SIERRA INSTRUMENTS
THE MASS FLOW COMPANY

CAL-TRAK™ XL

Gas Flow Calibrator
Instruction Manual

Revision A **September 2008**

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1.0 General Description

The Sierra Cal=Trak XL is our first automated primary gas flow calibrator for measuring flows up to 500 slpm (17.6 scfm) since the Sierra Cal=Bench Bell Prover system was discontinued 10 years ago. Using near-frictionless piston technology, it combines the accuracy of a primary standard with unequaled speed and convenience. Cal=Trak XL provides all this in a compact package (24 x 36 x 12 inches)—less than half the size of traditional bell provers!

By design, the Cal=Trak XL is a primary volumetric flow device. It measures the rate of rise of a piston inside a precisely defined glass cylinder. Only time and distance are used to calculate the flow rate—the definition of a primary standard (see 2.0 below for detailed description).

As many applications for flow measurement and calibration require mass flow instead of volumetric flow, Cal=Trak XL utilizes extreme precision pressure and temperature transducers to convert volume to mass flow. What makes Cal=Trak XL special is the speed and convenience at which extremely accurate (0.25% reading) mass flow readings are obtained. With the push of a button, Cal=Trak XL will take flow readings manually, one reading at a time, or in series in the continuous mode. The Cal=Trak can be programmed for 1 to 100 readings in an averaging sequence. It can be used to measure gas flow rates from most positive pressure sources or under vacuum.

Cal=Trak XL includes a convenient LCD display and keypad at the base that permits user-configuration of many measurement parameters. In addition, Cal=Trak XL utilizes an RS-232 port for computer interface capability. By using this capability with our provided Cal=Soft Software (on included CD), Cal=Trak XL becomes part of an automated system for validation or calibration of flow instruments. For validation of Mass Flow Meters and Rotameters (see Chapter 7 for installation details), you can purchase from Sierra our Model C100H-XL flow controller specially calibrated to work with the Cal=Trak XL. This MFC, when used with the Cal=Soft Software, provides a series of flow set points to your DUT while the Cal=Trak XL validates the flow rates and the software collects all the data--Automatically! When the sequence is complete, you can save the data on your computer and even print out a Calibration Certificate of the results. To validate Sierra 100 Series Mass Flow Controllers, simply connect the DUT upstream of your Cal=Trak XL. Connect both to your computer running the Cal=Soft program and you can validate instrument performance with total automation. If you have other makes of flow controllers, contact you Sierra Distributor for information on our upcoming Universal Calibration Electronics that will offer these capabilities for any brand of instruments you have or for complete calibration system commissioning services. Appendix C: *Cal=Soft Communication Program* at the end of this Manual provides full details on installing and operating your Cal=Trak XL from a computer.

2.0 Theory of Operation

The Sierra Cal=Trak XL is a true primary gas standard. The time required for the graphite composite piston to traverse a known distance through the flow cylinder is precisely measured and an internal computer calculates the flow. The volumetric accuracy of the instrument is built into its dimensional characteristics. Standardization of the gas flow readings to obtain mass flow is achieved with precisely calibrated temperature and pressure sensors.

Piston provers like the Cal=Trak are characterized by the most basic of quantities: length and time. As flow is necessarily a derived unit, such a dimensionally-characterized system is as close as possible to direct traceability from national dimensional standards.

An idealized piston prover would consist of a mass-less, friction-less, leakproof, shape-invariant and impermeable piston inserted within the flow stream and enclosed by a perfect cylinder. The time that the piston takes to move a known distance (which implies a known volume) yields the volumetric flow *Q* as:

$$Q = V / T = \pi r^2 h / T$$

Where:

- V is measured volume
- T = measurement time
- r = radius of cylinder
- h = length (height) of measurement path

Such a device would be as accurate as its physical dimensions and its clock, with almost insignificant drift mechanisms. Although such idealized devices do not exist, we believe the Cal=Trak offers close to ideal performance.

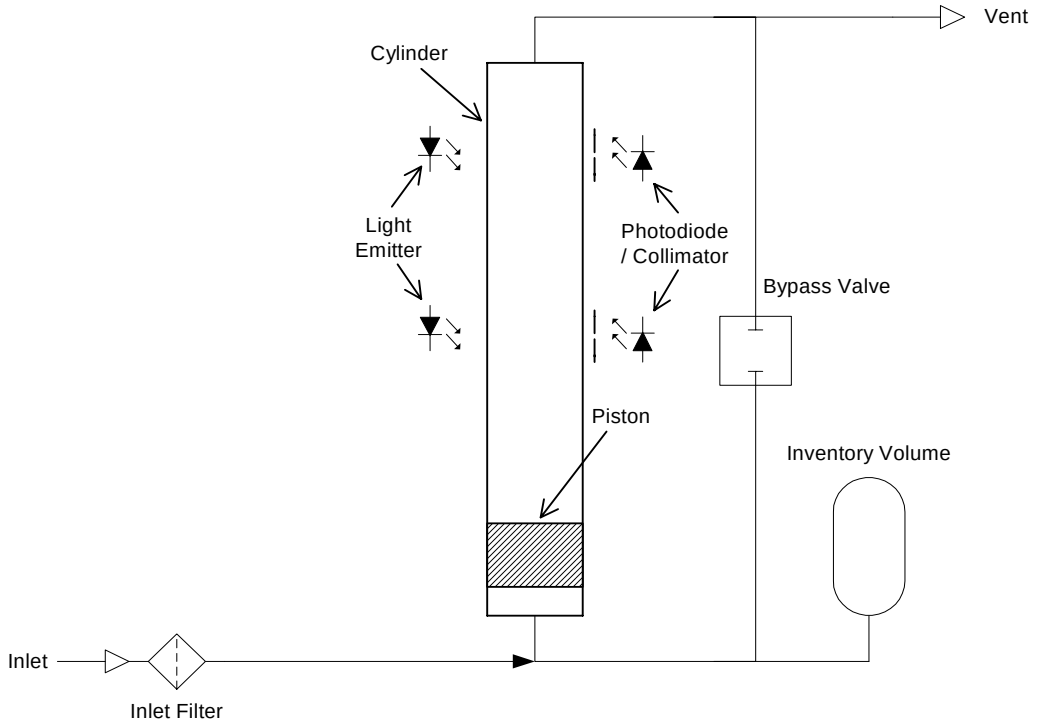

Figure 1 Idealized Piston Prover

The Cal=Trak clearance-sealed prover uses a piston and cylinder fitted so closely that the viscosity of the gas under test results in a leakage small enough to be insignificant. For reasonable leakage rates, such a gap must be approximately 10 microns. As a practical matter, the piston and cylinder are made of graphite and borosilicate glass because of their low, matched temperature coefficients of expansion and low friction (Figure 1). In order to make an intrinsically volumetric device useful for measurement of gases, it is generally necessary to adjust the readings to a standardized temperature and pressure, yielding mass flow. For this reason, we include temperature and pressure transducers to allow computation of standard (mass) flow by the internal computer (Figure 2).

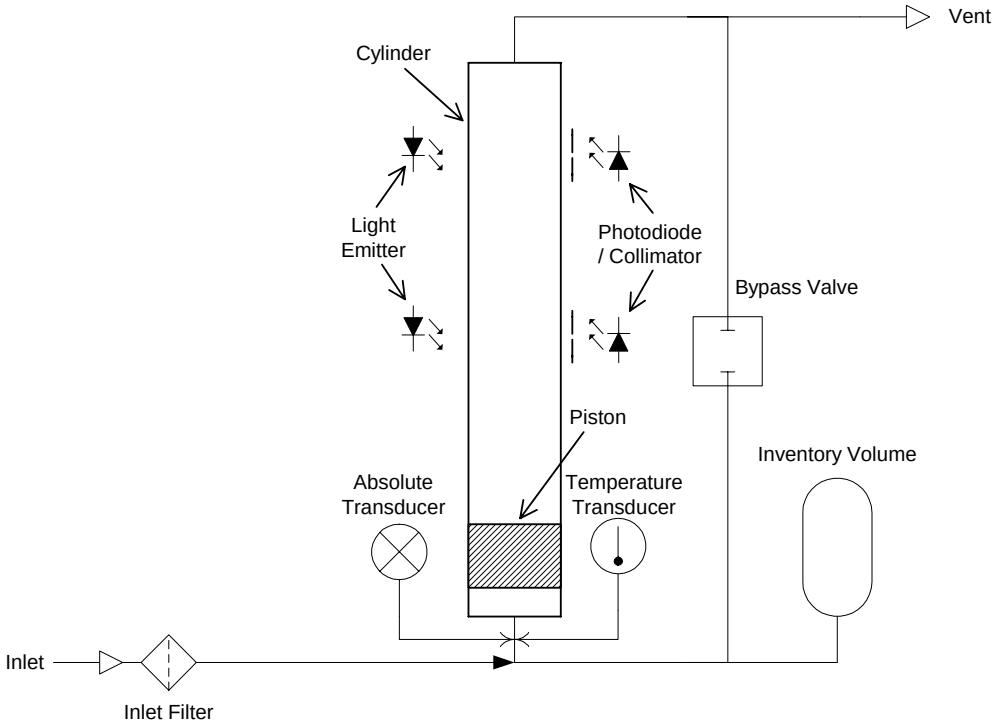

Figure 2 Practical Piston Prover

3.0 Unpacking your Cal=Trak XL

Your Sierra Cal=Trak XL will arrive packed in its reusable shipping container. Upon removing your calibrator, please keep this container for return of the Cal=Trak XL to the factory for calibration or in the event service is required.

The Cal=Trak XL weighs 90 lbs (41 kg). We recommend that a minimum of 2 people unpack the calibrator from the shipping container. Remove your new calibrator from the shipping container by verifying the nuts on the large inlet and outlet fittings are tight and lifting it by these fittings. During this process, the top of the Cal=Trak XL should be supported to prevent tipping

The Cal=Trak XL includes all components necessary for complete operation. Please take a moment to check that you have received the following items. If you believe you have not received a full shipment or if you have any questions, please contact Sierra immediately.

Your Cal=Trak XL Includes

- AC Power Adapter / Battery Charger
- RS-232 Cable
- Instruction Manual
- Certificate of Calibration (behind top cover foam insert)
- Cal=Soft CD-ROM (Application software for downloading data to your computer and making calibration certificates)

4.0 Warnings

⚠ The Sierra Cal=Trak XL is not intrinsically-safe and is not for use with explosive or flammable gases, or for use in explosive environments. If you choose to calibrate explosive or flammable gases with your Cal=Trak XL, please follow your organization's laboratory safety procedures, which typically require operation within an inert atmosphere. To enable use in an inert atmosphere, your Cal=Trak XL has two (2) ¼" gas **Purge** fittings, located on its right side, and its electronics are isolated from the gas flow stream, contained within an internal, partitioned compartment.

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⚠ The Sierra Cal=Trak XL is designed for use at ambient pressures. This is easiest to obtain by leaving the outlet open to atmospheric pressure. For vented applications, make certain that your calibrator does not experience pressure above 20 psiA. In other words, the pressure differential across the flow cell must be less than 0.27 bar (4 psi) or the flow cell may be damaged. If pressurization reaches 19 psiA, the following warning will appear on the display on the main control panel: "OVERPRESSURE!" If this occurs, remove the overpressure situation and then choose "Reset" from the LCD display to clear this warning.

⚠ The Sierra Cal=Trak XL is not designed for gas flow rates above 500 slpm. If the flow rate exceeds 500 slpm, an error message will appear in the display. Reduce the flow immediately or your calibrator could be damaged.

⚠ The Sierra Cal=Trak is for use with clean laboratory air or other inert, non-corrosive gases only.

⚠The Sierra Cal=Trak XL does not contain user-serviceable parts and must be returned to the factory for maintenance or repair. The calibrator uses lasers for timing of the piston displacement during gas flow measurement. It is certified as a "Class 1" laser product because radiation emitted inside the instrument is completely confined within the housing. Non accessible Internal Laser Parameters:

Wavelength: 840 – 860 nm

Laser Power: < 5mW

Beam Divergence: 10°

5.0 Cal=Trak XL Layout

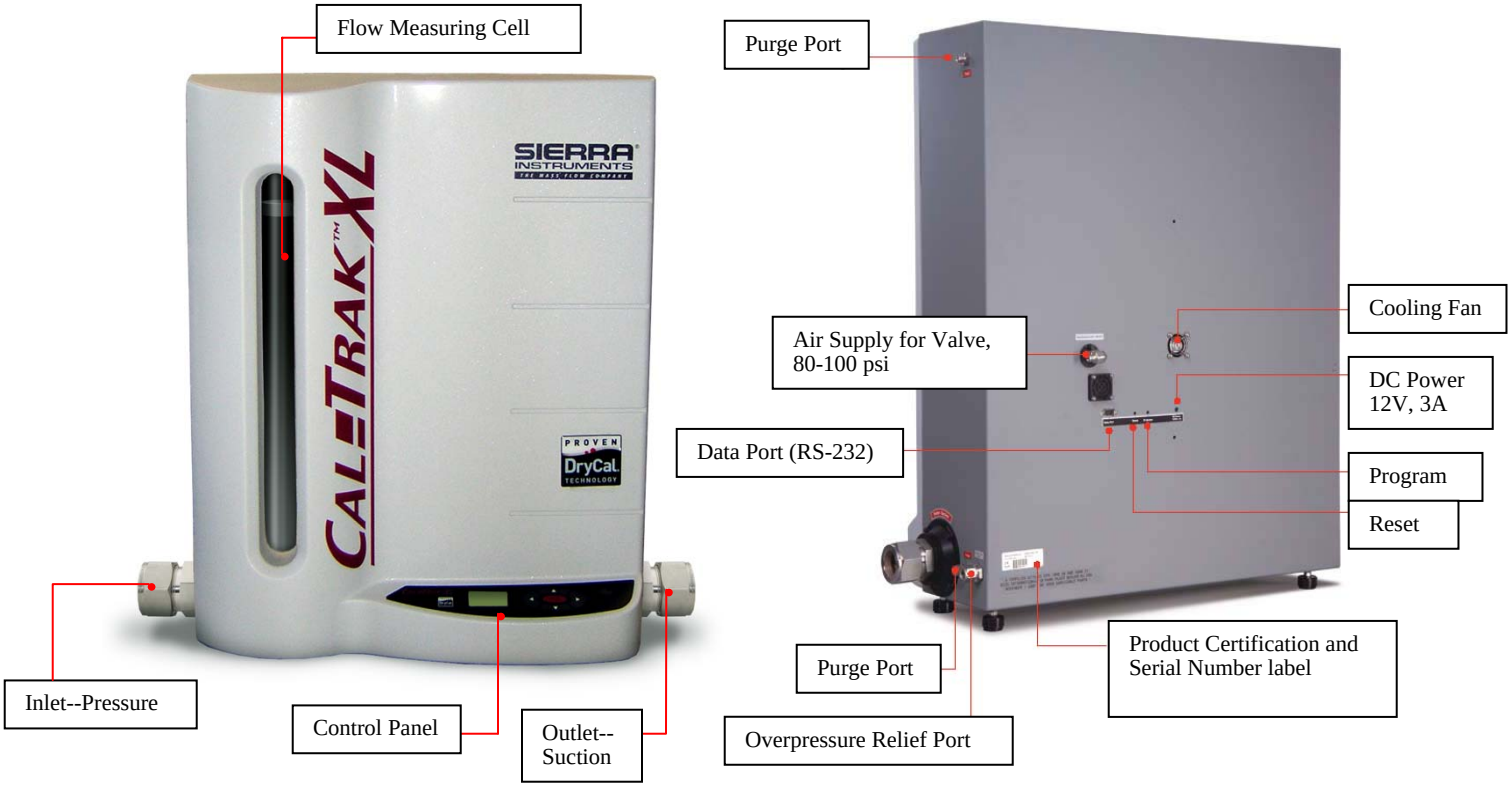


Figure 3 Cal=Trak Layout

6.0 Cal=Trak XL Installation

6.1 Measurement Gas Connections

The Sierra Cal=Trak XL must be placed on a stable, secure work surface. Use the adjustable feet on the calibrator base to make certain your Cal=Trak XL is secure. Remove the protective caps on the Inlet and Outlet fittings. Use the minimum length of tubing necessary between your calibrator and the flow source. As with all piston provers, minimizing the inventory volume between your device under test and the calibrator assures the greatest accuracy of measurement.

When using a positive pressure flow source, connect the gas line to the 1.5" compression fitting labeled Inlet--Pressure (Figure 3). When using a suction (vacuum) flow source, connect the gas line to the 1.5" compression fitting labeled Outlet--Suction (Figure 3).

The internal pressure transducer in the Cal=Trak XL is rated at 19.5 psia, or 4.8 psi more than normal ambient pressure at sea level. When taking mass flow measurements, we recommend that any tubing or exhaust vent line connected to the calibrator's outlet fitting have a maximum pressure drop of 3 psi (200 mbar) or less.

When taking volumetric flow measurements, there should be no significant pressure difference (such as the pressure drop of restrictive tubing or filters) between your Cal=Trak XL and the point in the flow stream that is of interest (i.e., at its inlet or outlet fitting). If there is a significant pressure difference, there will also be a corresponding volumetric flow difference (from the Ideal Gas Law). In that case, the Cal=Trak XL's indicated volumetric flow should be adjusted by a factor of the absolute pressure at your calibrator divided by the absolute pressure at the point of interest.

6.2 Power

Plug your AC power adapter/charger (supplied) into an AC wall outlet, and attach its DC output cord to the rear connection (DC Power 12VDC, 3A) on your Cal=Trak XL.

6.3 Valve Actuation Air Supply

Your Cal=Trak XL uses an internal valve that is actuated by air pressure. It must be connected to an air source of at least 80 psig and no higher than 100 psig. Connect your facility air supply to the ¼ compression fitting on the back panel of the calibrator (see "Air Supply for Valve" Figure 3). Turn on your air source and verify that the pressure is between 80 to 100 psig.

6.4 Overpressure Exhaust

When your Cal=Trak XL completes a flow measurement, its internal valve opens, releasing the gas from the flow cell and enabling the piston to drop to the bottom (reset). If for any reason the valve doesn't open, the piston will remain at the top of the flow cell and pressure will build. To prevent damage that could result from over-pressurization of the flow cell, your Cal=Trak XL is equipped with a safety pressure relief valve. This vale will open in an over-pressure situation, exhausting the gas through a ½" Swagelok® fitting (see "Overpressure Relief Port" in Figure 3). If this fitting is currently open to ambient and you don't want the gas to vent to atmosphere, you should connect a direct line from this fitting to your exhaust system; or, if your calibrator is already directly connected to your exhaust system, you can "tee" a line from the Overpressure Relief Port fitting into your exhaust line.

6.5 Purge Fittings

Your Cal=Trak XL is not intrinsically-safe for use with explosive or flammable gases (see section 4.0 Warnings). If you choose to calibrate explosive or flammable gases with your Cal=Trak XL, please follow your organization's laboratory safety procedures, which typically require operation within an inert atmosphere. To enable use in an inert atmosphere, your Cal=Trak XL has two (2) ¼" compression gas **Purge** fittings, located on its right (outlet) side. Connect inert purge gas to these fittings and make sure purge gas is flowing before supplying flammable gases to your calibrator. The Cal=Trak XL also has its electronics isolated from the gas flow stream contained within an internal, partitioned compartment. But, electric current is still present within the gas flow stream at the pressure and temperature sensors.

6.6 The Cal=Trak Measurement Cycle

Operation of a Cal=Trak XL is extraordinarily simple, and little training is required. However, any measurement interacts with the device being calibrated to some degree. Often, these interactions are negligible. However, sometimes device interactions can seriously affect measurement accuracy. Here we will explain what happens during a Cal=Trak XL measurement to aid in installing and using the instrument appropriately.

In its inactive state, the Cal=Trak XL will, like any device, exhibit a constant insertion pressure drop. At all but the highest flows, the pressure drop is very small. In the inactive state, gas flows from the inlet to the outlet through the bypass valve (Figure 2 above). When a measurement cycle begins, the bypass valve closes, and the gas is directed into the cylinder, effectively inserting the piston in series with the gas flow, allowing measurement. Timing commences after the piston has accelerated to the flow stream's speed. At the end of the timed cycle, the valve opens and the piston falls to its inactive position at the bottom of the cylinder.

In real-world applications, there are significant dynamics to consider. At the beginning of a cycle, pressure rises rapidly until the piston accelerates to the speed of the flow stream. Figure 4 is an illustration of a typical Cal=Trak's internal pressure during a measurement cycle. A near-maximum flow rate is illustrated to accentuate the pressure variations. The initial pressure pulse, lasting some tens of milliseconds, reaches a peak of about 0.5 kPa, or 0.5% of its working, near-atmospheric pressure. The pressure settles out to about 0.1 kPa (0.1% of working pressure) during the timed period. This pressure represents the added pressure due to the weight of the piston. Very small oscillations continue due to the piston's under damped nature.

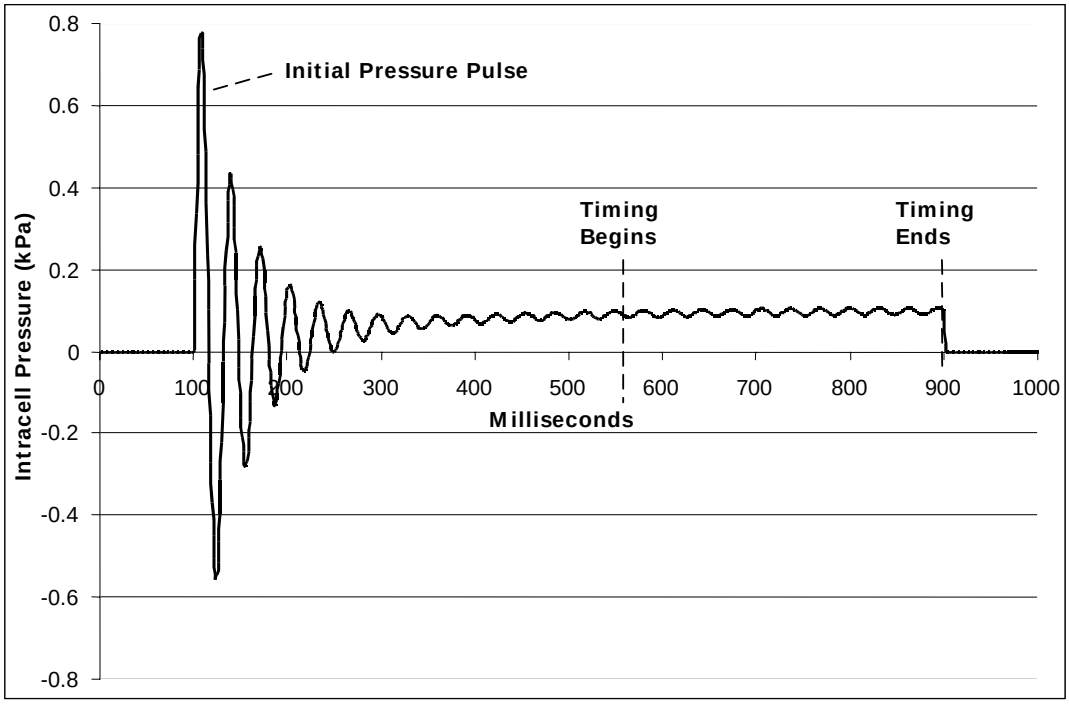


Figure 4 Cal=Trak Internal Pressure

6.7 Application Precautions

Initial Pressure Pulse

Although the Cal=Trak XL's dynamic pressure effects are very small, about 1% of an atmosphere or less, in some circumstances they may affect the measurement or interact with the device under test.. Two examples of this are the resonant transducers used in LFE systems or capillary-based thermal devices like MFCs. As a result, certain precautions should be observed when using a Cal=Trak XL.

Intra-Cycle Pressure Change

After the initial brief pressure pulse, the change in insertion pressure is typically 0.1% of an atmosphere (~0.1 kPa or 1 cm water column). Often, this is insignificant. For example, flow from a 100 kPa gauge pressure (15 psi) source will change by 0.1%. However, the lower the pressure source, the larger the flow changes will be during a Cal=Trak XL cycle.

Minimizing the Flow Impact of Pressure Effects

When the Cal=Trak XL begins its measurement cycle, the piston's weight causes the internal pressure to rise by about 0.001 atmospheres (~0.1 kPa). If a simple pressure regulator feeds the test chain, we are simply using the resistance of the entire flow chain to set our flow rate. The rate will then change significantly when the Cal=Trak XL is in its measurement cycle. This can cause the actual flow measured during the cycles to be less than the average flow seen by the DUT. Therefore, the best way to minimize any impact on flow rate from the Cal=Trak XL's cyclic pressure changes is to maintain a constant inlet pressure to the DUT (or flow limiting element) at 30 psig (2 barg) or higher. Sierra recommends dual pressure regulators upstream of the DUT to maintain the pressure at this value. At a stable 30 psig (2barg) inlet pressure, the impact of the piston's insertion pressure change during the measurement cycle will be <0.05%. Note this is the pressure upstream of the DUT, not necessarily the pressure into the Cal=Trak XL.

6.8 Comparison vs. Calibration

Calibration consists of comparing an instrument with one of significantly greater accuracy (ideally, at least four times the accuracy of the device under test--the "4 to 1 rule" widely accepted by industry). We use the term "comparison" in most of the following applications because, depending upon their respective accuracies, either device can be calibrating (or simply compared with) the other.

For example, a 0.2% LFE can calibrate a .08 % LFE, while a 0.25% Cal=Trak XL can calibrate a 1.0% mass flow controller. On the other hand, a 0.15% lab prover cannot calibrate a 0.15% Cal=Trak to its rated accuracy (or vice-versa). One can calibrate the other to only 0.3% with great certainty, so we simply call it a comparison.

7.0 Installation Diagrams and Application Guide

The Cal=Trak XL is one of the simplest gas flow calibrators to use. In fact, it is so easy, the actual plumbing of the flow system used with the Calibrator is often overlooked. This can lead to reduced accuracy from your calibrator as the discussions above have described. So, please review the following Installation Diagrams and confirm that your Cal=Trak XL is properly installed for optimum accuracy depending on the type of instrument it will be calibrating.

7.1 Comparison of Cal=Trak XL with Piston or Bell Provers

Piston or bell provers have a much longer measurement time than the Cal=Trak XL. For this reason, it is possible to compare them simultaneously, but the precautions outlined above must be observed: pressure must be double-regulated and > 30 psig (2 barg).

For a comparison of the Cal=Trak XL with Bell Provers, we recommend the setup shown in Figure 5. The adjustable regulator is used to set the flow rate within the range of a properly sized flow restrictor. A bell prover cycle is instituted. The Cal=Trak and the prover can then be alternately measured using the fixed flow source.

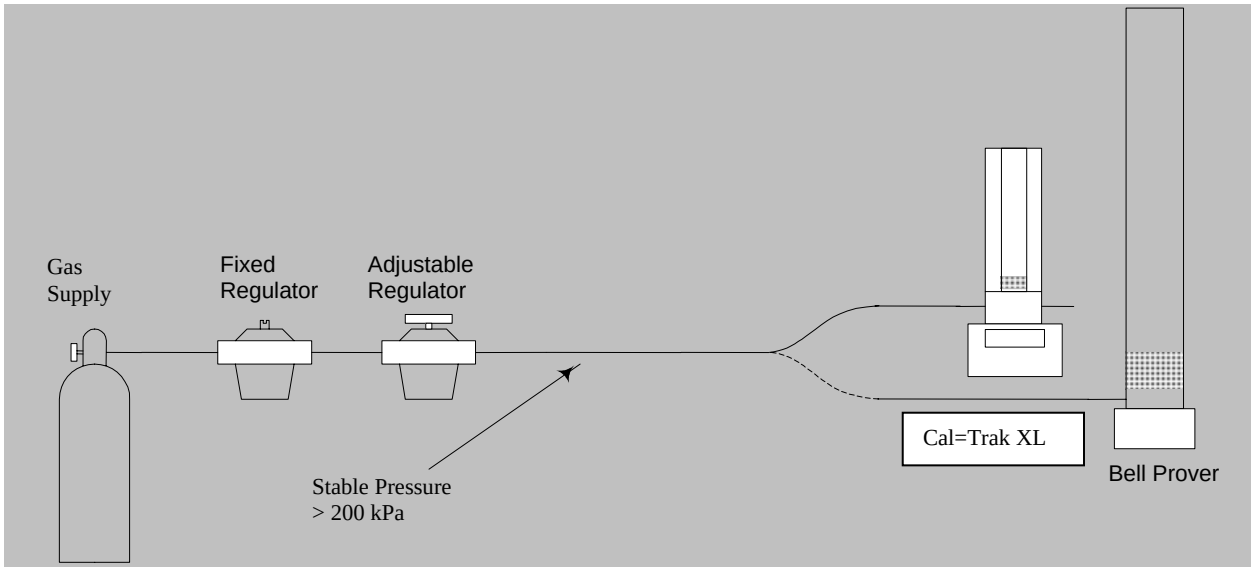


Figure 5 Setup for Piston or Bell Provers

An alternative approach can be used with piston provers, as shown in Figure 6. A cycle is initiated on the prover, which is much slower than a Cal=Trak XL. The Cal=Trak XL is then started in a cyclical mode, averaging its flow. Before the prover ends its cycle, the Cal=Trak XL is stopped and the average flow read.

The Cal=Trak XL can be set for sufficient cycles in its average to allow interruption by the “stop” button, or smaller averages, such as 5 or 10 readings, can be taken during the prover cycle. It should be noted that the periodic pressure pulses might cause oscillations in bell provers, reducing the bell prover’s accuracy somewhat.

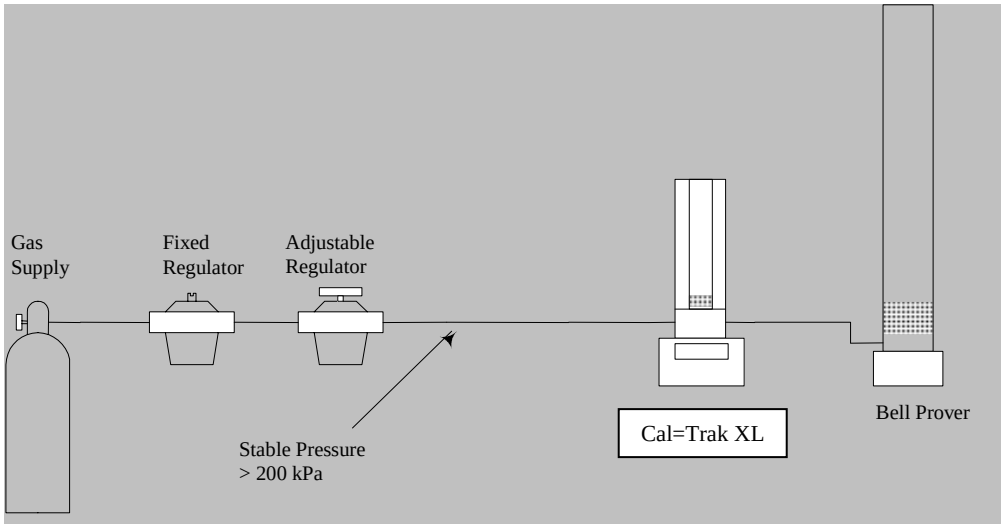


Figure 6 Alternative Setup for Bell Provers

7.2 Vacuum Comparison of Cal=Trak with Piston or Bell Provers

The Cal=Trak XL operates similarly in both pressure and suction (vacuum) applications. With a piston or bell prover, the setup of Figure 7 should be used for vacuum applications. Note that the inlet to the Cal=Trak XL is at atmospheric pressure while dual back-pressure regulators are be used. Be very careful if the inlet to the Cal=Trak XL is not at ambient pressure as it can be easy to create an over-pressure situation. See Section 4 and Section 6 about pressure cautions

In volumetric, comparisons, it is important to compensate for the difference in outlet temperature from input temperature. Although the pressure is the same on each end, the restrictor and the pump affect the outlet temperature and flow must be normalized to the inlet (ambient) temperature.

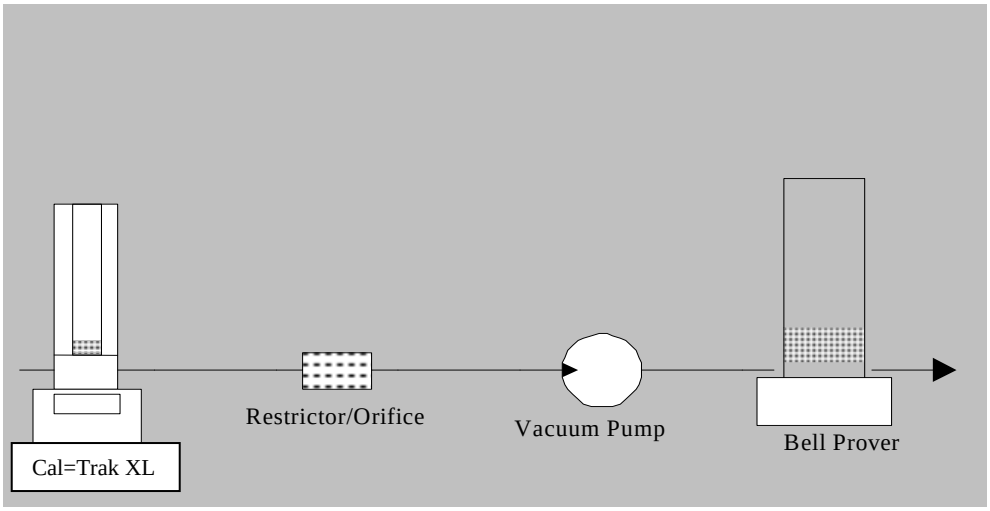


Figure 7 Vacuum Setup for Piston or Bell Provers

7.3 Comparison of Cal=Trak with Laminar Flow Element Transfer Standards

When the Cal=Trak XL begins its cycle, the piston's acceleration causes the internal pressure to spike briefly by about 0.01 atmosphere (~1 kPa). The pressure then remains elevated by about 0.001 atmosphere (~0.1 kPa) due to the piston's weight. If a simple pressure regulator feeds the test chain, we are simply using the resistance of the entire flow chain to set our flow rate. The rate may then change significantly when the Cal=Trak XL is in its measurement cycle. This will cause the actual flow measured during the Cal=Trak cycles to be less than the average flow seen by the laminar flow element (LFE). Moreover, the initial pressure pulse may cause the LFE instrument's sensitive pressure transducers to be destabilized for several seconds. For the latter reason, the LFE instrument should be read only immediately before the Cal=Trak XL reading, and afterward only when the LFE instrument's readings stabilize. At low flows, the Cal=Trak XL measurement may take sufficient time to allow LFE stabilization. In that case, the instruments can be read simultaneously.

In addition, the flow must not be affected significantly by the Cal=Trak XL's cyclic pressure increase. This can be achieved by use of a sonic nozzle as the stable flow source, or by feeding a fixed restrictor with a precisely regulated pressure of more than 200 kPa. (At 200 kPa [30 PSI], the dynamic flow decrease caused by the piston's weight will be about 0.05%.)

For this type of calibration, we can use the setup shown in Figure 8. The adjustable regulator is used to set the flow rate within the range of a properly sized flow restrictor.

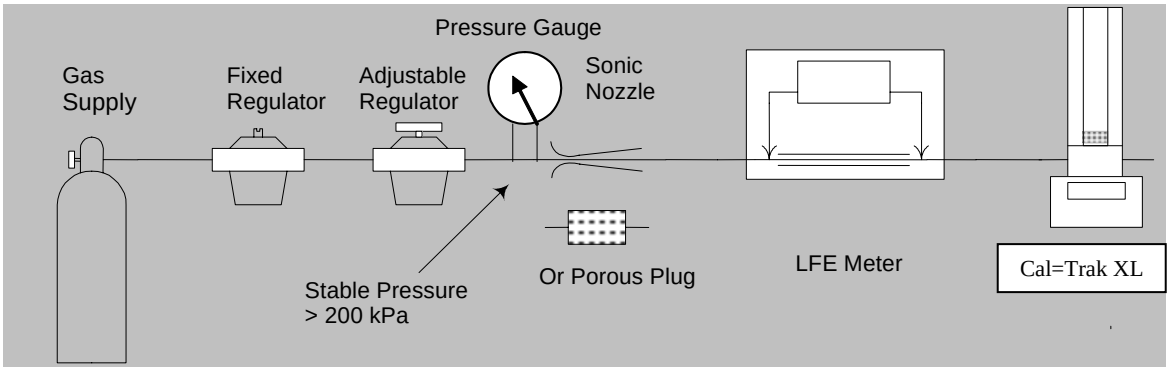


Figure 8 Setup for LFE Transfer Standards

7.4 Comparison of Cal=Trak with Sonic Nozzle Transfer Standards

A high quality sonic nozzle used above its critical pressure ratio will supply a constant flow despite changes in its outlet pressure. For this reason, a calibrated sonic nozzle can be compared to a Cal=Trak XL by simply connecting its outlet to the Cal=Trak's inlet as shown below in Figure 9. It is not recommended to calibrate a sonic nozzle under vacuum conditions because the cycling of the Cal=Trak XL can cause a slight change in the nozzle's inlet pressure, leading to changing flows.

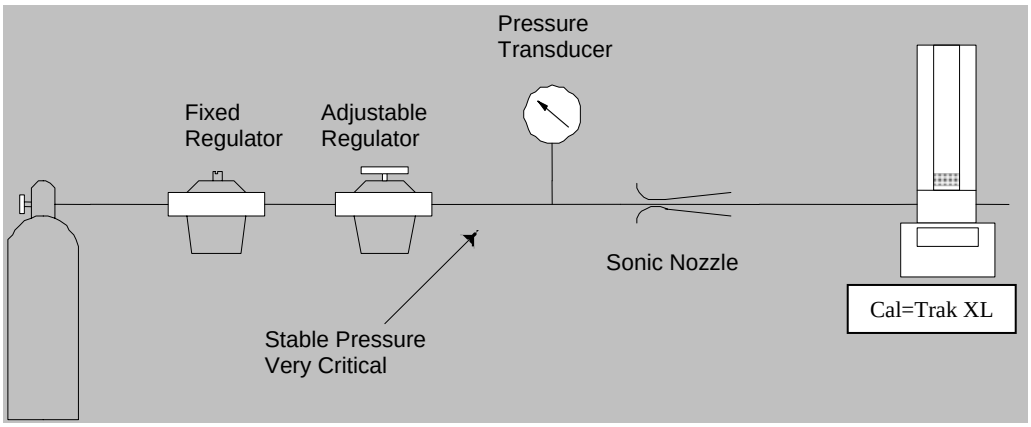


Figure 9 Setup for Sonic Nozzle Transfer Standard

7.5 Calibration of Mass Flow Controllers (MFCs)

Modern mass flow controllers have fast response times on the order of milliseconds. They can simply be connected to an appropriate inert gas source and their output stream applied to the Cal=Trak XL, as shown in Figure 10. Proper calibration consists of comparing the Cal=Trak XL reading to the MFCs actual indicated flow and not to its control signal.

If a slow response flow controller is to be calibrated, it is best to calibrate it in its metering mode. Apply the appropriate signal to fully open the controller's internal valve (full scale or "purge"), and calibrate the device as shown for mass flow meters (MFMs), below.

Remember that the Cal-Trak XL is designed to be operated at ambient pressure. If the outlet pressure of the MFC is atmospheric, then Figure 9 is correct. If the outlet pressure of the MFC is above ambient, insert a back-pressure regulator and a pressure gauge between the MFC and the Cal=Trak. Adjust the back pressure regulator until the pressure gauge reads the correct pressure for the MFC under test (usually the same pressure the device will see in its normal operation). Calibrate under the actual operating pressures with the outlet of the Cal=Trak XL at atmospheric pressure.

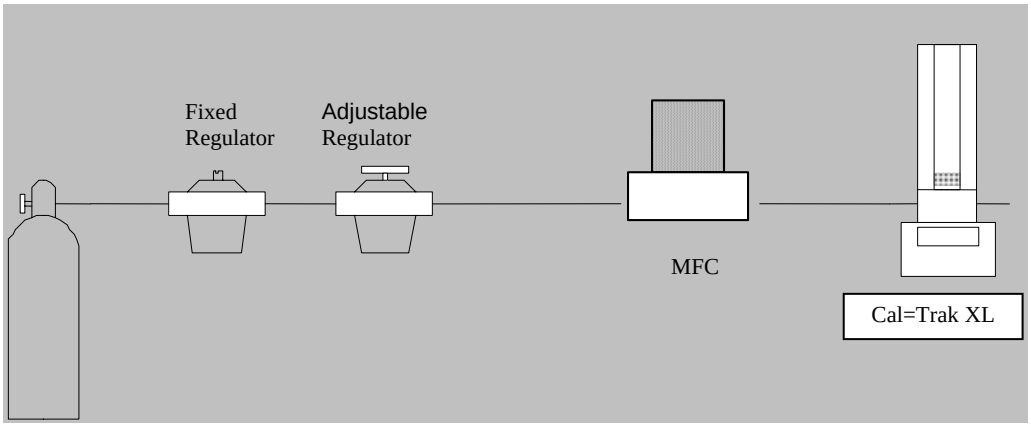


Figure 10 Setup for Calibrating MFCs

7.6 Calibration of Mass Flow Meters (MFMs)

Mass flow meters can be calibrated with the setup of Figure 11, which is similar to that shown for LFE transfer standards. Again, the flow must not be affected significantly by the Cal=Trak's cyclic pressure increase. This can be achieved by use of a sonic nozzle as the stable flow source, or by feeding a fixed restrictor with a precisely regulated pressure of more than 200 kPa. In many circumstances, the sonic nozzle or porous plug flow generator may be replaced with a mass flow controller (MFC) specifically tailored to this task. An example is the Sierra Model C100H-XL specifically built to provide a stable flow source for the Cal=Trak XL calibrator. Using the MFC allows easy adjustments of the flow during calibration. An additional benefit of using the Sierra specific MFC is the ability to communicate with both the calibrator and the MFC using your Cal=Soft software. In this way, an automated calibration system can be created. Please contact Sierra Instruments for additional information on these special mass flow controllers and building your own automated calibration system.

In the scenario below, the MFC will function as a pressure stabilizer and precision flow regulator with the Cal=Trak XL defining the accuracy of the device under test. If the MFM under test must be calibrated at pressure (i.e. because it is always used under pressure) then a fine resolution valve (needle valve) and a gauge should be installed between the MFM and the Cal=Trak XL. Adjust the valve until the pressure gauge reads the correct pressure for the MFM under test.

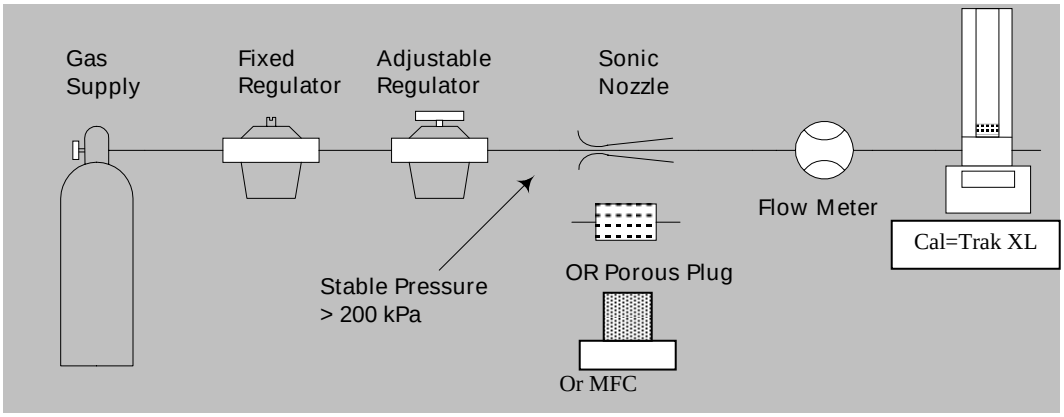


Figure 11 Setup for Calibrating Mass Flow Meters

7.7 Calibration of Rotameters (Variable Area Flow Meters)

Variable-area meters can become unstable when connected in series with a volume. Cavity resonance may even occur. They are best calibrated using the setup of Figure 12. The flow stream is alternately applied to the Cal=Trak XL and to the device under test. A sonic nozzle or a specially calibrated MFC is used to render the differences in the two devices' insertion pressures insignificant with respect to the required accuracy. An example is the Sierra Model C100H-XL MFC specifically built to provide a stable flow source for the Cal=Trak XL calibrator. Using the MFC allows easy adjustments of the flow during calibration. An additional benefit of using the Sierra specific MFC is the ability to communicate with both the calibrator and the MFC using your Cal=Soft software. In this way, automated validation and calibration of Rotameters can be achieved. Please contact Sierra Instruments for additional information on these special mass flow controllers and building your own automated calibration system.

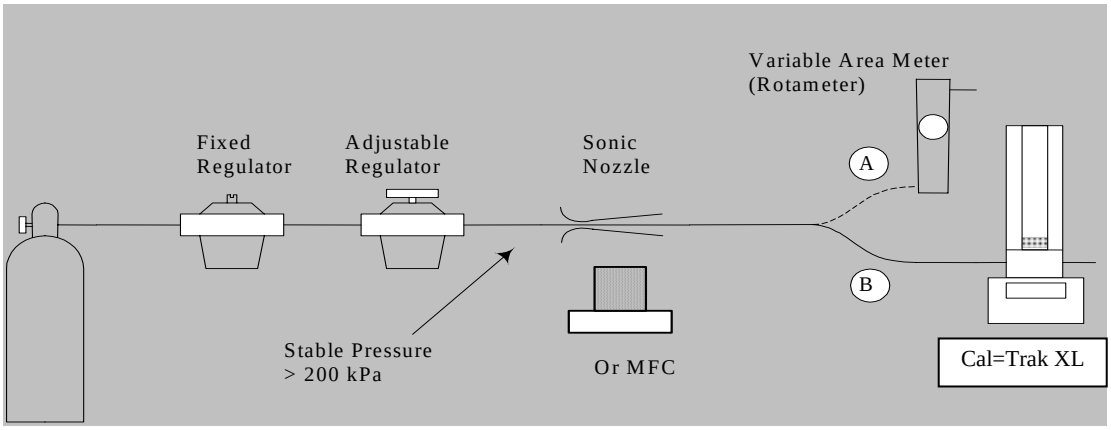
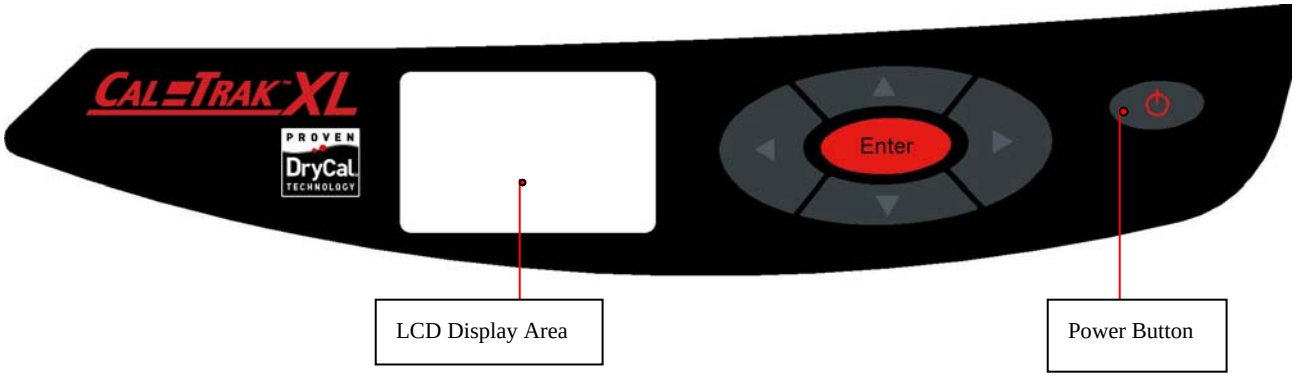


Figure 12 Setup for Calibrating Rotameters (Variable Area Flow Meters)

8.0 Operating Instructions

8.1 Cal=Trak XL Keypad



8.2 How to Use the Cal=Trak XL Keypad

Turning the Cal=Trak XL On

To turn on your Cal=Trak XL, press the Power Button in the right corner of the control panel for one second. To turn it off, press and hold the Power Button for three seconds. When turned on, the LCD display area will show the product name, model number and flow range while the internal cooling fan powers up. In this Manual this screen is called the Main Menu. At the bottom of the screen you have 2 selections: "measure" or "setup."

General Menu Navigation

Navigating through your Cal=Trak XL menu screens is easy and intuitive – simply use the four directional arrows on the control panel for toggling between menu options (right, left, up, down). Your location within each menu or menu item is highlighted (shaded) on the LCD. A menu item in angle brackets (< >) indicates that multiple options exist for that item; these options are displayed when that item is selected. To select highlighted or bracketed items, press the red ENTER button at the center of the control panel.

8.3 Setting User Preferences

The Sierra Cal=Trak XL may be configured for your convenience. From the Main Menu screen, use the right arrow button to select SETUP and press ENTER to access the Cal=Trak XL's many customizable options. To modify an option, move between menu selections using the up and down arrows. When a selection is highlighted, use the right and left arrows to toggle between your choices for that selection. Choose CONFIRM to save any changes and return to SETUP, or choose EXIT to return to SETUP without saving any changes. If at any time you'd like to return your calibrator to its factory default settings, navigate to Preferences, set Default Settings to "Yes" and then CONFIRM the changes.

A list of options and the factory default settings for your Cal=Trak XL are in the table below:

Setup Menu	Sub-menu	Factory Defaults	Options
Readings	Calibration Style	Mass Flow (Standardized)	Volumetric Flow
Readings	Number in Average	10	001 - 100
Readings	Time Between:	00	00 – 60
Readings	Sensor Factor:	1.000	0.200 – 3.000
Units	Flow in:	sL/min	scf/min
Units	Pressure:	mmHg	Psi or kPa
Units	Temp:	C	F
Units	Std. To:	21.1	0.00 - 50.0 C (32.0 – 122.0 F)

Time	Hour:	12	00 – 12 (AM/PM) 00 – 24 (24 Hr)
Time	Minutes:	00	00 – 59
Time	Format:	PM	AM, 24H
Date	Month:	06	01 – 12
Date	Date:	15	01 – 31
Date	Year:	2008	2000 – 3000
Date	Format:	MM-DD-YYYY	DD-MM-YYYY
Preferences	Read Default:	Single	Burst or Continuous
Preferences	Magnification:	Detail	Zoom
Preferences	Default Settings:	No	Yes
About	Technical Values Displayed	N/A	N/A

8.3.1 Setup: Readings

You may select to calibrate either Volumetric flow or Mass flow instruments with your Cal=Trak XL. Mass flow is defined as volumetric flow automatically corrected by the Cal=Trak XL to specified temperature and pressure conditions. This is useful for calibrating instruments that read directly in mass flow, such as MFCs).

Choose the preferred number of measurements taken in a burst sequence, from 1 to 100. A running average will be calculated during this sequence.

If you'd like a delay between flow measurements (i.e., in order to time-profile MFCs to verify their long-term performance), set the "Time Between" from 1 to 60 minutes.

As applicable, change the Sensor Factor from its default value of 1.000 to the value provided by the MFC or MFM manufacturer (see Using Sensor Factors section below).

8.3.2 Setup: Units

Depending on whether you've selected Volumetric or Standardized flow in the Readings menu, you may view flow measurements in liters per minute or cubic feet per minute.

Choose to view pressure in units of mmHg, kPa or psi.

Choose to view temperature in Celsius or Fahrenheit.

Choose your Standard Temperature. If you're measuring Mass flow, you must enter the temperature to which the gas flow volume will be standardized (depending on the application, 0 or 21.1 Celsius are most common). Pressure standardization is not adjustable, and is always 101.325 kPa, or 1 atmosphere of absolute pressure.

8.3.3 Setup: Time

Choose the format for time and set your local time here.

8.3.4 Setup: Date

Choose the format for the date and set your current date here.

8.3.5 Setup: Preferences

Read Default offers you a choice of Single, Continuous or Burst measurements. Single means only one measurement will be taken at the press of the button. Continuous means the Cal=Trak XL will continue to take measurements indefinitely until the operator commands it to stop. Burst is the method most commonly used. In "Burst" the Cal=Trak XL will take the number of measurements you choose (see Selecting Reading Styles above) and then stop. It will display the running average of this number of measurements and the last flow measured. Once selected, your Cal=Trak XL always defaults to this setting when Measure is selected from the main menu.

Default Settings allows you to reset your Definer 1020 to the factory defaults.

Magnification controls the amount of data on the display. Zoom displays only flow measurements in large font for easy viewing. Detail simultaneously displays flow measurements, temperature conditions, pressure conditions, and sensor factor in smaller font.

8.3.6 Setup: About

This selection provides detailed technical information about your Cal=Trak XL and its factory calibration. It is a useful screen to refer to when speaking with a technical support representative.

8.4 Taking Readings

Once you've customized your Cal=Trak XL and have confirmed your changes, return to the Main Menu and select MEASURE to begin a set of measurements. This will bring you to TAKE MEASUREMENTS, where you choose between the following options (note that whichever style you selected in SETUP is the default, but you can make any choice at this time):

- SINGLE. A manual measurement with a running average (default is 10 measurements in the average and is user-definable from 1 to 100).

- CONT. Continuous hands-free measurements mode with an on-screen running average (default is 10 measurements in the average and is user-definable from 1 to 100). Note, in this mode the Cal=Trak XL will continue to run until the operator stops the calibrator.

- BURST. A stream of hands-free measurements taken in a user-definable grouping of 1 to 100 with a running average. Once the group is completed, no more measurements are taken until another Burst is initiated.

Select the type of flow measurement you want, and then press ENTER. Cal=Trak XL will begin taking flow measurements. You can stop a series of hands-free measurements at any time by choosing either PAUSE or RESET. PAUSE terminates the flow measurement or sequence of flow measurements but leaves the flow results on the screen, while RESET terminates the flow measurement or sequence of flow measurements and clears the screen, allowing a new sequence of measurements to begin.

When taking flow measurements, your Cal=Trak XL simultaneously displays the actual flow rate generated by the Device Under Test (DUT), the running average of all measurements in the group you selected and the number of measurements in the average. The flow cell-viewing window lights each time the piston rises, and you'll hear the internal valve clicking open and closed at the beginning and end of each flow measurement cycle.

EXIT returns you to the TAKE MEASUREMENTS screen.

8.5 Using Sensor Factors (K-factors)

Your Cal=Trak XL is factory-calibrated with nitrogen or purified laboratory air, although you can run other gases, provided they are noncorrosive, noncondensing and noncombustible (like most primary standards, the Cal=Trak XL is not intrinsically-safe). Many

instrument manufacturers, including Sierra Instruments, calibrate their instruments using air or nitrogen as a substitute for the actual process gas (for reasons of safety, expense, convenience, etc). In such cases, the air or nitrogen is called a substitute or proxy gas. When calibrating an MFC or MFM using a proxy gas, you must input the manufacturer's sensor factor or K-factor into your Cal=Trak XL so that the calibrator output will be equivalent to the DUT. Sierra publishes its calibration K-factors in a table in the Appendix of each instrument Instruction Manual. Other manufacturers publish similar data.

To enable your Cal=Trak XL to scale its actual flow measurements to match the adjusted flow from the DUT, locate the proper sensor factor or K-factor from the DUT literature and enter it into the calibrator using the SETUP menu (see Selecting Reading Styles above) before calibrating the DUT.

Because a sensor factor other than the factory default value of 1.000 modifies the actual flow to a "reported" flow, an exclamation mark (!) will appear in the LCD Display whenever a sensor factor is used and your display is be set to Zoom (see SETUP, Preferences, Magnification). If your display is set to Detail, then no exclamation point appears. Instead, the sensor factor (K-factor) will be displayed with its value on the measurements screen along with the individual flow measurements.

8.6 Out of Range

If your Device Under Test is generating more flow than your Cal-Trak XL rated flow range of 500 liters per minute, the "Out of Range!" warning appears when you attempt to take a flow measurement. Immediately reduce or disconnect the flow source. When the flow is within the proper range, choose "Reset" from the LCD display to clear the warning, and then take another flow measurement.

8.7 Reset

If your Cal=Trak XL fails to respond to push-button commands, try resetting the unit by pressing the reset button on the back. This can be done easily with a piece of wire or an unfolded paper clip. Please note that resetting your calibrator will not affect your user settings. However, if you are in the middle of a calibration, your Cal=Trak XL will return to the initial measurement phase and you'll need to begin a new flow measurement.

9.0 Maintenance

Although the Sierra Cal=Trak XL is a rugged instrument, certain care and maintenance requirements must still be met. When not in use always store your Cal=Trak in a clean, dry environment. Disconnect your valve actuation air pressure from the calibrator when not in use. Place the protective caps over the inlet and outlet fittings to prevent dirt from entering your instrument. Wipe only with a damp cloth and do not spray with liquid solvents or use abrasive cleaners.

Any service to the Sierra Cal=Trak XL must be performed by Sierra maintenance personnel.

Current service or calibration information and pricing can be received by contacting Sierra Instruments, Inc. at any of the locations listed on the front cover. Alternatively, you can contact us via our web site www.sierrainstruments.com.

10.0 Calibration and Recertification of Cal=Trak XL

As a quality assurance measure, Sierra recommends annual calibration of all measurement instruments. However, how often you have your Cal=Trak calibrated is your organization's internal quality control decision. Units used in a laboratory setting may require calibration less frequently than a unit that is used in a manufacturing environment. The annual calibration program is an elective and is therefore not included as a warranty item. Expedited "RUSH" turnaround service may be available at an additional cost. Please contact the factory for more information on available calibration services and pricing. Our recertification program is a complete product service package that provides pre-calibration data at significant flow points; complete product refurbishment, testing, available upgrades; post-calibration data recorded at significant flow points; and NIST-traceable Sierra calibration certificates. Recertification includes a 90-day service warranty should any related labor or parts replacements prove faulty.

10.1 Service or Repair of your Calibrator

If you are experiencing any difficulties with your Cal=Trak XL (not including elective calibration or recertification), please contact your Sierra distributor or one of our three corporate offices for technical support or troubleshooting assistance prior to returning the unit. We will first attempt to resolve your problem over the phone or via email. If you've provided us with a detailed description of your difficulty and application details and we're unable to resolve the situation by phone or email, we'll issue you an RMA number for prompt return of your calibrator. Do not return your calibrator without an RMA number or your service may be delayed.

Please have the following information available before calling Sierra for support:

- Your Cal=Trak XL serial number
- Instruments being calibrated and/or used with the Cal=Trak XL
- Your Windows version and service pack level (i.e. Windows Vista, Windows XP)
- The COM port you are operating with (i.e. COM1, COM2, COM3, COM4)

SIERRA INSTRUMENTS NORTH AMERICA HEADQUARTERS
5 Harris Court, Building L
Monterey, CA 93940
USA
Phone (831) 373-0200 (800) 866-0200 Fax (831) 373-4402

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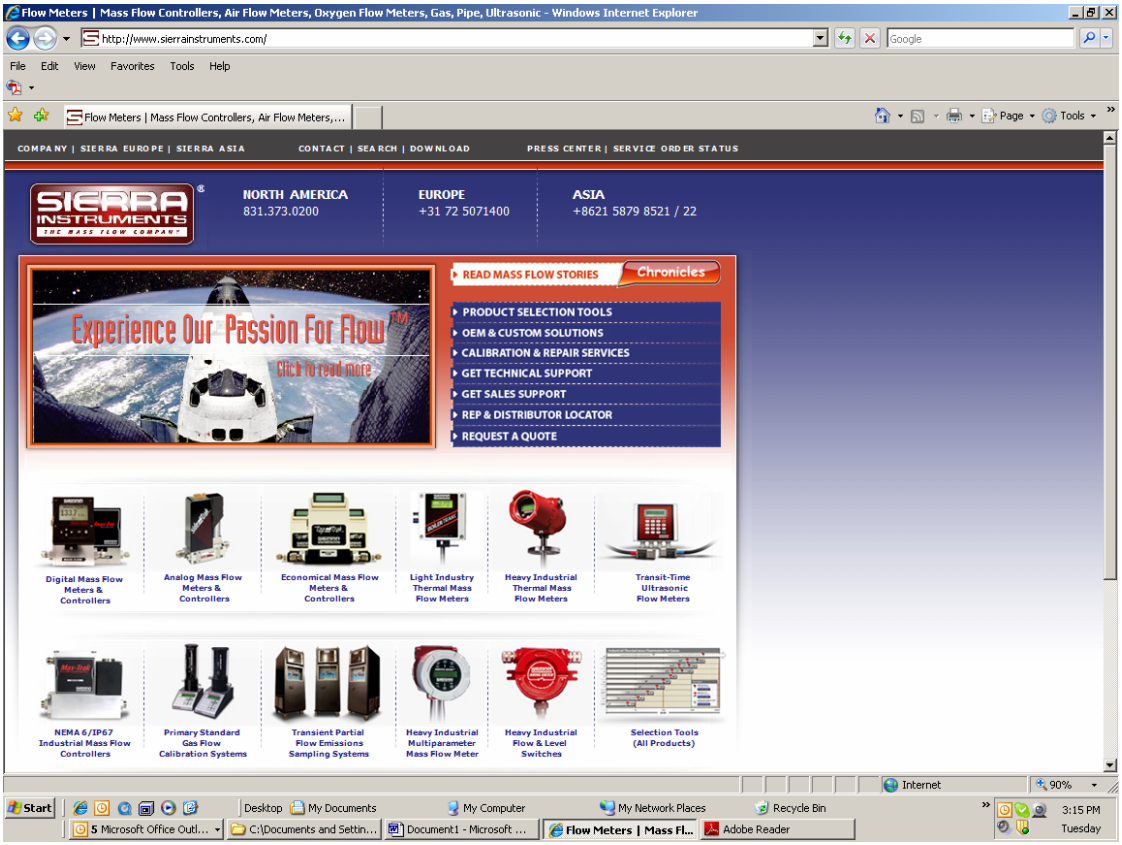
188 Zhang Yang Road
Pu Dong New District
Shanghai, PR China, 200122O
Phone +8621 5879 8521/22 Fax +8621 5879 8586

10.2 Shipping the Cal=Trak XL

When shipping the Sierra Cal=Trak XL please ensure that the packaging is adequate to protect the instrument. We strongly recommend that your Cal=Trak XL be shipped in its original packing crate. Sierra Instruments, Inc. is not responsible for damage that occurs during shipment.

11.0 Additional Information

Technical Specifications for your Cal=Trak calibrator can be found in Appendix C of this manual. Should you desire more information on Sierra Instruments and our products, you are welcome to visit our website at: www.sierrainistruments.com.



Additional information on the Cal=Trak calibration systems are available by clicking on the Cal=Trak photos at the lower left, which will take you to dedicated pages on our flow calibrators. You can also obtain a copy of the Cal=Trak Uncertainly Analysis from any of our 3 offices or more than 100 distributors world-wide.

12.0 Limited Warranty

The Sierra Cal=Trak XL is warranted to the original end user to be free from defects in materials and workmanship under normal use and service for a period of 1 year from the date of purchase as shown on the purchaser's receipt.

The obligation of Sierra Instruments Inc. under this warranty shall be limited to repair or replacement (at our option), during the warranty period, of any part which proves defective in material or workmanship under normal use and service provided the product is returned to Sierra Instruments Inc. with transportation charges prepaid.

Sierra Instruments Inc. shall have no liability to repair or replace any Sierra Instruments Inc. product:

- Which has been damaged following sale, including but not limited to damage resulting from improper electrical voltages or currents, defacement, misuse, abuse, neglect, accident, fire, flood, act of God or use in violation of the instructions furnished by Sierra Instruments Inc.,
- Where the serial number has been altered or removed or
- Which has been repaired, altered or maintained by any person or party other than Sierra Instruments, Inc. or a Sierra-authorized service center

This warranty is in lieu of all other warranties, and all other obligations or liabilities arising as a result of any defect or deficiency of the product, whether in contract or in tort or otherwise. All other warranties, expressed or implied, including any implied warranties of Merchantability and fitness for a particular purpose, are specifically excluded. In no event shall we be liable for any special, incidental or consequential damages for breach of this or any other warranty, express or implied.

Appendix A: Troubleshooting

A-1.0 The piston does not move when the "Enter" is pushed

1 Are you in the Measurement menu?
2 Is a flow source connected?
3 Is the flow source connected correctly (Pressure vs. Vacuum)?
4 Is the flow source inadvertently set too low? Minimum flow rate for the Cal=Trak XL is 5 slpm.
5 Are any of the ports sealed?
6 Are any of the tubes pinched?
7 Are any of the connections loose or leaking?
8 Can you hear the valve working? Is the valve actuation air supply connected and set for 80 to 100 psig pressure? If the supply pressure is too low, the valve will not activate.

A-2.0 Readings taken with the Cal=Trak XL do not correlate to those taken with another flow meter

1 Are any of the connections loose or leaking?
2 Are any of the tubes pinched?
3 Is the sensor factor set to the proper number?
4 Are you comparing volumetric flow with standardized flow?
5 If both units are set to "Standardized", are both units set to the same standardized conditions? If a standardization temperature of 21C is compared against a standardization temperature of 0C, an error of approximately 7.5% will result.
6 Are there any large containers/manifolds in the flow stream, such as extra tubing, manifold(s), Magnehelic gauges, etc.? These items can cause inaccurate readings.
7 Does the flow source have enough pressure so that it will not be affected by small variants of back pressure caused by the piston rising?

A-3.0 The Cal=Trak XL does not appear to be sending data through the serial (RS-232) port

1 Review Appendix C: *Cal=Soft Software Instructions*
2 Is the serial cable plugged into the correct COM port and the Cal=Trak?
3 Is cable correct? The cable should be a 1 to 1 connection, not a null modem cable.

Appendix B: Cal=Trak XL Specifications

Performance Specifications

Flow Range: 5 to 500 slpm

Accuracy, Volumetric and Mass (Standardized): +/-0.25% Reading

Flow Units:

Volumetric:	L/min, cf/min
Mass:	sL/min, scf/min
Temperature Units:	ºC, ºF
Temperature Accuracy:	+/- 0.2 ºC (sensor in the gas flow stream)
Pressure Units:	mmHg, psi, kPa
Pressure Accuracy:	+/- 0.05% FS (sensor in the gas flow stream)

Operating Specifications:

Configuration: Fully self-contained gas flow calibration system suitable for pressure or suction (vacuum) measurements

Operating Modes: Single Reading, Burst or Continuous

Time per Measurement: 5 to 100 seconds depending on flow rate

Gas Compatibility: any non-corrosive, non-condensing, non-combustible gases with <70% humidity

Operating Temperature Range: 15-30 ºC

Operating Pressure: 19.5 psia maximum

Ambient Humidity: <70%, non-condensing

Power Requirement: 110-240 VAC, 50-60 Hz, 5 watts; universal power supply provided

Measurement Control Valve: pneumatic valve, internal

Shop Air Requirement for Internal Valve: 80-100 psi, ¼ inch compression fittings

Calibration Gas Fittings (Inlet and Outlet): 1.5” compression fittings

Purge Gas Fittings: ¼” compression fittings

Over Pressure Fitting: ½” compression fitting

Output Signal: RS-232 serial port

Physical Specifications:

Dimensions: 33" H x 24.6" W x 12" D / 84 cm H x 63 cm W x 30 cm D

Weight: 90 lbs / 41 kg

Display: backlit graphic LCD panel

Flow Measuring Cell Materials of Construction: Graphite composite piston in borosilicate glass cylinder

Note: All specifications are subject to change. Please contact Sierra or visit our web site at www.sierrainstruments.com for the most current product information.

Appendix C: Cal=Soft v 2.0 Communication Program

1.0 Introduction

This is the second version of the Sierra Cal=Soft concept. It was created to support Cal=Trak firmware version 2.03, so it compatible with all Cal=Trak XL systems. This program enables the transfer of flow data from your Cal=Trak into an Excel spreadsheet for data series analysis. The data is collected in the program in a convenient format which can generate a Calibration Certificate, if desired. Currently you can automatically certify a Sierra 100 series, use any Sierra 100 Series MFC automatically as a flow generator to calibrate other flow meters and perform manual entry for calibration of any analog MFM or MFC instruments. The program cannot communicate directly with analog units or but this should be available by late 2008.

Cal=Soft is written in Visual Basic embedded in an Excel Spreadsheet as a "macro."

Requirements

- Your Cal=Trak base must be loaded with firmware version 2.03 or above
- A PC with Windows XP. A local serial port is convenient, but a USB port may be used with appropriate adapters.
- Microsoft Excel 2000 (or higher)
- WinZip or an equivalent program for extracting from zipped files
- Administrator rights in Windows 2000, XP

2.0 Installation

The CD-Rom provided from Sierra Instruments contains the Cal=Soft Calibration Program, a short instruction manual and some troubleshooting hints. Load the CD-Rom into your computer. Select the Excel program "Cal=Soft" and copy it to your computer in a convenient location. Open the program and Enable Macros, if prompted.

3.0 Operating Instructions for Cal=Soft Software

Cal=Soft is separated into 4 separate worksheets for convenience.

Worksheet descriptions:

Short Manual: A copy of this operation manual included inside the Cal=Soft program.

Operating Screen: The start screen where you enter your details and from which you operate the program. Tip: If you cannot see the full screen view on the Operating Screen go to top bar and select: View -> Zoom and adjust the zoom to a suitable value

Startup: A system sheet in which the visual basic operating mode operates. During the actual calibration the program will switch to this sheet and opens a Visual basic screen. If the red screen window is shown, do not select any worksheet with your mouse! Only leave this window by pressing EXIT.

Calibration sheet: In this sheet we find the layout of the certificate. The data taken during the runs will be placed in this sheet and this can be printed and saved later on. You can make changes to this sheet (f.i. replace the Logo with your own), but DO NOT insert rows or columns!!

Instrument Information: This is a small database in which you can enter your instruments description. Sierra models are already entered here. These instruments can be selected in the Operating screen and the relevant information will be entered in the calibration sheet.

Introduction

This software in combination with a Sierra Cal=Trak can certify flow meters and flow controllers for gases and will generate a calibration certificate. Depending on the capability of your DUT (Device Under Test) this can be done semi or fully automatic. If you connect a Sierra 100 series mass flow controller (MFC) by RS232 and a Cal=Trak by RS232, this software obtains most of its required settings and variables from the 100 series and the certification requires minimal human intervention. If you calibrate a unit with a display, the readout will have to be entered manually into the program during the certification. If you have a DUT with an analog output, you have to measure this output with a DVM and enter the readout manually into this program during the certification.

The software communicates with the Cal=Trak through RS232 and will configure your calibrator automatically.
It is recommended that you power on your Cal=Trak, DUT, Sierra 100 Series MFC (if used) and then run the Cal=Soft program.

Setup Cal=Trak

To make the Cal=Trak communicate correctly with this software the following settings have to be made to the Cal=Trak before you start using this program. After you switch the Cal=Trak on insure the following settings are indicated as below.

1) Setup Menu 1, See Section 8.7 on pg. 35
Choose STD or VOL based upon your DUT. For Mass flow meters or controllers, you must use STD.
Set the Sensor Factor = 1.000 for calibration with Air or Nitrogen gas.

2) Setup Menu 2, See Section 8.8 on pg. 36 of this Manual.
Set BURST "On".
It is not necessary to set the "# in AVERAGE," because this value will be determined in the Software automatically.
You must set the "MIN/READING to 00"

3) Setup Menu 3, See Section 8.9
Select the proper units for Temperature and Pressure. Make them match your DUT.
Set the Reference temperature on 21.1 C (Standard conditions) or to 0.0 C (Normal conditions).
NOTE: some DUT instruments will have other Reference Conditions. Set up the Cal=Trak to match your DUT, then make sure in the next section you set the Cal=Soft to the same units.

4) Cal=Trak to Computer cable
Connect the Cal=Trak to your Computer with a RS232 9-Pin to 9-Pin cable like the one supplied with your calibrator. The cable should not be longer than 10 meters, but 1 meter cables can improve the reliability of the connection.

Trouble shooting digital comms:
When the program is not communicating with the Cal=Trak you will find in most cases one of the settings in the Cal=Trak is incorrect.
Please review steps 1-3 above, then check all the cables and perform a hard reset the Cal=Trak (See hole in the back of the Cal-Trak base).
Follow steps 1-3 again.

Please see if the basic communication is already happening:
When you press START on the operating screen, have a look at the display of the Cal=Trak. The program will move the Cal=Trak from the Main Menu to the Run Mode. You will see this change just as if you had pressed the buttons yourself. Please verify that this is happening!

If this is not happening check the RS232 cables (Are they properly plugged in?) Check if you selected the correct com port for the Cal=Trak in the Operating screen. Are you sure you did not select the Com port of the Sierra 100 series or DUT? Does your selected com port exist? (see My Computer (Right mouse button) -> Properties -> Hardware -> Device Manager -> Ports (Com & LPT) to view the com ports on your computer, and check that there are no errors reported.

If you use a USB to RS 232 converter, this could be the problem. Sierra has tested the ASUS and CONRAD (Nr. 982417) and BELKIN converters which all worked OK, but we cannot confirm that all converters will function properly.
If this does not solve the issues please write down the error. What do you see on the screen? Report what you have tried this far and report to your Sierra agent or e-mail this to: service@sierrainstruments.com

Setup DUT

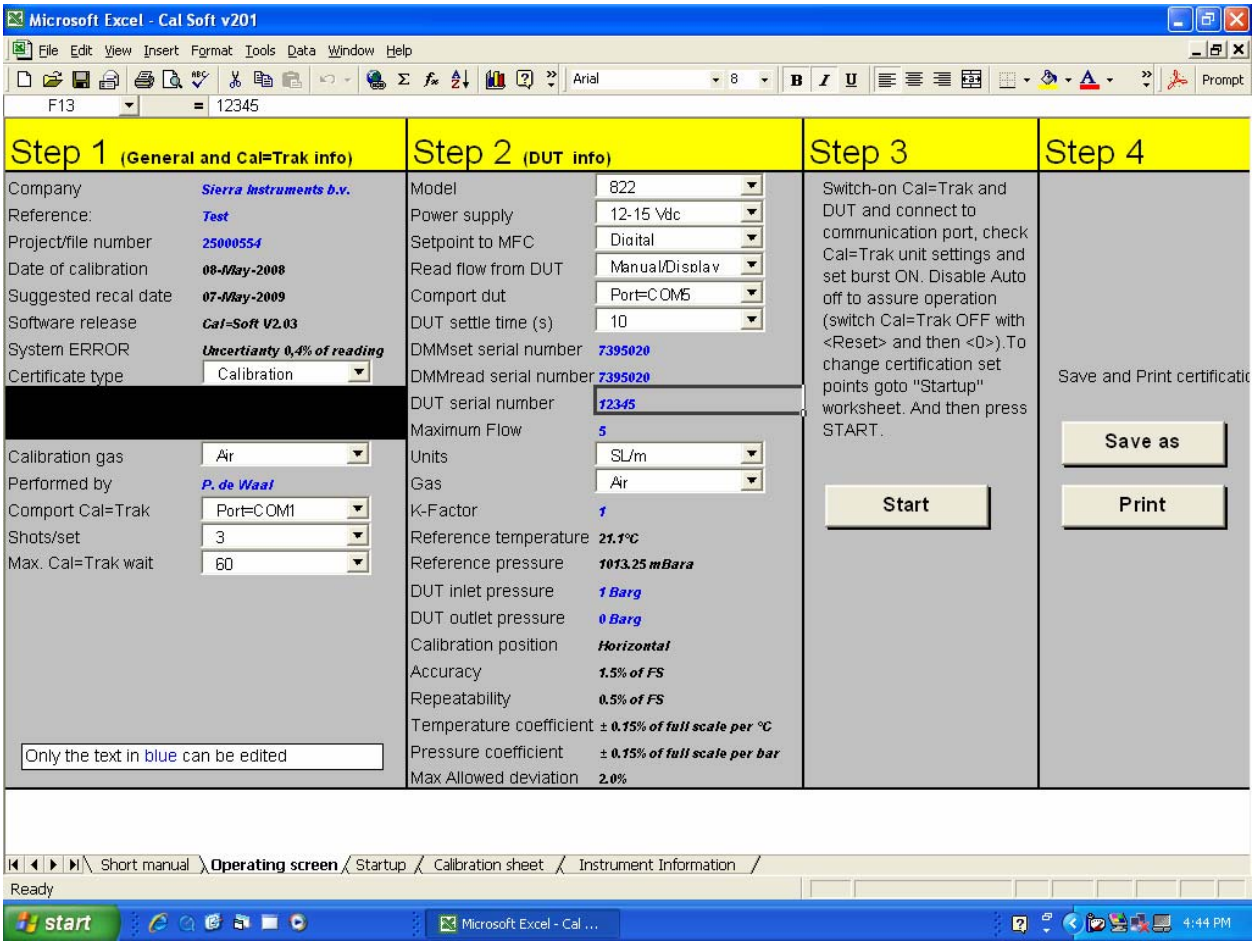
Insure that the Cal=Trak flow cell is suited for the range of the DUT. In general, flow instruments are commonly tested at 0-25-50-75-100% of their rated maximum flow, so the Cal-Trak flow cell selected should be suited for 25% to 100% of the range of the DUT. Currently the program is not suited to change Cal=Trak flow cells during a certification run. You would have to make 2 runs and merge the data manually.

Connect a suitable gas supply to the DUT and insure the inlet pressure is correct. Set up the DUT to its operating condition. Please remember the Cal=Trak only operates under atmospheric pressure conditions. If your DUT requires some back-pressure, place a back pressure regulator between the DUT and the Cal=Trak.

Insure your system is free of leaks.

Setup Cal=Soft

Go to the tab marked "Operating screen". In this screen you find 4 steps that need to be taken to certify your DUT. The Operating screen looks like this:



Step 1--Enter information about you and the Cal=Trak

Company: Enter the name of your Company

Reference: Enter your reference number that will be shown on the calibration certificate

Project/file number: Enter your internal project number that will be shown on the calibration certificate

Date of calibration: Will be automatically filled in here. To enter date manually (Used for certificate data only) type in date.

Suggested recal date: Will be automatically filled in with today's date + 1 year

Software release: Current software version 2.03, cannot not be edited

System ERROR: Uncertainty of the Cal=Trak, factory set at 0.4%. Change to 0.2% for use with Cal=Trak SL-800.

Certificate type: Select the type of certificate you are going to generate (Determines title of the Certificate, no other effect)

Measured gas pressure: this information is obtained from the Cal=Trak

Measured Gas temperature: this information is obtained from the Cal=Trak

Calibration gas: Use the pull-down menu to select the gas you will use for the calibration. At this moment this is only suitable for Air and Nitrogen. Consult factory for other gasses

Performed by: Enter your name here. It will be printed on the certificate

Comport Cal=Trak: Select the RS232 Com port to which the Cal=Trak will be connected (Selectable from Com port 1 to 10)

Shots/set: Enter the number of "shots" that the Cal=Trak will have to take at each flow point. (The more "Shots" the more accurate the result will be but this will also take more time. Common settings for this are 4 to10 shots)

Max. Cal=Trak wait: This is the maximum time in seconds that the program will wait before it aborts it's data collection. If the flow is very low you might have to increase this time. It also determines how long the program will wait when you check the zero flow point. Recommended setting is 30 or 60 seconds. If you select a value below 30 seconds, it is possible the program will stop it's data collection before the Cal=Trak completes its cycle. This would result in an error at one or more flow points.

Step 2--In this step you enter information about the DUT

Model: Select the unit you want to certify. The pull down list will show you a number of options that are defined under that Tab "Instrument information". You can freely edit and add to this data base and than select your specific instrument. Data like accuracy and P+T effects will be used in the calibration sheet. Only Sierra Models are programmed into the software upon delivery, but others may be added.

Power supply: Select the power supply for the unit (Only used for Certificate sheet data)

Input signal: Here you select the source of the setpoint signal to your DUT. For Flow meter enter NA. For RS232 for a Sierra 100 Series MFC enter digital. For all others, choose from the pull-down menu the proper setpoint signal for your DUT.

Output signal: Here you select what kind of output your DUT is using. (for RS232 for a Sierra 100 Series, enter digital)

Comport DUT: Select the RS232 Com port on which the Sierra 100 Series will be connected (Selectable from Com port 1 to 10). This will be used if your DUT is a Sierra 100 Series or if the Sierra 100 Series MFC will be automatically controlling flow into your DUT. If you will control flow to your DUT manually, select "NONE."

DUT settle time(s): When using a Sierra 100 Series MFC in automatic mode or when calibrating a Sierra 100 Series MFC, select the number of seconds that you want your controller to stabilize after the Cal=Soft program gives it a setpoint. (60 seconds recommended).

DMMin serial number: If a DMM is used to measure the DUT setpoint analog signal you can enter the serial # of that DMM here.

DMMout serial number: If a DMM is used to measure the DUT output analog signal you can enter the serial # of that DMM here.

DUT serial number: Serial number of the DUT (If a Sierra 100 Series is connected through RS232, it obtains this automatically)

Maximum Flow: Enter the max range value of the DUT (Add no units, numbers only!) (If a Sierra 100 Series is connected through RS232, the software obtains this value automatically)

Units: Enter the units of your DUT as you wish them to appear on the Calibration Certificate. The new firmware of Cal=Trak always reads in "sccm" units, but the program will convert to your chosen units when it completes the certificate. If a Sierra 100 Series is to be used as part of your calibration system, set the units of the 100 Series to "sccm" to match the Cal=Trak

Gas: enter the gas the DUT will be used with during normal operation. Note that many instruments are calibrated on nitrogen or air even if they are to be used with a wide variety of gases. If a Sierra 100 Series is connected through RS232, it obtains this information automatically.

K-Factor: Enter the K-factor that relates that calibration gas to the gas for which the DUT will be used. For air or nitrogen, enter 1.00.

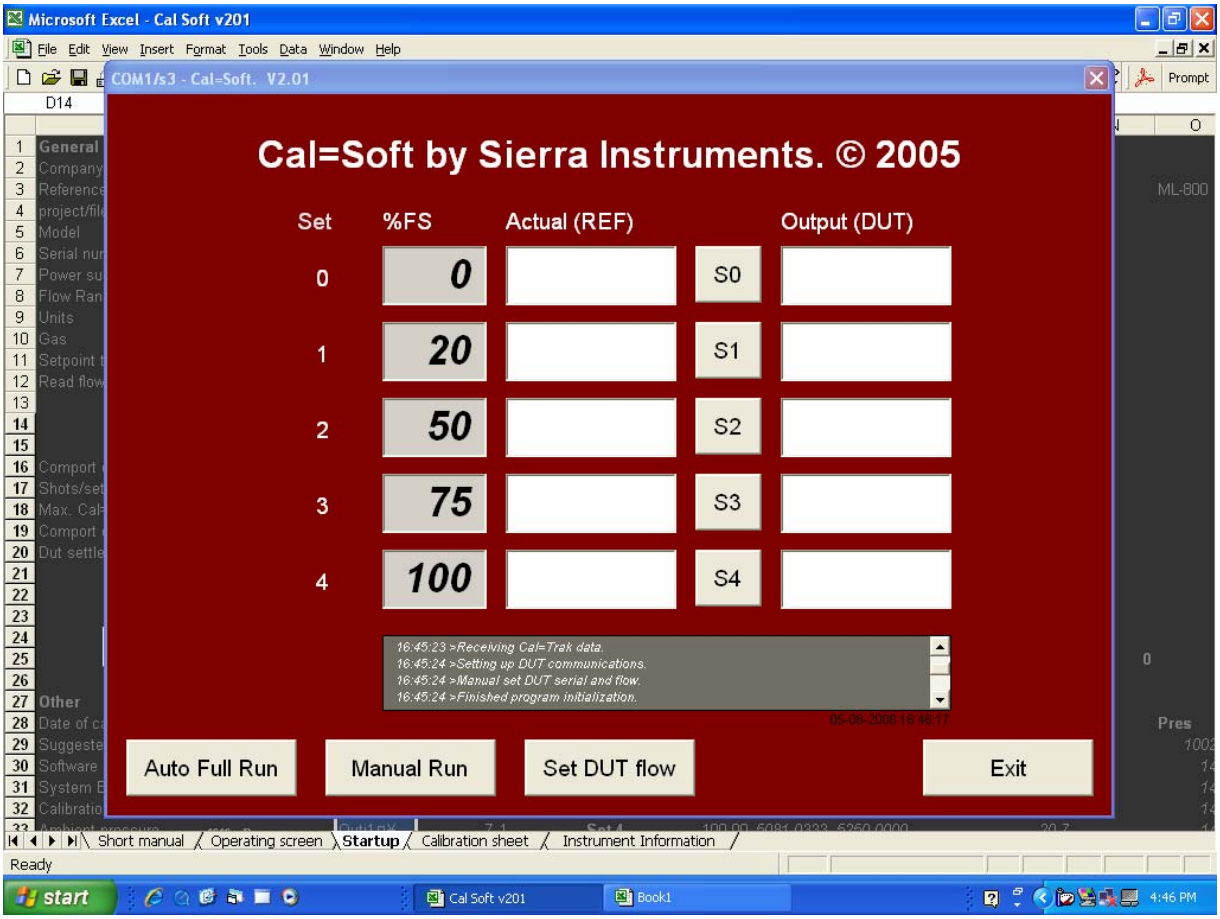
Reference temperature: Will be selected automatically based in the units selected (Normal= 0C, Standard=21.1C)
Reference pressure: Will be selected automatically based in the units selected
DUT inlet pressure: enter the inlet gas pressure to the DUT. (Used for certificate data only)
DUT outlet pressure: enter the outlet gas pressure of the DUT. (Used for certificate data only)
Calibration position: Enter the position in which your DUT is mounted during the calibration (Used for certificate data only)
Accuracy: Will be pulled down from the program's instrument database "Instrument information" if you are calibrating a Sierra Model. If you are calibrating an instrument of another manufacturer, enter the rated accuracy of the DUT here.
Repeatability: same as Accuracy above.
Temperature coefficient: Will be pulled down from the database "Instrument information" if you are calibrating a Sierra Model. For other makes, enter the DUT coefficient here.
Pressure coefficient: Same as Temperature coefficient above.
Max Allowed deviation: Will be pulled down from the program's database "Instrument information" based on the Sierra Model selected (This value is the pass/fail criteria as shown on the calibration certificate. It is in general either the accuracy of the meter + uncertainty of the calibrator or the RSS of the accuracy of both devices {Sq Root of [meter accy^2 + calibrator accy^2]}.

Step 3—Perform a calibration

Press the START button

This will begin the calibration routine. A red screen will appear in which several options are given to start the certification.

Do nothing until the window: "Please wait" disappears. The screen looks like this:



Never select with your mouse the background sheet or another sheet until after you press "Exit" or the program could stop running.

Begin your calibration by defining the flow points that you will measure. These are pre-defined in the program under the heading “%FS” as 0,25,50,75,100. If you want to take data at these 5 points, continue to the next section. If you wish to select alternate flow points, click on the grey box “%FS” and change to another percent as desired. In the example above, the second flow point has been changed from 25 to 20 using this method. You can only measure up to 5 points per calibration. Should you desire more than 5 points, you will need to run the program more than one time.

Automatic Flow Calibration Using Sierra 100 Series MFC

If you have selected on the Operating Screen (Step 2) a “Setpoint to MFC” that is DIGITAL, the program will establish communication with a Sierra 100 Series MFC via the selected COM port. All the squares at the bottom of the red screen will become active when “Please wait” disappears. You may choose:

Auto Full Run: By pushing this button you can do a fully automatic calibration run. If the DUT is a Sierra 100 series the settings to this unit are given by the program and the values from the 100 series and the Cal=Trak are read automatically into the computer software. If the DUT is not a Sierra 100 Series, but you are controlling the gas flow via a 100 series MFC, the program will automatically generate the proper gas flows and ask you to input the data from your DUT at the proper intervals. Follow the instructions on the screen until all white boxes under “Output (DUT)”are filled, then click EXIT when your calibration is complete.

Manual run: By pushing this button you make a single run of the Cal=Trak as if you pressed the “single” command from the keypad. No data is transferred to the Program.

Set DUT flow: If you have a Sierra 100 series connected you can set the gas flow here to any value. Simply enter a setpoint from 0-100% of FS when asked and click OK. The software will send this setpoint to the Sierra 100 Series and it will generate the flow requested. This is convenient to confirm that the Sierra 100 Series, DUT or Cal=Trak is working properly before starting an Auto Full Run.

At any time, if you suspect that the data collected at one of the 5 defined flow points is incorrect, you can run just that point again. Click on the box S0,S1,S2,S3, or S4. The program will set the flow to the value indicated to the left and ask you to enter the value for the DUT. When you have done this, it will replace the previous data with your new value, run the Cal=Trak automatically and enter the new value from the Cal=Trak.

Manual Flow Calibration

If the “Setpoint to MFC” you entered in the Operating Screen (Step 2 above) is not DIGITAL, you will be performing a manual flow calibration. The squares named Auto Full Run, Manual Run and Set DUT Flow will be dark and will not function.

Select the flow points that you will measure or choose the default values for “%FS”. Generate gas flow equal to the flow points selected using a manual valve or an MFC. Wait up to 2 minutes at each flow point for the flow to stabilize.

Now you will collect data at each flow point by selecting S0 to S4. By pushing these boxes you take the data for these individual flow points one at a time. The program will ask you to record the flow from the DUT, then it will run the Cal=Trak and record the calibrator’s measured flow beside your DUT flow. After you have collected data at one point, adjust the gas flow to the next value, wait for the flow to stabilize and repeat the process. When all the boxes are filled, calibration is complete. NOTE: the Cal=Trak always records data in sccm units. The program will modify these units to match your DUT in the next step.

Step 4--Print and or Save the certificate

The Certificate is saved to C:/certification/

If you want to save the file to a different location you can go to the bottom on the certificate (see worksheet "Calibration sheet") and press the "Save Certificate" button.

4.0 Software Troubleshooting

Most software problems encountered will fall into one of two areas:

Serial Port Selection Issue

The Cal=Trak Communications program might be configured for a serial port that you are not connected to. Most modern computers have only one serial port, but many older computers have two 9-pin serial ports. If your computer has two 9-pin ports and you are experiencing difficulty with installation, please switch your serial cable to the other port and test again. If your computer has no serial ports, you may use USB ports with corresponding USB/serial adapters.

Serial Port Configuration Issue

You might have the correct physical port selected on the computer, but the wrong port selected in the Cal=Trak Communications Program. Remember that the default serial port selection is COM1. If you are using a port other than COM1, you will need to use the procedure listed in Section 3.0, Changing the COM port. If you have additional problems using the Cal=Trak Communications Program please see Section 6.0, Contacting Support.