concentration outside the range of 17,000-23,000ppmv)

Identifier 1, Identifier 2: unique identifiers for each sample

days_Mean: Time of injection, expressed as days since 01-Jan of the current year.

d(18_16)_SD: Standard deviation of O18 to O16 isotopic ratio over the pulse, expressed in delta.

d(D_H)_SD: Standard deviation of deuterium to hydrogen isotopic ratio over the pulse, expressed in delta.

H2O_SD: Standard deviation of water concentration over the pulse, expressed in ppmv.

d(18_16)_Sl: Slope of O18 to O16 isotopic ratio over the pulse.

d(D_H)_Sl: Slope of deuterium to hydrogen isotopic ratio over the pulse.

H2O_Sl: Slope of water concentration over the pulse.

Tray: The tray name, which is either MT1-Rear or MT1-Front.

Sample: The vial number from which the sample was taken.

Job: The autosampler job number associated with this injection.

Method: The autosampler method name associated with this injection.

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Data Handling

Warning: Opening Results files or other instrument configuration or data files during operation of the instrument may result in a software conflict. To avoid conflicts it is best to copy the –UserLog file to a USB flash drive so that it can be imported and analyzed on another computer. Do not use a USB hub, only a flash drive. Data can be copied from the host computer by attaching a USB flash drive to an available USB port. After the host computer identifies the USB drive, Windows Explorer can be used to copy files to the flash drive. The data can then be processed by importing the file into a program suitable for data manipulation. The –UserLog file has contains all of the output parameters that the user needs to analyze the measurement results of the instrument. The table below shows a few lines of a typical –UserLog file imported into Excel. The number of columns in the table is larger than shown below.

DATE	TIME	DAYS_SINCE_JAN	DAS_TEMP_(C)	H2O	DELTA_1816	DELTA_DH
6/26/2009	11:41:26	176.4455	29.3438	8.1	41.110	379.1343
6/26/2009	11:41:27	176.4455	29.3203	8.1	41.103	379.1433

Data columns descriptions:

DATE & TIME: The date and time the sample was reported
DAYS_SINCE_JAN: The fractional day since January 1 of the current year
DAS_TEMP_(C): The DAS temperature in Celsius.
H2O: The measured concentration of H_2O in the sample in percent volume
DELTA_1816 & DELTA_DH: the measured isotope ratios in permil (also reported with 30-second averages as noted)
H2O_N2: the water concentration value in %v with fit parameters corresponding to nitrogen background (all other data assume an air background)
BASELINE: in arbitrary units, this is a measure of the spectroscopic measurement's baseline value and is generally not useful other than for diagnostic purposes

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Remote Data Access

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

1) Send data from the instrument to a list of e-mail accounts.
2) 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, and may be a dial-up connection accessible via a user-supplied USB modem. The task of sending data and/or synchronizing the clock on the analyzer is performed using the RemoteAccess.exe program. This program is run periodically using the Windows task scheduler at a user-configurable frequency. If a dial-up connection to the Internet is employed, it is used only on demand in order to minimize the connection time.

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 called RemoteAccess.ini and it should be placed in the same directory as the executable RemoteAccess.exe (typically in C:/Picarro/Host). The file has one required section named LOGGING and three optional sections named NTP, DIALUP and EMAIL. The logging section has a single key Logfile whose value is the path to the log file. Once this log file exceeds 64 kbytes 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, 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 e-mail attachments. If the section is not present, e-mail 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 e-mail messages.

The From key is the e-mail 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 e-mail addresses to which copies of the e-mail is sent is specified by the keys To1, To2, etc. The Subject key is used to fill the subject field in the e-mail header, and may be set to any string. Depending on the SMTP server, it may be necessary to use authentication before e-mails can be sent, as described in RFC2554. If such authentication is not needed, the key UseAuthentication is set to false. If this key is set to true, two additional keys Username and Password must also be specified for the e-mail 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
```

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Autosampler Overview

Introduction

During normal operation of the analyzer the Autosampler is controlled by the coordinator software running on the embedded computer. The scheduler software coordinates sample injections with the Picarro instrument and eliminates the need for user intervention during sample analysis. However there are some one time set up and once per run operations which will need to be performed directly with the Autosampler keypad, these are described in this section of the documentation.

 When the Autosampler is running, either during manual set up or under the control of the scheduler software, the Autosampler robot will move rapidly and automatically as part of its normal operations. These movements all take place within the guard rail that encloses the washes, tray holder, and injector ports. Keep yourself and all non-sample related items outside of the guard rail at all times to prevent injury or damage to the equipment.

Factory Defaults

The Picarro analyzer is delivered with a single method and job. The factory default method (named 5µlRns- for 5 microliter syringe with rinse) was used to verify instrument performance specifications and is recommended for general use.
The factory default job delivers 6 injections from vial number 1 of the MT1-Rear tray provided with the instrument. The default job may be easily modified to deliver injections from all sample vials in the tray. Instructions can be found under 'Autosampler Jobs'.
Factory default values are listed under the appropriate parameter in various tables throughout the Autosampler documentation.

Autosampler Training

With each installation and at periodic time intervals the Autosampler will need to be recalibrated to ensure the needle goes to the correct positions. This is described in the 'Autosampler Training' section.

Overview

The Autosampler must be initially trained to the correct positions of the tray holder, washes and vaporizer port. Training is done using the keypad of the Autosampler; the Picarro analyzer does not need to be operational. This procedure will need to be performed again if the Autosampler starts to go out of alignment. The locations to which the Autosampler must be trained are shown in the diagram below:

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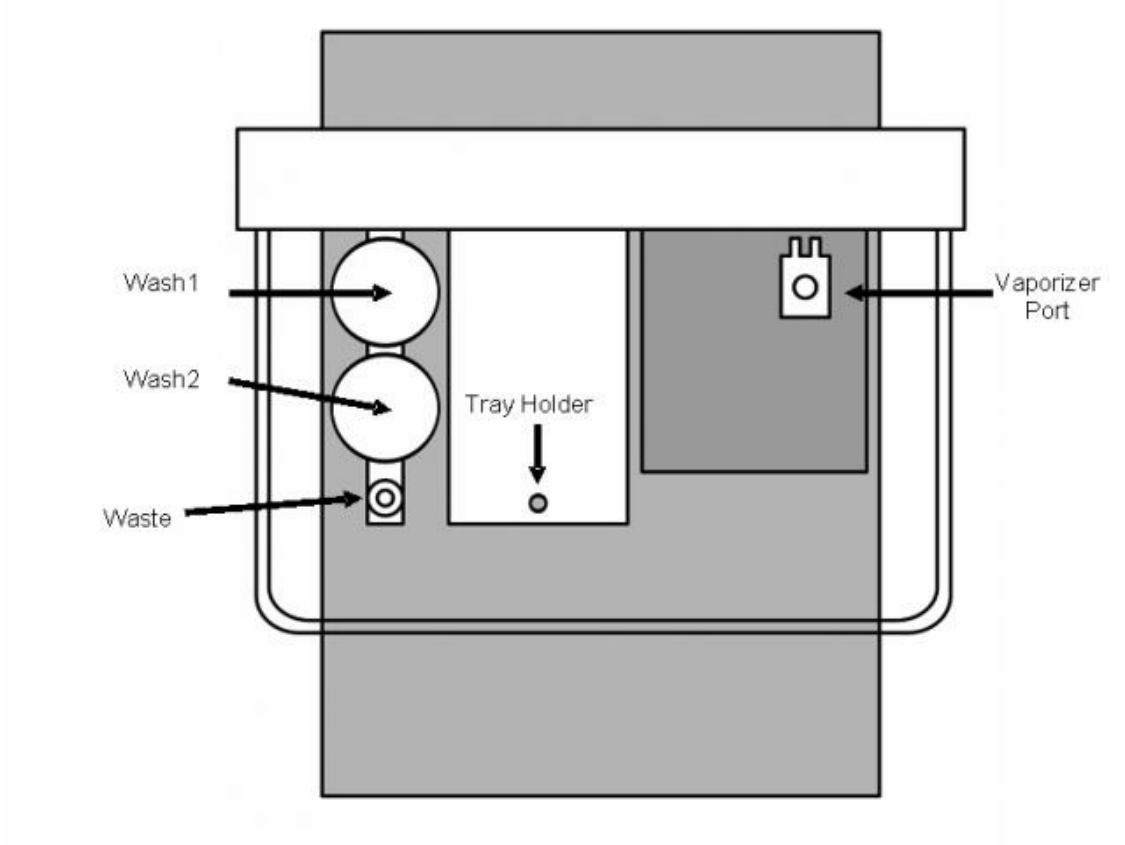
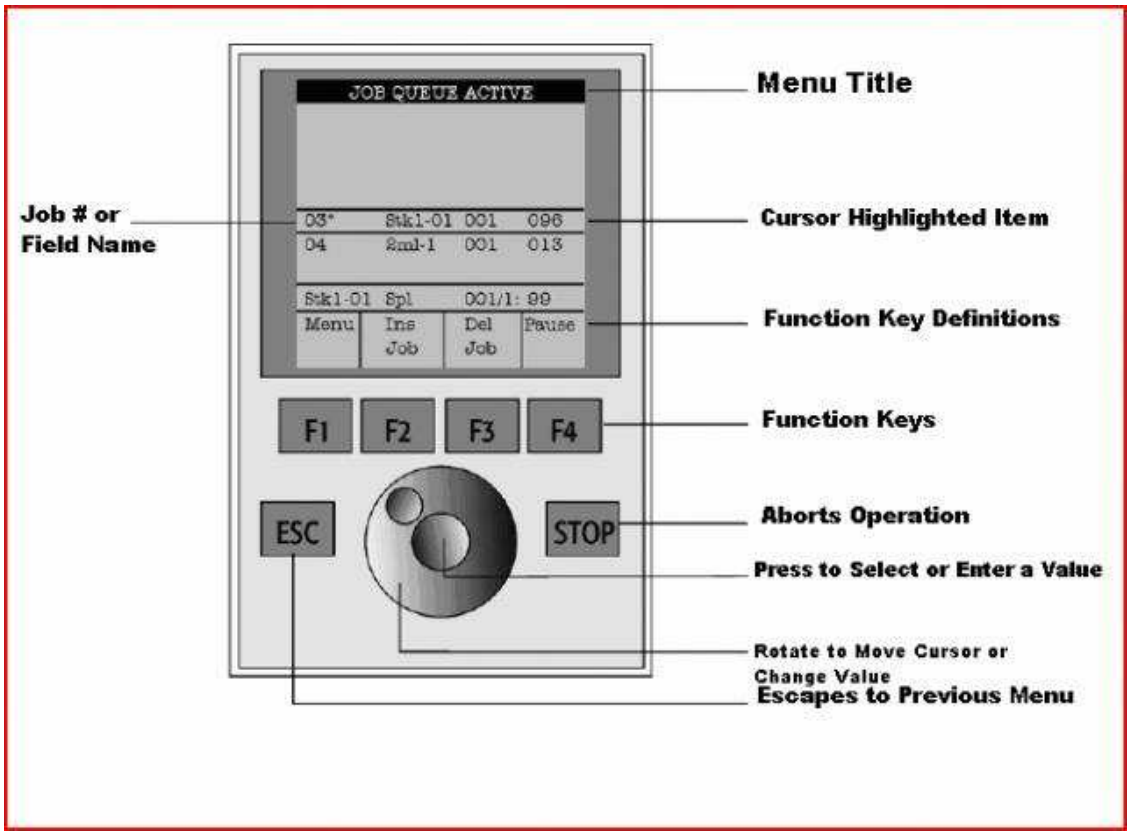


The keypad layout is as follows:



To perform the Autosampler training you will first need to:

1) turn on the Autosampler
2) install caps and septa on the washes, waste and injector

Note: sample trays and vials should not be placed in tray holder, syringe should be installed

Preventing Syringe Needle Damage

The autosampler is shipped with X and Y position values for all objects which are very close to correct. The Z position value is set to 0 to avoid any damage to the syringe needle. Whenever the autosampler configuration is changed (change in needle, tray holders, vials, disassembly/reassembly, etc) the Z value should be set to zero for each relevant object before starting the training.

1. Press F1 (Menu)
2. Rotate outer knob clockwise (scroll) until "Setup" is highlighted by the cursor bars (bottom of the list)
3. Press inner knob (enter)
4. Scroll to "Objects", enter

5. Scroll to relevant object, enter
6. Press F2 (clear position)
7. Scroll to “Z”, enter. This step ensures the syringe needle will not accidentally hit anything.

Tray Holder Training

1. Press F1 (Menu)
2. Rotate outer knob clockwise (scroll) until “Setup” is highlighted by the cursor bars (bottom of the list)
3. Press inner knob (enter)
4. Scroll to “Objects”, enter
5. Scroll to “Tray Holders”, enter
6. Scroll to “MTH1dr1”, enter
7. Scroll to “X position”, enter
8. Now rotate outer knob until lower assembly moves to align left-right with hole in tray holder, enter
9. Scroll to “Y position”, enter
10. Now rotate outer knob until lower assembly moves to align front-back with hole in tray holder, enter
11. Scroll to “Z position”, enter
12. Now rotate outer knob until lower assembly touches the edge of the hole in tray holder, enter
13. Press F1 (Check Pos)

Autosampler will first return to the home position (center, back, up) and then automatically move to insert lower assembly into the hole in the tray holder.

If the Autosampler is touches something before reaching the target position and error message will appear and it will ask to “retry”. You can rotate the outer knob until the “abort” option appears, then press enter. Correct the appropriate X,Y, or Z position and then check position again.

Press “ESC” button on keypad 2 times to return to main screen

Wash Station Training

1. Press F1 (Menu)
2. Rotate outer knob clockwise (scroll) until “Setup” is highlighted by the cursor bars (bottom of the list)
3. Press inner knob (enter)
4. Scroll to “Objects”, enter
5. Scroll to “Wash Stations”, enter
6. Scroll to “Wash1”, enter

Repeat steps 7-13 of previous section to train Autosampler to wash 1 (wash station in the back) Autosampler will first return to the home position (center, back, up) and then automatically move to Wash1.

If the Autosampler is touches something before reaching the target position and error message will appear and it will ask to "retry". You can rotate the outer knob until the "abort" option appears, then press enter. Correct the appropriate X,Y, or Z position and then check position again.

Press "ESC" button on keypad 2 times to return to main screen.

Repeat for Wash2.

Injector Port Training

1. Press F1 (Menu)
2. Rotate outer knob clockwise (scroll) until "Setup" is highlighted by the cursor bars (bottom of the list)
3. Press inner knob (enter)
4. Scroll to "Objects", enter
5. Scroll to "Injectors", enter
6. Scroll to "Evaportr", enter

Repeat steps 7-13 to train Autosampler to vaporizer (on top of the vaporizer unit)
For the Z position the lower assembly should slowly lowered into the vaporizer port until a click sound is heard and and then be lifted up two increments, enter that as the Z position.
Autosampler will first return to the home position (center, back, up) and then automatically move to the vaporizer port.

If the Autosampler is touches something before reaching the target position and error message will appear and it will ask to "retry". You can rotate the outer knob until the "abort" option appears, then press enter. Correct the appropriate X,Y, or Z position and then check position again.

Press "ESC" button on keypad 2 times to return to main screen

Waste Port Training

1. Press F1 (Menu)
2. Rotate outer knob clockwise (scroll) until "Setup" is highlighted by the cursor bars (bottom of the list)
3. Press inner knob (enter)
4. Scroll to "Objects", enter
5. Scroll to "Injectors", enter
6. Scroll to "Waste", enter

Repeat steps 7-13 to train Autosampler to waste
For the Z position the lower assembly should slowly lowered into the waste port, enter that as the Z position.
Autosampler will first return to the home position (center, back, up) and then automatically move to the vaporizer port.

If the Autosampler is touches something before reaching the target position and error message will appear and it will ask to "retry". You can rotate the outer knob until the "abort" option appears, then press enter. Correct the appropriate X,Y, or Z position and then check position again.

Press "ESC" button on keypad 2 times to return to main screen

Repeat for Waste2 using the Wash2 position (or same waste port as previously).

Syringe Setup

With each installation and with changes in the syringe type the syringe and needle parameters will need to be set or corrected using the Autosampler keypad. This is described in the 'Syringe Setup' section. Syringe positions associated with trays, injectors, washes, and vials are set in the station training procedures and should be verified if the syringe is reinstalled or replaced.

1. Press F1 (Menu)
2. Rotate outer knob clockwise (scroll) until "Utilities" is highlighted by the cursor bars (2nd on the list)
3. Press inner knob (enter)
4. Scroll to appropriate function (syringe, injector, wash station, and vial)

Verify the appropriate values are entered for each of the parameters.

The following values are the factory specified values for the syringe provided with the instrument and are used for product specification. These values may differ for user provided syringes.

Function	Parameter	Value	Comments
Syringe			
	Actual ID	13	Value specific to factory default syringe
	Fill Volume	0 nL	Pre-existing fill volume
	Fill Strokes	1	1 always
	Pullup Del	5.0 s	delay before Z motion
	Fill Speed	500 nL/s	Maximum fill rate

Function	Parameter	Value	Comments
	Eject Speed	1 µL/s	Maximum waste rate
	Inject Speed	1 µL/s	Maximum injection rate
	Plg Change Pos	10.0 mm	Plunger change position

Verify the appropriate values are entered for each of the parameters.

These values will differ slightly between instruments and are calibrated at the factory. The user should verify/adjust the needle penetration values visually at the given locations after installation or reinstalling/replacing syringes.

Function	Location	Parameter	Value	Comments
Tray				
	MT1-Frnt			
		Needle Penetr	32.0 mm	Unit specific
		Tray Type	VT54	Do not change
		Offset X	-64.5 mm	Unit specific
		Offset Y	-47.2 mm	Unit specific
		Offset Z	-2.0 mm	Unit specific
	MT1-Rear			
		Needle Penetr Tray Type	32.0 mm VT54	Unit specific Do not change
		Offset X	-64.5 mm	Unit specific
		Offset Y	-135.9 mm	Unit specific
		Offset Z	-2.0 mm	Unit specific
Injector Vaporizr				
		Needle Penetr	44.5 mm	Unit specific
	Waste			
		Needle Penetr	10.0 mm	Unit specific
	Waste2	-	-	Not applicable
Wash Station				
	Wash1			

Function	Location	Parameter	Value	Comments
		Needle Penetr	40.0 mm	Unit specific
	Wash2			
		Needle Penetr	45.0 mm	
Vial	Applies to all	Needle Penetr	34.0 mm	Unit specific
Dilutor	-	-	-	Not applicable

Autosampler Methods

Occasionally direct interaction with the Autosampler may be needed to create, edit or delete methods. This is described in the 'Autosampler Methods' section.

Overview

For this Autosampler methods are used to define the syringe used, how much/fast/where the injection is, syringe cleaning routine and related parameters. Only one cycle and syringe can be used per method and cannot be changed once the method is saved.
Jobs are based on a particular method and the job will include tray used, vial to be sampled, number of injections and choice of method. You cannot edit methods from the job—so be sure to set up the method first!

Factory Supplied Methods

The Picarro is supplied with 1 method which can be used with the system in its delivered configuration or modified to create a new method. The factory supplied method was used in the instrument performance testing and should be used to verify instrument performance.

Creating a New Method

1. Press F1 (Menu)
2. Rotate outer knob clockwise (scroll) until "Methods" is highlighted by the cursor bars (bottom of the list)
3. Press inner knob (enter)

4. Scroll to “Insert Method”, enter
5. Input a method name by scrolling to desired letter, enter, repeat until name is complete. Press F4 when complete.
6. “LC-Inj” will appear, enter
7. Scroll to desired syringe, enter
8. Under “Cycle” scroll to desired value (LC-Inj, only available choice by factory default), enter.
9. Under “Syringe” scroll to desired value (factory default=5µL), enter.
10. Under “Sample Volume” scroll to desired value (factory default=1.8µL), enter. Use of a lower volume will reduce the water vapor concentration and consistency thereby affecting accuracy and precision.
11. Under “Air Volume” scroll to desired value (factory default=0nL), enter.
12. Under “Pre Cln Slv1” scroll to desired value (factory default=0), enter. This is the number of syringe wash strokes with solvent from Wash 1.
13. Under “Pre Cln Slv2” scroll to desired value (factory default=0), enter. This is the number of syringe wash strokes with solvent from Wash 2.
14. Under “Pre Cln Sp1” scroll to desired value (factory default=2), enter. This is the number of times the syringe is filled with sample before the actual injection sample is pulled. These pre-cleaning samples are automatically injected into the waste port.
15. Under “Fill Speed” scroll to desired value (factory default=500nL/s), enter.
16. Under “Fill Strokes” scroll to desired value (factory default=1), enter.
17. Under “Pullup Del” scroll to desired value (factory default=1.0s), enter.
18. Under “Inject to” scroll to desired value (factory default=Vaporizr), enter. This tells the Autosampler to inject the sample into the vaporizer port.
19. Under “Inject Speed” scroll to desired value (factory default=1µL/s), enter.
20. Under “PreInj Del” scroll to desired value (factory default=0ms), enter.
21. Under “PstInj Del” scroll to desired value (factory default=2.0s), enter.
22. Under “Pst Cln Slv1” scroll to desired value (factory default=0), enter. This is the number of syringe wash strokes with solvent from Wash 1 after an injection.
23. Under “Pst Cln Slv2” scroll to desired value (factory default=0), enter. This is the number of syringe wash strokes with solvent from Wash 2 after an injection.
24. Under “Vlv Cln Slv1” scroll to desired value (factory default=0), enter. This would rinse the valve inlet with solvent from Wash 1. The Autosampler as delivered is not equipped with a valve.
25. Under “Vlv Cln Slv2” scroll to desired value (factory default=0), enter. This would rinse the valve inlet with solvent from Wash 2. The Autosampler as delivered is not equipped with a valve.

Creation of a new method is now complete. Further details on any of these steps can be found in the supplied HTC manual, specifically pages 9-10 and 47-49.

Press “ESC” button on keypad 2 times to return to main screen

Autosampler Jobs

Direct interaction with the Autosampler is needed to create, edit, start or delete jobs, change syringes, and for editing methods. This is described in the ‘Autosampler Jobs’ section.

Overview

For this Autosampler methods are used to define the syringe used, how much/fast/where the injection is, syringe cleaning routine and related parameters. Only one cycle and syringe can be used per method and cannot be changed once the method is saved.
Jobs are based on a particular method and the job will include tray used, vial to be sampled, number of injections and choice of method. You cannot edit methods from the job—so be sure to set up the method first!

Factory Supplied Jobs

The Picarro is supplied with one job which can be used with the system in its delivered configuration or modified to create a new job.

Creating a New Job

7. Load a sample tray into the tray holder, note the tray name and location.
8. Press F2 (Add Job)
9. Scroll to “Insert”, enter
10. Under “Tray” scroll to desired value (factory defaults=MT1-Rear), enter.
11. Under “First” scroll to desired value (factory default=1), enter. This means the Autosampler starts at vial position labeled number 1.
12. Under “Last” scroll to desired value (factory default=1), enter. This means the Autosampler finishes at vial position labeled number 1 (i.e. in the default configuration it only samples from vial number 1. in order to measure the entire tray choose 54, the number of the last vial)
13. Under “Increment” scroll to desired value (factory default=1), enter. This means every single vial is sampled for injection. If 2 is entered then every second vial is sampled for injection. If 3 is entered then every third vial is sampled for injection.
14. Under “Counts” scroll to desired value (factory default=1), enter. This means there will be 1 injection from each sample vial. Picarro recommends using 6 injections to completely eliminate memory effects.
15. Under “Methods” scroll to change method choice (factory default=Picarro), enter.

Creation of a new job is now complete. Further details on any of these steps can be found in the supplied HTC manual, specifically pages 11-12 and 47-49.

Press “ESC” button on keypad 2 times to return to main screen

Starting the Autosampler

For each run a job will need to be started from the Autosampler keypad. This is described in the ‘Starting the Autosampler’ section.

Overview

To run the Autosampler a job must be queued, and that that will be based on a predefined method. The loaded sample tray must be placed in the tray holder, wash solvent(s) and a syringe should also be in place.
This procedure assumes the factory default job and method or a verified user created method and job have been used and the Autosampler has been properly installed and connected to the Picarro analyzer.

Preparing the Autosampler

1. Place the loaded sample tray into the tray holder and note the location (front or rear). The sample vials hold 2mL of sample, fill with a minimum of 200µL (more is recommended to minimize isotopic fractionation due to vapor equilibrium). Ensure caps are screwed on properly (see Autosampler Maintenance for example).
2. Verify the syringe is installed.
3. Fill Wash 1 with wash solvent (factory recommendation is 1-methyl-2-pyrrolidinone (NMP))
4. Place fresh glass wool or new septa in the waste port. These should be replaced every 300 injections (at same time as injector port septa). See Autosampler Maintenance for instructions on this procedure and for a discussion of the pros/cons of using glass wool or a septa.
5. Place a new septa in the vaporizer injector port. The septa should be replaced every 200-300 injections. See Autosampler Maintenance for instructions on this procedure.

Starting a Job

1. Verify the Picarro GUI shows the instrument is taking measurements
2. Start the Coordinator software by double clicking on the coordinator icon on the desktop. This ensures all the valves of the vaporizer are synchronized correctly when injecting.

3. On the Autosampler keypad press the “start” key.
4. Under “Select Job(s) to Process” select all or selected (you must scroll to desired job), enter
5. the Autosampler will move the syringe to the zero position
6. the Autosampler will now wait for a start command from the Picarro coordinator software

Do not start the ‘Coordinator’ before the instrument starts showing measurements on the GUI.

After the job queue is finished, the Autosampler will stop, and the analyzer will continue to wait for a new sample injection. At this point, the user can start a new job on the Autosampler and click on ‘New output file’ button on the CRDS Coordinator window. The user can append more data to the same output file by simply starting a new job queue without pressing the “New output file” button.

Autosampler Maintenance

The Autosampler requires daily maintenance for reliable operation. The various procedures are described in the ‘Autosampler Maintenance’ section.

Overview

The Autosampler requires daily maintenance to ensure proper operation. Many of the consumable parts need to be replaced on a daily basis if full sample trays are run. To ensure uninterrupted operation a minimum of a week’s supply of consumables should be kept on reserve.
The consumables and how to replace them is described in the following subsections.

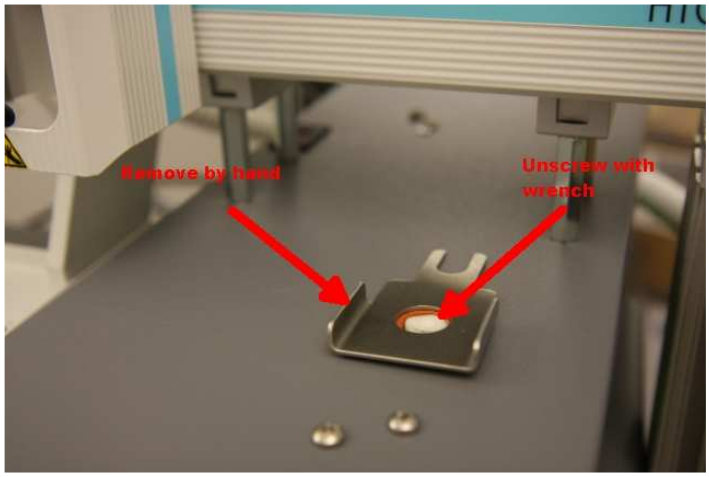
Changing Injector Port Septa

The injector port septa should be replaced every 200-300 injections. The more closely grouped needle piercing on the septa, the earlier the septa 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.

16. To change the vaporizer injection port septum when an autosampler job is running (i.e. actively injecting samples), press the “change injector septum” button on the coordinator software. The analyzer will fill the vaporizer with dry gas. If the autosampler is not running a job then proceed directly to step 3. If no job is running and the “change injector septum” button is pressed the coordinator software will wait indefinitely (to resolve this either start a job on the autosampler or manually end the coordinator software).

17. Wait for the software indication to change the septum.
18. Remove the protective metal cover around the injection port (ensure that the insulation foam stays attached to the cover).
19. Unscrew the cap of the port.

Warning: the bottom of the cap is very hot!



20. The old septum will usually stick to the port, but if it is in the cap, remove it using tweezers (again the port and cap are really hot!).
21. Insert a new septum into the cap and screw the cap onto the port by hand until it comes to a hard stop. It should be finger tight only.

Caution: do not overtighten or use a wrench, the injector port will be damaged.

Replace the metal cover around the injector port.

22. Press “continue” on the user interface; the analyzer will restart the vaporizer purge cycle and then wait for the next sample injection.

Note: A septa can be replaced at any time. If a job queue is in progress, the analyzer will wait until the current sample measurement is complete (potentially as long as the cycle time) before preparing to change the septum.

Additional injector port septa can be purchased by ordering the part number "Picarro 01IPS" which is a single package contains 100 units of 9.5 mm septa.

Waste Port Septa and Glass wool

The waste port can be have one of two configurations.

Configuration 1:
Waste port is sealed with a septa and attached to a vacuum pump (not included). This configuration requires additional hardware and there have been reports of septa material clogging the syringe needle.

The waste port septa should be replaced every 200-300 injections, at the same time as changing the injector port. The following procedure assumes this is done at the same time as the injector port septa.

1. Pull up on cap by hand to remove from waste port. Press up from the bottom if the cap does move easily.
2. Use tweezers to remove the old septa.
3. Place the new septa into the cap and replace the cap

   Additional waste port septa can be purchased by ordering the part number "Picarro 01WPS" which is a single package contains 20 units of red PTFE septa.

Configuration 2:
Waste port is filled with glass wool and a small positive pressure pump (such as an aquarium air pump attached). The pump helps evaporate the water and the large mass of the glass wool serves as a reservoir. This configuration requires minimal hardware and is what is used at Picarro. No septa is used in this configuration, the top of the waste port is left open to speed evaporation.

The waste port glass wool should be replaced every 200-300 injections, at the same time as changing the injector port. The following procedure assumes this is done at the same time as the injector port septa.

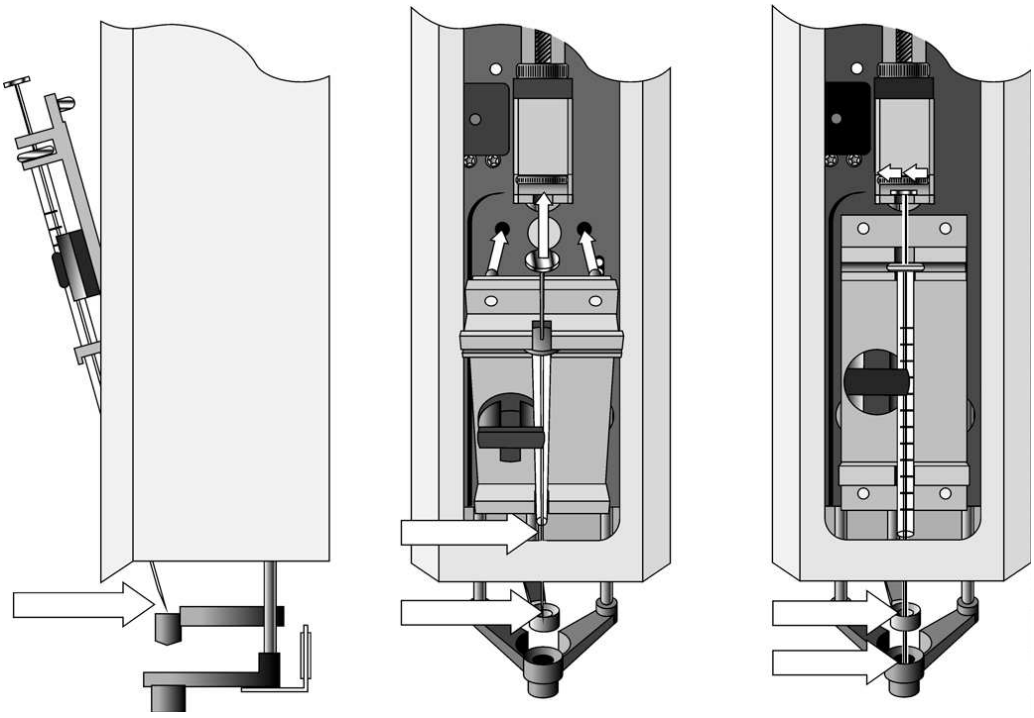
23. Pull up on cap by hand to remove from waste port. Press up from the bottom if the cap does not move easily.
24. Use tweezers to remove the old glass wool.
25. Place the new glass wool into the waste port and replace the cap. Do not use a septa.

Cleaning the Syringe

The **syringe should be cleaned daily**. The syringe should be removed (see subsection 'Replacing the Syringe' for removal instructions) and cleaned by hand. Use 1-methyl-2-pyrrolidinone (NMP) and flush the syringe completely 5 times. **If the plunger does not move smoothly** in either direction **replace the syringe**. Use of NMP will extended the syringe life versus using water or acetone to clean the syringe.

Replacing the Syringe

The syringe should only be replaced when the coordinator software is not running and no job is running on the Autosampler. This procedure is done using the Autosampler keypad.



Removing a Syringe

1. Select "Menu" and press F1/Chang Syr. The Injection Unit will move to a location that will facilitate removal of the syringe.
2. Loosen the plunger retaining screw. Move the plunger slightly out of the plunger holder.

3. Pull the syringe adapter out and then carefully up to remove the syringe adapter with the syringe from the Injection Unit.

Installing a Syringe

1. Select Menu and press F1/Chang Syr. The Injection Unit will move to a location that will facilitate installation of the syringe.
2. Place the syringe in the appropriate syringe adapter. Pull the plunger out to approximately 20% of it's length.
3. If necessary, loosen the plunger retaining screw in the plunger holder (see figure above).
4. Move the syringe, installed in the syringe adapter, partially into the Injection Unit. Guide the needle first into the upper needle guide and then into the lower needle guide.
5. Place the plunger button into the plunger holder. Allow the syringe adapter to "click" into place by magnetic force, against the syringe carrier.
6. Tighten the plunger retaining screw against the plunger button.
7. Press "Home". The plunger moves down until it hits the mechanical stop. This position is stored as the syringes zero volume position. Then the Injection Unit returns to the HOME position.

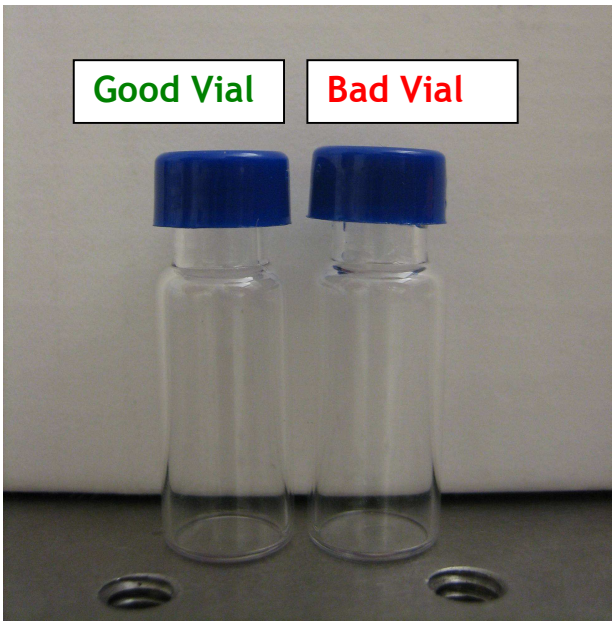
After replacing a syringe, always check the needle penetration in the injector valve (described in Autosampler training section).

Caution: failure to check the needle penetration can cause permanent damage to the syringe.

Additional syringes can be purchased by ordering the part number “Picarro 01SYR” which is a single 5 µL glass syringe.

Sample Vials

Improper sealing of the sample vial is the most common cause of accidental isotopic fractionation! The caps of the vials can easily be threaded incorrectly. Check the cap screwed on level to the vial:



Proper capping of vial shown on left, improper capping of vial on right

Additional sample vials can be purchased by ordering the part number “Picarro 01VIA” which is a single package contains 100 units of clear glass, 2mL, 12 x 32mm screw-top vials with a 9mm thread finish.

Additional caps and septa can be purchased by ordering the part number “Picarro 01CAP” which is a single package contains 100 units of 9-mm thread PTFE/Silicone septa to fit 2 ml vial.

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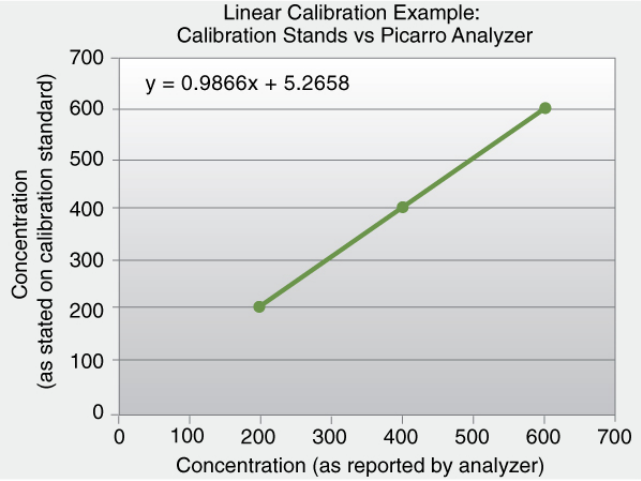
Calibration (vapor measurements)

Since the Picarro Analyzer is extremely linear, it is only necessary to use three calibration standards to calibrate each gas or isotopic species. The exact value of each calibration standards 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, the user simply introduces 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 and the value the analyzer reads for that sample are recorded for each calibration standard used. These values can then be plotted, as shown below, in a spreadsheet, for example, to determine the linear relationship between the known calibration values and the analyzer's reported values. A linear best-fit equation can be calculated from the data. It is important to plot the analyzer's reported concentration on the horizontal axis and the gas standards' stated concentrations on the vertical axis. The slope and intercept of the best-fit line through these points are the two values that are used to calibrate the analyzer. By determining what the linear relationship is between the known calibration values and the analyzer's reported concentration values in this way, a calibration offset (slope and intercept) can be calculated so as to add 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. Using the equation in the graph below, this would be accomplished point-by-point by calculating the corrected data "y" by using the analyzer's data "x" so that: Datacorrected = 0.9866•Dataraw+5.268.

	Value given by analyzer	Value of calibration standard
Calibration point #1	200.1	202.7
Calibration point #2	600.3	597.6
Calibration point #3	400	400



Calibration values are input into the software by modifying the "Picarrocrds.ini" file found in C:\Picarro\HBDSxx\GUI\ directory (where HBDSxx is the instrument's serial number). This is a simple ASCII text file and will automatically open in a default text editor. The calibration section of the file will look like the following example.

[CALIBRATION]
CONCENTRATION_H2O_CONC_INTERCEPT=0.00
CONCENTRATION_H2O_CONC_SLOPE=0.73
CONCENTRATION_H2O_USER_INTERCEPT=0.000
CONCENTRATION_H2O_USER_SLOPE=1.000

Note: before changing these values, it is useful to save a copy of the picarrocrds.ini file (under a different file name) in case the user wants to return to the factory calibration.

In this latter example, the two calibration values for each species labeled by "CONC" and "USER" correspond to the factory and user calibrations, respectively. The numbers for the "CONC," or factory, calibration should not be changed. Rather, only the "user" or offset from the factory values (in red) should be changed – the analyzer will automatically add the two intercepts from "CONC" and "USER" and multiply the slopes from "CONC" and "USER." So, to revert to the factory calibration, the "USER" intercept should be set to 0 and the "USER" slope should be set to 1.0. There are separate calibrations for the isotope values as well, and these calibrations are all independent of one another.

After the calibrations are changed in the file, save the file, and re-start the analyzer's software to enable the new calibration. This is done simply by clicking the "Shutdown" button, and then re-starting the analyzer software by double-clicking the User Interface icon on the desktop.

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The concentration and isotope calibrations are separately specified in the calibration file of isotope analyzers and they are not linked, therefore, the calibration for concentration must be done separately from that for isotope ratio. Isotope calibrations are accomplished in the same manner described above, but with gas standards differing in isotopic content, ideally measured at the same concentration.

Calibration (liquid measurements): Using Standards to Scale Isotope Data

During every run of unknown samples, it is recommended that the user periodically measure known standards to scale the analyzer's data appropriately. The number and frequency of measurement of standards will depend on the ultimate accuracy required by the particular user. Since the Picarro analyzer is extremely linear, it is only necessary to use three calibration standards across the intended span of isotope values to calibrate each isotope ratio (two points define the calibration line, and a third intermediate point is used for verification). The exact value of each calibration standards is not of particular importance as long as they span a representative range of values over which the analyzer will typically be operated. (Although it is not necessary to use more than three standards, additional standards can be used to further constrain the linear calibration coefficients.)

It is best to measure three or more standards, bracketed around the delta values of the unknown samples, in order to construct a calibration line whose regression coefficients can be used to scale the unknown sample data. For example, assuming ten unknown samples numbered 1-10 and the three standards S1, S2, S3, the following arrangement of samples in the autosampler tray is recommended:

S1	S2	1	2	3	4	5	S3	6	7	8	9	10	S1	S2

Plot the true values of the standards used above against the measured values recorded by the analyzer. Two separate plots should be made, one for δ18O and one for δD.
Fitting a straight line through each of the two plots yields an equation of the form:
y = m· x + b where m is the slope and b is the intercept.

For each plot, the equations correspond to:

$$\delta^{18}O_{calibrated} = m_{\delta 18O} \cdot \delta^{18}O_{measured} + b_{\delta 18O}$$

and

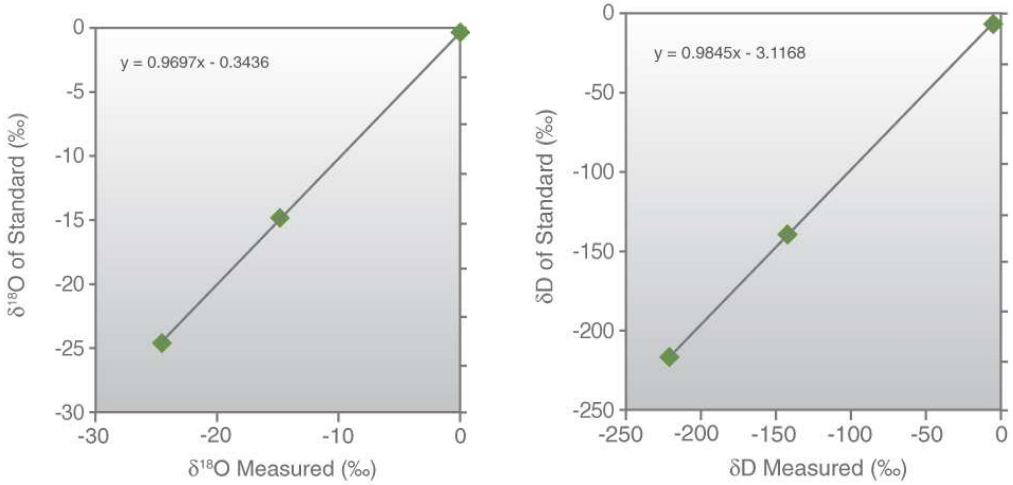
$$\delta D_{calibrated} = m_{\delta D} \cdot \delta D_{measured} + b_{\delta D}$$

Analyzer Measurements of Standards			
	S1	S2	S3
$\delta^{18}O$	-0.35	-17.00	-26.46
δD	0.35	-122.93	-205.28

Known Values of Standards			
	S1	S2	S3
$\delta^{18}O$	-0.72	-16.72	-26.07
δD	-2.67	-124.39	-205.08

Regression Coefficients	
$\delta^{18}O$ slope:	0.9697
$\delta^{18}O$ intercept:	-0.3436
δD slope:	0.9845
δD intercept:	-3.1168

Use the slopes and intercepts in the equations above to calculate the calibrated isotope ratios from the measured values.



The number of samples between the standards S2 and S3 and between S3 and S1 may vary depending on the specific samples being measured and the user's desired level of accuracy, as well as the number of injections measured per sample, with fewer samples interleaved between the standards corresponding to the highest accuracy measurements. As an example, the Picarro liquid water isotope analyzer has guaranteed specifications regarding drift (i.e. accuracy relative to a measured standard) over a particular temperature range and over a 24-hour period without calibration. This means for example that without measuring standards during a 24-hour run of samples, the absolute values of the delta measurements could vary from the beginning to end of the run by an amount consistent with this specification. By interleaving the samples with standards, however, the delta values can be constrained by appropriately scaling them relative to nearby measured standards – again, this adjustment is undertaken after the run has been completed.

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To calibrate water vapor isotope measurements, liquid standards are measured periodically and the water vapor isotope data scaled in the manner described above. It is not recommended that the analyzer itself necessarily be recalibrated but rather, during sample runs, standards be measured and the data scaled accordingly. The reasoning for scaling the data with standards (interspersed among samples) rather than re-calibrating the analyzer itself is because a re-calibration prior to a sample run ensures only that those samples measured near in time to the recalibration will be of the highest accuracy. In other words, not running standards along with samples – but rather relying on a one-time recalibration of the analyzer – does not allow the user to maximally constrain all the measurements throughout the sample run to known standards.

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SPECIFICATIONS

Absolute Maximum Ratings

The following limits are the absolute maximum ratings. Operation beyond any of these limits may result in permanent damage to the analyzer (unless otherwise specified for custom or OEM systems).

Parameter	Min	Max	Units
Storage Temperature	–40	+40	°C
Storage Relative Humidity (non-condensing)	5	90	%
Ambient Operating Temperature	10	35	°C
Operating Relative Humidity (non-condensing)	5	95	%
Warm-Up Time from OFF (at 15 °C)		1	hour
Temperature Ramp		0.3	°C/min
Total Power Dissipation (steady state)		375	W

Sample Gas Requirements

Parameter	Value	Comment
Inlet gas temperature	15-45°C	
Inlet gas pressure	500 – 1000 Torr	
Inlet gas flow rate	< 0.4 L / min at 760 Torr	
gas type	oil free non-corrosive non-flammable non-condensing*	Samples with condensing levels of H_2O content may damage the analyzer.
Particle free	< 0.1 µm	

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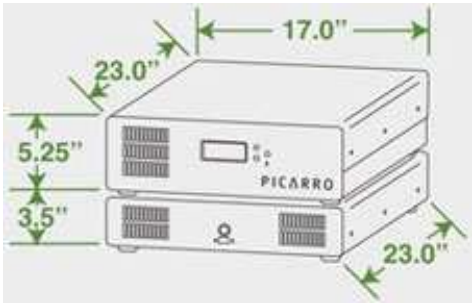
Please consult the Compliance Certification for analyzer performance and performance specifications. Size specifications below are listed for standard instruments only and may differ for customized or OEM systems.

Physical specifications

Parameter	Value
Inlet / Outlet gas connectors	¼" stainless steel Swagelok
W x H x D	See drawing below
AC power	100/110 VAC @ 50/60 Hz 220VAC @ 50 Hz

Picarro Analyzer Dimensional Drawing:



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Service and maintenance

The advanced, rugged design of the Picarro Analyzers provides stable, long-term operation with minimal service or maintenance. With the exception of the fan filter, particulate filter and air pump, the analyzer is not user serviceable. Should it appear to malfunction, please refer to the Troubleshooting Guide or contact Picarro.

Vacuum Pump in CPVU:

The pump is rated for 10,000 hours. It is advised that arrangements be made with Picarro to replace the pump as it approaches this number of operational hours. If the pump fails, please contact Picarro.

At the rear of the CPVU is a meter that indicates the accumulated hours of operation of the vacuum pump. The hour meter only displays numbers when the vacuum pump is on. *Note: The pump is off while the instrument is warming up.* The vacuum pump is rated for 10,000 hours. The hours indicated should be recorded when the vacuum pump is serviced or replaced.

Picarro Analyzer CCPVU Vacuum Pump Replacement Procedure

Tools

- 5/64” Hex driver
- 9/64” Hex driver
- Small flat screw driver
- 9/16” open ended wrench
- 11/16” open ended wrench
- Wire cutter, (for cutting wire ties)

Supplies (supplied in replacement kit)

- Small Wire ties (qty 1)
- Pump mounts (max qty 4)

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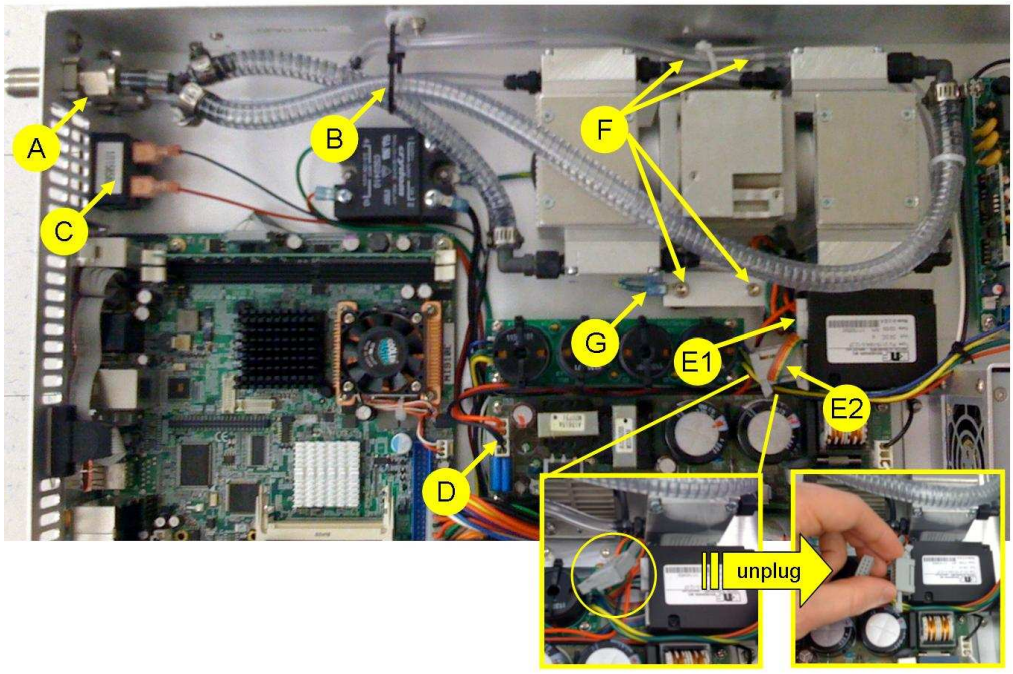
Vacuum Pump Removal

Refer to the picture below:



1. Disconnect the AC from the CPVU
2. Remove the cover
3. Cut tie wrap(s) on the hoses to the pump at (B)
4. Disconnect the vacuum and exhaust tubes from the connectors at (A)
5. Unplug the red and black wires from the hour meter at (C)
6. Unplug the connectors at (D) use flat blade screwdriver to release the clips.
7. Unplug connector at (E1) on the power supply (connector on left in photo below). Push down and away from power supply, with screwdriver to release the clip. Do not disconnect the connector shown on the right in the photo below:

8. Unplug (E2) near the power supply. Note, the connector at (E2) connects two cables and is not to be confused with the connector on the right side of the power supply directly beside (E1) shown above.

9. Unscrew and remove the four 8x32 star-washer nuts at the middle of the pump (F) that attach the base plate to stand-offs affixed to the chassis. Take care not to strip the hex heads. Lift the pump off to remove. Note that one of the nuts secures a grounding lug for the base plate, which is connected via a green-yellow wire to the chassis (G).

Vacuum Pump Installation

1. Seat the pump so that its base plate is on the four stand-offs and the air tubes point towards the back panel
2. Ensure that the lug on the green-yellow grounding wire is on the standoff at (G) and replace the four 8x32 star-washer nuts to secure the base to the standoffs
3. Re-connect the connectors at: (C) black wire goers closest to vacuum tube, (D) red wires are closest to the vacuum pump, be careful not to reverse red and black, (E) Be careful not to pinch ribbon cable in retaining clip, make sure retaining clips are fully closed as shown.

4. Connect the 1/4" id (3/8"od) and 1/8" id (1/4"od) tubes to the bulkhead connection on the rear of the CPVU (A)
5. Organize and tie wrap the pump hoses at (B)
6. Replace the cover

Testing

This is only necessary if a newly-installed pump does not correctly function in the system. The test procedure requires a CPVU tester which must be supplied by Picarro.

1. Supply AC power to the CPVU
2. Attach the CPVU tester to the CPVU umbilical cable
3. Press the power button – this will start the CPVU
4. If a voltage reading is not correct the tester display will indicate an error
5. Toggle the pump switch to on
6. The pump should start
7. Place a cap on the vacuum port on the rear of the CPVU

8. Measure the flow from the pump
9. The flow should be less than 5 sccm, if it is larger than this the pump or connection has a leak
10. Toggle the Pump switch to off
11. Disconnect the tester from the CPVU umbilical to power off

Fan Filters:

If the instrument is not used in a clean environment, than dust will gather on the fan filters at the front of the unit. It is recommended that the filter element be replaced or cleaned when a reasonable amount of dust is visible.

Particulate Filter:

There are two in-line, sub-micron particulate filters before the measurement cavity. The first is user-replaceable and replacement filters can be purchased from Picarro and installed by the user. **It is important NEVER to remove the filter which is attached directly to the cavity. Only change the filter immediately following the inlet at the back of the analyzer. Refer to the filter replacement procedure in this document for further details.** The symptoms of a clogged filer can be analyzer reporting "pressure low" or there being no flow into the instrument, causing unusual measurements. Filters can become clogged after years of use in dirty environments. 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 it eventually dries. If this occurs, it is important to NOT turn off the analyzer or replace the filter until it 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.

Picarro Analyzer Replacement Procedure for User-Serviceable Particulate Filter

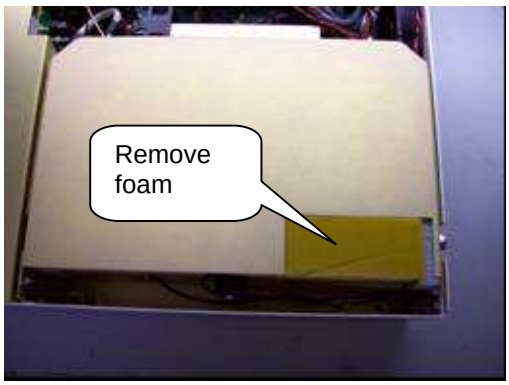
Tools Required:

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

First, remove the old particulate filter:

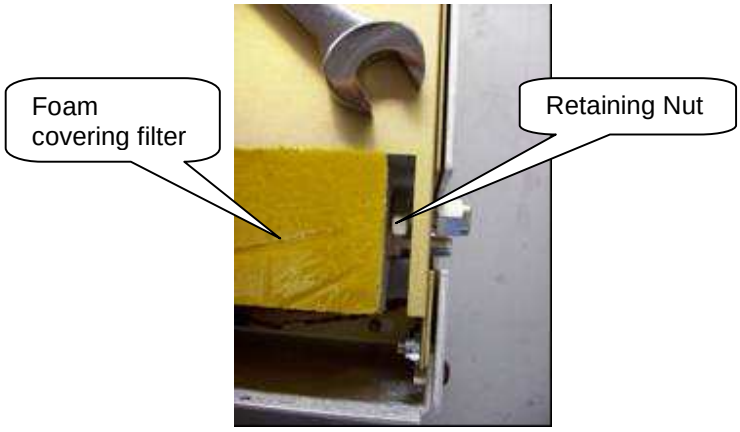
1. Move the DAS unit to a clean work environment
2. Using the 1.5mm Hex, remove DAS lid by removing six (3 per side) M3x6mm socket flathead screws.

3. Remove the piece of foam from around the input bulkhead by sliding it towards the right of the DAS.



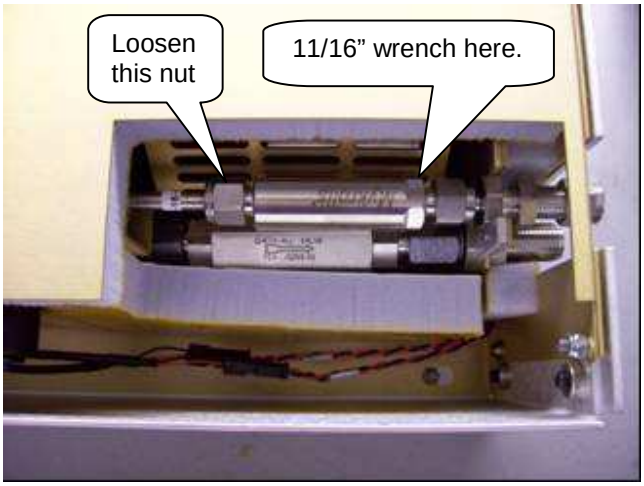
View of right side of DAS

4. Using the 5/8" wrench, loosen the retaining nut on the input bulkhead (about 1 full turn should be enough).



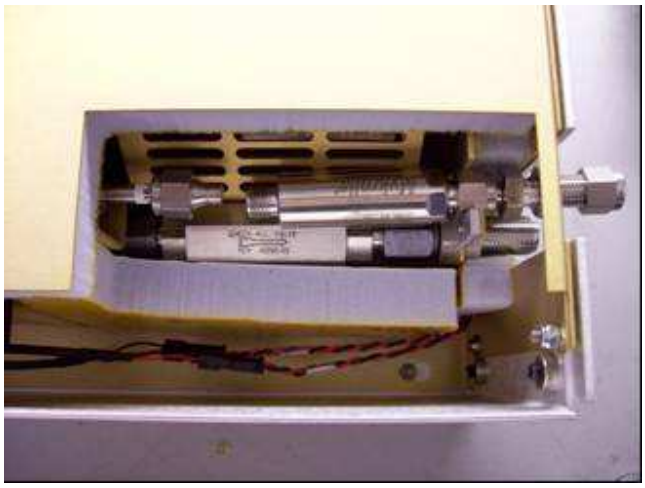
Bulkhead Retaining Nut loosened

5. Slide the filter cover (with foam on top and side) towards the right side of the DAS to remove it.
6. Using the 9/16" and 11/16" wrenches, disconnect the filter from the tube section near the front of the DAS.



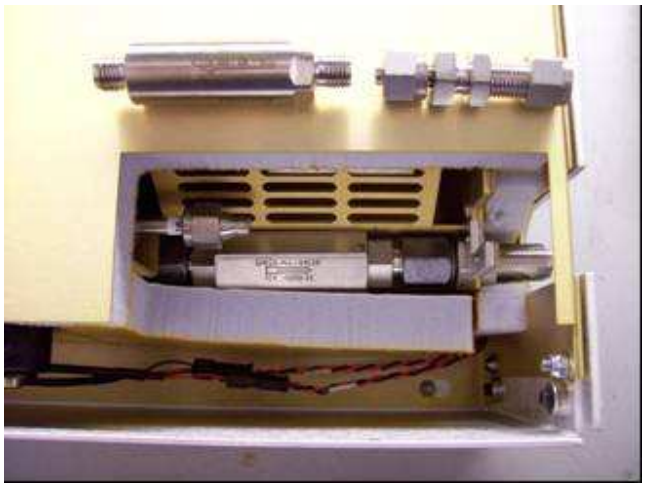
Filter cover removed

7. Slide the filter and bulkhead slightly towards the back of the DAS and lift out.



Filter and bulkhead slid slightly towards back of DAS

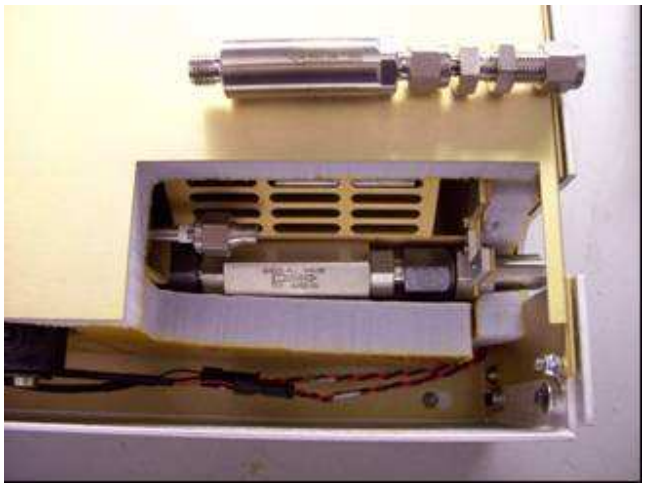
8. Using the 9/16” and 11/16” wrenches, disconnect the filter from bulkhead fitting.



Filter removed and separated from bulkhead fitting

Now, the new filer can be installed:

9. Note: When reattaching 1/4" Swagelok fittings, the nut should be hand tightened and then turned another 1/8 of a turn beyond that.
10. Using the 9/16" and 11/16" wrenches, remove the filter from its packaging and attach it to the bulkhead fitting. The arrow on the filter needs to point away from the bulkhead fitting.
11. Using the 9/16" and 11/16" wrenches, reposition the filter and bulkhead fitting, and reattach to the tube section.



New filter attached to bulkhead fitting

12. Sing the 5/8” wrench, reposition the filter cover and tighten the retaining nut on the bulkhead fitting. The metal edge of the filter cover should be under the foam of the top of the enclosure.
13. Reposition the piece of foam around the input bulkhead fitting.
14. With the 1.5mm Hex, reattach the DAS top with 3 screws on each side. The top is symmetrical: a side with threaded inserts can be to the left or the right.

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Troubleshooting guide

The following table 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 Customer Service at (408) 962-3900 or your Distributor.

1. Power LED on analyzer does not illuminate

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

(a) Check that the DC Power Connection Cable between the PVU and the DAS is in place and that the plug at the end of the cable is securely mated with the socket on the analyzer. The plug shield should be rotated clockwise to lock the plug into the socket.

(b) Check that the USB cable between the rear of the computer and the rear of the analyzer is in place and securely plugged in at both ends. Ensure that the plug at the rear of the analyzer is in the correct orientation, with the arrow (or USB logo) facing upwards, and that it is securely screwed onto the analyzer socket. Note that the power supplies in the power vacuum unit are activated in response to a signal from the computer carried on the USB cable.

(c) Check that the fuse located in the PVU next to the (AC power) cable is operational. If the analyzer still fails to turn on, contact Customer Service.

2. User interface program does not start

Context: The computer may be configured to start the instrument and the associated user interface program automatically after it completes its boot-up sequence, or the program may be launched using the "Start instrument" icon on the desktop. During this process, the computer establishes communications with the analyzer via the USB interface, starts a number of background programs, and finally runs the user interface program.

(a) Communications problems with the analyzer may occur if the analyzer fails to initialize correctly on power up. Should the analyzer initialization process not complete correctly, shut down the instrument by shutting down the Windows operating system on the control computer: use the Start menu, select the red Shut down button and select "Shut down" in the drop-down box under "What do you want the computer to do?". Wait for the shutdown to complete normally and for the computer and analyzer to turn off completely. After a few seconds, restart the computer by momentarily depressing the power button.

Note: Do not simply restart Windows, since this does not cycle the power to the analyzer.

(b) Check that the USB cable between the rear of the computer and the rear of the analyzer is in place and securely plugged in at both ends, since communications problems may also result from a bad connection. Ensure that the arrow (or the USB logo) on the plug is facing upwards when inserting it into the socket on the rear of the analyzer, and that it is securely screwed onto the analyzer socket. Follow the procedure in (a) to shut down and restart the instrument if the cable has been reconnected.

3. Sample pressure cannot be controlled to the appropriate value for concentration measurement

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 not correct.

(a) 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.

(b) 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.

4. Vacuum pump stalls, and fails to reduce cavity pressure to the operating point

Context: Under normal operation, the vacuum pump is turned on during the instrument startup procedure after the warm chamber temperature has stabilized. The pump may stall and not operate even though it is receiving power if the pressure at its inlet is too low. If the pump is stalled, there is no gas flow through the cavity.

(a) Confirm that power is being applied to the vacuum pump by observing the hour meter liquid crystal display on the rear panel of the power vacuum unit. The display is switched on only if power is being applied to the vacuum pump. Next, check the flow meters on the front of the power vacuum unit to establish if there is gas flow through the pump. If power is being applied to the pump but there is no gas flow, the pump is stalled.

(b) If the pump is stalled, disconnect one end of the tube between the analyzer and the power vacuum unit to allow air into the inlet of the vacuum pump. The pump should start operating. Reconnect the tube after the pump restarts. If the pump still fails to operate, contact Customer Service.

5. User interface program "freezes" and does not update graphs as data are collected

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

(a) Resetting the computer and the instrument requires that the computer be shut down and restarted. If the computer responds to the mouse, a normal Windows shutdown may be carried out: use the Start menu, select the red Shut down button and select "Shut down" in the drop-down box under "What do you want the computer to do?" Wait for the shutdown to complete normally and for the computer and analyzer to turn off completely. After a few seconds, restart the computer by momentarily depressing the power button.

(b) If the computer does not respond to the mouse, hold down the power switch on the front panel for a few seconds until the computer and the instrument turn off. After another few seconds, restart the analyzer by momentarily depressing the power button.

(c) It is possible that the USB cable connecting the DAS and the control PC has become damaged. Replace this cable with another standard USB cable (type A-B), and restart the system.

6. USB Connection in Windows warning: "Unrecognized Device" or similar USB connection problem

Context: The USB cable can, in some circumstances, be physically forced to connect upside-down (see below). If this occurs during improper installation, the computer will show a USB connection error. If the USB connector is verified to be plugged in correctly and a USB error persists, contact Picarro for technical assistance.

Note: WHEN CONNECTING THE USB CABLE TO THE DAS, MAKE SURE THE WHITE ARROW ON THE CABLE IS ORIENTED CORRECTLY – THE ARROW SHOULD BE ON TOP, AS SHOWN IN THE PHOTOS BELOW:

7. Autosampler does not wait for sync signals from the Coordinator and instead continuously keeps injecting sample into the vaporizer

Context: Sometimes when the instrument is first started, the sync signal for injecting sample into the vaporizer might be initialized to high. In such a case, if the 'Coordinator' program is not started before the autosampler, then the autosampler will continue injecting into the vaporizer until its job queue is stopped. In such a case, stop the autosampler job queue and run the 'Coordinator' program and then re-start the autosampler.

8. Autosampler cannot find y- axis reference

Context: If the autosampler cannot find its 'y-reference', that is generally an indication that the ribbon cable connecting the autosampler moving arm to its base is pinched. Remove the moving arm and disconnect the ribbon cable, straighten the cable as much as possible with your fingers and then re-connect. If problem still persists, call Leaptec.

9. Error in Coordinator: Error (10061, 'Connection refused') in state StateWaitForAnalysisDone

Context: If the instrument GUI shuts down while the 'Coordinator' program is still running, the 'Coordinator' will show this error because it is not able to communicate with the GUI. Restart the GUI and the 'Coordinator' program.

10. Concentration of water in the injection pulses not consistent

Context: If the concentration of the injected water is not consistent, replace the existing syringe with a new one. If problem persists, change the injection port septa. If problem still persists, call Picarro for tech support.

11. Vaporizer heats up very slowly or not at all

Context: If the vaporizer takes an unusually long time to heat up, the voltage switch may be set incorrectly for the mains voltage. If it is set incorrectly, the symptoms will be as follows: On 220V mains, a switch setting of 110V will blow the vaporizer fuse. On 110V mains, a switch setting of 220V will result in the vaporizer heating up much more slowly than normal.

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Transportation and Storage

In the event that the instrument will be transported or stored, the following procedures can be used to prepare the instrument and repack it into the original cartons.

Packing the DAS

1) Shutdown the instrument using the shutdown button, using the "prepare for shipment" option. Clean dry gas should be attached to the instrument prior to shutting down. (This prevents condensation inside the system during storage or shipment).
2) Disconnect the all tubing and electrical connections from the DAS and CPVU. (DC Power Connection Cable, vacuum line, USB cable, inlet gas line, CPVU AC power cord, monitor, mouse and keyboard).
3) To prevent contamination and possible damage to the connector threads, place caps on all gas connections. (DAS inlet, DAS vacuum, CPVU vacuum, CPVU exhaust).
4) Place the DAS and CPVU each in a plastic bag with a package of desiccant. Seal the bags with tape.
5) Place the two pieces of edge foam on the bottom of the large box.
6) Place the small box inside the large on top of the edge foam.
7) Place on sheet of foam on the bottom of the small box.
8) Lower the DAS into the small box.
9) Place the four side pieces of foam in the box.
10) Place one sheet of foam on top of the DAS.
11) Seal the small box.
12) Place the two pieces of edge foam between the small box and the large one.

Packing the CPVU

1) Place two pieces of foam in the bottom of the box, labeled bottom front (BF), and bottom rear (BR).
2) Place the CPVU in a plastic bag with a package of desiccant. Seal the bag with tape, with the DC distribution cable sticking out of the bag.
3) Cover the connector end of the distribution cable with a bubble wrap bag, and seal with tape.
4) Low the CPVU onto the two pieces of foam in the box.
5) Place the two top pieces of foam on top of the CPVU, labeled front top (TR), and top rear (TR).
6) Place the system accessories in a bag. (vacuum tube, two AC power cables, manual, and software CD)
7) Tape the accessory bag to the top of the CPVU, between the foam and seal the box.

CAUTION: WHEN SHIPPING OR RELOCATING THE ANALYZER, IT IS IMPORTANT TO PROTECT IT FROM MECHANICAL SHOCKS. FAILURE TO DO SO CAN COMPROMIZE ITS PERFORMANCE. WHEN SHIPPING THE ANALYZER, USE ITS ORIGINAL PACKAGING ONLY.

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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.

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.

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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. Shipping and transportation charges shall be the sole responsibility of the customer.

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 Picarro factory or Picarro distributor. The price of all Products, unless otherwise specifically stated, is Ex- Works, Sunnyvale, CA as defined by Incoterms, 2001. 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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Picarro Analyzer User's Guide