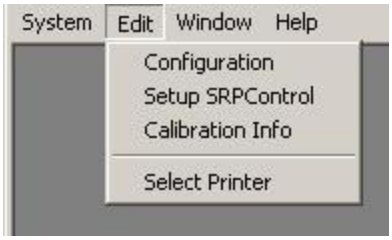
5 GUIDELINES FOR GUEST INSTRUMENT CONFIGURATION

The main purpose of the SRP is to verify other O_3 measurement devices as Level 2 transfer standards. The O_3 measurement devices are generally commercial O_3 instruments, but can be any device that can draw a sample from the SRP's sample manifold, and in some cases, draw both sample and reference gases from the SRP's dual manifold. There are of course, limitations on the amount of sample and reference gas that an SRP can provide. In all cases, a device being verified against an SRP is referred to as a "Guest Instrument".

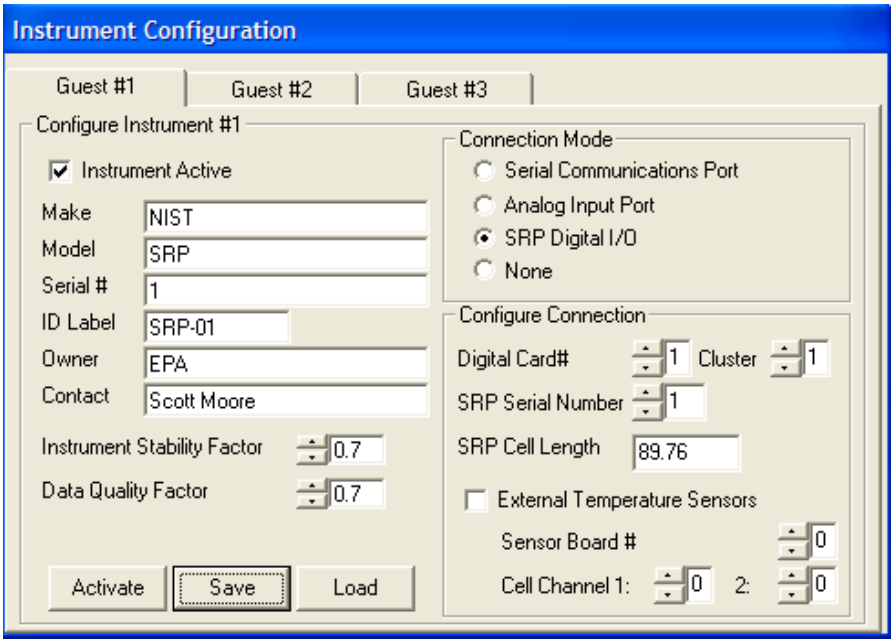
Guest systems can be connected to the SRP Control System for automatic data collection via SRP digital, serial communication, or analog input signal. Additionally, comparisons can be done by manually entering data from a guest system into the SRP control program. NIST will be providing a more detailed SOP for connecting commercial units; until then the following will be a general guide.

5.1 Guest Instrument / SRP Software Configuration:

The program must be setup for operation with guest instruments through the "***Edit/Configuration***" menu option as shown below.



This option brings up the configuration panel where you may configure up to three guest instruments to simultaneously operate with the control program. The guest instrument configurations are selected by clicking the tabs in the upper portion of the panel.



On the left are fields that are common to all instrument types:

Instrument Active: Checking this box will make this guest active and available to the control program. When activating a guest instrument be careful not to assign the same COM Port to two different instruments. If this is inadvertently done the SRP will save the setting then detect a "Conflict" with the COM Port and then shut the program down. Upon restarting the SRP Software the guest instruments will be reopened and detect the Conflict with the port settings and shut the program down. To get out of this "Shut Down Loop" there is a very narrow window of time (3-5 seconds) when the Software starts up but before the guests are activated where you can go into the Configuration and "Deactivate" the Instrument causing the conflict.

Make: The manufacturer of the instrument. This will appear in the report.

Model: The Model of the instrument. This will appear in the report.

Serial #: The serial number of the instrument. This will appear in the report.

ID Label: The label that will be used to identify this instrument in reports and in the control program.

Owner: The name of the company that owns this instrument. This will appear in the report.

Contact: The name of the contact in the company that owns this instrument. This will appear in the report.

Instrument Stability Factor: The maximum standard deviation (in ppb) of four readings that will indicate that the O_3 concentration is stable. Data acquisition will not start until this factor is met.

The setting for this field should be 0.7 for all instruments. However, due to stability issues, you may need to increase the Data Quality Factor for a guest instrument. The maximum should be no greater than 2.0 for guest instruments.

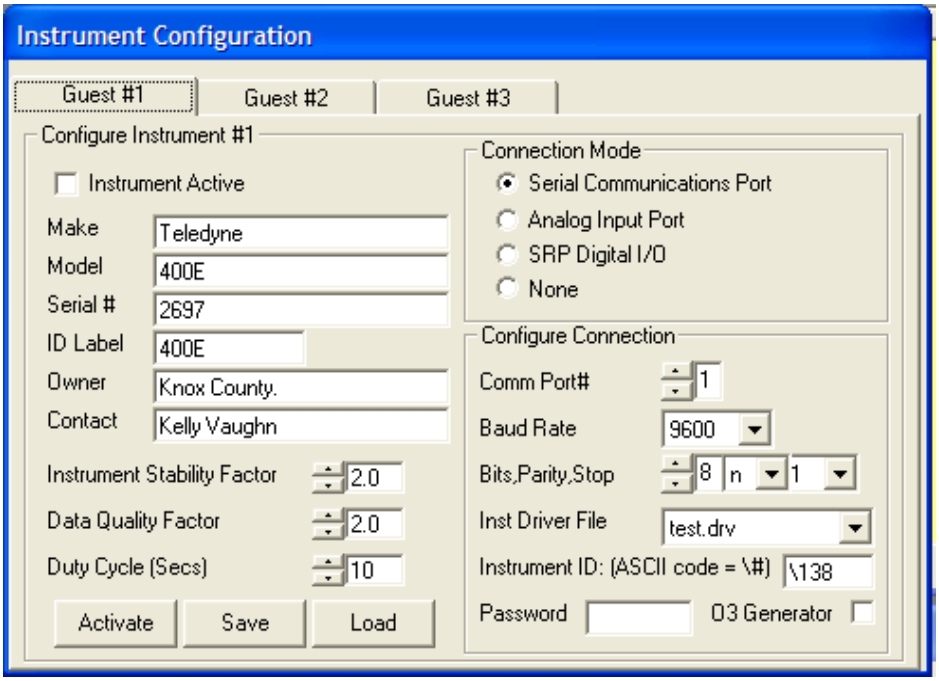
Data Quality Factor: The maximum standard deviation (in ppb) allowable during actual data acquisition. Data acquisition will restart if this factor is not met.

The setting for this field should be: 0.7 for all instruments. However, due to stability issues, you may need to increase the Data Quality Factor for a guest instrument. The maximum should be no greater than 2.0 for guest instruments.

NOTE: When running multiple instruments, one noisy instrument can cause a calibration to abort. For example, if you are running an instrument with a Zero to one Volt output and then multiply the voltage by 1000 (O_3 (ppb) = Slope x Voltage + Intercept) then your noise ratio is also amplified by 1000. There would be two acceptable options. First run an "O_3 Conditioning" at the flow rate you are going to use and at the highest Lamp % that you are going to use and let it run until all other instruments are stable. Check to see what the Stability Factor is for that instrument and then use a value that is slightly greater than that. Or second, just record the raw voltage with no multiplier and correct the data after the calibration is completed. Any time a factor > 0.7 is used there should be a statement in the QA Report or the Calibration File with an explanation of the reason why a different value is used and how you came up with the alternate value. An "Analog Calibration" can also be run to determine the Slope and Intercept to be used for a specific instrument by setting the Slope to one and the intercept to Zero. Run a calibration of three points of Zero Maximum range to be used and a half way point. Then a slope and intercept can be calculated and used. Some users already have a slope and intercept that they use to correct their data. This can also be used, however if the user is calculating their O_3 concentration to ppm, you would need to recalculate the slope and intercept for ppb. Be sure to include any of this in the final report.

Select the connection mode by choosing; 1) ***Serial Communications Port***; 2) ***Analog Input Port***; 3) ***SRP Digital I/O***; or 4) ***None***. These options will be discussed individually below;

1) Serial Communications Port



The guest settings for serial communications can be seen in the image above, and they are described below

Comm Port#: The port number of the computer's serial port and that the instrument is connected to. A DB 9 pin com port is usually used, but you will need to know the difference between a Null Modem cable and a straight through cable. Most venders will have a cable for their instrument and it would be best to use it. Also, some of the instruments will have a switch that can reverse the Text Out (TX) and Receive (RX). Once you find a combination that works, save it. USB to Serial adapters can also be used. Some instruments (API is an example) have an internal buffer and when it is full it can inhibit serial communication. It is extremely helpful to have an individual who is very familiar with the guest instrument that you are setting up to assist with communication issues.

Baud Rate: The baud rate of the guest instrument. This can be found in the instruments manual, or on the instrument front panel display.

Bits,Parity,Stop: The settings for your instrument should be found in the instrument manual. They should usually be set to 8,n,1.

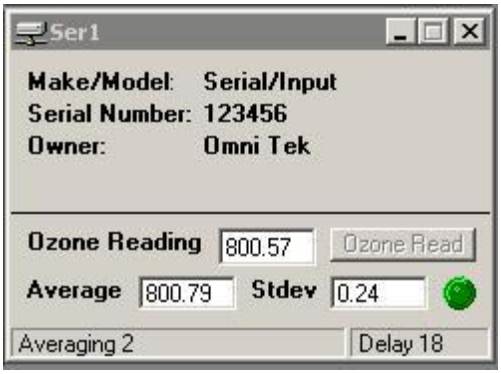
Inst Driver File: Select the driver file for your instrument model from the pull down menu. It is possible to write your own instrument ID if you understand the communication language to the guest instrument and the SRP. NIST may have some ID files for new instrument models. NIST is also willing to write an ID file for us, however, we would need to send the guest instrument to NIST for them to evaluate and write the ID file. Currently NIST and EPA are working on other options for converting an analog input into a serial input and at this time it is not available.

Instrument ID: Please note that the Instrument ID is typically used only for the TECO 49 Series. These instruments have an ID code that must be used in serial communications. Check your instrument manual or cycle thru the guest instrument front panel options in order to obtain instrument ID. This code is typically an ASCII number that requires you to add 128 to the ID, then input \ and the number. Example: Instrument ID = 59. 59 + 128 = 187. Enter "\187 "into the field. For any other instrument you may need to leave this blank.

Password: Some instruments require a password in order to communicate over a serial line. Check your instrument manual for the password.

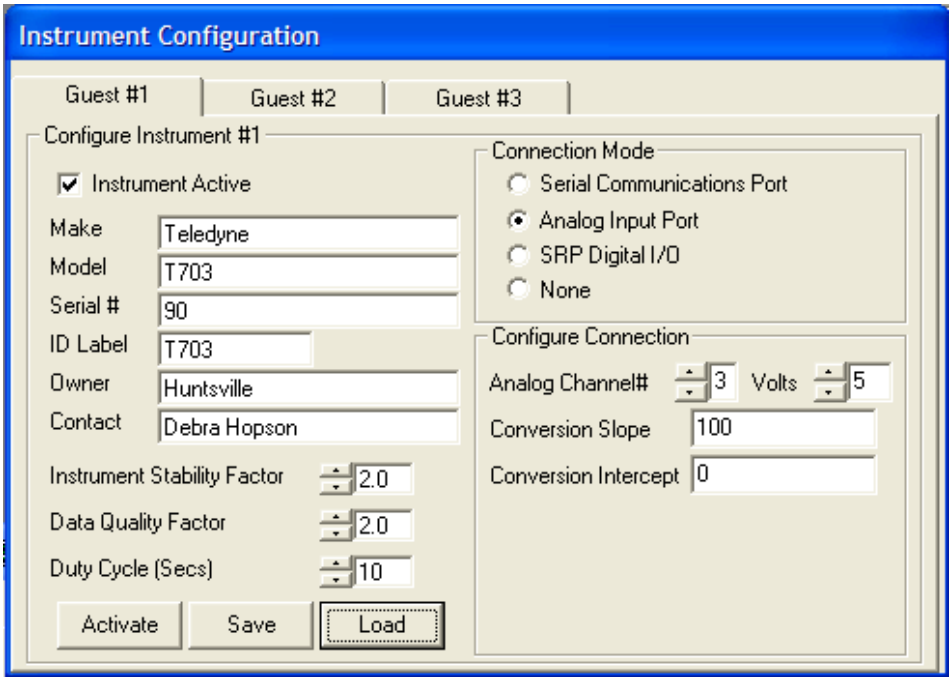
O_3 Generator: Check this option if the instrument has an internal O_3 generator that is controllable over the serial link, and you intend to use the internal generator instead of the SRP generator. Please note that it is discouraged not to use anything other than an SRP to generate O_3. There are two reasons for this. One: using an unknown source for O_3 can introduce contamination into your SRP and Two: many other generators may have a feedback loop for controlling the O_3 concentration. The end result will be that the generator is constantly "tweaking" the O_3 Lamp up and down to control the concentration selected and this can cause stability issues with the SRP. It should also be noted that in the new TAD (Link reference in Section 1.1) that the concentration should be evenly spaced rather than specific concentrations.

Duty Cycle (Secs): The time in seconds the instrument takes to update the O_3 reading. To measure this, turn on the instrument and time how long it takes for the O_3 reading to change (in seconds). Generally this takes 10 seconds or less.



Shown above is the guest instrument panel for a serial port instrument. The upper part of the panel is the instrument description, and the lower part of the panel shows the instrument data. The reported ***average*** is the average of the last four points. The reported Standard Deviation (***Stdev***) is the standard deviation of the last four points. The green indicator indicates that the instrument has passed the instrument stability factor test. A yellow indicator indicates instrument stability is marginal, but passed. A red indicator indicates failure of the stability test. There is also yellow (getting close), light green (for good) and dark green (for very good) The "***Ozone Read***" button can be used to retrieve an instrument reading.

2) Analog Input Port



The goal is to collect guest instrument data that agrees with the front panel. The front panel is the common denominator for all users of the instrument, regardless of the method used to record data during the comparison. So, the SRP Control software will be configured so that it collects data that matches the front panel, just as an end-user's data-logger could be adjusted to so that the analog data it collects matches the front panel.

The guest settings for analog input can be seen in the image above, and they are described below

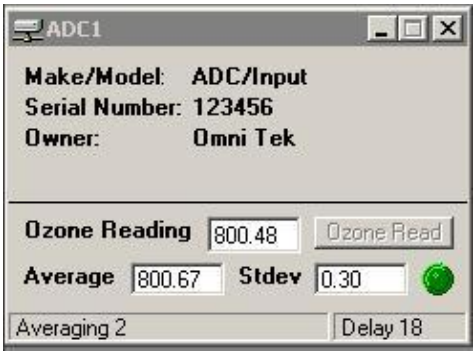
Analog Channel#: The channel number of the analog port to be used

Volts: The voltage range of the instrument analog output. If not an exact match to what is available, then choose the range that is closest.

Conversion slope: The value to multiply the raw voltage by to convert to concentration. For example: if a 5 volt maximum signal is available and the instrument is set to a range of 0 to 1000 ppb, then this factor should be set to 200 (1000/5). This can be adjusted to account for minor discrepancies between the O_3 readings from the analog output and the front display of the guest instrument. Also note that the higher the slope is that the higher the noise will be. This is further addressed in an upcoming section

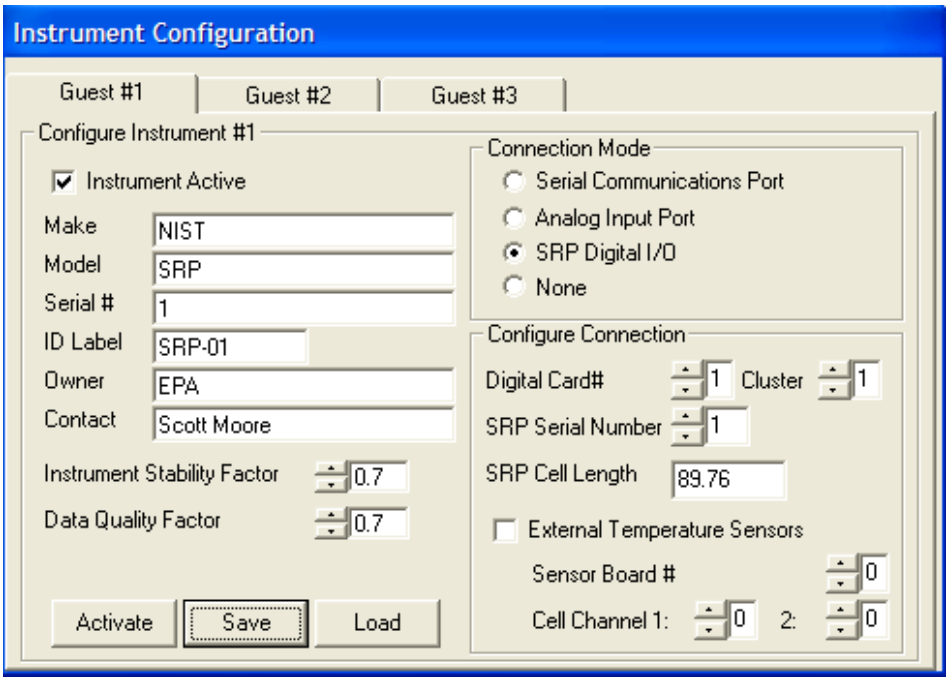
Conversion Intercept: The offset of the instrument at zero O_3 concentration. If you do not know this value then set it to zero. This can be adjusted to account for minor discrepancies between the O_3 readings from the analog output and the front display of the guest instrument.

Duty Cycle (Secs): The time in seconds the instrument takes to update the O_3 reading. To measure this, turn on the instrument and time how long it takes for the O_3 reading to change (in seconds). Generally this takes10 seconds or less.



Shown above is the guest instrument panel for an analog input port instrument. The upper part of the panel is the instrument description, and the lower part of the panel shows the instrument data. The reported ***average*** is the average of the last four points. The reported Standard Deviation (***Stdev***) is the standard deviation of the last four points. The green indicator indicates that the instrument has passed the instrument stability factor test. A yellow indicator indicates an instrument's stability is marginal, but passed. A red indicator indicates failure of the stability test. The "***Ozone Read***" button can be used to retrieve an instrument reading.

3) SRP Digital I/O



The guest settings for a SRP can be seen in the image above, and they are described below

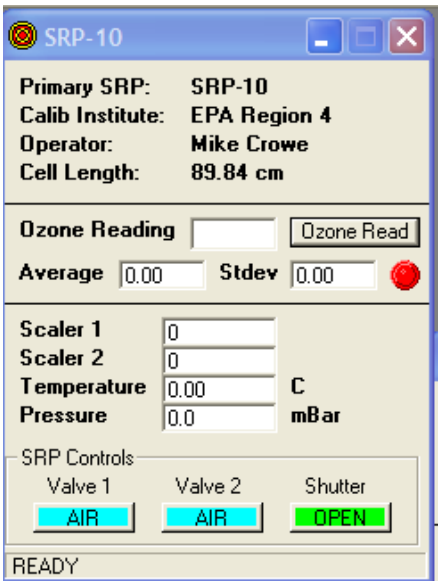
Digital Card#: The number assigned in InstaCal for the digital input card used with this SRP. This is set to 1 for the PCI-DIO24 card.

Cluster. The port cluster to use for this instrument (1 through 4). This is usually set to 1 for the PCI-DIO24 card.

SRP Serial Number: The serial number of the main SRP, this is found on the brass panel on the photometer

SRP Cell Length: The length in cm of the SRP gas cell. This value is for information only, and should be approximately 89.3 cm. If no value, or a zero value, appears here contact NIST.

Duty Cycle (Secs): The time, in seconds that it takes an instrument to complete a "cycle. In many instruments with dual cells a "measurement is taken with the O_3 in path "A" and then the solenoids will switch and O_3 will be read in path "B" and the opposite with Reference. You will need to listen for the solenoid valve to switch, or if there is a light to indicate when the solenoid switches to O_3 Read Path "A". This is your start time, the solenoids will then switch to read O_3 in Path "B", keep counting the time and then stop the timer when the solenoid switches back to read Path "A". This usually takes 20 seconds and it will help prevent the SRP from recording data from just one cell and skew the test results. Also if there is a noticeable discrepancy between Cell A and Cell B the owner should be informed to determine if they would like the cells to be cleaned. .



Shown above is the guest instrument panel for an SRP instrument. The upper part of the panel is the instrument description, and the middle part of the panel shows the instrument data. The reported ***average*** is the average of the last four points. The reported Standard Deviation (***Stdev***) is the standard deviation of the last four points. The green indicator indicates that the instrument has passed the instrument stability factor test. A yellow indicator indicates instrument stability is marginal, but passed. A red indicator indicates failure of the stability test. The "***Ozone Read***" button can be used to retrieve an instrument reading.

The lower part of the panel is visible only for SRPs:

Scaler 1: The current reading from the SRP for the Scaler 1 value.

Scaler 2: The current reading from the SRP for the Scaler 2value.

Temperature: The current temperature in the SRP cell.

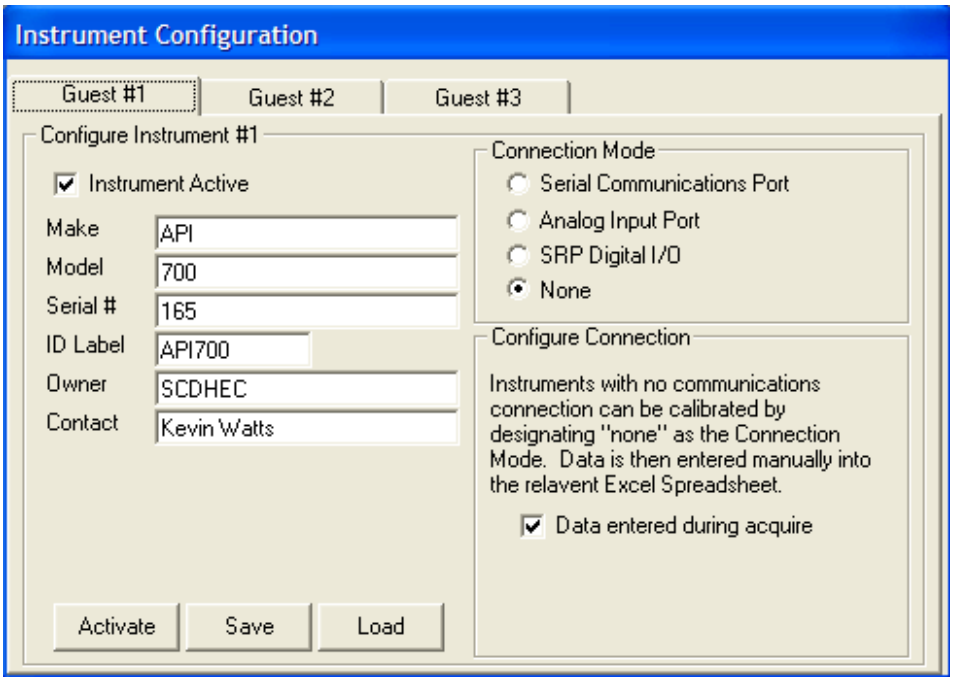
Pressure: The current pressure in the SRP cell.

Valve 1: The current state of cell 1 can be either reference air or O_3. This will allow control of the valve by the user during system inactivity.

Valve 2: The current state of cell 2 can be either reference air or O_3. This will allow control of the valve by the user during system inactivity.

Shutter: The current state of the shutter can be either open or closed. This is a button and allows control of the shutter by the user during system inactivity.

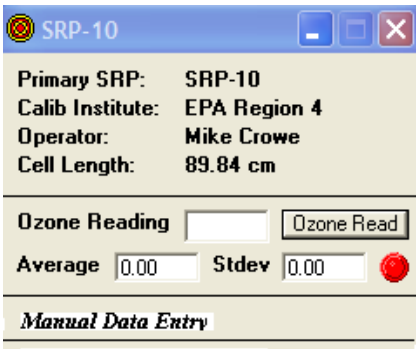
4) None



You may still verify older instruments that do not have the capability of communicating with the control program. You have two options for manual input of data:

Run the verification and write down the instrument concentrations. Then calculate and input the averages for each O_3 setting into the Excel™ spreadsheet.

As you run the verification you can enter the instrument reading into the guest instrument form. You do this by checking the "***Data entered during acquire***" option shown above. The guest instrument panel will then prompt you to enter the data. Enter the data from the front panel of the guest instrument into the O_3 Reading box (shown below) and hit enter.



Shown above is the guest instrument panel for a manual input instrument. The upper part of the panel is the instrument description, and the middle part of the panel shows the instrument data. The reported ***average*** is the average of the last four points. The reported Standard Deviation (***Stdev***) is the standard deviation of the last four points. The green indicator indicates that the instrument has passed the instrument stability factor test. A yellow indicator indicates instrument stability is marginal, but passed. A red indicator indicates failure of the stability test. One precautionary note: If you select "None" and then select "Manual Input" the SRP will still remember the COM Port used last time in Serial Mode. So if you used COM 1 on your last run and

you are now using “Manual Input” with a different guest assigned to COM 1 you may get a “COM Conflict Error”. You will need to go back into the configuration and change the “None” back to “Serial” and select a Com Port not being used and then go back to “None” and try again.

5.2 Guest Instrument Pneumatics Configuration

Guest instrument follows the sample pneumatics set-up as with the SRP initially outlined in section 3.2.3 interface through the dual external manifold. Key questions should be asked of the state operator about their guest instrument normal configuration on how they perform verification of their transfer standard. Ask about any special procedures or conditions they followed. Question on minimum pressure, flow requirements, communications, password, etc… That way verification between the SRP will be done in a similar manner as the guest instrument operates.

5.2.1 Reference supply for guest instruments

The reference air supply used in both the SRP and guest instrument should be in 1 LPM excess. Verify that the SRP supply air is greater than the sum of all the guest instruments to prevent room air from drawing into the manifold, check with a stopcock attached to a flow meter to make sure set-up is venting at the top of the glass dual external manifold. Note: At end of run, or when the valves are off, more air is needed in the reference manifold. Some guest instruments may require positive pressure for the reference and it should be delivered at the same pressure used during guest instrument verification.

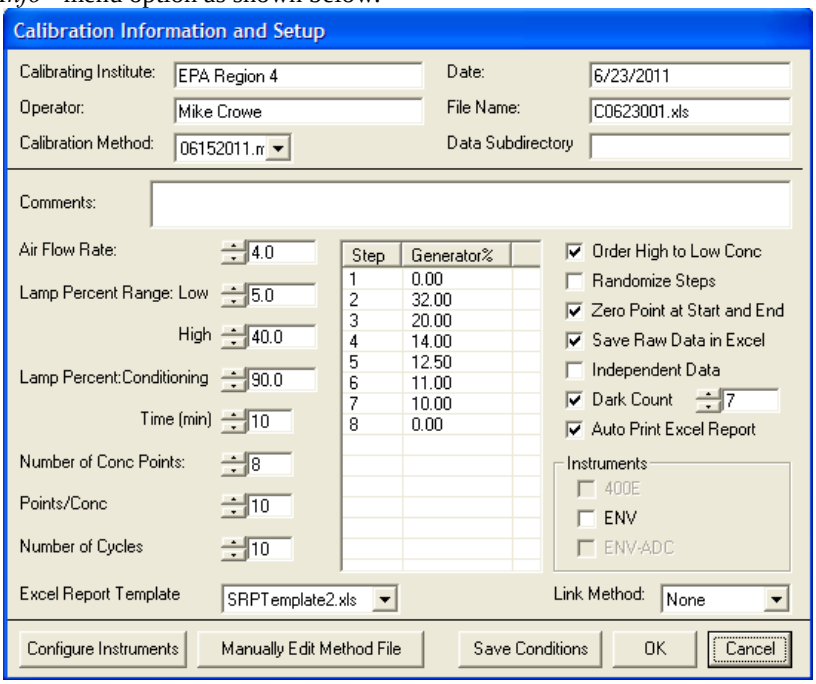
5.2.2 Sample supply for guest instruments.

The sample supply for guest instrument should be taken from one of the four fittings on the dual external manifold “S”. Prior to initiating a run, ensure that there is at least one liter per minute of excess by using a stopcock and a rotameter to check sample flow at the top of the glass sample manifold. Ensure that the guest instrument is being operated under normal conditions. Guest Instrument Calibration Information

The SRP comparison is accomplished by comparing a minimum of 7 replicate values of a zero point and a minimum of 6 upscale audit concentrations points. This 7 replicate 6 upscale concentration test is considered a cycle. At a minimum, the comparison will consist of three cycles (approximately 1 hour per cycle). For an acceptable comparison, the average slopes of the 7 replicates for each audit point must be within ± 3% for all three cycles and ± 3 ppb at the 0 intercept. The SPRControl program allows for unattended runs, making it is easy to run additional replicates and cycles overnight during these verification tests.

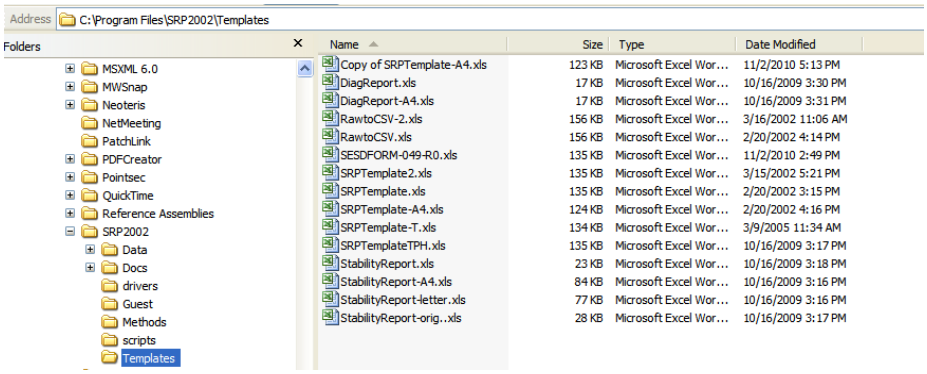
NOTE on running a 6x6; This is basically the same as mentioned above but it would be 3 cycles (or more) per day and the range is 4% and the guest instruments should be powered down for a minimum of one hour before starting the next day’s challenges.

The program must be setup for operation with guest instruments through the *"Edit/Calibration Info"* menu option as shown below.



Either load a saved calibration method or manually edit the *parameters to perform* the Level 2 verification (the program refers to this as a calibration).

- Set the *Air Flow Rate* high enough to supply the SRP and all guest instruments with sample, plus at least one liter per minute surplus.
- Set *Lamp Percent Range Low to High;*
- Set the *Lamp Percent* to 90% (used in auto selecting *Generator %*);
- Set the *Time* in minutes;
- Set the number of *Conc Points*, *Points/Conc*, and *Number of Cycles* per verification test.
- Select Choice of Options(on right): *Order High to Low Conc, Randomize Steps, Zero Point at Start and End, Save Raw Data in Excel™, Independent Data, Dark Count, and Auto Print Excel™ Report;*
- Enter Lamp% high and low ranges or manually enter *Generator% values by double clicking on the values in the Generator% column.*
- Select Instruments to also include (on right).



- Load the Excel™ Report Template – to be used in Client's report (*see Appendix B).*

Save Conditions once completed. Click *OK* if all options are correct. Select *Configure Instruments as in section 5.1* activate instrument and proceed to run Calibration to perform verification.

Over the past decade, ambient ozone concentrations, on average, have decreased substantially. There is also increased interest in assessing the quality of trace-level ambient ozone concentrations. Newer, commercially available ozone analyzers and transfer standards typically demonstrate excellent accuracy, precision, and linearity. Historically, the SRPcomparison concentration points were evenly spaced throughout the full-scale of the guest instrument. But it has recently been suggested that the concentrations selected for Level 2 ozone transfer standard comparisons reflect the lower ambient ozone concentrations, as well as the new levels that have been selected for audit concentrations.
The MEMORANDUM located on the AMTIC website http://www.epa.gov/ttn/amtic/cpreldoc.htm. 11/10/10 from Lewis Weinstock addresses the use of an expanded list of audit levels for Annual Performance Evaluations for SO_2, NO_2, O_3, and CO as Described in 40 CFR Part 58 Appendix A Section 3.2.2. O_3 audit concentrations range from 5 ppb to 300 ppb over ten levels, in order to be more in line with real ambient concentrations. When selecting concentrations for use during Level 2 ozone transfer standard verifications, SRP operators should assess the need to manually select generator percentages that will provide the Level 2 instruments with traceability at lower ozone concentrations.

5.3 Examples of Common Commercial Instrument Configurations

SRP operators should make a list of each commercial instrument that receives a request for Level 2 verification by state/local organization. Include unique communication requirements, passwords, etc., in order to easily load the required instrument driver that allows for the direct communication between SRP and guest instrument, through Serial Communications Port, Analog Input Port, or Digital I/O.

- The current drivers are available plus any additional that are saved: