H20®

Water Quality Multiprobe

Operating Manual

November 1993

HYDROLAB CORPORATION

P.O. Box 50116•Austin, TX 78763

800-949-3766 or **512-255-8841**

HL#003062, REVISION A

H20® Multiprobe Operating Manual
ADDENDUM
December 1994

(upgrades H20 Multiprobe Operating Manual to Revision A)

THIS ADDENDUM UPDATES THE H20 MULTIPROBE SOFTWARE TO V2.10

1. SOM

The opening header has been modified to indicate the new software revision and copyright notice:

Hydrolab H20 V2.10
(C)opyright 1994 Hydrolab Corporation
No Label

Time Temp pH Cond Salin DOsat DOmg/L Redox Depth Trb-r Batt

The Standard Operating Mode (SOM) has been modified to include the DO mg/L parameter. The DO ppm heading in previous releases has been changed to DO mg/L to indicate the currently accepted units for dissolved oxygen concentration.

In order to fit the DO mg/L parameter on an 80 column line, the special add-on characters for each parameter have been compressed to one character. For example, if conductivity was not calibrated and not temperature compensated, "*" would appear after the conductivity reading. When conductivity is calibrated, the "*" would then be replaced by "@". If conductivity is then compensated for temperature effects, the "@" would be replaced by a blank.

The compression is only in effect if all parameters are enabled. If one or more parameters are disabled, then two positions will be used for the add-on characters as in previous software releases.

2. Parameter Changes

A. Salinity

Salinity is now computed using the Practical Salinity Scale 1978 as outlined in Standard Methods. Using this scale, a KCL solution of 32.4356 g/kg at 15°C would have a salinity of 35. The scale is intended for salinities ranging from 2 to 42, although the H20 will compute salinity readings ranging from 0 to about 72.

B. Conductivity

The salt water temperature compensation function for conductivity has been removed. The fresh water temperature compensation function is used regardless of the setting in the fresh/salt conductivity variable. The fresh/salt variable must still correspond to the type of cell block that is installed.

C. DO mg/L

The measurement range of the DO mg/L parameter has been expanded to independently range from 0 to 20 mg/L. The H20 Multiprobe indicates a parameter over-range condition based on the maximum attainable value for that parameter. Previous H20 Multiprobe releases would over-range the DO mg/L parameter when the DO %sat parameter reached 200. However, a DO %sat reading of 200 does not always correspond to a DO mg/L reading of 20 due to temperature effects.

3. Parameter Calibration Changes

Input for calibration standards has been limited to a maximum of six characters, except for the Label which is limited to a maximum of 12 characters. The wording of the Calibration Help Menu has been slightly changed for consistency. The "(I)nterval" entry has also been added to the Calibration Help Menu.

A. Resistivity

A resistivity calibration error has been corrected. If the conductivity units were set to microsiemens/cm, the software would try to divide the resistivity standard by 1000 resulting in a "NC" even though the calibration standard was valid.

B. pH Zero

A pH calibration error has been corrected. If the pH zero point was calibrated using a standard other than 7.00, the H20 would still force the reading to 7.00 regardless of the standard value that was typed in. The H20 will accepts pH zero standards from 6.80 to 7.1999 and now sets the reading accordingly.

C. DO

Calibration acceptability for DO mg/L and DO %sat has been improved for high altitude applications.

4. Miscellaneous Menu Changes

A. Parameters

The % entry has been added to the Parameter Menu to allow the DO %sat parameter to be enabled or disabled.

B. Oxygen Variables

The %/O menu has been removed from the Oxygen Variables Menu since both DO parameters are now available.

C. Variables Report

The %/O status has been eliminated from the oxygen variables section of the Variables Report. The prompt "Press a key to continue..." has been added to the end of the report.

5. H20 SDI-12 Interface Update

Please see "Addendum, Rev A" located in Appendix 5 at the back of this manual for changes to the SDI-12 Interface for compatibility with H20 Multiprobe Software Versions 2.10 and higher.

Appendix 5: "Using the H20 SDI-12 Interface"
ADDENDUM
December 1994

(upgrades Appendix 5 to Revision A)

THIS ADDENDUM UPDATES THE SDI-12 OPERATION FOR COMPATIBILITY WITH H20 MULTIPROBE SOFTWARE VERSIONS 2.10 OR HIGHER

Hydrolab H20 Multiprobes with software versions 2.10 or higher utilize a new data format which affects the operation of the SDI-12 Interface. Specifically, the H20 now includes the DO mg/L parameter following the DO %sat parameter. In addition, the turbidity parameter now follows the depth parameter:

Time Temp pH Cond Salin DOsat DOmg/L Redox Depth Trb-r Batt

The SDI-12 Interface to the H20 makes the parameters available on the SDI-12 data channels in the same order as they appear in the multiprobe SOM. The SDI-12 data channels correspond to the water quality parameters for the H20 software releases as follows:

Rec 1.34 1.60

SDI Channel	V1.00 -V 1.99	V2.00 - V2.09	V2.10+
0	Temp	Temp	Temp
1	pH	pH	pH
2	Cond	Cond	Cond
3	Salin	Salin	Salin
4	DO %sat	**DO***	DO %sat
5	DO mg/L	**Turb**	DO mg/L
6	Redox	Redox	Redox
7	Depth	Depth	Depth
8	Batt	Batt	**Turb**

** This parameter can be either DO %sat or DO mg/L based on the current H20 variable settings.*

Turbidity will appear on SDI channel 5 or 8 depending on the H20 software version. If the H20 software version is 2.10 or higher, turbidity replaces the battery parameter on channel 8.

The SDI-12 Interface is now compatible with SDI-12 Release 1.1. The H20 SDI Interface can be tested for compliance with the SDI-12 Specification using the SDI-12 Verifier V1.62 available from NR Systems, Inc.

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Foreword

The **Hydrolab H20® Multiprobe** is an on-line transmitter of in-situ temperature, pH, dissolved oxygen (both mg/l and percent saturation) conductivity (milliSiemens/cm, microSiemens/cm, or resistivity, K ohms-cm) and salinity (parts per thousand or total dissolved solids, mg/l), depth (either level or total depth), turbidity (NTUs) and redox readings (mV) in lakes, rivers, streams, process pipes, bays, estuaries, tanks, aquaria, sewers, or other large or small water bodies. Highly portable and fieldworthy, it can be used for profiling, sampling, or long- or short-term monitoring.

The multiprobe can be connected to any RS-232 receiving device, such as a personal computer, since its output is "printer ready"; the data is sent in engineering units and printed in orderly rows with descriptive headers. An optional internal SDI-12 interface also allows the H20 to be used with certain data loggers (such as the Basic Data Recorder) and data collection platforms.

A user-selectable interval determines how often the readings are automatically printed. Calibration is accomplished simply by immersing the sensors in standard solutions, waiting for stable readings, and briefly interrupting the data printout to set the new calibration points.

Either the **Hydrolab Surveyor® 3 Display Logger** or **Scout 2 Display Unit** may serve as a watertight display for the H20 Multiprobe. Contact Hydrolab Sales for more information on the Surveyor 3 or Scout 2.

Contents

PART THREE: MAINTENANCE & CALIBRATION....25

PART FOUR: DEPLOYMENT 45

PART FIVE: TECHNICAL NOTES 51

PART FIVE (continued)

PART SIX: TROUBLESHOOTING 59

PART SEVEN: LOGGING 65

APPENDICES

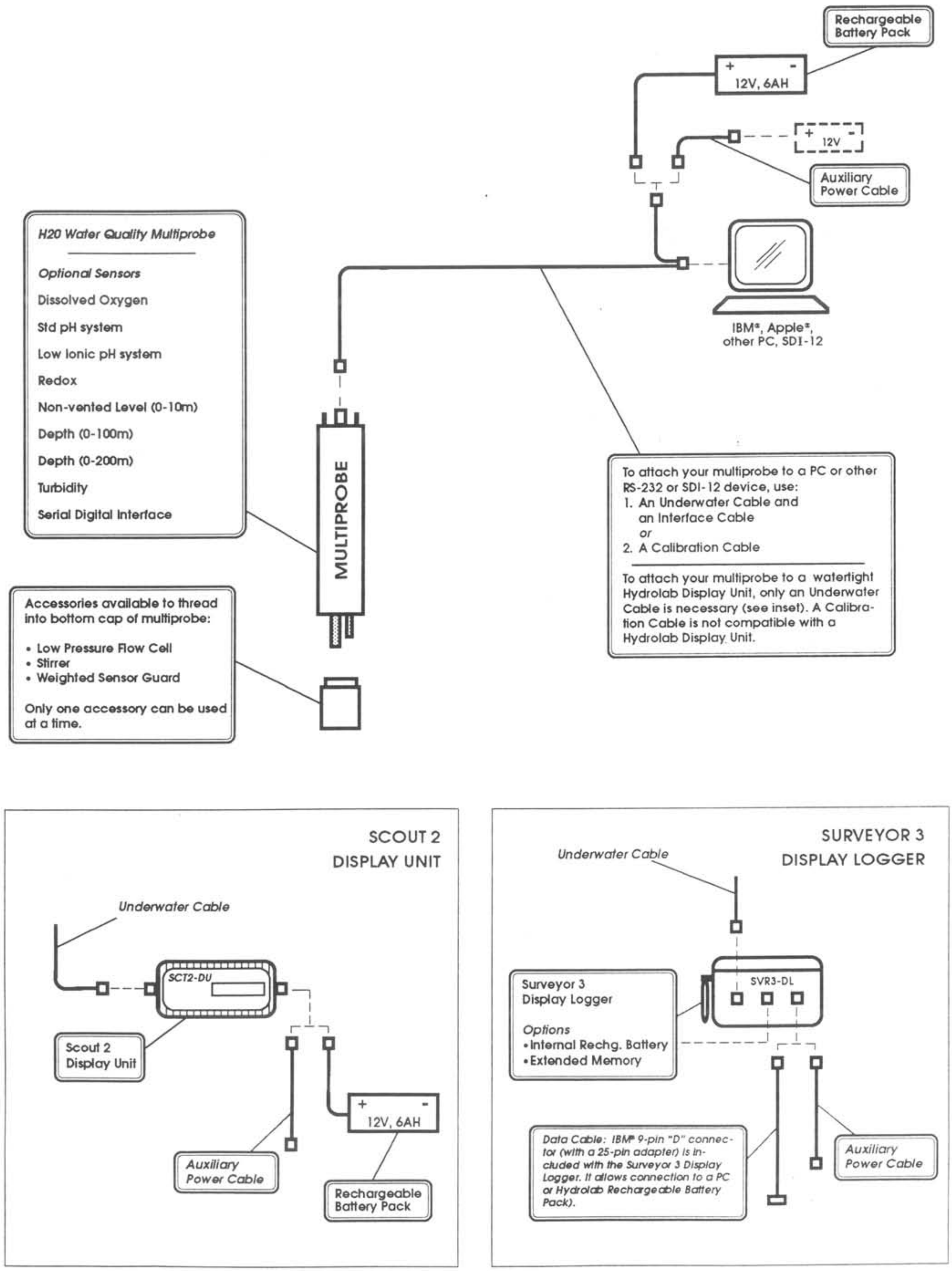


Figure 1.1 H20 System Components

PART ONE
INTRODUCTION

1.1 Components and Assembly

Use FIGURE 1.1 to identify the Terminal, Multiprobe, Battery, Underwater Cable, Interface Cable, and other parts of the H20 multiprobe system.

Now turn on your Terminal and, if your Terminal is a computer, boot a communications program (such as ProComm® Plus for the IBM® PC compatibles, or MacTerminal® for the Apple® Macintosh®). Set the Terminal to 1200 baud, eight bit, no parity.

Attach the rubber connector on the Underwater Cable to the multiprobe. Note the keying of the connectors; don't force the multiprobe's pins into the wrong part of the Underwater Cable's connector.

Next, connect the metal connector on the Underwater Cable to the Interface Cable and connect the Interface Cable to the Battery. Attach the remaining end of the Interface Cable to the RS-232 connector on your Terminal. Use the supplied 9- to 25-pin adapter, if your Terminal requires a 25-pin connector. Or, simply use a single Calibration Cable instead of the dual Underwater Cable and Interface Cable. An external power source is required. You can use Hydrolab's rechargeable 12-volt gel cell Battery, or any other 12-volt battery. The latter will require an Auxiliary Battery Cable; be sure to observe the polarity markings (red is positive, black is negative).

WARNING: CONNECTION OF HYDROLAB INSTRUMENTATION TO ANY POWER SOURCE THAT IS IN ANY WAY CONNECTED TO A VOLTAGE SOURCE RATED OVER 18 VOLTS CAN RESULT IN ELECTROCUTION THAT CAN KILL YOU. DO NOT USE A TRANSFORMER THAT PLUGS INTO THE WALL TO PRODUCE A LOW-VOLTAGE SUPPLY. USE ONLY BATTERIES WHOSE TOTAL VOLTAGE IS UNDER 18 VOLTS DC.

At this point, if the connections are correct, the multiprobe will begin sending data to the Terminal. If not, check your battery's voltage (it must be between about 9 and 18 volts), or refer to PART 6.

The first information you see printed is the multiprobe's software version, the software copyright notice, and the multiprobe's identification label:

Hydrolab H20 VX.YZ
(C)opyright 1990 Hydrolab Corporation
SN00000

Hydrolab stores the multiprobe serial number in the identification label.

On the next row are printed the parameter abbreviations that identify the data columns to follow:

Time	**Elapsed time starting from 00:00:00**
Temp	**Temperature (degrees centigrade or Fahrenheit)**
pH	**pH (units)**
Cond	**Conductivity (millimhos/cm = milliSiemens/cm)**
Salin	**Salinity (parts per thousand)**
DOsat	**Dissolved oxygen (% saturation)**
Trb-r	**Turbidity (ratiometric)**
Redox	**Redox (millivolts)**
Depth	**Depth (meters or feet)**
Batt	**Battery voltage**

After the header is printed, data from the multiprobe is automatically printed, 5 seconds later, row after row, until the operator causes printing to cease. The automatic sending of rows of data is called the Standard Operating Mode (SOM) for the H20 multiprobe. If, after turning the multiprobe on, you get only one line of data, please refer to section 2.5.11.

It is possible that after turning the Terminal on, you will get, after a 5-second pause, lines of data without any header information. This is the result of a previous operator disabling the header function so that only uninterrupted data is sent to the Terminal. See section 2.6.9 for more information.

Notice that the time reading (left-most column) starts at zero each time you turn the multiprobe on (because the multiprobe does not have a power supply of its own to run a real-time clock).

The column headings that you see may be different from those described above since the H20 has numerous setup options that will effect the water quality data. For example, you may see an Res for Resistivity (instead of Cond for specific conductance), a TDS (instead of salinity), and/or an L for Level (instead of depth). These can be changed at any time using keyboard commands.

1.2 Introductory Exercise

Suppose that you were using a computer as your Terminal and you wish to store the readings on disk. But, to preserve memory space, you wished only to store temperature, conductivity, and time data. Press the space bar to go from the SOM to the Basic Menu:

PCVHMBI:

This means Parameters, Calibrate, Variables, Header, Measure, Battery, and Identify. When you are asked to respond to a menu and you don't remember what the letters mean, then type a ? (question mark) to get a description of the options. Typing a ? in response to the menu above will produce:

(P)arameters
(C)alibrate
(V)ariables
(H)eader
(M)easure
Warmup (B)attery Measure
(I)dentify
Please enter your choice:

Type a P to get:

PCSOYRDBA:

By the way, you do not have to press the return key if you type in a one-key response to any of the multiprobe's questions. However, you must press the return key after answering questions with more than one keystroke (for instance, calibration numbers). Also, you can edit responses on most terminals with a backspace or Control H. Any time an invalid character is typed (such as a number when a letter is expected), a bell will sound. A Control X or Escape will exit the menu and return you to the SOM without having implemented anything you typed since you last left the SOM.

PCSOYRDBA stands for **p**H, specific **C**onductance, **S**alinity, dissolved **O**xygen, turbidit**Y**, **R**edox, **D**epth, **B**attery voltage, and **A**ll parameters. Typing a P will, for instance, access the pH parameter, for which you will then be asked:

DE?

Type a D (for Disable), since we wish to remove parameters (typing an E, for Enable, would allow you to add parameters that have been disabled).

You will be returned automatically to the SOM; access "Parameters" again from the Basic Menu to remove more parameters until only temperature, specific conductance, and time remain. Notice that temperature and time cannot be disabled.

Suppose that you now wish to calibrate specific conductance. Fill the Calibration Cup with a prepared standard for which the specific conductance is known, for example, to be 1.413 millimhos/cm. (See PART 3 for more details on calibration.) When the specific conductance readings have stabilized for this new solution (this might require one or two minutes), press the Terminal's space bar to get from the SOM to the Basic Menu:

PCVHMBI:

This time, type in a C to get to the Calibrate menu:

PCS%OYRDLTIM:

This stands for **p**H, specific **C**onductance, **S**alinity, dissolved oxygen (**%** saturation), dissolved **O**xygen (mg/l), turbidit**Y**, **R**edox, **D**epth, **L**abel, **T**ime, **I**nterval, and **M**essage. Type in a C to access Specific Conductance's calibration routine:

Std:

If you are sure that the specific conductance reading had stabilized before you started this calibration routine, type in 1.413 (the Standard's value in millimhos/cm; remember that a control-H or backspace can be used for editing typing mistakes) and press the Terminal's return key. The calibration is automatically set, and the multiprobe will revert to the SOM. Notice that the specific conductance reading is now 1.413: the calibration point. (If you should get a bell and the message "NC", please see PART 6.

Suppose that we wish to set the time reading. If you press the Terminal keyboard's space bar during the SOM, you will get the Basic Menu:

PCVHMBI:

Type a C to get to the Calibrate menu:

PCS%OYRDLTIM:

Type a T to access Time:

HHMMSS:

If the current time is 59 seconds past 2:38 PM, you would now type in 143859. If the time is exactly 9:18 AM, you would type in 091800. After you have typed in the sixth digit, hit the return key and to set the time. The regular listing of parameter data (SOM) will resume.

1.3 Important Note

Although you have now performed most of the basic operations available on the H20 multiprobe, please read PART 2 to discover the multiprobe's other features. Also, be sure to read PART 3, since only a well-maintained and carefully-calibrated instrument will provide quality data. The remainder of this manual, although primarily reference material, should be read, too.

1.4 The Performance Manual

At the end of this manual, past the appendices, you will find a copy of Hydrolab's **"Performance Manual for Field Water-Quality Instrumentation"**. This article contains many helpful hints for both qualifying and improving the reliability of your data. You might be surprised to find out what your Hydrolab H20 Water Quality Multiprobe can really do.

PART TWO
DATA DISPLAYS & MENUS

2.1 Data Display

Once you have established communication between the multiprobe and your Terminal (in other words, if the multiprobe is powered and its RS-232 Transmit line is taken "active"), the system will automatically print the introductory heading:

Hydrolab H20 VX.YZ
(C)opyright 1990 Hydrolab Corporation
SN00000
Time Temp pH Cond Salin DOsat Turb-r Redox Depth Batt

The first line tells you your multiprobe's software version (as in version 2.00, for instance); the second line is the multiprobe's software copyright notice; the third line is the multiprobe's alpha-numeric name (usually the multiprobe's serial number). The fourth line identifies the columns for the parameter readings: Time, Temperature (C or F), pH, Specific Conductance (millimhos/cm = milliSiemens/cm, or micromhos/cm), Salinity (parts per thousand), Dissolved Oxygen (% saturation), Turbidity, Redox (oxidation-reduction potential = Redox = Eh, in millivolts), Depth (meters or feet), and Battery voltage.

It is also possible that your multiprobe's specific conductance column has been changed to Resistivity (k ohm-cm), and/or the salinity column has been changed to Total Dissolved Solids (k mg/l), and/or the Depth column has been changed to Level (meters or feet), and/or the dissolved oxygen column has been changed to DO ppm (mg/L concentration).

Immediately following the printing of the header, the multiprobe will adopt its standard operating mode (SOM): printing row after row of parameter readings. The fourth line of the introductory header will be reprinted periodically (once every 24 lines) so that you can identify the columns after the initial header has scrolled off the computer's screen. This also guarantees that any data printed on standard-sized paper will have parameter identification on each page.

If no header information is printed (and you want to see the header information), you can re-enable the header function. See section 2.6.9.

If any of the parameter values in the printout are accompanied by an asterisk (*), that parameter value is based on a default calibration setting. This means that the particular sensor must be recalibrated. Note that some calibrations affect more than one parameter. For instance, loss of specific conductance calibration information will cause an asterisk annotation on the specific conductance, salinity, dissolved oxygen (ppm, but not % saturation), and depth readings. This is because specific conductance data is used to calculate or correct the latter three parameters.

2.2 The Menu Hierarchy

FIGURE 2.1 shows the menu structure for the H20 Multiprobe. Remember that pressing the space bar while the multiprobe is in the SOM will produce the Basic Menu:

PCVHMBI:

2.3 The Basic Menu

The multiprobe will stay in the SOM until you unplug it from the power supply or the Terminal, or by accessing the Basic Menu. The latter is accomplished by pressing the Terminal's space bar; data printing will stop and the following message, the Basic Menu, will appear:

PCVHMBI:

This stands for Parameters, Calibrate, Variables, Header, Measure, Battery, and Identify; select whichever you wish by typing in a P, C, V, H, M, B, or I. When you are asked to respond to a menu and you don't remember what the letters mean, then type a "?" (question mark) to get a description of the options. Typing a "?" in response to the Basic Menu will produce:

(P)arameters
(C)alibrate
(V)ariables
(H)eader
(M)easure
Warmup (B)attery Measure
(I)dentify
Please enter your choice:

This on-line help feature can be invoked at any menu by typing a "?" except where you are required to enter calibration standards. If you change your mind about accessing the Basic Menu, just press ESCAPE or Control X and you will be returned to the SOM.

Depth to level Control I

Figure 2.1 H20 Menu Tree

Version 2.0
12/93

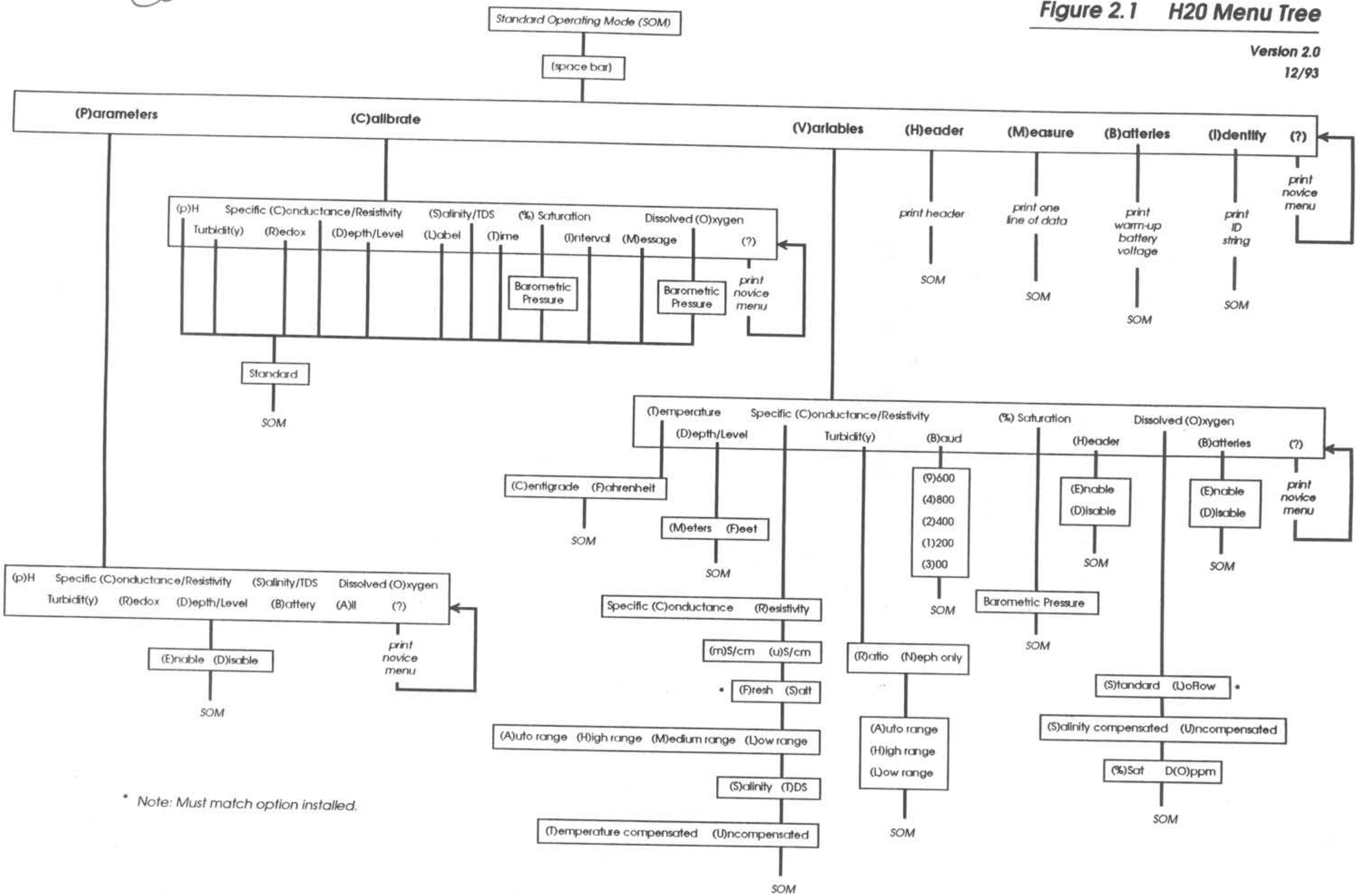


Figure 2.1 H20 Menu Tree

2.4 Parameters

Typing a P from the Basic Menu will give you the message:

PCSOYRDBA:

This allows you to remove (or add) pH, specific Conductance/resistivity, Salinity/TDS, dissolved Oxygen (% saturation/mg/L), turbiditY, Redox, Depth/level, and/or Battery voltage, and/or All parameters simply by typing their respective letters, to get:

DE:

E means Enable, D means Disable. If you wish to remove one or more parameters from the data rows, you would type a D. You will then be returned to the SOM.

You can add or remove parameters only one at a time (unless you use All); you must re-access Enable or Disable of the parameter menu to add or remove others. Time and temperature cannot be removed.

2.5 Calibrate

If you type a C while in the Basic Menu, you will access the Calibrate menus:

PCS%OYRDLTIM:

This stands for pH, specific Conductance/resistivity, Salinity/TDS, dissolved oxygen (% saturation), dissolved Oxygen (mg/l), turbiditY, Redox, Depth/level, Label, Time, Interval, and Message. Notice that temperature and battery voltage are not calibratable, since they are permanently set at the factory. Also, salinity is calibrated automatically when specific conductance is calibrated (directly), or specific conductance is calibrated automatically when salinity is directly calibrated. You can only directly calibrate one of those two parameters; pick the one you are most interested in. The same applies for DO % saturation and DO mg/l.

You might notice that the H20 Multiprobe has built-in checks for calibration acceptability. If the calibration value you enter is too far out of bounds, the message "NC" (for "No Calibration") will appear and your

Terminal's bell will ring once. You will be returned to the SOM. You should verify your calibration standard value and/or check the condition of the sensor to determine why the calibration was not acceptable. See PART 3 for more help.

2.5.1 pH

Typing P will result in:

Std:

This is a prompt for you to enter the value of a calibration standard. Always calibrate with 7-buffer (the pH system's zero) before calibrating with a second buffer (the pH system's slope). If your readings for 7-buffer had stabilized (you would monitor this while in the SOM), you would now type in the value of your buffer (the multiprobe will accept any pH value between 6.8 and 7.2 for the zero setting) to automatically calibrate the pH system zero. At this point, you would be returned to the SOM so that you could begin monitoring pH readings for the second, slope-setting buffer. Once these readings had stabilized, you would again access the Basic Menu, then the Calibrate menu, then the pH menu to get:

Std:

So type in the value of your slope buffer (such as 9.18 or 4.02 pH units) and hit the return key. (Your slope buffer value cannot fall between 6.8 and 7.2.) The slope will be set and you will be returned to the SOM.

2.5.2 Specific Conductance

If you wish to calibrate specific conductance, you would monitor the specific conductance readings in the SOM until they had stabilized for whatever specific conductance standard solution you have immersed the sensor in. Typing C (for specific Conductance) from the Calibrate menu will result in this message:

Std:

This stands for Standard; type in the specific conductance calibration Standard's value in milliSiemens/cm (same as millimhos/cm). For instance, one millimolar KCl (value of 147 micromhos/cm) would be typed in as 0.147. Hit the return key to set the calibration and return to the SOM. Salinity will be calibrated automatically according to the conversion formula detailed in section 5.4.2.

Remember that you might not be calibrating specific conductance; you may have opted to calibrate resistivity (in k ohm-cm), salinity (in ppt), or TDS (in k mg/l); see section 2.5.3. You might also have chosen to read (and so also to calibrate) specific conductance in microSiemens/cm (same as micromhos/cm). See section 2.6.3.

2.5.3 Salinity

If you wished to calibrate Salinity instead of specific conductance, you would type an S from the Calibrate menu to get:

Std:

Now type in the value of your salinity standard, in parts per thousand at 25 C, and hit the return key. (Type in the standard as k mg/l if you are reading (and so calibrating) in TDS; see section 2.6.3.) You will be returned to the SOM after the new calibration is set. Specific conductance will be calibrated automatically according to the conversion formula detailed in section 5.4.2.

2.5.4 Dissolved Oxygen (% Saturation)

After setting up the dissolved oxygen (DO) probe as required for calibration (see PART 3) and waiting for a stable reading, type % from the calibrate menu to get:

Bar Press:

This is a prompt for you to enter the ambient barometric pressure. For dissolved oxygen, you would type in the local barometric pressure in millimeters of mercury (for instance, 760 at sea level). Check your barometer or weather bureau for this information (and see APPENDIX 1). The calibration for both DO mg/l and DO % saturation will be set once you press the return key, and you will be returned to the SOM. Check the calibration by looking at the DO % saturation reading; it should be 100.0 (102.5 for the LoFlow Membrane). Please read APPENDIX 1 to see how this number correlates to the DO concentration (i.e., the concentration) reading.

2.5.5 Dissolved Oxygen (mg/l)

After setting up the dissolved oxygen (DO) probe as required for calibration (see PART 3) and waiting for a stable reading, type O (that's the letter O, not zero) from the calibrate menu to get:

Bar Press:

This is a prompt for you to enter the ambient barometric pressure. For dissolved oxygen, you would type in the local barometric pressure in millimeters of mercury (for instance, 760 at sea level). Check your barometer or weather bureau for this information (and APPENDIX 1). Upon hitting the return key, you will see:

Std:

You may now enter a DO reading, such as 7.11 (mg/l), that you have determined from an analysis such as a Winkler titration. Again, the calibration for both DO ppm and DO % saturation will be set once you press the return key, and you will be returned to the SOM.

2.5.6 Turbidity

Typing a Y will produce the message:

Std:

Always calibrate with "turbidity free" water (the zero point) before calibrating with a second standard (the slope). If your readings for the "turbidity free" water had stabilized in the SOM, you would now type in "0" and press the return key to automatically calibrate the turbidity zero point. The multiprobe will only accept zero for the zero point setting. At this point you will be returned to the SOM so that you can begin monitoring turbidity readings for the second slope-setting standard. Once the turbidity readings have stabilized , you can again access the Basic Menu, then the Calibrate menu, then type a Y to get:

Std:

Type the known value of your turbidity slope standard (in NTU units) and press the return key. The slope will be set and you will be returned to the SOM.

2.5.7 Redox

Typing an R will produce the message:

Std:

You must now type in the value of your Redox standard, and press the return key. You will be returned to the SOM. Be sure that the Redox readings have stabilized before conducting the calibration.

Note that you cannot calibrate the slope for Redox. A change of one millivolt at the sensor will always be reported to you as a one millivolt change. What you are setting when you calibrate Redox is the "zero"; making the H20 read, for instance, 154 mV in a solution that you know should read 154 mV.

2.5.8 Depth/Level

Depth (or Level) can be simply zeroed in air, at or near the surface of the water to be sampled. Otherwise, it can be set at some known depth in the water column. Once the multiprobe is a position for which the depth is known, type D from the calibrate menu to get:

Std:

Type in the calibration depth, and hit the return key to return to the SOM. In most cases, you would set Depth in air before immersion at 0 meters/ feet.

2.5.9 Label

Typing L (for Label) will allow you to change the multiprobe's up-to-12-character name (that will be printed beside the multiprobe's software version number in the opening header):

Std:

Type in as many as 12 characters (alpha, numeric, or spaces) to give the multiprobe a name that you can use for identification. You will be returned to the SOM. The label information will be printed each time you request that a header be printed. (See section 2.8)

2.5.10 Time

If you typed a T while in the calibrate menu, you accessed the Time function and got this message:

HHMMSS:

You must now type in a new real-time setting to replace the time currently displayed in the first column of the SOM printout. The time will be reset to 000000 each time the multiprobe is turned on, since it has no real-time clock of its own. Type in the correct time in the HHMMSS (Hour-Hour Minute-Minute Second-Second, or military) format: if it is exactly 5:30 in the morning, you would type 053000. If it is 25 seconds past 10:18 PM, you would type 221825. Once you have typed exactly six digits, press the Terminal's return key and you will be returned to the SOM that now includes the correct time reading. Obviously, numbers greater than 59 cannot be typed into the minutes or seconds positions, and numbers greater than 23 cannot be typed into the hours position (you will hear a bell if you try). 000000 is the designation for midnight.

2.5.11 Interval

If you type an I (for Interval) while in the calibrate menu, you would receive the message:

HHMMSS:

You are now required to specify the interval between sets of readings. If you wished to have a new line of data printed every 10 seconds, you would type 000010; if you wished a new line only every hour and a half, you would type 013000. Hit the return key after having typed exactly six digits and you will be returned to the SOM. The multiprobe remembers this number even after it is unplugged, so that the next time you establish communication between the multiprobe and the Terminal, the data will be printed at the frequency last specified by the operator.

Note that numbers greater than 60 cannot be typed into the number positions for either seconds or minutes (you will hear a bell if you try). For example, if you want to see readings every 90 seconds, you must type in 000130, not 000090. Similarly, a number greater than 23 cannot be entered in the hours position.

The maximum interval time allowable is 24 hours (designated 000000). The minimum interval is one second (000001).

After turning the multiprobe on, you may get the header but only one line of data. This might be caused by a very long interval setting. Hit the space bar (to get into the Basic Menu), type C, and then type I, so that you can enter a shorter interval time, if desired.

2.5.12 Message

If you are having your personal computer save multiprobe data to disk storage, you can annotate data through the Message function. Type an M from the calibrate menu to get:

Msg:

You may now type in a message (followed by a carriage return) to be stored on disk along with your data. For instance, suppose you wanted to remind yourself of the reason for a sudden decrease in pH readings. You would access Message and type something like this:

Msg: Accidently poured HCl into Aquarium #54 at 10:27 AM.

Your data record would now contain that message.

2.6 Variables

The V of the Basic Menu stands for Variables; accessing this menu by typing a V allows you to specify several measurement criteria. These variables will be remembered by the multiprobe even after the multiprobe has been turned off (that is, there is no need to reset the variables each time the multiprobe is turned on). The Variable menu is:

RTC%OYDBHU:

This stands for Report, Temperature, specific Conductance, dissolved oxygen (% saturation), dissolved Oxygen (mg/l), turbiditY, Depth, Batteries, Header and baUd rate, respectively.

2.6.1 Report

Typing an R from the Variable menu will produce a listing of all of the current variable settings that are stored in the multiprobe. For example:

Current Variable Settings
Temperature: Celsius
Conductivity: Cond mS/cm Salt Auto-range Salin Temp-comped
Barometric pressure: 760
Dissolved oxygen: Standard Sal-comped %-sat
Turbidity: Ratio Auto-range
Depth: Meters 100m-max
Warmup batteries: Disabled
Header: Enabled
Baud rate: 1200

To return to the SOM, type any key. Refer to the following sections for information on these variable settings.

2.6.2 Temperature

Typing a T from the Variable menu will produce:

CF:

Type a C if you want the temperature readings to be in degrees Centigrade; type an F if you want them in degrees Fahrenheit. Either way, you will be returned to the SOM.

2.6.3 Specific Conductance

Typing a C from the Variable menu results in:

CR:

Typing a C means your multiprobe will report specific Conductance readings; typing an R means that the readings will be Resistivity. Next you will see:

UM:

Type M if you want your specific conductance readings in milli- Siemens/cm (= millimhos/cm); type a U if you want readings in μSiemens/cm (= micromhos/cm). This will not matter if you are reading resistivity instead of specific conductance. Either way, you will next see:

SF:

Type an F if your multiprobe is equipped with a fresh water specific conductance cell block, or type an S if it has a salt water cell block (see FIGURE 3.1 and section 3.4). You will then be asked:

AHML:

This stands for Auto-range, High range, Medium range, and Low range, and allows you to specify whether the specific conductance readings are auto-ranged (i.e., automatically set for the most measurement resolution), or set to one of the three specific conductance ranges. This feature is designed mainly for data collection platforms: the specific conductance is set to a single range, meaning that the decimal can be eliminated (for maximum data compression). You will then be asked:

ST:

Type S if you want to see Salinity data; type T if you want the Salinity readings to be replaced by Total dissolved solids data. Then you will see:

TU:

Type a U if you want your specific conductance (or resistivity) and salinity (or total dissolved solids) readings to have their temperature compensation removed. This feature is designed mainly for oceanographic work in which conductivity (i.e., non-temperature compensated specific conductance) readings are modified with a user-generated temperature compensation to produce very accurate salinity readings.

You will now be returned to the SOM.

2.6.4 Dissolved Oxygen (% Saturation)

If the barometric pressure changes from whatever it was at calibration, the DO % Saturation readings will be affected (the DO mg/l readings will not be affected). Typing % from the Variable menu will produce:

Bar Press:

Type in the local barometric pressure (in mm Hg) and hit the return key. You will be returned to the SOM, and your dissolved oxygen (% saturation) readings will now be based on the local barometric pressure instead of the barometric pressure at calibration.

2.6.5 Dissolved Oxygen (mg/l)

Typing an O from the Variable menu will get you:

SL:

Type an S if you are using a Standard Membrane, or type an L if you are using a LoFlow Membrane (see APPENDIX 1 for more explanation). Either way, you will next be asked:

SU:

2.6.10 Baud Rate

To change the communications baud rate, access the Variable menu and type a U. The following menu will be printed:

31249:

The available baud rates are represented as 300, 1200, 2400, 4800, and 9600. Once you select a new baud rate, the multiprobe will send a carriage return and a line feed at the old baud rate and then change to the new baud rate. If you did not change baud rates (i.e., you selected the same baud rate that was previously in effect), the multiprobe will automatically return to the SOM.

If you selected a new baud rate, at this point you will need to set the baud rate of your communications program or terminal to match what you selected for the multiprobe. At this point, also be sure that you select a word length of 8 bits, no parity, and one stop bit. These settings will remain the same regardless of the baud rate that you select. Once you have changed the baud rate of your communications program or terminal to the new baud rate, press any key to resume the SOM at the new baud rate.

As usual, typing Escape or Control-X from the baud rate menu will cancel the menu without altering the baud rate. After you have typed a new valid baud rate selection, you must proceed to change the baud rate; you may not cancel the menu after this point.

All multiprobes are configured at the factory for 1200 baud. If you elect to change to a new baud rate, there are some precautions to consider:

Before changing baud rates, be certain that your communications program can be set to the new baud rate and that you know how to accomplish this. If your communication program cannot be set to the newly-specified baud rate, you will be unable to re-gain communication with the multiprobe.

The multiprobe must be set for 1200 baud to operate with the Hydrolab Surveyor 3 Display/Logger, Scout 2 Display, and the SDI-12 communications option. Also keep in mind that many third party data loggers may require a specific baud rate.

Be certain that when you change the baud rate of the multiprobe that you don't forget to change the baud rate of your communications program or device or you will see only random letters and figures where the parameter readings or menus should be.

Baud rate for an RS-232 device indicates the frequency at which the data is transmitted in the cable. If you are using extremely long cable lengths (> 100 meters), you may need to change to a lower baud rate to insure reliable data transmission.

2.7 Identify

If the multiprobe is in the SOM, typing an I will get you a printout of the H20 multiprobe's "identity":

Hydrolab H20 VX.YZ TPCORLYB

This means that the device you are connected to is a Hydrolab model H20, with software version X.YZ. Further, the H20 is equipped with the sensors to make readings for Temperature, pH, specific Conductance, Dissolved oxygen, Redox, Level, Turbidity, and Battery. (Your actual H20 may not have the full complement of sensors.) The L indicating that the Level transducer is installed may be replaced by a 1 (for 100 meter depth) or a 2 (for 200 meter depth). You will be returned automatically to the SOM.

2.8 Header

If the multiprobe is in the SOM, hitting the space bar and then typing an "H" will cause the header and label to be printed. This feature is useful if the Header has been disabled, yet one Header is needed for disk storage or for review.

2.9 Measure

From the SOM, hitting the space bar and then typing an "M" will cause one line of data to be printed. This feature is designed mainly for data loggers and data collection platforms that must be able to produce a line of data on demand, regardless of the SOM's interval setting.

2.10 Battery

From the SOM, hitting the space bar and then typing an "B" will print the voltage level of the two warm-up batteries:

B1(volts) = 3.5 B2(volts) = 3.5

PART THREE
MAINTENANCE & CALIBRATION

3.1 Parameter Selection

Not all multiprobes have the full complement of sensors, so select from the information of PART 3 that which pertains to your system. The label on the multiprobe housing shows your options. Use FIGURE 3.1 to identify the sensors.

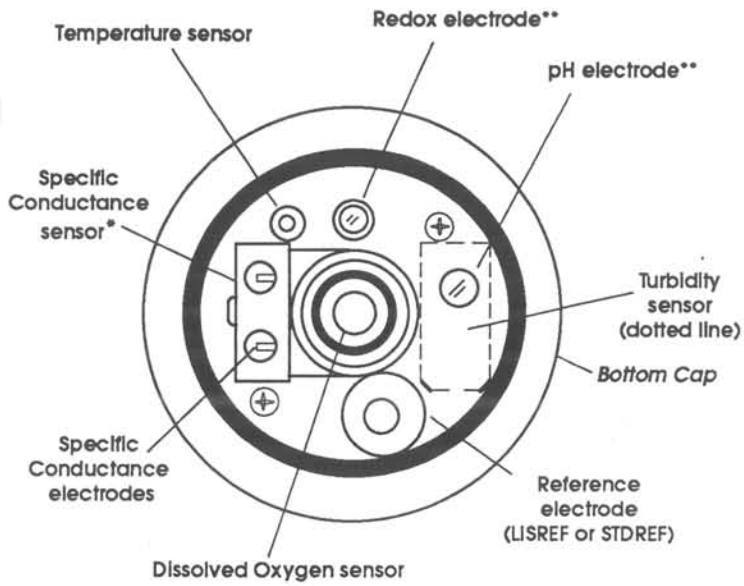
Fundamentally, the multiprobe is calibrated by pouring a calibration standard into the Calibration Cup and watching the readings (for the parameter to be calibrated) in the SOM. When the readings stabilize (meaning that step-response and/or temperature transients have disappeared), the Basic Menu is accessed by hitting the Terminal's space bar. Typing a C will then produce the Calibrate menu, from which the particular parameter value can be set. Section 2.5 has more menu-specific information for calibration.

You might notice that the H20 Multiprobe has built-in checks for calibration acceptance. If a sensor's response is nowhere near what it should be for the calibration value you type in, the calibration value will not be accepted. For example, if you type in 7.02 for a pH calibration, but have accidently immersed the sensors in a buffer of value 9.18, the message "NC" will appear, the Terminal's bell will ring once, and you will be returned to the SOM.

If for any reason you cannot complete calibration for any parameter, the multiprobe will continue to use the calibration from the last time that particular parameter was calibrated. However, you should try to determine why the multiprobe will not accept the new calibration (faulty sensor, bad standard, low battery, mis-typed standard value, etc.).

If any parameter values are accompanied by an asterisk (*), that value is based on a default calibration setting. This means that the multiprobe has for some reason forgotten the calibration information provided for that particular sensor, and has replaced (i.e., defaulted) it with a nominal calibration setting. So, the sensor must be recalibrated.

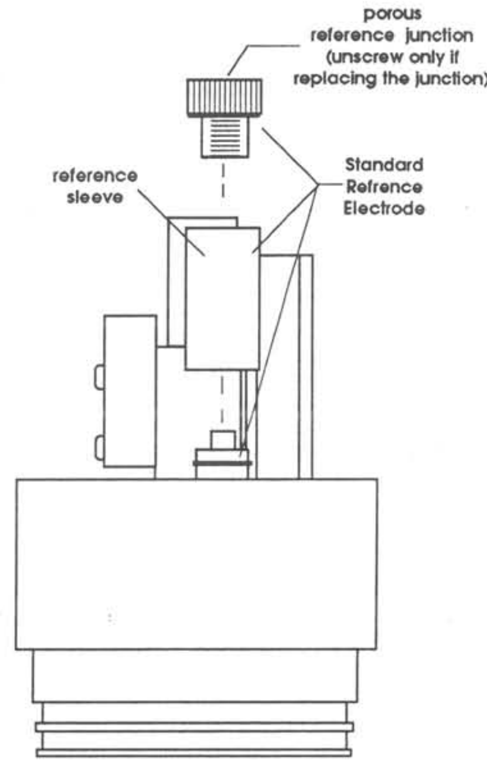
Note that some calibrations affect other parameters. For example, loss of calibration information for specific conductance will cause an asterisk annotation for specific conductance, salinity, dissolved oxygen (ppm), and depth readings, since each is calculated from, or influenced by, the specific conductance reading.



* Depth sensor port located underneath

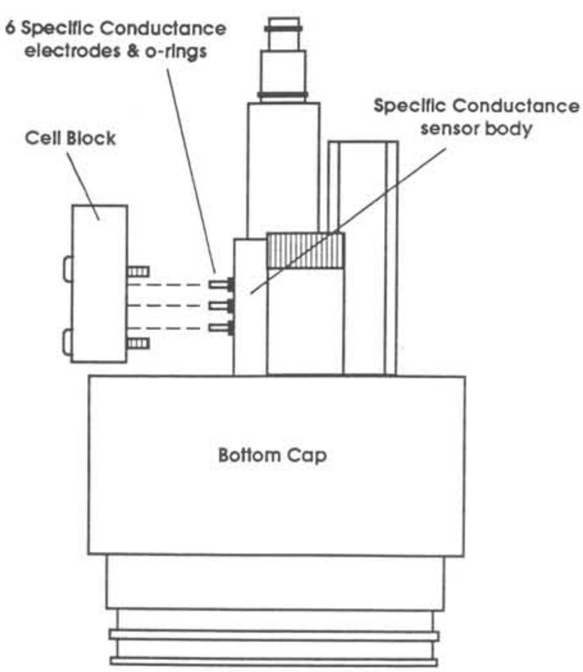
** If turbidity is installed, the pH and redox sensors are combined into a single, 'combo' sensor

Sensor Identification

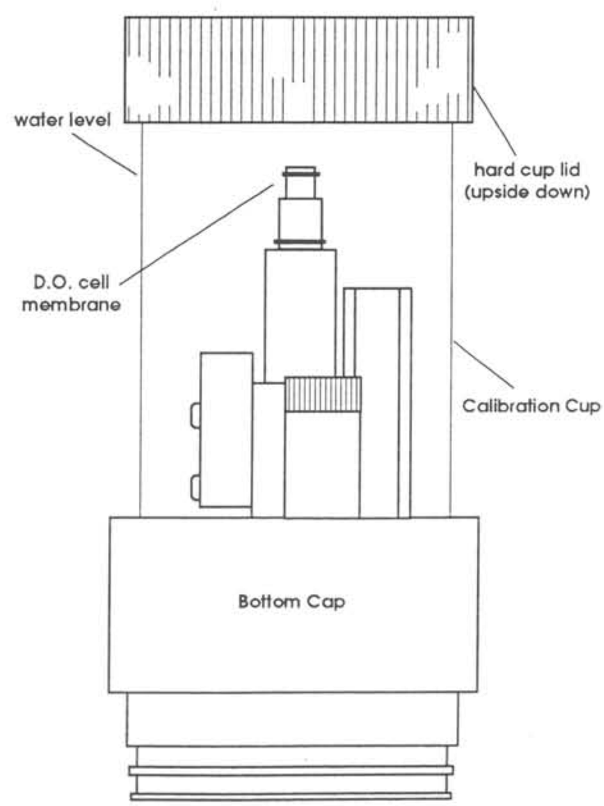


- STANDARD -

Reference Electrode Maintenance



Conductivity Sensor Maintenance



Dissolved Oxygen Sensor Calibration

Figure 3.1 Sensor Maintenance & Calibration Illustrations

(continued next page)

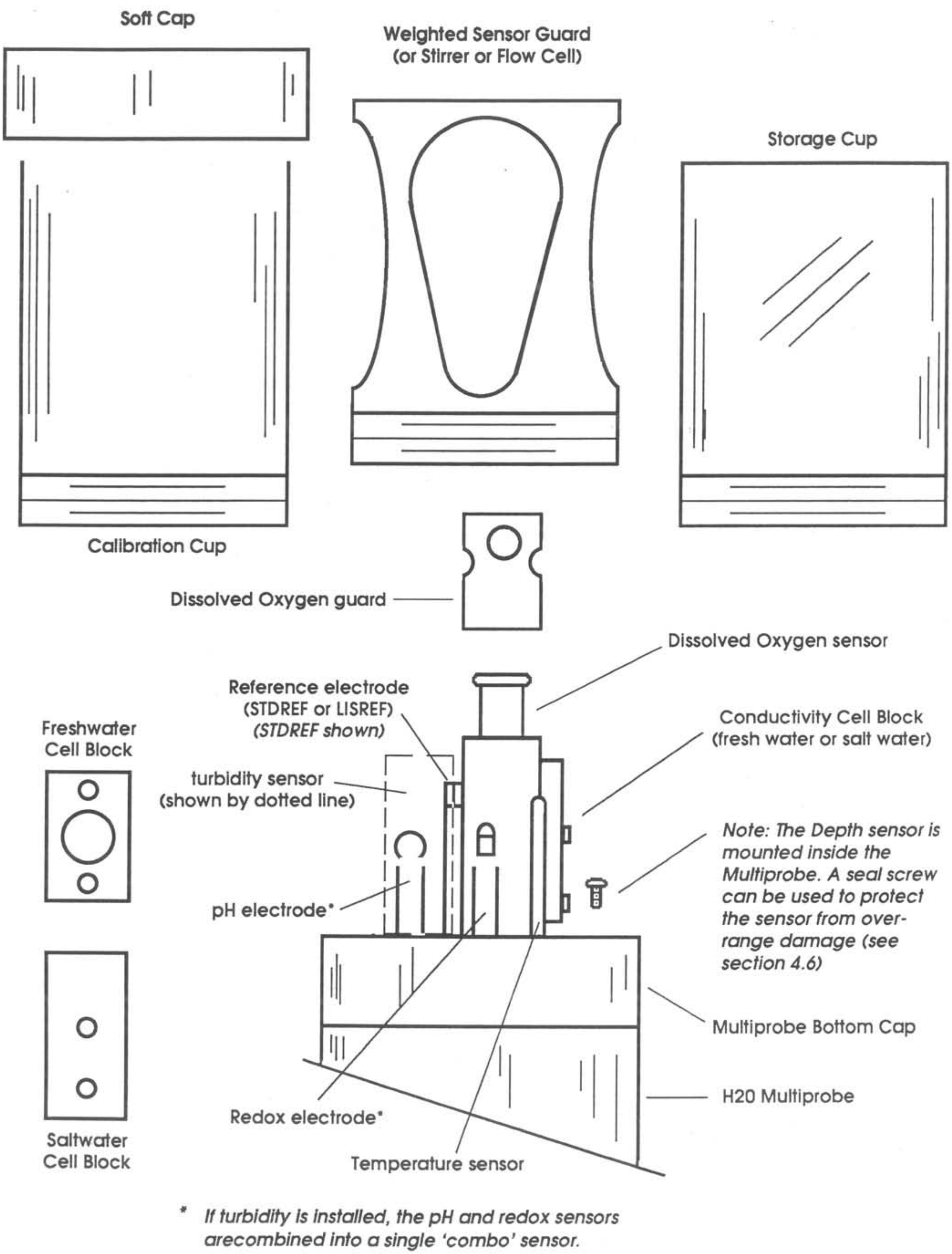


Figure 3.1 Sensor Maintenance & Calibration Illustrations

(continued from previous page)

3.2 Remarks Concerning Sensor Preparation

Sensor preparation is probably the most important action you can take to maintain or improve the quality of your field measurements. A contaminated, worn-out, or damaged sensor simply will not produce a reliable reading. It is well worth your time to set up a routine in which all sensors are serviced frequently and then allowed to rest in tap water overnight before calibration.

3.3 Temperature

Because of the unvarying nature of the temperature sensor and its conditioning circuitry, the temperature calibration is factory-set and requires no recalibration or maintenance.

3.4 Specific Conductance and Salinity

Specific Conductance measurements are divided into ranges to maximize the resolution. The **fresh water cell block** (see FIGURE 3.1) provides the ranges 0 to 0.15, 0.15 to 1.5, and 1.5 to 10 milliSiemens/cm. The **salt water cell block** (see FIGURE 3.1) provides the ranges 0 to 1.5, 1.5 to 15, and 15 to 100 milliSiemens/cm. The salt water cell block should be used only if specific conductances greater than 10 mS/cm are anticipated.

To maintain the sensor, remove the white cell block covering the six pin-shaped nickel electrodes of the specific conductance sensor. Remove the six small o-rings that are slipped over the electrodes and polish all of the exposed surface of the electrodes with the emery cloth supplied in the Maintenance Kit, or with #400 wet/dry sandpaper. Be sure to polish the ends of the electrodes, but be careful not to touch the nearby pH glass electrode with the abrasive. Clean the electrodes and the cell block with an alcohol-soaked swab.

Re-install the six o-rings (replace the o-rings if they have been flattened by long service). Re-install the white cell block, tightening the screws just enough to make sure the cell block is seated flat against the specific conductance sensor body. Once the sensor has been rinsed well with deionized water, it can be calibrated.

It is good practice, however, to let the sensor soak in tap water overnight to allow freshly-polished electrode surfaces to re-equilibrate with an aqueous environment.

When calibrating specific conductance, use a standard whose specific conductance is near that of your field samples; for instance, don't use 1M KCl to calibrate for fresh water work. Unless you are practiced in quantitative preparations, or know someone who is, you are better off purchasing prepared specific conductance standards. The following table shows several potassium chloride solutions and their specific conductance values:

KCl Molar Concentration	Specific Conductance in mS/cm
0.5	58.64
0.2	24.82
0.1	12.90
0.05	6.668
0.02	2.76
0.01	1.413
0.005	0.718
0.002	0.292
0.001	0.147
0.0005	0.074

For calibration, first make sure that the multiprobe knows which cell block is employed (section 2.6.3). Next, make sure the sensor is clean and serviced. Then:

1) Thoroughly rinse the sensors several times by half-filling the Calibration Cup with deionized water and shaking the multiprobe to make sure each sensor is free from contaminants that might alter your specific conductance standard.
2) In a similar manner, rinse the sensors twice with a small portion of the specific conductance standard to be used for calibration, each time discarding the rinse.
3) With the Calibration Cup screwed onto the multiprobe, sensors pointed toward the ceiling, pour in the standard to within a centimeter of the top of the cup, making sure there are no bubbles in the bores of the cell block.
4) Watch the specific conductance readings until they have stabilized; the sensor is now ready for calibration.
5) Access specific conductance from the Calibrate menu, type in the calibration standard value, and hit the return key to revert to the SOM.

Because the salinity parameter is algorithm-generated (section 5.4.2) from the specific conductance reading, once you have calibrated specific conductance, you have also calibrated salinity. However, if your field work requires salinity rather than specific conductance readings, you should calibrate salinity instead of specific conductance. Simply access salinity instead of specific conductance from the calibrate menu and type in the value (in parts per thousand at 25 C) of your salinity standard. Note that calibrating salinity simultaneously calibrates specific conductance. You cannot separately calibrate both salinity and specific conductance.

3.5 pH

The pH sensor consists of a glass pH electrode and a reference electrode. Your multiprobe may use a pH sensor that also incorporates a redox electrode. The pH glass electrode requires maintenance only when obviously coated with oil, sediment, or biological growth. Clean the glass with a very clean, soft, non-scratching cloth wet with rubbing alcohol (a cotton ball will do).

Slow response or non-reproducible measurements are signs that the electrodes have become coated or clogged.

The pH glass electrode is susceptible to coating by many substances. The speed of response, normally 95% of the reading in less than 90 seconds, is dramatically changed. Usually a rinse with methyl alcohol will remove any films on the glass and restore the speed of response.

If the methanol rinse does not restore the response, soak the electrode in 0.1 Molar HCl for five minutes. Remove and rinse the electrode with water and rinse the electrode in pH buffer for 10 minutes. This should improve the response.

Servicing the reference electrode mainly involves replacing the electrolyte by gently pulling the entire covering sleeve away from the multiprobe body. Empty the remaining electrolyte from the reference sleeve, and refill the sleeve to the top with standard electrolyte: 3.5-molar KCl saturated with silver chloride.

With the multiprobe sensors pointed toward the floor, push the full reference sleeve back onto its mount until the sleeve has just covered the o-ring located on the mount (just behind the silver electrode). Now turn the multiprobe so that the sensors point toward the ceiling and push the sleeve the rest of the way onto its mount. Notice that while you are seating the sleeve, you are purging any air trapped in the electrolyte chamber, and are using the air and excess electrolyte to flush and clean the porous junction on the tip of the sleeve. This junction is the most important part of the pH system; make sure it is clean and passes electrolyte readily. If not, replace it with the spare in the maintenance kit.

The pH system can now be calibrated. However, it is a good idea to let the electrodes re-equilibrate overnight in tap water after being cleaned, especially if you have used alcohol.

pH calibration is accomplished by filling the Calibration Cup first with the "zero" buffer (value between 6.8 and 7.2) and then with a "slope" buffer whose pH is near that of the anticipated samples to be measured (but not between 6.8 and 7.2). For each buffer, once the reading has stabilized, follow the calibration procedure detailed in section 2.5.1. Always rinse the sensors thoroughly with deionized water between buffers.

The general-purpose Hydrolab reference electrode is designed for normal field application: measurement of middle-range ionic strength waters. For use in very low ionic-strength waters (generally, those under 0.2 mS/cm specific conductance), measurement reliability can often be enhanced by the LISREF (an optional one-piece, white, bullet-shaped "low ionic-strength reference electrode" that does not require electrolyte replacement). The LISREF requires a maintenance procedure different from that prescribed for the rebuildable Hydrolab reference.

First, and most importantly, the tip of the LISREF should be soaked in 4-molar potassium chloride whenever the system is not in use; for instance, overnight when the instrument is in daily use. Fill the black cap provided with the LISREF (or a similar cap) with KCl and install it on the LISREF for this storage procedure, since the other sensors, such as the pH glass itself, should be stored in plain tap water. This step facilitates a reference junction that is homogeneously saturated with strong electrolyte, a condition necessary for stable and accurate readings in dilute samples. **Be sure to remove the black cap for calibration or field use.**

As a rule of thumb, make sure the LISREF reference electrode is soaked in KCl as long, per week, as it is exposed to sample waters.

Second, always keep the LISREF clean by rinsing with soapy water to remove visible contamination, and by wiping the sensor occasionally with a cloth soaked in rubbing alcohol to remove oils and grease that might have accumulated. The sensor should be soaked in KCl at least 24 hours after cleaning, then recalibrated before field use.

Third, check the sensor's span frequently by calibrating with standard buffers and then checking performance with a standard whose ionic strength approximates that of the anticipated field samples. Calibration with standard buffers alone is no guarantee of measurement quality in low ionic-strength samples (see section 5.6).

See section 3.12 for information on pH "warm-up".

3.6 Redox

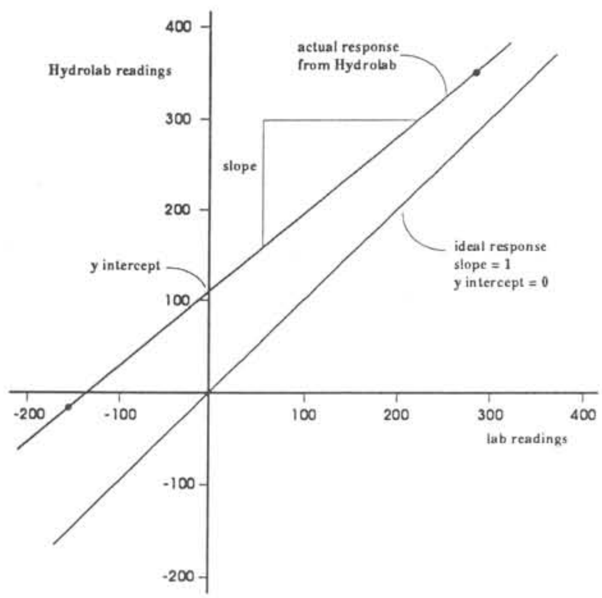
The redox sensor consists of a platinum redox electrode and a reference electrode. Your multiprobe may use a redox electrode that also incorporates a pH electrode. Generally the Redox sensor requires the same infrequent cleaning procedure as the glass pH electrode. Should the platinum band on the Redox sensor get really dirty and discolored, it can be polished with a clean cloth and a very mild abrasive, such as toothpaste; or use a fine polishing strip. After polishing, the sensor should be allowed to soak overnight in tap water so that the platinum surface can restabilize.

As long as the platinum band of the Redox sensor and the reference electrode are kept properly serviced, you may not need to frequently check the Redox system calibration. However, you can verify your Redox system performance by dissolving a few grams of quinhydrone in 500 ml of 4- and 7-pH buffers. For the temperatures of 20 , 25 , and 30 C, respectively, the Redox values for the pH 4 solution are 470, 462, and 454; for the pH 7 solution 295, 285, and 275. These Redox values are in millivolts (European sign convention) and are based on the standard hydrogen reference electrode. Note that Hydrolab uses a silver-silver chloride reference electrode instead of the hydrogen reference electrode. This means that, without calibration, each of your readings will differ by about +200 millivolts from the traditional values that are based on the hydrogen electrode. Calibration, however, removes this offset.

Alternatively, you can calibrate with any solution (with a stable Redox) by reading the Redox on a trusted laboratory meter, and using this solution for your standard. Remember that the laboratory meter is likely to use a silver-silver chloride reference electrode; add 200 millivolts to its readings if you want your Hydrolab readings to be based on the hydrogen standard. Select a standard value near that of your field samples.

See section 3.12 for information on Redox "warm-up".

Standardizing Redox Readings: The Redox values of quinhydrone solutions vary with pH. So, two quinhydrone solutions of suitably different pHs can be used to "calibrate" Redox readings. Suppose, after plenty of time for sensor equilibration, a trusted laboratory instrument gave readings of 275 and -150 milliVolts for two quinhydrone solutions. At the same temperature, a properly-maintained Hydrolab gave readings of 350 and -30 mV, respectively. The graph below shows the plotted results.



The line created by the two Hydrolab readings shows a y-intercept of about 104 and a slope of about 0.89. These numbers are calculated as follows:

slope = (350 + 30)/(275 + 150) = 0.894 (from m = rise/run)
y intercept = -30 - 0.894(-150) = 104 (from y = mx + b)

Thus, the Hydrolab readings must first be decreased by 104 mV, and then divided by 0.894 to get the correct reading (that is, the reading that matches the laboratory instrument's reading). For instance, suppose the Hydrolab gave an equilibrated reading of 350 mV for some field sample. The "corrected" reading would be:

350 - 104 = 246, and then 246/(0.894) = 275 mV

We know that this is the right answer, because 350 and 275 are two of the comparison points from the original quinhydrone solutions.

However, assuming that the laboratory instrument is using a silver-silver chloride reference electrode, the corrected Hydrolab reading must be increased by about 200 mV to match it to the standard hydrogen reference electrode (the basis upon which most published half-reaction potentials are based):

275 + 200 = 475 mV.

Thus, the real Redox potential of the solution is not 350, but 475 mV.

3.7 Dissolved Oxygen

DO sensor maintenance is usually required only when calibration becomes impossible or when the membrane covering the cell becomes wrinkled, bubbled, torn, dirty, or otherwise damaged. It is, however, good practice to replace the membrane on a regular schedule, before trouble becomes visible. Frequent electrolyte changes will maximize the life of the sensor.

Please read APPENDIX 1 for information on the two methods available in the H20 for measurement of DO.

To change membranes, remove the white DO sensor guard and the o-ring securing the membrane. Shake out the old electrolyte, rinse with deionized water, and refill with fresh electrolyte (provided in the Maintenance Kit, or use 2M potassium chloride) until there is a perceptible meniscus of electrolyte rising above the entire electrode surface of the sensor. Make sure that there are no bubbles in the electrolyte.

Hold one end of a new membrane (either Standard or LoFlow) against the body of the DO sensor with your thumb and with a smooth, firm motion, lay the other end of the membrane over the sensor surface and hold it in place with your index finger. Secure the membrane with the o-ring. Note: When applying a LoFlow membrane, allow the o-ring to stretch the membrane just enough to have it conform to the sensor without wrinkles. If you stretch the membrane too tight, the readings will be too high for calibration. If such is the case, simply replace the membrane, without quite so much stretch, and recalibrate.

There should be no wrinkles in the membrane or bubbles in the electrolyte. Trim away the excess membrane extending below the o-ring.

The DO sensor is now ready for calibration, but you should let it soak overnight to give the membrane time to relax to its final shape (i.e., calibration condition).

To calibrate DO:

1) With the multiprobe oriented so that the sensors are pointed toward the ceiling, fill the Calibration Cup with tap water (specific conductance less than 0.5 mS/cm) until the water is just level with the o-ring used to secure the membrane.
2) Carefully remove any water droplets from the membrane with the corner of a tissue and cover the open top of the Calibration Cup.
3) The sensor is ready for calibration once the readings have stabilized. Just follow the instructions printed by the multiprobe; refer to sections 2.5.4 and 2.5.5 for calibration menu details.

You can also calibrate the DO system in a well-stirred bucket of temperature-stable, air-saturated water. This situation more closely resembles the actual field measurement conditions.

Remember that the two polarizing batteries in the multiprobe can power the oxygen sensor (and the pH and Redox circuits) continuously, so that a stable reading is always available quickly. **(Generally, the polarizing batteries are used only with the LoFlow Membrane.)** If you know that the multiprobe is not going to be in use for an extended period, say a week or more, you can extend the life of the batteries and of the oxygen sensor by removing the sensor's membrane, removing all of the sensor's electrolyte, and installing a membrane over the dry sensor. For best results, replace the electrolyte and membrane the day before calibration for the next deployment.

When using the polarizing batteries, you can greatly prolong the life of the sensor by changing the electrolyte frequently (twice or more a month), and/or by removing the electrolyte when the sensor is *not to be used for a week or more.*

• **Remove electrolyte or disable warm-up batteries when the H20 is not in use.**

3.8 Depth

Generally, the depth (or level) sensor needs no maintenance. Occasionally, you may wish to squirt a very weak acid (such as acetic) into the depth sensor port (the hole in the face of the Bottom Cap that seems to have no use) with a hypodermic syringe if you notice deposits (calcium, biological growth, etc.) forming in the port. Calibration information is found in section 2.5.8.

Normally, calibration is done by simply entering zero for the standard at the water's surface. However, if you have another method, such as a carefully-marked cable, you can type in any number you wish when calibrating.

Because the density of water varies with its specific conductance, the depth readings must be corrected for specific conductance. This correction is applied linearly from zero specific conductance (no correction) to 100 mS/cm. At 52 mS/cm (seawater's specific conductance), the correction reduces the actual reading by 3 percent.

Note that there are three depth sensors: 0 to 200 meters (656 feet), 0 to 100 meters (328 feet) and 0 to 10 meters (33 feet). The 100 and 200 meter sensors are usually used to determine the depth at which readings of the other parameters are being made. The 10 meter sensor is often used to detect level changes, such as those accompanying tidal flows or rainfalls. The following table gives the maximum operating depths for the three sensors:

Depth Sensor	Maximum Unprotected Depth
0–10 meters	20 meters
0–100 meters	150 meters
0–200 meters	225 meters

Note: **The sensors must be protected from excessive pressures by installing the seal screw (found in the Maintenance Kit) in the face of the bottom cap. A sensor damaged by excessive pressure may give erroneous readings that may not be readily apparent.**

3.9 Turbidity

3.9.1 Maintenance

Turbidity sensor maintenance is required when any of the lenses have a visible coating. To clean the sensor, first rinse with water directed at the lens to remove any large caked deposits. Then remove the retainer/guard by unscrewing the black nylon screw. DO NOT REMOVE the lens. The lens can be cleaned in place by wiping with a very clean, soft, non-abrasive cloth wet with rubbing alcohol. After cleaning, rinse the sensor and retainer/guard with water, and reattach the retainer/guard.

The frequency of maintenance depends upon the rate and type of fouling, and the deployment technique. These are factors which must be evaluated by the operator.

3.9.2 Calibration Standards

First, prepare "turbidity-free" water for the zero calibration. "Turbidity-free" water may be purchased from many supply houses or created by passing distilled water through a membrane filter with 0.2 µm precision-sized holes.

Dilutions of formazin or styrene divinylbenzene beads (AMCO-AEPA-1) may be used for the slope calibration.

CAUTION: Formazin is a suspected carcinogen. A material safety datasheet has been included with the formazin contained in your maintenance kit. Please read, understand, and follow all safety instructions before using this material.

Formazin may be prepared as per Standard Methods or purchased from many supply houses. AMCO-AEPA-1 is available from Advanced Polymer Systems of Redwood, California. The dilution may be performed using standard lab glassware and the following formula:

$$\text{Standard} = \text{STOCK}_{NTU} * \text{STOCK}_{VOL} / (\text{STOCK}_{VOL} + \text{TF}_{VOL})$$

where:

STOCK_{NTU} is the NTU value of the stock,

STOCK_{VOL} is the volume of stock used,

and TF_{VOL} is the volume of "turbidity-free" water used.

Note that the final volume of the standard is $STOCK_{VOL} + TF_{VOL}$. For example, if I want 500 mL of 90 NTU as my slope standard and I am using 4000 NTU stock, then I would add 11.3 mL of stock to 489 mL of turbidity free water. Generally, good measurement technique requires that standards at or near the expected field value be used for slope calibration.

Note: **Ensure that the standard is well mixed prior to making the dilution. Failure to do so can create an inaccurate calibration and eventually ruin the quality of the stock standard.**

Additional standards may be prepared to check the linearity and interranging of the turbidity system. If so, all dilutions should originate from the same stock solution. Notice that the stock formazin solutions have a tolerance of +/-5%, which even with a perfect instrument, could produce an apparent 10% error.

Note: **Standard Methods recommends daily preparation of formazin dilutions.**

3.9.3 Calibration Technique

Calibration can be performed in the Calibration Cup or in a stirred vessel. The latter is preferred for high turbidity standards or time intensity studies. Well-mixed 900 NTU formazin can settle to 350 NTU in 20 minutes.

3.9.3.1 Calibration Cup

Rinse with turbidity free water several times and then dry the sensors as much as possible. Any residue or fluids left behind can affect the zero and slope calibrations. Next, fill the Calibration Cup with turbidity-free water and wait for equilibrium. While filling, check for bubbles trapped in the turbidity sensor. Then execute the turbidity calibration with a standard value of 0 NTUs.

Discard the turbidity free water and again dry the sensors as much as possible. Now fill the Calibration Cup with the well-mixed standard and wait for equilibrium. Then execute the turbidity calibration with the value of the standard used.

3.9.3.2 Stirred Solution

Rinse with turbidity free water several times and then dry the sensors as much as possible. Place the multiprobe sensors into the stirred vessel of turbidity-free water. Keep the turbidity sensor as close to the center of the vessel as possible. Check to make sure no bubbles are trapped by the guard/retainer.

Wait for equilibrium and then execute the turbidity calibration with a standard value of 0 NTUs. Repeat for the slope standard.

Dilutions may be performed in a similar manner by adding stock, allowing equilibrium, and noting the result.

3.10 Care of the Multiprobe

Besides normal maintenance of the sensors and the polarizing batteries, just keep the multiprobe cleaned with soap and water. Always use the Calibration Cup or the Storage Cup (filled with tap water) to protect the sensors from damage, and **especially from drying out**, whenever the multi-probe is not deployed.

Remember: When using the polarizing batteries, you can greatly prolong the life of the sensor by changing the electrolyte frequently (twice or more a month), and/or by removing the electrolyte when the sensor is not to be used for a week or more, or by disabling the polarizing batteries.

Always rinse the multiprobe with clean water soon after returning from deployment.

3.11 Care of the Cables

Just keep these parts clean and off the floor. Additionally, some connectors, such as any that plug into a Terminal, are not waterproof and so must be kept dry at all times.

Protect the cables from abrasion, unnecessary tension, repetitive flexure (fatigue), and bending over sharp radii (like the edge of the side of a boat). Excessive weight added to the multiprobe (10 pounds or more) can greatly increase the possibility of cable breakage due to stress on the mold and attachment points.

When not in use, cables should be clean, dry, and stored, neatly coiled, in a plastic bag.

3.12 Changing the Dissolved Oxygen/ pH Sensor Batteries

If your H20 Multiprobe is equipped to measure dissolved oxygen (DO), Redox, or pH, you need to decide whether or not to use the H20's internal polarizing batteries. These are two 2/3 A size 3.5 volt lithium batteries. When installed inside the multiprobe, they eliminate the need to wait over two minutes for stable readings once the multiprobe has been turned on.

The polarizing batteries are shipped in the Maintenance Kit. Install them if you wish to eliminate the two-minute "warm-up" time for pH or the Standard Membrane DO sensor. (Warm-up times are approximate and can change with such variables as temperature.)

Remember that using the batteries can shorten the life of the DO sensor. Be sure to remove the electrolyte from the sensor or disable the batteries from the Variables menu if the multiprobe will not be used for an extended time. Also, when the sensor is in use, change the electrolyte once every week or so to extend sensor life.

3.12.1 When to Use the Warm-up Batteries

Here's an example of when to use, or not use, the polarizing batteries: Joe had three multiprobes that he was using to monitor fish-rearing tanks. The multiprobes were equipped with Standard Membrane DO sensors and pH sensors, and Joe needed measurements from all three tanks every 15 minutes. Joe elected to use the multiprobes without polarizing batteries, since he could program his computer to turn each multiprobe on for five minutes - more than enough time to produce stable readings for pH and Standard Membrane DO.

However, things worked out so well that six months later Joe added 27 more tanks. Now, he can turn each multiprobe on for at most 30 seconds - not enough time to guarantee stable readings without the polarizing batteries. So, Joe installed the polarizing batteries in all his multiprobes and adopted a new maintenance plan that required weekly electrolyte and membrane changes for the DO sensors.

Had Joe been using the LoFlow Membranes, he would always have had to use the polarizing batteries, since even two minutes is not a long-enough warm-up for the LoFlow Membrane.

3.12.2 Changing the Warm-up Batteries

To change or install the batteries, first put the dummy cap back onto the 6-pin bulkhead connector (if you have a detachable cable). Don't leave the sensors unguarded; always attach either the Storage Cup or Calibration Cup to the multiprobe. Take the multiprobe over to the sink and scrub it all over with a vegetable brush and soapy water.

WARNING: EXCESS PRESSURE MAY BUILD UP INSIDE AN UNDERWATER HOUSING. THIS CAN CAUSE THE BOTTOM CAP, TOP CAP, SENSORS, OR OTHER REMOVABLE PARTS TO POP OUT OF THE HOUSING WITH ENOUGH FORCE TO CAUSE SERIOUS INJURY TO THE EYES, FACE, OR OTHER PARTS OF THE BODY.

WHENEVER YOU LOOSEN OR TIGHTEN SCREWS THAT HOLD REMOVABLE PARTS, ALWAYS POINT THE PARTS AWAY FROM YOUR BODY AND OTHER PEOPLE.

When it is cleaned and dried, remove the two Allen screws that hold the multiprobe's Bottom Cap (the cap with the sensors) fixed in the multiprobe's tubular body. Now carefully and slowly (with a slight twisting motion) remove the Bottom Cap, using, if necessary, a large screwdriver blade between the cap and multiprobe body (just to get it started). Pull the cap out only about six inches (it is very tight and might come free suddenly; don't fling it across the room). Lift the cap straight out of the housing, slowly, until you can see the wires connecting the multiprobe's external connector (the one at the top of the multiprobe) to the rectangular circuit boards. Carefully detach the wire's connector from the exposed circuit boards so that you can finish pulling the circuitry out of the tube. Set the tube aside, making sure that no contaminants enter the opened end.

Now, remove the spent batteries from their holders and replace them with fresh batteries; observe the polarity markings of the battery holders. Reinstall the retaining clips.

Examine the o-rings on the cap and the area inside the tube which seats the o-rings. Is there any sign of nicks, gouges, or flattening of the o-rings? Is the seating area undamaged? Is everything incredibly clean; no sand, hair, grit, dirt, sediment, sticks, etc.? Is there a light coat of white silicone grease (supplied in the Maintenance Kit) present? This is the Moment of Truth. If you are in a big hurry at this point, check the price of a new multiprobe before proceeding.

When you are satisfied that the o-rings and seats are ready for re-assembly, slide the circuitry back in the tube, remembering to reconnect the wires to the circuit board as they were connected before. Now push the Bottom Cap back into the tube (with a slight twisting motion). Add a small amount of anti-seizing compound or light grease to the Allen screw threads to prevent seizing of screws and replace the screws with a small Allen wrench **(just finger-tight)**. DO NOT OVER-TIGHTEN!

These batteries power the dissolved oxygen sensor (and pH and Redox amplifiers) continuously, so that a stable reading is always available. (When these batteries are changed, be prepared to wait a few hours or overnight for the DO sensor to restabilize.) If you know that the multiprobe is not going to be in use for an extended period, say a week or more, you can extend the life of the two batteries and of the oxygen sensor by removing the membrane and all of the electrolyte, and installing a new membrane over the **dry sensor**. For best results, replace the electrolyte and membrane on the day before calibrating for the next deployment.

PART FOUR
DEPLOYMENT

4.1 Deployment in Open Waters

4.1.1 Long-term

If you are using the multiprobe in open water, try to locate the multiprobe so that any available protection is utilized. For instance, in a swiftly flowing river, anchor the multiprobe to the downstream side of a bridge piling so that floating debris will strike the piling, not the multiprobe. Likewise, in a recreational lake deployment, use a marking buoy that will not attract the attention of vandals.

The multiprobe can be anchored by running a rope or chain through the bail that can be fixed into the two eyebolts on the top of the multiprobe. If you have a detachable Underwater Cable, be sure to run the bail through the eyebolt on the cable's molded breakout, also. This way, the weight of the multiprobe is suspended from the breakout, via the bail, and no weight is on the cable-to-multiprobe connector.

Try to fix the multiprobe in an upright or on-side position, and avoid areas that might see deep deposits of sand, gravel, or silt in the case of a heavy rainfall event. Being caught in water that is icing over can also cause the loss of the multiprobe.

Take similar precautions with the Underwater Cable to protect it from floating debris, navigation, and vandals.

Always make sure the sensors are protected. This can be done with the Guard (with or without the Stirrer) or Weighted Guard (or Flow Cell, for that matter). Use of the DO sensor guard is also recommended, though some operators may elect to run the DO cell unguarded to make the best use of low sample flows.

Be sure to remove the black storage cap from the reference electrode if your multiprobe is equipped with Hydrolab's optional low ionic-strength reference electrode, the LISREF (see section 3.5).

Some sensors cannot remain in calibration for long periods in certain situations. For instance, a DO cell may become hopelessly fouled after just a few days in a warm, shallow, biologically-active lake. Likewise, a reference electrode's performance will begin to deteriorate quickly in a flowing stream of low ionic-strength water. On the other hand, if the only parameters being measured are temperature and conductivity, the multiprobe can be left for weeks in a clean-water lake. The decisions regarding deployment time are best based on experience; however, deployment time can be judged by making periodic (say, daily) measurements of sensitive parameters with another instrument. The day on which the spot-measurements and the logged data begin to diverge significantly may be considered the maximum deployment time for that particular water and season.

The wrapping of the Guard with a fine mesh nylon material or fine copper mesh (.050") can prevent premature fouling of the sensors and should be tried on a case by case basis.

4.1.2 Short-term

Generally, short-term deployment implies hand-held operation. Just follow common sense; for instance, don't lower the multiprobe into the water without screwing on a Guard (with or without Stirrer) or Weighted Guard. Watch out for hazards such as outboard motor propellers. Protect the Terminal from dampness and mechanical shock.

If you have a detachable Underwater Cable, be sure to run the bail through the eyebolt on the cable's molded breakout, also. This way, the weight of the multiprobe is suspended from the breakout, via the bail, and no weight is on the cable-to-multiprobe connector. You can weight the multiprobe (for faster sinking) by attaching large lead fishing weights (or diving or barbell weights) to the Guard. Do this with 25-pound test monofilament fishing line, so that if the weights become fouled on an underwater hazard, you can break the line and free the multiprobe. Don't use more than about 10 pounds of add-on weight.

4.2 Turbidity

4.2.1 Bubbles

When lowering the sensors into the water body, try to keep the "U" shaped portion of the turbidity sensor pointed toward the water's surface until the sensor is completely submerged. This technique will minimize the chances of trapping bubbles in the sensor retainer/guard. Bubbles have optical properties such that they cannot be distinguished from turbidity particles in the water.

4.2.2 Probe Guard

The orientation of the weighted sensor guard or stirrer can affect turbidity readings. A 6% non-linearity can be observed by rotating the guard by only 30 degrees from the optimum location.

The optimum location is noted by a mark on the side of the sensor bottom cap. The guard should be rotated until one of its "webs" is aligned with this mark. If the mark is missing or damaged, the optimum location can be found by rotating the guard until a web is just about to enter the "U-shaped" portion of the turbidity sensors view.

Note that at this position the adjacent web has just left the turbidity sensor's field of vision.

Older multiprobes have harder o-rings which only allow 30 degrees of rotation after the guard reaches the o-ring. The o-ring installed in new multiprobes equipped with turbidity is a softer durometer which will allow 90 degrees of rotation.

4.2.3 Objects

Try to secure the H20 where the turbidity sensor will not "see" other objects. These object include the dock, brush, cables, etc. During operation, water currents can cause the H20 to move toward and away from these objects, creating strange turbidity results.

4.2.4 Orientation

If possible, orient the H20 where the "U-shaped" portion of the turbidity sensor is directed away from the surface of the water. Otherwise, settleable solids (as contrasted with suspended solids) may accumulate on one or more of the lens surfaces. Such fouling will decrease the useful deployment time.

4.3 Using the Stirrer

Many users choose to operate with a Stirrer to provide adequate flow for reliable readings. The Stirrer is coupled to the multiprobe with a Guard, which screws into the multiprobe's Bottom Cap. The Stirrer is powered by attaching its power lead to the Underwater Cable (the Stirrer connector is an option on Underwater Cables). The Battery powers both the multiprobe and the Stirrer. If you do not need any data for an extended time, disconnect the Battery to extend its life.

4.4 Flow Cell Operation

For process or pump-through situations, the Hydrolab flow cell can be attached to the multiprobe so that the system does not have to be submerged in the water being studied. This device simply screws on in place of the storage cup. Don't exceed a pumping rate of about 1.5 liters per minute; that should change the contents of the flow cell about eight times per minute.

WARNING: DO NOT LET THE PRESSURE IN THE FLOW CELL OR ITS FEED LINE EXCEED 15 PSIG. HIGHER PRESSURES CAN BURST THE FLOW CELL, POSSIBLY CAUSING SERIOUS BODILY INJURY TO THE OPERATOR AND/OR BYSTANDERS.

Filter debris from the feed line if necessary. If possible, invert the multiprobe so that bubbles will tend to float away from the sensors and out the port on the bottom of the Flow Cell (see FIGURE 1.1).

4.5 Modems

If an instrument is to be operated at a very remote location, telephone lines can be used to transmit the data. Basically, this involves "lengthening" the instrument's cable by insertion of a modem, a telephone line, and another modem. Hydrolab multiprobes do not provide all of the necessary RS-232 signals required to directly operate a modem. A modem adapter is required to connect a multiprobe directly to a modem. Contact Hydrolab for further information.

4.6 Pressure and Temperature Extremes

Note:

- **If you have a regular housing (white) do not submerge your multiprobe more than 150 meters (492 feet).**
- **If you have an extended depth housing (gray) do not go deeper than 225 meters (738 feet).**

Note that there are three depth sensors: 0 to 200 meters (656 feet), 0 to 100 meters (328 feet) and 0 to 10 meters (33 feet). The 100 and 200 meter sensors are usually used to determine the depth at which readings of the other parameters are being made. The 10 meter sensor is often used to detect level changes, such as those accompanying tidal flows or rainfalls. The following table gives the maximum operating depths for the three sensors:

Depth Sensor	Maximum Unprotected Depth
0–10 meters	20 meters
0–100 meters	150 meters
0–200 meters	225 meters

Note: **The sensors must be protected from excessive pressures by installing the seal screw (found in the Maintenance Kit) in the face of the bottom cap. A sensor damaged by excessive pressure may give erroneous readings that may not be readily apparent.**

The multiprobe's operating temperature range is -5°C to 50°C (23°F to 113°F). Exposure of the multiprobe to temperatures outside of this range might result in mechanical damage or faulty electronic performance. The latter may be very subtle.

4.7 Data Transmission Lines

If you are adding transmission cable to your Underwater Cable, the added cable must be large enough to carry the operating current and transmit data without distortion. For up to a total of 1000 feet of cable, a pair of twisted #26 AWG wires is suitable for data transmission, but a pair of #18 AWG must be used for the power wires (see Wiring Charts at end of manual). Alternatively, smaller power wires can be used if the power supply is located closer to the multiprobe.

For instance, if a lake is 50 feet deep and the computer to which the multiprobe is connected is 950 feet away from the lake, you would be wise to buy a 50-foot Cable for the multiprobe and supply the other 950 feet yourself with a cheaper wire. Attaching the battery at the shore of the lake (instead of near the computer) will further save you the cost of the large wires requires for power transmission.

Note that a Stirrer can add significantly to voltage losses in cables. If your installation requires circulation, it is a very good idea to locate the Battery as near the multiprobe as possible.

To be safe, make your extended cable no longer than 1000 feet if you use #26 AWG wires for the two data transmission lines (red and yellow) and #18 AWG wires for the power lines (brown and orange). If you wish to make a longer cable, please contact Hydrolab and we will gladly help with its design.

PART FIVE
TECHNICAL NOTES

5.1 Dissolved Oxygen Temperature and Salinity Compensations

There are five components to dissolved oxygen readings. The "raw reading" received from the dissolved oxygen sensor is a function of the partial pressure of oxygen in the sample. The operator sets the "scale factor" during air calibration. The "membrane temperature function", determined experimentally, compensates for the changing oxygen permeability of the particular membrane (Standard or LoFlow™) with temperature.

The "solubility temperature function" compensates for the changing solubility of oxygen in water with temperature:

$$DO = 7.2542\,(10^{-9})\,T^5 - 5.1387\,(10^{-7})\,T^4 + 9.8316\,(10^{-6})\,T^3 + 5.2276\,(10^{-4})\,T^2 + 0.19665\,T + 6.8356$$

DO is the oxygen solubility (mg/l) for water of temperature T (°C). The data used to generate this polynomial comes from the oxygen solubility data in the 1985 Standard Methods.

The "salinity function" compensates for the changing solubility of oxygen in water with salinity: .

$$F(C,T) = 1 - C\,[3.439\,(10^{-3}) + 0.361/(22.1 + T)^2]$$

For water of specific conductance C (milliSiemens/cm) at a temperature T (°C), the raw reading is multiplied by F(C,T) to produce the salinity- corrected reading, so divide the dissolved oxygen reading by F(C,T) to un-correct for salinity. The data used to generate this polynomial comes from the oxygen solubility vs. chlorinity data in the 1985 Standard Methods.

Note that unlike dissolved oxygen concentration, dissolved oxygen % saturation is not a function of solubility, and so has neither solubility temperature compensation nor salinity compensation. Note also that you can disable the salinity correction through the Variables menu.

5.2 The LoFlow™ Membrane Flow Optimization Factor

When sample flow is stopped (i.e., reduced to one cm per minute), dissolved oxygen readings made with a Standard Membrane (1-mil Teflon™) fall to about 50% of the full-flow (25 cm/sec or greater) reading. Readings made with Hydrolab's LoFlow™ Membrane fall only to about 95% in the same situation. In order to optimize this LoFlow flow sensitivity of -5% to ±2.5%, all LoFlow readings are automatically boosted by 2.5%.

This means that if a sample of water is at exactly 8 mg/l dissolved oxygen concentration, readings made at full flow with the Standard would read 8.0, while those made with the LoFlow would read 8.2 mg/l. If flow stops, the Standard would read around 4.0, while the LoFlow would read around 7.8.

5.3 Dissolved Oxygen Altitude-Pressure Function

When you are in the dissolved oxygen submenu of the Calibrate menu, you can estimate barometric pressure (BP, mm of Hg) using:

$$BP = 760 - 2.5(A/100)$$

"A" is your local altitude above sea level in feet. Also, if you are using the BP given by your local weather bureau, remember that their numbers are corrected to sea level, and you must use BP', the uncorrected atmospheric pressure:

$$BP' = BP - 2.5(A/100)$$

5.4 Specific Conductance

5.4.1 Conductivity to Specific Conductance Compensation

Conductivity is a measure of a water's ability to conduct electricity, and therefore a gross measure of the water's ionic activity. Generally, the higher a water's concentration of ionized impurities, the higher its conductivity. However, the capacity of those impurities to conduct electricity varies with temperature. The conductivity of a water sample heated from 15°C to 35°C changes greatly during the heating.

On the other hand, specific conductance is the conductivity measured when a water's temperature is fixed at 25°C. Unlike conductivity readings, specific conductance readings are easily compared if the readings are made at different temperatures, for instance in a lake during various seasons.

Here is the function (based on 0.01N KCl) used to compensate conductivity readings to 25°C (i.e, to produce specific conductance readings) for a sample temperature T (°C), when the fresh water cell block is used:

$$F(T) = 1.4326\,(10^{-9})\,T^5 - 6.0716\,(10^{-8})\,T^4 - 1.0665\,(10^{-5})\,T^3 + 1.0943\,(10^{-3})\,T^2 - 5.3091\,(10^{-2})T + 1.8199$$

Here is the function (based on standard sea water) used to compensate conductivity readings to 25°C (i.e, to produce specific conductance readings) for a sample temperature T (°C), when the salt water cell block is used:

$$F(T) = 1.2813\,(10^{-11})\,T^7 - 2.2129\,(10^{-9})\,T^6 + 1.4771(\,10^{-7})\,T^5 - 4.6475\,(10^{-6})\,T^4 + 5.6170\,(10^{-5})\,T^3 + 8.7699\,(10^{-4})\,T^2 - 6.1736\,(10^{-2})\,T + 1.9524$$

In both cases, the conductivity reading is multiplied by F(T) to produce the specific conductance reading. So, divide the specific conductance reading by F(T) to convert to conductivity readings. Note that you can disable the temperature compensation through the Variables menu.

These compensations are based on reference data, from several sources (including the U.S. Geological Survey Water Supply Paper No. 2311), over the 0 to 30°C range. An optimization of the characteristics of both salt and fresh waters is used for temperatures outside the 0 to 30°C range. If you need a more specific correction, then record your data as conductivity and later apply your own temperature correction to the data.

Because resistivity is calculated from the specific conductance readings, resistivity also has the above temperature compensations. However, salinity and total dissolved solids (TDS) are not compensated to 25°C.

5.4.2 Specific Conductance to Salinity Conversion

The H20 calculates salinity (parts per thousand) readings from specific conductance using the following relationship:

$$S = 5.9950(10^{-8})\,C^4 - 2.312\,(10^{-5})\,C^3 + 3.4346(10^{-3})\,C^2 + 0.53532\,C - 1.5494(10^{-2})$$

This relationship is based on salinity data from the U.S. Geological Survey Water Supply Paper No. 2311. While the H20 will calculate salinities in the 0 to 70 ppt range, salinity technically is defined only for mild concentrations and dilutions of sea water (ie., in the 30 to 40 ppt range).

Note that salinity, unlike specific conductance, the parameter from which salinity is calculated, does not vary with temperature. A part-per-thousand is a part-per-thousand, no matter the temperature. However, the above conversion algorithm was generated to work with specific conductance readings.

If you want to produce salinity readings based on a special knowledge of your particular water samples, simply record specific conductance instead of salinity. Then, use your own algorithm to calculate salinity.

5.4.3 Specific Conductance to Resistivity Conversion

Resistivity is the inverse of specific conductance. For example, the resistivity of a water of 0.1 milliSiemems/cm specific conductance is 10 k ohm cm.

5.4.4 Specific Conductance to Total Dissolved Solids (TDS) Conversion

TDS (K mg/l = g/l) is calculated from specific conductance (milli-Siemens/cm) as:

$$TDS = C\ (0.640)$$

(from Water Chemistry, by Snoeyink and Jenkins).

If you want to produce TDS readings based on a special knowledge of your particular water samples, simply record specific conductance instead of TDS. Then, use your own algorithm and a spreadsheet to calculate TDS.

5.5 Correcting Depth for Specific Conductance

The density of water, and hence its ability to impart pressure, increases with increased loads of dissolved materials. Therefore, if depth (or level) is calibrated for fresh water, the readings must be reduced for measurements made in waters with higher specific conductances, such as salt waters. The following correction is used for depth/level readings:

$$F(C) = 1 - 0.03\ (C/52)$$

C is the measured specific conductance in milliSiemens/cm. The raw depth readings are multiplied by F(C) to produce the displayed reading. In effect, no correction is made at zero specific conductance, and readings are reduced by three percent at the specific conductance of sea water (52 milli-Siemens/cm).

5.6 Measuring pH in Very Low Specific Conductance Waters

Making pH measurements in water whose specific conductance is less than 0.2 millisiemens/cm is a whole different ball game. See Application Note #102 in Appendix 3 for more information.

5.7 Turbidity

5.7.1 Measurement Principle

The ISO-7027 specification calls for a nephelometric detector at 90 degrees from an infrared light source of 860 nm. Hydrolab's turbidity sensor, when operated in nephelometric mode, meets all these specifications except the light source is at 880 nm.

The ratio mode adds a transmissive correction to eliminate the "blinding out" phenomenon common in nephelometric instrumentation at high turbidities.

Selection of mode is highly dependent upon your data requirements, adherence to any measurement specifications, and your primary range of measurement.

5.7.2 Ambient Light

The multiprobe measures the sensor responses when the light source is on and when it is off. The difference between the on and off responses is used to eliminate the effects of ambient light and provide the turbidity measurements.

But there is a limit the to the amount of ambient light which can be rejected. If the ambient light "saturates" the sensors, then the on and off responses to the light source will be nearly the same. Incorrect turbidity values are produced. The multiprobe can detect when the ambient light is causing questionable turbidity data. When this condition is detected, a "?" is printed next to the turbidity data value.

The maximum ambient light threshold is equivalent to the amount of light reaching the sensor at a 1m submersion in "turbidity-free" water at full sunlight. At 1m deep, infrared light detected by the sensor is attenuated to 1%.

5.7.3 Light Source Variation

The light source output varies tremendously from part to part and over temperature. A third sensor was added to measure the light output and normalize the nephelometric and transmissive sensor responses.

Additionally, this third sensor allows the multiprobe to detect a faulty light source. The photodiode measures the light source output to insure proper operation. If the light source output becomes too low, a "?" is printed next to the turbidity data. To determine if the "?"' is caused by ambient light or a faulty light source, shield the sensor from ambient light. If the "?" disappears, then the ambient light is too high. Otherwise, please contact Hydrolab Customer Service.

5.8 Performance Measurement and Improvement

This manual is designed to best meet the needs of the "typical" client. However, if your application requires increased performance or operation under unusual circumstances, Hydrolab is willing and able to help. Just call 1-800-949-3766 or 1-512-255-8841. Hydrolab's staff of engineers and application experts will be more than happy to share with you their years of experience in producing good data under demanding field conditions. Just call.

PART SIX
TROUBLESHOOTING

1) Data will not start printing:

a) Are all connectors mated properly?
b) Is the battery voltage between 9 and 18 volts?
c) Is the computer (or other data collection device) on and set to the baud rate to match the multiprobe setting, 8-bit, no parity?
d) Have you properly installed a communications program in your computer?
e) Is your Interface Cable/Calibration Cable compatible with your computer?
f) Is your Interface Cable/Calibration Cable connected to correct serial/RS-232 communications port on the back of your computer and not the parallel port?

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2) Data is printed without header information:

a) Is the header function enabled? (Section 2.6.9)

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3) Only one data line is printed:

a) What is the interval set to? (Section 2.5.11)

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4) "<E" message is printed and/or a bell is sounded:

a) Did you type a character that is not an acceptable answer, for instance, a letter for a numeric value?
b) Did you type the required number of characters? For instance, the standard for calibrating time or interval must be exactly six numeric characters.

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5) Typed command is not accepted; functions cease:

a) Did you hit the return key after typing in a numeric answer?

6) "NC" message printed and a bell is sounded:

a) Are you sure of the value of your calibration standard?
b) Are the sensors properly serviced? (Part Three)
c) Did you type in the value of your calibration standard correctly, and in the proper units?
d) Are the multiprobe's warm-up batteries fresh (if utilized)? (Section 3.12.2)

7) Dissolved oxygen readings are too low to calibrate, and/or pH and/or ORP readings are very high or very low:

a) Are you sure of the value of your sample solution?
b) Are the multiprobe's warm-up batteries fresh (if utilized)? (Section 3.12.2)
c) Are the sensors properly maintained? (Part Three)

8) Specific conductance, temperature, and/or depth readings seem wrong:

a) Are the sensors maintained and calibrated properly? (Part Three)
b) Are you sure of the units being printed? For instance, are the depth/level readings in feet or meters? (Section 2.6.7)

9) Dissolved oxygen readings seem wrong:

a) Is the sensor properly maintained and calibrated? (Section 3.7)
b) Are the multiprobe's warm-up batteries fresh (if utilized)? (Section 3.12.2)
c) Does the multiprobe know whether you are working with a Standard Membrane or a LoFlow™ Membrane? (Section 2.6.5 and Appendix 1)
d) Did you overstretch the LoFlow™ Membrane?

10) Terminal shows random numbers and figures:

a) Have you correctly set the baud rates of both the multiprobe and your communications or terminal emulation software? (Section 2.6.10)

11) Has water leaked into your multiprobe?

WARNING: EXCESS PRESSURE MAY BUILD UP INSIDE AN UNDERWATER HOUSING. THIS CAN CAUSE THE BOTTOM CAP, TOP CAP, SENSORS, OR OTHER REMOVABLE PARTS TO POP OUT OF THE HOUSING WITH ENOUGH FORCE TO CAUSE SERIOUS INJURY TO THE EYES, FACE, OR OTHER PARTS OF THE BODY.

WHENEVER YOU LOOSEN OR TIGHTEN SCREWS THAT HOLD REMOVABLE PARTS, ALWAYS POINT THE PARTS AWAY FROM YOUR BODY AND OTHER PEOPLE.

Follow the multiprobe disassembly instructions in Section 3.12.2.

WARNING: AS YOU REMOVE THE TWO ALLEN RETAINING SCREWS, BE SURE THAT THE BOTTOM CAP IS NOT POINTED AT ANYONE, SINCE THE INTERNAL PRESSURE CAUSED BY THE WATER LEAKAGE MAY BLOW THE BOTTOM CAP OUT OF THE H20 HOUSING. RINSE THE CIRCUIT BOARDS WITH DISTILLED WATER AND BLOW DRY WITH A HAIR DRYER. REPLACE THE WARM-UP BATTERIES (IF USED) AND REASSEMBLE.

Note: Please call Hydrolab Customer Service if you have a leakage problem, even if your multiprobe works well. Customer Service would like to help you prevent the recurrence of leaks.

12) Cannot calibrate turbidity zero

a) Is the standard turbidity-free water? (Section 3.9)
b) Has the sensor been properly cleaned? (Section 3.9)
c) Did you enter exactly zero for the standard?
d) Are bubbles trapped in the guard/retainer? (Section 4.2.1)

13) Cannot calibrate turbidity slope

a) Were errors made in the dilution calculation/execution? (Section 3.9.2)
b) Was stock or dilution allowed to settle before use?
c) Is stock standard correct? (Section 3.9.2)
d) Has the sensor been properly cleaned? (Section 3.9.1)
e) Was the correct standard value entered?
f) Are bubbles trapped in the guard/retainer? (Section 4.2.1)

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14) Dilution produces large turbidity errors

a) Was dilution done from same stock standard as calibration?
b) Were errors made in the dilution calculations/execution? (Section 3.9.2)
c) Was stock or dilution allowed to settle before use?
d) Is stock standard correct?
e) Has error exceeded +/-5% of range at temperature of calibration?
f) Has the +/-5% inter-ranging error been considered?
g) Are bubbles trapped in the guard/retainer? (Section 4.2.1)

---

15) Turbidity values are erratic

a) Are objects moving around the sensor? (Section 4.2.3)
b) Are the particles few and large?

---

16) Turbidity Sensor Drift

a) Has sensor fouled?
b) Has temperature changed? (+/-5% allowed over temperature)

---

17) Turbidity Fouling

a) Has the sensor been properly cleaned? (Section 3.9.1)
b) Has a proper maintenance interval been established? (Section 3.9.1)

18) '?' attached to turbidity data

a) Has sensor been sheltered from ambient light? (Section 4.2.4)

b) Has the light source failed? (If so, please contact Hydrolab Customer Service at 800-949-3766 or 512-255-8841)

19) '@' attached to turbidity data

a) Turbidity variables have been set to nephelometric only operation.

20) '*' attached to turbidity data

a) Both turbidity zero and turbidity slope must be calibrated to remove the asterisk.

PART SEVEN
LOGGING

Logging with the Surveyor 3

Hydrolab manufactures a dedicated logger that connects directly to the H20. Built for reliable field duty, the Surveyor 3 can record data at the operator's command, or can be programmed to log data for long periods with no operator present. Logged data can be transferred directly to a personal computer, and then into spreadsheets, data bases, word processors, graphics packages, etc.

The Surveyor 3 also provides rechargeable internal battery power, a liquid crystal display of six parameter readings at once, and a keypad for field calibrating an H20 without a computer. Please call Hydrolab for specific information.

The DataSonde 3

Hydrolab offers the DataSonde 3 for data logging applications that require a submersible logger. The DataSonde 3 is essentially identical to the H20, except it has a logger and battery supply built into the transmitter housing. Programming and data recovery are done with a personal computer; logged data can be transferred directly to a personal computer, and then into spreadsheets, data bases, word processors, graphics packages, etc.

Please call Hydrolab for specific information.

Logging with a Personal Computer

Almost any personal computer can communicate with, and accept data from, the H20's standard RS-232 output. With software packages available from third-party software producers, this data can then be logged onto floppy or hard disc for later use. The software can be customized to your needs.

There are also several third-party field loggers available that interface to the H20 via RS-232. Please call Hydrolab for specific information.

Logging with Analog Voltage Output

Hydrolab offers an Analog Converter that converts the H20 digital output to parallel voltages or currents. This allows an H20 to be used with virtually any logger, controller, or SCADA system that accepts analog inputs, while retaining the advantages of RS-232 for long cable runs. Please call Hydrolab for specific information.

APPENDIX 1

Dissolved Oxygen

Appendix 1
DISSOLVED OXYGEN: SATURATION VALUES and SENSOR TYPES

A1.1 DO Saturation Values

Here is a listing of the dissolved oxygen saturation values used by Hydrolab water quality multiprobes when performing an air calibration of the DO system. The source of these values is an algorithm given in Measurement of Dissolved Oxygen, Hitchman, 1978. Included for comparison are saturation values from the 1971 and 1985 editions of Standard Methods for the Examination of Water and Wastewater. Each value is in milligrams per liter of zero chlorinity water, with first the temperature noted in degrees Centigrade.

	Hitchman	1985 SM	1971 SM
T°C	milligrams dissolved oxygen per liter water at one atmosphere		
0	14.57	14.621	14.6
1	14.17	14.216	14.2
2	13.79	13.829	13.8
3	13.43	13.460	13.5
4	13.08	13.107	13.1
5	12.74	12.770	12.8
6	12.42	12.447	12.5
7	12.11	12.139	12.2
8	11.81	11.843	11.9
9	11.53	11.559	11.6
10	11.26	11.288	11.3
11	10.99	11.027	11.1
12	10.74	10.777	10.8
13	10.50	10.537	10.6
14	10.27	10.306	10.4
15	10.05	10.084	10.2
16	9.83	9.870	10.0
17	9.63	9.665	9.7
18	9.43	9.467	9.5
19	9.24	9.276	9.4
20	9.06	9.092	9.2
21	8.88	8.915	9.0
22	8.71	8.743	8.8
23	8.55	8.578	8.7
24	8.39	8.418	8.5

(continued)

(continued)

T°C	Hitchman	1985 SM	1971 SM
	milligrams dissolved oxygen per liter water at one atmosphere		
25	8.24	8.263	8.4
26	8.09	8.113	8.2
27	7.95	7.968	8.1
28	7.81	7.827	7.9
29	7.68	7.691	7.8
30	7.55	7.559	7.6
31	7.42	7.430	7.5
32	7.30	7.305	7.4
33	7.18	7.183	7.3
34	7.07	7.065	7.2
35	6.95	6.950	7.1
36	6.84	6.837	7.0
37	6.73	6.727	6.9
38	6.63	6.620	6.8
39	6.52	6.515	6.7
40	6.42	6.412	6.6
41	6.32	6.312	6.5
42	6.22	6.213	6.4
43	6.13	6.116	6.3
44	6.03	6.021	6.2
45	5.94	5.927	6.1
46		5.835	6.0
47		5.744	5.9
48		5.654	5.8
49		5.565	5.7
50		5.477	5.6

Note that these values are for the standard atmospheric pressure of 760 mm Hg. Linear interpolation will provide a reasonable estimate for saturation values of non-whole number temperatures.

See Part Five of the Operating Manual for information on the effect of barometric pressure on DO calibration and readings.

A1.2 LoFlow™ and Standard Membranes

The Standard Membrane (1-mil Teflon™) allows fast, accurate DO measurements in situations where fouling is not a problem and adequate sample flow (greater than about one foot per second) is assured. The LoFlow Membrane (patent pending) trades a little accuracy and response speed for greatly reduced sensitivity to flow and fouling. The LoFlow Membrane is suitable for flows down to about one mil per second.

Best of all, the LoFlow Membrane allows Hydrolab multiprobes to work in either fast-flowing clean waters, or waters where fouling and low or variable flow exist, because a single DO sensor can accommodate the Standard Membrane (1-mil Teflon) or the LoFlow Membrane. To change between the two types of membranes, simply change the membrane (both membrane types are found in the Maintenance Kit), notify the software of the change, and recalibrate.

Software notification is simple: access the Variables menu and select O (o, not zero) for Dissolved Oxygen; you will then be asked to specify S or L. Type an S if you have installed the Standard Membrane; an L if you are using the LoFlow Membrane. Then type an S (meaning you want your DO readings corrected for Salinity) or a U (meaning that you want your DO readings Uncorrected for salinity). You will then be returned to the SOM.

The LoFlow Membrane is a special, low-permeability polymer that reduces the oxygen passage across the membrane (into the sensor) required for a stable reading. It is thus less affected by variations in sample flow and membrane foulants than is the high-permeability Standard Membrane.

The LoFlow Membrane's error due to flow is about -6%, for flows above about one inch per minute. To optimize this error, each reading for the LoFlow Membrane sensor is automatically raised by 2.5%. You will notice this at calibration when the % Saturation reading is set to 102.5%, instead of the expected 100%.

Laboratory tests have shown that fouling that reduces the reading of a Standard Membrane by 20% has no effect on the readings of a sensor equipped with a LoFlow Membrane.

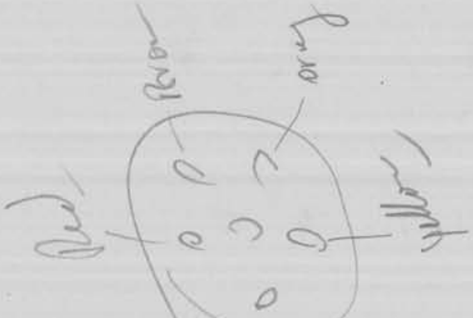
The software that incorporates the operation of the LoFlow Membrane also accommodates a new feature of interest to those measuring DO. If you access the Calibrate menu, and then you access O (for Dissolved Oxygen), you will be asked to state not one, but two standards. The answer to the first Std: "question" is the barometric pressure; type it in as mm of Hg and hit the return key. In answer to the second Std: "question", type in the DO reading you want your calibration to match. For instance, if you had a Winkler reading of 7.11 mg/l and you wanted to calibrate your multiprobe accordingly, you would type in 7.11 and hit the return key. Your multiprobe would then match the result of your Winkler determination.

This is an alternative to the other method for calibrating DO, as explained in Part Three of the Operating Manual, whereby you access % (for % Saturation) and type in a single Std: answer: the barometric pressure. The calibration is then set as the saturation value for the pressure you specified, and the ambient temperature as measured by the multiprobe.

Please read the paper included in the back of this manual (Application Note #105) comparing the LoFlow Membrane with the Standard Membrane and the Recessed Cathode sensor.

APPENDIX 4

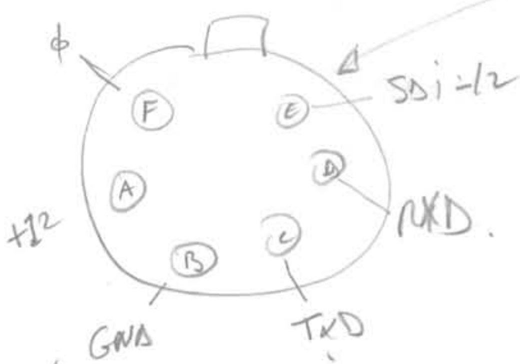
Technical Data

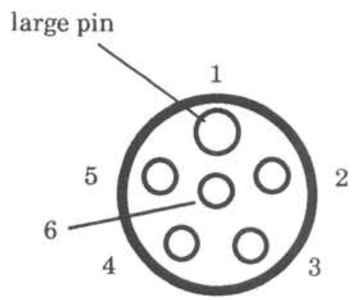

Red
yellow

H20 to RS-232 (with 9D) Pinout

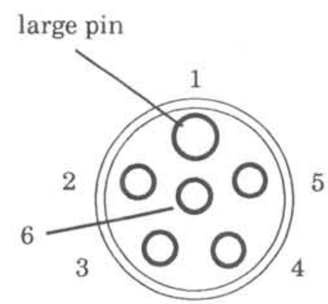
	H20	H20 Underwater Cable			H20-IC9			
Function	6PM bulkhead conn**	6PF marine conn to H20	2PF marine conn to Stirrer*	6PM metal shell conn	6PF charger conn	9PD female conn (to PC)	4P charger conn (to batt)	RBP-6AH battery
+12	1	1	—	A	A	—	A	A "+"
GND	2	2	2	B	B	5	C	C "-"
$\overline{\text{TXD}}$ (to H20)	3	3	—	C	C	3	—	—
$\overline{\text{RXD}}$ (from H20)	4	4	—	D	D	2	—	—
SDI Data	5	5	—	E	E	—	—	—
Stirrer	6	6	1	—	—	—	—	—

* Only if H20-SC option ordered
** Some bulkhead connectors arriving from the manufacturer are misnumbered or not numbered. Use this pictorial to orient numbering system.





6 pin male bulkhead connector **



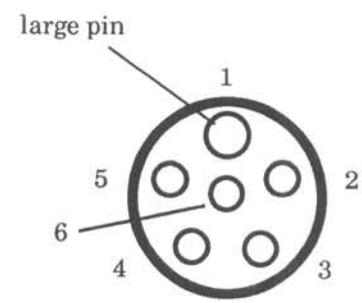
6 pin female marine connector

H20 to RS-232 (with 25D) Pinout

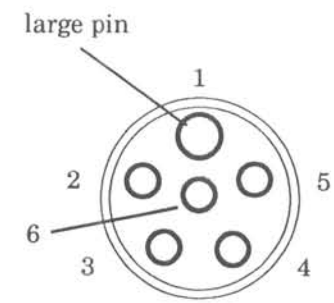
	H20	H20 Underwater Cable			H20-IC25			
Function	6PM bulkhead conn**	6PF marine conn to H20	2PF marine conn to Stirrer*	6PM metal shell conn	6PF charger conn	25PD female conn (to PC)	4P charger conn (to batt)	RBP-6AH battery
+12	1	1	—	A	A	9	A	A "+"
GND	2	2	2	B	B	7	C	C "-"
$\overline{\text{TXD}}$ (to H20)	3	3	—	C	C	2	—	—
$\overline{\text{RXD}}$ (from H20)	4	4	—	D	D	3	—	—
SDI Data	5	5	—	E	E	—	—	—
Stirrer	6	6	1	—	—	—	—	—

* Only if H20-SC option ordered

** Some bulkhead connectors arriving from the manufacturer are misnumbered or not numbered. Use this pictorial to orient numbering system.



*6 pin male bulkhead connector ***



6 pin female marine connector

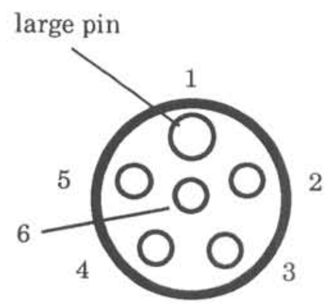
H20 to SDI Pinout

Hydrolab supplied ←

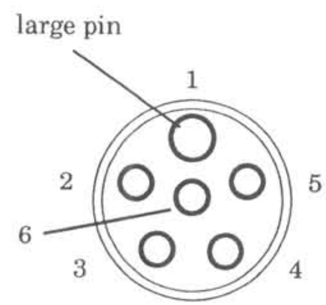
	H20	H20 Underwater Cable			H20-SDIC			
Function	6PM bulkhead conn**	6PF marine conn to H20	2PF marine conn to Stirrer*	6PM metal shell conn	6PF charger conn	wire color	External SDI batt	Campbell BDR SDI-12 conn
+12	1	1	—	A	A	brn	"+"	B
GND	2	2	2	B	B	red	"-"	C
$\overline{\text{TXD}}$ (to H20)	3	3	—	C	—	—	—	—
$\overline{\text{RXD}}$ (from H20)	4	4	—	D	—	—	—	—
SDI Data	5	5	—	E	E	orn	—	A
Stirrer	6	6	1	—	—	—	—	—

* **Only if H20-SC option ordered**

** **Some bulkhead connectors arriving from the manufacturer are misnumbered or not numbered. Use this pictorial to orient numbering system.**



*6 pin male bulkhead connector ***



6 pin female marine connector

H2O Connectors

# of pins	Bendix Part No.		Bendix Part No.
4	H2O-IC POWER (metal shell) PT01A-8-4-SW(SR)(005)	**<--- mates to --->**	PT06A-8-4-PW(SR)(005)
6	H2O Underwater Cable (metal shell) PT06A-10-6-PW(SR)(005)	**<--- mates to --->**	PT07A-10-6-SW(005)

H20 Currents

(@ 12VDC input)

	H20 Supply Current
Standby/Sleep	180–550 µA
RS-232 mode (without Stirrer)	50–60 mA
RS-232 mode (with Stirrer)	90–180 mA
SDI mode "command" response	12–15 mA
SDI mode "measure" (without Stirrer)	65–75 mA
SDI mode "measure" (with Stirrer)	105–195 mA

ADDITIONAL INFORMATION

0 —— 0.15

0.15 —— 1.5 Freq

1.5 → 10

0 → 1.5

1.5 → 15 Sol

15 —— 100

1%

50 ms Act — is ± 1 ms.

.5 ms

Hydrolab Corporation
Multiparameter Water Quality Instrumentation

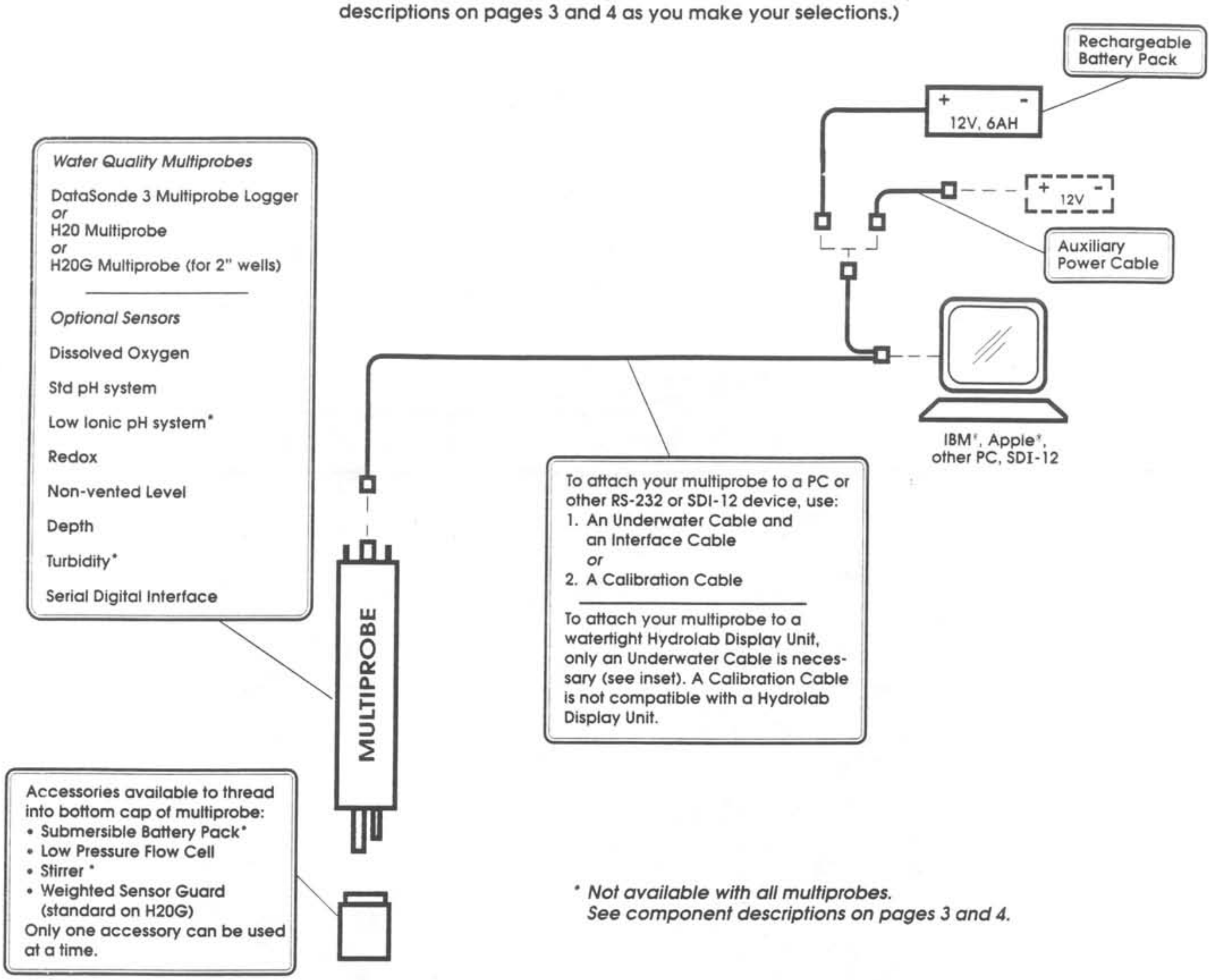
ORDERING GUIDE

Helping Preserve Our World's Water Resources

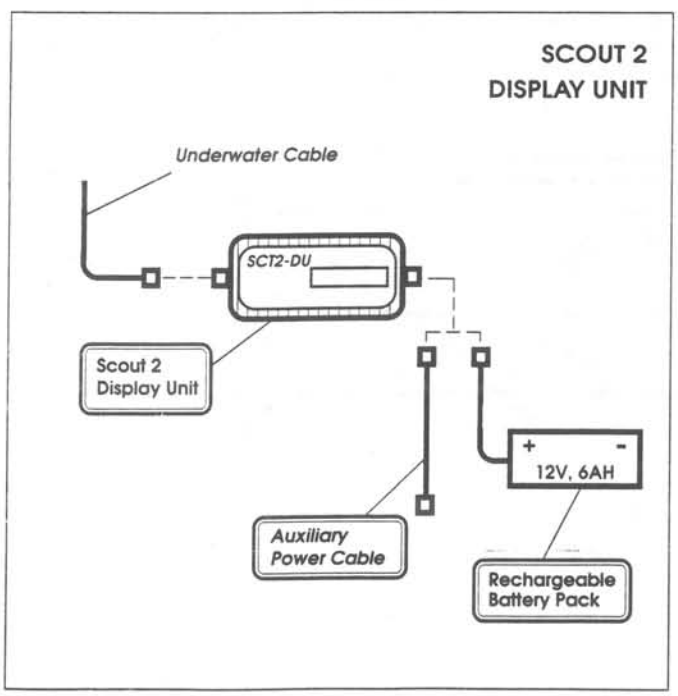
June 1993

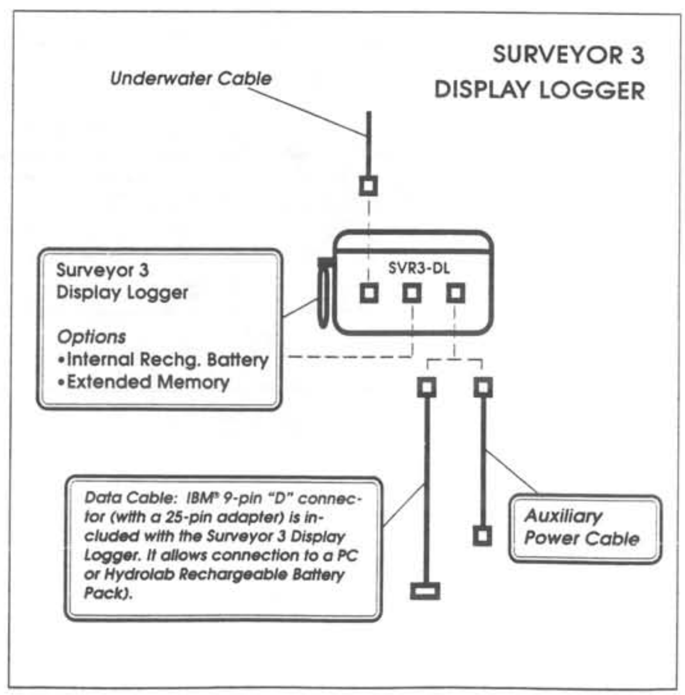
COMPONENT CONFIGURATION

(This diagram does not show all components. Please consult the component descriptions on pages 3 and 4 as you make your selections.)



** Not available with all multiprobes.*
See component descriptions on pages 3 and 4.





COMPONENT DESCRIPTIONS

MULTIPROBES

All our multiprobes include measurement systems for :

• temperature • specific conductance • salinity • resistivity • conductivity • total dissolved solids.

Each is constructed of an engineered plastic housing, 316 stainless steel hardware, and double o-ring seals. Maximum immersion is 150 meters.

H20® MULTIPROBE

Our standard multiprobe. Use it with a Scout 2 Display Unit for profiling and spot-checking. Connect it to a Surveyor 3 Display Logger for unattended logging. Connect it to a PC for viewing and storing data. Collect data remotely while linked through modems or transmitters.

H20®G MULTIPROBE

This multiprobe was designed specifically for monitoring 2" groundwater wells. It serves as an alternative or complement to customary purging and sampling techniques. Same functionality as the H20.

DATASONDE® 3 MULTIPROBE LOGGER

Our most versatile and feature-packed multiprobe. The DataSonde 3 combines all H20 multiprobe capabilities with an internal data logger. Able to store approximately 32,000 readings, it reliably gathers data around the clock for weeks at a time without an operator present.

• EXTENDED MEMORY (70K)

Increases the data storage capacity of the DataSonde 3 to approximately 70,000 readings with all parameters enabled.

• INTERNAL BATTERY PACK

This 10 "AA" alkaline battery cluster for the DataSonde 3 provides an estimated operating time, without a Stirrer, of 30 days, with all parameters and warm-up enabled, using a measurement interval of one hour. If using a Stirrer, the estimated operating time is reduced to approximately 20 days. Installing the Internal Battery Pack increases the overall length of the DataSonde 3 by 3.5 inches. Special note: A battery of one type or another is required for system operation; see other battery packs listed under ACCESSORIES.

• SUBMERSIBLE BATTERY PACK

12 alkaline "C" cells provide an estimated operating time of 140 days, with all parameters and warm-up enabled, using a measurement interval of 1 hour. It is threaded onto the sensor end of the DataSonde 3 and provides negative buoyancy and protection of the sensors. Note: A Submersible Battery Pack cannot be used at the same time with a Stirrer or Flow Cell.

OPTIONAL SENSORS

All sensors are packaged in a single, compact multiprobe. Each multiprobe is configured to your specifications. For extra flexibility, you may add sensors to your multiprobe at a later date in your own facility. If desired, ask for detailed parameter specifications from Hydrolab Sales.

DISSOLVED OXYGEN

Two measurement membranes are included. The Standard Membrane (normally used during profiling) provides fast response (less than 1 minute), but requires a Stirrer (H20-STR) if sample velocities fall below 25 cm/sec. The LoFlow™ Membrane (normally used during unattended monitoring) operates without a Stirrer, even at low sample velocities, but with an increase in response time (approximately 5 minutes).

STANDARD PH

Appropriate for pH measurements in waters with specific conductance above 0.2 mS/cm.

LOW IONIC pH

Recommended if sample specific conductances can fall below 0.2 mS/cm. Either pH system can be installed, but not both. *Not available on H20G.*

REDOX (ORP)

Requires that a pH system also be installed.

NON-VENTED LEVEL

Has an operating range of 10m, a resolution of 0.09m and must not be immersed deeper than 20m.

DEPTH

Has an operating range of 100m, a resolution of 0.45m and must not be immersed deeper than 150m. Either Depth or Level can be installed, but not both.

TURBIDITY

Uses nephelometric method (90° scatter). 0-1000 NTUs with multiple ranges available. Based on ISO 7027. *Not currently available on H20 or H20G.*

SERIAL DIGITAL INTERFACE

Allows a multiprobe to be connected to many 3rd party devices, including the U.S.G.S. "Basic Data Recorder" (BDR) and others that accept inputs from "smart" sensors conforming to the SDI-12 Serial Digital Communication Specification. *Standard on DataSonde 3.*

DISPLAYS

Our display units are compact, portable and lightweight. User-friendly software facilitates fast implementation of all calibration and display commands. Units can read and display six parameters simultaneously on an LCD. Both are powered by internal batteries for reliable field operation.

SCOUT® 2 DISPLAY

Our basic display unit. Just connect a multiprobe and press the "on" button. Includes an internal battery; a neckstrap leaves both hands free.

SURVEYOR® 3 DISPLAY LOGGER

This display logger can store up to 32,000 readings collected during spot-measurements or profiling. Or, it can be deployed with a multiprobe to perform unattended logging for weeks at a time.

• INTERNAL RECHARGEABLE BATTERY

Provides the Surveyor 3 with approximately 11 hours of con-

(continued next page)

tinuous operation with Stirrer running (during profiling) or 14 days while recording all parameters at hourly intervals (in unattended logging mode and warm-up enabled). An international battery charger is also available.

• EXTENDED MEMORY
Increases data storage capacity of Surveyor 3 to approximately 70,000 readings with all parameters enabled.

CABLES

All of our cables consist of custom, high-pressure marine connectors and tough, urethane jackets.

UNDERWATER CABLES
An Underwater Cable connects a multiprobe to a display unit (or, with the help of an Interface Cable, to a PC or other device). Select according to required length. (Note: Maximum immersion of the multiprobe is 150 meters; SDI-12 data transmission is limited to 100 meters.)

STIRRER CONNECTOR
Each cable that will employ a Stirrer requires a Stirrer Connector. If ordering more than one cable, designate each cable that is to have a Stirrer Connector installed. *Not available with H20G cables.*

INTERFACE CABLE
Required to connect an Underwater Cable directly to a PC or other RS-232 device. The cable's standard connector is an IBM® 9-pin D connector (with a 25-pin D adapter). Contact Hydrolab Sales for Interface Cables to fit other 3rd party devices.

SERIAL DIGITAL INTERFACE CABLE
Required to connect an Underwater Cable directly to an SDI-12 compatible device.

CALIBRATION CABLE
A short (3m) cable recommended for convenience during calibration, setup, and data retrieval. Provides direct connection between multiprobe and PC or other RS-232 device, using an IBM® 9-pin D connector (with a 25-pin D adapter). Can be used instead of an Underwater Cable/Interface Cable pair. Contact Hydrolab Sales for Calibration Cables to fit other 3rd party devices.

ACCESSORIES

WEIGHTED SENSOR GUARD
Threaded onto the sensor end of a DataSonde 3 or H20 (when the Stirrer is not used) to provide negative buoyancy and sensor protection during deployment. Note: A Weighted Sensor Guard is standard on the H20G.

STIRRER
Threaded onto the sensor end of the DataSonde 3 or H20 for circulation and to provide negative buoyancy and sensor protection during deployment. Requires Stirrer Connector on cable. *Not available on H20G.*

LOW-PRESSURE FLOW CELL
Used when in-situ operation is not required and the sample is pumped past the sensors, during groundwater well purging, for example. CAUTION: User must not allow sample pressure to exceed 15psi.

STIRRER ADAPTER
Required when a Stirrer is connected directly to the DataSonde 3 during "off-line" (unattended) operation without an Underwater Cable. Note: A Stirrer cannot be used while operating a Submersible Battery Pack or Flow Cell. Must have Internal Battery Pack, DS3-IBP. *DataSonde 3 only.*

ANALOG CONVERTER
The Hydrolab Analog Converter provides industry standard analog output for our multiprobes. The Analog Converter accepts the digital RS-232 output of the multiprobe and can be configured for voltage or current output that is compatible with commercial analog data collection devices. The Analog Converter includes one output card of your choice (expandable to eight), a controller card, and an operating manual. An LCD is optional for real-time display of water quality data.

SUBMERSIBLE BATTERY PACK
12 alkaline "C" cells provide an estimated operating time of 140 days, with all parameters and warm-up enabled, using a measurement interval of 1 hour. It is threaded onto the sensor end of the DataSonde 3 and provides negative buoyancy and protection of the sensors. (Note: A Submersible Battery Pack cannot be used while operating a Stirrer or Flow Cell.) *DataSonde 3 only.*

RECHARGEABLE BATTERY PACK
Provides the DataSonde 3 or H20 an estimated minimum 24 hours of continuous operation with a Stirrer installed. It can also be used to power the H20G. It is recommended for all operation in the laboratory. An international battery charger is also available.

AUXILIARY POWER CABLE
Required for use with customer-owned batteries. CAUTION: Do not connect to a charger, any line-powered device, or any source greater than 18 volts DC.

COMMUNICATION SOFTWARE
A communication software program is required for operating a multiprobe with a PC. We recommend and supply "PROCOMM PLUS®" for IBM® compatibles, though other types may be used.

CUSTOM CARRYING CASE
Recommended to transport and store the DataSonde 3 or H20 Multiprobe and Hydrolab Accessories. *Not currently available for the H20G multiprobe.*

H20 MULTIPROBE

components and pricing

	MODEL	DESCRIPTION	PRICE
	H20-BT	***H20® MULTIPROBE*** Includes an operating manual, calibration/maintenance kit, storage cup, and measurement systems for **temperature, specific conductance, salinity, resistivity, conductivity,** and **total dissolved solids.**	$1,990
OPTIONAL SENSORS	H20-OX	Dissolved Oxygen	395
	H20-SPH	Standard pH	365
	H20-LPH	Low Ionic pH	995
	H20-RDX	Redox (ORP); requires pH	230
	H20-NVL	Non-vented Level (range 0-10meters)	440
	H20-DEP	Depth (range 0-100meters)	440
	H20-SDI	Serial Digital Interface	285
CABLES		***UNDERWATER CABLE LENGTHS***	
	H20-005	5 meter (16 ft.)	360
	H20-010	10 meter (33 ft.)	410
	H20-025	25 meter (82 ft.)	560
	H20-050	50 meter (165 ft.)	810
	H20-075	75 meter (248 ft.)	1,060
	H20-100	100 meter (330 ft.)	1,260
	H20-ICX	Custom length: ______ meters x $9.80/m+$340	______
	H20-SC	Stirrer Connector – factory installed on cable (required to operate Stirrer H20-STR)	95
		INTERFACE CABLES	
	H20-IC	Connects Underwater Cable to IBM® 9-pin D connector (with a 25-pin D adapter)	85
	H20-SDIC	Connects Underwater Cable to SDI-12 device (bare leads, coded)	70
		CALIBRATION CABLE	
	H20-CC	Connects multiprobe to IBM® 9-pin D connector (with a 25-pin D adapter) (3 meters)	85
ACCESSORIES	DS3-WSG	Weighted Sensor Guard	60
	H20-STR	Stirrer, with Sensor Guard (requires a Stirrer Connector)	475
	H20-LFC	Low-Pressure Flow Cell	190
	RBP-6AH	Rechargeable Battery Pack – U.S. (110VAC, 50-60Hz; with carrying case)	185
	RBP-6AHF	Rechargeable Battery Pack – International (220VAC, 50-60Hz; with carrying case)	195
	AUX-PC	Auxiliary Power Cable (for other 12V batteries only)	65
	COM-PCX	Communication Software (terminal emulation)	100
	DS3-CCC	Custom Carrying Case	145
	HYD-PAC	Analog Converter (customer-supplied 12VDC required) – Specify "voltage" or "current" for standard card and any additional cards – Additional Cards: Voltage = $130/ea; Current = $110/ea; Optional LCD = $150	1,295
DISPLAYS	SVR3-DL	***SURVEYOR® 3 DISPLAY LOGGER***	2,850
	SVR3-M70	• Extended Memory (70K)	220
	SVR3-IRBP	• Internal Rechargeable Battery Pack – U.S. (110VAC, 50-60Hz; domestic charger)	300
		– To substitute an international charger (220VAC, 50-60Hz), write "INTL CHGR" on order	15
	SCT2-DU	***SCOUT® 2 DISPLAY UNIT***	1,195

Please refer to component descriptions on pages 3 and 4 before making order selections.

Prices and specifications are subject to change without notice.
Quotes are valid in U.S. dollars (for 30 days)
Payment Terms: Net 30 days; U.S. dollars
Shipping Terms: FREE ground delivery within the 48 states.

DATASONDE 3 MULTIPROBE LOGGER

components and pricing

	MODEL	DESCRIPTION	PRICE
	DS3-BS	***DATASONDE® 3 MULTIPROBE LOGGER*** Includes an operating manual, calibration/maintenance kit, storage cup, video, 35K memory (32,904 readings with all parameters enabled, software version V1.23), SDI-12 capability and measurement systems for **temperature, specific conductance, salinity, resistivity, conductivity,** and **total dissolved solids**.	$3,340
	DS3-M70	• Extended Memory (70K)	220
	DS3-IBP	• Internal Battery Pack	745
OPTIONAL SENSORS	H20-OX	Dissolved Oxygen	395
	H20-SPH	Standard pH	365
	H20-LPH	Low Ionic pH	995
	H20-RDX	Redox (ORP); requires pH	230
	H20-NVL	Non-vented Level (range 0-10meters)	440
	H20-DEP	Depth (range 0-100meters)	440
	DS3-TRB	Turbidity	750
CABLES		***UNDERWATER CABLE LENGTHS***	
	H20-005	5 meter (16 ft.)	360
	H20-010	10 meter (33 ft.)	410
	H20-025	25 meter (82 ft.)	560
	H20-050	50 meter (165 ft.)	810
	H20-075	75 meter (248 ft.)	1,060
	H20-100	100 meter (330 ft.)	1,260
	H20-ICX	Custom length: ______ meters x $9.80/m+$340	______
	H20-SC	Stirrer Connector – factory installed on cable (required to operate Stirrer H20-STR)	95
		INTERFACE CABLES	
	H20-IC	Connects Underwater Cable to IBM® 9-pin D connector (with a 25-pin D adapter)	85
	H20-SDIC	Connects Underwater Cable to SDI-12 device (bare leads, coded)	70
		CALIBRATION CABLE	
	H20-CC	Connects multiprobe to IBM® 9-pin D connector (with a 25-pin D adapter) (3 meters)	85
ACCESSORIES	DS3-WSG	Weighted Sensor Guard	60
	H20-STR	Stirrer, with Sensor Guard	475
	H20-LFC	Low-Pressure Flow Cell	190
	DS3-SA	Stirrer Adapter	150
	DS3-SBP	Submersible Battery Pack	665
	RBP-6AH	Rechargeable Battery Pack – U.S. (110VAC, 50-60Hz; with carrying case)	185
	RBP-6AHF	Rechargeable Battery Pack – International (220VAC, 50-60Hz; with carrying case)	195
	AUX-PC	Auxiliary Power Cable (for other 12V batteries only)	65
	COM-PCX	Communication Software (terminal emulation)	100
	DS3-CCC	Custom Carrying Case	145
	HYD-PAC	Analog Converter (customer-supplied 12VDC required) – Specify "voltage" or "current" for standard card and any additional cards – Additional Cards: Voltage = $130/ea; Current = $110/ea; Optional LCD = $150	1,295
DISPLAYS	SVR3-DL	***SURVEYOR® 3 DISPLAY LOGGER***	2,850
	SVR3-M70	• Extended Memory (70K)	220
	SVR3-IRBP	• Internal Rechargeable Battery Pack – U.S. (110VAC, 50-60Hz; domestic charger)	300
		– To substitute an international charger (220VAC, 50-60Hz), write "INTL CHGR" on order	15
	SCT2-DU	***SCOUT® 2 DISPLAY UNIT***	1,195

Please refer to component descriptions on pages 3 and 4 before making order selections.

Prices and specifications are subject to change without notice.
Quotes are valid in U.S. dollars (for 30 days)
Payment Terms: Net 30 days; U.S. dollars
Shipping Terms: FREE ground delivery within the 48 states.

R.G.A. No. ____________

Date Shipped to Hydrolab ____________

HYDROLAB

SERVICE MEMORANDUM

The following information is requested in order to process your order for warranty or non-warranty service. Please include this form, fully completed, with your return shipment.

Customer Contact Name ____________

Customer Phone Number ____________

Address for return shipment of repaired equipment ____________

City ____________ State ____________ Zip ____________

Address for billing (or purchase authority) for repair charges not covered by warranty ____________

City ____________ State ____________ Zip ____________

WARRANTY INFORMATION – please check the appropriate box and furnish requested materials:

- ☐ *Sales Warranty* — Attach copy of Invoice or Proof-of-Purchase
- ☐ *Service Warranty* — Attach copy of previous R.G.A.
- ☐ *Non-Warranty* — Method of payment: ☐ VISA/MC ☐ P.O. No. ____________ ☐ Other ____________

SHIPPING INSTRUCTIONS – Please refer to the instructions given under SERVICE AND WARRANTY (found in the back of your Instrument Operating Manual) before packaging your instrument for shipment to Hydrolab.

Note: Please install dummy plugs and fill storage cups about 2/3 full of water prior to packaging.

Address each carton to:

HYDROLAB CORPORATION
SERVICE DEPARTMENT
12921 BURNET ROAD
AUSTIN, TX 78727 U.S.A.

Please clearly mark each box with: **R.G.A. No.** ____________
Carton # ______ **of** ______

Please describe equipment problem on the reverse side of this memorandum.

HYDROLAB CORPORATION • P.O. Box 50116 • Austin, Texas 78763 • USA
Telephone 800-949-3766 or 512-255-8841 • FAX 512-255-3106

INVENTORY OF EQUIPMENT BEING RETURNED

Model No. and Description	Serial No.

Description of Problem(s) or Explanation

R.G.A. No. ______________

Date Shipped to Hydrolab ______________

HYDROLAB

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