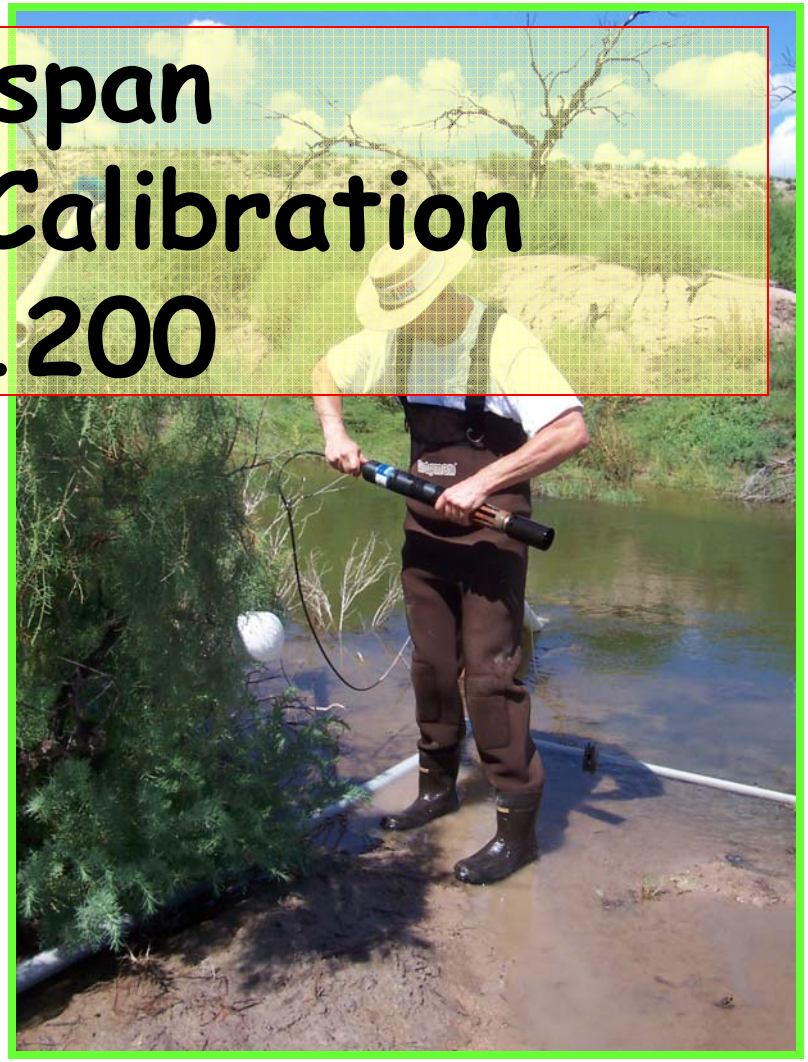
Greenspan Multiprobe Calibration CS4-1200



Christine Kolbe
Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program
Water Quality Monitoring & Assessment Section

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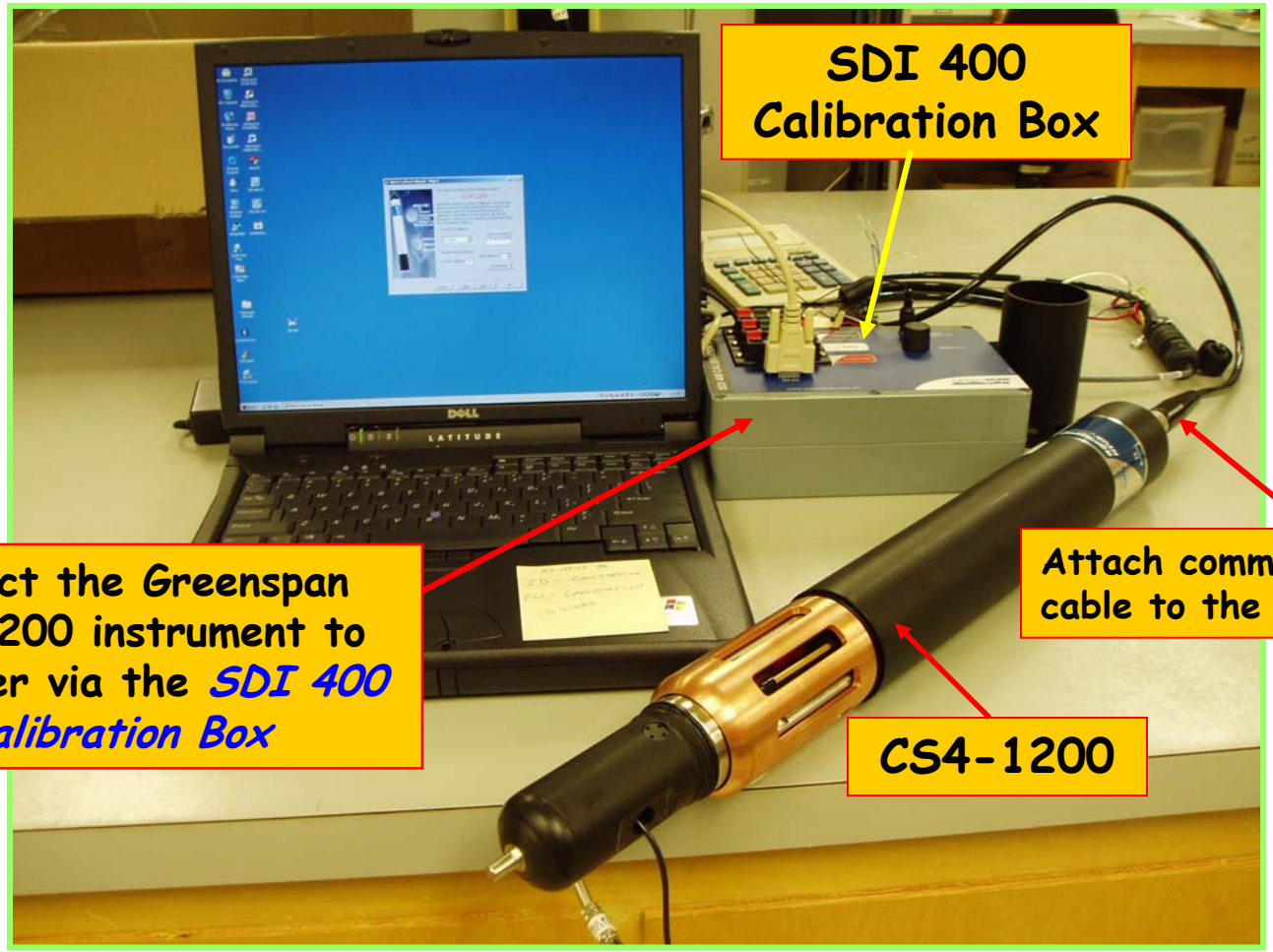
Calibration Equipment Checklist

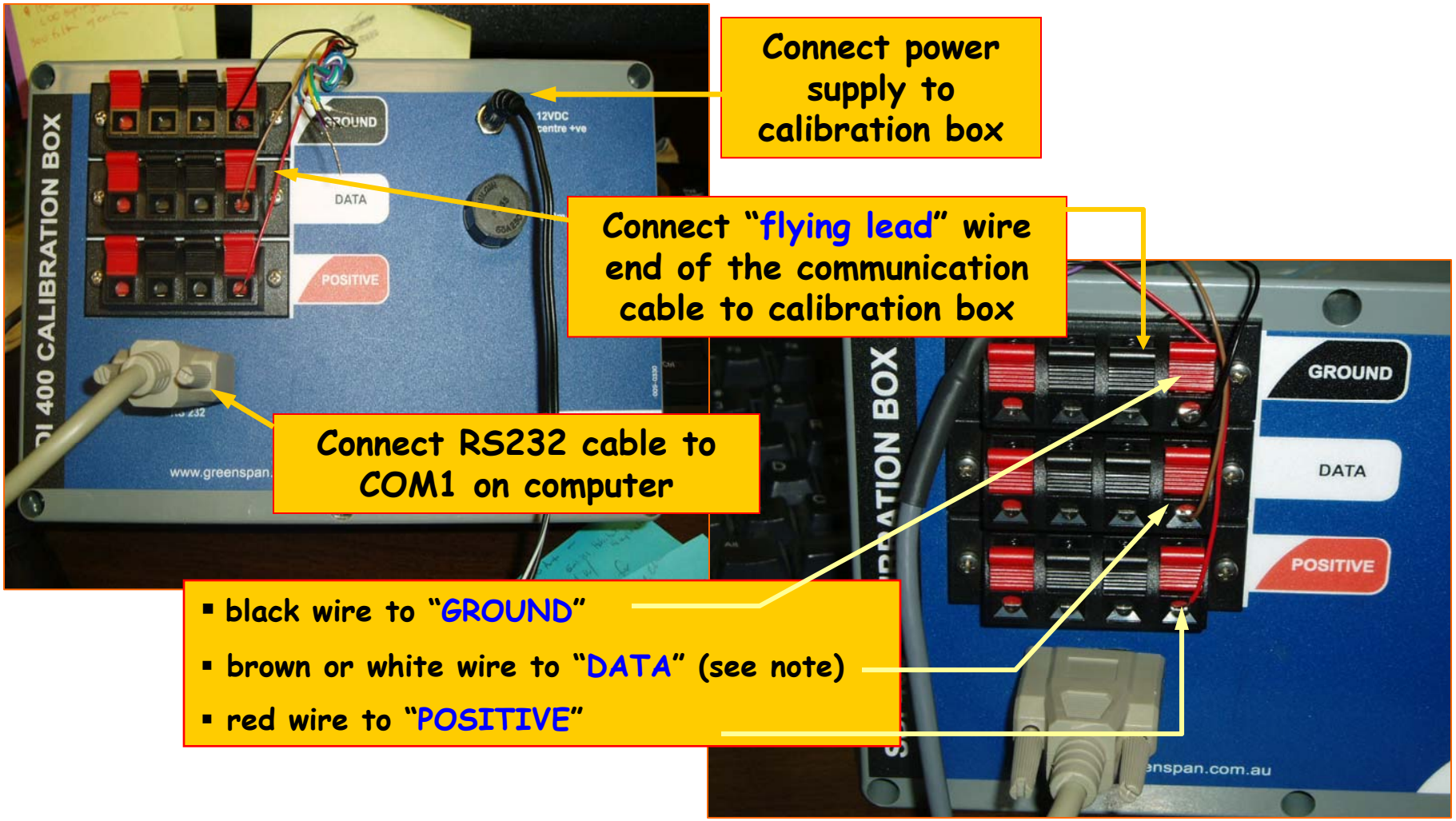
- SDI Calibration Box
- RS232 Cable (connect calibration box to computer)
- Power Supply (for calibration box)
- Calibration Cable (connect instrument to the calibration box)
- Laptop Computer
- SDI CalTech Software
- Barometer

Greenspan Calibration Set-up



Note: Calibration of Greenspan instruments must be done in a temperature controlled environment. The calibration is done prior to going to the site. When switching out instruments, the one being removed is taken back to the lab or office for the post calibration check. *Before doing the post calibration check, allow the instrument to acclimate to room temperature for at least 2 hours*.

SDI 400 Calibration Box

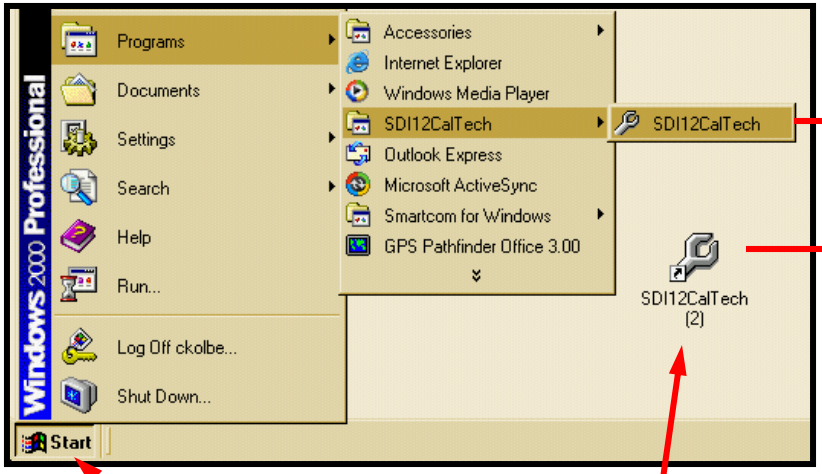


- black wire to "GROUND"
- brown or white wire to "DATA" (see note)
- red wire to "POSITIVE"

Note: The newer Greenspan communication cables require a flying lead (loose wires) adaptor cable. The wires are different than the older cables. The brown wire is used for the data port on the calibration box instead of white.

Greenspan Calibration Software

Load the "**SDI 12CalTech**" software on the computer being used for calibration.

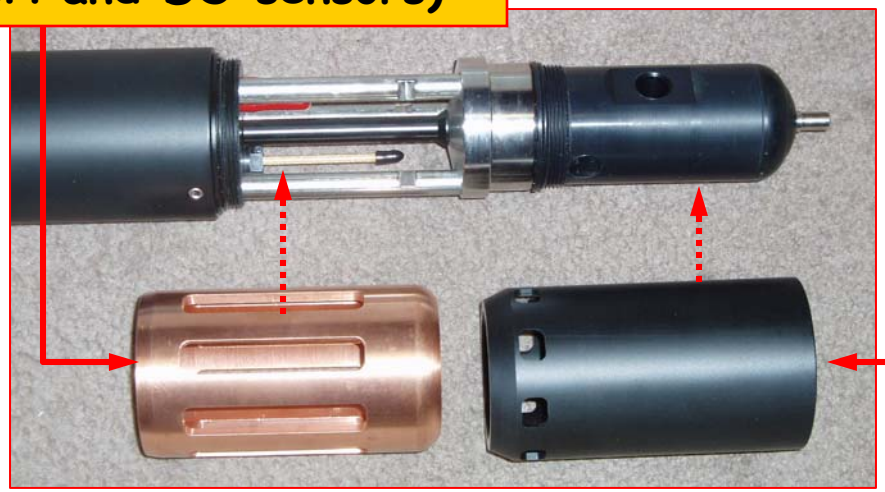


From the Start Menu or Desktop Icon open the "**SDI 12CalTech**" program.

Sensor Guards

Copper Shroud

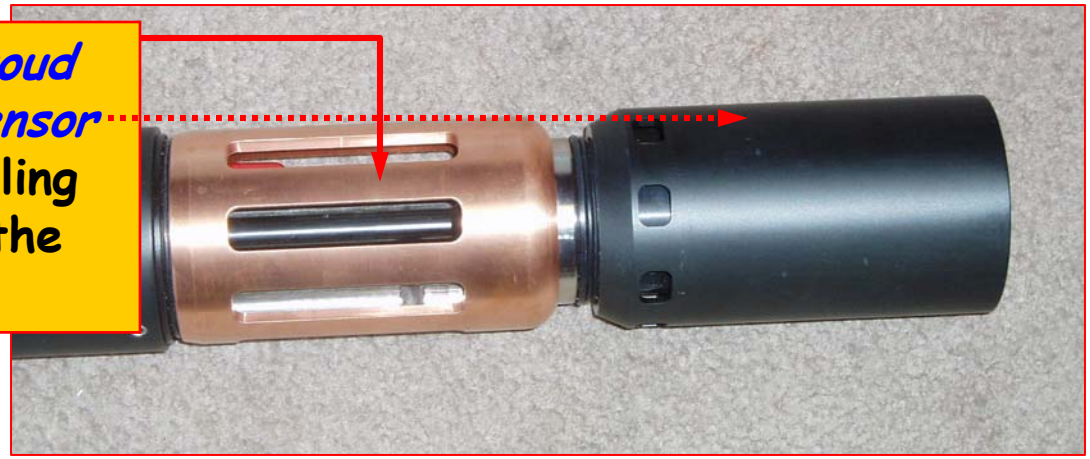
(Reduces biofouling of pH and DO sensors)



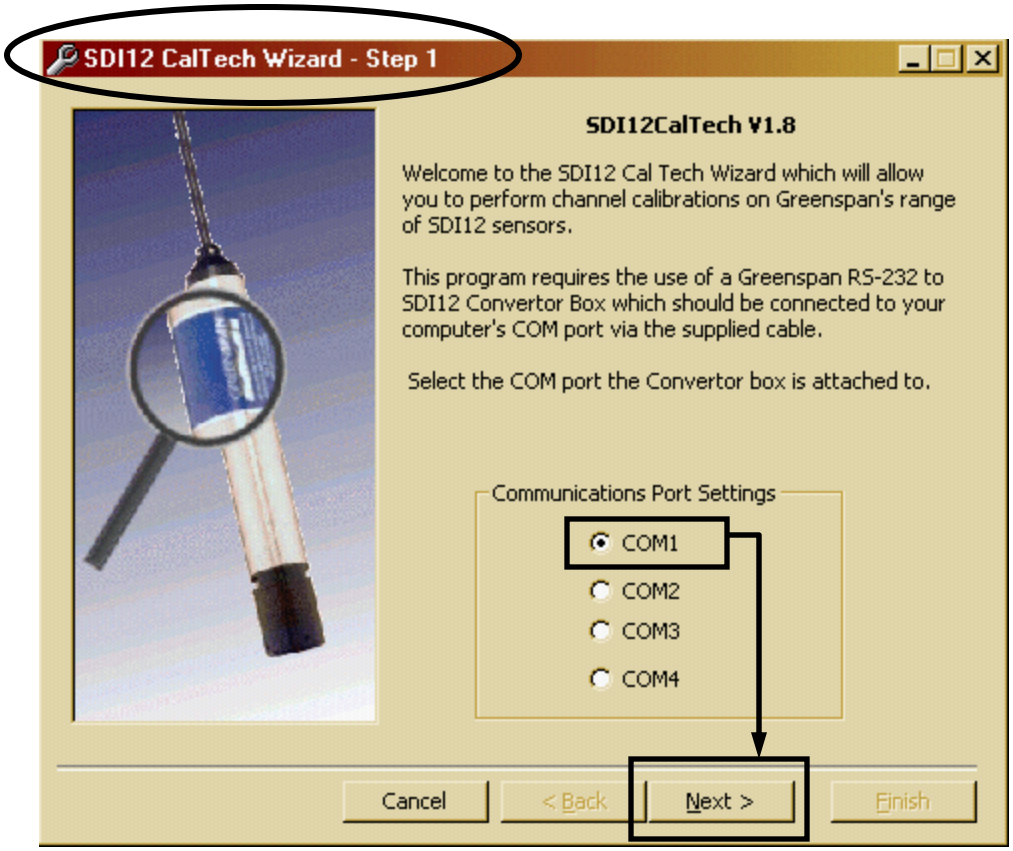
Conductivity Sensor Guard

Remove both before calibrating the instrument.

Replace *copper shroud* and *conductivity sensor guard* before installing the instrument at the site.



Step 1: Communications Port Settings



Select COM 1; Press "Next>"

Note: Each time "Next>" is pressed a "Communication Status Box" will appear; "retrieving data" and "retrieving configuration"

Calibration Logsheet
QA/QC Check

Function	Required Value	Sensor Reading	Calibrate To	Comments
EC Raw	0.000	4.9	0.00	
Slope "Calibration Loop Value"	10,003	10,029.4	10,003	
pH	7.00	7.03	7.00	
Slope	10.00	10.03	10.03	
Temperature		21.8		
D.O. (Gain) "DO Table Value"	8.81	8.55	8.81	

A record of calibration and a post calibration check must be kept. This is required for data validation. The complete form is attached at the end of this document.

Definitions:

Required Value = Calibration standard value; calibration loop value, pH 7 and 10 buffers, and DO table value.

Sensor Reading = Initial sensor reading before calibration.

Calibrated To = Value reported in Step 6 of the calibration process.

Post Calibration Check

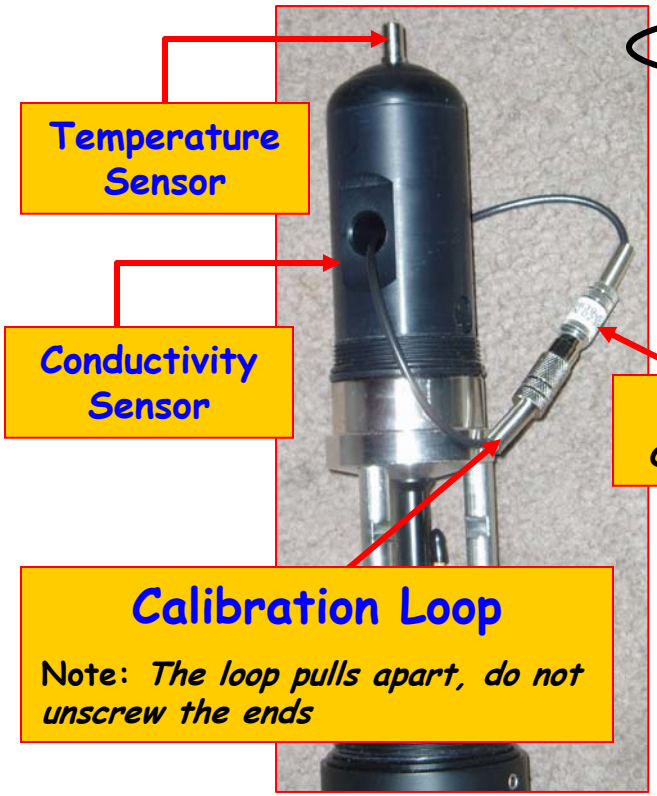
Function	Required Value	Sensor Reading	Post-Calibration Check Error Limits
EC Raw	0.000	0.000	± 5%
Slope	10,003	10,006	
pH	7.00	7.02	± 0.5 mg/L
Slope	10.00	10.03	
Temperature		21.8	
D.O. (Gain)	8.81	8.80	± 0.5 mg/L

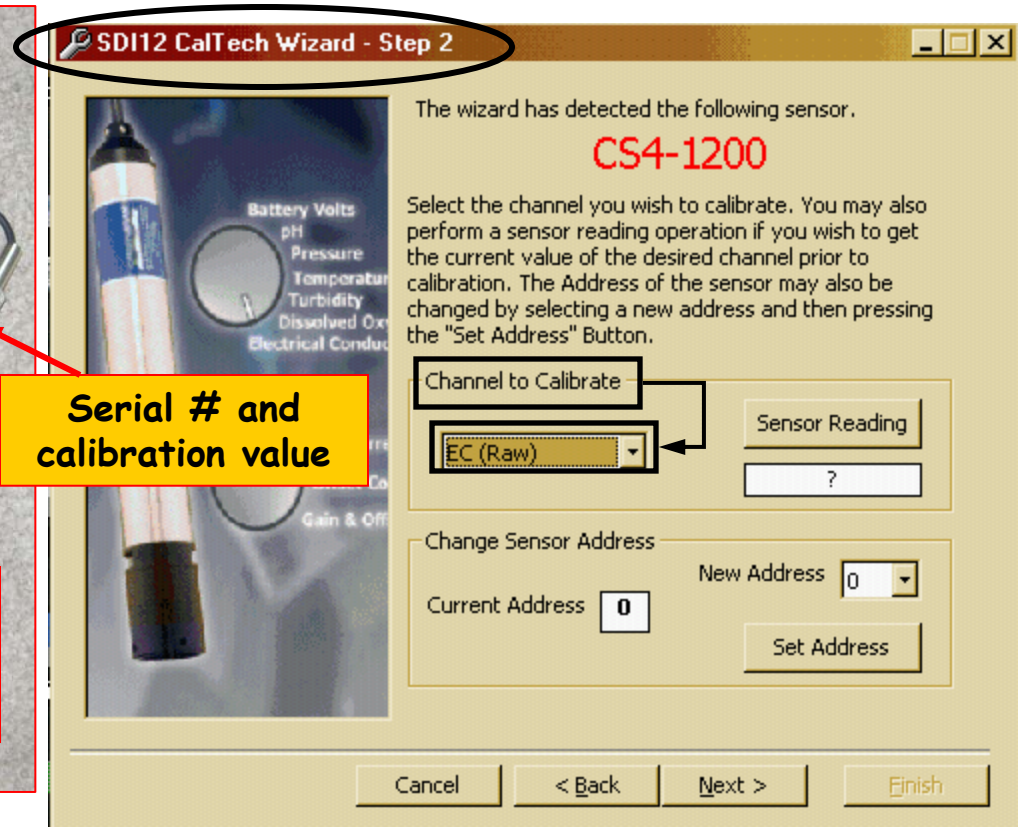
After the instrument is removed from the site and taken back to the lab, a post calibration check is done to detect drift in the sensors. The sensors must fall within an acceptable error range. Values outside this range are considered invalid.

This check only requires recording the "**Sensor Readings**" for each parameter with the appropriate calibration standard ("Required Value").

The complete form is attached at the end of this document.

Calibrating Specific Conductance
Step 2: Select Channel to Calibrate



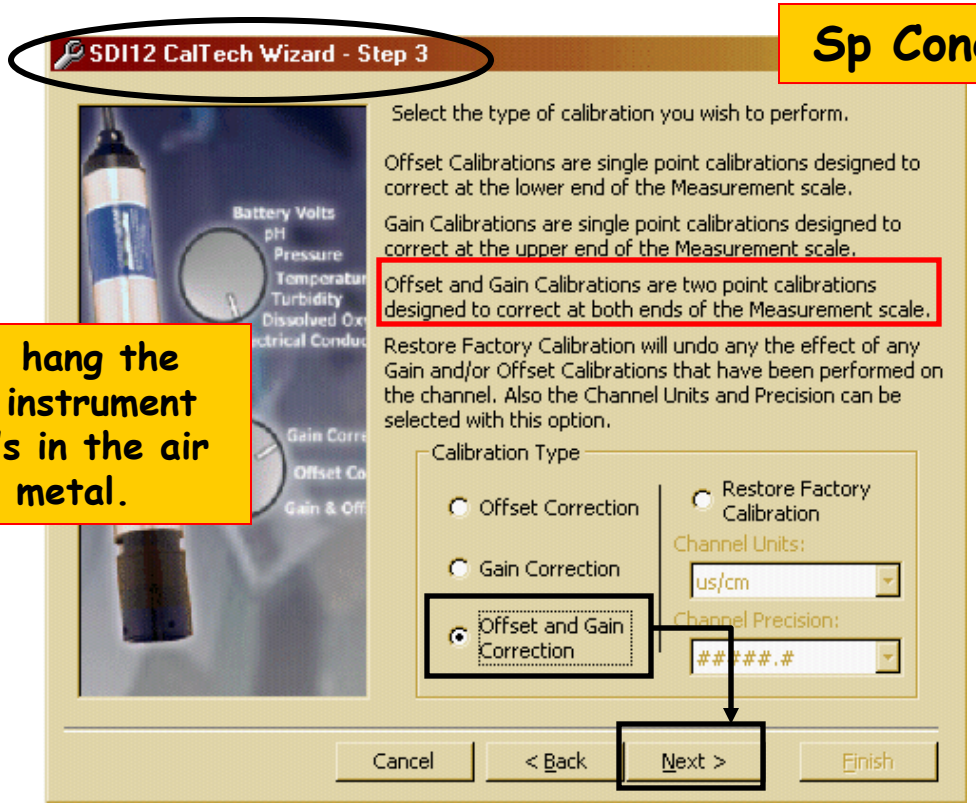


From the same screen, Select "**Channel to Calibrate**" from drop down menu; For specific conductance select "**EC (Raw)**". Press "**Next>**".

Note: ***Do not attach the calibration loop until Step 5 of the EC (Raw) calibration.***

Step 3: Select Calibration Type

Sp Cond (continued)



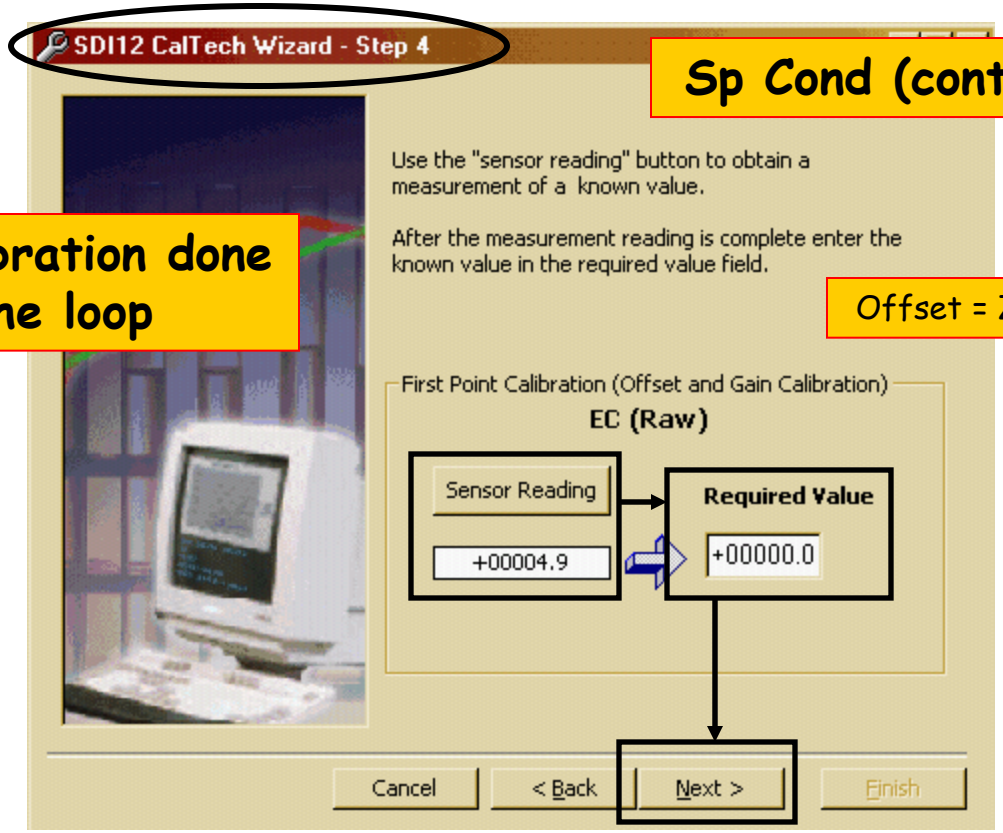
When calibrating, hang the sensor end of the instrument off the table so it's in the air and away from metal.

Specific Conductance is a *two point calibration*; Select "**Offset and Gain Correction**"; Press "**Next >**".

Note: A calibration loop is required. Each loop is specific to an instrument. The serial number on the loop must match the serial number of the instrument.

Step 4: First Point Calibration

Zero calibration done *without* the loop

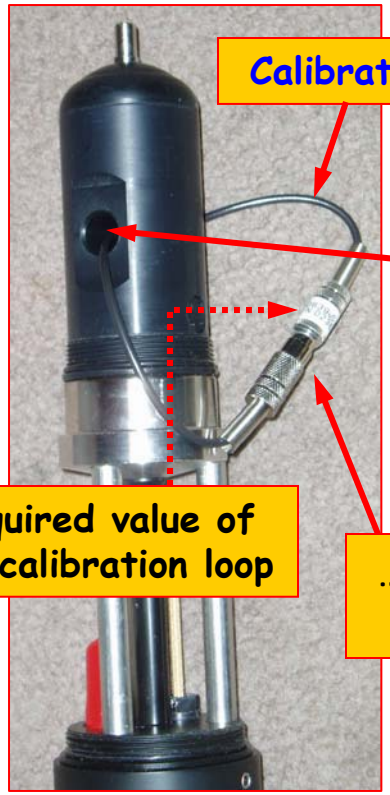


Sp Cond (continued)

Offset = Zero

Press "**Sensor Reading**". This value is recorded on the calibration log sheet as "**Sensor Reading**". This is the "zero calibration"; the "**Required Value**" is 00000.0; Press "**Next >**". The value may not be zero but should be with ±5%.

Step 5: Second Point Calibration

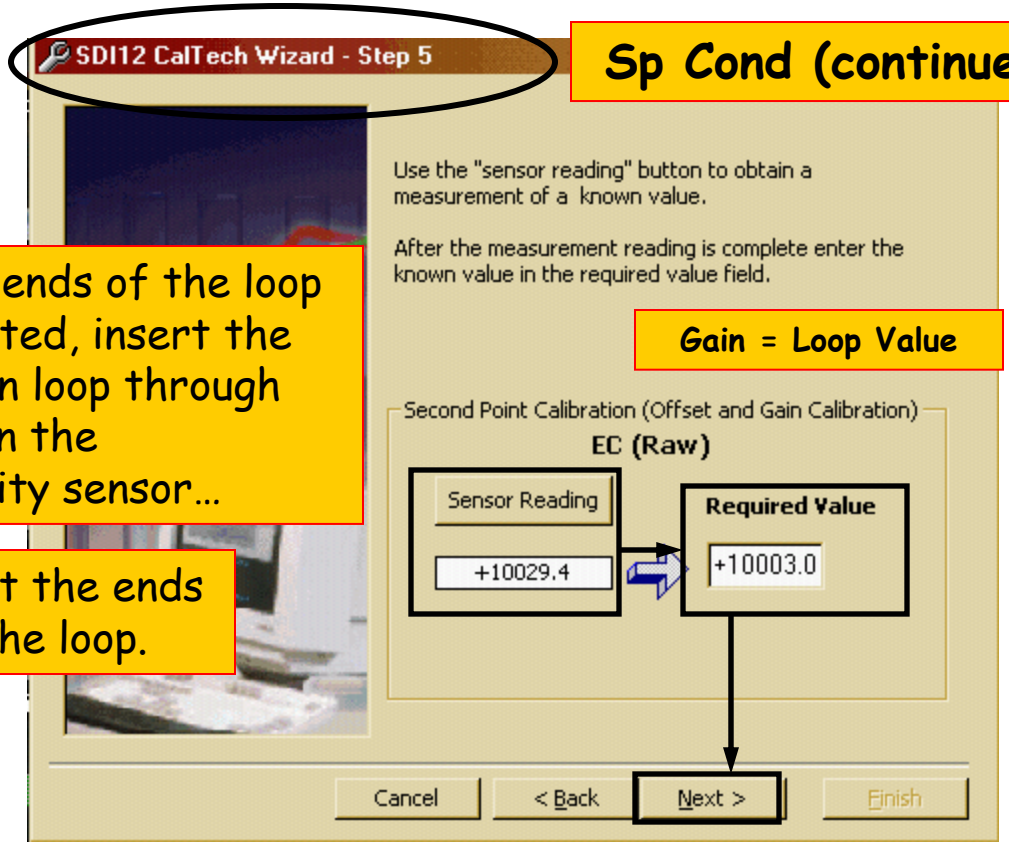


Calibration Loop

With the ends of the loop disconnected, insert the calibration loop through the hole in the conductivity sensor…

…and connect the ends to close the loop.

Required value of the calibration loop



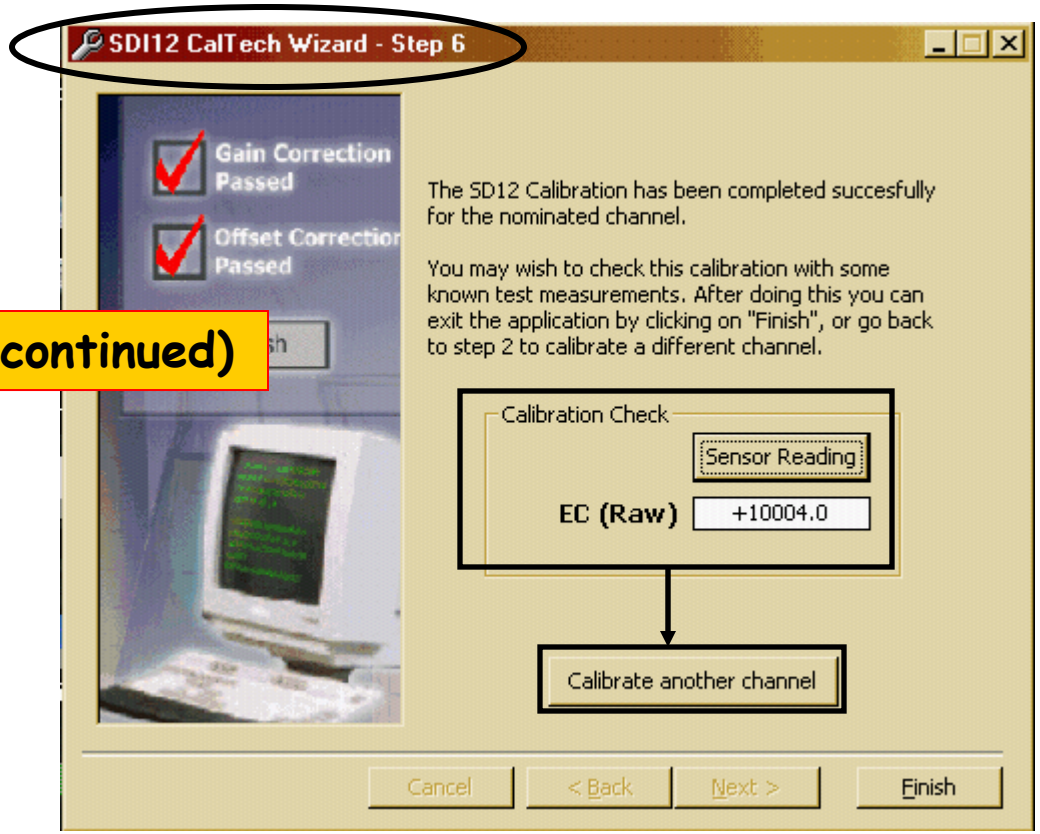
Sp Cond (continued)

Gain = Loop Value

Connect the calibration loop (described above) and press "**Sensor Reading**". Record this value on the calibration log sheet as "**Sensor Reading**". Next, enter the required value from the calibration loop in "**Required Value**"; in this example the resistance of the loop is 10,003; Press "**Next >**".

Step 6: Calibration Check

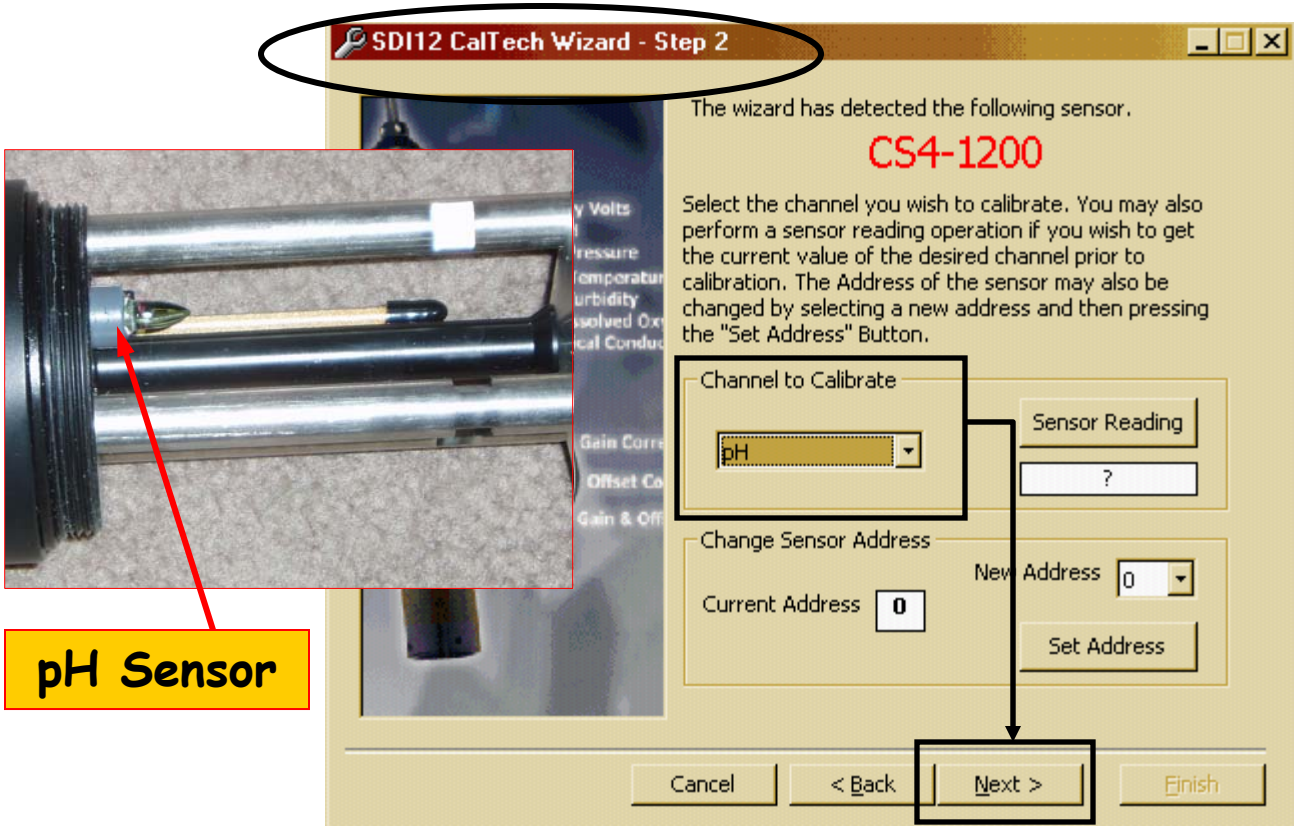
Sp Cond (continued)



Press "**Sensor Reading**" to check the calibration; Record this value on the calibration log sheet as "**Calibrated To**" value. Press "**Calibrate another channel**".

Calibrating pH

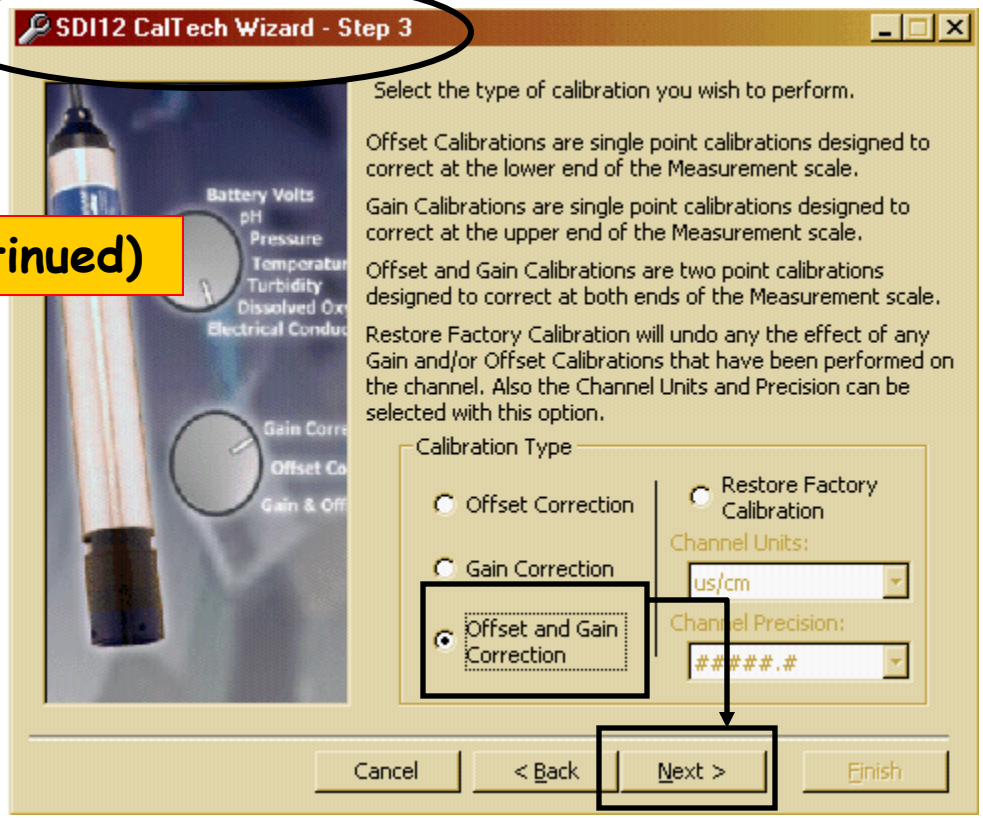
Step 2: Select Channel to Calibrate



From the same screen, Select "**Channel to Calibrate**" from drop down menu; Select "**pH**". Press "**Next>**".

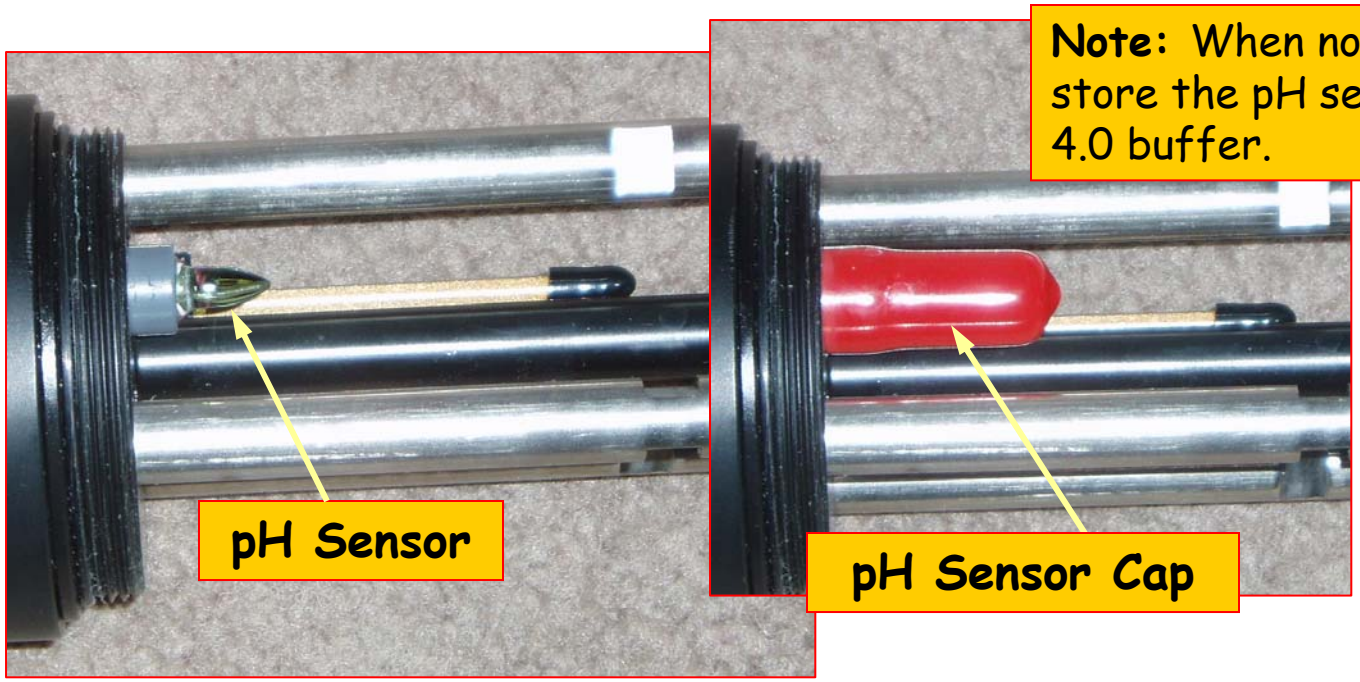
Step 3: Select Calibration Type

pH (continued)



pH is a *two point calibration*; Select "**Offset and Gain Correction**"; Press "**Next>**".

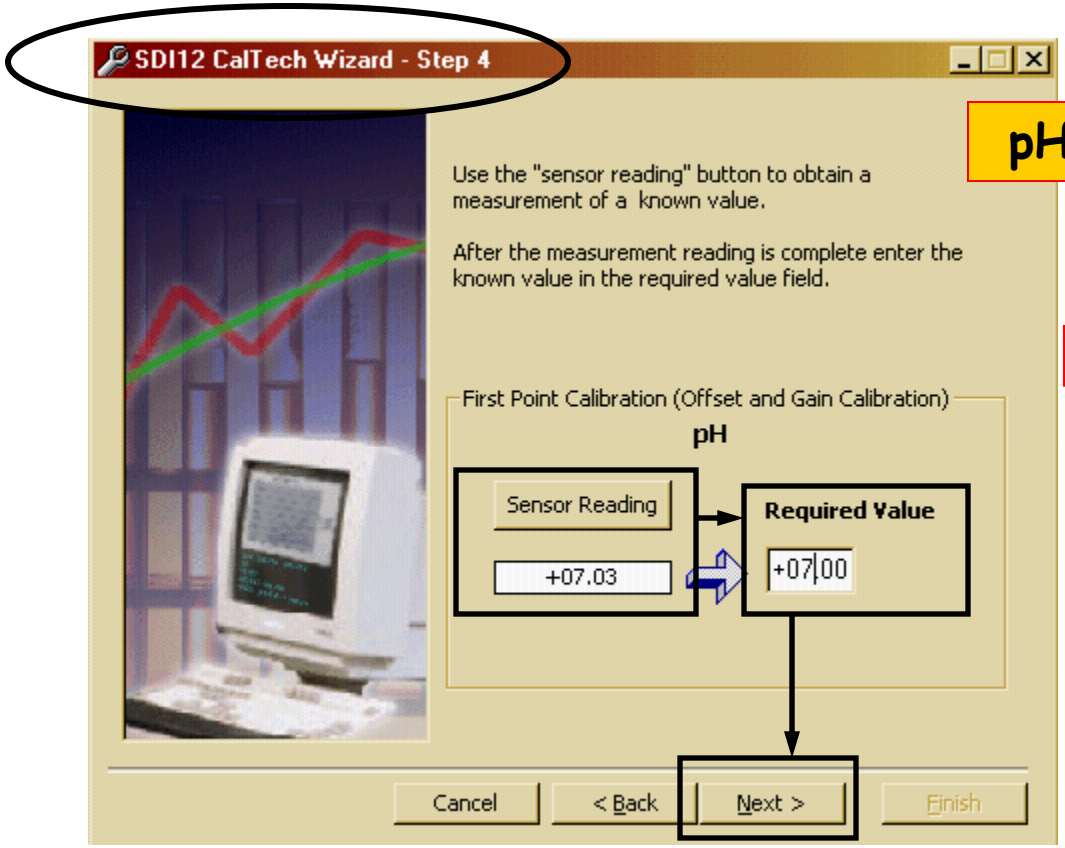
Step 3.5: pH Calibration Standards



Note: When not in use store the pH sensor in pH 4.0 buffer.

For the "**first point calibration**", rinse the pH sensor and pH sensor cap with tap water. Using a squirt bottle filled with pH 7 buffer, rinse the sensor and sensor cap several times and fill the sensor cap. Place the cap over pH sensor and follow the calibration procedure. This will be done again for the "**second point calibration**" with pH 10 buffer. ***Note***: In water bodies with low pH, use pH 4.0 and 7.0 buffers to calibrate the pH sensor.

Step 4: First Point Calibration



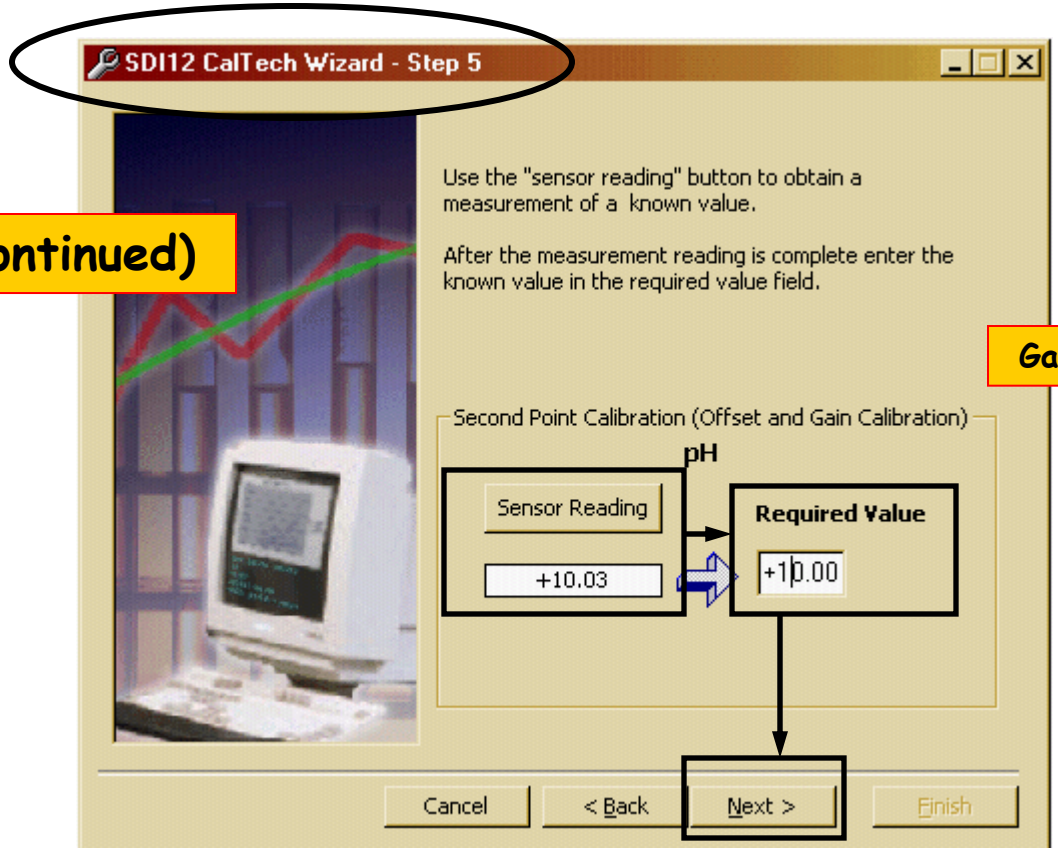
pH (continued)

Offset = pH 7.0

After following Step 3.5, press "**Sensor Reading**". This value is recorded on the calibration log sheet as "**Sensor Reading**". Enter the calibration standard (pH 7.0) in "**Required Value**". Press "**Next>**".

Step 5: Second Point Calibration

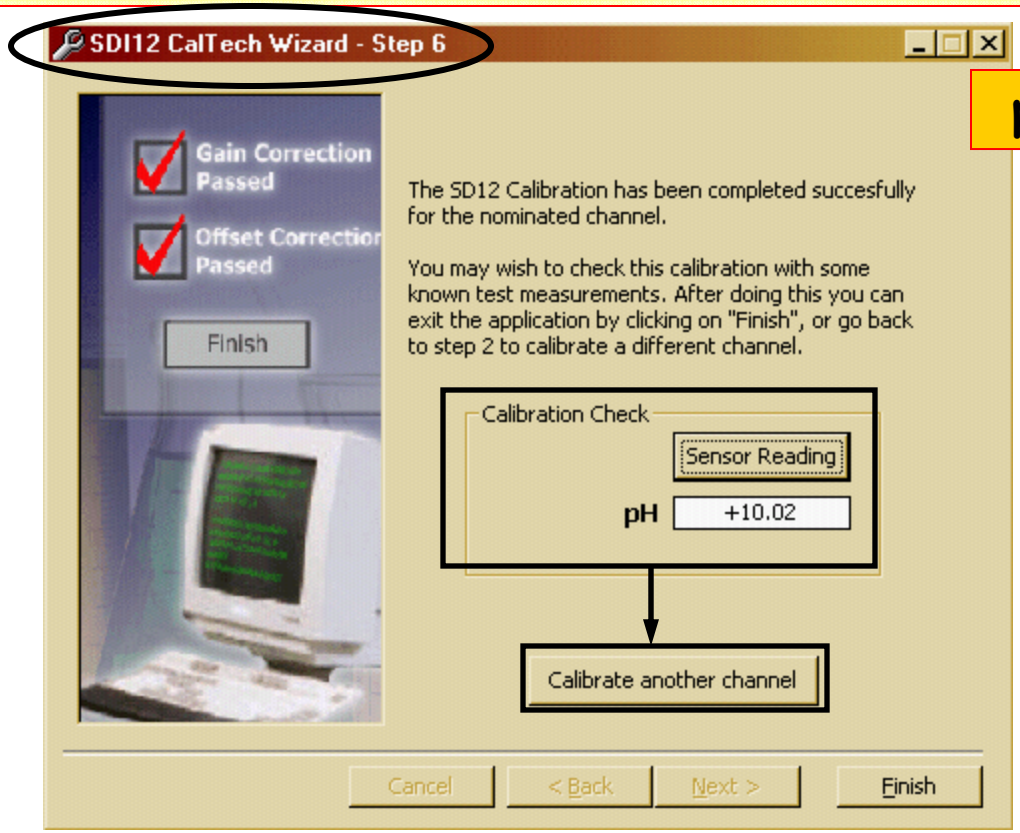
pH (continued)



Gain = pH 10.0

After following Step 3.5, press "**Sensor Reading**". This value is recorded on the calibration log sheet as "**Sensor Reading**". Enter the calibration standard (pH 10.0) in "**Required Value**". Press "**Next>**".

Step 6: Calibration Check



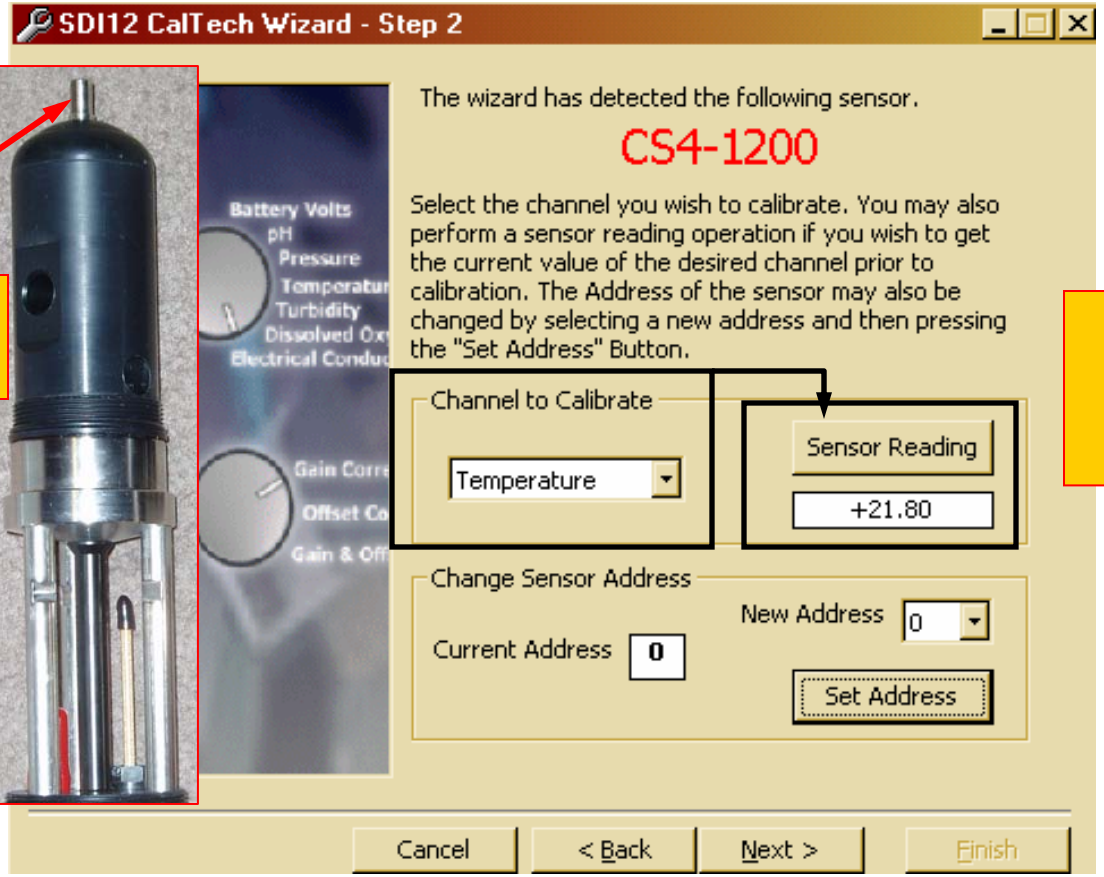
pH (continued)

Press "**Sensor Reading**" to check the calibration; Record this value on the calibration log sheet as "**Calibrated To**" value. To check the pH 7.0 calibration, rinse and fill the sensor cap with pH 7.0. Press "**Sensor Read**" to check the pH 7.0 calibration. Record this value on the calibration log sheet as "**Calibrated To**" value. Press "**Calibrate another channel**".

Calibrating Dissolved Oxygen

Step 1: *Record Instrument Temperature*

Temperature Sensor



Note: Do not calibrate temperature

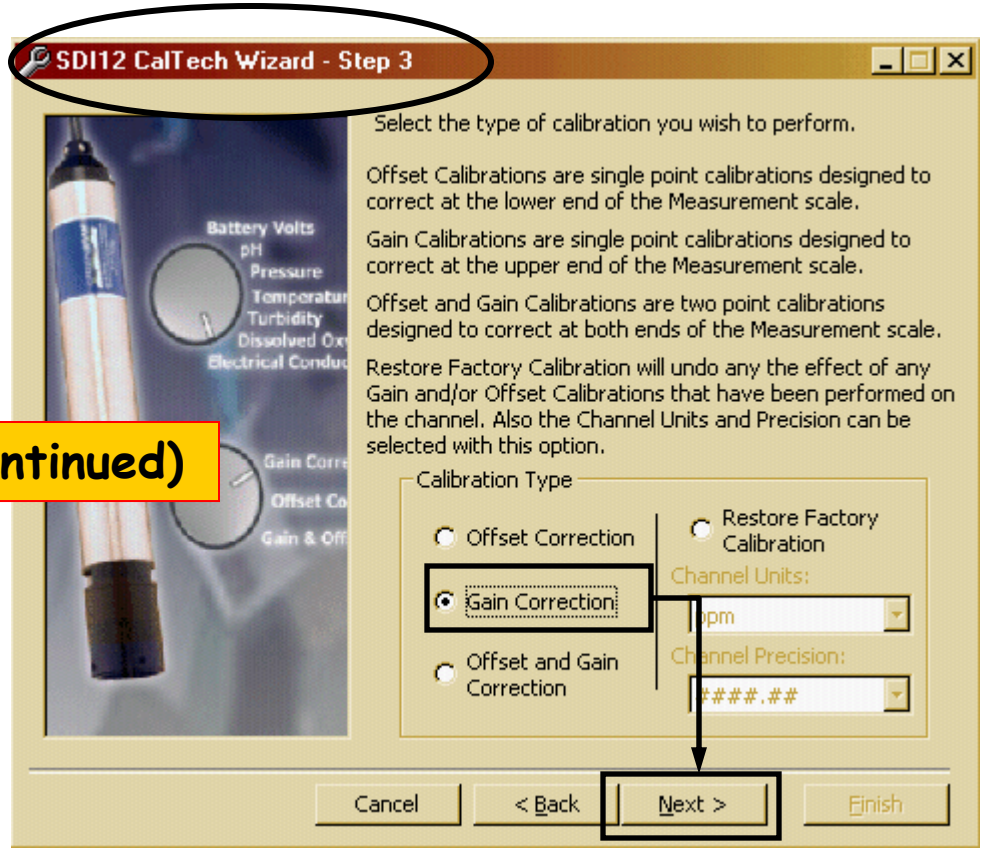
Select "**Channel to Calibrate**" from drop down menu; select "**Temperature**". Press "Sensor Reading"; This value is recorded on the calibration log sheet as "Sensor Reading". *This value is needed for calibrating DO.*

Calibrating Dissolved Oxygen
Step 2: Select Channel to Calibrate

Note: *The DO diffusion rod is the only sensor that can be changed by the operator. All other repairs must be done by a manufacturers rep.*

From the same screen, Select "**Channel to Calibrate**" from drop down menu; For dissolved oxygen select "**DO (ppm)**". Press "**Next>**".

Step 3: Select Calibration Type



DO (continued)

DO is a *one point calibration*; Select "**Gain Correction**"; Press "**Next>**". The DO sensor (diffusion rod) is calibrated in air.

Determining the DO Calibration Required Value

DO Saturation Table

DO Saturation Values Oxygen Content of Air-Saturated Freshwater at 760 mm Hg										
Temp°C	Oxygen Solubility at 760 mmHg									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	14.17	14.13	14.09	14.06	14.02	13.98	13.94	13.90	13.87	13.83
2	13.79	13.75	13.72	13.68	13.65	13.61	13.57	13.54	13.50	13.47
3	13.43	13.40	13.36	13.33	13.29	13.26	13.22	13.19	13.15	13.12
4	13.08	13.05	13.01	12.98	12.94	12.91	12.88	12.84	12.81	12.77
5	12.74	12.71	12.68	12.64	12.61	12.58	12.55	12.52	12.48	12.45
6	12.42	12.39	12.36	12.33	12.30	12.27	12.23	12.20	12.17	12.14
7	12.11	12.08	12.05	12.02	11.99	11.96	11.93	11.90	11.87	11.84
8	11.81	11.78	11.75	11.73	11.70	11.67	11.64	11.61	11.59	11.56
9	11.53	11.50	11.48	11.45	11.42	11.40	11.37	11.34	11.31	11.29
10	11.26	11.23	11.21	11.18	11.15	11.13	11.10	11.07	11.04	11.02
11	10.99	10.97	10.94	10.92	10.89	10.87	10.84	10.82	10.79	10.77
12	10.74	10.72	10.69	10.67	10.64	10.62	10.60	10.57	10.55	10.52
13	10.50	10.48	10.45	10.43	10.41	10.39	10.36	10.34	10.32	10.29
14	10.27	10.25	10.23	10.20	10.18	10.16	10.14	10.12	10.09	10.07
15	10.05	10.03	10.01	9.98	9.96	9.94	9.92	9.90	9.87	9.85
16	9.83	9.81	9.79	9.77	9.75	9.73	9.71	9.69	9.67	9.65
17	9.63	9.61	9.59	9.57	9.55	9.53	9.51	9.49	9.47	9.45
18	9.43	9.41	9.39	9.37	9.35	9.34	9.32	9.30	9.28	9.26
19	9.24	9.22	9.20	9.19	9.17	9.15	9.13	9.11	9.10	9.08
20	9.06	9.04	9.02	9.01	8.99	8.97	8.95	8.93	8.92	8.90
21	8.88	8.86	8.85	8.83	8.81	8.80	8.78	8.76	8.74	8.73
22	8.71	8.69	8.68	8.66	8.65	8.63	8.61	8.60	8.58	8.57
23	8.55	8.53	8.52	8.50	8.49	8.47	8.45	8.44	8.42	8.41
24	8.39	8.38	8.36	8.35	8.33	8.32	8.30	8.29	8.27	8.26
25	8.24	8.23	8.21	8.20	8.18	8.17	8.15	8.14	8.12	8.11
26	8.09	8.08	8.06	8.05	8.03	8.02	8.01	7.99	7.98	7.96
27	7.95	7.94	7.92	7.91	7.89	7.88	7.87	7.85	7.84	7.82
28	7.81	7.80	7.78	7.77	7.76	7.75	7.73	7.72	7.71	7.69
29	7.68	7.67	7.65	7.64	7.63	7.62	7.60	7.59	7.58	7.56
30	7.55	7.54	7.52	7.51	7.50	7.49	7.47	7.46	7.45	7.43
31	7.42	7.41	7.40	7.38	7.37	7.36	7.35	7.34	7.32	7.31
32	7.30	7.29	7.28	7.26	7.25	7.24	7.23	7.22	7.20	7.19
33	7.18	7.17	7.16	7.15	7.14	7.13	7.11	7.10	7.09	7.08
34	7.07	7.06	7.05	7.03	7.02	7.01	7.00	6.99	6.97	6.96
35	6.95	6.94	6.93	6.92	6.91	6.90	6.88	6.87	6.86	6.85

Step 1: Use the temperature value previously recorded to find the **DO Saturation Table Value**

Temperature = 21.8°C

DO Saturation Table Value for 21.8 °C = 8.74 mg/L

Continued on Next Page

Determining the DO Calibration Required Value (Continued)

Step 2: Get the local uncorrected barometric pressure (BP) value in mm Hg.
See "Correcting Local Barometric Pressure" for details.

Example: 30.36 inches x 25.4 = 771.1 mm Hg

Step 3: Calculate the Correction Factor (CF) for the Table DO Value.
This adjusts the table DO value to the local barometric pressure.

The correction factor is determined using the following calculation:

Uncorrected BP mm / 760mm = CF

For example, 771.1 mmHg/ 760 mmHg = 1.0146

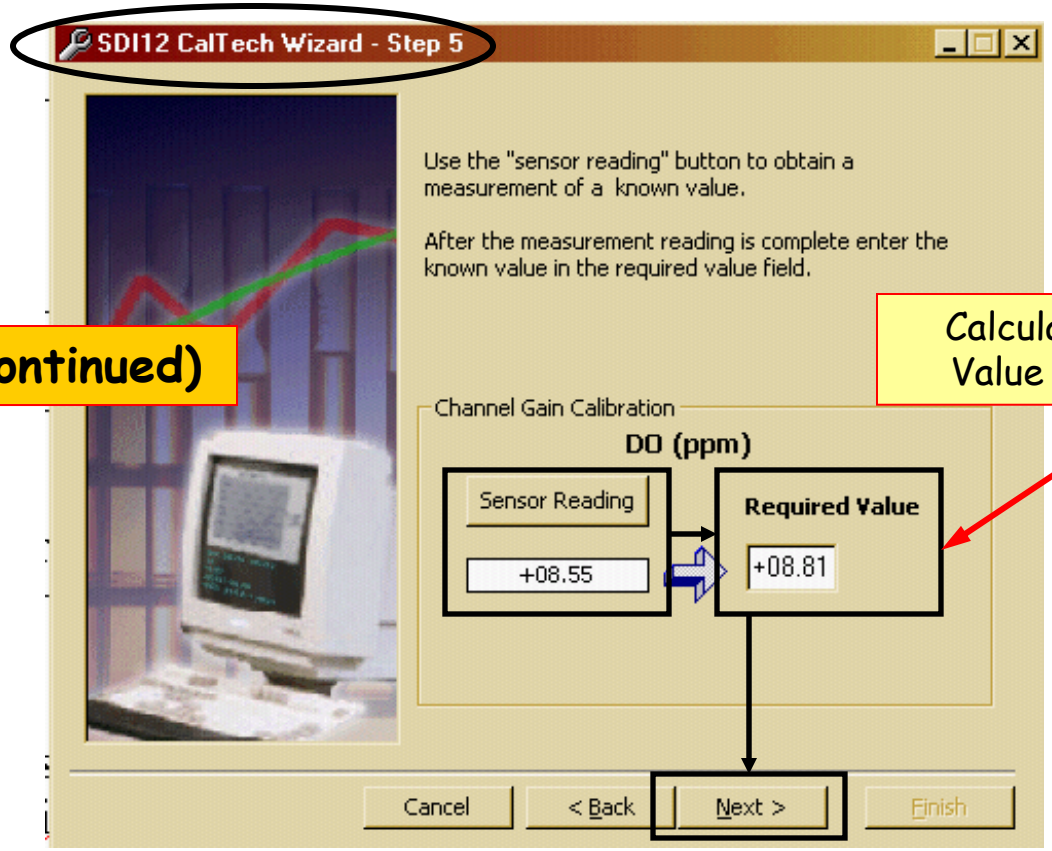
Step 4: Calculate the Required Value.

The **Required Value** is determined using the following calculation:

Table Saturation Value x CF = Required Value

For example, 8.74 mg/L x 1.0146 = 8.87 mg/L

Step 5: One Point Calibration
(Step 4 is skipped)

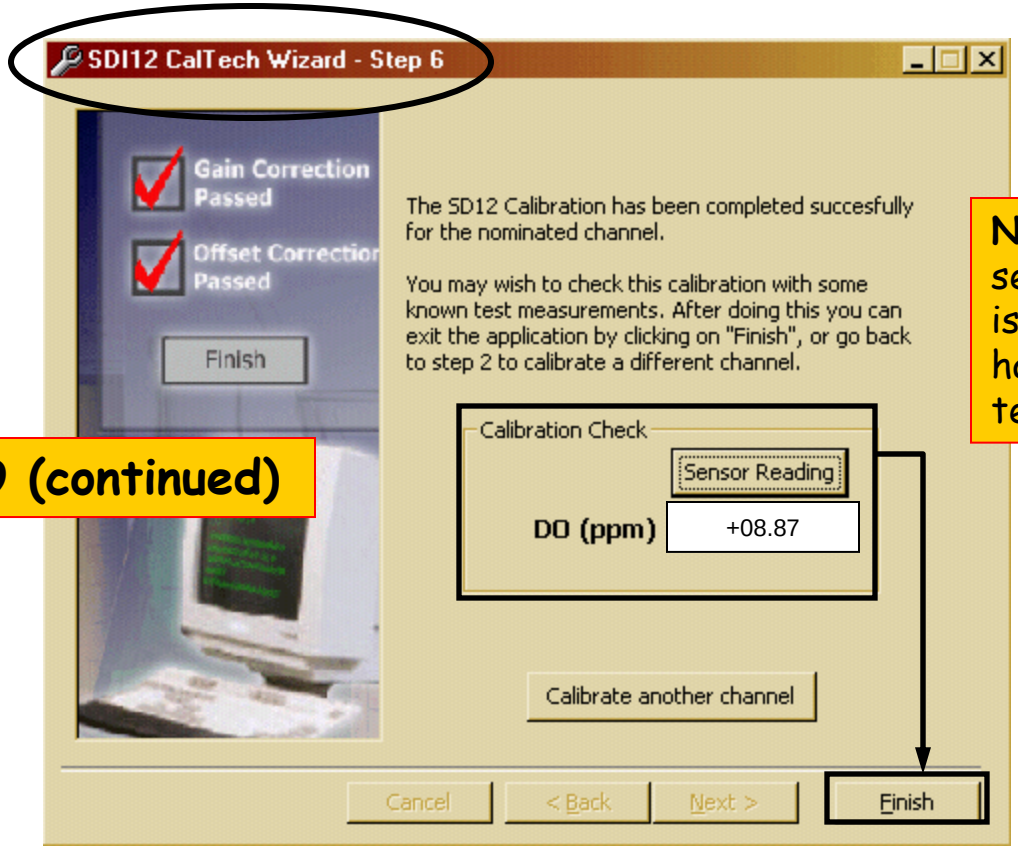


DO (continued)

Calculated Required Value = 8.87 mg/L

Press "**Sensor Reading**". Record this value on the calibration log sheet as "**Sensor Reading**". Enter the calibration standard in "**Required Value**". Press "**Next>**".

Step 6: Calibration Check



DO (continued)

Note: To check for drift take several sensor readings. If there is drift the instrument may not have not have acclimated to room temperature.

Press "**Sensor Reading**" to check the calibration; Record this value on the calibration log sheet as "**Calibrated To**" value. Press "**Finish**". This will exit the SDI12 CalTech software.

Ready to Install

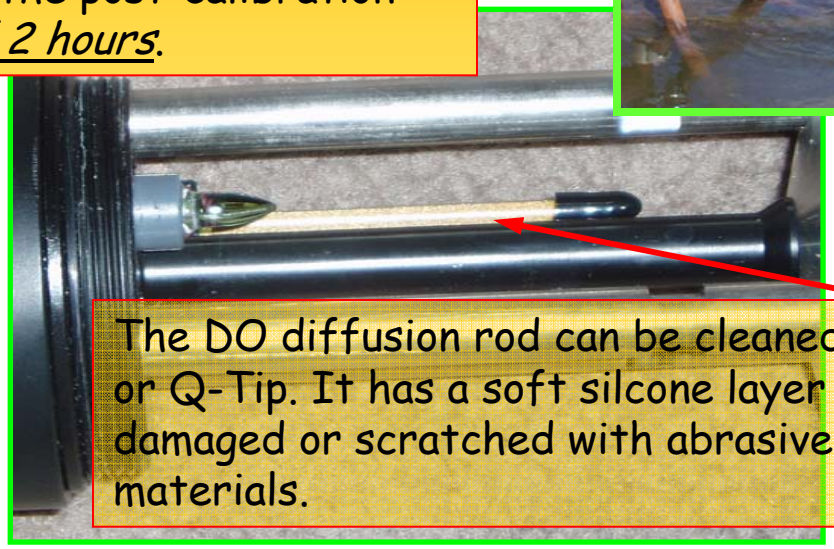
Note: *The instrument needs to be fully submersed in the water to correctly acclimate to the water temperature.*

Note: *The response time is approximately 2 hours when first installed.*

Removing an Instrument from the Site

After removing the instrument from a site, a minimum amount of cleaning can be done to keep mud or other debris from drying on the instrument before getting back to the lab.

Allow the instrument to acclimate to room temperature before the post-calibration check. *A minimum of 2 hours*.



The DO diffusion rod can be cleaned with a soft cloth or Q-Tip. It has a soft silcone layer that can get damaged or scratched with abrasive cleaning materials.

Greenspan Technical Support

Jason Harrington
512-267-4740 (office)
512-217-5591 (cell)
jharrington@goyen.com

Stevens Water Monitoring Systems
Lloyd Traum
1-800-452-5272 x 565
ltraum@stevenswater.com

Determining the DO Calibration Required Value

Using the temperature recorded at start of calibration, go to the DO saturation table to **obtain the "DO Saturation Value**". The temperature in this example is 22.2°C. The DO saturation value for this temperature is 8.68 mg/L.

Get the local barometric pressure (BP) value. Local weather stations correct BP values to sea level. The barometric pressure used to calibrate multiprobe instruments must be consistent with the altitude where the instrument is being calibrated. This is not a problem for those monitoring along the Texas coast which is at or near sea level.

For example, the BP is 30.36 inches Hg in Austin from the NOAA Water Web page. First, the BP must be converted to millimeters (mm) of mercury (Hg). Multiply BP in inches by 25.4; For example, 30.36 x 25.4 = 771.1 mm of Hg.

To **uncorrect the barometric pressure** (also see "Correcting Local Barometric Pressure") for this example,

771.1 mm Hg - 2.5 (altitude/100)
771.1 mm Hg - 2.5 (570/100)
771.1 mm Hg - 14.3 = 756.8 uncorrected barometric pressure

Next, **calculate the correction factor** for the table DO value. This adjusts the table DO value to the local barometric pressure. The correction factor is determined using the following calculation:

Uncorrected barometric pressure mm / 760mm = Correction Factor (CF);
For example, 756.8 mm / 760mm = 0.996

After determining the correction factor, **calculate the required value** for calibrating DO:

Table Saturation Value x CF = Required Value;
for example, 8.68 x 0.996 = 8.82 mg/L or the required DO calibration value

Correcting Local Barometric Pressure

To uncorrect the barometric pressure that was set to sea level:

Barometric Pressure (BP) = Corrected Barometric Pressure (CBP) -2.5 (A/100)

Where: BP = estimated absolute barometric pressure

CBP = local barometric pressure corrected to sea level (from weather bureau other source; convert reading supplied in inches to mm; inches x 25.4 = mm

2.5 = a constant, atmospheric pressure decreases 2.5 mm Hg for each increase in altitude of 30.5 meters (100 feet)

A = local altitude in feet above mean sea level

Example: A barometric pressure reading of 29.50 inches Hg , corrected to sea level, and an altitude of 650 feet above sea level is uncorrected by:

29.5 inches x 25.4 = 749 mm Hg
BP = 749 mm - 2.5 (650/100)
BP = 749 mm - 16.3
BP = 732.8 mm Hg

The above equation should be posted in the laboratory or site where the instruments are routinely calibrated. Once an initial calculation is made, the back half of the equation, 2.5 (A/100), will then be constant and can be subtracted from the corrected barometric pressure.

DO Saturation Values
Oxygen Content of Air-Saturated Freshwater at 760 mm Hg

Temp°C	Oxygen Solubility at 760 mmHg									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	14.17	14.13	14.09	14.06	14.02	13.98	13.94	13.90	13.87	13.83
2	13.79	13.75	13.72	13.68	13.65	13.61	13.57	13.54	13.50	13.47
3	13.43	13.40	13.36	13.33	13.29	13.26	13.22	13.19	13.15	13.12
4	13.08	13.05	13.01	12.98	12.94	12.91	12.88	12.84	12.81	12.77
5	12.74	12.71	12.68	12.64	12.61	12.58	12.55	12.52	12.48	12.45
6	12.42	12.39	12.36	12.33	12.30	12.27	12.23	12.20	12.17	12.14
7	12.11	12.08	12.05	12.02	11.99	11.96	11.93	11.90	11.87	11.84
8	11.81	11.78	11.75	11.73	11.70	11.67	11.64	11.61	11.59	11.56
9	11.53	11.50	11.48	11.45	11.42	11.40	11.37	11.34	11.31	11.29
10	11.26	11.23	11.21	11.18	11.15	11.13	11.10	11.07	11.04	11.02
11	10.99	10.97	10.94	10.92	10.89	10.87	10.84	10.82	10.79	10.77
12	10.74	10.72	10.69	10.67	10.64	10.62	10.60	10.57	10.55	10.52
13	10.50	10.48	10.45	10.43	10.41	10.39	10.36	10.34	10.32	10.29
14	10.27	10.25	10.23	10.20	10.18	10.16	10.14	10.12	10.09	10.07
15	10.05	10.03	10.01	9.98	9.96	9.94	9.92	9.90	9.87	9.85
16	9.83	9.81	9.79	9.77	9.75	9.73	9.71	9.69	9.67	9.65
17	9.63	9.61	9.59	9.57	9.55	9.53	9.51	9.49	9.47	9.45
18	9.43	9.41	9.39	9.37	9.35	9.34	9.32	9.30	9.28	9.26
19	9.24	9.22	9.20	9.19	9.17	9.15	9.13	9.11	9.10	9.08
20	9.06	9.04	9.02	9.01	8.99	8.97	8.95	8.93	8.92	8.90
21	8.88	8.86	8.85	8.83	8.81	8.80	8.78	8.76	8.74	8.73
22	8.71	8.69	8.68	8.66	8.65	8.63	8.61	8.60	8.58	8.57
23	8.55	8.53	8.52	8.50	8.49	8.47	8.45	8.44	8.42	8.41
24	8.39	8.38	8.36	8.35	8.33	8.32	8.30	8.29	8.27	8.26
25	8.24	8.23	8.21	8.20	8.18	8.17	8.15	8.14	8.12	8.11
26	8.09	8.08	8.06	8.05	8.03	8.02	8.01	7.99	7.98	7.96
27	7.95	7.94	7.92	7.91	7.89	7.88	7.87	7.85	7.84	7.82
28	7.81	7.80	7.78	7.77	7.76	7.75	7.73	7.72	7.71	7.69
29	7.68	7.67	7.65	7.64	7.63	7.62	7.60	7.59	7.58	7.56
30	7.55	7.54	7.52	7.51	7.50	7.49	7.47	7.46	7.45	7.43
31	7.42	7.41	7.40	7.38	7.37	7.36	7.35	7.34	7.32	7.31
32	7.30	7.29	7.28	7.26	7.25	7.24	7.23	7.22	7.20	7.19
33	7.18	7.17	7.16	7.15	7.14	7.13	7.11	7.10	7.09	7.08
34	7.07	7.06	7.05	7.03	7.02	7.01	7.00	6.99	6.97	6.96
35	6.95	6.94	6.93	6.92	6.91	6.90	6.88	6.87	6.86	6.85

Greenspan Calibration Log

Serial #_____ Location Description:

Date Calibrated:_____Time:_____Initials:_____

Deployment Period: Date Deployed_____; Date Retrieved from Site_____

Function	**Required Value**	**Sensor Reading**	**Calibrate To**	**Comments**
EC Raw µS	0.000			
Slope*				
pH	7.00			
Slope	10.00			
Temperature				
D.O. (Gain)				

* The EC calibration standard is printed on the calibration loop. That value is entered as the required value.

Barometric Pressure (BP): _____inches X 25.4 = _____mm / 760mm =_____Correction Factor (CF)
Table Saturation Value_____ X CF_____ =_____ Required Value

Date Post Calibrated: Time: Initials:

Function	**Required Value**	**Sensor Reading**	**Comments**
EC Raw	0.000		
Slope*			
pH	7.00		
Slope	10.00		
Temperature			
D.O. (Gain)			

BP: _____inches X 25.4 = _____mm / 760mm =_____Correction Factor (CF)
Table Saturation Value_____ X CF_____ =_____ Required Value