Futek VCal™ Sensor Verification System

User's Manual and Operating Instructions

Futek Advanced Sensor Technology – Futek VCal™ Documentation
Written by Futek Advanced Sensor Technology ¶

Futek VCal™ Sensor Verification System – Table of Contents

Futek VCal™ Sensor Verification System – Table of Contents

I. About Futek VCal™

Important: Please read

{If, during your reading, you come across words or terms which you are unfamiliar with, please check the Glossary we have provided. You can find this Glossary at the end of this document, or by clicking this link. You may return to the Table of Contents from any page by clicking the small VCal™ icon in the top corner of every page. Also, any references to page numbers llisted in blue are also links to those pages.}

System Features

1. The Futek VCal™ System comes equipped with an internal memory capability, which allows you to customize VCal™ to your own needs. This capability allows for the storage of the data acquisition system and its related documents. It also allows for the storage of all of your test data which can then be referenced later for print outs, certificates, signature checking, and for graphical analysis purposes.

2. The Futek VCal™ System supports Internet applications such as the remote management of your test data, test data backup & retrieval, and for technical support and software upgrades.

3. The Futek VCal™ System features convenient ON/OFF and RESET switches.

4. The Futek VCal™ System offers the ease of 'on the fly' USB connections.

5. The Futek VCal™ System is very flexible and integrates easily into your current system by providing you a choice of either saving and maintaining your test data in the VCal™ memory, or directly onto your PC.

6. The Futek VCal™ System offers a 'user-friendly' software and system environment, which requires no outside training. Easy to follow, step by step instructions for installation and use are included in the VCal™ manual as well as online.

7. The Futek VCal™ System software supports one RS-232 channel (ASCII only).

Calibration / Verification Features

1. Includes (2) sensor inputs that support a full bridge input, and also includes a 5VDC-bridge excitation source.

2. Includes ± 20 bit Analog to Digital conversion of the sensor input.

3. Supports the use of sensors with amplified outputs (VDC or mA).

4. Offers software selectable, built-in Shunt Cal measurement, with scaling, for each input channel. Also supports external Shunt Cal resistors.

5. Offers built-in resistance measurement capability, which is useful as a bridge measurement tool or for troubleshooting sensors.

6. Offers sensor auto recognition capability (For sensors equipped with the Futek VCal™ Auto Recognition Chip).

7. Features built-in calculators for Zero Offset and Span adjustments, as well as a Unit Conversion calculator.

8. Offers additional features for troubleshooting strain-gaged sensors, and also for the revalidation of overloaded sensors.

9. Supports force, torque, and pressure types of measurements, as well as linearity, hysteresis, and repeatability testing with user-defined load points.

10. Supports multi-component sensor testing with crosstalk check capability.

11. Supports either an automated or a manual test input.

12. Supports calibration records with multiple ranges for reference sensors. Also allows you to manually enter test data from a previously calibrated reference sensor.

13. Provides 3rd Order real time curve-fitting capabilities (Linearization).

14. Provides built-in, user-definable overload warnings, log reports, and recalibration date alarms.

15. Offers user customizable print outs, reports, and certificates.

16. Utilizes calibration methods that support ASTM Standards E4, E74-00a, ANSI/NCSL Z540, ISO Standards 17025, and 9001:2000, and follows practices and procedures that are recommended by organizations such as A2LA and NVLAP.

Quality Features

1. Your stored test and calibration data is exportable to spreadsheet applications like Microsoft Excel for data analysis and graphing functions. This aids in process control analysis, process and product performance analysis, and for meeting quality system statistical analysis requirements.

2. Offers features that aid in the management of reference sensors; (1) support of multi-range calibration records, (2) allows manual entry of test data from previously calibrated reference sensors, (3) provides 3rd Order, real-time polynomial linearization of reference sensors.

3. Offers built-in, user-definable overload warnings and log reports which aid in the documentation and control of nonconforming products and built-in, user-definable recalibration alarms which aid in the control of planned calibration interval programs for reference sensors.

4. Utilizes methods, and provides tools for support of the following Quality Standards; ASTM E4 and E74, ANSI/NCSL Z-540, ISO 17025 and 9001:2000. Follows practices recommended by organizations such as A2LA and NVLAP.

5. Provides a clear audit trail for Reference Sensor traceability.

Connections

1. Includes (1) 15 VDC / 2A power supply connection.

2. Includes (1) 4-terminal connector block for I/O port connections.

3. Includes (2) sensor inputs.

4. Includes (1) temperature input connection.

5. Provides (2) LEMO quick-disconnect receptacles for sensor connections that utilize mV/V outputs, and (2) screw terminal connector blocks for sensors that utilize amplified outputs.

6. Includes (1) 4-terminal connector block for external Shunt resistor connections.

7. Includes (1) USB connection.

Service Agreement

The Service Agreement includes; software upgrades and support, on-line data management access, VCal™ annual NIST traceable calibration and system check, data transfer and storage on VCal™ Server at Futek Advanced Sensor Technology, and a membership to the VCal™ User Group. Please contact Futek Advanced Sensor Technology for more information and details.

Technical Support (The following features are available at the vcal.net web site - www.vcal.net).

1. On-line data management support.

2. Capability to review and/or print data reports or certificates via the Internet.

3. Store all test records and log all sensor overloads.

4. Easily monitor and manage upcoming recalibration due dates for your sensors.

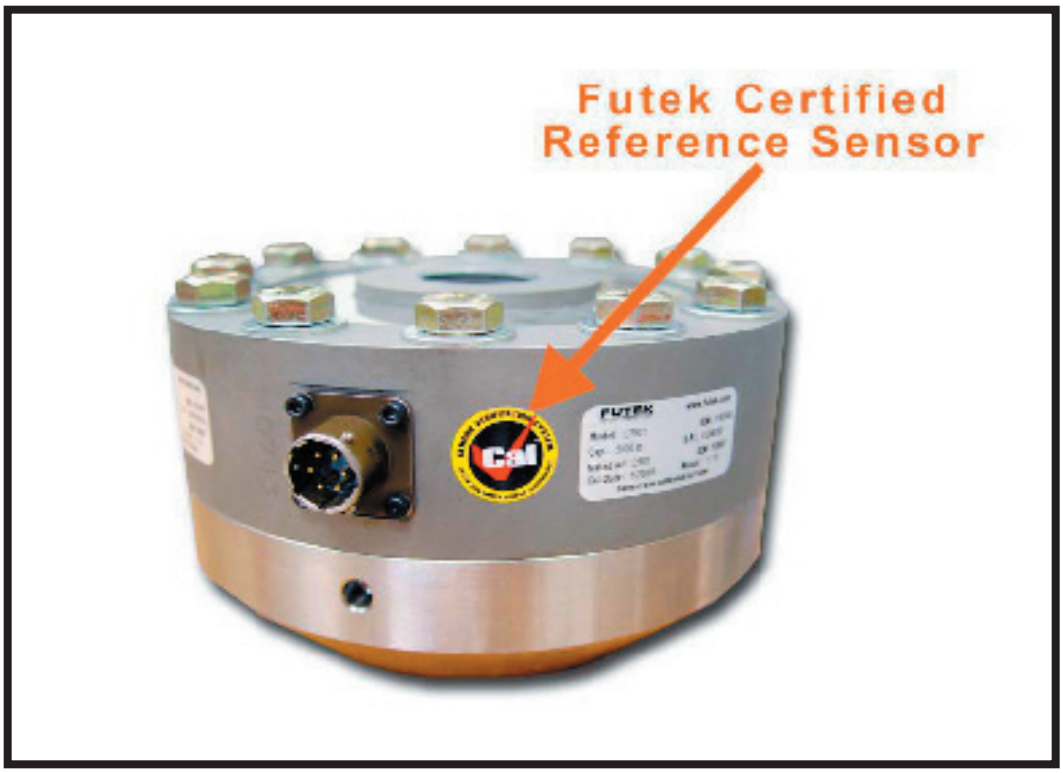
5. On-line software upgrades and support.

Futek VCal™ Accessories

1. A Futek VCal™ Accessory Checklist is available online at the vcal.net web site in either HTML or PDF formats, or you may contact

Futek VCal™ Certified Auto Recognition Sensor

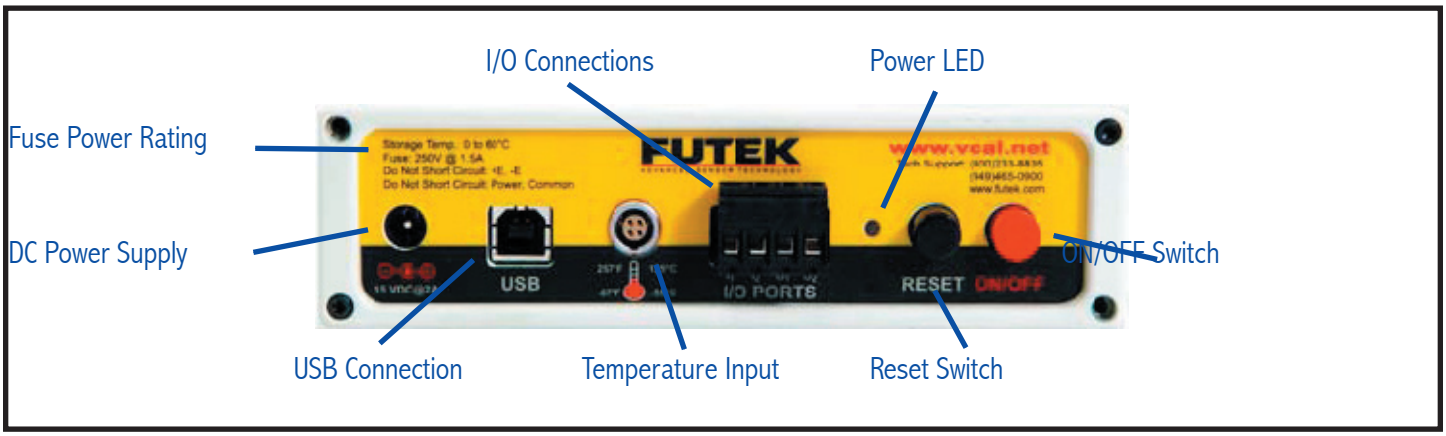
The following picture shows the Futek VCal™ Certified Auto Recognition Reference Sensor, all Certified Reference Sensors will feature the label bearing the VCal™ logo. Auto Recognition means that all you have to do is plug in your Futek VCal™ Reference Sensor and VCal™ will recognize your sensor and will display its ID number on the Display window of the Channel you have plugged your sensor into.



II. Getting Started

Getting To Know Your VCal™ System

Power Face Plate



{Temperature Probe Part # F-4569 / FSH01538}

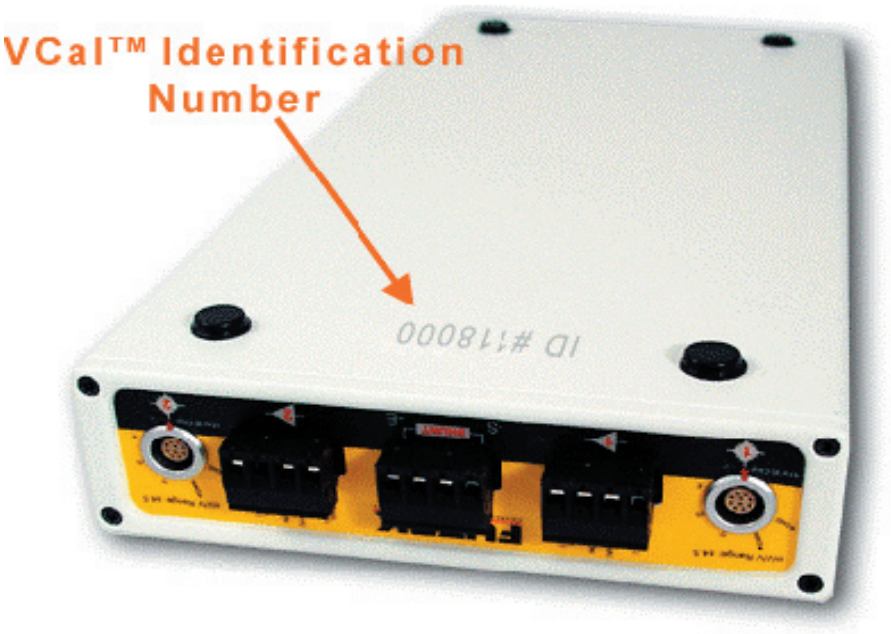
{Temperature ExtensionCable Part #PK-10201 / FSH01537}

We are in the process of transitioning to a new system of Stock numbers for our inventory; for your convenience both are given when listing model or part numbers in this manual. Older numbers are in black and newer numbers are in blue.

Sensor Fade Plate

Note: You may notuse the Channel 1 strain gage Connection and the Channel 1 Amplified connection at the same time. You may utilize a mV/V connection and an amplified connection at the same time, however; one must be connected to Channel 1 and one connected to Channel 2. When using either of the Amplified Sensor connections; ***Please ensure that the exposed sections of sensor jumper wires do not contact each other.**

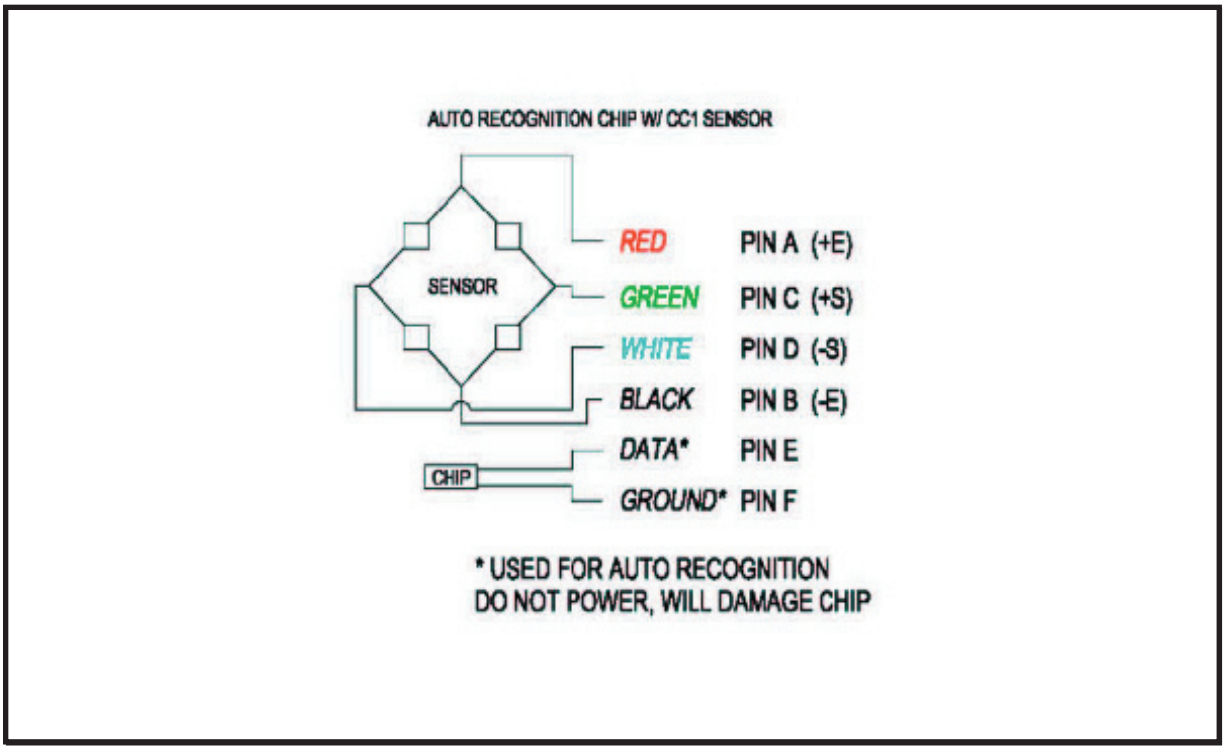
VCal™ Identification Number Location – Also displayed on Channel Display Screens when you are logged into VCal™



VCal™ Overload Fuse Location

Warning! – Your Futek VCal™ Reference Sensor comes equipped with an ID Auto Recognition Chip. Please do not apply power to this chip or you may seriously damage it. Your Reference Sensor should only be connected to your Futek VCal™ unit, Futek accepts no responsibility for any damage to ID Recognition Chips that are damaged in this manner.

Below is the Futek VCal™ Standard Wiring Code (CC1 Wiring Code)



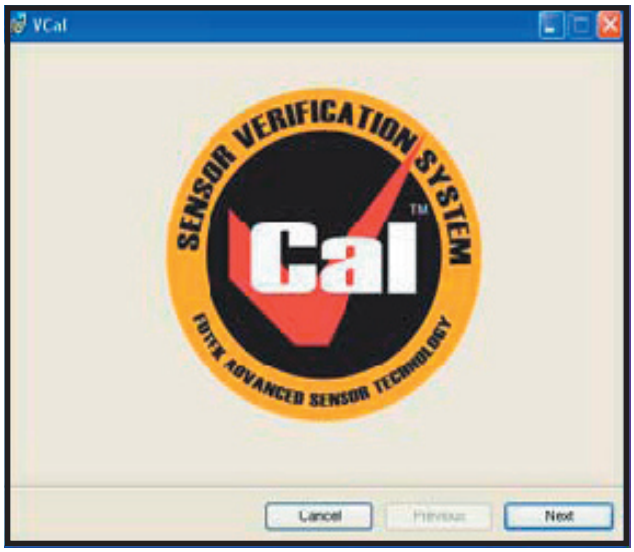
The Futek VCal™ Certified Auto Recognition Reference Sensor will support the IEEE 1451.4 Standard in the near future.

Installation of Your VCal™ System

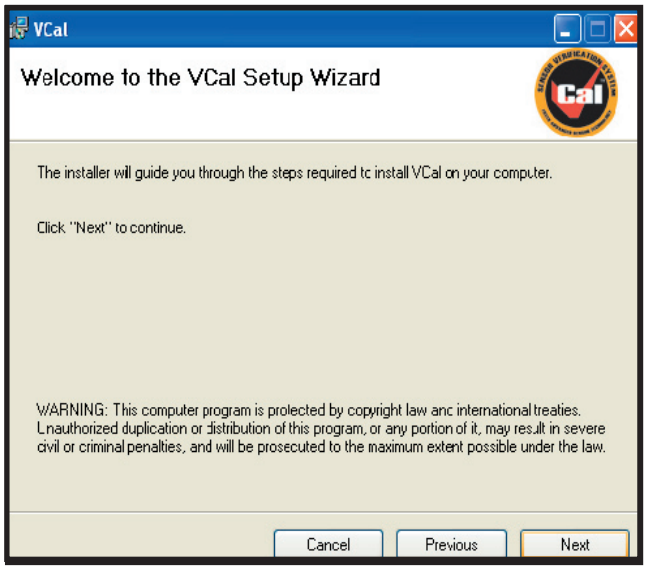
We recommend installing your VCal™ from the included installation CD; however you may also install from the VCal™ module. **From CD:** If you have AutoPlay enabled simply plug in and follow the instructions on the screen. If not, you will need to open your CD drive and run the Setup program from there. **From VCal™:** You will need to open the Removable Disk that VCal™ created, open the Setup Folder, and run the VCal.msi installation program. Either method will work equally well; whichever method you use, please note the following:**Minimum Requirements:** It is recommended that your VCal™ be installed on a PC running either Windows 2000 or Windows XP; and with a Pentium II, 400 MHz or better, with an available USB port, and with a screen resolution of 1024 x 768, 256 colors, MDAC 2.7 (available at www.microsoft.com), all the latest service releases and updates (both critical and Windows) for you roperating system, 100 MB of free disk space. You are also responsible for your PC's hardware and BIOS updtaes and drivers. The exact screens you will see after starting the installation CD will vary depending on your PC system's setup and configuration. However, no matter what your operating system or configuration they should all progress through the following steps in one form or another.

Note: Windows XP users may encounter a message regarding Windows Logo Testing and incompatibility: we ask that you please disregard this message and continue with the installation. We are in the process of working this issue out.

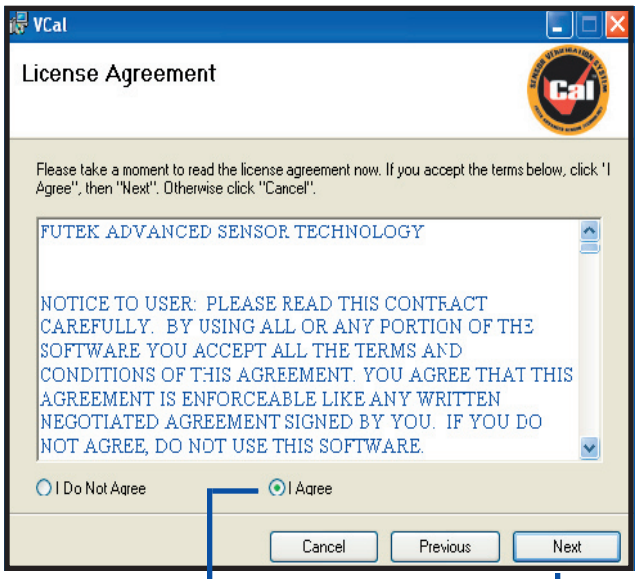
1. First you should see the Futek Vcal™ Installation opening screen...



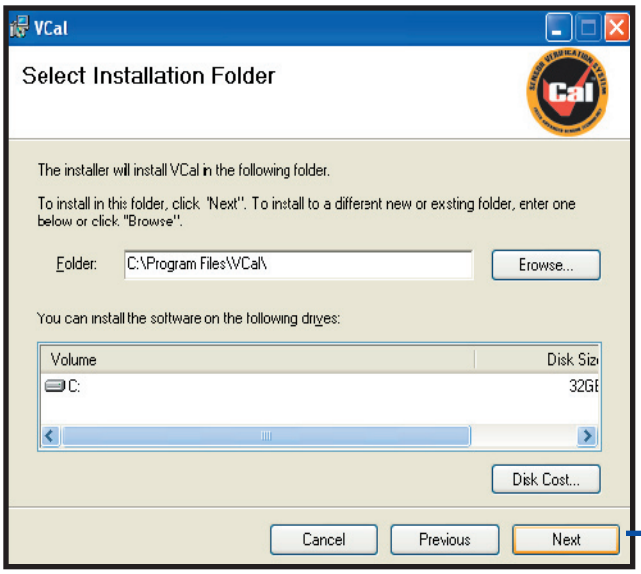
2. Clicking Next brings up the Welcome to VCal™ Setup screen...



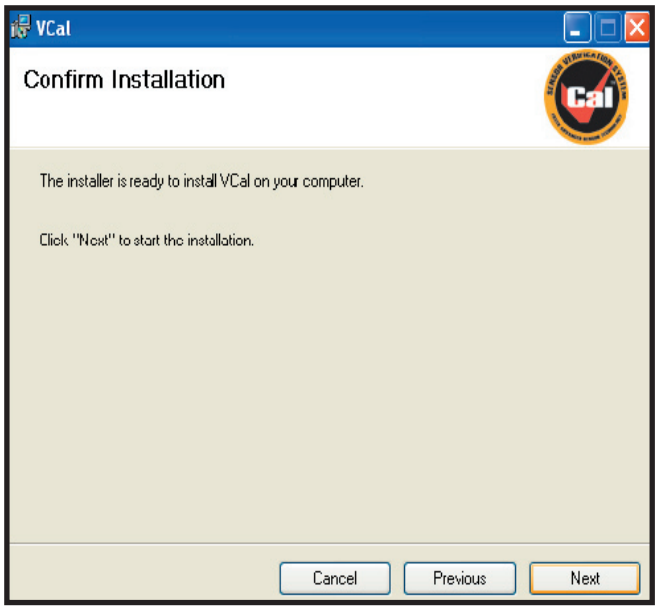
3. Clicking Next brings up the **License Agreement** screen…



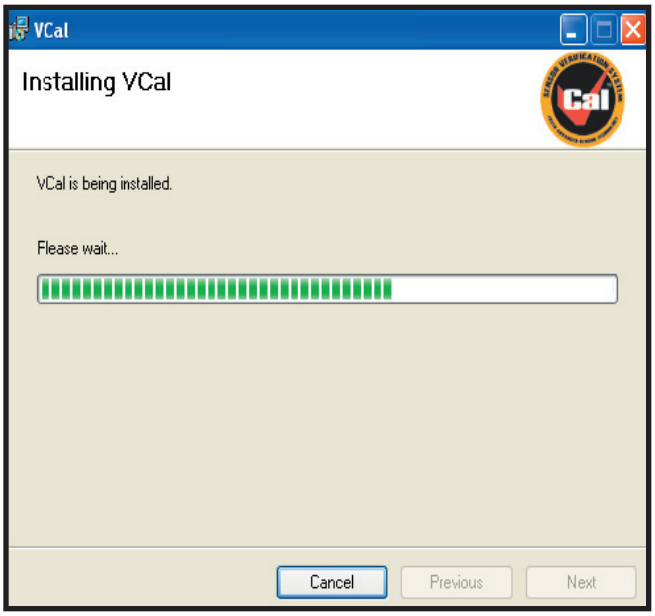
4. If you first select I Agree, and then Next, you will see the **Select Installation Folder** screen…
VCal™ will by default install to C:\Program Files\VCal\…, if this will work for your computer's setup then simply click Next. If this will not work for your computer's setup then you may Browse and select the Drive and Folder that will work for you, and then click Next; or click Previous to return to a previous screen and change a setting, or click Cancel to exit the **Installation** program.



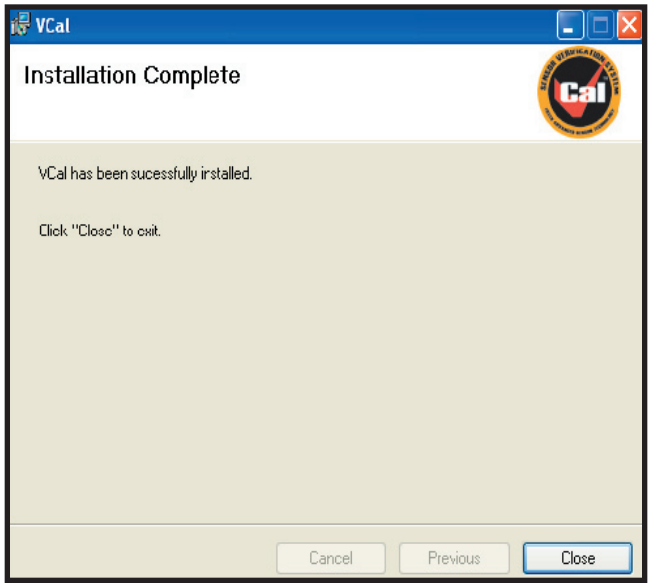
5. Clicking Next, brings up the Confirm Installation Screen . . .



6. If you are satisfied with the Installation settings you have chosen, then click Next. If not, then click Previous to return to a previous screen and change a setting, or click Cancel to exit the **Installation** program. Clicking Next will bring up the **Installing VCal™** screen…



7. Once the installation is complete you will see the **Installation Complete** screen, simply click Close here and your VCal™ installation is complete!

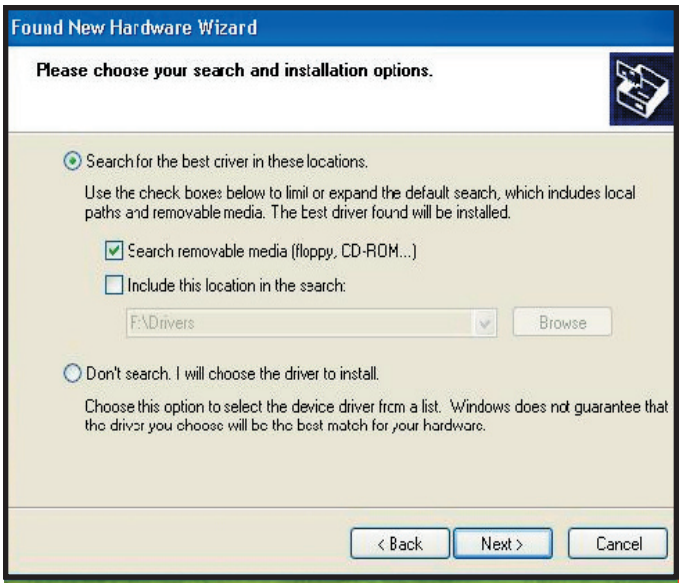


Connecting Your VCal™ System

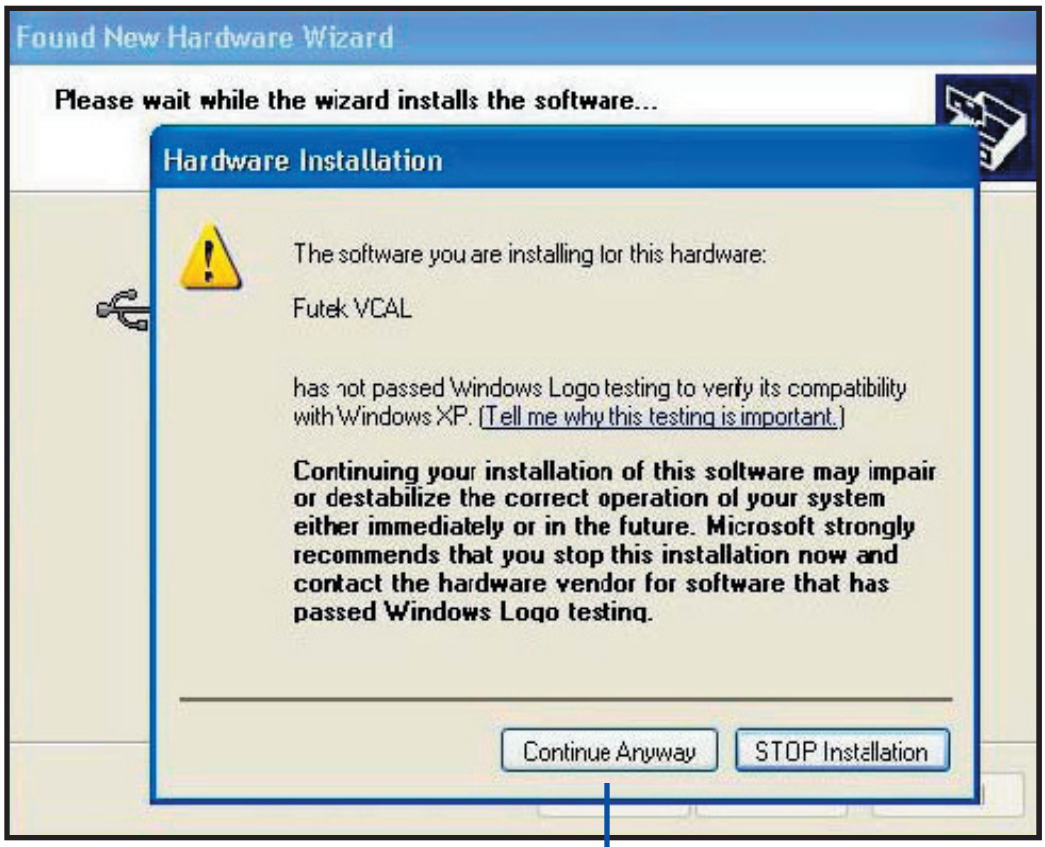
Now that you have successfully installed your Futek VCal™ system, it is time to connect your VCal™. Futek VCal™ is very simple to connect. For best results we recommend that you connect your VCal™ in the following manner; Please note the General Safety precautions listed on (page 57) before connecting your VCal™.

1. Plug in the **DC Power Supply** (included with your VCal™) into the wall outlet and then into your VCal™ unit.
2. Push in the ON/OFF power button, the red power LED should light.
3. Plug the **USB** cable (included with your VCal™) into the USB outlet on your PC
4. Plug the **USB** cable into your VCal™ unit, and plug your **Temperature Probe** into the connector on the **Power Face Plate**.
5. Your Futek VCal™ unit is now connected.
6. After connecting your VCal™ you should first see the **Found New Hardware Screen**...

7. Clicking Next, brings up the **Choose Driver Screen**, please choose to search Removable Media {CD…}



8. Some Windows XP users may encounter the following **Incompatibility message**; Please disregard and **continue**…

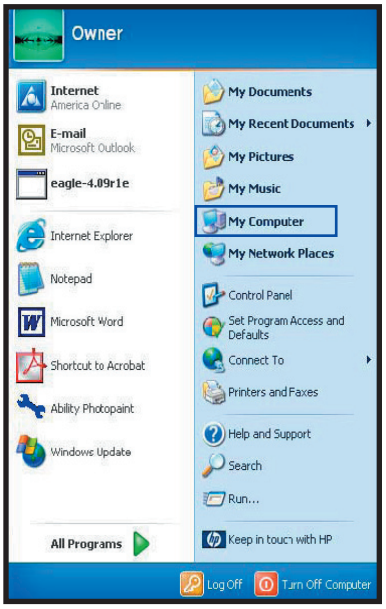


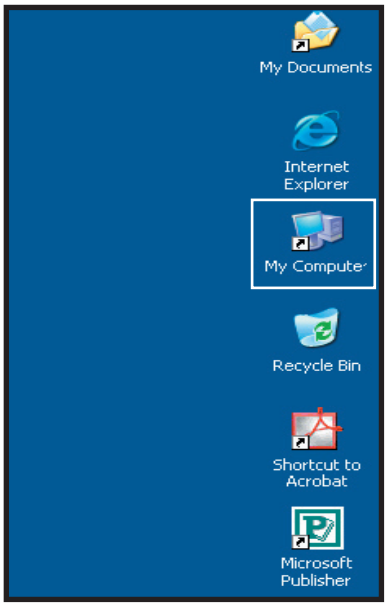
9. Clicking the Continue Anyway icon brings up the following **Completing the Found New Hardware Screen**, where if you click Finish you will have successfully installed Futek VCal™!

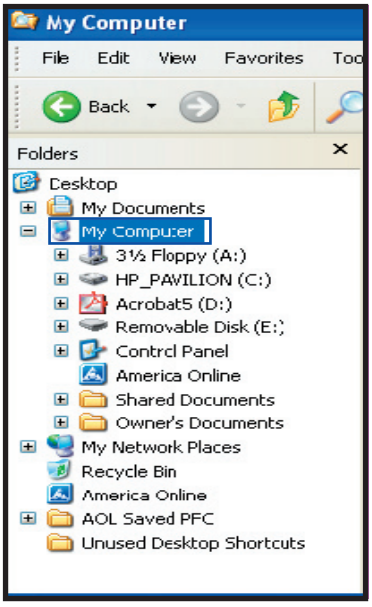
10. If you are using **Windows XP**, the first time you install VCal™ you will need to repeat steps 6 – 9 two additional times (once for each storage device installed).
11. You should see a series of dialog boxes informing you that your system has recognized that a new **USB** device has been plugged in, that it is installing the Futek VCal™ Device, and the Mass Storage Device.
12. You should see an icon appear in the right hand side of the taskbar at the bottom of your screen, which indicates that an **USB** piece of hardware is installed, and which allows you to safely unplug or eject the hardware. (An icon with a green arrow).

To Start Futek VCalTM

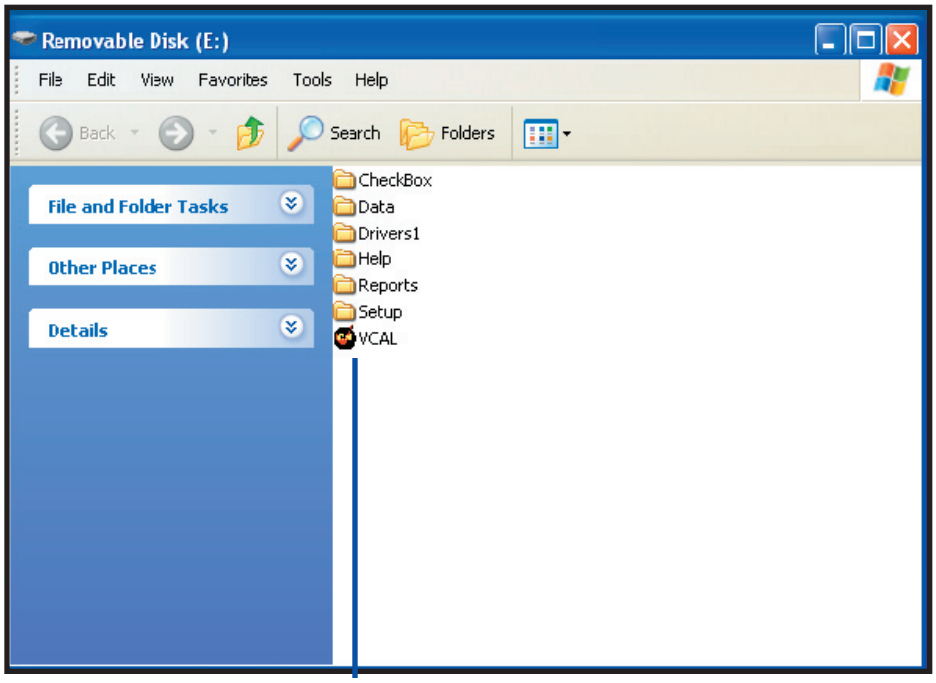
Now that you have successfully installed and connected your Futek VCal™ system, it is time to start VCal™. To do this you will need to open the Removable Disk that VCal™ has installed, and to do this you will need to open your My Computer folder. If you have a shortcut to your My Computer folder on your desktop you may simply double click on this; or you can open your Windows Explorer and you will find My Computer, or you can open your Start Menu and find My Computer. Use whichever method is easiest for you; regardless of how you do it, once you open My Computer...







You will see that Futek VCal™ has installed a '**Removable Disk**' on your computer. What is already installed on your computer will determine what drive letter VCal™ will assign to this '**Removable Disk**', but for most systems it will probably be assigned the letter E:. Double clicking this **Removable Disk** icon will bring up the following screen…

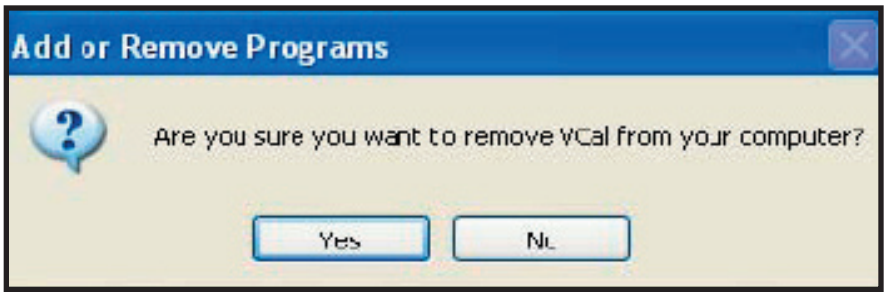


You may now double click the VCal™ icon to start Futek VCal™, or you may click and drag the icon onto your desktop to create a convenient Shortcut to VCal™.

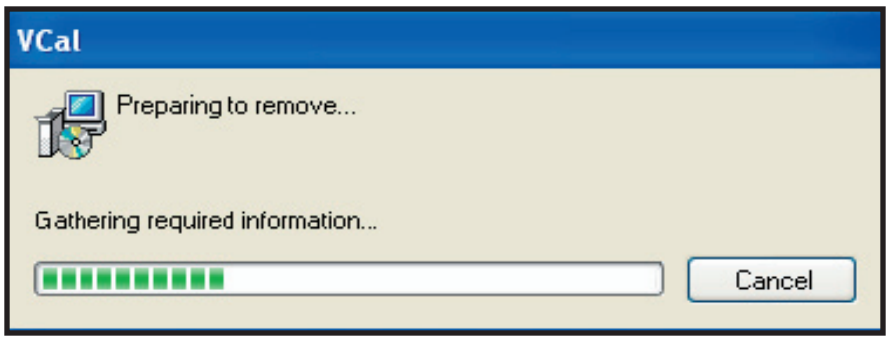
Removal of Futek VCal™

To remove Futek VCal™ from your system you may either go to My Computer Control Panel -->Add Remove Programs --> VCal™ OR you may go to My Computer -->Removable Disk E: -->Setup -->Setup -->VCal™ (this way provides an option for repairing the installation **configuration settings**). Either of these methods will work. First, the method which uses Add Remove Programs:

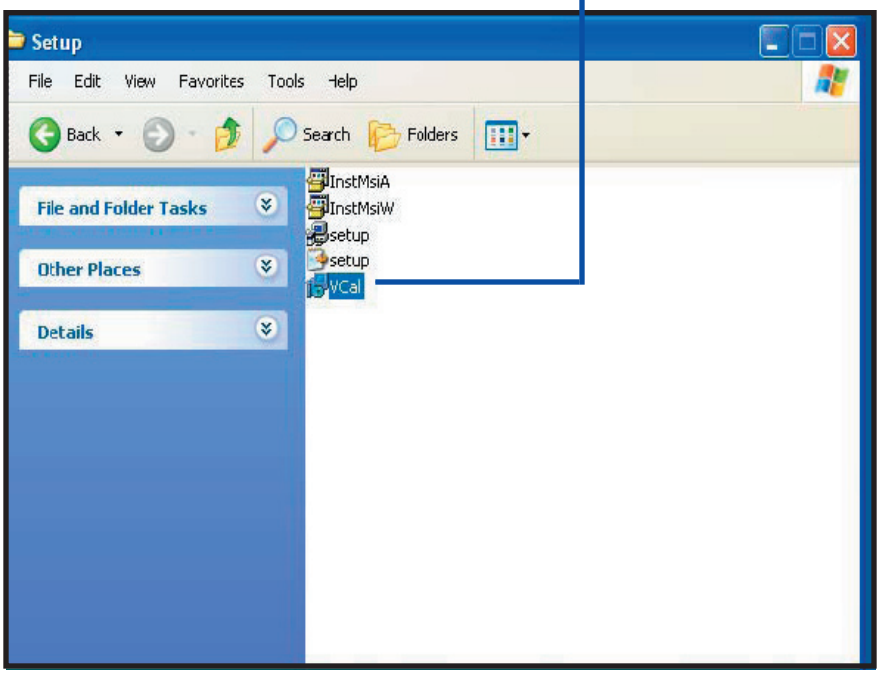
When you click on the Remove button under VCal™ in the Add Remove Programs window you are first asked to confirm that you wish to that you wish to remove VCal™:



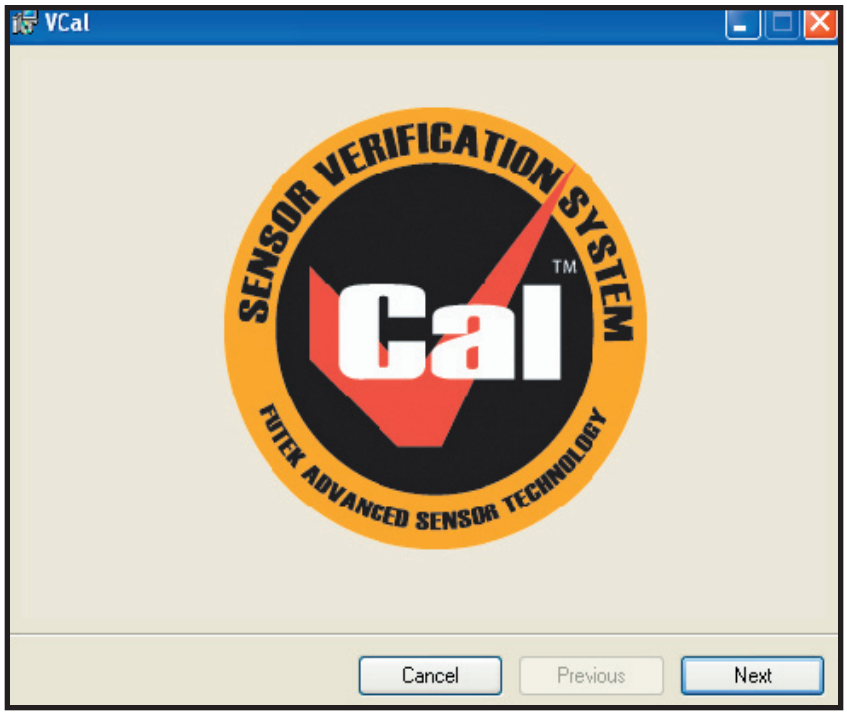
Clicking Yes will bring up the **Removal Progress Bar** window . . .



When this removal process finishes you will see the VCal™ listing disappear from your list of currently installed programs, and you have successfully removed VCal™ from your computer.
Using the VCal™ installation program to remove VCal™; once you click on the VCal installation icon in the Setup folder:

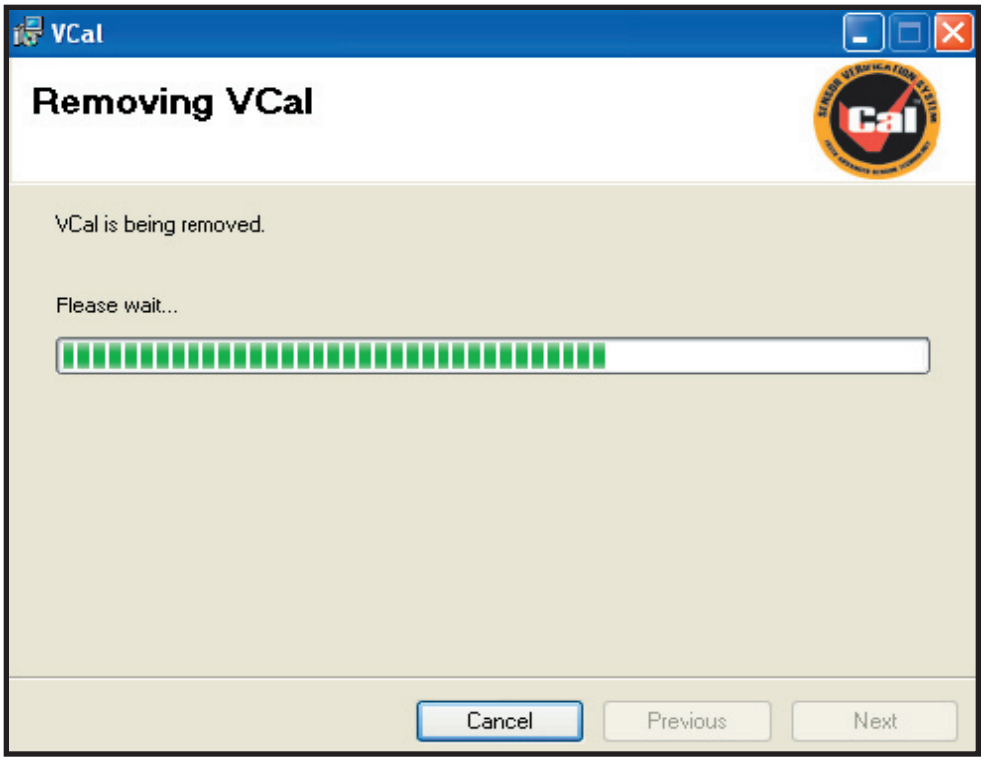


You will first see the **VCal™ Logo Screen**, clicking Next . . .

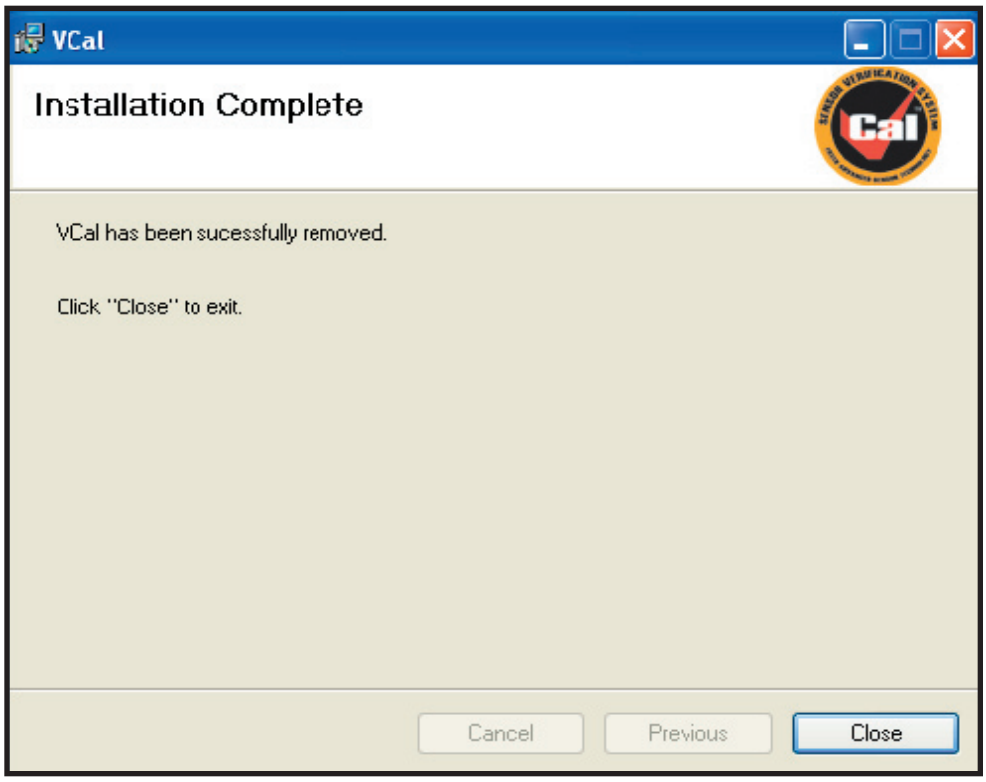


Will bring up the **Welcome To The Setup Wizard Screen**, where you are given the option to **Remove** or **Repair**. Choosing to **Remove VCal™** and then clicking Finish . . .

Will bring up the **Removing VCal™ Progress Bar Window** . . .



Followed by the **Installation Complete Screen** when the process is finished. If you will click on the Close button you will have successfully removed **VCal™** from your computer.

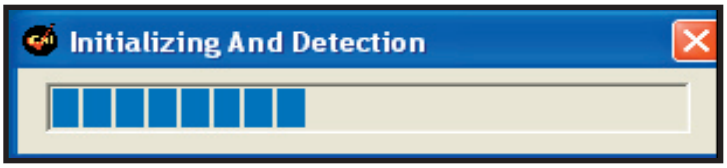


III. Tour of The VCal™ Environment

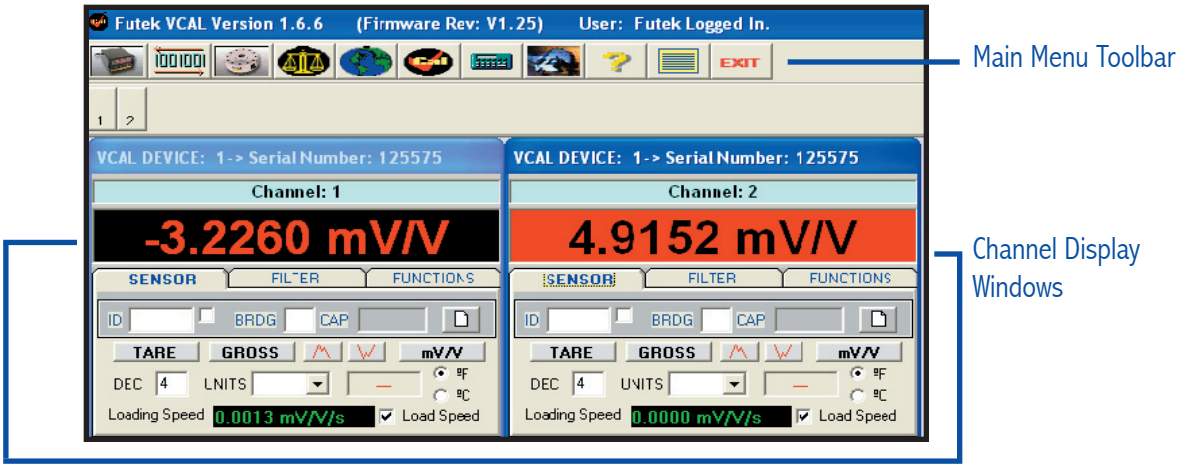
Logging In To Futek VCal™

Now, you have installed the VCal™ software, you have connected VCal™ to your computer system, and you have learned how to start your VCal™ system. Now it is time to Log in to VCal™ and get started. When you double click the VCal™ icon in the Removable Disk E: or on the shortcut to VCal™ which you created earlier on your desktop, you will see the VCal™ Log In Screen . . .

The first time you log in to VCalTM you will need to use the Futek factory provided password to log in (located on the silver label on the bottom of your VCal™, next to the VCal™ ID Number). Once you have logged in the first time you may go to **Management Tools** (see pgs. 34 - 39) and set up your usernames and passwords to suit your application. Once you have entered your username, password, and clicked OK, you will briefly see the Initializing and Detection Screen . . .

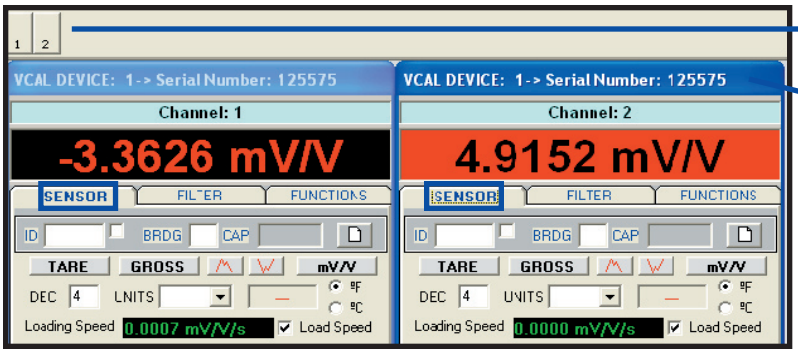


Followed by the VCalTM Main Screen, which contains the Main Menu Toolbar and the Channel Display Windows . . .



Channel Display Window Options

The **Channel Display Windows** are where your test readings are displayed, and also where you set your initial configuration settings for your tests and verifications. There are three main tabs to the **Channel Display Windows**; (1) the **Sensor Tab**; (2) the **Filter Tab**; and (3) the **Functions Tab**:



Hide or Unhide the Channel Display Window

You may also drag and drop the windows to to any convenient location on the screen by grabbing the blue title bar.

Under the Sensor Tab - You will find the following tools and command buttons (from left to right, and top to bottom):

ID Input Box - If your sensor is equipped with the Futek VCal™ auto-recognition ID chip the sensor serial number will appear here, or you may enter a sensor serial number here manually. The checkbox allows you to select/unselect the Auto Read function. (pg. 32)

BRDG - Bypass ID-Chip Polling: Use when calibrating reference sensors with no ID chip.

CAP - This box lets you enter a capacity for the sensor you are testing or verifying on this channel.

Clear the Scaling - Clears any scaling factor which may currently be loaded. Used for creating a new calibration curve for calibrating your Reference Sensors.

Tare - The zeroed reading of your sensor with all offsets nulled.

Gross - The untared reading of your sensor with all offsets still in place.

Set to Peak Mode - Takes a peak reading, unselect to clear the peak reading.

Set to Valley Mode - Takes a valley reading, unselect to clear the valley reading.

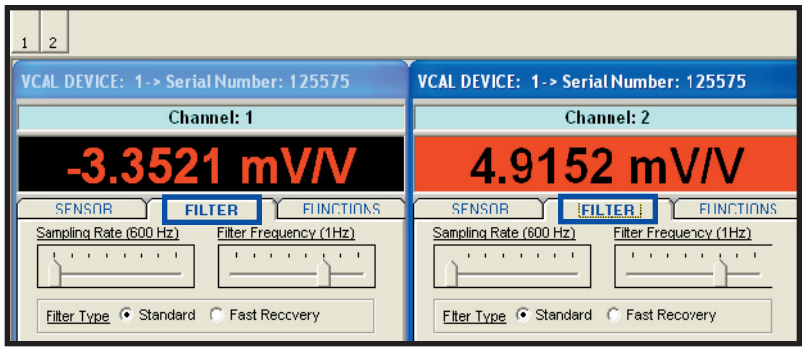
mV/V - Shows you the current mV/V reading of the sensor without clearing the scaling factor, used to verify that mV/V matches load.

DEC - Allows you to define the decimal places displayed.

F / C - Allows you to define whether test temperature is displayed in Fahrenheit or Celsius.

Loading Speed - Allows you to monitor and subsequently control, the speed with which your load, and thus output, changes.

UNITS - Allows you to change the displayed units in real time.

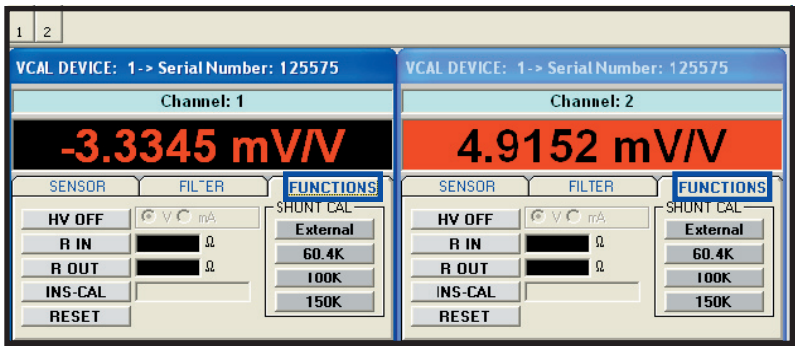


Under the Filter Tab - You will find the following available settings, which you may customize to your needs by simply adjusting the sliding bars to the value you require.

Sampling Rate - This setting is used to adjust the internal sampling rate, the eight available rates are: 4.688; 9.375; 18.75; 37.5; 75; 150; 300; and 600 readings per second. Please note that filter settings and system overhead in general, will affect the VCal™ actual throughput.

Filter Frequency - This setting is used to adjust the frequency of the low pass filter. On Standard Filter the following settings are available: 40; 18; 8; 4; 2; 1; 0.5; and 0.25 Hz. On Fast Recovery Filter the following settings are available: 18; 11; 9; 7; 5; 4; 3.5; 3; and 2.5 Hz. The filter setting determines how fast the system will respond to changes in load.

Filter Type - This setting allows you to choose between Standard and FIR Fast Recovery filters. Transient recovery of this filter is independent of the filter's cutoff frequency. The filter setting determines how fast the system will respond to changes in load.

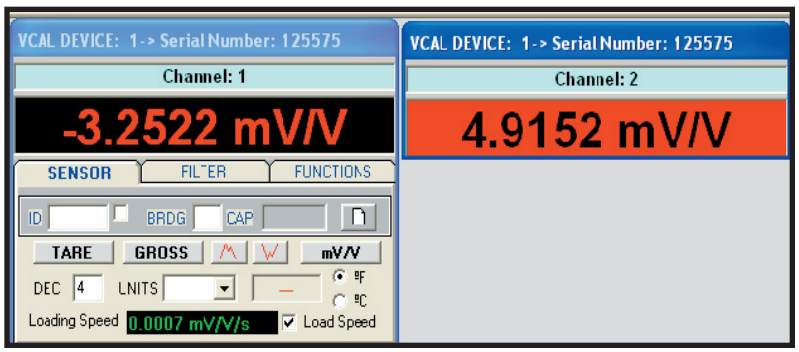


Under the Functions Tab - The following command buttons are available:

HV OFF/ON - This button toggles **High Voltage** off and on, which determines whether reading is in mV/V or Volts
R IN / R OUT - These buttons take input / output resistance readings from the sensor connected to the chosen channel.
V / mA - This button toggles between voltage and mA readings. Please note that electrical connections for voltage and current are separate. Also note that when HV is ON, no VCal™ sensor will be detected, and that 'Clear Scaling', mV/V, R IN, R OUT, and shunts will all be disabled.
INS-CAL - This button executes an internal calibration and compensation for the analog to digital converters (ADCs). This procedure compensates for any changes in temperature and ensures that the instrument is in calibration. This procedure is automatically performed when the Reference or Test Sensor tests are initialized. It is recommended that the INS-CAL be executed prior to taking readings when VCal™ is to be used as a display.
RESET - Under normal circumstances you will never need to use this button. It is mainly for factory testing. It causes the ADCs to do a warm reset, clears any tares, and initiates a calibration cycle.
SHUNTS - EXTERNAL - A shunt resistor must be connected to the shunt terminal, press 'External' to activate shunt.
Shunt button must turn yellow to indicate it is on. You must shut off any shunt buttons that are **ON**, before switching to another shunt value. Please note that some shunt values will exceed your calibration range and produce undesired results. Please select shunt values which are appropriate to the current range you are using.

Main Menu Toolbar Options

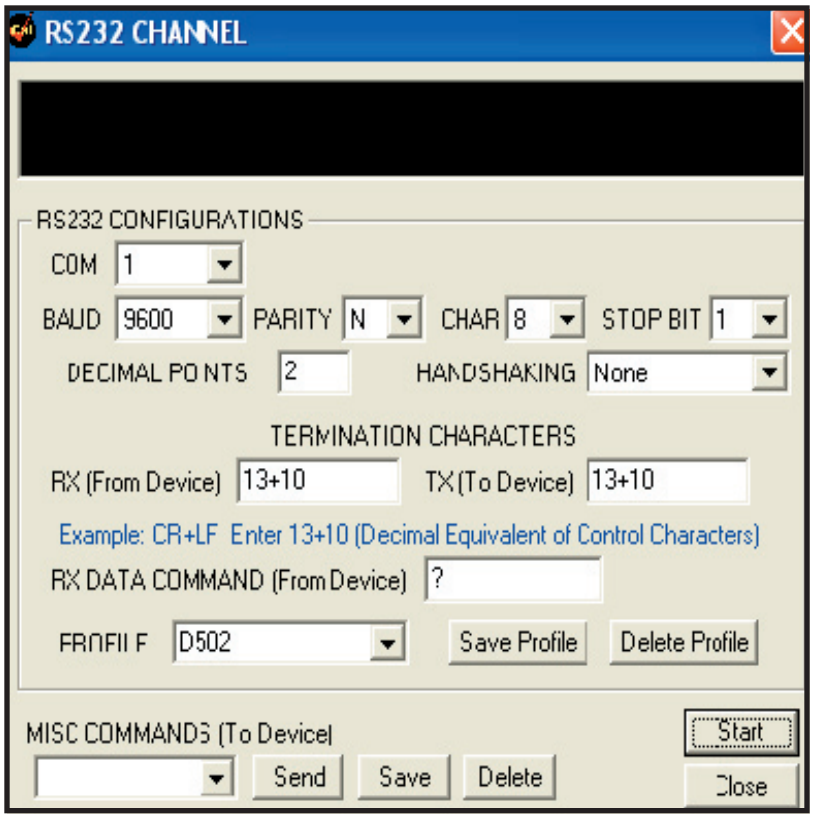
Display / Arrange - This option provides you some ways to customize the look and function of the channel 1 & 2 displays. You can drag and drop the displays to anywhere on your screen, by grabbing the blue, title bar at the top of the window with your mouse. You can also hide the Sensor, Filter, and Functions tabs, leaving just the display itself, by simply clicking in the display portion of the window. Please note that when the background of the display turns RED this indicates an "Over Load Condition", and when the background of the display turns YELLOW it indicates an "Over Range Condition."



Please note that an "**Over Range Condition**" indicates a load outside of the range of the sensor is being applied and care should be taken.

An "**Over Load Condition**" is more severe (as indicated by the red screen). This indicates that a sensor is in a condition of Overload and is in danger of being damaged.

RS - 232 Channel - This option allows you to access the RS - 232 channel, where you can then connect ASCII devices to your VCal™ system, such as the Futek D502, D506, and D526 . . .



COM - Allows you to designate which communication port you wish to use (COM's 1 – 16 are available).

Baud - Allows you to designate the baud rate you wish to use (300 – 115200 are available).

Parity - Allows you to choose between Non, Odd, or Even parity checking.

Char – Allows the user to choose between 7 or 8 character.

Stop Bit - Allows you to choose either 1 or 2 as your stop bit.

Handshaking - Allows you to choose between None, XonXoff, RTS, and RTSXonXoff as your handshake method.

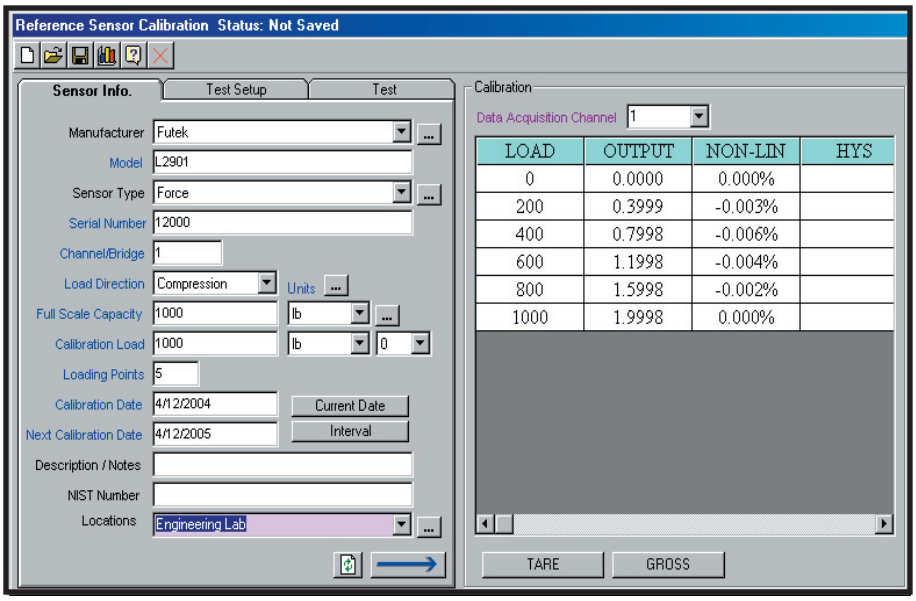
Termination Characters - Allows you to define termination characters for strings received from, or transmitted to the device.

RX Data Command - Allows you to define data commands received from the device.

Profile - Allows you to enter and save commonly used profiles, so that they may be easily used later.

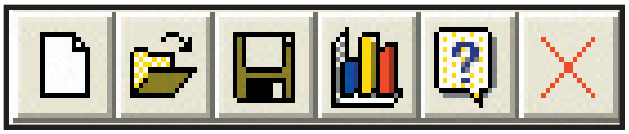
Misc. Commands - Allows you to define commonly used commands that are transmitted to the device.

Setup Reference System - This option allows you to enter and setup Reference Sensor Information and Records, and to calibrate your Reference Sensors. When you click the Reference Sensor button, it brings up the following Reference Sensor screen . . .



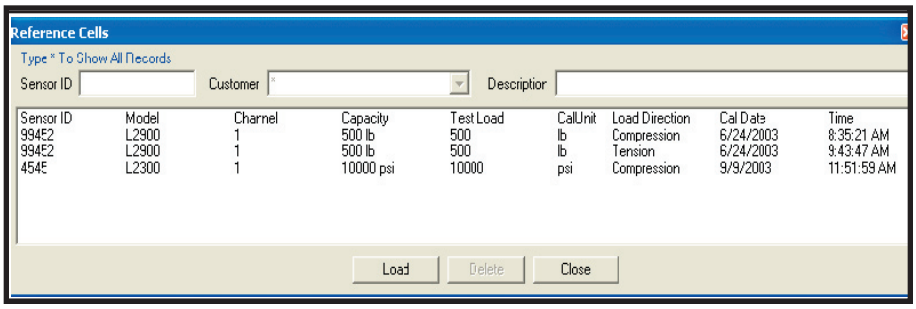
Reference Sensor Options -

First off, there is a row of command buttons near the top left corner of the screen that should be familiar to anyone familiar with Windows. . .

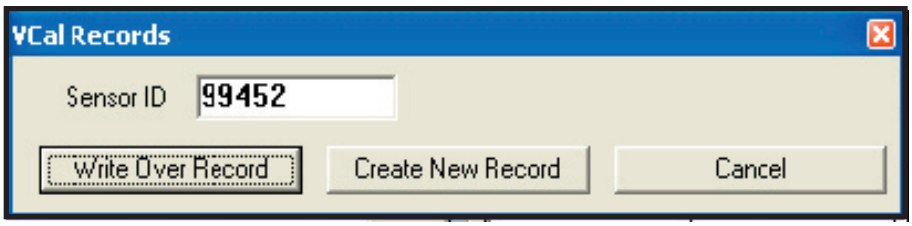


Clear - This option allows you to Clear currently loaded Reference Calibration information.

Open - This option allows you to manage your saved Reference Cell records by providing you the options to Load, Delete, or Close any saved Reference Cell record



Save - This option allows you to Save the currently loaded Reference record (If there are existing records under the same serial number you are asked if you wish to Create a New Record, Write Over the Existing Record, or Cancel the Save action)...




Help - This option allows you to access this User Manual.

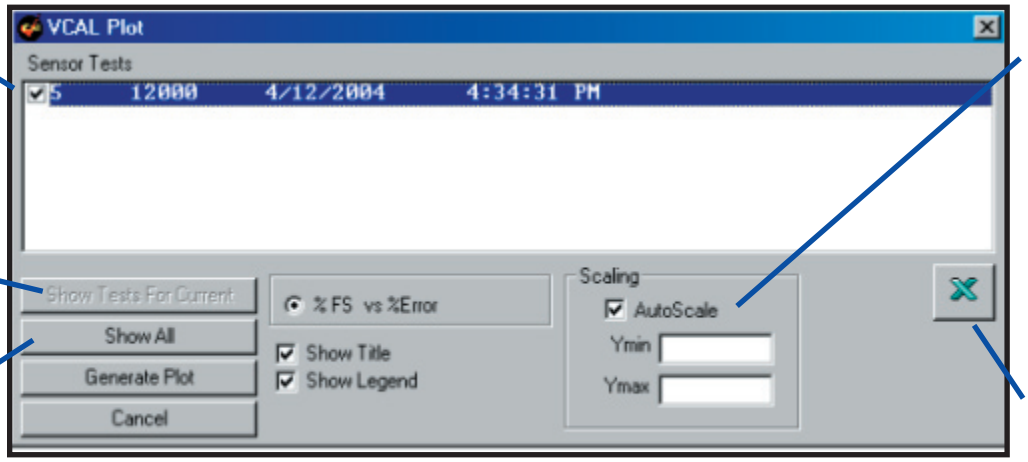

Exit - This option allows you to Exit the Reference Calibration interface of Futek VCal™.


Plot - This option allows you to create 3D Graphs of your test results, or export your data to a spreadsheet application. Clicking the Plot icon brings up the **Plot** interface. Here you can load your saved tests, determine which tests should be included in your plot, and then either Generate your VCal™ 3D graph, or export your data to a spreadsheet application for further analysis or graphing.

Select which test results you would like to create Graphs of by selecting check box

Show Tests for Current - all saved tests under current ID

Show All - all saved tests under any ID



Autoscale Check Box - Automatically scales Y axis based on given values. Uncheck to enter custom values.

Select either **Generate Plot** (to view Graph) or the **Export** button to send the data to a spreadsheet

Clicking Generate Plot brings up this **Plot** screen . . .

Here, each colored line in the **Graph** represents a separate set of test results chosen from the screen above.

The bottom, or x-axis in this **Graph** represents **% of Load**, while the vertical, or y-axis represents the **Non-Linearity** error as a percentage of **Rated Output.**

Plot Screen Toolbar


Print - This button allows you to print the current **Graph(s)** in the **Plot** screen.


Orbit - Creates a 360 Degree orbit of the plot **Graph(s)** in a separate window.


Zoom - Allows you to zoom in and out of the current **Plot** screen.

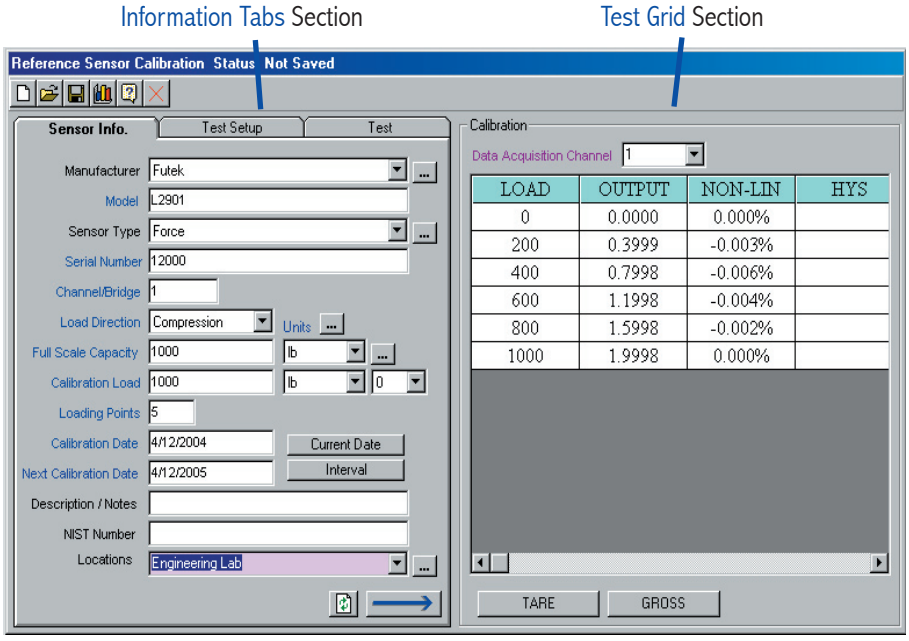

Pan - Allows you to pan left to right or up and down withing the **Plot** screen.


Restore - This button restores the default **Graph** view

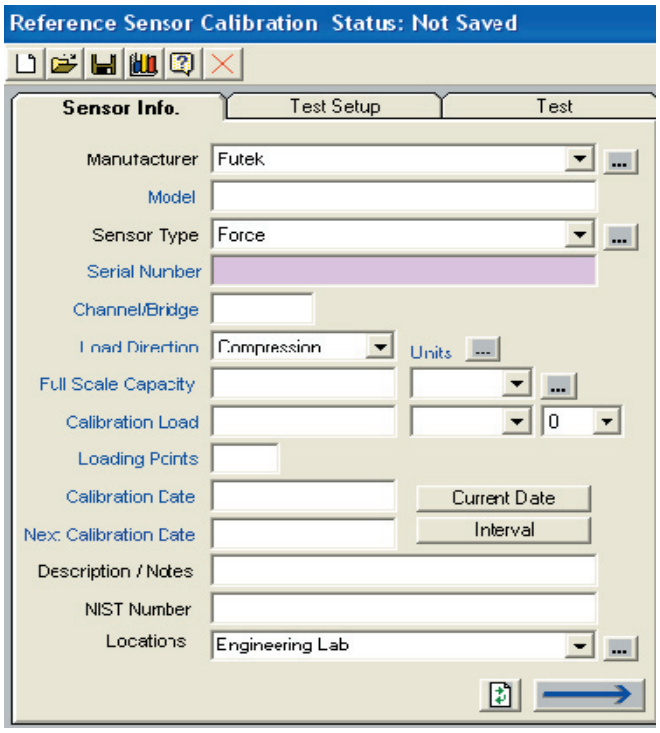

Show Text - This option creates markers indicating point values on the **Graph(s)**.


Close - Closes the **Plot** screen.

The rest of the Reference Sensor Calibration interface is broken into two, basic sections; the Information Tabs, and the Test Grid sections . . .



Information Tabs Section - There are three main windows to the Information Tabs Section . . .
First is the Sensor Info tab; this is where you will enter the descriptive information on the Reference Sensor you are calibrating. Please note that Text Box Titles which are displayed in Blue are required if you wish to perform a calibration or test.



Manufacturer - This is where you enter the name of the manufacturer of the load cell you are calibrating. Clicking the down arrow icon at the right of the text box displays a pull - down menu which lists all **Manufacturers** you have saved in the Management Tools section of VCal™. (see pg. 36) Clicking the icon with three periods will talke you to the section of **Management Tool**s where you save **Manufacturer Names**.
Model - This is where you enter the Model number of your sensor.
Sensor Type - This is where you enter the type of sensor you wish to test or calibrate. Again, you have icons for accessing the pull - down menu of saved sensor types, and for going to the Sensor Types in the Management Tools section of VCal™. (see pg. 37)
Serial Number - This is where you enter the Serial Number of the reference sensor you wish to calibrate.
Channel/Bridge - This is where you enter the Channel or Bridge you wish to use (on multi-channel sensors) Default is 1.
Load Direction - This is where you specify which Direction you wish to apply your load in. Again, there are icons for accessing the pulldown menu of saved Load Directions and for going directly to the saved load direction Units in the Management Tools section.(p. 38)

Full Scale Capacity - This is where you enter the Full Scale Capacity (max load) for your sensor. Again, there is the familiar, pull-down menu of saved load units, and an icon for going directly to the saved Conversion Factors in the Management Tools section. (p. 37)
Calibration Load - This is where you designate the Maximum Load you wish to apply during this test. Please note that this amount may or may not be the same as the Full Scale Capacity for your sensor. Again, there is an icon for the pull-down menu for Load Units, and also for 26 decimal places in the Calibration Load values.

Loading Points - This is where you enter the number of Load Points you wish to include in your test. Default is 5 points.

Calibration Date - This where you enter the Date of your test. If you are entering data from a previous test you may enter the date manually. If you are performing the test now there is a convenient button for entering the current date with one click.

Next Calibration Date - This is where you define the Calibration Interval for your sensor. You may enter a date manually, or you can click the Interval button to bring up a window where you can define Interval in terms of Daily, Weekly, Monthly, or Yearly.

Description / Notes - Here you can enter a brief Description or Notes to help you label or differentiate your tests (maximum 50 characters).

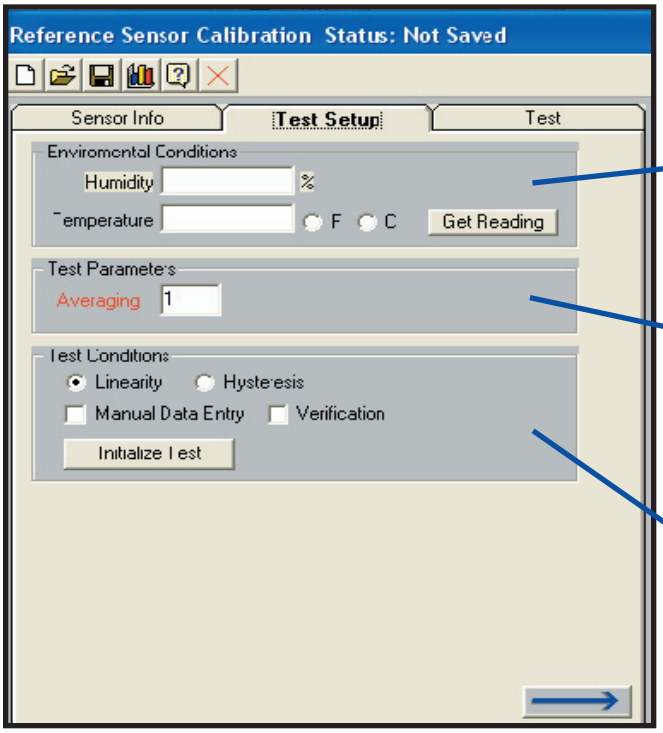
NIST Number - Here you can enter the NIST traceability number for your test.

Locations - Here you can enter the Location where your test took place. Once again, there is an available pull-down menu to quickly access previously saved locations, as well as an icon for going directly to the **Location** section of **Management Tools**. (p.38)

Refresh - You can use this button to reload or Refresh your screen.

Next Tab - This button allows you to move to the next tab (Example: from **Sensor Info** to **Test Setup**). You can also click on the tab title to move to that tab.

The next window under the Information Tabs is the Test Setup tab. This is where you define/document the conditions for your Test. . .

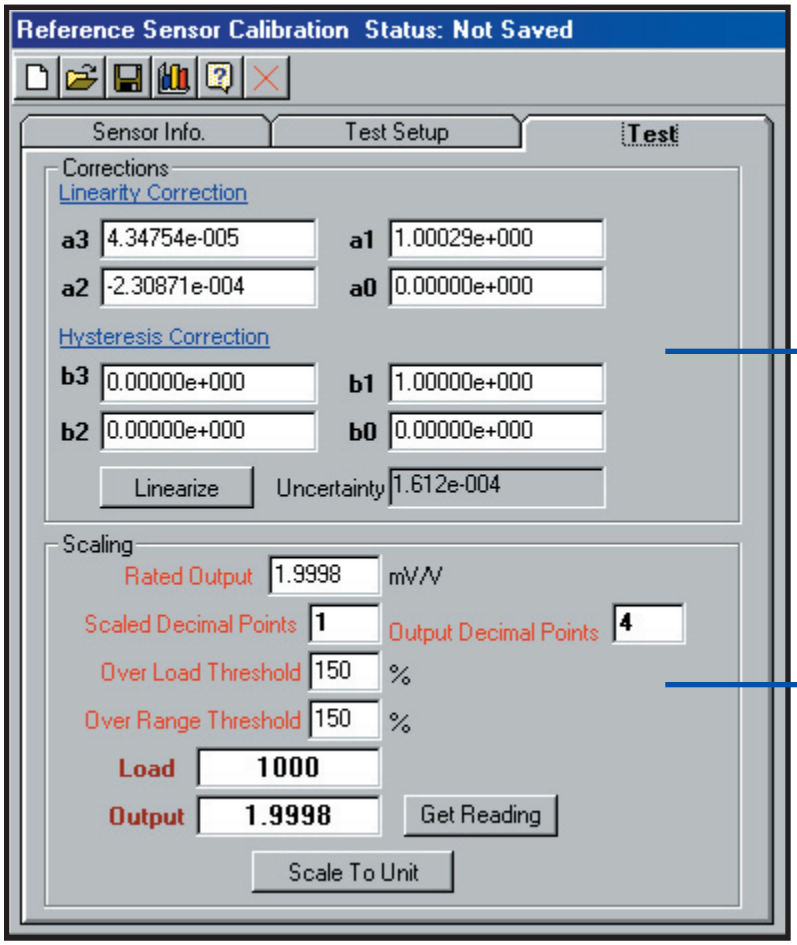


There are three main divisions to the Test Setup Tab;

The first is the Environmental Conditions Window - Here you can manually enter readings for temperature and humidity from your external sensors; **OR** you can use the Futek VCal™ temperature probe and click Get Reading and VCal™ will take and enter a value for you.

The next main division is the Test Parameters Window - Here you can enter an Averaging Value, this number tells VCal™ how many readings to take, and then return the value which is the Average of these readings.

The last division under the Test Setup Tab is the Test Conditions Window - Here you define whether you wish to test for Linearity **OR** Linearity and Hysteresis; and also whether you wish to enter your Data Manually, or let VCal™ take and enter your Verification readings. There is also an Initialize Test Button when you are ready to start your test, and the Arrow Button to take you to the next tab when you are ready.

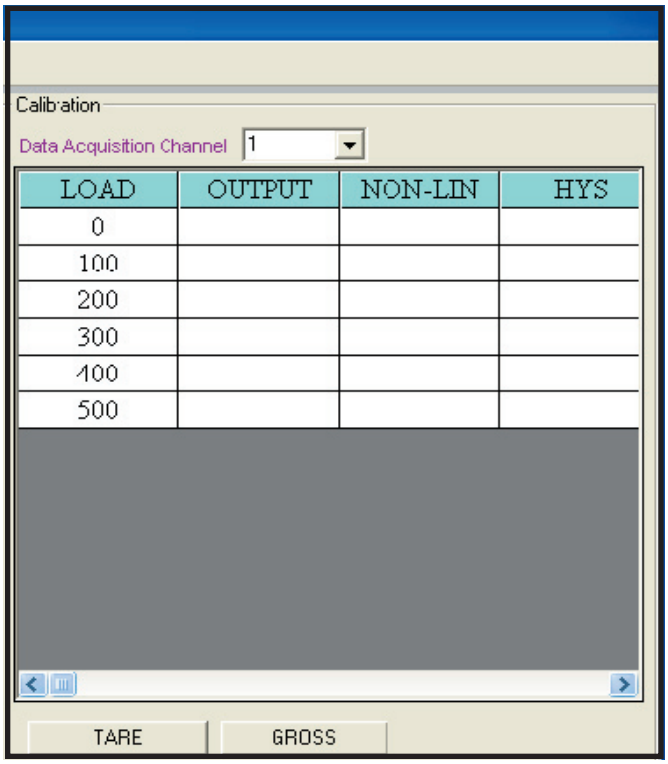


The final window under the Information Tabs Window - is the Test Tab Window. This window provides you some options for applying correction factors and uncertainty values to your test to provide added confidence in the accuracy of your results.

The Corrections section of this window is where you can view the Linearization Coefficients and Uncertainty Values for your calibration. Once you have completed a test you can come to this tab and click the Linearize Button to view these values. Please note that Hysteresis Correction values will only be calculated if Hysteresis was selected on the Test Setup Tab under **Test Conditions**.

The Scaling section of this window is where you can set Over Load and Over Range warning points, as well as set Scaling Factors. You simply enter the Rated Output of your sensor, load to the desired calibration load, take a current output reading, and then press Scale To Unit (more detail will be given in the **Instructions** section). The number of decimal points for pre-calibrated reference sensor output can be entered in the Output Decimal Points textbox.

Calibration Test Grid



The other half of the **Reference Sensor** interface is
The **C alibration Test Grid.**

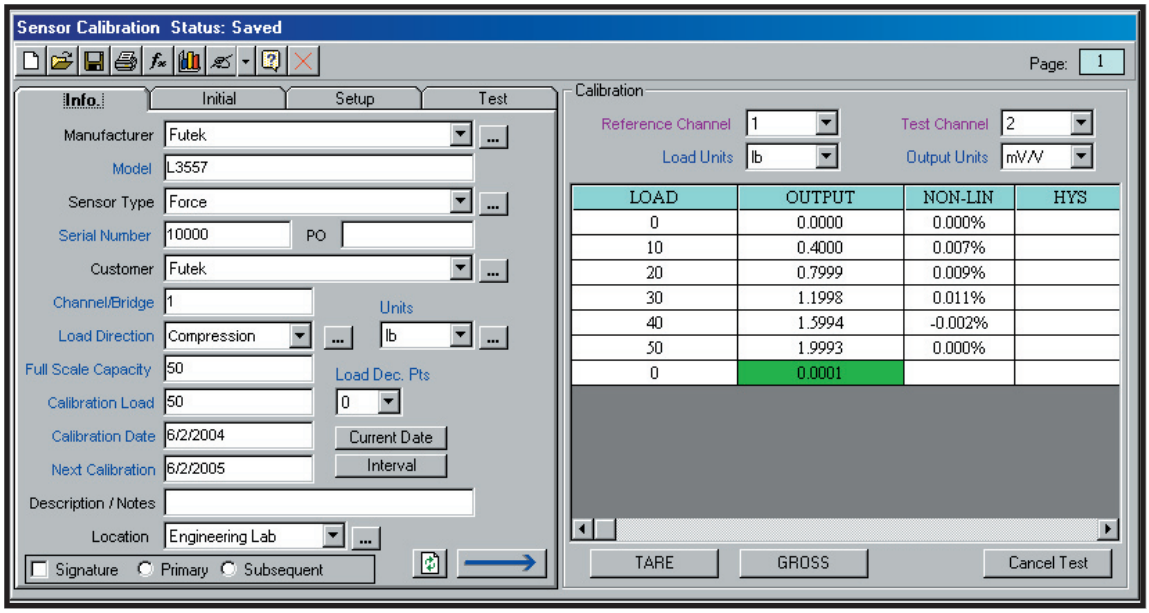
The Data Acquisition Channel is the channel you have your **Reference Sensor** connected to.

The Test Grid is where you will perform your tests and view your test results.

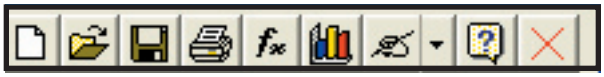
The **Tare Button** allows you to utilize offsets and zero the unloaded output.

The **Gross Button** allows you to take an untared reading with all offsets in place.

Calibration / Verification - This option allows you to access the following interface used for calibrating and verifying sensors . . .



Once again, there is the familiar looking row of command buttons across the top of the interface . . .



New - This option allows you to create a New calibration record.

Load - This option allows you to Load a previously saved calibration record.

Save - This option allows you to Save the currently loaded record.

Print - This option allows you to Print a saved calibration record. (See page 25 for details.)

Polynomial - This option allows you to view the Polynomial coefficients for the current calibration

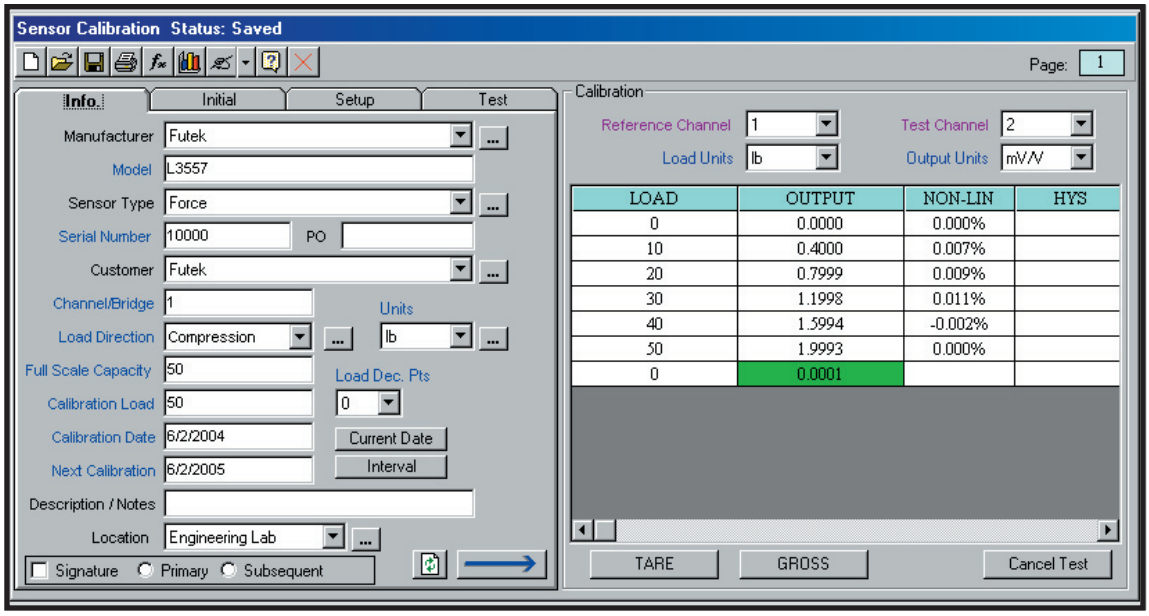
Plot - Graph the results of a saved calibration record.

Test - This option allows you to choose from three types of test; Main Test, Time Test, and Signature Test (see Calibration instructions for details on these tests pgs. 40 - 56).

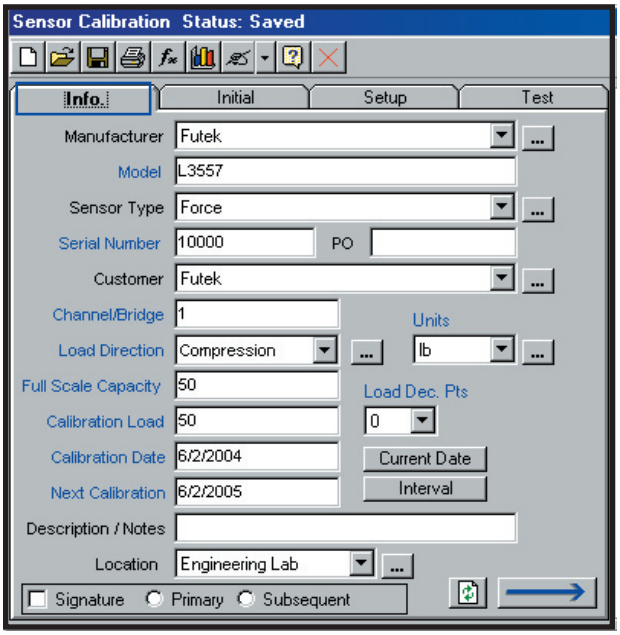
Help - This option allows you to access this User Manual.

Exit - This option allows you to Exit the Sensor Calibration interface.

The rest of the Calibration / Verification interface is (like the Reference Sensor interface) divided into two main sections; the Information Tabs section, and the Test Grid section . . .



Information Tabs Section - Under the Information Tabs section there are four tabs; Info, Initial, Setup, and Test . . .
First is the Info Tab, this is where you will enter the descriptive Sensor Information for your test. Please note that **Text Box Titles which are displayed in Blue are required information if you wish to perform a calibration or verification.**



Manufacturer - This is where you will enter the name of the Manufacturer of the load cell you are calibrating or verifying. Again (as in the Reference Sensor interface) the icon with the down arrow just to the right of the text box, will bring up a pull-down menu of the Manufacturer names you have saved in the **Management Tools** section, and the icon with the three periods will take you to the section of **Management Tools** where you save Manufacturer Info.

Model - This is where you will enter the Model Number or Model Name of the sensor you are calibrating.

Sensor Type - This is where you will enter the Type of sensor you are calibrating. Again, there are the down arrow and three period icons for entering saved Sensor Types and for going directly to the Sensor Type section of **Management Tools**. (pg. 37)

Serial Number - This is where you will enter the Serial or ID Number of the sensor you are calibrating.

PO - This is where you will enter the Purchase Order number if applicable to your situation.

Customer - This is where you will enter the name of the Customer for whom you are performing the calibration. Once again there are icons available for accessing saved customers and for going to **Management Tools**. (pg. 37)

Channel / Bridge - This is where you will enter which Bridge (on multi-channel sensors) you are calibrating (default is channel 1).

Load Direction - This is where you will enter which Direction you wish to apply your Load in (Compression, Tension, CW, CCW, etc.). There are again the icons available for accessing your saved load directions, and for going to Load Direction in the **Management Tools** section.(pg. 38).

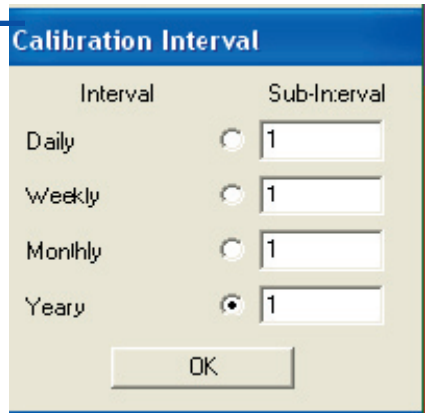
Loading Units - This is where you wil enter the Units you measure your Load in. This option also offers you command icons for accessing Units you have saved previously, and also for going directly to Units in the **Management Tools** section. (pg. 37)

Full Scale Capacity - This is where you enter the maximum Capacity your sensor is rated at.

Calibration Load - This is where you enter the Maximum Load you are going to apply during your calibration. This value may or may not be the same as your sensor's Full Scale Capacity. For example, your sensor may be rated at 1000 lbs but you only wish to calibrate the sensor to 500 lbs on this particular test.

Calibration Date - This is where you will enter the Date your calibration is being performed. There is a Current Date button available for tagging your test with today's date with one click, or if you are entering data from a previous test you can manually enter the correct date.

Next Calibration - This is where you define the Calibration Interval (recalibration date) for your sensor. If you click the Interval button it will bring up the **Interval** screen . . .Here, under the **Interval** column, you can select from Daily, Weekly, Monthly, or Yearly as your main Interval definition; and under the Sub-Interval column you can designate an incremental of the main Interval you defined. **For example**; if you Select Yearly and a **Sub-Interval** of 1, your Calibration Interval would be 1 year from the date of the test.



Description / Notes - Here you can enter a descriptive comment to help you label your test, making it easier to identify and more traceable.

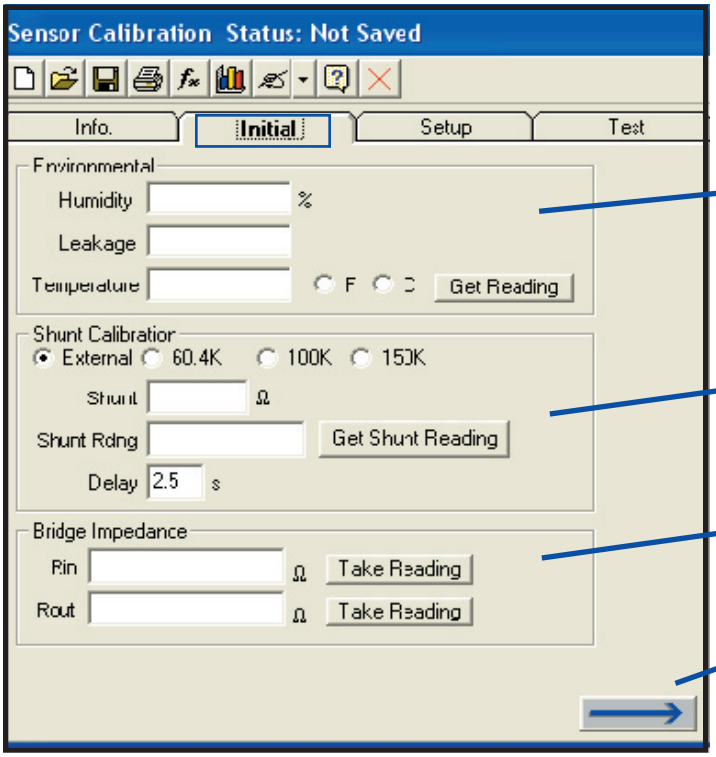
Location - Here you can record the name of the department or Location where your test was performed for future reference and as a documentation aid. There are the now familiar icons for a pull-down menu of saved Locations, and for going directly to the Location section of **Management Tools**. (pg. 38)

Signature Checking - By selecting this option (and also either **Primary** or **Subsequent**) you can define your test as either a **Primary** or **Subsequent** test, and VCal™ will record the standard characteristics of your test (non-linearity, output, error, etc), and compare these characteristics against any **Subsequent** tests performed under identical test situations and conditions and using the same processes and procedures as in the **Primary** test. More details will be given on **Signature** testing in the **Instructions for Calibrating and Verifying** section on pgs. 45, 48.

In the bottom, right corner of the **Info** tab window, there is the familiar Refresh icon, clicking this will Refresh or Reload your screen.

Also in the bottom, right corner of the **Info** tab window is this Next Tab icon, which will take you to the next Tab or **Window** in the **Information Tabs** section of the screen.

The next **Tab** or **Window** under the **Information Tabs** section of the **Calibration / Verification** interface is the Initial Tab, where you will do the Initial setup for your test: Record **Environmental** conditons, perform **Shunt Calibration** with either the built-in **Shunt** values,or with your own, external shunt resistors, and also take and record **Bridge Resistance** readings.



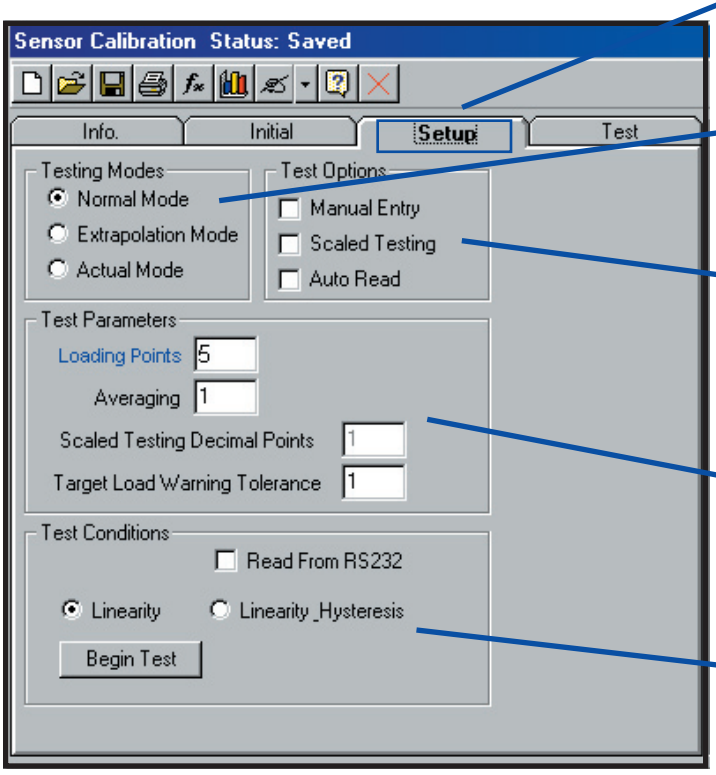
The first section of the Initial tab is the **Environmental Conditions** section; here you can enter and record the relative humidity levels and leakage factor for your test, as well as obtain and record the temperature in either Fahrenheit or Celsius from your VCal™ temperature probe.

Next is the **Shunt Calibration** section; here you can use VCal™'s built in **Shunt** values or select **Externa**l and connect your own shunt resistors to VCal™, and obtain and record the **Shunt Calibration** readings for your test.

The final section of the Initial tab is the **Bridge Impedance** section; here you can obtain and record the bridgeresistance for the sensor you are calibrating by clicking the **Take Reading Button**

The Next Tab icon will move you to the next window, in this case, to the Setup Tab . . .

The Setup Tab is where you can define the **Testing Mode**, your **Test Options**, the **Test Parameters**, and the **Test Conditions** for your test.



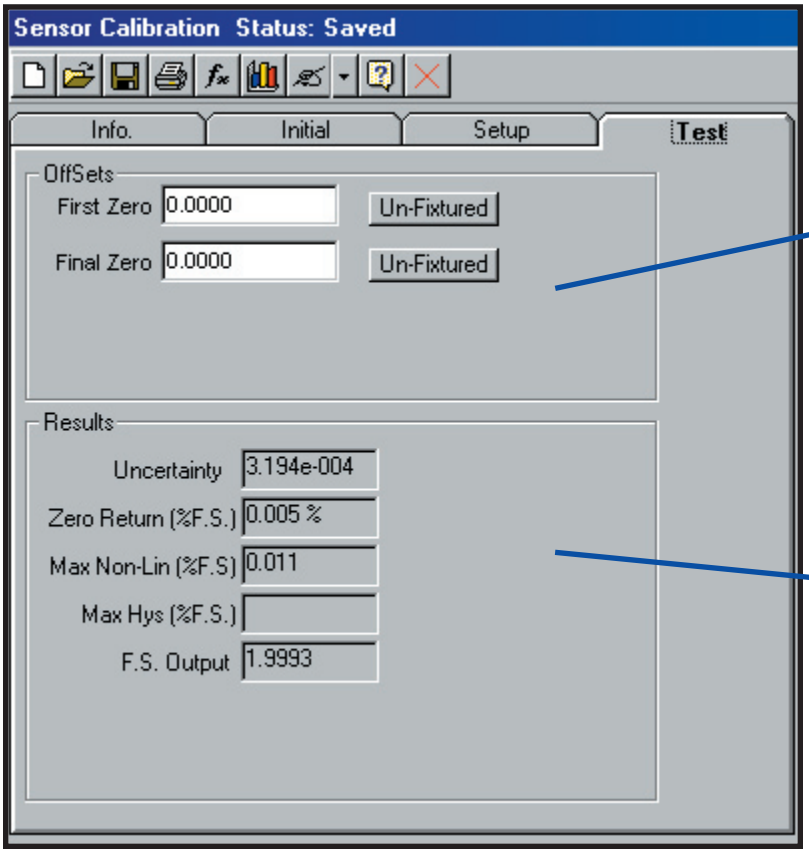
Under Testing Modes you can choose between **Normal**, **Extrapolation**, and **Actual Modes of Testing**. Descriptions of these Modes will be given in the **Calibration/Verification Instructions** section of this Manual. (pg. 42)

Under Test Options you can choose between either **Manual Entry**, or **Scaled Testing**. More detail will be given on these options in the **Calibration/Verification Instructions** section of this Manual. (pg. 42)

Under Test Parameters you can define such parameters for your test as Loading Points, **Averaging**, **Decimal Points**, and **Target Load Warning Tolerances**. The **Scaled Testing Decimal Points** textbox allows you to select output decimal points when performing a scaled test. More details will be given on setting these parameters in the **Calibration/Verification Instructions** section of this Manual. (pg. 43)

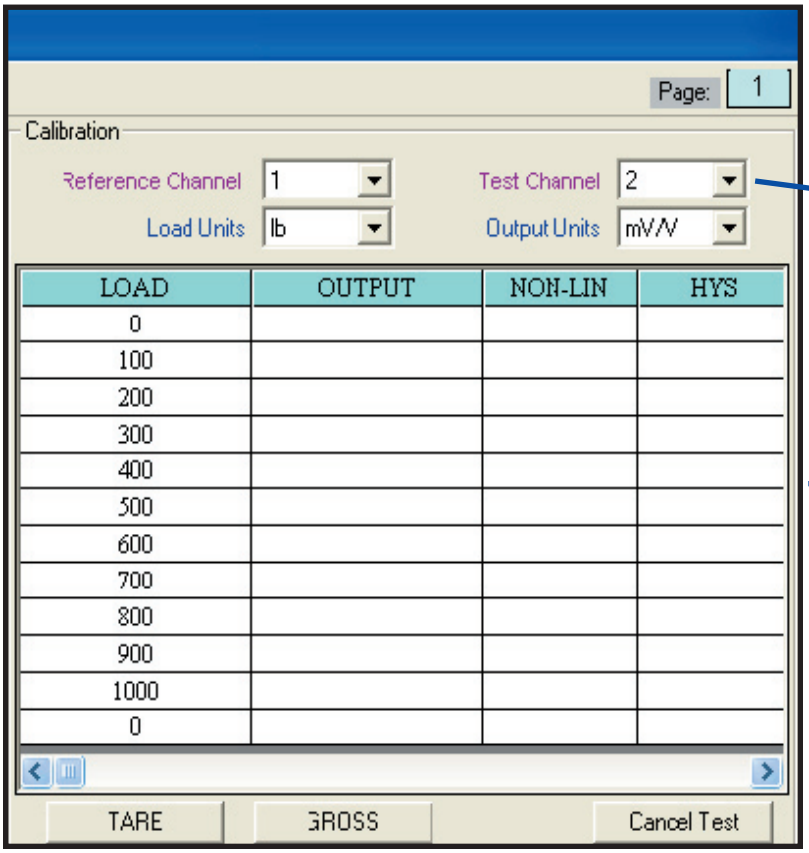
Under Test Conditions you can define whether your test is performed with VCal™ **automatically** taking readings at your pre-determined load points, or whether you wish to read your data from an **RS232** device, and also whether you wish to test for **Linearity** or **Linearity / Hysteresis**. There is also a button for **Beginning** your test. (pg. 43)

The final tab under the Information Tabs section of the **Calibration / Verification** interface is the Test tab. Here is where you obtain and record your **Offset** readings (**First and Final Unfixtured Zero Readings**), and also where you will view the **Uncertainty** and **Zero Return** values generated by your test results.



Under the **Offsets** section of the Test tab window is where you will take your unfixtured zero readings, both the **First** and the **Final Zero Readings**. To do this you can either click into the text box next to the **Zero** reading you wish to take and press **Enter**; or you can click into the box and click on the Un-Fixtured button to the right of the text box. Either way your unfixtured zero reading will appear in the text box.

Under the **Results** section of the Test tab window is where you will come to view the **Uncertainty** factor calculated for your particular test results. This is also where you will come to view the **Zero Return** value as a percentage of **Full Scale**.



The Test Grid makes up the other half of the **Calibration / Verification** interface window.

Here is where you will define which Channel you have connected your **Reference Sensor** to, and which you have connected your **Test Sensor** to.
It is also where you will define which Units you want to use to measure your **Load** and your **Output**.

This is the Test Grid where you perform your tests and view your outputs.

There are also buttons available here for you to Tare your display, take a Gross reading, and Cancel the Current Test.

Futek Online - This option allows you to connect directly to Futek's web site (www.futek.com): Here you can make use of the many resources available at Futek online. There are product catalogs, calculators, application solutions, and technical support options.

VCal.Net - This option allows you to access (www.vcal.net), where database management tools, software updates and upgrades, record maintenance tools, and reference sensor maintenance tools are all available, as well as the HTML and PDF versions of this User Manual.

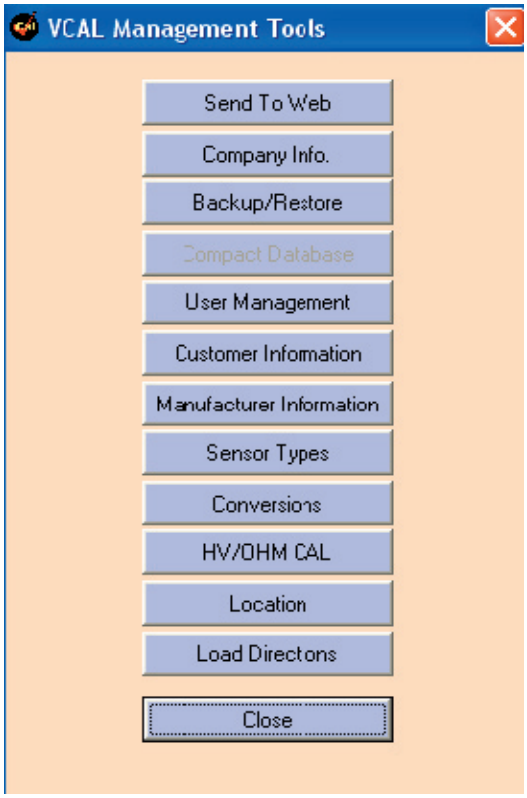
Calculators - This option allows you to access the built-in calculator functions of VCal™. Below you will find a brief description of each of the built-in calculator functions of VCal™:

Zero Balance Calculator: This calculator allows you to calculate the external resistance value required to bring the zero balance within acceptable limits. You can enter the actual zero reading from the test in mV, the bridge resistance of the sensor, and the excitation voltage, and the program returns the value of resistance needed in ohms. You can then enter the actual resistor value that you have on hand, (as close to the calculated value as possible) and VCal™ will return the zero value in mV for that resistance.

Span Adjustment Calculator: This calculator allows you to calculate the external resistance required to bring the sensor output within an acceptable tolerance limit. You can then enter an actual output reading from the test in mV/V, enter the desired output in mV/V, enter the input resistance of the bridge, and VCal™ will return the span resistor value required. You can then enter an actual resistor value that you have on hand, and VCal™ returns the adjusted output.

Conversions Calculator: This calculator allows you to get immediate unit conversions in the following list of categories; Pressure, torque, force, length, volume, temperature, Ratiometric, voltage, and current.

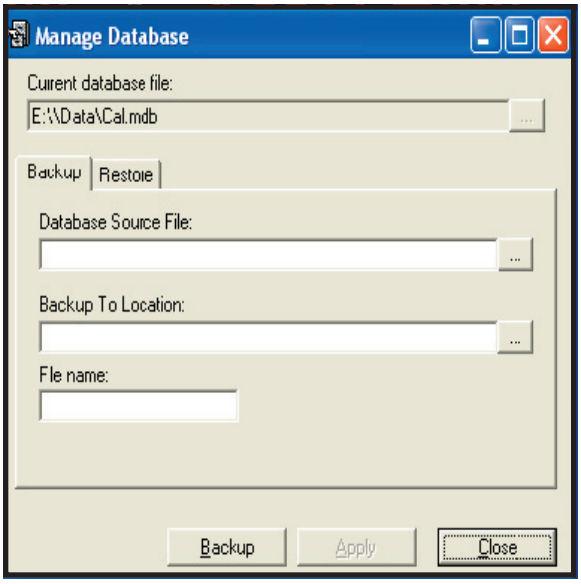
VCal™ Management Tools - This option allows you to acces VCal™'s array of Management Tools. The following outlines these tools:



Send To The Web - This feature allows you to transfer your test data to the Futek host server, where it is stored and available to you as a resource management tool on the vcal.net web site.

Company Info: This utility allows you to enter your **Company Information**, the common information (company name, address, city, state, etc.) that is attached to all references to the companies that you do business with regularly. Clicking this button brings up the following interface for entering and saving your company information.

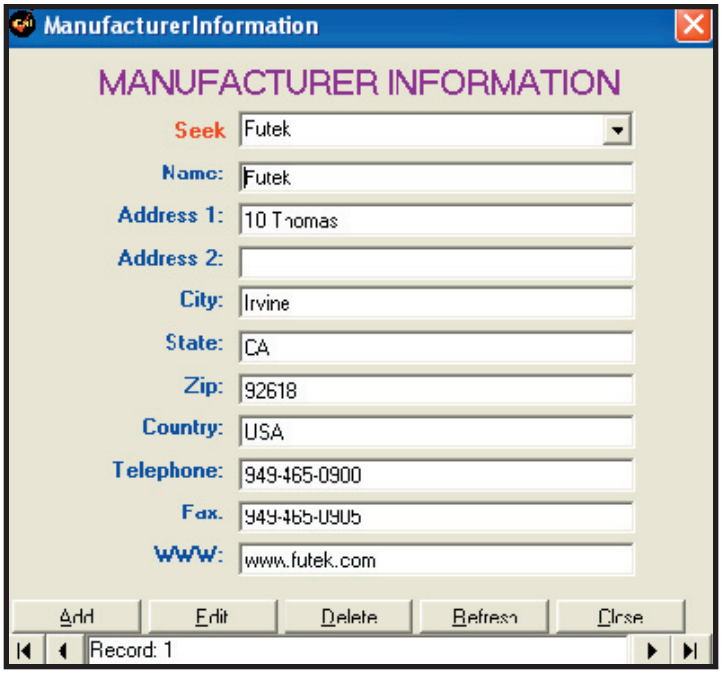
Backup / Restore: This utility allows you to manage your VCal™ test data by backing up and restoring your stored test data…



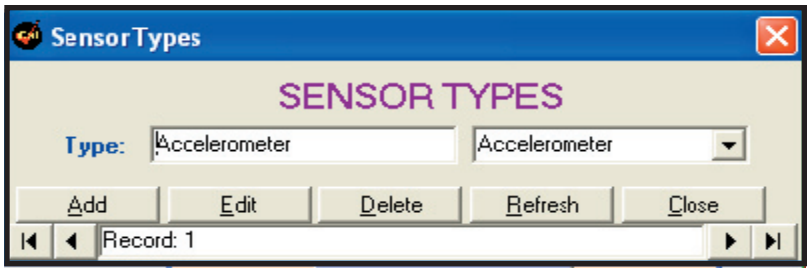
User Management: This utility allows you to add, edit, or delete approved users and their associated passwords…

Customer Information: This utility is used to record and store your **customer** information. Entries made here are available in the **Customer** pull down menu of the **Calibration** program, and do not have to be entered manually. The Seek textbox allows you to type the first few letters of a **Customer** name and VCal™ brings up the closest saved match.

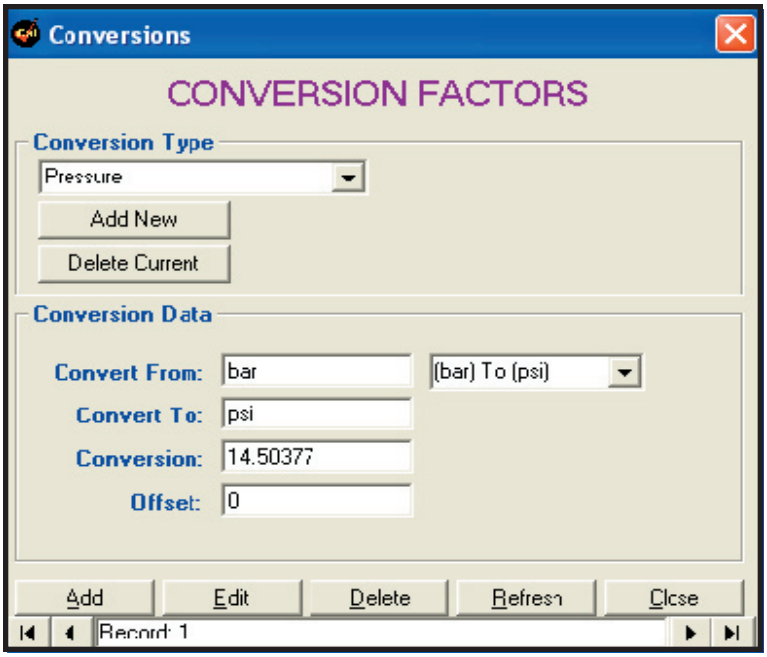
Manufacturer Information: This utility is used to record and store your **manufacturer** information. Entries made here are available in the **Manufacturer** pull down menu in the **Calibration** program and do not have to be entered manually. The Seek textbox allows you to enter the first few letters of a **Manufacturer** name and VCal™ brings up the closest saved match.



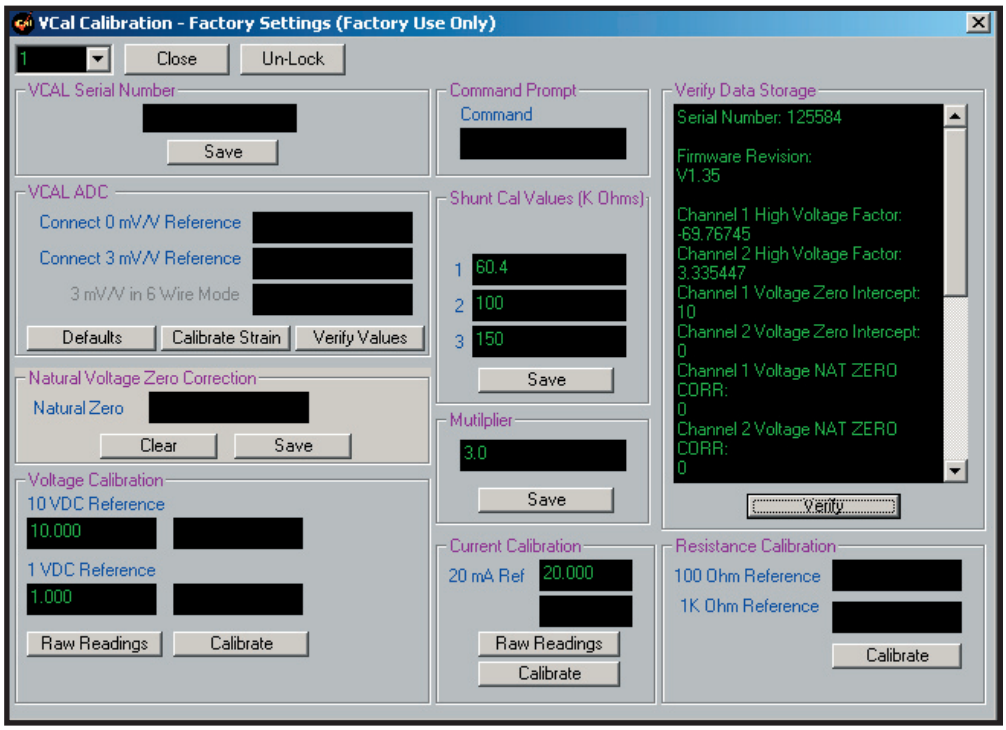
Sensor Types: This utility allows you to add, edit, or delete sensor type information. Sensor types listed here are available through the Sensor Type pull down menu in the Calibration program and do not have to be entered manually.



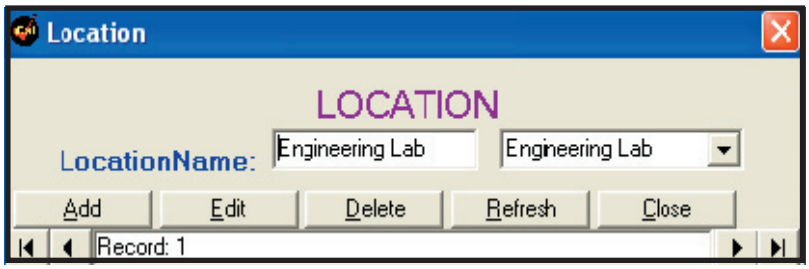
Conversions: This utility allows you to add, edit, or delete unit conversion factors for pressure, force, torque, length, and temperature.



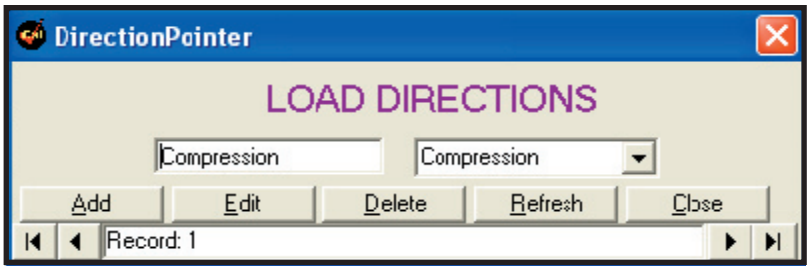
HV / OHM Cal: This utility contains factory calibration settings. These settings affect VCal™'s accuracy and performance and have therefore been password protected by Futek at the factory.



Locations: This utility allows you to enter and save **Locations** where your testing takes place at. Entries made here are available in the **Locations** pull down menu in the **Calibration** program and do not need to be entered manually. Here you can add, edit, delete, or Refresh your screen.



Load Directions: This utility allows you to enter and save **Load Directions** used often during your tests. Entries made here are available in the **Locations** pull down menu in the **Calibration** program. Here you can add, edit, or delete **Load Direction** records.



Close : This button allows you to close the VCal™ **Management Tools** interface.

Help - This option allows you to access this User Manual or Help file.

Electronic Data Sheet - This option stores VCal™ Sensor test data used for reports and certificates. The VCal™ Electronic Data Sheet will soon support the IEEE Standard 1451.4.

Exit - This option allows you to close down and exit the entire VCal™ Program.

IV. Operational Instructions - "How To"

Instructions For Calibrating A Reference Cell

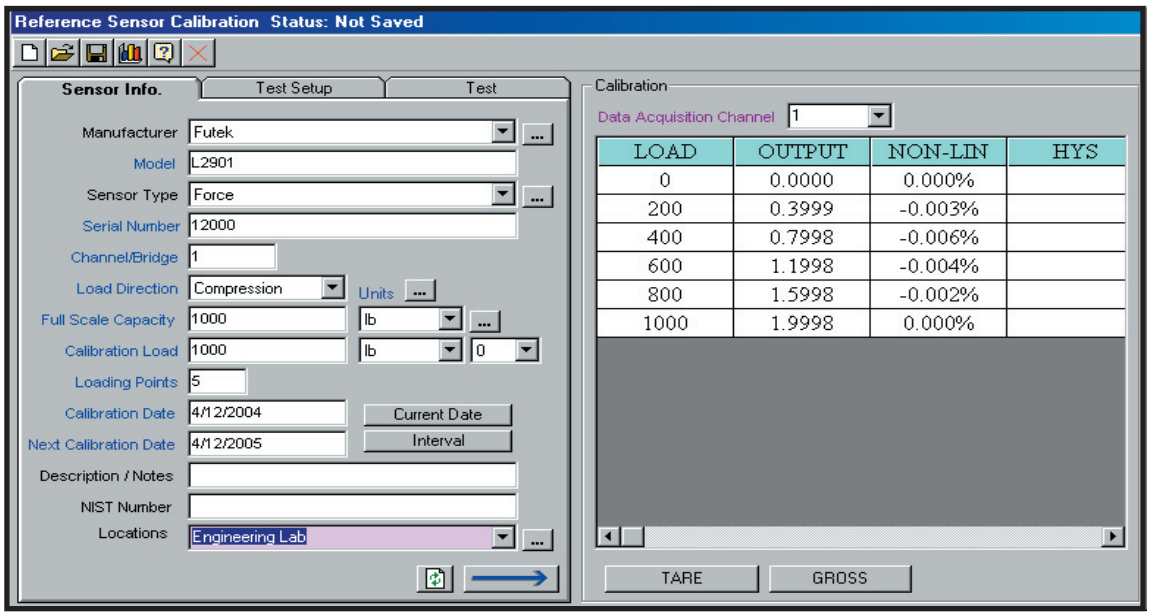
Now that we have explored the layout of the **Reference Sensor** and **Calibration** interfaces; let's walk through an instructive example calibration using your Futek VCal™ system and **Futek Reference Sensor**:

1. The first thing you will want to do is to open the **Reference Sensor** interface by clicking on the Reference Sensor icon,  and then connect your VCal™ Reference Sensor to the desired channel (usually this is channel 1). Once VCal™ has recognized the sensor ID and displayed it at the top of the Channel Display window (4 - 5 seconds), you should press the Gross Button (either on the **Channel Display** or **Test Grid** windows) to remove any previous tare values which may still be in memory.

2. Next you should press the "Clear Scaling" button  on the Channel Display window; this will clear any previous scaling factors and also set the default output readings to mV/V. If this is not done your test will not be a valid calibration.

3. Next, you would need to enter all relevant information on the **Sensor Info** and **Test Setup** tabs (VCal™ will return an error message if you attempt to initialize a test without providing all required information on each tab). For a description of each required field you may review the information on pages 26 - 27.

4. When you have filled in all required fields on the Sensor and **Test Setup** tabs; then choose either "Linearity" OR "Hysteresis" on the **Test Setup Tab**, and click on the Initialize Test button. This will fill in the **Test Grid** with the proper load points for your calibration. The following is an example of a window similar to what you should see on your screen:



5. Next, you would need to fixture your sensor (see pages 49-50 for fixturing examples), and then tare your load cell by pressing the Tare button (this puts all offsets in place and zeroes your display). You are now ready to begin taking readings. Click in the first **Output** box in the test grid, next to zero, and press **Enter** to take your first zero reading. Next, load the cell to the first load point (50 lbs in this example), click in the output box next to 50 and press **Enter** and VCal™ will take the reading. Repeat this process for each load point in the **Test Grid**.

6. Once you have taken the last reading, the "Linearize" button (on Test tab) will begin flashing; at this point you have the choice of whether or not you wish to Linearize the load cell. A Hysteresis correction is also possible, for this correction you must select the hysteresis option on the Test Setup tab before beginning a test. The correction works by applying a linearization factor on the loading and unloading of the cell. Hysteresis corrections are only applied when doing a calibration on the Sensor Calibration window. Just click the Linearize button to apply the corrections. The first linearization coefficients are applied on the loading of the sensor up to full scale. After that, the hysteresis coefficients are applied during the unloading of the sensor.

7. Under **Scaling**, enter the rated output of the load cell: For example if a 5000 lb cell is rated at 2.000 mV/V (from cert or test), you should enter 2.000 mV/V even if you are only loading to a calibration load of 500 lbs. Enter your **Default Decimal Points** to display. **Over Load Threshold** determines at what level VCal™ will issue a red, flashing **Sensor Overload Warning**. **Over Range Threshold** determines at what level VCal™ will issue a yellow, flashing **Outside Calibration Range Warning**.

8. Make sure the system is at zero load, press tare and then load to your calibration load. Click in the **Output Box**, press Enter and VCal™ will take the current reading. If you wish to recalibrate, just unload your sensor, press **TARE** and reload to your desired calibration load. The reading taken will still be in mV/V even though the display is showing a scaled output. Press "**Scale To Unit**" to calibrate. You will have to re-save the data iin order to store new calibration factors if you have saved the test previously. You won't have to do a multi-point loading again unless you wish to. During the scaling procedures the linearization factors are being applied. If entering calibration data in **Manual Mode** from a pre-calibrated load cell, the scaling factor will be estimated automatically.

9. Unless you are using VCal™ in **Manual Mode**, the test temperature will be automatically recorded.

10. You will now want to save the test, and you have calibrated your VCal™ **Reference Sensor**.

11. **Manual Mode** is used when entering calibration information that was done by a third party and calibration equipment is not available for a self calibration.

Introduction To Performing A VCal™ Calibration / Verification

You are nearly ready to do some calibrating, however; before we step through some Calibration Examples, there are several items which require some additional explanation. **Testing Modes, Testing Options, Testing Parameters and Test Conditions** are all items which really need to be explained a little before we proceed. All of these can be found under the **Setup** tab. We will also talk some more about the three types of testing you can do in the **Calibration / Verification** interface; the **Main Test**, the **Time Test**, and the **Signature Test**.

Testing Modes

Under the Testing Modes section of the **Setup** tab you have a choice of whether you wish to use **Normal**, **Extrapolation**, or **Actual Modes**, when you perform your test. Let's define what these calibration modes actually are.

Normal Mode Calibration: This is your default calibration mode. In this type of calibration you load your sensor to as close as possible to the load points indicated in the **Load** column of the **Test Grid** window, pressing Enter at each load point. Each time you press Enter, VCal™ takes an output reading and calculates the non-linearity (and hysteresis if selected), based on the deviation from the nominal or ideal value.

Extrapolation Mode Calibration: In this calibration mode you load your sensor to a point somewhat close to the indicated load point (max+/-10% of load), and press Enter, and VCal™ takes a reading at the point you actually hit Enter at and extrapolates the output at the the load value indicated in the Test Grid. It calculates the non-linearity (and hysteresis if selected) based on the deviation from the nominal. **For Example**; If you pressed Enter at 79.3 lbs load, and your output was 0.5335 mV/V, but the load indicated in the **Test Grid** is **80** lbs, then; 80.0 lbs X (0.5335/79.3) = 0.5402 mV/V (this would be VCal™'s output reading in **Extrapolation Mode** under the test conditons described.

> **Note: Extrapapolation Mode** only works when you have a calibrated reference cell connected as well as your test cell, and all channels must be designated correctly for the calculations to work correctly.

Actual Mode Calibration: In this mode you take readings at any pattern of points you desire, pressing Enter at each point, and VCal™ takes a reading at that point, and changes the indicated loads in the **Test Grid** to reflect the points at which you pressed Enter. VCal™ then gives an output reading at that point, and calculates the non-linearity based on the deviation from the new nominal value. **For Example**; If the load indicated on VCal™'s **Test Grid** is 80 lbs and you press Enter when there is only 79.3 lbs of load applied, then VCal™ will change the value indicated in the **Test Grid** to 79.3 lbs and will display the output value that corresponds to 79.3 lbs of load.

> **Note**: Because hysteresis requires exactly matching ascending as well as descending load points, it is not available in this mode of calibration.

Testing Options

Manual Entry: Manual Entry allows you to enter data from a certificate or a different data acquisition system, through the keyboard, directly into the **Test Grid**. The use of **Manual Entry** actually prevents the program from obtaining data from the VCal™ module. With **Manual Entry** you can enter the **Load** and **Output** values from your test, and VCal™ will caluclate the non-linearity (and hysteresis if you selected it) as soon as you press Enter in the final zero output box in the **Test Grid**.

Scaled testing: Scaled Testing is designed to be used when data is being entered from an outside source which has already been scaled to a known unit, such as a pre-calibrated Sensor-Display system (Futek D500 series). If you are using a sensor that is giving you a raw output in Volts or mV/V you cannot use Scaled Testing, because your scaling factor is unknown at this time. Using Scaled Testing changes the way in which errors are calculated. Below are a couple of examples which illustrate the procedures used to calculate errors in both Scaled and Non-Scaled Testing:

Non-Scaled Example: (Output in mV/V)

LOAD	OUTPUT
0	0.0000
20	0.3995
40	0.8000
60	1.2000
80	.6000
100	2.0000

In this case the error is a percentage of full-scale, for example the error at 20 lbs is ((0.4000 - 0.3995) / 2.0000) * 100 = 0.025% of full-scale. Note that 0.4000 is the ideal output at a load of 20 lbs.

Scaled Testing: (known output in lbs, kg, etc.)

LOAD	OUTPUT
0	0.0
20	19.8
40	39.9
60	60.0
80	79.7
100	101.3

In this case the error is a percentage of load, for example; the error at 20 lbs is ((20 - 19.8) / 20) * 100 = 1% of the Load.

Test Parameters

Under the Test Parameters section of the **Setup** tab there are are options for defining the number of Load Points (required to perform a test), **Averaging**, **Decimal Points**, and **Target Load Warning Tolerances**.

Load Points: This field is required to perform a calibration or test. This is where you define how many points in the load range you will take readings at. **For example**; if your cell is rated at 500 lbs, your calibration load is also at 500 lbs, and you set Load Points to 5, your Load Points will be 100, 200, 300, 400, and 500 lbs.

Averaging: The number you enter here determines the number of readings VCal™ will take when you press Enter, and then return an output value that is an Average of all the output readings taken.

Decimal Points: This setting is where you determine the resolution of the data points. This box is only used with the **Manual Entry** mode of calibration. Under normal calibration or testing circumstances the number of decimal points will be determined by the resolution of the display.

Target Load Warning Tolerance: This setting allows you to set a tolerance level with regards to your load points, so that VCal™ will issue a warning that you are within the tolerance level you have set of your load point. **For example**; if your first load point is 50 lbs, and you have your **Target Load Warning Tolerance** set to 1, then when you increase the load applied to 49 lbs, VCal™ 's display screen background will change from **Black to Yellow** to let you know that you are within the 1 lb tolerance level you have set. The number you enter in the **Tolerance** box is an increment of whatever units you are measuring your load with. If you enter a 2 in the box, and you are measuring your load in kilograms; then VCal™ will issue a warning when the load applied is within 2 kgs of the load point.

Test Conditions

The final section of the Setup tab is the Test Conditions section. Here is where you decide whether to perform your calibration using **VCal™'s Auto Read** function, or maybe to read from an **RS232** device, and also where you decide whether to test for **Linearity** or **Linearity** and **Hysteresis**.

Auto Read: By selecting this option you are telling VCal™ that you wish to utilize the **Automatic Reading Taking** function. This feature works like a normal calibration except that you do not need to press Enter as you reach each **Load** point. With **Auto Read** selected you simply start loading your sensor, and as you reach each load point indicated in the **Test Grid**, VCal™ will automatically take a reading and display the corresponding outptut value in the **Output** column of the **Test Grid**.

Read from RS232: This setting allows you to read from an externally connected **RS232** device (such as the **Futek D500** series displays), and display the data on your VCal™ display.

Linearity: With this type of calibration, VCal™ takes a reading every time you press Enter on the ascending loading of your sensor, returns an output value to the **Test Grid**, and calculates the non-linearity error based on your output's deviation from the ideal value at that load point.

Hysteresis: With this type of calibration, VCal™ takes a reading every time you press Enter on both the ascending and descending loading of your sensor, returns output values for each point, and then calculates the error based on the differences between the ascending and descending output values at each load point.

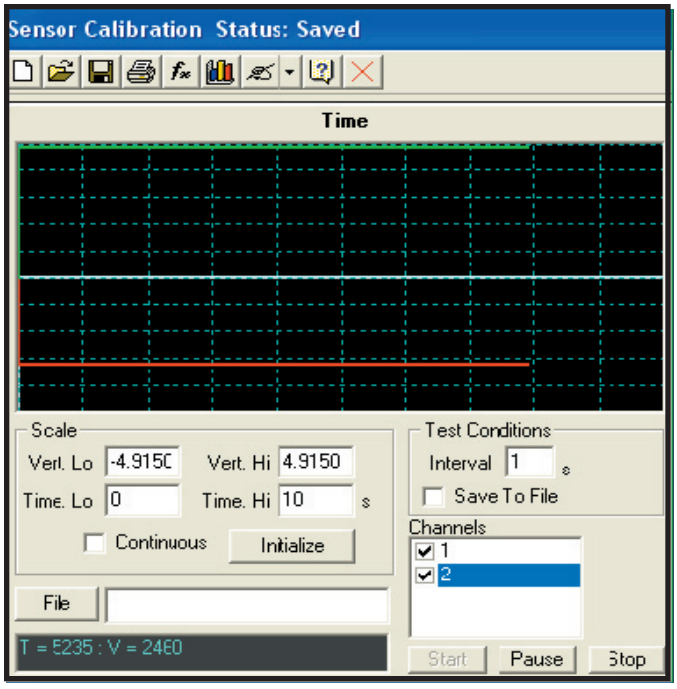
Now we need to talk a little about the three types of testing which are available to you in the **Calibration** interface. I told you a little earlier that we would give some more details about the **Main Test**, the **Time Tes**t, and the **Signature Test**. The Main Test is the default type of test, and iwhat type of test you will perform if you do not select either Time or Signature Test on the pull-down menu available from the hand signing icon in the row of command buttons along the top of the interface window (see page 30 for location).

Main Test

The **Main Test** is the default, or standard calibration type. It consists of you entering all the required information asked for on the Information Tabs sections of the interface (the **Info**, **Initial**, **Setup**, and **Test** tabs), followed by you pressing Begin Test on the **Setup** tab,, and then taking a first zero reading with your sensor unfixtured on the Test tab. You would then fixture your sensor, click into the **Output** box to the right of the first Load point (0) in the Test Grid, and press Enter. After this you would proceed through the load points indicated on the Load column of the **Test Grid**, after clicking into each of the output boxes in a progressive fashion (0 through full scale, then final zero still fixtured) in the Test Grid. After this you would take a final zero reading with your sensor unfixtured on the Test tab, and possibly view your **Uncertainty** and **Zero Return** values on the Test tab. You would then have the options of saving, graphing, or printing certificates and reports stating the results of your calibrations and tests.

Time Test

Selecting the **Time Test** option in the pull-down menu brings up the following screen, where you can perform VCal™'s Time Test calibration. Here you are able to run a timed test with readings taken at pre-defined intervals, watch the graphic display of the outputs in real time, and also save the results of these timed tests to a file of your choosing. The screen below and the descriptive text that accompany it will give you an overview of the Time Test interface; more detailed instructions for using this interface will be given in the Instructions **For Performing A Calibration Verification** section of this Manual. (pg. 47)



Vert Lo - This setting determines the lower output limit which will be displayed on the **Time Test Grid**. This output is displayed in the same units you have chosen for output.
Vert Hi - This setting determines the upper output limit which will be displayed on the Time Test Grid. This output is displayed in the same units you have chosen for output.
Time Lo - This setting determines the start time for your test run. Please note that negative start times aren't valid, you must start your test at 0 seconds start time or higher.
Time Hi - This setting determines the end time for your test, or if your start time is 0, the length of your test. Please note that all end, as well as start times are in seconds. You may also choose to make your test continuous (no end time) by selecting the **Continuous** checkbox.
Initialize - This button initializes the test grid with traces for the **Channels** you have selected in the **Channels** section.
Interval - This option allows you to set at what interval VCal™ will take readings. These can be set at any increment of 0.1s. For example; if you have **Time Hi** set to 10s, and your Interval set to 0.1s, then VCal™ will take 100 readings during the test.
Save To File - This option allows you to save the data from your test to a spreadsheet application file.

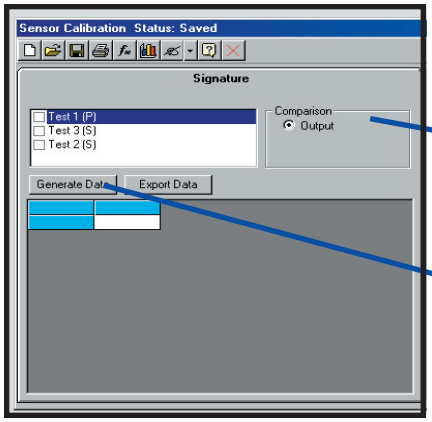
File - Click this button and point the window at the location of the file where you wish to save your data.

Channels - Here you select which channels you wish to have displayed on the Grid during the test.

Start / Pause / Stop - These buttons give you contol over your test by allowing you to **Start**, **Pause**, or **Stop** your test at any time.

Signature Test

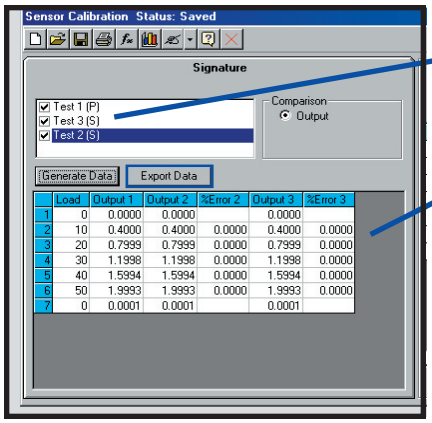
In this type of calibration you are given the chance to take advantage of Futek VCal™'s tools for **Signature Checking**. This tool allows you to monitor and control the performance of your sensors. Here you can define a **Primary** 'signature' for a sensor; VCal™ will create a profile for your sensor, recording such characteristics as **Output**, **Non-Linearity**, and **Hysteresis**. Then, you can perform Subsequent tests and match the characteristics of your **Subsequent Test** against the **Primary Signature Test** characteristics. This allows you to track the performance of your sensor, and allows you to identify non-conforming trends in their earliest stages. This aids in the establishment of performance traceability, and in the definition of calibration intervals, and gives added assurance in the reliability of your calibration measurement results. If you load a saved test on the sensor you wish to perform **Signature Checking** on, and then select **Signature Test** under the **Signing Hand** icon pulldown menu, you will first see the following screen . . .



Here you can see a list of the **Signature Test Profile Tests** you have performed on this specific cell. Select all of the tests you wish to compare the results of.

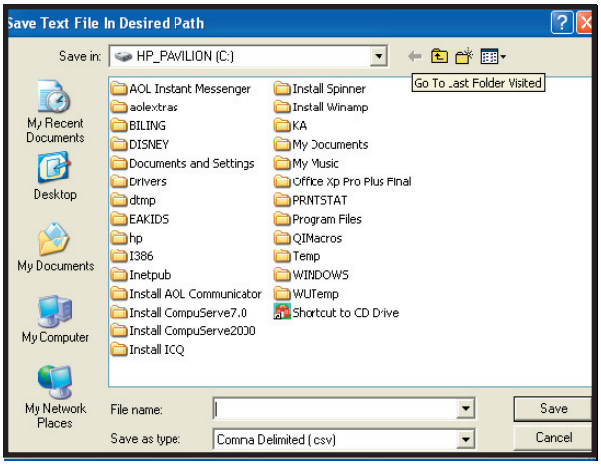
Under the **Comparison** section of the pane you can select which output characteristics of the tests you wish to compare.

Once you have selected which tests you wish to compare, and you have selected which characteristics of these tests to include in your comparison, you can press the Generate Data button to bring up the next screen . . .



Here you can see that I have selected all three saved tests, one **Primary (P)**, and two **Subsequent (S)**, and that I have chosen **Output** as my characteristic to compare.

Then when I pressed Generate Data it brought up the this comparison Grid. In this Grid VCal™ lists the load points, (which must be same in all tests you wish to compare), the outputs in all three tests and the percentage of error between the first and second tests, and the first and the third tests. Had I chosen Non-Linearity instead of Output in the Comparison area, the **Comparison Grid** would have shown the Load points from the three tests, the the Non-Linearity errors from the three tests, and the percentage of error between the readings of the tests. Had I chosen Hysteresis the Grid would have displayed the appropriate hysteresis data.



There is also a button marked Export Data, clicking this will bring up this **Save Text File in Desired Path** box; here you can specify where to save a text version of your test. Just give your test file a name, and specify where on your hard drive or **Removable** media to save the file to, and it may be referenced later for analysis, or performance monitoring activities.

Instructions For Performing A Calibration Verification

A test cell calibration describes the procedure determining the sensitivity of an unknown sensor, or a repetition of previous tests to acquire comparable data. The sensor calibration interface allows you to test various sensors under a pre-determined load. The load would usually be supplied by a pre-calibrated reference sensor or a dead weight load or pressure system. When the interface is loaded you will choose initially which channel the reference sensor is connected to and which channel the test sensor is connected to. It makes no difference which cell is connected to which channel, although under normal circumstances channel 1 would be used for the reference sensor.

Now that you have gotten familiar with the layout of the **Calibration** interface, and we have discussed configuring your test (setting **Test Modes**, and **Options**, **Conditions** and **Parameters**), and we have discussed the three different types of tests (**Main**, **Time**, and **Signature**), let's walk through a couple of examples and take a look at some pictures that will illustrate the calibration procedures described here.

Example Calibration Verification (Main Test): (Please refer to the screen shot below as a visual aid for performing the following steps:)

1. The first step in performing a **Calibration Verification** is to fill in all the information we have just talked about; starting with the Info tab, to the Initial tab, and on through the Setup tab. Once you have filled in all required information on these three tabs you can press the Begin Test Button, and the **Test Grid** will be filled in based on the information you have provided on these **Information Tabs**.

2. Once the Test Grid appears with the **Load Points** you chose filled in, you will want to connect the reference and test sensors to the appropriate channels (if they are not connected already), and the temperature probe to the **Power Face Plate** of your VCal™.

3. The next step would be to take a **First Zero** (unfixtured) reading by going to the Test tab, making sure the cell is under no load, pressing the Gross button on the T**est Grid** window, clicking into the **First Zero** text box, and either pressing Enter, or clicking the Un-fixtured button next to the **First Zero** text box.

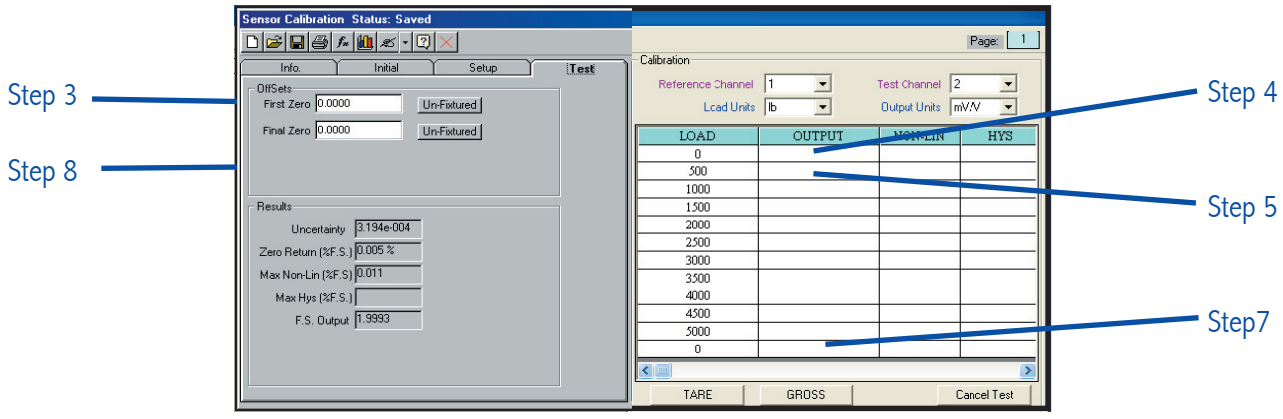
4. Next you would fixture your sensors, Tare both channel displays, click into the first output grid box and press Enter to take a first fixtured zero reading.

5. Next you would click into the second output grid box, load the cells (with either dead weight or pressure system) until the reference cell display reflects the first load point (500 lb in our example), and then press Enter.

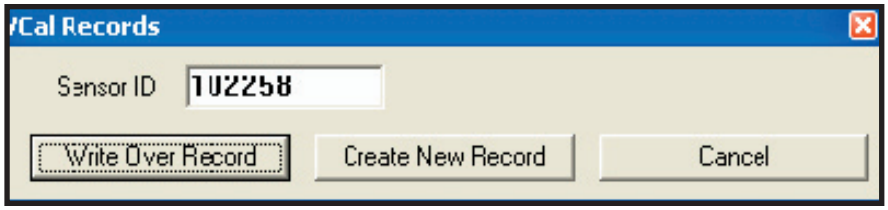
6. Repeat Step 5 for each of the remaining load points.

7. Take a final fixtured zero with no load applied, by clicking into the last output grid box and pressing Enter.

8. Take a final unfixtured zero with no load applied, by clicking into the **Final Zero Box**, and pressing Enter.



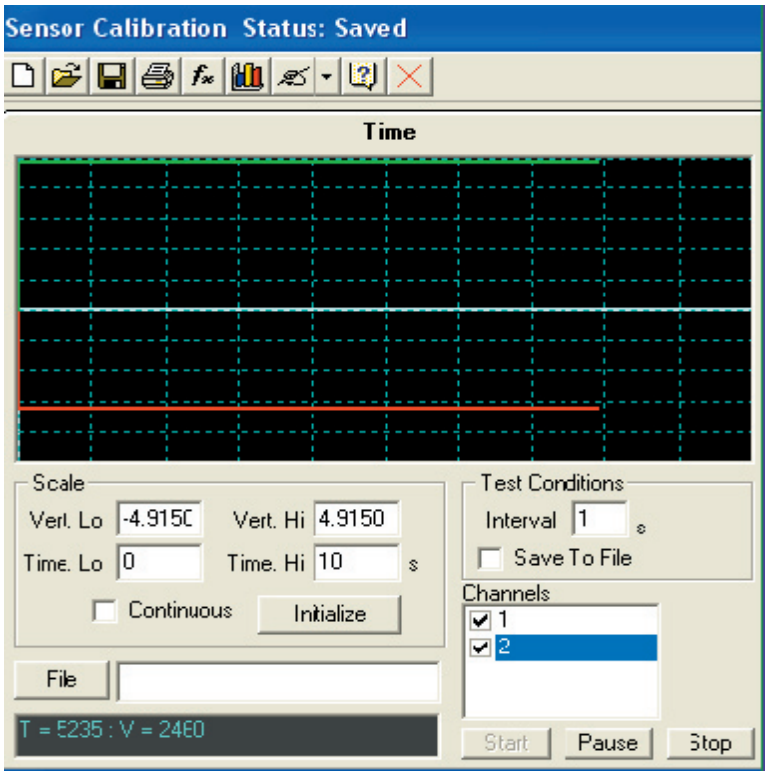
9. The only things left to do is to save your test by clicking the **Save** button , If this is the first time you have saved a test under this serial number then VCal™ will save the test without any further prompting. If however, this serial number has been saved before, then VCal™ will ask whether you wish to Write Over An Existing Record or Create a New Record..... simply choose the option which works best for your application.



Example Calibration Verification (Time Test):

1. The first step in performing a **Time Test** is to connect your **Reference** and **Test** sensors to the appropriate channels (you may connect either sensor to either channel, although connecting your Reference sensor to **Channel 1** is the common connection method).

2. Next you would need to open the **Calibration Verification** interface if it is not already. Once you have opened the **Calibration** interface, you will need to select **Time Test** from the pull down menu of the 'Signing Hand' icon. Once you have selected the **Time Test** option, you will see the **Time Test** interface . . .



3. Next you need to set your **Output** limits (**Vert Hi & Lo**), these are an increment of whatever **Units** your output is being measured in.

4. Next you need to set the **Start** and **End Times** for your test. Please note that the **Start** time cannot be less than zero, and also that all times are measured in seconds. You can also choose **Continuous** instead of setting **Start** .

5. Next you need to set the **Interval** (frequency of readings) Please note that the interval can be set in increments of one-tenth of a second, or 0.1seconds (You can also set your test to run continuously by selecting the **Continuous** box).

6. Next you need to select all channels that you wish to run the **Time Test** on.

7. Next you need to let VCal™ know if you wish to save the results of your **Time Test** to a file by selecting or unselecting the checkbox next to **Save To File**. If you choose to Save, you should also click the File button, and point the resulting window to the location of the **Excel** file where you wish to save your results.

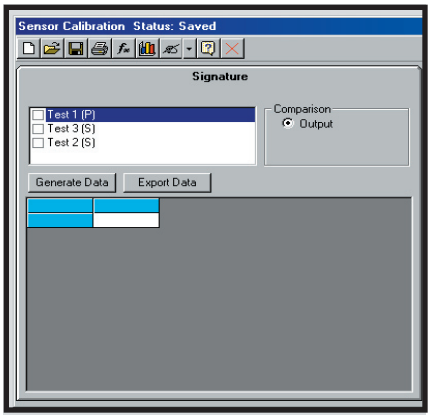
8. Finally, you will need to click the Initialize button to bring up the **Time Test Grid**, and then press Start to begin the test. You may temporarily halt your test at any time by pressing Pause, or can cancel the test at any time by pressing Stop.

Example Calibration Verification (Signature Test):

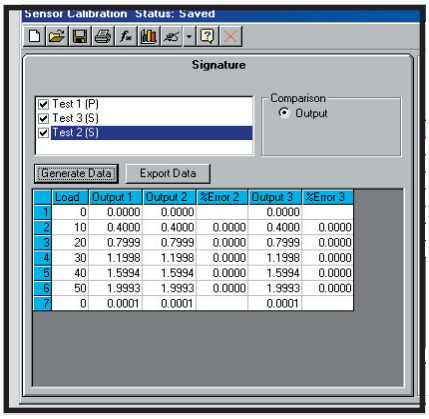
1. The first step in performing a **Signature Test Calibration** is to fill in all the required information on the **Information Tabs** (Info, Initial, and Setup), be sure to check the checkbox next to **Signature Test** (at the bottom of the Info tab), and also to check either **Primary** or **Subsequent**, whichever applies to your particular test. Once you have filled in all the appropriate information to configure your test, you can press the Begin Test button on the **Setup** tab. Doing this will bring up the **Test Grid**, filled in per your configuration settings.

2. If you are performing this test right now, you would connect your sensors and proceed through the Instructions for **Performing a Main Test** first, (see pgs. 46 - 47), and when you have completed and saved your test, continue with Step 3.

3. If you are comparing the results of previously performed calibrations which you have loaded from the database, you would then click on the down-arrow icon just to the right of the 'Signing Hand' icon. This will bring up the pull-down menu where you can select the **Signature Test** option. Clicking this option will bring up the **Signature** screen . . .



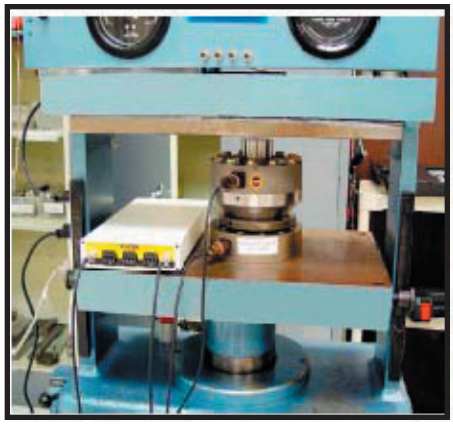
4. Here you can select which saved tests you wish to compare the results of. Select all that are appropriate to your needs. You can also select which output characteristic you wish to compare the results of , here you can only compare one characteristic at a time. For this example I am going to pick all three tests, and I will select **Output** as my characteristic to compare. Next you would press Generate Data, and that would bring up this screen . . .



5. You have successfully completed your **Signature Test**. If you wish to save the comparison results to a file you may press the Export Data button, and follow the directions there to save your results.

Application Examples

The following are some examples of different types of calibrations being performed; and also some examples of how the VCal™ **Reference Sensor** can be fixtured for these different types of calibrations. Of course your applications may be different than what is shown here. These pictures are included for general guidance purposes only. This first picture shows the Futek VCal™ **Reference Sensor** hooked up in a hydraulic **Tension/Compression Calibrator** machine, fixtured for a **Force Calibration / Verification in Compression** . . .

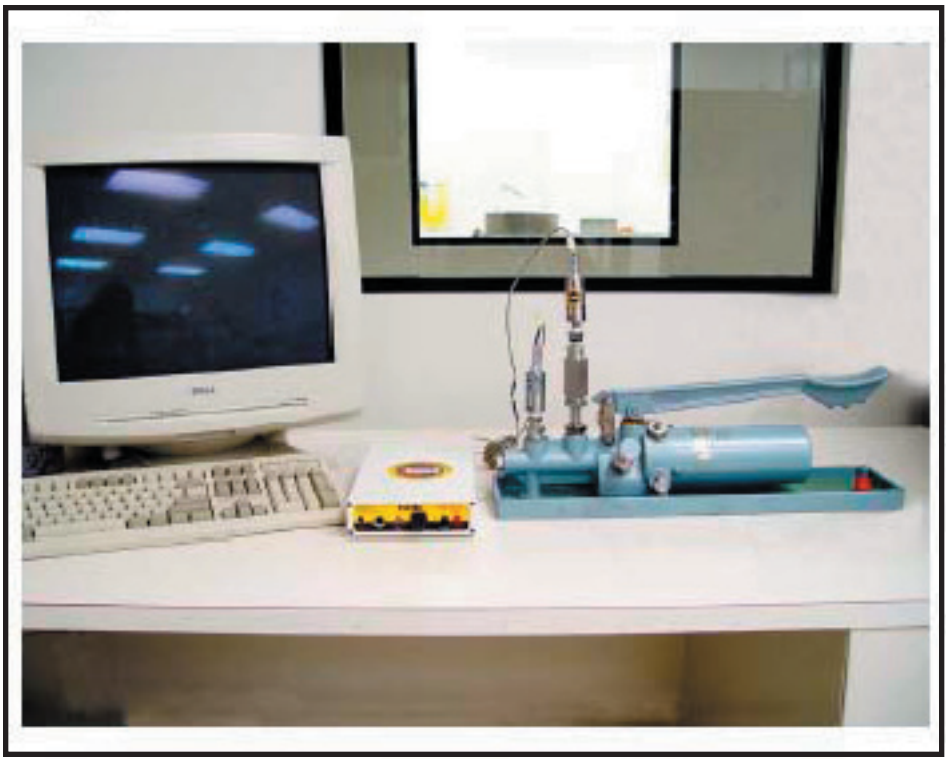


The following picture shows the Futek VCal™ System connected, and the Futek VCal™ Reference Sensor fixtured for Force Calibration /Verification iin Tension . . .

The following picture shows the Futek VCal™ System connected, and the Futek T5410 (TDF 600) Reference Sensor connected for a Torque Calibration / Verification of the Futek model T6005 (TAT 500) Torque Wrench . . .

Application Examples - Continued

The following picture shows the Futek VCal™ Module connected, and the Futek VCal™ **Reference Sensor** fixtured for **Pressure Calibration / Verification**, using a hydraulic pressure testing system . . .



The following picture shows two Futek VCal™ systems hooked up in a **Multi-System** manner with two Futek VCal™ **Reference Sensors**, using the VCal™ **Loading Tower** in a **Compression** direction . .

Instructions For Printing A Calibration Verification Certificate

Now that we have walked through the layout of the **Calibration** interface, we have talked about the methods of configuring your test to obtain the types of results you desire. We have also talked about the three different types of calibrations you can perform (Main, Time, and Signature), we have now walked through some examples of each type, and we have looked at some pictures of some different ways to fixture your sensor for the different calibration directions. Now we need to talk about printing out reports and certificates which will state your results.

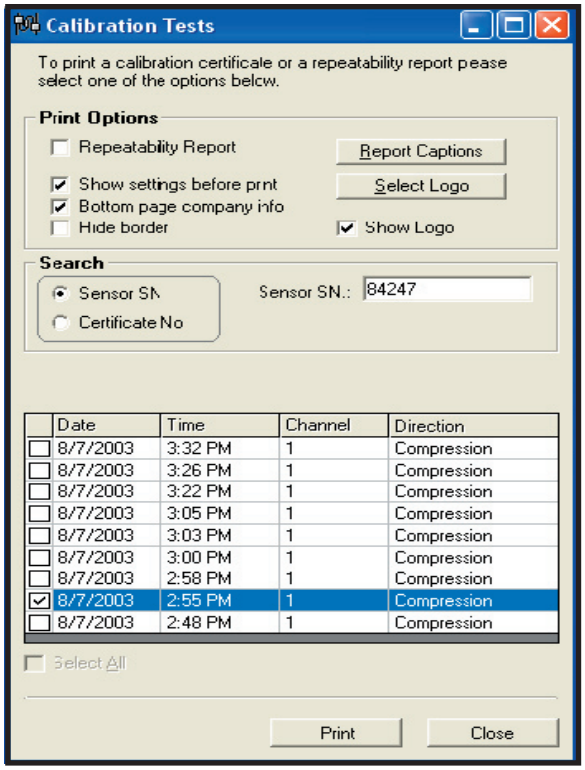
Print - Clicking this icon brings up the **Print Options** interface. Here you can search for and select which tests to print, set print options before printing, decide whether you wish to print a simple report or a full certificate, decide exactly which fields you wish to include or exclude in your print out or certificate, and decide exactly how you want the included fields named. This allows you to fully modify and customize your print out or certificate to fit your individual application.

1. Under **Print Options** the first thing to decide is whether to print a **Certificate** or a **Repeatability Report**. For our purposes we will list the steps for printing a Certificate first, so we will leave the Repeatability Report Box unselected for now.

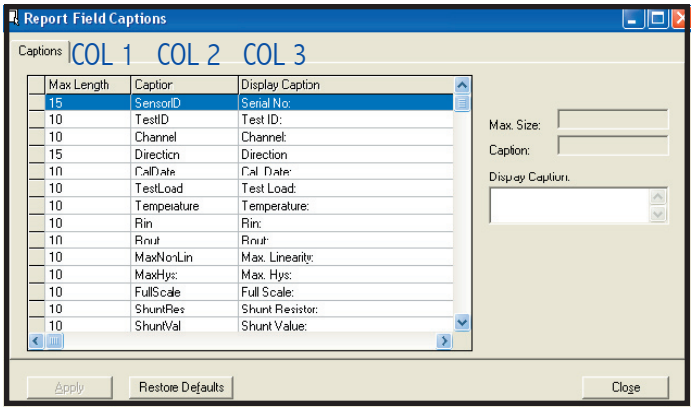
2. Next, by simply selecting or unselecting the appropriate checkboxes, you can decide whether to Preview the Certificate before printing, whether to include an additional page which will show **Company Information**, whether to print your Certificate with borders, and whether to include your **Company Logo** or not. Please select or unselect the options as you see fit.

3. Also under Print Options; pressing Report Captions shows the following screen where you have the option of changing how any of the fields are labeled on your Certificate. The first column on this screen shows the maximum allowed length for the name of this field; the second column shows VCal™'s current name for the field; the third column shows the name which will be displayed on the Report or Certificate. To edit the name which is displayed on your Certificate or Report, simply click on it in the **Report Captions Screen**, then type the name you wish to appear in the **Display Caption** text box on the right half of the Report Captions Screen. In the example below; VCal™'s name for the field is **Sensor ID**, the Display Caption name is Serial No, and I have changed the Display Caption name to **Sensor Number**.

Print Options Interface



Report Captions Screen

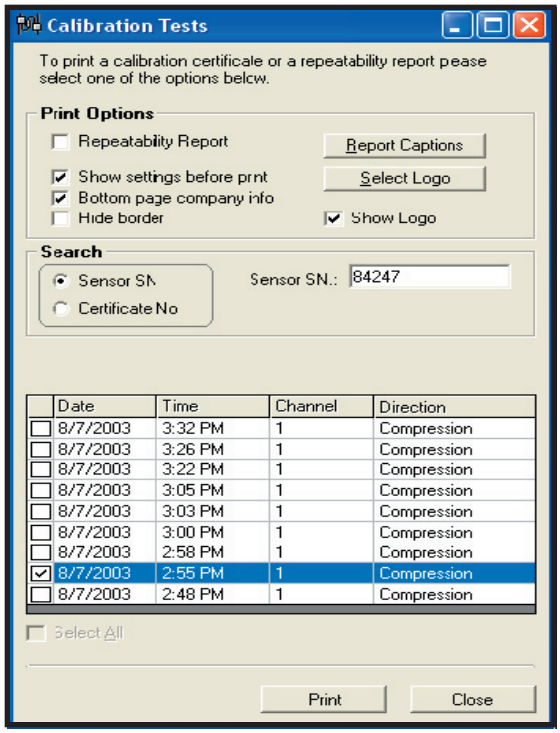


4. Under Print Options you are also given the chance to include your company logo on your Report or Certificate. To use this function simply click on the Show Logo button, and then point the Save window at the location of your Company Logo file. (At this time VCal™ only supports Logo files in the bitmap format).

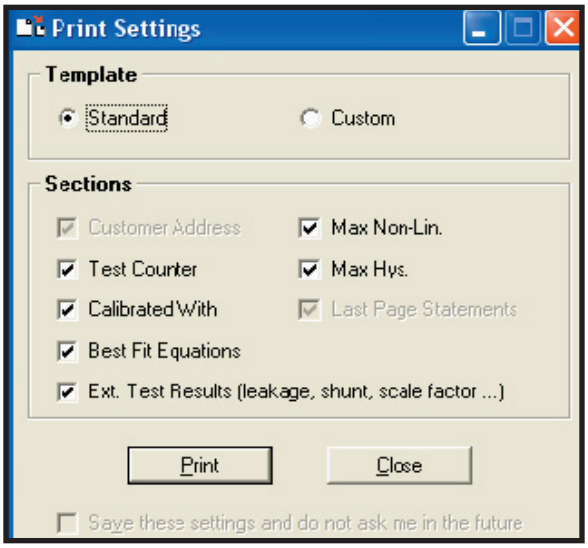
5. Under the Search section of the Print Options interface, you can bring up a previously saved Certificate by entering a known Certificate Number, or you can search for a particular test to print by entering the sensor Serial Number, pressing Enter, and then selecting the specific test you wish to print by double clicking on it, and then pressing Print. Please note that to print a Certificate, you must select one, and only one test at a time,

6. This will bring up the "Print Settings" screen where you can choose exactly which sections are or are not included in your Certificate. Under Template with Standard selected; Test Counter, Calibrated With, Best Fit Equations, Extended Test Results, Max Non-Linearity, and Max Hysteresis are all sections that you can choose to include or not include. Under Template with Custom selected; all of the above-mentioned sections, and also Customer Address and Last Page Statements (Calibration Technician, etc.) can be selected for including or excluding from your Certificate.

Print Options Interface



Print Settings Screen



7. Once you have decided on, and selected all of the Sections you wish to include on your Report or Certificate, then pressing Print will either allow you to preview the certificate (if you selected the Show Settings Before Printing checkbox on the Print Options interface), or print the Report

On the following pages is an example of the Standard Mode Calibration Certificate with all Sections selected…

Standard Mode Calibration Certificate (pg. 1)

Customer Information

Sensor Information

Reference Sensor Information

Test Results Information

Best Fit Equation Information

FUTEK
Advanced Sensor Technology

Certificate of Calibration

Certificate No: 0303120006
Customer: Futek
Contact:
Street: 10 Thomas
City: Irvine CA 92691
Country: USA

Sensor
Model: L2900 Capacity: 500 lb
Serial No: 102208 SensorType: Force
Manufacturer: Futek

Calibrated With VCal SN: 118,586
Model: L2501 Capacity: 5000 lb
Serial No: 110747 NIST #: 15326987
Manufacturer: Futek

Test Count: 1
Calibration Technician: VCAL Test Load: 500.00 lb
Cal. Date: Mar 07, 2003 3:04:03 pm Temperature: 333.0 °
Next Cal. Date: March 2004 Humidity 333.0 %

Load (lb)	Output (mV/V)	Non-Lin. Error (%)	Hysteresis (%)

Channel: 1

Compression

0.00	0.0000	0.000
100.00	0.2000	0.000
200.00	0.4000	0.000
300.00	0.6000	0.000
400.00	0.8000	0.000
500.00	1.0000	0.000
0.00	0.0000	

Uncertainty: 0.00

* Error and Uncertainty was calculated using Strategic Line Method in accordance with ASTM E74 with K = 3

Best Fit Equation: $Y = A_0 + A_1X + A_2X^2 + A_3X^3$
A 0 = 1.74827e-009 A 2 = 8.64783e-005
A 1 = 5.00000e-003 A 3 = -7.76111e-005

Best Fit Equation: $X = B_0 + B_1Y + B_2Y^2 + B_3Y^3$
B 0 = -6.80816e-012 B 2 = 6.91809e-013
B 1 = 2.00000e-003 B 3 = -1.24171e-015

Y = Output X = Load

Best Fit Equation was calculated using the Method of Least Squares

Page 1 of 2 Print Date: 3/12/2003

Standard Mode Calibration Certificate (pg. 2)

Final Test Results

Calibration Closing/ Disclaimer State-ments

Company / Calibration Lab Information

FUTEK
Advanced Sensor Technology

Certificate No:	0303120006
Full Scale:	1.0000 mV/V
Shunt Resistor:	60.4K
Shunt Value:	2.3333 mV/V
Rin:	365.00 Ω
Rout:	555.00 Ω
Leakage:	333
Max. Linearity:	0.000 %
Zero Return:	0.000 %
Unfixtured Zero	
Prior To Test:	0.8177 mV/V
After Test:	0.8176 mV/V

Calibration Technician Signature : _____

This calibration report may not be reproduced, except in full, without the written approval of the calibration laboratory.

This calibration report relates only to the transducer tested:

Manufacturer:	Futek
Model:	LP900
Serial No:	102208
SensorType:	Force

Company Information:
Futek Advanced Sensor Technology
10 Thomas
Irvine CA 92618
USA

Calibration Lab Information:
Futek Advanced Sensor Technology
10 Thomas
Irvine CA 92618
US

Page 2 of 2 Print Date: 3/12/2003

Instructions For Printing A Repeatability Report

The instructions for printing a **Repeatability Report** are identical to those for printing a Certificate with the following exceptions:
1. You must check the **Repeatability Report Box**; (on the Print options screen pg. 51)
2. Enter the sensor serial number and press' Enter '; (Under Search on the Print Options screen pg. 51)
3. Choose the correct **Channel** and **Direction** information;
4. You must choose exactly three identical tests to compare for repeatability (same sensor, direction, load points, etc.), by double clicking on them from the list of available tests, and then press Print.
The following pages show an example of a **Standard Mode Repeatability Report**....

Standard Mode Repeatability Report (pg. 1)

Customer Information

Sensor Information

Reference Sensor Information

Test Conditions Information

Test Results Information

Best Fit Equation Information

FUTEK
Advanced Sensor Technology

Certificate of Calibration

Certificate No: 03031200002
Customer: Futek
Contact:
Street: 10 Thomas
City: Irvine CA 92691
Country: USA

Sensor
Model: LF900 Capacity: 500 lb
Serial No: 102208 SensorType: Force
Manufacturer: Futek

Calibrated With VCal SN: 118,581
Model: LF901 Capacity: 5000 lb
Serial No: 110747 NIST #:
Manufacturer: Futek

Channel: 1 Direction Compression

Calibration Technician: VCAL Test Load: 500.00 lb
Cal. Date: Mar 07, 2003 3:04:03 pm Temperature: 333.0 °
Next Cal. Date: March 2004 Humidity 333.0 %

Load (lb)	Cycle 1	Cycle 2	Cycle 3	BF Output (mV/V)	Average To BF/O	Error (%)
0.00	0.00000	0.00000	0.00000	0.00000	0.00	0.00
100.00	0.20000	0.20000	0.00000	100.00000	-99.87	-99.84
200.00	0.40000	0.40000	0.00000	200.00000	-199.73	-99.84
300.00	0.60000	0.60000	0.00000	300.00000	-299.60	-99.84
400.00	0.80000	0.80000	0.00000	400.00000	-399.47	-99.84
500.00	1.00000	1.00000	0.00000	500.00000	-499.33	-99.84

Shunt Resistor: 60.4K
Shunt Value: 2.33 mV/V
Rin: 365.00 Ω
Rout: 555.00 Ω
Leakage: 333
Max. Linearity: 0.00 %

Zero Return: 0.00 %

Unfixtured Zero
Prior To Test: 0.82 mV/V
After Test: 0.82 mV/V

Uncertainty: 0.00
* Error and Uncertainty were calculated using Straight Line Method in accordance with ASTM E74 with K = 2

Best Fit Equation: $Y = A_0 + A_1X + A_2X^2$
A 0 = 1.862645e-006
A 1 = 3.061862e+005
A 2 = 1.122577e+001
Y = Output X = Load
Best Fit Equation was calculated using the Method of Least Squares

Page 1 of 2 Print Date: 3/12/2003

Standard Mode Repeatability Report (pg. 2)

Calibration / Closing Disclaimer Statements

Company / Calibration Information

FUTEK
Advanced Sensor Technology

Certificate No: 0303120002

Calibration Technician Signature : _____

This calibration report may not be reproduced, except in full, without the written approval of the calibration laboratory.

This calibration report relates only to the transducer tested:

Manufacturer:	Futek
Model:	LF900
Serial No:	102208
SensorType:	Force

Company Information:

Futek Advanced Sensor Technology
10 Thomas
Irvine CA 92618
USA

Calibration Lab Information:

Futek Advanced Sensor Technology
10 Thomas
Irvine CA 92618
US

Page 2 of 2 Print Date: 3/12/2003

V. Troubleshooting and Technical Support

Problems Powering on Your VCal™ Unit:

- Check that the red LED is lit on the ON/OFF switch faceplate of your VCal™. If not then . . .
- Check that the wall AC outlet is operating correctly
- Check that all cable connections are secure
- Check that the fuse in your VCal™ unit has not been blown

  Warning! – If you must open your VCal™ unit to change or check the fuse, we ask that you obtain Futek factory authorization and instruction first, and then remove only the Power side faceplate! And please observe all precautions appropriate for the handling of electronic components. Failure to observe these precautions could result in the voiding of your warranty !
- If Futek VCal™ is closed incorrectly or unexpectedly (USB cable gets disconnected etc.), you will need to restart the VCal™ program.

Installation or USB Related Problems:

- If VCal™ gives a message that it was unable to locate the driver files, please make sure you are not on the Internet, and use the Browse function of the dialog window to point VCal™ to the folder labeled Drivers in the Removable Drive that VCal™ installed.
- Check that USB Devices are enabled in your PC's BIOS setup
- Please shut the unit off and power on again
- Windows XP users - If you receive any incompatibility messages, please disregard. We are in the process of working this detail out.

General Safety and Use :

- Please observe all appropriate safety precautions for electronic devices.
- Please do not short circuit +E and –E.
- Please do not short circuit power and common.
- Please only run your Futek VCal™ from the installed 'Removable Drive' only. Failure to do so could cause VCal™ to become unstable.
- Please do not use in conditions of extreme heat or cold. (Operating Temperature = 0 to 60° C.)
- Please do not consume food or beverages near your VCal™ unit.
- Please do not open your VCal™ unit, unless you have to check or change the fuse, and then obtain Futek factory authorization and instruction first, and then observe the above-mentioned warning.
- There is a slight delay when printing a report or certificate before the preview image comes up, this is normal and unavoidable due to the Crystal viewing components
- Please note that because of the significant amount of resources required by the 3D graphing program, we recommend that it be used on systems utilizing at least 128 MB of RAM and with a processor speed of at least 400 MHz.

To Contact Futek :

- Email us at futek@futek.com
- Or, call us directly at 800–23–FUTEK or at 949-465-0900

VI. Futek VCal™ Specification Page

Physical Specifications :

- Length – 12 3/8 in or (31.5 cm)
- Width – 6 in or (15.24 cm)
- Height – 1 5/8 in or (4.06 cm)
- Weight – 2.8 lbs. or (1.27 kg)

VCal™ Data Acquisition Module Specifications :

- Resolution: ± 20 bits
- Input range: ± 4.5mV/V
- Analog input range: ±15 VDC, 4 – 20 mA
- Power Supply Output: 15 VDC @ 2A
- Default Shunt Cal Values: 60.4KΩ, 100KΩ, and 150KΩ (Other Shunt Values available per customer request)
- Measuring rate: 4.7 to 600 Hz
- Filter frequency: 0.25 to 40 Hz
- Storage Temperature: 0 to 60° C (32 to 140° F)
- Temperature Probe Range: -55 to 125° C (-67 to 257° F)
- Sensor Connection: 4 wire
- Fuse: 250V @

VII. Futek VCal™ Glossary of Terminology

A2LA The American Association for Laboratory Accreditation. (http://www. a2la2.net)

Accuracy Stated as a limit tolerance which defines the average deviation between the actual output versus theoretical output. In practical transducer applications, the potential errors of nonlinearity, hysteresis, nonrepeatability and temperature effects do not normally occur simultaneously, nor are they necessarily additive. Therefore, accuracy is calculated based upon the RMS value of potential errors, assuming a temperature band of ± 10° F, full rated load applied, and proper set up and calibration. Potential errors of the readout, crosstalk, or creep effects are not included.

ANSI The American National Standards Institute. (http://www.ansi.org)

ASTM The American Society for Testing and Materials. (http://www.astm.org)

Audit Trail The chronological set of records that provides evidence of system activity. These records can be used to reconstruct, review and examine transactions from inception to output of final results. The records can also be used to track the calibration history of a reference sensor back to it's original calibration (generally with NIST calibrated dead weights).

Average to Best Fit Output The average of the standard deviations between the individual measured outputs and the Best-Fit Outputs for each load point.

Axial Load A load applied along a line concentric with the Primary Axis.

Best Fit Equation The equation of a straight line, calculated from a set of measurement results, which attempts to minimize the differences (usually called residuals) between the line and the measurement results. There is more than one statistical method used, each of which may place the straight line in a slightly different position with respect to the measurement data.

Calibration Certificate For the purposes of this Glossary; A document which lists all of the information relevant to a Calibration (Customer info, Sensor info, Test Conditions, Test Results, etc.), and certifies that the information is accurate within a certain limit of uncertainty.

Calibration Curve A record of the comparison of the transducer outputs versus standard test loads.

Calibration Interval A period of time or amount of use between calibrations determined to be adequate to ensure equipment remains reliable, where reliable is defined as within sufficient tolerance (or uncertainty) for the tests being done.

Calibration Load For the purposes of this Glossary; The maximum load which is to be applied during a particular Calibration.

Calibration The comparison of transducer outputs against standard test loads.

Compensated Temperature The range of temperature over which the transducer is compensated to maintain Rated Output and Zero Balance within specified limits.

Correction Factor Numerical factor by which the uncorrected result of a measurement is multiplied to compensate for systematic error.

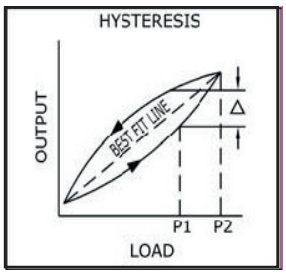
Creep The change in transducer output occurring with time, while under load, and with all environmental conditions and other variables remaining constant. Usually measured with Rated Load applied and expressed as a percent of Rated Output over a specific period of time.

Crosstalk With one component loaded to capacity, and the other unloaded, the output of the unloaded component will not exceed the percentage specified of its full-scale capacity.

Deflection The change in length along the Primary Axis of the load cell between no-load and Rated Load conditions.

Drift A random change in Output under constant Load conditions.

Error The algebraic difference between the indicated and true value of the load being measured. Error is numerically equal to correction but opposite in sign.



Excitation The voltage or current applied to the input terminals of the transducer.

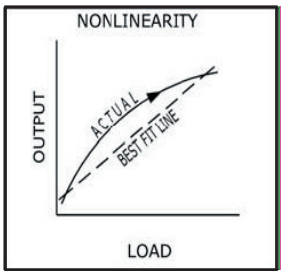
Hysteresis The maximum difference between the transducer output readings for the same applied load; one reading obtained by increasing the load from zero and the other by decreasing the load from Rated Output. Usually measured at half Rated Output and expressed as a percent of Rated Output. Measurements should be taken as rapidly as possible to minimize Creep.

IEEE Standard 1451.4 (Institute of Electronic and Electrical Engineers) Standard for Plug and Play for Sensors and Signal Conditioning (http://www.ieee.org)

ISO International Organization for Standardization. (http://www.iso.ch/iso/en/ISOOnline.frontpage)

Linearity The closeness of a calibration curve to a specified straight line. Linearity is expressed as the maximum deviation of any calibration point on a specified straight line during any one-calibration cycle.

Load Cell A force transducer typically employing strain gages to measure elastic deformation, which produces an output signal that is proportional to the applied load or force.

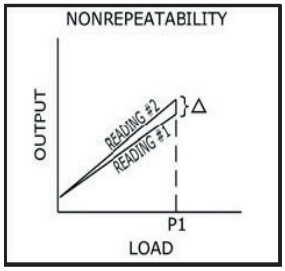


Load The weight, torque, pressure or force applied to the transducer.

Natural Frequency The frequency of free oscillation under no-load conditions.

NIST National Institute of Standards and Technology (http://www.nist.gov)

Non-linearity The maximum deviation of the Calibration Curve from a straight line drawn between the No-load and Rated Load outputs, expressed as a percentage of the Rated Output and measured on increasing load only.



Non-repeatability The maximum difference between transducer output readings for repeated loadings under identical loading and environmental conditions.

Operating Temperature The extremes of temperature within which the transducer will operate without permanent adverse change to any of its performance characteristics.

Primary Axis The axis along which the transducer is designed to be loaded; normally its geometric centerline.

Rated Load (Rated Capacity) The maximum Axial Load that the transducer is designed to measure within its specifications.

Rated Output The signal (voltage) produced by the transducer. Where the output is directly proportional to excitation, the signal is expressed in terms of (mV/V) of excitation.

Reference Sensor Sensor, generally having a known, output versus load quality, at a given location or in a given organization, from which measurements made there are derived. The reference sensor itself must be periodically claibrated.

Repeatability (of results of measurement) Closeness of the agreement between the results of successive measurements of the force carried out under the same conditions of measurement. Conditions include same procedure, observer, instrument, conditions, and location; and carried out over a short period of time.

Repeatability Report For the purposes of this Glossary; a document which reports the results of comparing three separate, but identical, test for closeness of result agreement.

Reproducibility (of results of measurements) Closeness of the agreement between the results of measurements of the force carried out under changed conditions of measurement. Includes changing some of those conditions that are held constant for 'repeatability', and may refer to measurements carried out over a long period of time.

Resolution The smallest change in mechanical input which produces a detectable change in the output signal.

Safe Overload The maximum load in percent of Rated Capacity that can be applied without producing a permanent shift in performance characteristics beyond those specified.

Scale Factor The full-scale output minus any offsets, divided by the full-scale load applied.

Sensor Element of a measuring instrument or measuring chain that is directly or indirectly affected by the measurand.

Shunt Calibration Electrical simulation of transducer output by insertion of known shunt resistors between appropriate points within the circuitry.

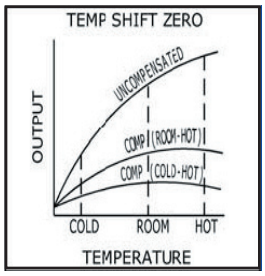
Signature Test A type of calibration procedure which involves performing a Primary test under repeatable conditions to establish a sensor's "signature" (output, non-linearity, and zero characteristics), so that Subsequent tests may be performed to be compared against this Primary Signature for performance monitoring and control.

Span Modulus of the difference between the two limits of a nominal range. (Maximum - Minimum = Span)

Standard Deviation A mathematical quantity used to characterize the dispersion of results.

Strain Gage A measuring element for converting force, pressure, torque etc., into an electrical signal.

Tare The weight of the container in which goods are packaged, and a deduction from the gross weight to compensate for this.



Temperature Shift Span The change in Output due to a change in transducer temperature. Expressed as a percentage of load per degree Fahrenheit (Celsius) change in temperature.

Temperature Shift Zero The change in Zero Balance due to a change in transducer temperature. Expressed as the change in Zero Balance in percent of Rated Output per degrees Fahrenheit (Celsius) (change in temperature).

Time Test A type of test procedure which involves setting a start and end time for the test, setting limits on viewable outputs (Hi and Lo limits), and setting the Interval (how often VCal™ is to take and save readings during the duration of the test).

Uncertainty of Measurement A parameter, associated with the result of a measurement that characterizes the dispersion of values that could reasonably be attributed to the measurand.

Validation Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use or purpose are fulfilled (ISO 8402).

Verification Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled (ISO 8402).

Wheatstone Bridge A network of four resistances, an emf source, and a meter connected such that when the four resistances are matched, the meter will show a zero deflection or "null" reading.

Zero Balance The output signal of the transducer with rated Excitation and with no-load applied usually expressed in percent of Rated Output.

Zero Offset The difference expressed in degrees between true zero and an indication given by a measuring instrument.

Zero Return The difference in Zero Balance measured immediately before Rated Load application of specified duration, and measured after removal of the load, and when the output has stabilized.

Zero Stability The degree to which the transducer maintains its Zero Balance with all environmental conditions and other variables remaining constant.