



YSI Environmental

Pure
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**YSI ADV6600
Environmental Monitoring System**

**Operations
Manual**

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Section 1. Introduction to the ADV6600

1-1. About the ADV6600

The ADV6600 is a fully integrated system that measures both water velocity and water quality. The instrument combines the Acoustic Doppler Velocimeter (ADV) technology of the established Argonaut ADV instrument from SonTek with most of the water quality sensors of the 6600 sonde from YSI.

The appearance of the ADV6600 is similar to other YSI 6-Series sondes and the 6600 and ADV sensors function in an identical fashion to that of their “parent” instruments. The principal design differences between the ADV6600 and its parent instruments are the interface capabilities. For example, the ADV6600 uses new cable assemblies for interface to a PC or DCP, rather than the standard YSI 6-series cables and, at this time, there is no capability to interface to a handheld field display other than a laptop computer. In addition, interface with the ADV6600 occurs through a specially designed software package called ADVantage 6600 rather than EcoWatch for Windows which is used with 6-series sondes. The ADVantage 6600 software (provided with the ADV6600 as part of the standard package) allows the user to set up the instrument, calibrate sensors, deploy the instrument, download data, and perform data analysis.

A full range of parameters can be measured using the ADV6600. The system comes standard with the ADV, compass/tilt, conductivity and temperature sensors. In addition, the instrument may be outfitted with sensors for pressure, pH, ORP, dissolved oxygen, two optical parameters (chlorophyll, turbidity, or rhodamine WT), and two ISE parameters (chloride, ammonium, or nitrate).

The ADV6600 instrument is suitable for a variety of different applications including the monitoring of streams and estuaries. It is also ideal for low flow applications in wetlands and marshes. The common theme among all of the ADV6600 applications is to correlate patterns of water movement with data from traditional water quality sensors such as dissolved oxygen, conductivity, and pH.

1-2. About YSI, Inc.

From a three-man partnership at Antioch College in Yellow Springs, Ohio, in 1948, YSI Inc. has grown into a commercial enterprise that designs and manufactures precision sensors and instrumentation for users around the world. Through our broad range of products, YSI provides innovative solutions to sustain the environment and enhance life. Our four major markets are water testing and monitoring, health care, bioprocessing, and OEM temperature measurement.

In the 1950s, Hardy Trolander and David Case made the first practical electronic thermometer using a thermistor. This equipment was developed for Dr. Leland Clark’s original heart-lung machine. In the 1960s, YSI refined a Clark invention, the membrane-covered polarographic electrode, and commercialized oxygen sensors and meters that revolutionized how dissolved oxygen is measured in wastewater treatment plants and environmental water. Today, geologists, biologists,

environmental enforcement personnel, officials of water utilities, and fish farmers, to name a few, recognize YSI as the leader in dissolved oxygen measurement. In the 1970s, YSI commercialized another Clark invention, the enzyme membrane, which resulted in the first practical use of a biosensor to measure blood sugar accurately and rapidly. Over the years, this technology was extended to applications in biotechnology, health care, and sports medicine.

In the 1990s, YSI launched a product line of multi-parameter water monitoring systems to address the emerging need to measure non-point source pollution. YSI has thousands of instruments in the field that operate with the push of a button, store data internally, and communicate with computers. These instruments are ideal for profiling and monitoring water conditions in industrial and municipal wastewater effluents, lakes, rivers, wetlands, estuaries, and coastal waters. With on-board battery power, the instruments may be left unattended for weeks with measurement parameters sampled at the user's choice of time interval and data securely saved in the unit's internal memory. The fast response of YSI's sensors makes the systems ideal for vertical profiling and their small size allows them to fit down 2-inch diameter monitoring wells. All YSI multi-parameter systems feature the patented Rapid Pulse™ Dissolved Oxygen sensor, which exhibits low stirring dependence.

YSI Incorporated is an international company with world headquarters in Yellow Springs, Ohio. The employee-owned company manufactures and markets sensor technologies dedicated to ecological sustainability. Its three strategic business units include YSI Environmental, YSI Temperature, and YSI Life Sciences.

SonTek, founded in 1992 and acquired by YSI in 2001, is a world leader in the field of water velocity measurement. SonTek manufactures affordable, reliable acoustic Doppler current profilers, velocimeters, Doppler velocity logs, and integrated systems for use in oceans, rivers, lakes, harbors, estuaries and laboratories.

YSI has established a worldwide network of selling partners in 54 countries that includes laboratory supply dealers, manufacturers' representatives, and YSI's sales force. Subsidiaries are located in the United Kingdom, Japan, Hong Kong, and China.

Employee-owned since 1983 and named ESOP Company of the Year in 1994 by the national ESOP Association, every YSI employee is one of its owners. YSI is proud of its products and is committed to serving its customers.

1-3. How to Use This Manual

The manual is organized to let you quickly understand and operate the YSI ADV6600 Environmental Monitoring System. However, it cannot be stressed too strongly that informed and safe operation is more than just knowing which buttons to push. An understanding of the principles of operation, calibration techniques, and system setup is necessary to obtain accurate and meaningful results.

If you have any questions about this product or its application, please contact YSI's Technical Support department or authorized dealer for assistance.

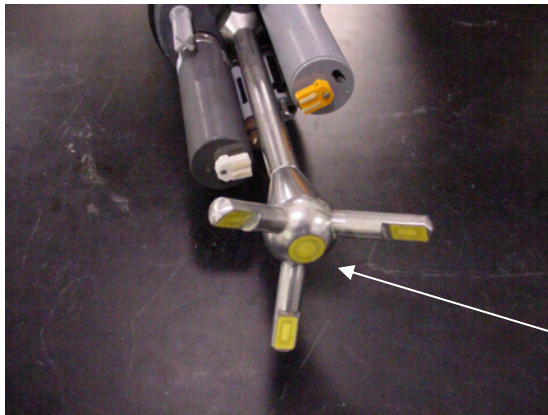
1-4. Unpacking and Inspection

Inspect the outside of the shipping box for damage. If any damage is detected, contact your shipping carrier immediately. Remove the equipment from the shipping box. Some parts or supplies may be loose in the shipping box so check the packing material carefully. Check off all of the items on the packing list and inspect all of the assemblies and components for damage.

If any parts are damaged or missing, contact your YSI representative immediately. If you purchased the equipment directly from YSI, or if you do not know which YSI representative your equipment was purchased from, please call 1-800-897-4151 for assistance.

1-5. Safety Considerations

The acoustic pulses transmitted from the ADV6600 sensor poses no safety concerns under all normal operating conditions which are likely to be encountered by the user. However, YSI does recommend that users avoid direct skin contact with the transmit transducer (the circular yellow disk in the center of the Doppler arm) while the Doppler sensor is active.



Transmit Transducer

Please contact YSI Technical Support at 800-897-4151 if you have any questions about the use of your ADV6600.

Section 2. Preparing the System for Field Studies

Before using your ADV6600 in field studies to correlate water movement with water quality parameters, you will need to prepare the dissolved oxygen sensor for use, install the water quality probes into their proper ports, supply a power source, and attach a cable between the ADV6600 and your PC. This section provides detailed instructions for this setup procedure.

2-1. Preparing the Dissolved Oxygen Probe

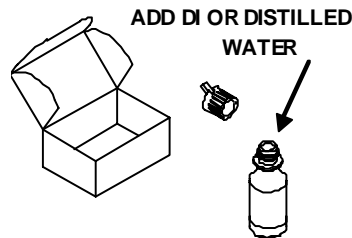
The DO probe is shipped with a dry, protective membrane secured by an o-ring. This membrane requires replacement before initial use of the sonde. Subsequent membrane changes should be performed before each deployment of the sonde and at least once every 30 days during sampling applications, or more frequently as needed.

Initial DO membrane installation can be performed before the 6562 DO probe is installed in the sonde. However, after installation of the probe, it is recommended that removal of the probe from the body of the ADV6600 be limited and future membrane changes should be performed while the probe is installed.

WARNING! Wash hands before installation and do not allow finger oils or O-ring lubricant to touch the probe face or the membrane.

2-1.1. Preparation of the DO Electrolyte Solution

Unpack the 6562 DO Probe Kit. Locate the 5775 DO Membrane Kit and prepare the electrolyte solution. Dissolve the KCl (Potassium Chloride) in the dropper bottle by filling it to the neck with deionized or distilled water and shaking until the solids are fully dissolved. After the KCl is dissolved, wait a few minutes until the solution is free of bubbles before using.

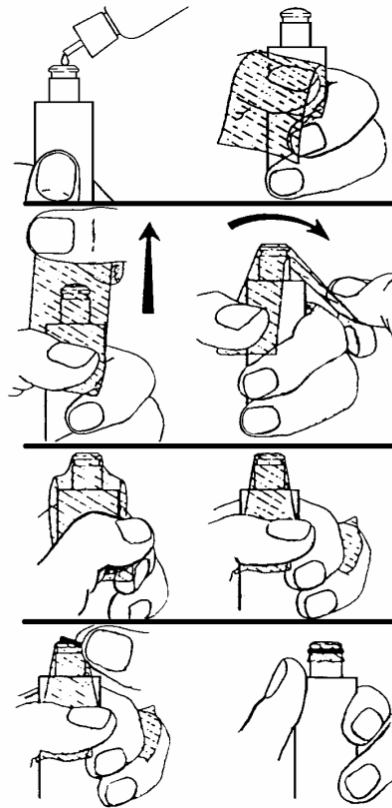


2-1.2. Membrane Installation without the DO Probe Installed in the Sonde

- Remove the protective cap and the dry membrane from the YSI 6562 DO Probe. **Handle the probe with care to prevent the sensor tip from becoming scratched or contaminated.**
- Leave the protective cap in place over the connector end of the probe to prevent contamination by the electrolyte.

Section 2. Preparation of the Sonde

- Hold the probe in a vertical position and apply a few drops of electrolyte solution to the tip. The fluid should completely fill the small moat around the electrodes and form a meniscus on the tip of the sensor. Be sure no air bubbles are visible. If necessary, shake off the electrolyte and start over.
- Secure a membrane between your thumb and the probe body. **Always handle the membrane with care, touching it only at the ends.**
- With the thumb and forefinger of the opposite hand, grasp the free end of the membrane. With one continuous motion, gently stretch it up, over, and down the other side of the sensor. Do not hesitate to stretch the membrane until it conforms to the face of the sensor. Secure the membrane with the forefinger of the hand holding the probe body.
- Roll the o-ring over the end of the probe, being careful not to touch the membrane surface with your fingers. There should be no wrinkles or air bubbles. If any are present, remove the membrane and repeat the installation procedure with a new membrane. Squeeze the o-ring every 90 degrees to equalize the tension. Do not use grease or lubricant of any kind on the o-ring.



- Trim off any excess membrane with a sharp knife, a scalpel, or scissors. Make the cut about 1/8-inch below the o-ring. Rinse off any excess KCl solution, but be careful not to get any water in the connector.

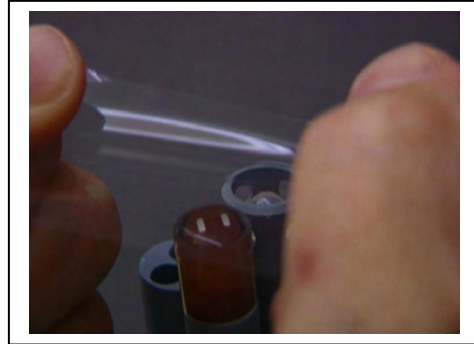
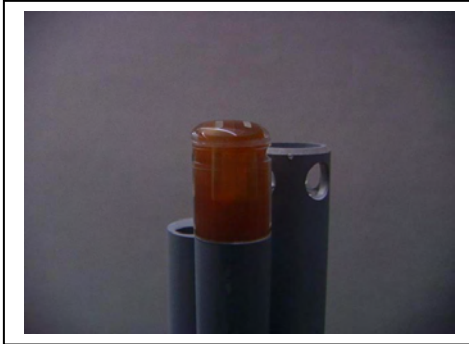
Note: You may find it more convenient to mount the probe vertically in a vise with rubber jaws while applying the electrolyte and membranes to the sensor tip.

2-1.3. Membrane Installation with the DO Probe Installed in the Sonde

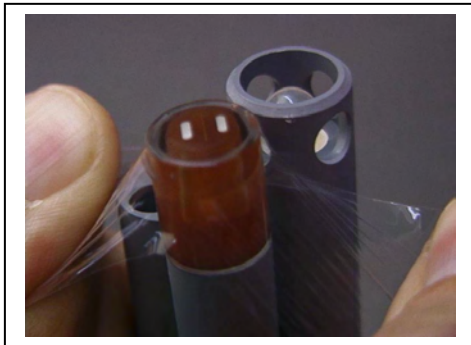
- Secure the sonde in a vertical position using a vise, or a clamp with rubber jaws and ring stand. Secure it tightly so that it will not move during membrane installation. Position the sonde with the sensors upright. Remove the calibration cup or probe guard from the sonde.

Section 2. Preparation of the Sonde

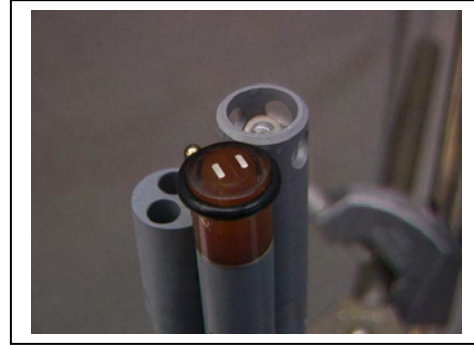
- Remove the old DO membrane and clean the probe tip with water and lens cleaning tissue. Make sure to remove any debris or deposits from the O-ring groove. **Handle the probe with care to prevent the sensor tip from becoming scratched or contaminated.**
- Apply a few drops of electrolyte solution to the tip of the probe. The fluid should completely fill the small moat around the electrodes and form a meniscus on the tip of the sensor. Be sure no air bubbles are visible. If necessary, shake off the electrolyte and start over.



- Hold the membrane so that all four corners are supported, but do not stretch the membrane laterally. **Always handle the membrane with care, touching it only at the ends.**
- Position the membrane over the probe, keeping it parallel to the probe face.
- Using one continuous downward motion, stretch the membrane over the probe face. Do not hesitate to stretch the membrane until it conforms to the face of the sensor.



- Roll the o-ring over the end of the probe, being careful not to touch the membrane surface with your fingers. There should be no wrinkles or air bubbles. If any are present, remove the membrane and repeat the installation procedure with a new membrane. Squeeze the o-ring every 90 degrees to equalize the tension. Do not use grease or lubricant of any kind on the o-ring.



- Trim off any excess membrane with a sharp knife, a scalpel, or scissors. Make the cut about 1/8-inch below the o-ring. Rinse off any excess KCl solution.
- Use caution when replacing the probe guard that you do not touch the membrane. If you suspect that the membrane has been damaged, replace it immediately.

2-2. Installing Water Quality Probes

Remove the calibration/transport cup from your ADV6600 by hand to expose the bulkhead.

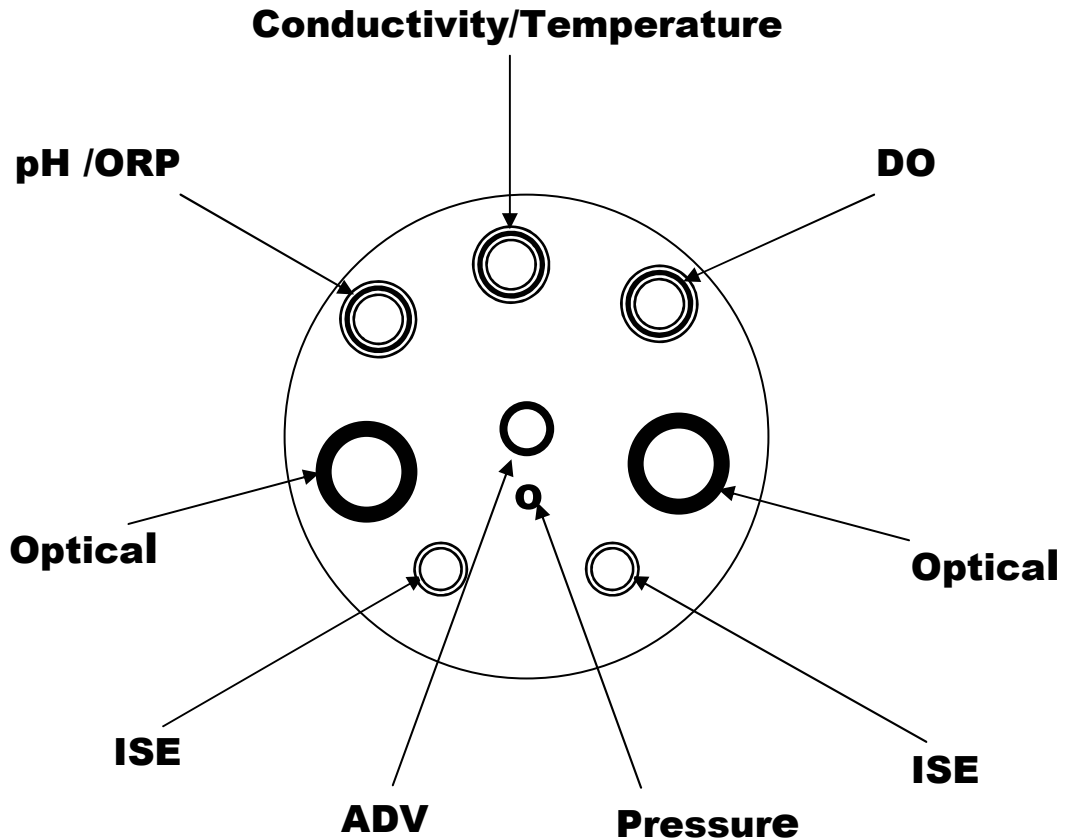
Note: The ADV probe is a non-removable sensor.

2-2.1. Removing the Port Plugs

Using the long extended end of the probe installation tool supplied in the YSI 6570 Maintenance Kit, remove the port plugs by unscrewing them from the bulkhead of the sonde. Save all the port plugs for possible future use. If the provided tool is misplaced or lost, you may use 7/64" and 9/64" hex keys as substitutes.

NOTE: *You may need pliers to remove the ISE port plugs, but do not use pliers to tighten the ISE probes. Hand-tighten only.*

2-2.2. Bulkhead Diagram



- ADV Probe = Non-removable
- Pressure Sensor = Non-removable
- 6562 Dissolved Oxygen (DO) probe = 3-pin connector
- 6560 Conductivity/Temperature = 6-pin connector
- 6561 pH probe = 4 pin connector
- 6565 Combination pH/ORP probe = 4 pin connector
- 6882 Chloride (ISE) Probe = leaf spring connector
- 6883 Ammonium (ISE) Probe = leaf spring connector
- 6884 Nitrate (ISE) Probe = leaf spring connector
- 6026 Turbidity (Optical) Probe, Wiping = 8 pin connector
- 6136 Turbidity (Optical) Probe, Wiping = 8 pin connector
- 6025 Chlorophyll (Optical) Probe, Wiping = 8 pin connector
- 6130 Rhodamine WT (Optical) Probe, Wiping = 8 pin connector

2-2.3. O-Ring Lubrication

Apply a very thin coat of o-ring lubricant, supplied in the YSI 6570 Maintenance Kit, to the o-rings on the connector end of each probe to be installed. After application, the o-ring lubricant should not be visible, but rather it will add a slight shine to the o-ring. If the lubricant can visibly be seen, remove the excess very carefully with a piece of lens tissue (or equivalent non-shedding material, i.e. fibreless q-tips), being careful not to get any on the probe connectors.

***Caution!** Make sure that there are no contaminants between the o-ring and the probe. Contaminants that are present under the o-ring may cause the seal to leak when the sonde is deployed.*

2-2.4. Installing the Optical Probes

If you have a turbidity, chlorophyll, and/or rhodamine WT probe, it is recommended that the optical sensors be installed first. If you are not installing one of these probes, do not remove the port plug, and go on to the next probe installation.

Install the probe into the port, seating the pins of the two connectors before you begin to tighten. Tighten the probe nut to the bulkhead using the short extended end of the tool supplied with the probe. Do not over-tighten. **Be careful not to cross-thread the probe nut.**

The optical ports of the ADV6600 are labeled “T” and “C” on the sonde bulkhead. Each port can accept any of the four optical sensors. Be sure to take note of which sensor is installed in which port so that you will later be able to set up the sonde software correctly.

2-2.5. Installing the Conductivity/Temperature, DO, and pH/ORP Probes

Insert the probe into the proper port using the diagram on the previous page as a guide and rotate the probe until the pins engage. Seat the pins of the two connectors together as far as possible before you begin to tighten.

The probes are held in place with slip nuts. With the connectors aligned and the two connector halves engaged, hand-tighten the probe nut and then use the long extended end of the probe installation tool to snug it. Do not over-tighten. **Be careful not to cross-thread the probe nuts.**

2-2.6. Installing the ISE Probes

The ammonium, nitrate, and chloride ISE probes do not have slip nuts and should be installed without tools. Use only your fingers to tighten. Make sure that the probe body of the ISE probes is seated directly on the sonde bulkhead. This will ensure that connector seals will not allow leakage.

Any ISE probe can be installed in either of the two ports labeled “3” or “4” on the sonde bulkhead. Be sure to take note of which sensor was installed in which port so that you will later be able to set up the sonde software correctly.

2-2.7. Installing the Probe Guard

Included with your sonde is a probe guard. The probe guard protects the probes during calibration and measurement procedures. Once the probes are installed, the guard can be installed by aligning it with the threads on the bulkhead and turn the guard clockwise until secure. **Be sure not to damage the DO membrane during installation of the probe guard.**

2-3. Attaching Your Sonde to a Computer

2-3.1. Installing the Batteries

The ADV6600 utilizes 8 C-size alkaline batteries which were supplied with the instrument. These batteries are not rechargeable and should be properly disposed of when expended.

Install the batteries into the ADV6600 according to the following directions:

1. Loosen the battery lid screws. If necessary, a flathead screwdriver may be used. It can be helpful to press the battery lid while unscrewing retaining thumb screws such that the lid or thumb screws do not bind.
2. Remove the battery lid and install the batteries, as shown. Observe the correct polarity noted on the outside of the battery lid before inserting each battery into the battery chamber.
3. Check the O-ring and sealing surfaces for any contaminates which could interfere with the O-ring seal of the battery chamber. Remove any contaminates present.
4. Return the battery lid and tighten the screws by hand. It can be helpful to apply some pressure to the battery lid while screwing the thumb screws to prevent binding or non-uniform compression.



Note: Always power the system off when not in use to avoid draining the system batteries.

2-3.2. Preparing the Cable

The cable purchased with your ADV6600 has an Impulse™ MCIL-8-MP connector on the ADV6600 end and a military-style 8 pin connector (MS-8) on the interface end. Before communicating with the ADV6600 through this cable, the YSI 6095B MS-8 to DB-9 adapter (supplied with each sonde) must be connected to the MS-8 end of the cable. Place the MS-8 ends of the cable and adapter together, and rotate until the alignment pins engage and the male and female portions of the connector slide together. Once the bodies of the connectors are fully engaged, twist the knurled ring on the cable until the two pieces lock together.

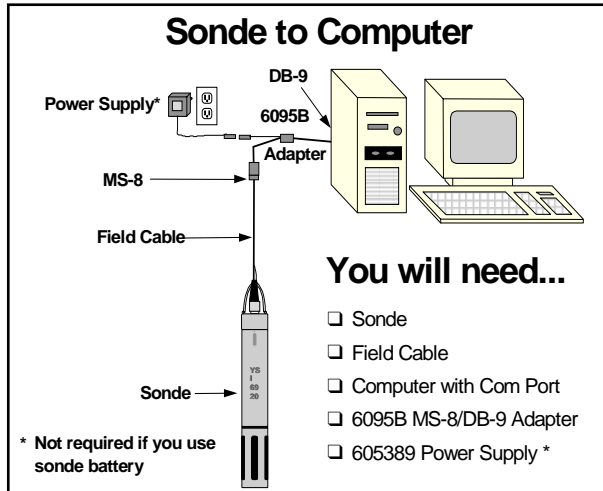
2-3.3. Using the AC Power Supply

Although the ADV6600 has internal batteries, using the optional Model 6651 power supply for laboratory studies and for sonde calibration and setup is often convenient and extends battery life. The 6651 will automatically convert line voltages of 90 to 264 to 12 VDC and allows for the use of line input cords from most countries world-wide. The 6651 is supplied with an American/Canadian cord.

To use the 6651, attach the four-pin connector from the power supply to the mating connector on the 6095B adapter by twisting them together and then simply plug the power cord into the appropriate AC outlet. Once the power and communications cable has been powered, be sure that the exposed 8-pin connector does not come in contact with water, metal, or other shorting material as this can cause permanent and irreversible damage to the connector.

2-3.4. Attaching the Cable

Attach your ADV6600 to a computer for initial setup by connecting the proper end of the cable to the sonde connector and attaching the strain relief connector to the sonde bail. Then connect the other end of the cable assembly (DB-9) to a serial port on your computer. Use the diagram and picture below to make sure that your connections are correct.



Now that the Water Quality sensors, power source, and cable have been installed on your ADV6600, you are ready to proceed to installation of ADVantage 6600 PC software and the setup of the firmware which resides within the sonde. These activities are detailed in Section 3.

Section 3. Configuring Your ADV6600 – Installation of ADVantage 6600 Software and Sonde Firmware Set-up

In Section 2, you set up the physical components of your ADV6600 – sensors, power source, and cable. In this section, you will learn how to install the PC software which allows interface to your ADV6600 and how to use this interface to correctly configure the firmware packages in the sonde which control the velocity and water quality sensors.

3-1. ADVantage 6600 Software – System Requirements

- IBM Compatible PC with Pentium processor or above
- Windows® 98, NT, 2000, ME, or XP
- 32 MB memory
- 5 MB available disk space
- CD-ROM Drive
- RS-232 Serial Port
- Monitor capable of 800 x 600 resolution or better

3-2. Installing ADVantage 6600 Software

To install ADVantage 6600 software to your computer, perform the following steps:

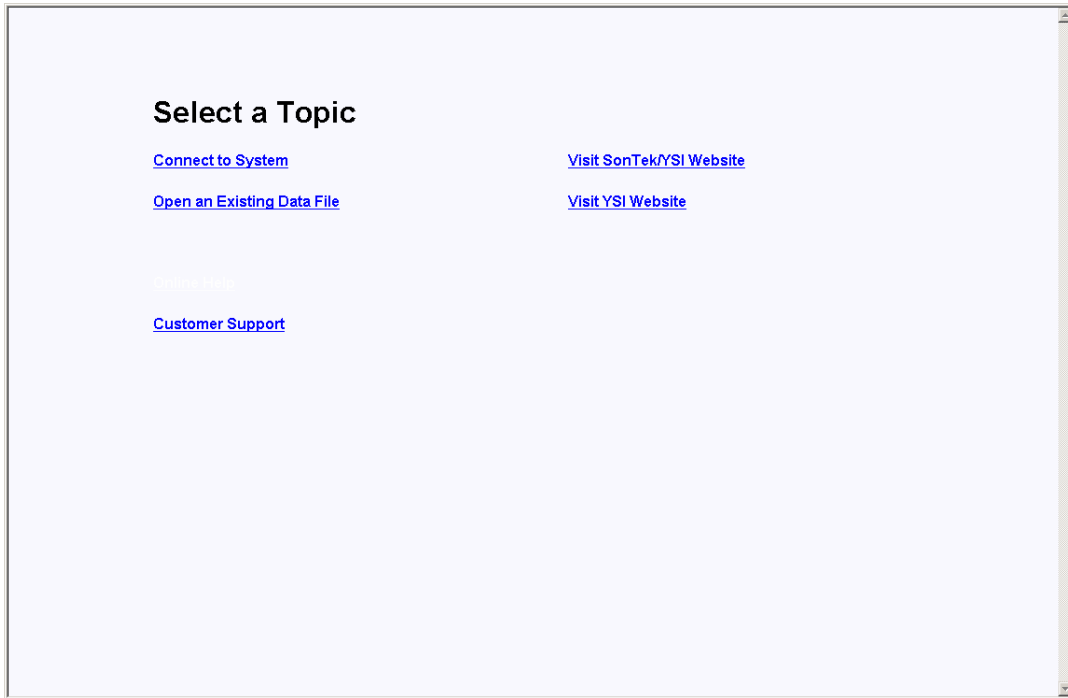
- Place the ADVantage 6600 CD-ROM into the CD drive of your computer.
- Use Windows Explorer or My Computer to view files on the CD-ROM. Double-click on the **ADVantage 6600_setup.exe** file.

The display will indicate that ADVantage 6600 is proceeding with the setup routine. Follow the instructions on the screen as the installation proceeds. For most applications, the default settings should work without problems. After installation, there is no need to restart the computer.

3-3. Launching the Software

To run ADVantage 6600, click on the Windows **Start** button. Go to **Programs>YSI Software>ADVantage 6600**; or click on the icon located on your desktop.

The program will display the following screen.



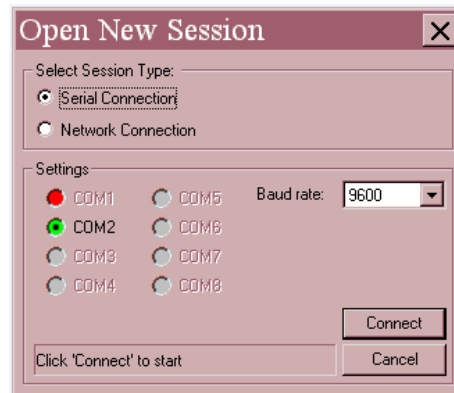
3-4. Connecting to the System

When choosing the “Connect to System” selection, the **Open New Session** dialog box will appear as shown below. A Session is used to describe a mode in which the software will be utilized. The type of session may be selected by clicking on the appropriate button.

The default settings in the dialog box establish a Serial Connection which allows direct connection between the ADV6600 and your computer through a serial (COM) port. **This option should be used for most ADV6600 applications.** You will need to select the COM port to which your ADV6600 is attached and confirm that the baud rate is set to 9600.

Settings

This area displays the available COM ports on your computer and the COM port being used



Section 3. Installation and Setup

for the current session. There are a maximum of eight available COM ports.

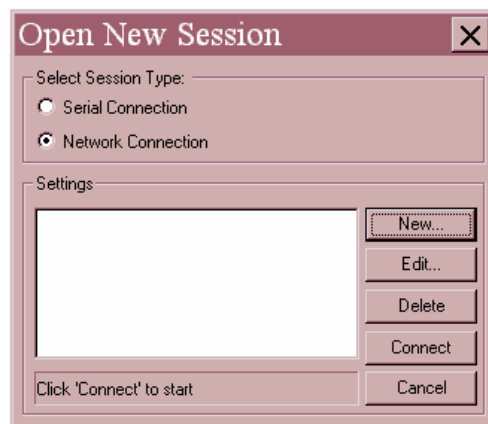
The COM port radio buttons (labeled **COM1** through **COM8**) will display in one of three colors – green = available for use by an instrument; red = in use or not available for use by an instrument; gray = not detected on the computer. Additionally, the “active” radio button (the one with a black dot in the middle) shows which COM port is connected to the instrument being used by the currently selected session.

If no radio button is “active” for the selected session, you can click on the appropriate COM port radio button to connect to the instrument via ADVantage 6600 software.

Baud Rate

This dropdown list lets you change the communications baud rate of your instrument for special applications. The default baud rate is set to 9600 at the factory and this setting should be used for all typical ADV6600 applications. **The baud rate should NOT be changed from 9600 except on advice from YSI Technical Support personnel.**

You may also select the **Network Connection** option by clicking the appropriate button and the following dialog box will be shown. This option is for connections established through SonTek’s SonGate software. A network (TCP/IP or LAN) must be in place and the host computer must be running for this option to be used. When a network connection is chosen, the user will have the option to select an existing network connection setup, create a new setup, or edit an existing setup using the buttons on the right of the dialog box. When the setup information is entered and selected, click on **Connect** to display the options for communicating with the instrument



REMEMBER: Unless advised otherwise by YSI Technical Support personnel, use the Serial Connection option at a baud rate of 9600 to interface to your ADV6600.

3-5. Understanding the Firmware of the ADV6600

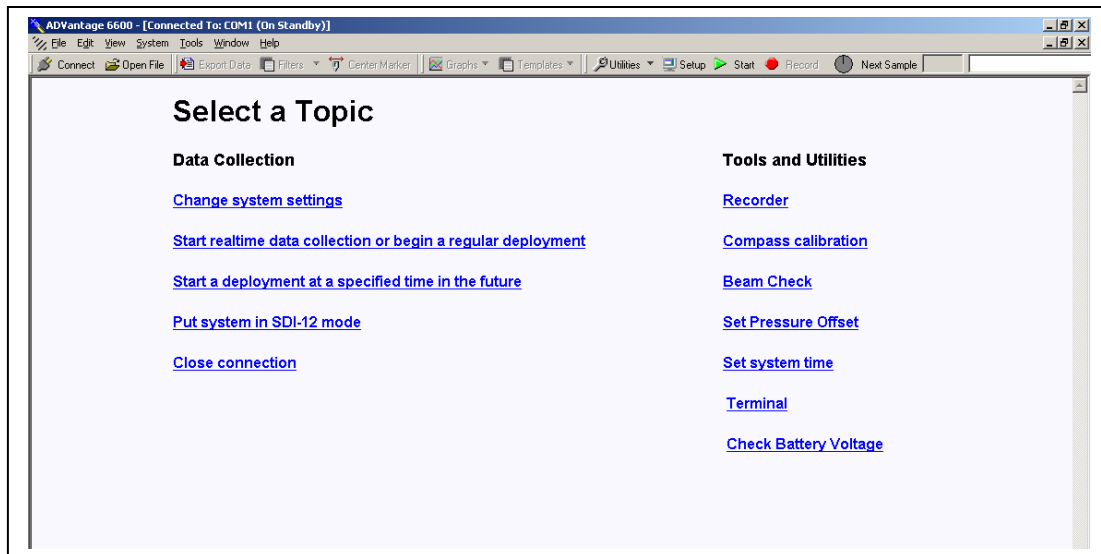
There are three sets of software being utilized when working with the ADV6600. The ADVantage 6600 interface software which was just installed resides in your PC. The other two software packages reside within the ADV6600 itself and are termed firmware. One firmware package is called “ADV Firmware” in this manual is designated as the “Master” of the two firmware components and controls the ADV, compass/tilt, and pressure sensors as well as the logging and data retrieval functions. The other firmware (called the “Water Quality Firmware” in this manual) is designated as the “Slave” and controls only the water quality sensors

When communication is established with the ADV6600 from ADVantage 6600, the PC-based software begins direct communication with the ADV firmware. If information is required from the water quality sensors, the ADV firmware communicates in turn with the Water Quality firmware to retrieve the data. Prior to using your ADV6600 in field studies it is necessary to set up both the ADV and Water Quality firmware packages to provide the output appropriate to your studies and this procedure is described in the following two sections.

3-6. Setting up the Water Quality Sensor Firmware

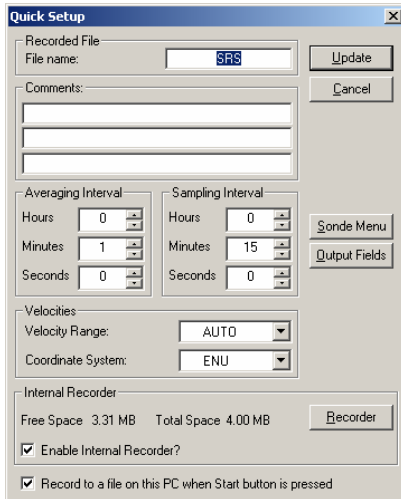
3-6.1. Setting Up the Water Quality Sensors

After connecting to the system and opening a new session, the following screen will appear:

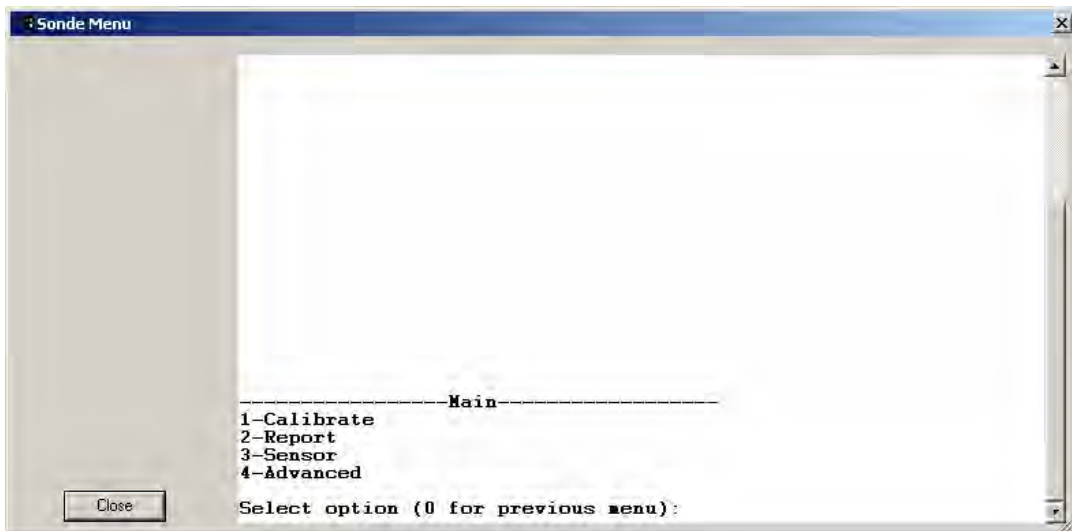


Section 3. Installation and Setup

Select **Change System Settings** to display the **Quick Setup** dialog box as shown below.



Click on **Sonde Menu** to open a dialog window so that selections specific to the water quality sensors can be viewed as shown below.



The water quality sensor items are selected by typing their corresponding number (e.g., 1 for Calibrate). It is not necessary to press Enter to confirm a selection. When moving between menus within the sonde software structure, use the **0** or **Esc** to back up to the previous menu. It is possible to display the sonde command line (#) by pressing **0** or **Esc** until the question “Exit menu (Y/N)?”

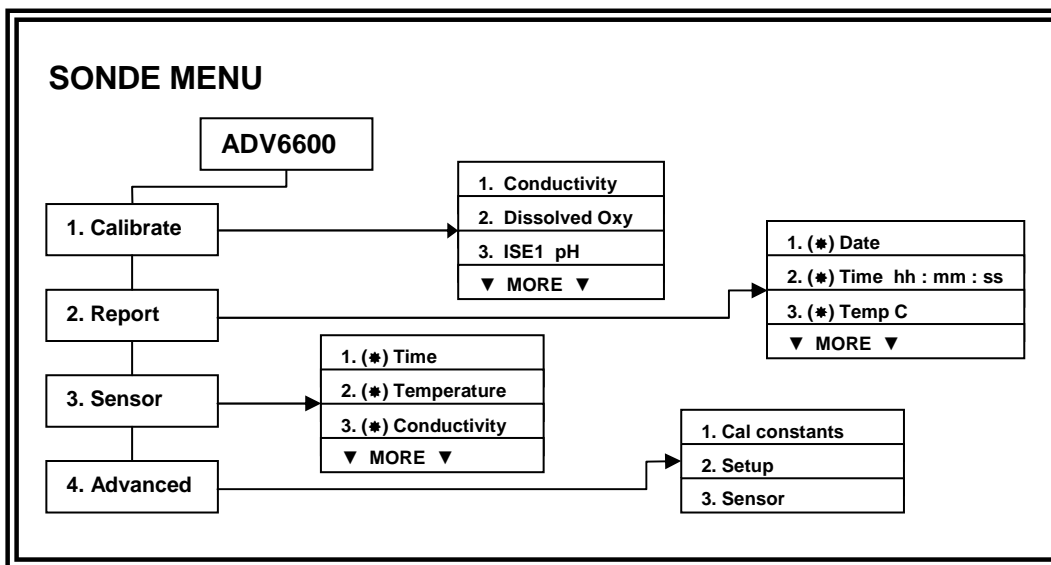
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appears and then typing **Y**. To return to the Main menu of the sonde menu, type **Menu** after the “#” and press **Enter**. The command line function may be useful during troubleshooting discussions with YSI Technical Support personnel.

To save power, the Water Quality hardware will power down automatically if no interaction from the keyboard occurs for approximately 60 seconds. When the firmware is in this “sleep” mode, the first subsequent keystroke simply “wakes it up” and has no visible effect on the display. The next keystroke after the unit is “awakened” will be input to the firmware in the intended manner. Thus, if you press a key after the sonde has been inactive for some time and receive no response, press the key again.

3-6.2. Water Quality Menu Flowchart

Several menu functions available on previous YSI sondes are no longer available on the ADV6600. Due to the master-slave relationship between the ADV and the Water Quality hardware packages, accessibility to these functions was removed, preventing interruption of communications between the firmware of each component.



3-6.3. Setting Up Installed Sensors

To activate the water quality sensors that are installed in the ADV6600, select **3-Sensor** from the Sonde Main menu. The Sensor menu allows you to Enable or Disable (turn on or off) any available sensor and, in some cases, to select the port in which your sensor is installed.



Enter the corresponding number or letter to enable the sensors that are installed on your sonde. An asterisk indicates that the sensor is enabled.

When selecting ISE3, ISE4, or any of the Optical ports, a submenu will appear. When this occurs, make certain the sensor selected corresponds to the port in which the sensor is physically installed.

Note:

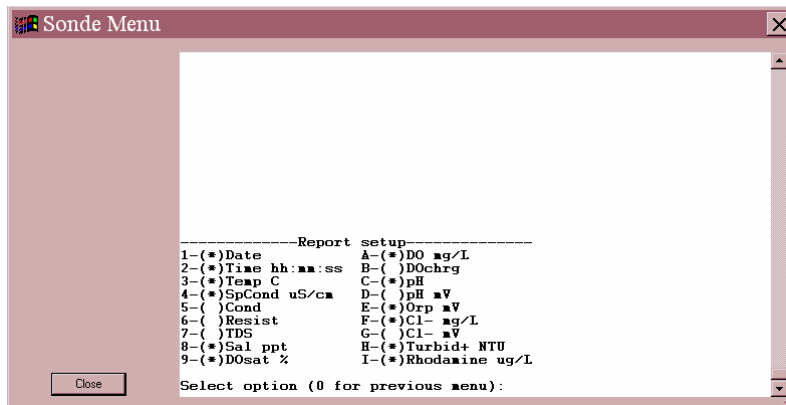
- Only ORP can be enabled as ISE2.
- ISE ports 3 and 4 can have one of three probes (nitrate, ammonium, or chloride) installed as indicated by the submenus.
- Each optical port can have one of four probes (6026 turbidity, 6136 turbidity, chlorophyll, or rhodamine WT) installed as indicated by the submenus.
- Only one probe of any type can be installed and activated in the ADV6600 sonde. For example, it is not possible to use chlorophyll probes in both the Optic T and Optic C ports. However, it is possible to use both the 6026 and the 6136 turbidity probes simultaneously

After all installed sensors have been enabled, press **Esc** or **0** to return to the Main Menu.

3-6.4. Setting Up Reports

The Report menu allows you to select the parameters and units of measure that will be output from the Water Quality sensors and eventually be available for display in the ADVantage 6600 software.

Select **2-Report** from the sonde Main menu. The menu below, or a similar menu, will be displayed. The parameters listed will depend on the sensors available and enabled on your sonde.



The asterisks (*) that follow the numbers or letters indicate that the parameter will appear on all outputs and reports. To turn a parameter on or off, type the number or letter that corresponds to the parameter.

For parameters with multiple unit options such as temperature, conductivity, specific conductance, resistivity and TDS, a submenu will appear as shown, allowing selection of desired units for this parameter.



After configuring your instrument with the desired parameters, press **Esc** or **0** to return to the Main menu.

Please note the following:

- *Even if all of the Water Quality sensors available on the ADV6600 are enabled, the measurements for those sensors will not appear on your display unless the parameter is selected in Report setup.*
- *Only the exact Report parameters and their selected units as selected in Report will be logged to internal memory during logging studies and you will NOT be able to obtain*

Section 3. Installation and Setup

calculated parameters after the fact. For example, if you want to log specific conductance during an unattended study, it MUST be active in the Report at the time the study is begun. If only conductivity is active in the report, it will NOT be possible to automatically convert the readings to specific conductance at a later time with ADVantage 6600 software.

The following table provides a complete listing of the abbreviations utilized for the various parameters and units available in the Report setup menu.

Parameter	Description
Date	Day/Month/Year (format selectable)
Time	Hour:Minute:Second (24-hour clock format)
Temp C	Temperature in degrees Celsius
Temp F	Temperature in degrees Fahrenheit
Temp K	Temperature in degrees Kelvin
SpCond mS/cm	Specific Conductance in milliSiemens per centimeter
SpCond uS/cm	Specific Conductance in microSiemens per centimeter
Cond mS/cm	Conductivity in milliSiemens per centimeter
Cond uS/cm	Conductivity in microSiemens per centimeter
Resist MOhm*cm	Resistivity in MegaOhms * centimeter
Resist Kohm*cm	Resistivity in KiloOhms * centimeter
Resist Ohm*cm	Resistivity in Ohms * centimeter
TDS g/L	Total dissolved solids in grams per liter
TDS kg/L	Total dissolved solids in kilograms per liter
Sal ppt	Salinity in parts per thousand (set to local barometer at calibration)
DO sat %	Dissolved oxygen in % air saturation
DO mg/L	Dissolved oxygen in milligrams per liter
DO chg	Dissolved oxygen sensor charge
pH	pH in standard units
pH mV	millivolts associated with the pH reading
ORP mV	Oxidation reduction potential value in millivolts
NH4+ N mg/L	Ammonium Nitrogen in milligrams/liter
NH4+ N mV	Ammonium Nitrogen in millivolt reading
NH3 N mg/L	Ammonia Nitrogen in milligrams/liter
NO3- N mg/L	Nitrate Nitrogen in milligrams/liter
NO3- N mV	Nitrate Nitrogen in millivolt reading
Cl- mg/L	Chloride in milligrams/liter
Cl- mV	Chloride in millivolt reading
Turbid NTU	Turbidity in nephelometric turbidity units from 6026 sensor
Turbid+ NTU	Turbidity in nephelometric turbidity units from 6136 sensor
Chl ug/L	Chlorophyll in micrograms/liter
Fluor %FS	Fluorescence in percent Full Scale
Rhod ug/L	Rhodamine WT in micrograms/liter

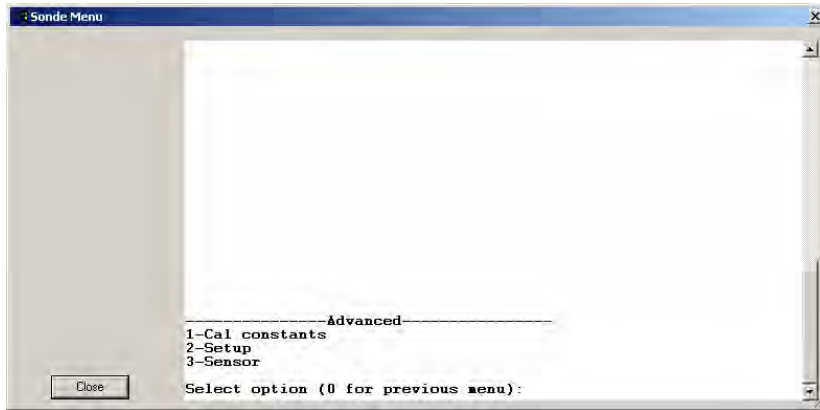
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DOsat % Local
calibration)

Dissolved oxygen in % air saturation (set to 100 % at
calibration)

3-6.5. Advanced Menu Features

From the Sonde Main menu select **4-Advanced** to display the sensor calibration constants, additional setup options, and sensor coefficients/constants as shown below. The parameters listed will depend on the sensors installed and enabled.



Select **1-Cal constants** to display the calibration constants. Note that values only appear for the enabled sensors. The following table provides the default value, operating range, and comments relative to the calibration constants. Error messages will appear during calibration if values are outside the indicated operating range unless the designation is “not checked”.

Parameter	Default	Operating Range	Comments
Cond	5	4 to 6	Traditional cell constant
DO Gain	1	0.5 to 2.0	
ORP offset mV	0.0	-100 to 100	
pH offset	0.0	-400 to 400	
pH gain	-5.0583	-6.07 to -4.22	
NH ₄ J	51.2	Not checked	
NH ₄ S	0.195	0.15 to 0.217	
NH ₄ A	1.092	Not checked	
NO ₃ J	99.5	Not checked	
NO ₃ S	-0.195	-0.217 to -0.15	

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Parameter	Default	Operating Range	Comments
NO ₃ A	2.543	Not checked	
Cl J	99.5	Not checked	
Cl S	-0.195	-0.217 to -0.15	
Cl A	2.543	Not checked	
Turb Offset	0	-10 to 10	
Turb A1	500	0.6 to 1.5	Range is ratio of M1 to A1
Turb M1	500		
Turb A2	1000	0.6 to 1.5	Range is ratio of (M2-M1) to (A2-A1)
Turb M2	1000		
Chl Offset	0	-30 to 20	
Chl A1	500	0.6 to 1.5	Range is ratio of M1 to A1
Chl M1	500		
Chl A2	1000	0.6 to 1.5	Range is ratio of (M2-M1) to (A2-A1)
Chl M2	1000		
Rhod Offset	0	-10 to 10	
Rhod A1	500	0.6 to 1.5	Range is ratio of M1 to A1
Rhod M1	500		
Rhod A2	1000	0.6 to 1.5	Range is ratio of (M2-M1) to (A2-A1)
Rhod M2	1000		

From the Advanced menu, select **2-Setup** to activate or deactivate Auto sleep RS-232. Activation of this feature enables a power savings system within the sonde. When enabled, power is only applied to the sensors during sampling or calibration. The most important aspect of this feature is its effect on the dissolved oxygen protocol. For this reason, the feature should be activated for most applications. The selection should only be deactivated if you are running spot sampling studies where the Averaging Interval and Sample Interval are set to the same value (see later).

From the Advanced menu, select **3-Sensor** to display and change user-configurable constants as shown. Select the appropriate number to view these parameters.

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The number of items on this menu depends on the sensors that are available and enabled on your sonde. Below we describe every possible item on this menu. Your sonde may not have every item described.

NOTE: The user is cautioned to retain the default settings unless advised to change them by YSI Technical Support. Changes should only be necessary for special applications.

TDS constant
Default: 0.65 This selection allows you to set the constant used to calculate TDS. TDS in g/L is calculated by multiplying this constant times the specific conductance in mS/cm. *This item will only appear if the conductivity sensor is enabled in the “Sensors enabled” menu.*

Salinity
Default: 0 This selection allows you to input a manually-acquired value of salinity for calculating DO mg/L. *This item is not used or displayed if the conductivity sensor is enabled in the Sensors menu.*

Pres psi
Default: 0 This selection allows you to set a value of pressure for calculating other parameters like salinity.

DO temp co %/C
Default: 1.1 This selection allows a user to input the dissolved oxygen temperature coefficient. Do not change this value unless you consult YSI Technical Support. *This item will only appear if the DO sensor is enabled in the Sensors menu.*

DO warm up sec
Default: 60 This selection allows a user to change the warm up period for the dissolved oxygen sensor. This setting should always be equal to the averaging interval established in the Quick Setup dialog box.

Wipes
Default: 1 This selection will determine the number of cleaning cycles that will occur when an optical probe wiper is activated manually or

automatically. The wiper functions bi-directionally. A selection of “1” results in three passes of the wiper over the optical face, twice in one direction and once in the reverse direction. In most applications, a single cleaning cycle is adequate to keep the optical surface free of bubbles and fouling. However, in particularly harsh environments additional cleaning cycles may be needed. *This item will only appear if a turbidity, chlorophyll, or rhodamine WT sensor is enabled in the Sensor menu.*

Wipe interval
Default: 1

In applications where the instrument is collecting data in SDI-12 communication mode, the wiper mechanism of the probe should be activated automatically in a periodic manner to clean the optical surface for fouling and bubbles. The value entered at this selection is the number of minutes between each automatic cleaning cycle. Thus, if Wipe Int is set to “5” and the instrument is in the Run mode, the wiper will activate every 5 minutes with no manual input. *This item will only appear if a turbidity, chlorophyll, or rhodamine WT sensor is enabled in the Sensors menu.*

The value of Wipe Int is sometimes overridden when the instrument is set up in the Unattended sampling mode. Under these conditions, the wiper will be automatically activated at the interval assigned in the Unattended setup rather than that assigned in Wipe Int. Thus, in an Unattended study setup at a 15 minute sampling interval, the wiper will be activated only once every 15 minutes rather than at the indicated Wipe Int of 1 minute.

CAUTION: If Wipe Int is set to zero, then no wiping will occur either in Discrete or Unattended Sampling. Make certain that Wipe Int is set to some finite value prior to setting up an Unattended study or no automatic cleaning will occur.

SDI12-M/wipe
Default: 1

This is the number of wiping cycles when the sonde is in SDI12 mode. The wiper will automatically wipe each time this many SDI12 “M” commands have been issued. If this value is set to zero, then no automatic wiping will occur. *This item will only appear if a turbidity, chlorophyll, or rhodamine WT sensor is enabled in the Sensors menu.*

Turb temp co %/C
6026 Default: 0.3
6136 Default: 0.6

This entry sets the coefficient for the temperature compensation of turbidity readings from the 6026 and 6136 sensors. The default values should not be changed by the user without consulting YSI Technical Support. *This item will only appear if a turbidity sensor is enabled in the Sensor menu.*

(*) TurbSpike Filter

When this item is activated, the output of the turbidity sensor is

mathematically processed to minimize the effect of unusual (or “bad”) readings on the overall data presentation. In most cases, these “spike” events are the result of the chance passage of large suspended particles across the probe optics just at the time a reading is taken. Activation of this option generally results in a better display of the “average” turbidity of the water under examination and its use is recommended for most sampling and unattended applications. *This item will only appear if a turbidity sensor is enabled in the Sensors menu.*

Chl temp co %/C
Default: 0.0

This entry sets the coefficient for the temperature compensation of chlorophyll readings from the 6025 sensor. The default value of zero should only be changed by the user after establishing the temperature compensation factor for the phytoplankton sample in question. *This item will only appear if a chlorophyll sensor is enabled in the Sensors menu.*

3-7. Setting up the ADV Sensor Firmware

The ADV firmware controls the velocity, pressure, and compass/tilt sensors. In addition, the real time clock which controls the overall ADV6600 system and is recorded with each data string, is part of the ADV firmware. Prior to using your ADV6600 in field studies, you must set the real time clock and customize your ADV parameter output as described in the sections below.

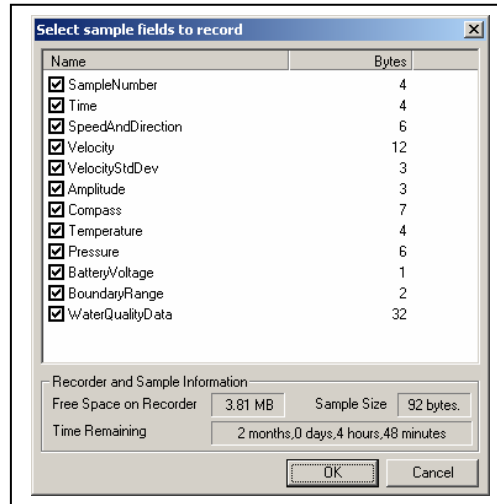
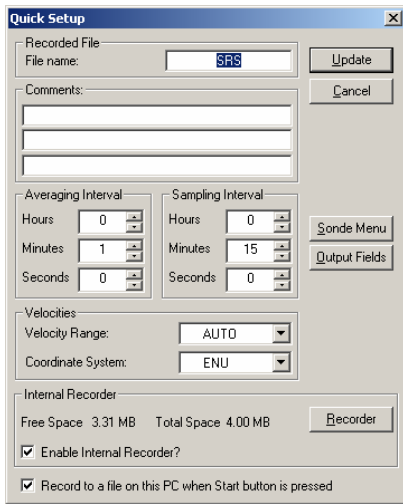
3-7.1. Setting the System Time

When establishing a connection to the ADV6600 for the first time from a new PC or laptop, it is advisable to set the time of the instrument. First, verify that the time shown on your computer is correct. Next, connect to the ADV6600 and open a new session. Under the Tools and Utilities screen options, select **Set system time**. The time in the ADV6600 will automatically be reset to match the time of the computer it is connected to.

3-7.2. Setting Up the ADV Parameter Output

The ADV parameter output format can be configured from the **Quick Setup** dialog box which is accessed by clicking the **Change System Settings** selection under the Data Collection screen menu. A typical **Quick Setup** box is shown below. To show a list of ADV parameters, click on the Output Fields selection as shown below.

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Under most circumstances, the user is advised to make sure that all of the items in the Fields listing are active, i.e., a check mark appears in all boxes. Outputting all parameters to the PC during real time studies and to the ADV6600 internal memory during unattended monitoring studies will allow the full capability of the ADV6600 system to be realized. If the user does not want to view some of the information in reports and plots, parameter outputs can easily be “masked” using the ADVantage 6600 software package, but still retained in the data files for use in later data analysis. Therefore, YSI strongly recommends that all fields be left active for studies where the data is stored to a PC or internal memory. The selection is present primarily to limit the ADV6600 output for SDI-12 studies as described in Section 6.3. However, there may be unusual circumstances in non SDI-12 studies where the user will want to eliminate some of the ADV parameters and this can be accomplished by clicking on the boxes to remove the check mark.

Note that many of the ADV parameters have subparameters bundled within the same item. For example, the velocity parameter contains three separate outputs (V_E , V_N , and V_U) which represent the velocity in the “East”, “North”, and “Up” directions relative to the earth coordinate system (and are derived using the velocity from the ADV and internal compass). Detailed descriptions of the parameters listed in the Fields dialog box are provided in the table below.

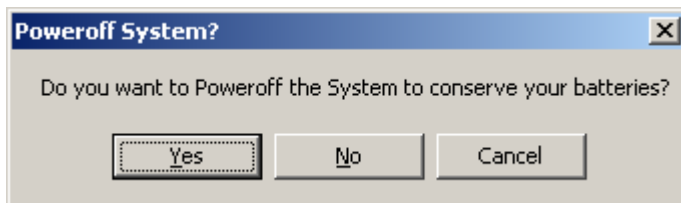
Sample Number	Sequential numbers (incremented by one unit) starting with “1” which are incremented by one unit and are displayed and/or logged time a sample is taken.
Time	The date and time stamps which are displayed and/or logged with each set of data points.
Speed and Direction	The speed and direction of the water.
Vel	The three components of water velocity (East, North, Up)
Vel Std Dev	The Standard Deviation of the water velocity

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Amplitude	The level of returned signal based on the concentration and/or particle size found in the water.
Compass	The heading, pitch, and roll data from the compass which is applied to the raw velocity data to convert it to East, North, Up components.
Temperature	The output of the temperature sensor associated with the ADV sensor. The output is reported as “ADV Temperature”. Note that there is also a temperature parameter associated with the Water Quality sensors which will be similar, but probably not identical, to the “ADV Temperature” due to differences in location and time constants.
Pressure	The reading of the ADV6600 pressure sensor which can be translated into depth of water value.
Battery Voltage	The voltage associated with the internal C-cells of the ADV6600 or external power source (whichever is greater).
Boundary Range	The range from the tip of the ADV (transmitter) to the closest boundary (i.e. the bottom of a stream) if within detectable range (varies depending on angle and material type). The value is reported as a -1 if not detected or is out of range.
Water Quality Data	The water quality parameters which are active in the Report setup.

3-8. Exiting the ADV6600 Firmware

When you have finished setting up the ADV6600 firmware, be sure to close ADVantage 6600 completely by clicking the “x” in the upper right hand corner of the window. You will see the following message:



Under virtually all circumstances, you will want to click the “Yes” selection so that the ADV6600 will power down to its idle mode in order to save power.

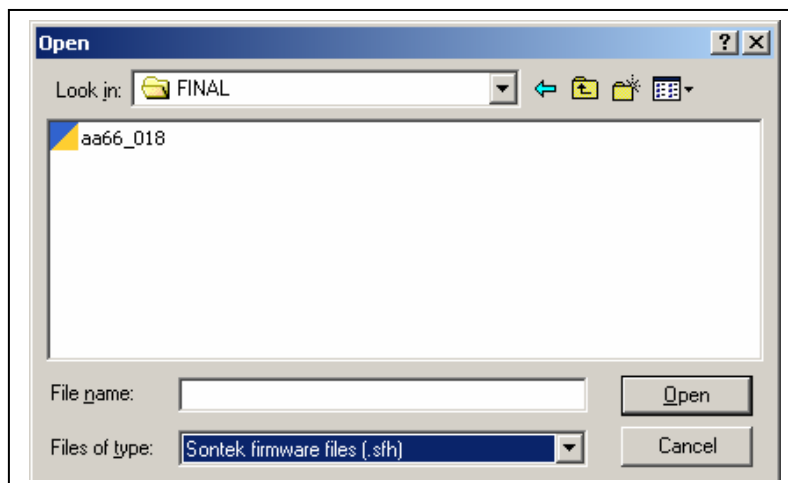
3-9. ADV6600 Firmware Upgrades

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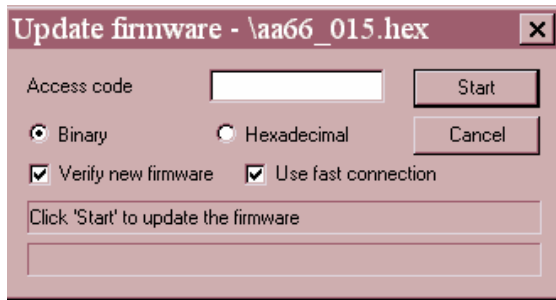
Periodically, YSI will make improvements and modifications to the firmware residing in an instrument. It is recommended that you periodically check for updated firmware for the ADV6600 on the YSI website at www.ysi.com/edownloads. To verify which version you are currently running and if an upgrade is necessary, perform the following procedures for the ADV and Water Quality firmware packages.

ADV Firmware:

1. Connect the ADV6600 to a computer.
2. Launch the ADVantage 6600 Software for Windows.
3. Choose **Connect to System**. Verify the **COM** setting and **Baud Rate**. Click on **Connect**.
4. From the menu at the top of the screen select **System>Hardware Configuration**. A window will appear showing the various specifications of the ADV6600, including the firmware version.
5. If the firmware on the instrument matches the current version listed on the YSI website, no upgrade is required. If it does not, continue with Step 6.
6. Close the hardware configuration window in ADVantage 6600.
7. Access the YSI Website (www.ysi.com/edownloads) and fill out the Login information.
8. Locate the ADV6600 firmware update file (.sfh extension) and download it to a known directory on your computer.
9. From the menu at the top of the screen, choose **System>Advanced>Update Firmware**. A dialog box similar to the one shown below should appear.



10. Browse for the update file that was just saved. Choose **Open**. An **Update Firmware** window should appear as shown below.



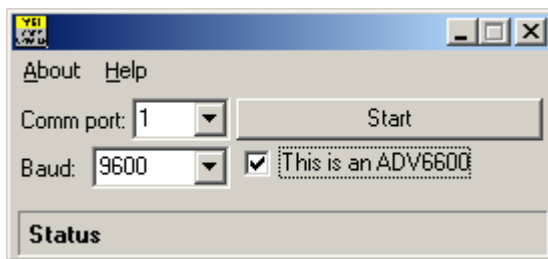
11. Choose a **Binary** update.
12. If you wish to have the firmware updated and then re-verified, be sure the **Verify new firmware** box is checked.
13. For a quicker update, check the **Use fast connection** box. Note, however, that this option should only be utilized for hard-wired

connections between PC and sonde (i.e. not through radios).

14. Click on **Start** to begin the firmware update. When it is complete, the Update Firmware window will close.

Water Quality Firmware:

1. Connect the ADV6600 to a computer.
2. Launch the ADVantage 6600 Software for Windows.
3. Choose **Connect to System**. Verify the **COM** setting and **Baud Rate**. Click on **Connect**.
4. Select **Change System Settings**. The **Quick Setup** dialog box will appear.
5. Click on **Sonde Menu**. A window will appear displaying the Main Menu of the 6600 firmware.
6. Press **Escape**, then **Y**. A “#” prompt will appear.
7. Type **ver** and press **Enter**. The unit will respond with the current version of 6600 firmware installed on the board.
8. If the firmware on the board matches the current version listed on the YSI website, no upgrade is required. If it does not, continue with Step 9.
9. Close the sonde menu and exit from ADVantage 6600.
10. Access the YSI Website (www.ysi.com/downloads) and fill out the Login information.
11. Locate the YSI Code Updater install file and save it to a known directory on your computer.
12. Locate the file and double click on it to install the YSI Code Updater program to your computer.
13. Follow the onscreen instructions to complete the installation of the program files.
14. When installation is complete, click on the **Start** button at the bottom left of your screen.
15. Select **Programs>YSI Code Updater>YSI Code Updater**. The screen shown below will appear.



Section 3. Installation and Setup

16. Verify the Comm port and Baud settings and make certain that the “This is an ADV6600” selection is checked. Then click on “Start” to upgrade your 6600 firmware.
17. The YSI Code Updater program will notify you when the update is complete.

The general setup of your ADV6600 is now complete and you should proceed to Section 5 for detailed instructions on the calibration and performance evaluation of the ADV and Water Quality sensors prior to field use of your instrument.

Section 4. Calibration and Diagnostics

All of the sonde sensors, with the exception of temperature, require calibration before the ADV6600 can be used. In addition, periodic calibration and/or diagnostics are necessary to assure accurate performance.

4-1. Beam Check Basics

It is critical to assure proper performance of the ADV sensor prior to any field or laboratory study and the “Beam Check” capability of the ADV6600 allows the user to easily evaluate the basic performance of the Doppler sensor. Using this program on a regular basis, or, at a minimum, prior to each deployment, is the best way to ensure consistently good ADV data.

Beam Check operates by sending a pulse of sound into the water, and then plotting the signal strength of the return signal versus range (or time) for each of the instrument’s receivers. Features in the returned signal strength profile (or amplitude) are then used to verify different aspects of system performance. For most applications, the user can simply look at the plot to confirm proper ADV functionality as evidenced by three factors:(a) all three receiver channel outputs are aligned (plotting on top of one another – not offset horizontally), (b) the amplitude of each receiver at the sampling volume is more than 10 counts above the baseline, and (c) the system has been placed such that the sampling volume of the ADV is sufficiently spaced.

4-2. Running the ADV Beam Check

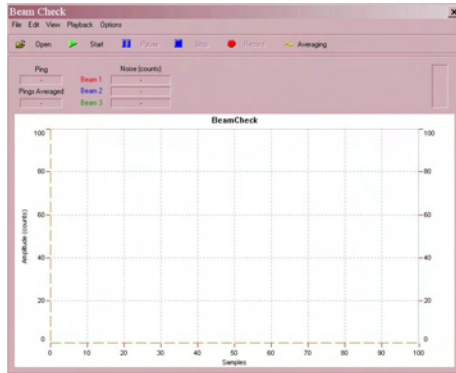
Initially, a Beam Check should be run in the laboratory using the procedure outlined below to confirm that the ADV sensor is functioning properly under ideal conditions. It is particularly important, however, to also perform the Beam Check at the site where the data will be collected (i.e., the system should be deployed as it will be under study condition). In addition, it is strongly recommended that a Beam Check be performed and recorded before and after each deployment (before cleaning or changing the location of the ADV6600). The Beam Check procedure is quick, and the results can be either printed or stored to a computer file for use in QC/QA programs. It is particularly important to note that the ability of YSI Technical Support personnel to aid in data analysis and troubleshooting will be significantly compromised if a beam check file from the site is not available.

The Beam Check test at the site will answer the following questions::

- Are there sufficient scatterers in the water to collect data.?
- Is the system operating correctly?
- Is the distance to the boundary (if present) sufficient?

4-2.1. Laboratory Beam Check Procedure

1. Connect the ADV6600 to a computer.
2. Launch the ADVantage 6600 software.
3. Choose **Connect to System**. Verify the **COM** setting and **Baud Rate**.
4. Click on **Connect** and then select **Beam Check** from the **Tools and Utilities** list.

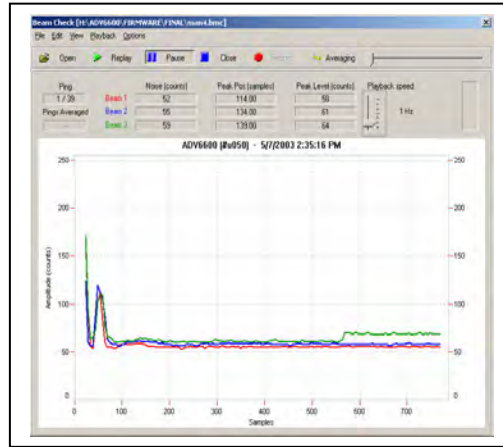


5. Remove the ADV6600 from its calibration cup and hold it within 0.05 inches of the bottom of a plastic bucket which has been filled with tap water as shown in the picture below left.

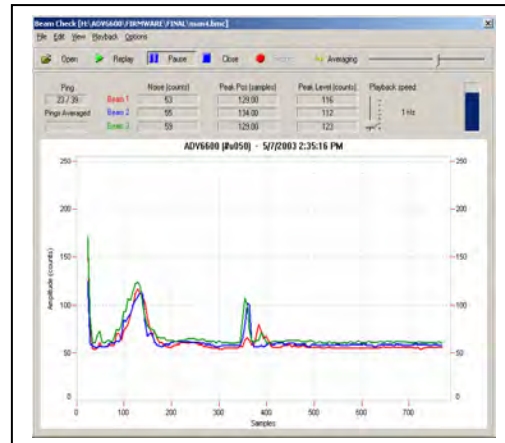


6. Start the Beam Check procedure by clicking on the green Start icon at the top of the screen.
7. The screen will update a display of data from the transducers every few seconds and the display will appear very similar to that shown below if the ADV sensor is functioning properly.

Section 4. Calibration and Diagnostics



- Click on the “Record” button so that the data acquired during the study will be saved to a file for later analysis. Give the file a name which is associated with your application so that you will be able to associate the beam check and the study at a later date.
- Now manually raise the ADV6600 up into the bucket so that the so that the head of the sensor is just immersed (i.e. transmitter and receivers are covered in water) as shown in the picture below left. Continue recording data and the display should change one which is similar to that shown below right.



- Acquire Beam Check data for approximately 60 seconds and then click on the red **Stop** icon at the top of the screen halt data acquisition. The final display will remain in place on the screen for analysis as well as having been stored for later use.

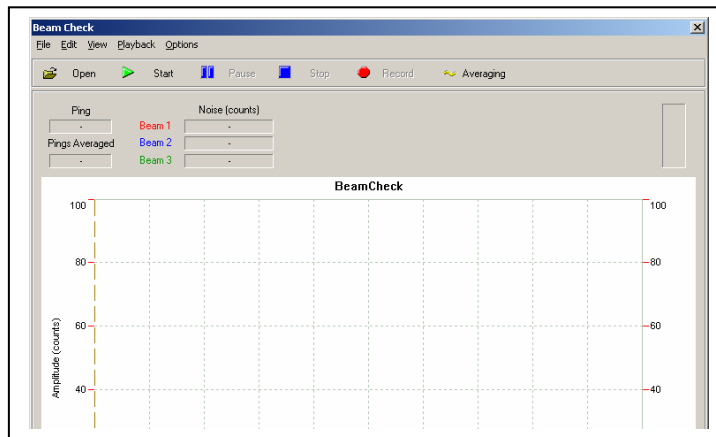
4-2.2. Creating a Beam Check File

As noted above, the Beam Check function includes the ability to record the displayed data to a file for later use. To do this, click on the **Record** icon at the top of the screen while Beam Check is running. The program will prompt you for a file name and location. To stop recording, click on the **Record** icon again, or **Stop** the data collection.

It is recommended that you record beam check data on a regular basis to provide a record of system performance and for permanent QC (Quality Control) record. These files may also be requested by YSI Technical Support in order to evaluate system performance and as an aid in troubleshooting system issues.

4-2.3. Opening a Recorded Beam Check File

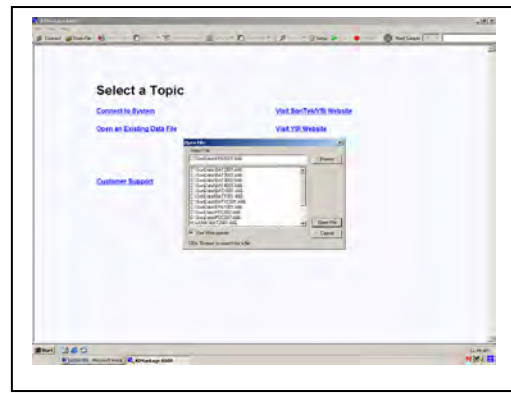
To open a recorded Beam Check file, the Beam Check window as shown below must be present on the computer screen while running ADVantage 6600 software.



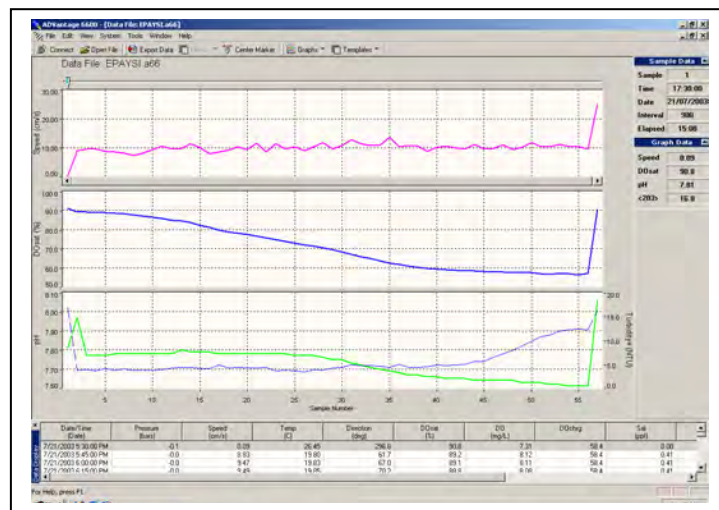
If an ADV6600 sonde is connected to the computer running ADVantage 6600 software, then the window can readily be opened by simply choosing Beam Check from the Tools and Utilities list. Then choose the File|Open selection, browse for the desired Beam Check file (.bmc extension), and click Open.

If no ADV6600 sonde is connected, however, then the Beam Check window cannot be opened in this manner. To open the Beam Check window with no sonde attached, choose the Open an Existing Data File selection from the screen below and open any saved ADV6600 file.

Section 4. Calibration and Diagnostics



A display similar to that shown will be presented. Details of data display and analysis using ADVantage 6600 software can be found in Section 8 below



Choose the System selection from the upper toolbar and then choose the Beam Check selection to generate the Beam Check window as shown above. Then use the File|Open selection to view the desired Beam Check file as described above.

4-2.4. Viewing a Recorded Beam Check File

At the top of the Beam Check screen are buttons used during program operation to view a recorded file:

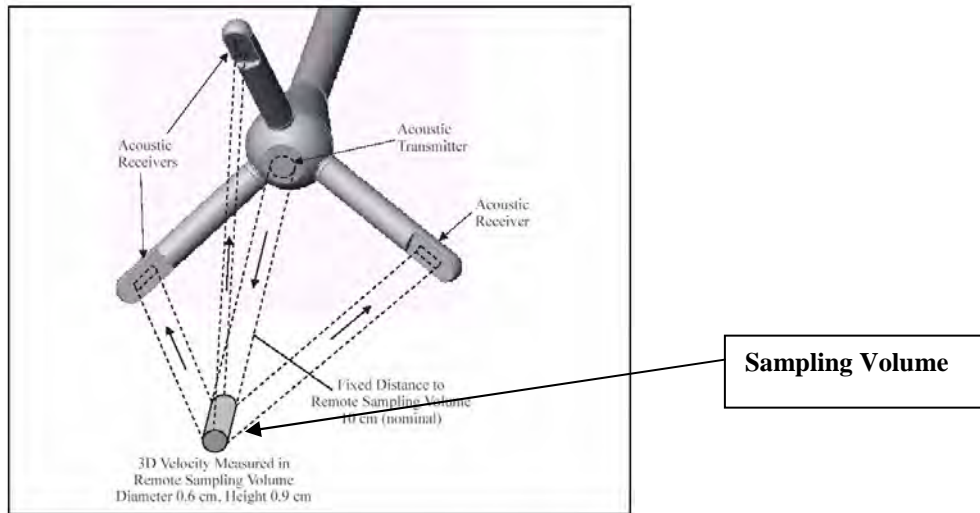
Pause	Temporarily halts the display of data.
Start	Starts regular updating of the data screen.
Stop	Ends the display of a recorded Beam Check data file.
Playback Speed	Adjusts the speed at which data is updated on the screen. Update interval is user-selectable. Click on the arrow and move it up or down to adjust the playback speed.
Averaging	Averages pings together from the ADV to produce smoother data.

4-2.5. Interpreting Your Laboratory Beam Check Data

While it is not necessary to be an expert in Doppler technology to acquire good velocity data with the ADV6600, it is important for all users to understand the output of a Beam Check test at a very basic level. The key is to remember that the “amplitude” parameter shown on the y-axis of the Beam Check plots represents the signal strength of returned signal for each of the receivers and the “samples” on the x-axis represents the time it takes for the acoustic pulse to get from the scatterers in the water back to the receiver. This time between scatterer and receiver can also be translated into the distance between the scatterer and the receiver since the speed of sound in water is well known.

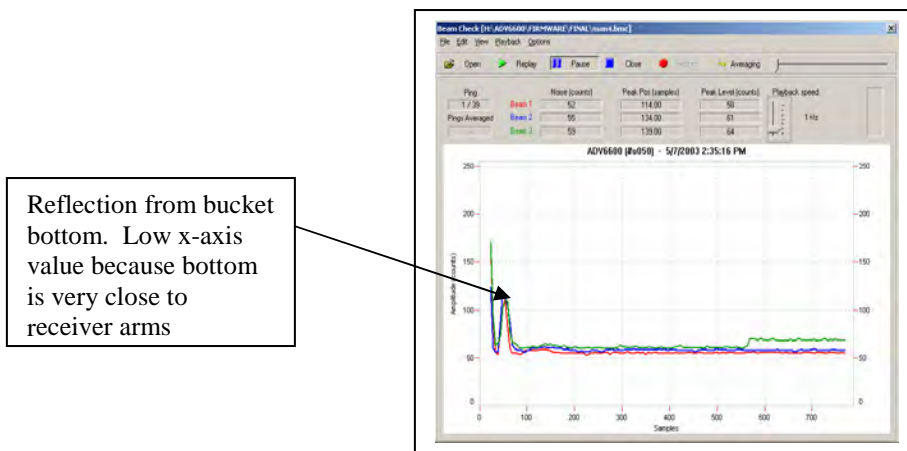
To understand the Beam Check data it is also important to be acquainted with the concept of the “sampling volume” of the Doppler sensor. As shown in the diagram below, because of the geometry of the receiver arms, return Acoustic pulses are only detected from suspended scatterers in a relatively small volume which is in the middle of the receiver arms and about 10 cm away from the transmitter. Acoustic pulses will also be reflected so strongly from solid surfaces, for example the bottom of the bucket in the tests above, that some signal will be detected even though the solid surface is not in the sampling volume itself.

Section 4. Calibration and Diagnostics



With these basic facts in mind, it becomes easier to understand what was observed in the two laboratory bucket Beam Checks and why the results of the two experiments indicated that the Doppler sensor was functioning properly.

For the first experiment, the sensor was on the bottom of the bucket and the following display was observed.

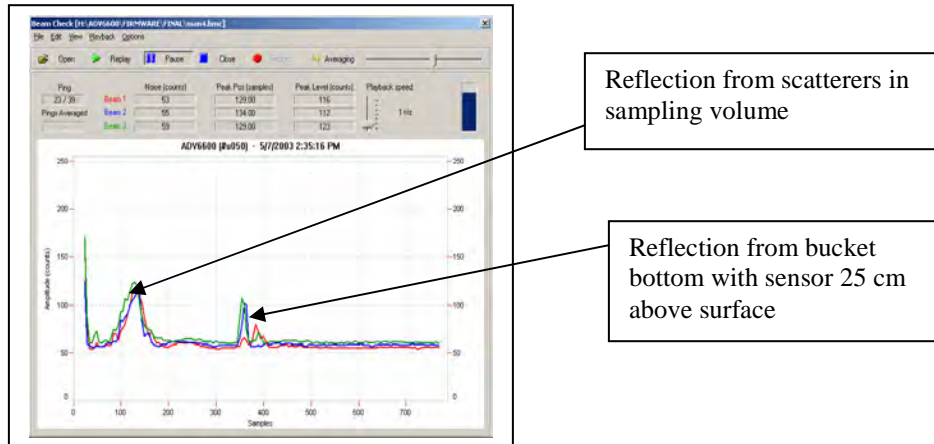


The key to understanding this display is to remember that with the sensor on the bottom of the bucket, the sampling volume of the sensor was not allowed to function at all. Instead, the acoustic pulses simply bounced off the plastic surface and returned very quickly to the receivers. It is possible to note that amplitudes (intensities) of the three signals are approximately equal and this

Section 4. Calibration and Diagnostics

indicates that (a) Doppler pulses are being sent out properly from the transmitter and (b) all three receivers appear to be working properly.

For the second experiment, the sensor was manually raised in the bucket such that the transmitter and receivers were about 25 cm (10 inches) from the bottom of the container and the following display was observed:



The key to understanding this display is to remember that the sensor is now in a position such that the sampling volume is well above the bottom of the bucket. Therefore, reflection of the acoustic pulses scatterers in the sampling volume are observed at a larger x-axis value than in the previous experiment. Note that reflections from the bucket bottom are still observed, but at a much larger x-axis value (farther from the receiver arms). Thus, the Beam Check pattern can be readily explained using a basic knowledge of the sensor technology. As for the other experiment, it is important to note that the amplitudes (intensities) of the three signals are approximately equal and this indicates that (a) Doppler pulses are being sent out properly from the transmitter and (b) all three receivers appear to be working properly.

4-2.6. Beam Check Feature Summary

To view real-time, ADV6600 beam check data, first select **Beam Check** from the Tools and Utilities List. Then use the following commands to fine tune the presentation.

- Click **Start**. This action will establish communication with the selected instrument and start the display of data.
- Use the menu and control items to alter the display of data as desired.
- Click **Stop** to end the display of data.
- Use **File|Exit** to close the **Beam Check** window and return to **ADVantage 6000**.

To record real-time beam check data for later playback:

- Start the display of real-time data as described above.
- Click **Record**. You will be prompted for a file name and storage location.
- Use the menu and control items to alter the display of data as desired (i.e., recorded data is not affected).
- Click **Pause** or **Stop** to interrupt or end data collection.

To playback previously recorded beam check data:

- Click **Open** to select a previously recorded beam check file.
- Click **Replay** (or **Pause**) to start the playback of data.
- Use the menu and control items to alter the display of data as desired.

The Beam Check window also shows a tabular output of diagnostic parameters for each of the three acoustic receivers.

Noise This gives the electronics noise level for each receiver, determined by the signal strength when the ADV6600 is not receiving any return reflection from the water. This should match the signal strength for the flat portion of the graph beyond the boundary. Normal noise levels are 60-70 counts.

Peak Position This is the location of the center of the peak for the sampling volume for each of the three receivers. The position should be approximately the same for each receiver; variations of 5 to 10 counts are typical

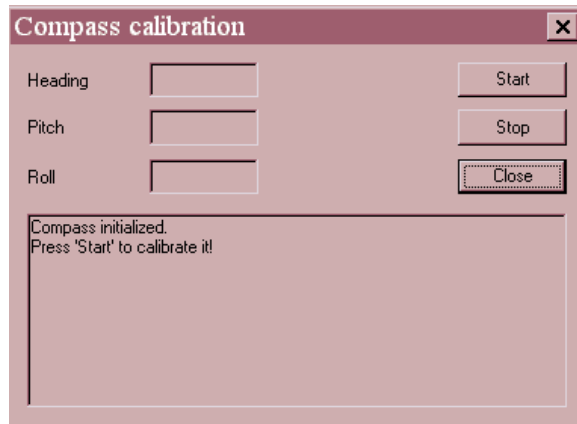
Peak Level This is the height of the peak for the sampling volume for each of three receivers. Peak level varies depending on the amount of scattering material in the water. The peak level should be approximately the same for each receiver; variations of 5 to 10 counts are typical

4-3. Calibrating the Compass

The compass which is standard in each ADV6600 is used to compensate for the effect of sonde movement on velocity readings during deployment. Before you use your ADV6600 in field studies, you must calibrate the compass to make sure it is functioning properly. The compass calibration is designed to minimize the effects of ambient magnetic fields on compass data and its subsequent effect on velocity readings. It is recommended that a compass calibration be performed at the site before each deployment and after moving the ADV6600 to a different environment or mounting apparatus. If possible, perform the compass calibration with the ADV6600 installed in the mounting frame that will be used for deployment. However, to become familiar with the calibration procedure, YSI recommends that you first carry out a compass calibration under more controlled conditions in the laboratory. Use the following steps to perform the calibration routine.

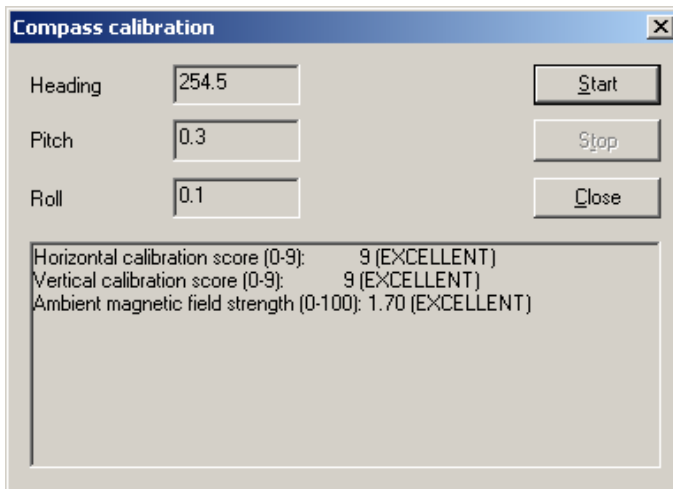
Compass Calibration Procedure

1. Connect the ADV6600 to a computer.
2. Launch ADVantage 6600 Software for Windows.
3. Choose **Connect to System**. Verify the **COM** setting and **Baud Rate**. Click on **Connect**.
4. Select **Compass Calibration** in the **Tools and Utilities** on-screen list (or choose it from the **System** menu). The window to the right should appear.
5. Prior to beginning the calibration in the laboratory, note the following tips:
 - Avoid performing the calibration near (i.e., within ca. 3 feet) large metallic objects such as metal walls, cabinets, or water pipes
 - Avoid jerky movements when performing the calibration
6. Click the **Start** button to begin the calibration procedure.
7. While standing, hold the ADV6600 at chest level with the Doppler sensor in the down position. Cock the top of the sonde at an angle of about 30 degrees away from your body as shown in the picture below left. Now rotate the instrument slowly through a complete (360 degrees) turn around its longitudinal axis first in the clockwise and then in the counterclockwise direction



Longitudinal Axis

8. Now cock the sonde at an angle of about 30 degrees toward your body as shown in the picture above center. Again rotate the instrument slowly through at least two complete (and opposite) turns around its longitudinal axis
9. Now cock the sonde at an angle of about 30 degrees to the left (above right) and repeat the rotation of the sonde around its longitudinal axis. Finally, repeat the step with the sonde cocked at an angle of about 30 degrees to the right.
10. When you are finished, click on **Stop**. The calibration process will report a calibration score
11. Calibration scores will be calculated and displayed as shown in the dialog box below. These are an indication of the quality of calibration. Horizontal and Vertical numbers should be high (scale of 0 to 9). The Magnetic Field Strength number should be low (scale of 0 to 100). Repeat the calibration if Horizontal or Vertical is below 6, or if Magnetic Field Strength is greater than 30. If results do not improve, change the location of the sonde or modify the mounting structure.



Remember that it is important to calibrate also calibrate your compass at the deployment site and in the mounting apparatus if at all possible.

4-4. Changing the Pressure Sensor Offset

The ADV6600 can be equipped with an optional pressure sensor which can be used to calculate the depth (level) of the water over the bottom of the ADV6600 bulkhead. The sensor is available in three configurations to provide maximum accuracy for shallow (10 m), medium (30 m), and deep (50 m) applications.

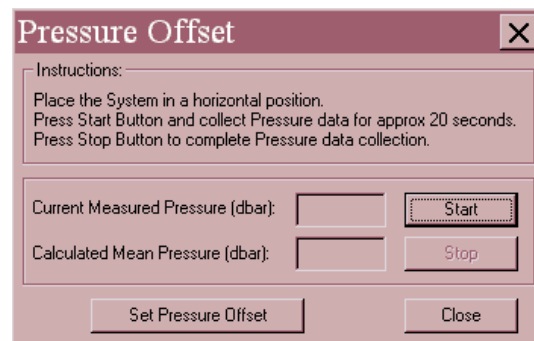
Section 4. Calibration and Diagnostics

NOTE CAREFULLY: Immersion of the pressure sensor to depths of greater than 150 % of its specification will result in irreparable damage. Thus, the 10 m sensor must not be immersed below 15 m to avoid this damage.

The output of the sensor is in pressure units only, such as psi or dbar, and the system is not designed for long-term deployments that require a high level of depth or level accuracy. Further, the pressure sensor cannot be vented to automatically remove the effects of barometric pressure changes on the overall reading. However, the pressure sensor can measure even slight changes in water level, but the data is not automatically corrected for offsets due to barometric, temperature, or conductivity. Users may choose to export the pressure data to an Excel spreadsheet and manually compensate for temperature, conductivity, and atmospheric pressure changes to allow for a precise reading of the water level (given that the necessary information is available).

The factory calibration of the pressure sensors is set to give a pressure output of zero at atmospheric pressure at the time / place of calibration. When deploying the instrument, it may be desired to reset the pressure offset to show zero pressure at the time / place of deployment. This may be done using the following steps.

1. Connect the ADV6600 to a computer.
2. Launch ADVantage 6600 Software.
3. Choose **Connect to System**. Verify the **COM** setting and **Baud Rate**. Click on **Connect**.
4. Be sure that the instrument is positioned properly (i.e., standing up in the vertical position with sensors down) and is not immersed in water.
5. Click on **Set Pressure Offset** in the **Tools and Utilities** on-screen list (or choose it from the **System** menu). The window to the right should appear.
6. Follow the instructions outlined in the window to collect Pressure data.
7. Click on **Set Pressure Offset** to “zero” your pressure sensor at the current atmospheric pressure.
8. Any pressure the instrument is being exposed to will be automatically removed (i.e., tared).



After completing the Beam Check procedure, calibrating the compass, and setting the pressure offset, the preparation of the ADV sensors is complete. Proceed to Section 4.5 below for calibration of the Water Quality sensors.

4-5. Water Quality Sensors – Preparing for Calibration

4-5.1. Health and Safety

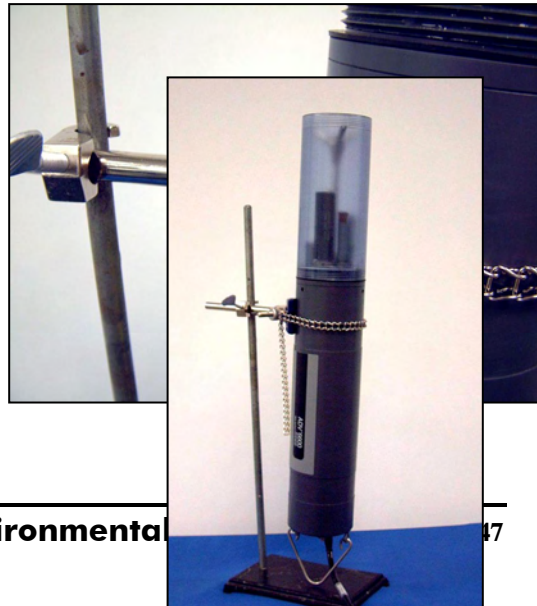
Reagents that are used to calibrate and check this instrument may be hazardous to your health and require special handling. Exercise caution and **avoid inhalation, skin contact, eye contact, and ingestion**. Take a moment to review health, safety, and disposal information about YSI reagents from the YSI website. MSDS documents may be viewed and downloaded at www.ysi.com/environmental.

4-5.2. Materials Required

- calibration/storage cup, provided with the sonde
- calibration reagents
- clean, absorbent paper towels, lens cleaning tissue, or cotton cloths
- ring stand and clamp (clamp provided with the sonde)
- tool kit

4-5.3. Calibration Tips

- Prior to beginning calibration, attach the provided chain clamp to the sonde. Users may find it easiest to make this attachment by laying the sonde on its side on a flat surface, placing the clamp on the top of the sonde and extending the chain beneath the sonde prior to attaching it to the tightening peg. The chain and clamp should be in the groove on the sonde body which is near the sensor compartment. Before making the attachment, make certain that the tightening nut is backed off as far as possible to facilitate the snugging up of the clamp to the sonde. Rotate the tightening nut clockwise by hand until snug. Then attach the clamp-sonde assembly to a sturdy ring stand as shown below.



- *Be very cautious that the apparatus does not tip over.*
- Perform calibrations for all sensors, except the optical sensors, in an inverted position with the bottom plug removed from the calibration cup (shown at right) to reduce the volume of calibration reagents required for calibration.
- Use recommended volumes when performing calibrations to ensure that all sensors are immersed in calibration standards. Many of the calibrations utilize readings from other probes (e.g., temperature probe). See Section 4-4.5 below for information on proper calibration volumes.
- Rinse the sonde with deionized or distilled water when changing calibration standard. Shake excess rinse water off and dry the outside of the sonde to reduce carry-over contamination of calibrator solutions and increase accuracy of the calibration. Note that when rinsing the sensors, it is usually more convenient to leave the clamp attached to the sonde and simply remove the assembly from the clamp holder.
- For maximum accuracy, old calibration standards may be saved and a small amount used to pre-rinse the calibration container and the sonde prior to insertion in a new standard.
- Make certain that port plugs are installed in all ports where probes are not installed. It is extremely important to keep these electrical connectors dry during calibration and deployment.
- If an ERROR message appears during a calibration, begin the procedure again. Be certain that the value you enter for the calibration standard is correct. Also see Section 8, Troubleshooting for more information on error messages.

4-5.4. Use of the Calibration Cup

Follow these instructions to use the calibration cup for calibration procedures.

With the sonde in an inverted position:

1. Inspect the installed gasket on the sonde for obvious defects and if necessary replace it by contacting YSI Technical Support.
2. Screw the cup assembly into place on the threaded end of the sonde and securely tighten by hand. *Do not over-tighten as this could cause damage to the threaded portions of the bottom cap and tube.*
3. Remove the calibration cup bottom cap.

With the ADV6600 in an upright position:

1. Ensure that a gasket is installed in the gasket groove of the calibration cup bottom cap and that the bottom cap is securely tightened. *Do not over-tighten as this could cause damage to the threaded portions of the bottom cap and tube.*

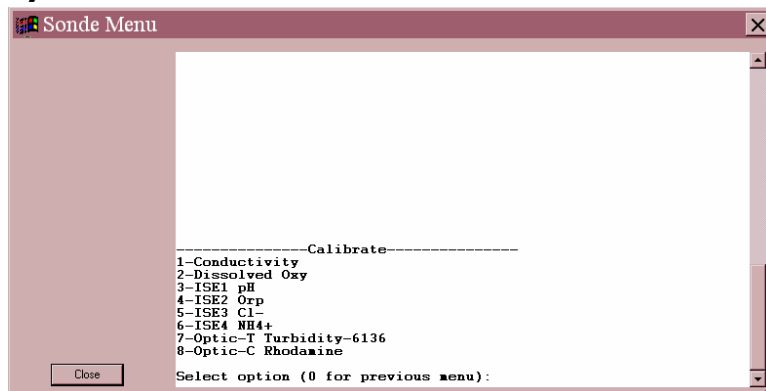
4-5.5. Recommended Volumes of Calibration Reagents

The approximate volumes of the reagents are specified below for both inverted and upright orientations.

Probe to Calibrate	Inverted	Upright
Conductivity	425ml	N/A
Temperature	425ml	N/A
pH/ORP	425ml	N/A
ISE	450ml	N/A
Turbidity, Chlorophyll, Rhodamine WT	N/A	675ml

4-6. Water Quality Sensors - Calibration Procedures

1. Connect the ADV6600 to a computer.
2. Launch the ADVantage 6600 Software for Windows.
3. Choose **Connect to System**. Verify the **COM** setting and **Baud Rate**. Click on **Connect**.
4. Select **Change System Settings** under the **Data Collection** screen menu.



A **Quick Setup** dialog box will appear.

5. Click on **Sonde Menu**. A window will appear displaying the Main Menu of the Water Quality firmware.

6. Select option **1-Calibrate** to access calibrations for the water quality sensors. The exact appearance of the Calibrate Menu (as shown) will vary depending upon the sensors that are enabled on your sonde.
7. Follow the instructions listed below for the calibration of each individual water quality sensor.

4-6.1. Temperature

There is no calibration required for the temperature sensor.

4-6.2. Conductivity

This procedure calibrates conductivity, specific conductance, salinity, and total dissolved solids. Perform sensor calibration at a temperature as close to 25°C as possible. This will minimize any temperature compensation error.

Calibration:

1. Attach the sonde to a ring stand in an inverted position with the clean, dry calibration cup attached.
2. Add enough conductivity standard to the calibration cup to ensure both openings of the conductivity cell are completely covered. Rotate and/or move the sonde up and down to remove any bubbles from the conductivity cell.
3. Allow at least one minute for temperature equilibration before proceeding.
4. Select **Conductivity** to calibrate the conductivity probe.
5. A second menu will offer the options of calibrating in **specific conductance**, **conductivity**, or **salinity**. Calibration of any one option automatically calibrates the other three. Calibration in specific conductance with a 10mS/cm standard is recommended.
6. Enter the value of the standard being used. Be certain that the units are correct and press **Enter**. The current values of all enabled sensors will appear on the screen and will change as they stabilize.
7. Observe the readings and when they show no significant change for approximately 30 seconds, press **Enter**. The screen will indicate if the calibration has been accepted.
8. Press **Enter** again to return to the Calibrate menu. Rinse the sonde with purified water and dry the sonde.

NOTE: *The YSI conductivity system is very linear over its entire 0-100 mS/cm range. Therefore, it is usually not necessary to use calibration solutions other than the 10 mS/cm reagent recommended above for all environmental applications from low conductivity (freshwater) to high conductivity (seawater). For users who want to assure maximum accuracy at the high and low ends of the sensor range, YSI does offer the 3161 (1 mS/cm) and 3165 (100 mS/cm) conductivity standards. Users of the 1 mS/cm standard should be particularly careful to avoid contamination of the reagent. Because of contamination issues, YSI does not recommend using standards less than 1 mS/cm.*

4-6.3. Dissolved Oxygen for Unattended Monitoring Studies

NOTE CAREFULLY: Before beginning the calibration of dissolved oxygen for unattended monitoring studies, first assure that the Autosleep RS232 selection in the Advanced|Setup menu is ACTIVE.

The dissolved oxygen calibration may be carried out in either % Saturation, or mg/L. The % saturation method is the simplest to perform and recommended by YSI. Calibrating either of the choices will automatically calibrate the other.

If % Saturation is chosen, the calibration will be performed in a water-saturated air environment. If a mg/L calibration is chosen, the user will be calibrating in a solution with a known DO concentration, usually determined by a Winkler Titration.

NOTE: If you have resurfaced your DO sensor, we recommend running the probe continuously with a one minute averaging interval and one minute sampling interval for 15-30 minutes or until good stability is realized before attempting to calibrate. After only a membrane change, no resurfacing, run the probe continuously for 3-4 minutes or until good stability is realized.

Air Calibration in % Saturation:

1. With the sonde/calibration cup in the upright position, place approximately 3 mm (1/8 inch) of water in the bottom of the calibration cup.
2. Carefully insert the probe end of the sonde into the cup, making certain that the DO and temperature probes are not immersed in water.
3. Engage only 1 or 2 threads of the calibration cup to ensure the DO probe is vented to the atmosphere.
4. Wait approximately 10-15 minutes for the air in the calibration cup to become water saturated and for the temperature to equilibrate.
5. Select **Dissolved Oxy.**
6. Select **1-DO %.**
7. The screen will prompt you to enter the local barometric pressure in mmHg.
8. Press **Enter**, and the calibration will automatically occur after a preset warm-up period of 60 seconds, followed by a message indicating that the DO calibration is complete.
9. Press **Enter** again to return to the Calibrate menu.

Note: At calibration, the DOSat % (percent air saturation) value will reflect the barometer value that was entered. For example, if a barometric pressure of 720 mm is entered, the DOSat % value will change to 94.7 % ($720/760 \times 100$). The parameter "DOSat %Local" is also available for users who prefer to set their percent air saturation value to 100%, no matter what barometer value is entered. The method of activating this parameter, its use, and its limitations are described in Appendix F of this manual. The key factor to remember, however, is that no matter which convention (DOSat % or DOSat %Local) is selected, the barometric pressure must still be entered during calibration and the mg/L value will not be affected.

mg/L Calibration in a Known Solution:

1. Determine a known DO concentration of a water sample by performing a Winkler Titration.
2. Place the correct amount of the known sample into the calibration cup with the assembly in the upright position. Allow at least 1 minute for temperature equilibration before proceeding.
3. Select **Dissolved Oxy**.
4. Select **2-DO mg/L**.
5. The screen will prompt you to enter the value of the known sample.
6. Press **Enter**, and the calibration will automatically occur after a preset warm-up period of 60 seconds, followed by a message indicating that the DO calibration is complete.
7. Press **Enter** again to return to the Calibrate menu.

4-6.4. Dissolved Oxygen for Spot Sampling Studies

NOTE CAREFULLY: Before beginning the calibration of dissolved oxygen for spot sampling studies, first assure that the Sample Interval and the Averaging Interval are set to the same value (usually 1 minute) in the Quick Setup box of ADVantage6000 and that the Autosleep RS232 selection in the Advanced|Setup menu associated with the Water Quality firmware is INACTIVE.

To calibrate the dissolved oxygen sensor for spot sampling studies, follow the exact procedures outlined above in Section 4-5.3 for % Saturation and mg/L modes. However, with Autosleep RS232 deactivated as directed above, the calibration will NOT occur automatically as outlined above for monitoring studies. Instead, the user should observe the DO readings in real time when they show no change for approximately 30 seconds, press **Enter** to confirm the calibration manually as is done for all other sensors.

4-6.5. pH

NOTE: When calibrating pH, remove ISE modules (ammonium, nitrate, and chloride) from the sonde bulkhead. After pH calibration is complete, replace the ISE sensors and proceed with their calibration. Exposure to the high ionic content of pH buffers can cause a temporary, but significant, perturbation of these ISE probes.

When selecting to calibrate pH, you will be given the choice of a 1-point, 2-point, or 3-point calibration.

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A 1-point calibration is used to adjust a previous calibration, generally using a pH 7 buffer. This calibration procedure adjusts only the pH offset and leaves the previously determined slope unaltered.

A 2-point calibration is used if the pH of the media to be monitored is known to be either acidic or basic. For example, if the pH of a pond is known to vary between 5.5 and 7, a two-point calibration with pH 7 and pH 4 buffers is appropriate. A 3-point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.

A 3-point calibration assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers.

Calibration:

1. Attach the sonde to a ring stand in an inverted position with the clean, dry calibration cup attached.
2. Add enough pH 7 buffer standard to the calibration cup to ensure that the pH and temperature sensors are completely covered. Allow at least 1 minute for temperature equilibration before proceeding.
3. From the Calibrate menu, select **ISE1 pH** to access the pH calibration choices and select either a 1-point, 2-point, or 3-point calibration.
4. Input the value of the first buffer at the prompt. No matter how many calibration points you are using, the first buffer should always be pH 7.
5. Press **Enter** and the current values of all enabled sensors will appear on the screen and change with time as they stabilize in the solution. Observe the readings under pH and when they show no significant change for approximately 30 seconds, press **Enter**. The display will indicate if the calibration is accepted.
6. After the pH 7 calibration is complete, press **Enter** again, as instructed on the screen. If a 2- or 3-point calibration was chosen, rinse the sonde in deionized or distilled water and dry the sonde before proceeding with the next pH buffer, following the same steps as outlined above.

4-6.6. ORP

1. Attach the ADV6600 to a ring stand in an inverted position with the clean, dry calibration cup attached.
2. Add enough solution with a known oxidation reduction potential value (we recommend Zobell solution) to the calibration cup to ensure that the ORP sensor is completely covered. Allow at least 1 minute for temperature equilibration before proceeding.
3. From the Calibrate menu, select **ISE2 Orp**.
4. Input the correct value of the ORP solution for the sample temperature. Press **Enter**.
5. Monitor the stabilization of the ORP and temperature readings. After no changes occur for approximately 30 seconds, press **Enter** to confirm the calibration.

6. Press **Enter** again to return to the Calibrate menu.

ORP readings for the same solution can vary up to 100 mV depending on the temperature. However, no standard compensation algorithms exist for this parameter. Be sure to take this factor into account when reporting ORP values and checking sensor calibration. When entering calibration values for Zobell solution, consult the following chart:

Temperature, C	Zobell Solution Value, mV
-5	270.0
0	263.5
5	257.0
10	250.5
15	244.0
20	237.5
25	231.0
30	224.5
35	218.0
40	211.5
45	205.0
50	198.5

Note: Instructions for preparation of ORP calibrator solutions (including Zobell reagent) can be found in Section 2580 A. of *Standard Methods for the Examination of Water and Wastewater*. Alternatively, the Zobell solution is available from YSI.

4-6.7. Ammonium

When selecting to calibrate Ammonium, you will be given the choice of a 1-point, 2-point, or 3-point calibration. The temperature response of ion selective electrodes is not as predictable as that of pH sensors. Therefore, be sure to carry out a 3-point calibration the first time you use the probe. This will provide a default setting for the effect of temperature on your particular sensor. After this initial calibration, you can use the less time-consuming 2-point and 1-point routines to update the 3-point calibration. However, it is strongly recommended to perform a new 3-point calibration after each deployment of 30 days or longer.

A 1-point calibration is used to adjust a previous calibration, using any solution of known ammonium concentration.

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A 2-point calibration is performed using two calibration standards that are both at approximately the temperature of your environmental sample. In this procedure, the NH_4^+ sensor is usually calibrated using solutions that contain 1 and 100 mg/L of ammonium-nitrogen ($\text{NH}_4\text{-N}$).

A 3-point calibration assures maximum accuracy when the temperature of the media to be monitored cannot be anticipated. This procedure utilizes three calibration solutions, two at ambient temperature and one at a temperature significantly different from ambient. The recommended order of calibration standards is:

1. 100 mg/L ammonium-nitrogen ($\text{NH}_4\text{-N}$) standard at ambient temperature
2. 1 mg/L ammonium-nitrogen ($\text{NH}_4\text{-N}$) standard at ambient temperature
3. 1 mg/L ammonium-nitrogen ($\text{NH}_4\text{-N}$) standard at a different temperature (usually lower) than ambient. For best results, ensure a temperature difference of at least 10 C° between the second and third standards.

Calibration:

1. Attach the ADV6600 to a ring stand in an inverted position with the clean, dry calibration cup attached.
2. Add enough ammonium standard to the calibration cup to ensure that the ammonium, pH, and temperature sensors are completely covered. Allow at least 1 minute for temperature equilibration before proceeding. (Allow at least five minutes for the third, chilled standard in a 3-point calibration.)
3. From the Calibrate menu, select **ISE NH_4^+** to access the ammonium calibration choices and select either a 1-point, 2-point, or 3-point calibration.
4. Input the value of the first standard at the prompt.
5. Press **Enter** and the current values of all enabled sensors will appear on the screen and change with time as they stabilize in the solution. Observe the readings under NH_4^+ and when they show no significant change for approximately 30 seconds, press **Enter**. The display will indicate if the calibration is accepted.
6. Press **Enter** again, as instructed on the screen. If a 2- or 3-point calibration was chosen, rinse the sonde in deionized or distilled water and dry the sonde before proceeding with the next ammonium standard, following the same steps as outlined above.

Ammonium sensors generally drift more than pH sensors. To check for this drift, place the probe in one of your standards at the end of each deployment.

Ammonium standards are good growth media for a variety of organisms. This growth can significantly reduce the nitrogen content of your standards, an effect that is particularly important for the 1 mg/L solution. It is best to use new standards for each deployment, but if you decide to save your solutions for reuse, we recommend refrigerated storage to minimize the growth of these organisms.

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The ammonium sensor should not be exposed to pH calibration buffers. If accidentally exposed, the ammonium readings will be erratic and take longer to stabilize. To restore function of the ammonium sensor, soak the probe in 100 mg/L standard for a few minutes to several hours (or overnight). Perform a new calibration and pay careful attention that ammonium readings are stable.

CAUTION: *The ammonium membrane module is for use only at depths less than 50 feet (15.2 meters). Use of the probe at greater depths is likely to permanently damage the sensor.*

4-6.8. Nitrate

When selecting to calibrate Nitrate, you will be given the choice of a 1-point, 2-point, or 3-point calibration. The temperature response of ion selective electrodes is not as predictable as that of pH sensors. Therefore, be sure to carry out a 3-point calibration the first time you use the probe. This will provide a default setting for the effect of temperature on your particular sensor. After this initial calibration, you can use the less time-consuming 2-point and 1-point routines to update the 3-point calibration. However, it is strongly recommended to perform a new 3-point calibration after each deployment of 30 days or longer.

A 1-point calibration is used to adjust a previous calibration, using any solution of known ammonium concentration.

A 2-point calibration is performed using two calibration standards that are both at approximately the temperature of your environmental sample. In this procedure, the NO_3^- sensor is usually calibrated using solutions that contain 1 and 100 mg/L of nitrate-nitrogen ($\text{NO}_3\text{-N}$).

A 3-point calibration assures maximum accuracy when the temperature of the media to be monitored cannot be anticipated. This procedure utilizes three calibration solutions, two at ambient temperature and one at a temperature significantly different from ambient. The recommended order of calibration standards is:

1. 100 mg/L nitrate-nitrogen ($\text{NO}_3\text{-N}$) standard at ambient temperature
2. 1 mg/L nitrate-nitrogen ($\text{NO}_3\text{-N}$) standard at ambient temperature
3. 1 mg/L nitrate-nitrogen ($\text{NO}_3\text{-N}$) standard at a different temperature (usually lower) than ambient. For best results, ensure a temperature difference of at least 10 C° between the second and third standards.

Calibration:

1. Attach the ADV6600 to a ring stand in an inverted position with the clean, dry calibration cup attached.
2. Add enough nitrate standard to the calibration cup to ensure that the nitrate, pH, and temperature sensors are completely covered. Allow at least 1 minute for temperature

- equilibration before proceeding. (Allow at least five minutes for the third, chilled standard in a 3-point calibration.)
3. From the Calibrate menu, select **ISE NO₃⁻** to access the nitrate calibration choices and select either a 1-point, 2-point, or 3-point calibration.
 4. Input the value of the first standard at the prompt.
 5. Press **Enter** and the current values of all enabled sensors will appear on the screen and change with time as they stabilize in the solution. Observe the readings under NO₃⁻ and when they show no significant change for approximately 30 seconds, press **Enter**. The display will indicate if the calibration is accepted.
 6. Press **Enter** again, as instructed on the screen. If a 2- or 3-point calibration was chosen, rinse the sonde in water and dry the sonde before proceeding with the next nitrate standard, following the same steps as outlined above.

Nitrate sensors generally drift more than pH sensors. To check for this drift, place the probe in one of your standards at the end of each deployment.

Nitrate standards are good growth media for a variety of organisms. This growth can significantly reduce the nitrogen content of your standards, an effect that is particularly important for the 1 mg/L solution. It is best to use new standards for each deployment, but if you decide to save your solutions for reuse, we recommend refrigerated storage to minimize the growth of these organisms.

The nitrate sensor should not be exposed to pH calibration buffers. If accidentally exposed, the nitrate readings will be erratic and take longer to stabilize. To restore function of the nitrate sensor, soak the probe in 100 mg/L standard for a few minutes to several hours (or overnight). Perform a new calibration and pay careful attention that nitrate readings are stable.

CAUTION: *The nitrate membrane module is for use only at depths less than 50 feet (15.2 meters). Use of the probe at greater depths is likely to permanently damage the sensor.*

4-6.9. Chloride

When selecting to calibrate Chloride, you will be given the choice of a 1-point, 2-point, or 3-point calibration. The temperature response of ion selective electrodes is not as predictable as that of pH sensors. Therefore, be sure to carry out a 3-point calibration the first time you use the probe. This will provide a default setting for the effect of temperature on your particular sensor. After this initial calibration, you can use the less time-consuming 2-point and 1-point routines to update the 3-point calibration. However, it is strongly recommended to perform a new 3-point calibration after each deployment of 30 days or longer.

A 1-point calibration is used to adjust a previous calibration, using any solution of known chloride concentration.

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A 2-point calibration is performed using two calibration standards that are both at approximately the temperature of your environmental sample. In this procedure, the Cl⁻ sensor is usually calibrated using solutions that contain 1 and 100 mg/L of chloride (Cl⁻).

A 3-point calibration assures maximum accuracy when the temperature of the media to be monitored cannot be anticipated. This procedure utilizes three calibration solutions, two at ambient temperature and one at a temperature significantly different from ambient. The recommended order of calibration standards is:

1. 1000 mg/L chloride (Cl⁻) standard at ambient temperature
2. 10 mg/L chloride (Cl⁻) standard at ambient temperature
3. 10 mg/L chloride (Cl⁻) standard at a different temperature (usually lower) than ambient. For best results, ensure a temperature difference of at least 10 C° between the second and third standards.

Calibration:

1. Attach the ADV6600 to a ring stand in an inverted position with the clean, dry calibration cup attached.
2. Add enough chloride standard to the calibration cup to ensure that the chloride, pH, and temperature sensors are completely covered. Allow at least 1 minute for temperature equilibration before proceeding. (Allow at least five minutes for the third, chilled standard in a 3-point calibration.)
3. From the Calibrate menu, select **ISE Cl⁻** to access the chloride calibration choices and select either a 1-point, 2-point, or 3-point calibration.
4. Input the value of the first standard at the prompt.
5. Press **Enter** and the current values of all enabled sensors will appear on the screen and change with time as they stabilize in the solution. Observe the readings under Cl⁻ and when they show no significant change for approximately 30 seconds, press **Enter**. The display will indicate if the calibration is accepted.
6. Press **Enter** again, as instructed on the screen. If a 2- or 3-point calibration was chosen, rinse the sonde in water and dry the sonde before proceeding with the next nitrate standard, following the same steps as outlined above.

Chloride sensors generally drift more than pH sensors. Be sure to check for this drift by placing the probe in a standard at the end of each deployment.

The chloride sensor should not be exposed to pH calibration buffers. If accidentally exposed, the chloride readings will be erratic and take longer to stabilize. To restore function of the chloride sensor, soak the probe in 1000 mg/L standard for a few minutes to several hours (or overnight). Perform a new calibration and pay careful attention that nitrate readings are stable.

4-6.10. Turbidity

Before calibrating your 6026 or 6136 turbidity sensor, pay particular attention to the following cautions:

- To properly calibrate YSI turbidity sensors, you **MUST** use standards that have been prepared according to the procedures and guidelines listed in *Standard Methods for the Treatment of Water and Wastewater (Section 2130 B)*. Acceptable standards include:
 - Formazin prepared according to *Standard Methods* guidelines.
 - Dilutions of 4000 NTU Formazin concentrate purchased from Hach.
 - Hach brand StablCal™ standards in various NTU denominations.
 - AMCO-AEPA standards prepared specifically for the YSI turbidity probe and purchased only from YSI.

***Warning!** Standards purchased from other vendors, including AMCO-AEPA standards from suppliers other than YSI, are not approved for use with the YSI turbidity probe and their use will likely result in both calibration errors and incorrect field readings.*

- For AMCO-AEPA standards, the value entered by the user during the calibration protocol is **DIFFERENT** depending on which sensor (6026 or 6136) is being calibrated. This reflects the empirically determined fact that 6026 and 6136 sensors that have been calibrated to the same value in the primary standard formazin will have different responses in suspensions of the AEPA-AMCO beads. This effect is likely due to the larger optical cell volume of the 6136. For example, the label of the YSI 6073 turbidity standard bottle indicates that the value of the standard is **100 NTU when used for calibration of the 6026 sensor, but 123 NTU when used to calibrate the 6136**. Note that the phenomenon of a sensor-specific formazin/AEPA-AMCO ratio is well known for sensors other than the 6026 and 6136.
- For best results, use only freshly prepared or purchased turbidity standards. Degradation of standards can occur on standing, particularly formazin prepared from dilution of concentrated suspensions such as Hach 4000 NTU standard.
- For most applications, purified water of any kind (distilled, deionized or filtered) will be acceptable for the 0 NTU standard. This water can be obtained from a laboratory or can be purchased at a local supermarket. It is not recommend that you use tap water as the 0 NTU standard. For maximum accuracy at very low NTU values (below the specification of the instrument), you may want to purchase turbidity-free water from YSI or another vendor
- Be certain that the probe compartment of the sonde has been cleaned and is free of debris. Solid particles from this source, particularly those carried over from past deployments, will

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contaminate the standards during your calibration protocol and cause either calibration errors and/or inaccurate field data.

When selecting to calibrate Turbidity, you will be given the choice of a 1-point, 2-point, or 3-point calibration. For the first usage, a 2- or 3-point calibration should be performed. Once the initial multi-point calibration has been carried out, the accuracy of the sensor at low NTU may be checked (or reset) by performing a 1-point calibration before each usage.

A 1-point calibration is normally used to zero the turbidity probe in 0 NTU standard.

A 2-point calibration is performed using two calibration standards. One of the standards must be 0 NTU and the other should be in the range of known turbidity for the water to be monitored. For example, if the water to be evaluated is known to be low in turbidity, an appropriate choice of standards might be 0 and 10 NTU. Or, for general purpose measurements an appropriate choice of standards is usually 0 and 100 NTU.

A 3-point calibration assures maximum accuracy over the entire range of 0 to 1000 NTU. One of the standards must be 0 NTU. Because of the linearity characteristics of the sensors, it is recommended that the other two standards have turbidity values of 100 and 1000 NTU. However, the user can select any values that are deemed appropriate.

Calibration:

1. With the ADV6600 in the upright position, place the correct amount of turbidity standard in a clean, dry or pre-rinsed calibration cup. Immerse the probe end of the ADV6600 into the solution, making sure that the temperature sensor is immersed. Allow at least one minute for temperature equilibration before proceeding.
2. From the Calibrate menu, select **Optic Turbidity** to access the turbidity calibration choices and choose either a 1-point, 2-point, or 3-point calibration.
3. Input the value of the first standard at the prompt. No matter how many calibration points you are using, the first standard should always be 0 NTU.
4. Press **Enter** and the current values of all enabled sensors will appear on the screen and change with time as they stabilize in the solution.
5. Activate the wiper 1-2 times by pressing **3-Clean Optics** as shown on the screen, to remove any bubbles. Be sure to observe the wiper during these cycles to assure that it is rotating and parking correctly (180 degrees from optics).
6. Observe the readings. After stabilization is complete, press **Enter** to confirm the calibration. The display will indicate if the calibration is accepted.
7. Press **Enter** again, as instructed on the screen. If a 2- or 3-point calibration was chosen, rinse the sonde in water and dry the sonde before proceeding with the next turbidity standard, following the same steps as outlined above.

4-6.11. Chlorophyll

To properly calibrate the YSI 6025 Chlorophyll sensor, calibration standards of known fluorescence are required. Two general types of standards can be used:

- Phytoplankton suspensions of known chlorophyll content
- Dye solutions whose fluorescence can be correlated to that of chlorophyll.

The user is responsible for determining the chlorophyll content of phytoplankton suspensions, either by employing the extractive analysis procedure described in *Standard Methods for the Examination of Water and Wastewater*, or by analyzing the suspension *in situ* using a laboratory fluorometer.

YSI does not recommend the use of molecular chlorophyll standards. The standards are usually only soluble in organic solvents such as acetone that would cause serious damage to the materials used in the YSI 6025 probe. Damage caused by exposure to solvents or other solutions is not covered under warranty. Even if molecular chlorophyll standards soluble in aqueous media were available, their fluorescence is not likely to emulate *in vivo* chlorophyll fluorescence any better than a dye solution.

CAUTION: *For assured accuracy of field measurements made with the chlorophyll sensor, it must either be initially calibrated using a phytoplankton suspension of known chlorophyll content, or post-calibrated in a spreadsheet comparing the fluorescence values obtained in field studies with laboratory analysis of grab samples collected during the field study. The use of a chemical dye standard for “calibration” of the sensor is only an approximation and may not result in accurate correlation between fluorescence and actual chlorophyll readings. Chemical dyes are designed primarily to evaluate the sensor for drift. YSI does not provide an accuracy specification for chlorophyll due to these limitations.*

Preparation of Rhodamine WT Standard Solution

CAUTION: Be certain to read and follow all the safety instructions and MSDS documentation which is supplied with the dye before proceeding. Remember that only trained personnel should handle chemicals.

Rhodamine WT dye is usually purchased in solution form and can vary somewhat in nominal concentration. YSI uses Rhodamine WT from the supplier noted below and recommends that the user purchase this exact item if possible. The solution is approximately 2.0 % in Rhodamine WT.

**Fluorescent FWT Red Dye (Item# 106023; 16 Fl. Oz.)
Kingscote Chemicals
3334 South Tech Blvd.
Miamisburg, OH 45342
Ph. 1-800-394-0678**

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Fax 937-886-9300
www.brightdyes.com

1. Accurately transfer 5.0 g of the Rhodamine WT solution into a 1000 mL volumetric flask.
2. Fill the flask to the volumetric mark with deionized or distilled water and mix well to produce a solution that is approximately 100 mg/L of Rhodamine WT. Transfer this standard to a glass bottle and retain it for future use.
3. Accurately transfer 5.0 mL of the solution prepared in the above step to a 1000 mL volumetric flask.
4. Fill the flask to the volumetric mark with deionized or distilled water. Mix well to obtain a solution, which is 0.5 mg/L in water (a 200:1 dilution of the concentrated solution).
5. Store the concentrated standard solution produced above in a glass bottle in a refrigerator to retard decomposition. The dilute standard prepared in the previous step should be used within 24 hours of its preparation.

When rhodamine standards are required in the future, perform another dilution of the concentrated rhodamine solution after warming it to ambient temperature. Our experience has indicated that the concentrated solution that has been kept at cold temperatures is much more stable than the dilute solution stored at room temperature.

It is well known that the intensity of the fluorescence of many dyes shows an inverse relationship with temperature. This effect must also be accounted for when “calibrating” the YSI chlorophyll sensor with rhodamine WT. Enter the calibration value from the table below corresponding to the temperature of the standard. The table shows the approximate algal chlorophyll equivalent of 0.5 mg/L Rhodamine WT as a function of temperature.

°C	µg/L Chl to Enter	°C	µg/L Chl to Enter
30	100	18	122
28	103	16	126
26	106	14	131
24	110	12	136
22	113	10	140
20	118	8	144

Calibration

When selecting to calibrate Chlorophyll, there will be a choice of zeroing the full-scale range of the fluorescence sensor (Fluor Zero), or calibrating with actual chlorophyll standards (µg/L 1-point, 2-point, or 3-point). A zero calibration should always be performed before each use of the YSI 6025 sensor. Multi-point calibrations will be required infrequently. In general, it is best to perform

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periodic 2-point calibrations using a dye sample more frequently during initial studies with the YSI 6025 to empirically determine its drift rate and use these results to set up the calibration frequency.

If post-calibration of the sensor with phytoplankton suspensions is being done to obtain accurate readings relative to chlorophyll as determined by laboratory extractive analysis, then effectively a 2-point calibration is being performed for every sampling or monitoring study.

The Fluor zero option is used to zero the fluorescence probe in a medium that is chlorophyll-free. If Fluor %FS is selected as a parameter in Report Setup, the sonde will report only relative values of fluorescence in the sample being measured. These values could then be converted into actual chlorophyll concentrations in $\mu\text{g/L}$ by using a post-calibration procedure, after the chlorophyll content of grab-samples taken during a sampling or monitoring study has been analyzed in a laboratory. This determination can involve conducting the extractive analysis procedure described for chlorophyll in *Standard Methods for the Examination of Water and Wastewater* or by carrying out an *in situ* measurement of chlorophyll using a commercial benchtop fluorometer.

A 1-point calibration is normally used to zero the fluorescence probe in a medium that is chlorophyll-free. If you use this method, you will either choose to utilize the default sensitivity for chlorophyll in the sonde software or to update a previous multi-point. This procedure will use the default sensitivity for calculation of chlorophyll concentration in $\mu\text{g/L}$, allowing fluorescence measurements that are only semi-quantitative with regard to chlorophyll. However the readings will reflect changes in chlorophyll from site to site, or over time at a single site.

A 2-point calibration is performed using two calibration standards of known fluorescence. One of the standards must be chlorophyll-free water ($0 \mu\text{g/L}$) and the other should be in the range of known chlorophyll content for the water to be monitored. For example, if the water to be evaluated is known to be low in chlorophyll, an appropriate choice of standards might be 0 and $10 \mu\text{g/L}$. Or, for general-purpose measurements an appropriate choice of standards is usually 0 and $100 \mu\text{g/L}$.

A 3-point calibration assures maximum accuracy over the entire range of 0 to $400 \mu\text{g/L}$. One of the standards must be $0 \mu\text{g/L}$. The user can select any values for the other two standards that are deemed appropriate.

Warning: The *Chl temp co %/C* must be set to zero before calibration with Rhodamine WT.

Fluor zero Calibration:

1. With the ADV6600 in the upright position, place the correct amount of chlorophyll-free water into a clean, dry or pre-rinsed calibration cup. Immerse the probe end of the ADV6600 into the solution. Allow at least one minute for temperature equilibration before proceeding.
2. From the Calibrate menu, select **Optic Chlorophyll** to access the chlorophyll calibration choices and select a **Fluor zero** calibration.
3. Input **0** at the screen prompt for Fluor %FS.

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4. Press **Enter** and the screen will display real-time readings that will allow you to determine when the fluorescence readings have stabilized.
5. Activate the wiper 1-2 times by pressing **3-Clean Optics** as shown on the screen to remove any air bubbles. Be sure to observe the wiper during these cycles to assure that it is rotating and parking correctly (180 degrees from the optics).
6. Observe the readings. Press **Enter** after the readings have stabilized to confirm the calibration and zero the sensor. The display will indicate if the calibration is accepted.
7. Press **Enter** again to return to the Calibrate menu.

Chl $\mu\text{g/L}$ Calibration:

1. With the ADV6600 in the upright position, place the correct amount of chlorophyll-free water into a clean, dry or pre-rinsed calibration cup. Immerse the probe end of the ADV6600 into the solution. Allow at least one minute for temperature equilibration before proceeding.
2. Place the correct amount of chlorophyll standard into a clean, dry or pre-rinsed calibration cup. Immerse the probe end of the ADV6600 into the solution. Allow at least one minute for temperature equilibration before proceeding.
3. From the Calibrate menu, select **Optic Chlorophyll** to access the chlorophyll calibration choices and select either a 1-point, 2-point, or 3-point calibration.
4. Input the value of the first standard at the prompt. No matter how many calibration points you are using, the first standard should always be 0 $\mu\text{g/L}$.
5. Press **Enter** and the screen will display real-time readings that will allow you to determine when the fluorescence readings have stabilized.
6. Activate the wiper 1-2 times by pressing **3-Clean Optics** as shown on the screen to remove any air bubbles. Be sure to observe the wiper during these cycles to assure that it is rotating and parking correctly (180 degrees from the optics).
7. Observe the readings. Press **Enter** after the readings have stabilized to confirm the calibration. The display will indicate if the calibration is accepted.
8. Press **Enter** again, as instructed on the screen. If a 2- or 3-point calibration was chosen, rinse the ADV6600 in water and dry the sonde before proceeding with the next chlorophyll standard, following the same steps as outlined above.

4-6.12. Rhodamine WT

Preparation of Rhodamine WT Standard Solution

CAUTION: Be certain to read and follow all the safety instructions and MSDS documentation which is supplied with the dye before proceeding. Remember that only trained personnel should handle chemicals.

We recommend that rhodamine WT concentrate be purchased from Keystone Aniline Corporation, 2501 W. Fulton Street, Chicago, IL 60612 (Telephone: 312-666-2015) under the name KEYACID

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RHODAMINE WT LIQUID (Part # 70301027). As purchased, the solution is approximately 20 % rhodamine WT by weight, i.e., 200 g/L.

1. Accurately weigh 0.500 g of the 20 % rhodamine concentrate. Quantitatively transfer the viscous liquid to a 1000-mL volumetric flask.
2. Fill the flask to the top graduation with purified water. This solution contains 100 mg of rhodamine WT per 1000 mL of water.
3. Accurately transfer 1.0 mL of the solution prepared in the above step to a 1000 mL volumetric flask.
4. Fill the flask to the top graduation with purified water. Mix well to obtain a solution that is 100 ug/L (0.10 mg/L) in water (a 1000:1 dilution of the concentrated solution).
5. Store the concentrated standard solution in a darkened glass bottle in a refrigerator to retard decomposition. The dilute standard prepared in the previous step should be used within 5 days of its preparation.

When rhodamine WT standards are required in the future, perform another dilution of the concentrated dye solution after warming it to ambient temperature. Our experience has indicated that the concentrated solution that has been kept at cold temperatures is much more stable than the dilute solution stored at room temperature.

Calibration

When selecting to calibrate Rhodamine, there will be a choice of a 1-point, 2-point, or 3-point calibration.

A 1-point calibration is used to zero the rhodamine sensor in 0 ug/L standard.

A 2-point calibration is used if the range of the rhodamine concentration for the study can be predicted. One of the standards must be 0 ug/L. For most measurements, an appropriate choice of standards is usually 0 and 100 ug/L.

A 3-point calibration assures maximum accuracy over the entire range of 0 to 200 ug/L. One of the standards must be 0 ug/L. Two additional standards of the user's choice are also used.

Calibration:

1. With the ADV6600 in an upright position, place the correct amount of rhodamine WT standard in a clean, dry or pre-rinsed calibration cup. Immersed the probe end of the ADV6600 into the solution. Allow at least one minute for temperature equilibration before proceeding.
2. From the Calibrate menu, select **Optic Rhodamine** to access the rhodamine WT calibration choices and select either a 1-point, 2-point, or 3-point calibration.

3. Input the value of the first standard at the prompt. No matter how many calibration points you are using, the first standard should always be 0 ug/L.
4. Press **Enter** and the current values of all enabled sensors will appear on the screen and change with time as they stabilize in the solution.
5. Activate the wiper 1-2 times by pressing **3-Clean Optics** as shown on the screen, to remove any bubbles. Be sure to observe the wiper during these cycles to assure that it is rotating and parking (180 degrees from optics) correctly.
6. Observe the readings. After stabilization is complete, press **Enter** to confirm the calibration. The display will indicate if the calibration is accepted.
7. Press **Enter** again, as instructed on the screen. If a 2- or 3-point calibration was chosen, rinse the ADV6600 in water and dry the sonde before proceeding with the next turbidity standard, following the same steps as outlined above.

4-7. Establishing Default Calibration – “UNCAL” Command

If it is required to return a Water Quality sensor to the factory default settings for calibration (slope and offset), follow the instructions below:

1. Activate a calibration for the parameter you wish to return to its factory default setting. Any calibration (1-point, 2-point, or 3-point) for the parameter may be selected.
2. When a numerical entry is requested, either the value of the first standard or mmHg for dissolved oxygen, instead of entering a numeric value, type the word **uncal** and press **Enter**.

Both slope and offset for the parameter will be returned to the factory default settings

Section 5. Field Mounting and Installation

Before deploying your ADV6600 in actual field applications, you should be aware of considerations which are likely to affect your site selection. In the sections below, several methods of field mounting your ADV6600 are described, along with some cautions which may eliminate certain sites. Be sure to read this section carefully before deciding where and how to deploy your ADV6600.

NOTE CAREFULLY: Regardless of the mounting method, the ADV6600 must be mounted in a vertical orientation with its sensors facing DOWN. Mounting with the sensors up or in a horizontal orientation will result in erroneous direction and velocity data.

5-1. Mounting Methods

The ADV6600 can be mounted in several ways depending on the field application. These range from temporary mounts for short-term data collection projects (a few minutes to a few hours) to permanent installations for long-term monitoring stations. In general, an ADV6600 can collect valid velocity data when deployed using the following methods.

- Mounted directly to a vertical pole, bridge abutment, or similar structure. Ideally, the sonde should be separated from the mounting pole by approximately 5 times the diameter of the pole in order to avoid any flow interference from the structure.
- Mounted vertically in a hollow PVC pipe that is attached to a pole, bridge abutment, or similar structure so long as the Doppler sensor extends completely below the pipe bottom
- Deployed vertically using a rope or chain as a tether
- Suspended beneath a tethered floating buoy

There are, however, several factors of which you need to be aware that will affect the quality and accuracy of the ADV data.

- High frequency rotations of the system can create temporary inaccuracies in the compass readings (described in the following section) that will compromise the accuracy of velocity measurements.
- There must be sufficient scatterers in the water so that accurate velocity measurements can be made. A Beam Check should be performed (if possible) at all sites before a deployment, and is a must at sites where the water is very clear.
- There must be minimal magnetic interference to avoid influencing compass readings (see compass section). Any magnetic interference (ferrous material) needs to be stationary in relation to the ADV6600, i.e., the interfering material and the ADV6600 should be attached to one another. A compass calibration should be performed before each deployment, as it can

Section 5. Mounting and Installation

compensate for limited magnetic disturbances, and, if possible, the calibration should be performed with the ADV6600 in the mounting frame.

- Both the ADV sensor and the Water Quality sensors need to be submerged to make accurate velocity measurements.
- Flow interference (caused by the mount, pilings, rocks, weeds, etc.) will affect velocity measurements. For this reason, deployment location must be considered carefully to be sure that the sampling area of the ADV is free from these disturbances for the entire deployment.
- The system can be deployed on the inside of a pipe but the Doppler sensor must be located below the bottom of the pipe at least as far as it extends below the probe guard for proper performance and to reduce flow interference.
- It is important to select a deployment site that is representative of the flow that you are trying to measure. Environmental stability (i.e., not subject to massive changes in conditions) is preferable but not required.
- If data will be collected in the internal memory of the ADV6600 during an autonomous deployment, the recorder must be enabled.

A few examples of good deployment conditions are:

1. Mounting the ADV6600 to a rigid aluminum post or pole that has been sunk into the bottom of the water body with no ferrous objects nearby. The sonde must be deployed such that the entire array of sensors will be submerged at all times.
2. Placing the ADV6600 in a piece of 6-inch PVC pipe that is suspended in the water with a weight on the bottom of the pipe to minimize movement. Remember that the Doppler sensor must extend below the bottom of the pipe.
3. Placing the ADV6600 in a piece of 6-inch PVC pipe that is securely mounted to a rigid post as in the example (1) above. Again, remember that the Doppler sensor must extend below the bottom of the pipe.

For any of the above common deployment methods, the ADV6600 can either be logging to internal memory using on-board battery power or be logging to an on-site data collection platform (DCP) that is also supplying power to the ADV6600.

5-1.1. Deploying Using the YSI 6650 Clamps

The ADV6600 is ideally supported by two YSI 6650 circular clamps attached at two locations along the probe housing as shown in the picture below. Note that when ideally installed, the clamps fit within the recessed grooves on the instrument.

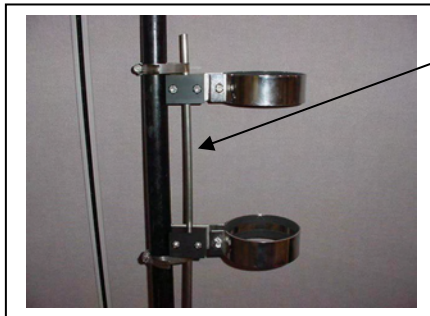
Section 5. Mounting and Installation



Cable Retainer

However, if the deployment requires a special mounting configuration, the clamps can be placed outside the grooves with minimal chance of slippage as long as they are securely tightened with the proper hex wrench.

The “cable retainer” portion of the clamp is designed to be used on steel cables which are suspended from a buoy and are ideal for this application. However, with a little custom user engineering, a tubular offset from a pole or abutment can be designed which will be compatible with the cable retainer opening (0.375 inches) of the clamp as shown below. Using this customer engineering two of the 6650 clamps can be used for virtually any type of deployment as shown in the pictures below.



3/8" Rod

5' Pipe w/ Clamps Attached



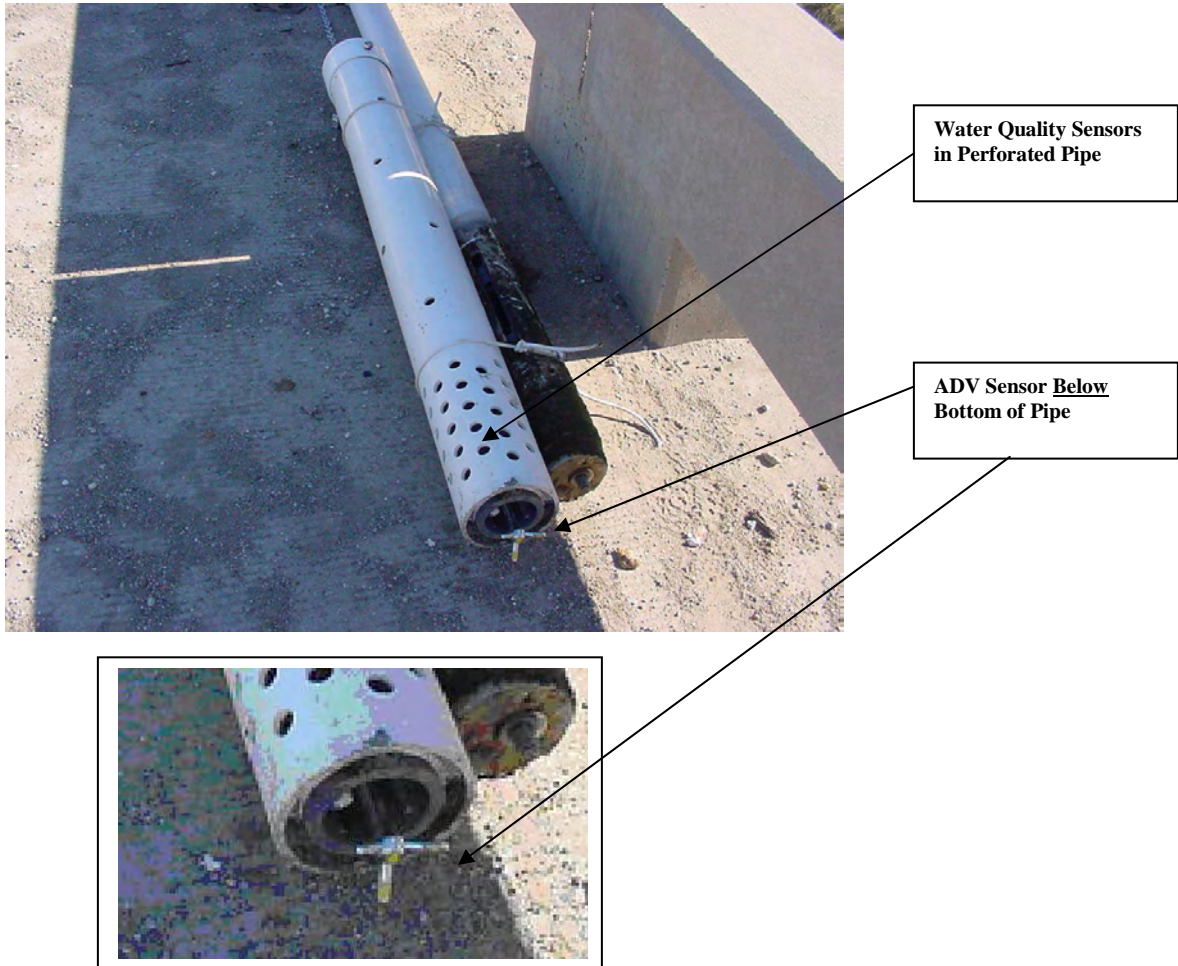
Deployed ADV6600

Safety Rope



5-1.2. Deploying in a PVC Pipe

A piece of commonly available 6 inch PVC pipe can also be used to deploy the sonde, again with a small amount of user engineering required. In this case, the engineering requires the mounting of a “bottom stop” at the end of the pipe on which the probe guard of the sonde will rest and allow the ADV sensor to extend beneath the deployment system as shown in the picture below. Note that the pipe also has to be perforated by the user to allow water to circulate to the water quality sensors.



Once modified, the PVC pipe can either be mounted to a post which has been driven into the bottom of the water body or suspended on a rope or chain as shown in the pictures below.



**ADV6600 Deployed
in Pipe**



**ADV6600 Deployed
in Pipe**

5-1.3. Deploying on a Simple Tether

The ADV6600 can also be deployed simply by tethering it to a bridge or support using a simple chain or rope as shown in the picture below.



ADV6600 on Simple Tether

Clearly, the ADV6600 will probably twist on its vertical axis during a “suspension” deployment such as shown above. To counter this problem, the ADV6600 is equipped with an internal compass that automatically compensates for most of the rotation of the sonde during deployments. However, as noted above, significant and sharp changes in rotation can cause temporary inaccuracies in the measurement of the water velocity. For fast water tethered deployments, the twisting of the sonde can be minimized by using a rudder which is easily attached to the 6650 clamps as shown below.



Some points to keep in mind regarding non-fixed (tethered) deployments either free or in a PVC pipe:

- The compass is sampled once per second, so rapid or abrupt movement of the system can yield inaccurate compass measurements, and therefore inaccurate velocity measurements.
- Some slight and regular movements of the system are acceptable and will be averaged out during the collection time period (averaging interval). How much of this environmental “white noise” that will be average out is a function of the amount of movement the system is experiencing and the length of time the ADV6600 is averaging. In all cases the longer the average the more of the regular movements will be removed (averaged out)
- The variation in the three rotations (heading, pitch, and roll) is recorded to the system as Heading Standard Deviation, Pitch Standard Deviation, and Roll Standard Deviation, respectively and can be used to determine how “active” the movement of the ADV6600 was during the deployment.

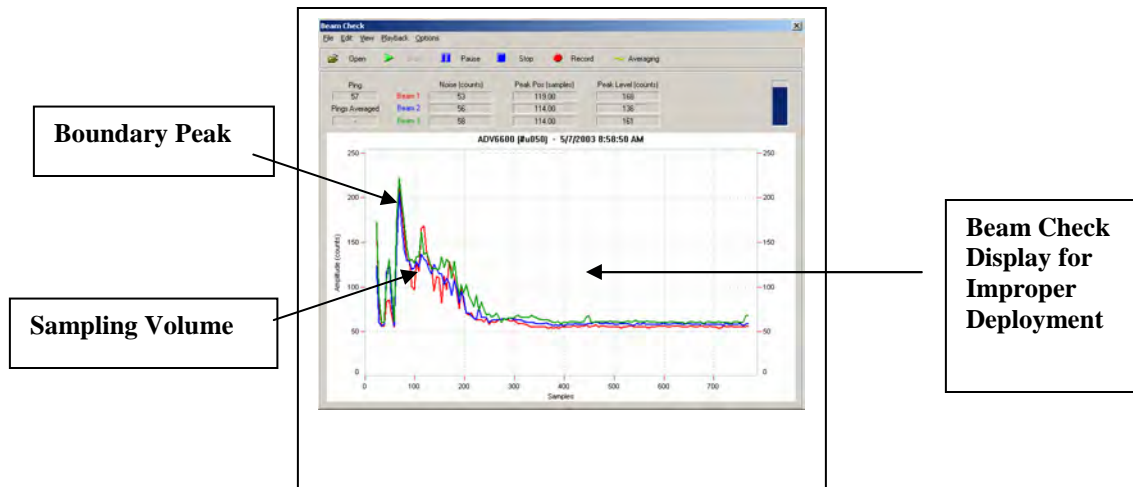
5-2. Mounting Cautions

In order to assure a successful deployment of your ADV6600, users should be aware of several situations to avoid when selecting a site or deployment method. Critical considerations are detailed below.

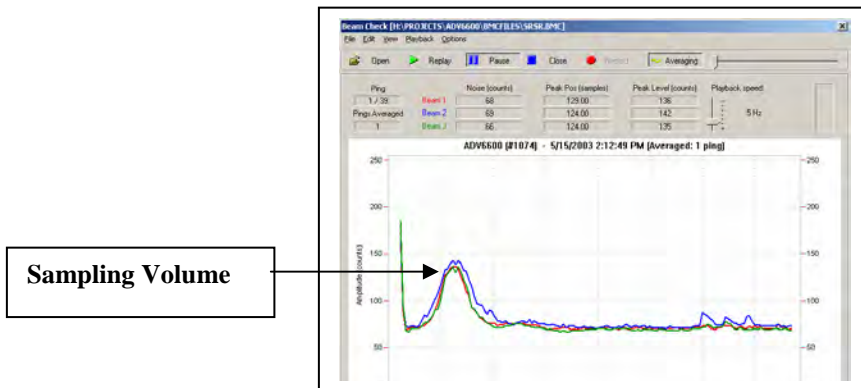
5-2.1. Bottom Interference

When deploying the ADV6600, it is critical to be certain that the sampling volume of the Doppler sensor extends approximately 7 cm (2.8 inches) from the bottom of the sensor transducer which is shown in the diagram below. This sampling volume **MUST** be well above the bottom of the body of water being monitored. Therefore, when considering a deployment site, assure that there is sufficient water depth present to allow the transducer to be at least 6 inches above the bottom (or other boundary) and still cover all of the water quality sensors. In practice, this means that the water at the deployment site must be at least 15 inches deep. By running a Beam Check at the site, you will be able to determine if the ADV sensor is too close to the bottom. For example, the beam check below shows a strong signal for all three receivers at a lower x-axis value than the sampling bottom indicating that the Doppler sensor is closer to the boundary (bottom of the body of water) than the sampling volume of the sensor which resides about 7 cm below the transmit transducer. Clearly, the ADV6600 would have to be raised until the boundary peak shifted to greater x-axis values than the sampling volume in order to be able to acquire useful velocity data.

Section 5. Mounting and Installation



This example clearly shows the importance of performing a beam check at the site prior to each deployment. A proper field beam check file is shown below for comparison.

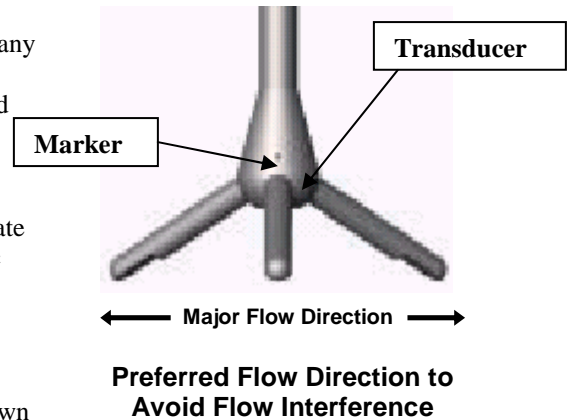


5-2.2. Flow Interference

As noted above, the ADV6600 measures velocity in a small sampling volume, ~25 cc, located about 7 cm (2.8 inches) from the tip of the probe. The placement of the sampling volume relative to other structures in the water must be considered so that the ADV6600 measures velocity free from flow interference.

The ADV6600 probe should be installed well clear of any underwater structures, particularly those upstream. Consider the size and location of nearby structures, and the probable magnitude and direction of flow when choosing an installation site.

Although the system's internal compass will compensate the head orientation as it relates to the Earth's magnetic field, it sometimes makes data analysis easier to check when the ADV6600 is oriented such that the marked receiver arm (there is a permanent dimple and a semi-permanent red-band indicating Beam 1) is roughly perpendicular to the expected direction of flow, as shown to the right. The arm is marked with an indentation on the bubble above the receiver arms as shown at the right.



5-2.3. Interference from Magnetic Material

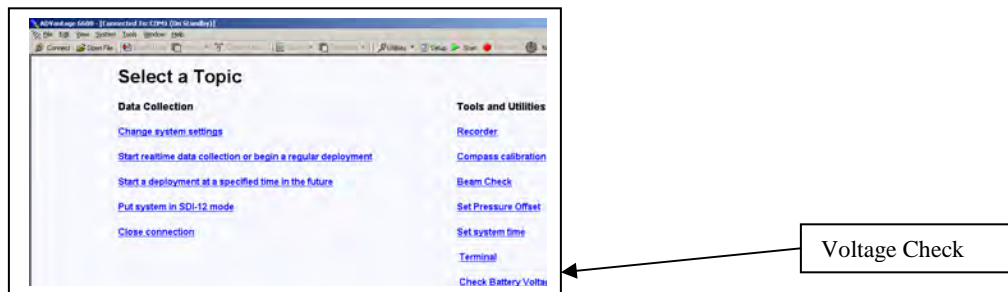
The ADV6600 uses a compass sensor to report velocity data in Earth coordinates and to compensate automatically for rotation of the sonde during deployment. Ferrous metal in the mounting structure near the instrument can affect the accuracy of compass measurements and hence the accuracy of velocity data. Ideally, all mounting fixtures should be designed using non-ferrous metals or plastics. However, if a magnetic (ferrous) material such as iron or steel pipe must be used, the ADV should be offset from the pole as much as possible to minimize magnetic interference from the support. Additionally, a compass calibration should be performed by rotating the entire ADV6600 and its mount so that the best possible compensation for the ferrous material can be accomplished.

Section 6. Using Your ADV6600 In The Field

After setting up your ADV6600, calibrating the sensors, and determining how the instrument will be mounted at the site of interest as described in the previous sections, the sonde is ready for use in the field. Detailed instructions for three types of field use (real-time, deployment with logging to internal memory, and deployment with logging to a data collection platform) are found below. Before moving to the field, you are also advised to consult Appendix D which answers questions frequently asked by first-time users of the ADV6600 and Appendix G which provides setup instructions in a quick-start format.

6-1. Checking Your Battery Voltage

No matter which mode of operation is relevant to your application, prior to taking the instrument to the field you should assure that the batteries in your sonde are either new (recommended) or have sufficient remaining capacity to handle a specific short term application (based on your empirical experience with correlating battery capacity with voltage). To make sure that your batteries have the power to suit your field needs, make sure that you check the voltage prior to any deployment using the Check Battery Voltage selection in the Tools and Utilities list as shown below



The battery life is a function of two major factors – the sample interval and the averaging interval. The instrument specification for battery life is approximately 30 days at a 15 minute sampling interval and a 1 minute averaging interval. An increase in the sample interval will improve the battery life; for example, you will get approximately 50 days at a sample interval of 30 minutes while maintaining an averaging interval of 1 minute. Conversely, an increase in averaging interval (perhaps to increase data smoothing) will result in a lower battery life – approximately 15 days with a 2 minute averaging interval while maintaining a 15 minute sample interval. Using these rough examples, users could estimate, for example, that the battery life with a 30 minute sample interval and 2 minute averaging interval would be about 25 days

Note, however, that the estimation of battery life is somewhat inaccurate and may vary slightly from instrument to instrument. Therefore, as stated above, it is always best to use new batteries for each deployment if possible.

6-2. Real-time Data Collection

Real-time data collection is an application where data is recorded directly to an external computer. This method of data collection may also be referred to as a spot sampling application. The user is usually present and may observe readings as they are recorded. Before beginning a deployment, make sure you have read and completed the procedures outlined in previous chapters of this manual, including membrane installation, probe installation, firmware setup, calibration and diagnostics. Be particularly careful that you have performed your dissolved oxygen calibration with Autosleep RS232 deactivated in the Advanced|Setup menu associated with the water quality sensors as described in Section 4.5.4 above.

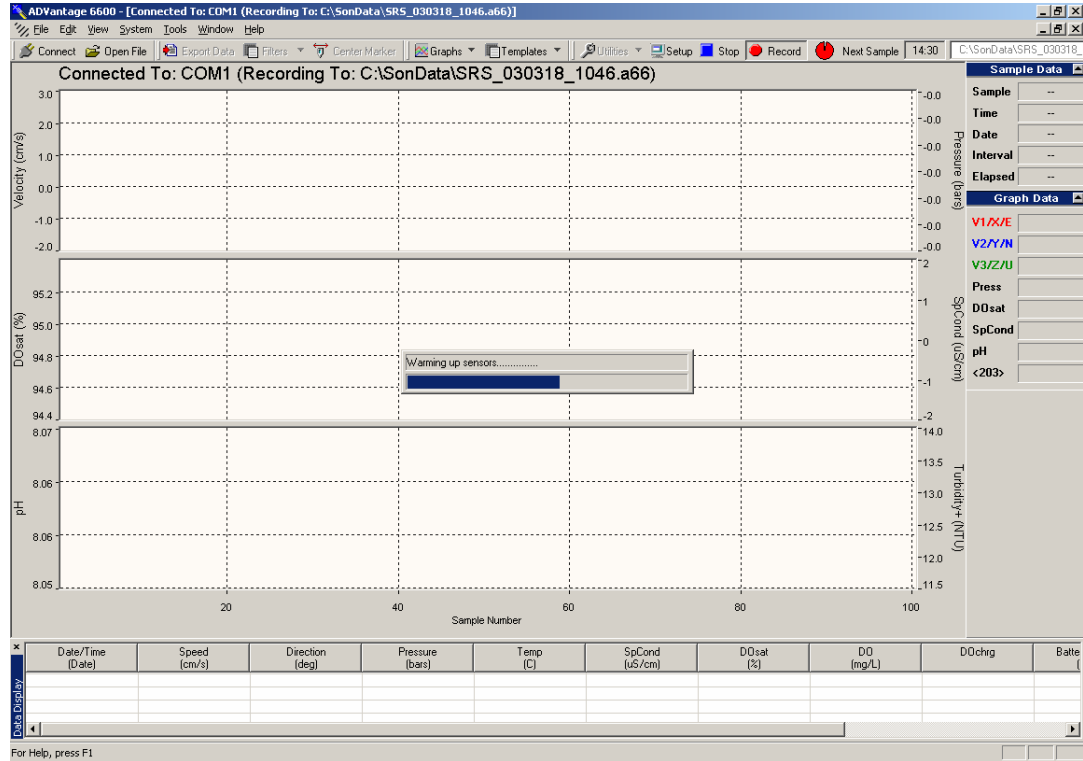
1. Connect the ADV6600 to a computer.
2. Launch the ADVantage 6600 software.
3. Choose **Connect to System**. Verify the **COM** setting and **Baud Rate**. Click on **Connect**.
4. Click **Change System Settings**. The Quick Setup dialog box, as shown at the right, will appear.
5. Enter up to 5 characters for a file name. Note that **ONLY** alpha-numeric characters are allowed. The software will automatically add the date (YYMMDD) and time (HHMM) to these 5 characters for a complete file name that appears as such:
5char_YYMMDD_HHMM.a66
6. Add comments regarding the deployment or data file, or leave blank.
7. Set the Averaging Interval and Sample Interval in minutes – usually a value of 1 min is appropriate for spot sampling.
8. For most spot sampling studies, make certain that the Velocity Range is set to AUTO and that the coordinate system is set to ENU.
9. Set up the **Enable Internal Recorder** and **Record to a file on this PC** boxes according to your needs. If both boxes are checked, data will be saved **BOTH** to internal sonde memory and to the PC as describe above. Generally, the only reason **NOT** to save data to both locations is that in very long real-time studies (days), the memory of the ADV6600 could become filled. The main reason to check both boxes is to provide a backup of your real-time data.
10. Click on **Update**. The settings will be saved and the Quick Setup window will disappear.
11. Choose the **Start real-time data collection or begin regular deployment** selection from the Data Collection list. The data display screen shown below will appear and after a 60

The screenshot shows the 'Quick Setup' dialog box with the following settings:

- Recorded File:** File name: RT 1 (with an 'Update' button)
- Comments:** Three empty text input fields (with a 'Cancel' button)
- Averaging Interval:** Hours: 0, Minutes: 1, Seconds: 0
- Sampling Interval:** Hours: 0, Minutes: 1, Seconds: 0
- Velocities:** Velocity Range: AUTO, Coordinate System: ENU
- Internal Recorder:** Free Space: 4.00 MB, Total Space: 4.00 MB, Recorder button, Enable Internal Recorder?, Record to a file on this PC when Start button is pressed

Section 6. Data Collection

second warm-up, readings will be logged to the file on the computer hard drive and to internal ADV6600 memory (if selected)..



12. When you are ready to stop data collection, click on the blue **Stop** icon at the top of the screen.

NOTE: During data collection, the plots and data tables can be custom configured using ADVantage 6600 without stopping the study. See **Section 8. Postprocessing of Data** for a description of ADVantage 6600 commands and capabilities

6-3. Unattended Data Collection

An unattended data collection application is one in which the sonde records all data to its internal recorder. Using this type of data collection, the user is not present when readings are collected. Rather, the instrument is programmed to record data readings at preset intervals and the completed data files are downloaded to a PC after several days or weeks in the field.

Section 6. Data Collection

Before beginning a deployment, make sure you have read and completed the procedures outlined in previous chapters of this manual, including membrane installation, probe installation, firmware setup, calibration and diagnostics. Be particularly careful that you have performed your dissolved oxygen calibration with Autosleep RS232 activated in the Advanced|Setup menu associated with the water quality sensors as described in Section 4.5.3 above.

1. Connect the ADV6600 to a computer.
2. Launch the ADVantage 6600 software.
3. Choose **Connect to System**. Verify the **COM** setting and **Baud Rate**. Click on **Connect**.
4. Click **Change System Settings**. The Quick Setup dialog box, as shown at the right, will appear.
5. Enter up to 5 characters for a file name. Note that **ONLY** alpha-numeric characters are allowed. The sonde firmware will automatically add a 3-digit site number to these 5 characters for a complete file name that appears as such: 5char001.a66
6. Add comments regarding the deployment or data file, or leave blank.
7. Set your Averaging Interval in minutes. For most unattended studies, an averaging interval of 1 minute provides sufficient data smoothing. Larger values may provide somewhat smoother data, but also will result in reduced battery life.
8. Select your Sample Interval in minutes. Typical values for most long term studies are 15, 30, or 60 minutes with the larger values providing longer battery life at the expense of time resolution. You may wish to select 15 minutes for your initial deployment to check for the rate at which velocity and water quality parameters typically change at a particular site and then later increase the sample interval if appropriate.
9. For most deployments, make certain that the Velocity Range is set to AUTO and that the coordinate system is set to ENU.
10. Make sure the **Enable Internal Recorder** box is checked.
11. Click on **Update**. The settings will be saved and the Quick Setup window will disappear.
12. From the Data Collection list choose either:
 - a.) **Start real-time data collection or begin regular deployment** to begin a deployment immediately.
 - b.) **Start a deployment at specified time in the future** to schedule a future start time

The screenshot shows the 'Quick Setup' dialog box with the following settings:

- Recorded File: File name: UAT 1
- Comments: (empty text area)
- Averaging Interval: Hours: 0, Minutes: 1, Seconds: 0
- Sampling Interval: Hours: 0, Minutes: 15, Seconds: 0
- Velocities: Velocity Range: AUTO, Coordinate System: ENU
- Internal Recorder: Free Space: 0 bytes, Total Space: 4.00 MB, Recorder button, Enable Internal Recorder? (checked), Record to a file on this PC when Start button is pressed (checked)

13. If you chose a.): The data display screen shown in previous section will appear and after a 60-second warm-up, readings will begin logging to a file on the computer hard drive and to the ADV6600's internal Recorder. Once you are satisfied the unit is functioning properly, choose **File>Close Session**. A window will appear asking if you wish to stop data collection and power system off. Choose **No**. The session will close, but the ADV6600 will continue to log data to the sonde Recorder at the Sample Interval which was previously set up.
14. If you chose b.): A window will appear asking if you wish to set the system time to match the computer's clock. Choose **OK**. Another window will appear asking for the start date and time to begin the deployment. Enter the information and click on **OK**. The instrument will confirm the deployment file information and verify the start date and time. **Close** the current session and the system will begin logging data to your internal Recorder at the preset start time and Sample Interval.
15. Disconnect the field cable from the sonde and replace it with a pressure cap/dummy plug. This will protect the connector from water damage during deployment
16. When you are ready to stop data collection, connect the ADV6600 to a computer, launch ADVantage 6600 and Make a Connection. Logging will be terminated when either the Recorder is accessed from the Tools and Utilities list or when the Quick Setup Box is displayed via the Change System Settings selection in the Data Collection list.

6-4. SDI-12 Data Collection

An SDI-12 data collection application is one in which the ADV6600 relays data to an external data collection platform (DCP). In this application, the external DCP requests data from the sonde at preset intervals. The DCP then logs the data in its own internal memory for later download or remote transmission. Using this type of data collection, the user is not present when readings are collected.

Before beginning a deployment, make sure you have read and completed the procedures outlined in previous chapters of this manual, including membrane installation, probe installation, firmware setup, calibration and diagnostics.

1. Connect the ADV6600 to a computer.
2. Launch the ADVantage 6600 software.
3. Choose **Connect to System**. Verify the **COM setting and Baud Rate**. Click on **Connect**.
4. Click **Change System Settings**. The Quick Setup dialog box, as shown at the right, will appear.
5. If you wish to log a “backup” data file to the internal memory of the ADV6600 while also collecting data in the DCP, enter a name for the file and make sure that the Internal Recorder is enabled. Under these conditions, data will automatically be logged to the ADV6600 at exactly the same time as it is logged to the DCP. The ADV6600 file will be in ADVantage 6600 format and can be analyzed later using the postprocessing power of this software.
6. *Make certain that the Velocity Range is set to AUTO and the Coordinate System is set to ENU.*
7. Click on the Output Fields button to display the list of possible parameters which can be output to your data collection platform or other SDI-12 device. Select the parameters to be output by checking or unchecking the appropriate box. The specifications of your data collection platform or its software may limit the number of parameters which can be collected by the device. For example, for a YSI 6200 data collection platform running EcoWatch DCP software, a maximum of 31 parameters can be handled. Consult your DCP manual to determine if the number of parameters will be limited. After choosing your parameters, click **OK** to return to the Quick Setup window.

Name	Bytes
<input checked="" type="checkbox"/> SampleNumber	4
<input checked="" type="checkbox"/> Time	4
<input checked="" type="checkbox"/> SpeedAndDirection	6
<input checked="" type="checkbox"/> Velocity	12
<input checked="" type="checkbox"/> VelocityStdDev	3
<input checked="" type="checkbox"/> Amplitude	3
<input checked="" type="checkbox"/> Compass	7
<input checked="" type="checkbox"/> Temperature	4
<input checked="" type="checkbox"/> Pressure	6
<input checked="" type="checkbox"/> BatteryVoltage	1
<input checked="" type="checkbox"/> BoundaryFrang	2
<input checked="" type="checkbox"/> WaterQualityData	32

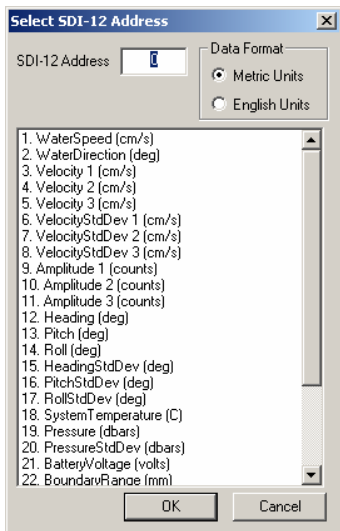
Recorder and Sample Information

Free Space on Recorder: 3.81 MB Sample Size: 92 bytes

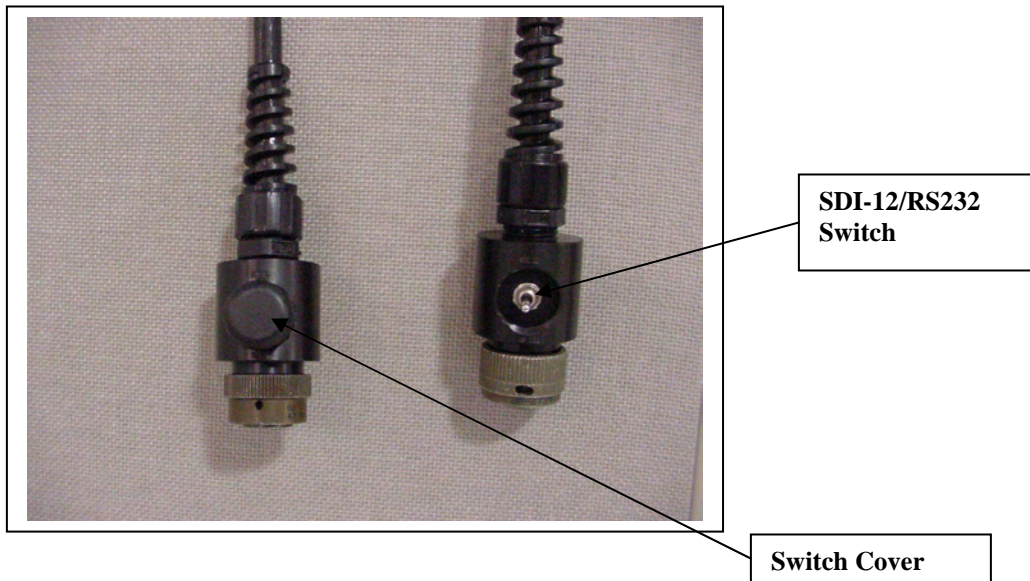
Time Remaining: 2 months, 0 days, 4 hours, 48 minutes

OK Cancel

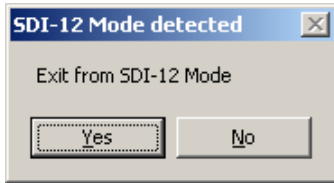
8. Click on **Update**. The settings will be saved and the Quick Setup window will disappear.
9. Choose **Put system in SDI-12 mode** from the Data Collection list... The window below will appear.



10. Select a unit preference (metric or English) and enter the SDI-12 address that you wish to have associated with your particular ADV6600. The address must be a single digit between 0-9, between A-Z (capital letters), or between a-z (lower case letters). After selecting the address, click on **OK**.
11. The instrument will confirm the deployment information and switch to SDI-12 mode. **Close** the window and then Choose “Yes” when asked to Close the current session”. The ADV6600 is now in SDI-12 mode.
12. Disconnect the field cable from the PC and remove the 6095B PC adapter cable.
13. Using the picture below as an aid, locate the threaded cover on the MS-8 end of the field cable. Unscrew this cover to reveal the SDI-12/RS-232 toggle switch. Adjust this switch to SDI-12 mode. Reattach the protective cover, being very careful not to cross-thread the connection.



14. Attach the required adapter or flying lead to the field cable and connect to the SDI-12 device.
15. Verify on the SDI-12 device that communication has been established with the ADV6600.
16. When direct communication with the ADV6600 is required through the use of ADVantage 6600, make sure the switch on the field cable is toggled back to RS232. Then select Connect to System >Change System Settings and click “Yes” when asked if you want to exit the SDI-12 mode as shown in the window below.



NOTE: If you have stored your data to the internal recorder during an SDI-12 study, it is likely that extraneous files were generated and will appear in the directory of the recorder. This effect is caused by attempts to “wake up” the instrument when it is not attached to the SDI-12 device prior to the beginning of the study and at the end of the study. The generation of these extraneous files will have no effect on the quality of the data in the data-containing file which can be identified by its size. The extraneous files contain no data and so cannot be opened using ADVantage 6600.

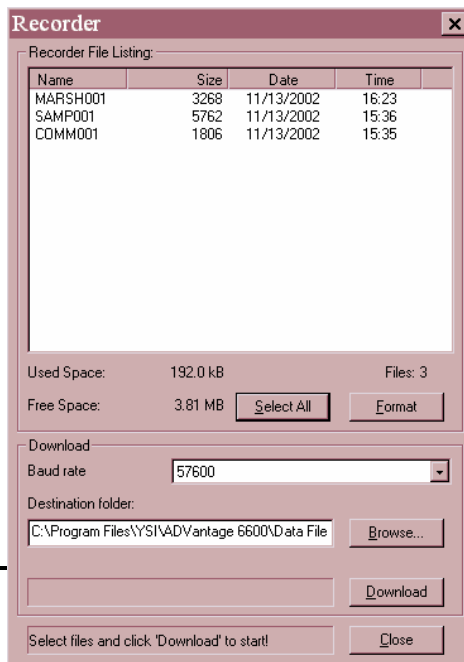
Section 7. Downloading ADV6600 Data

7-1. Important Information on Downloading Data

Data stored in the memory of the ADV6600 during unattended studies will need to be recovered – either periodically during a deployment and/or at the end of the deployment. These files can either be downloaded to a laptop PC in the field or to a laboratory computer on recovery of the ADV6600. The computer used in the download process must be running ADVantage 6600 software.

While the download process is straightforward, users need be aware of the following two features of the ADV6600:

- *When the user interfaces with an ADV6600 which is logging data to internal memory, the study is automatically terminated and logging ceases. In order for logging to continue, the user must RESTART the study following the connection. It is particularly important to remember this feature when downloading data in the field without recovery of the instrument. If you forget to restart the logging, no additional data will be saved to ADV6600 memory.*
- *Following the restart, the data for the new study will NOT be in the same file as the original data. Instead, the extension associated with the file name will be incremented by one unit when the new study is restarted (if the deployment name has not been changed). Thus, if the data for the original study is logged to YSI001, a new file designated YSI002 will automatically be created to contain the data after a download of data and a restart of logging.*



Data stored located in from the ADVantage Recorder dialog box

7-2. Data Location – Features of the Recorder

during ADV6600 logging studies is the Recorder which can be accessed Tools and Utilities screen menu list in 6600 software. Clicking on the selection will display the following with the features outlined below.

- At the top of the window is a listing of the files which are currently resident in the ADV6600 memory along with the date/time they were initiated and their size.
- In the block immediately below the directory is information on how much memory has been filled and how much is available. You will want to consider this information carefully before starting a study to assure that there is enough memory available for your planned length of deployment. When the recorder is empty, with no saved files, free space should appear as 4 MB.
- The **Format** button is used to erase the memory of the ADV6600. It is important to note that it is not possible to delete individual files – only the elimination of all data is possible. After you have assured that files have been transferred to your PC as described below, it may be prudent to format the memory to clear space for future deployments. However, it is recommended that backup of this data that has been downloaded is performed prior to formatting the ADV6600 internal memory (once the Recorder is formatted, the data can NOT be recovered).
- The **Baud rate** for data download can be varied to suit special user applications, but should normally be left at the default value of 57600.
- The **Select All** button is used as a time saver to activate all files in the directory for download to a PC as described below.

- **The Destination** folder is the location on your computer hard drive or server to which your data will be transferred when the download process is initiated. The location can be changed using the **Browse** button.
- The **Download** button is used to initiate the download to the Destination folder of the files which have been selected in the directory.

7-3. Data Download Procedure

To download recorded data files from the ADV6600 to a computer:

12. Connect the ADV6600 to a computer.
13. Launch the ADVantage 6600 Software for Windows.
14. Choose **Connect to System**. Verify the **COM** setting and **Baud Rate**. Click on **Connect**.
15. Select **Recorder** from the Tools and Utilities list (or choose it from the **System** menu).
The Recorder window as shown above will appear.
16. Select the file(s) you wish to download by highlighting one file or hold **Control** or **Shift** and click a series of files to select more than one file, or **Select All** to download all files on the ADV6600 recorder.
17. Set the download Baud rate. The **Recorder** portion of the ADVantage 6600 software uses a higher rate to download files (compared to the rate used for standard system communication). The default download baud rate is 57600. High baud rates should only be used with high-quality, relatively short cables (e.g., less than 50 m) such as the cables normally supplied with ADV6600. If you have trouble downloading data, try using a slower download baud rate.
18. Select the Destination Folder on the computer where the data files are to be stored.
19. Click on **Download**.
20. Watch the status area at the bottom of the dialog box to view the download progress.
21. When the file(s) have completed uploading, you may wish to **Format** your recorder, or select **Close** to exit the recorder window without deleting the files from the recorder.

Section 8. ADVantage 6600 Software – Post-Processing of Data

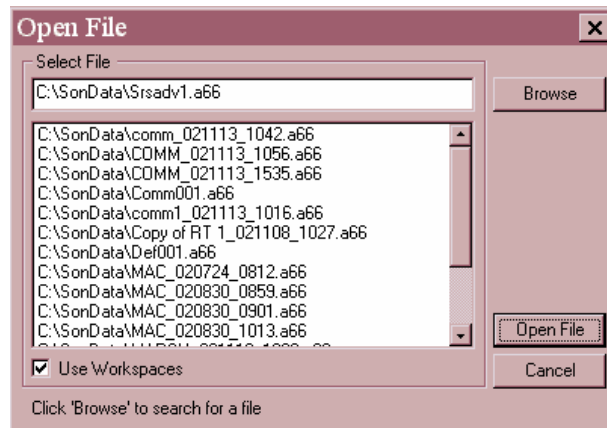
8-1. Opening a Saved File

After a file has been uploaded from the ADV6600 to a computer, it may be opened for viewing and post processing. In the ADVantage 6600 software, there are several ways a file may be opened.

- When ADVantage 6600 is first launched, choose **Open an Existing Data File** from the opening set of screen options.
- Click on the **Open File** icon from the tool bar.
- Choose **File>Open File** from the menu at the top of the screen.

No matter which method you choose to open a new file, the Open File window shown at the right will appear. Select the file you wish to open and designate with a checkmark if you want to **Use Workspaces**. Then click **Open File**.

If you have chosen to open a file without using workspaces, a Data File window will appear. This window provides information about what is contained in the file and allows you select either all samples or a limited number of samples to load when the data file is opened. This feature is useful if you have a very large file. For example, your file may contain four weeks of data and you may only want to focus in on one day's results.



8-1.1. Workspaces

Normally, a user will want workspaces enabled when opening a file. If you have previously viewed a file before, you may have changed the way in which the data appeared. For example, if you had 500 samples, you may have zoomed in to display only samples numbered 200 to 300 on the graph. Or, you may have chose to display only two graphs rather than four. When you close the data file at the end of your work, ADVantage 6600 saves the post processing work you have completed in what is called Workspaces.

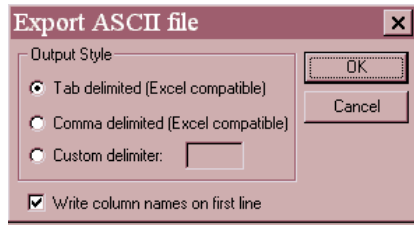
When you open a file, if you choose to **Use Workspaces**, the data is reopened to appear exactly as it did the last time you modified and closed your **Workspace** (note that the data file is NOT altered in any way from its original state). If you do not select to use workspaces, the data is opened using the

format of the default template. Note, however, that each time you open a file and make modifications to the appearance of data, you are creating a new workspace and your old workspace will be deleted. If you wish to have several different alternative ways in which to view a single file, it is best to save each view as a separate template.

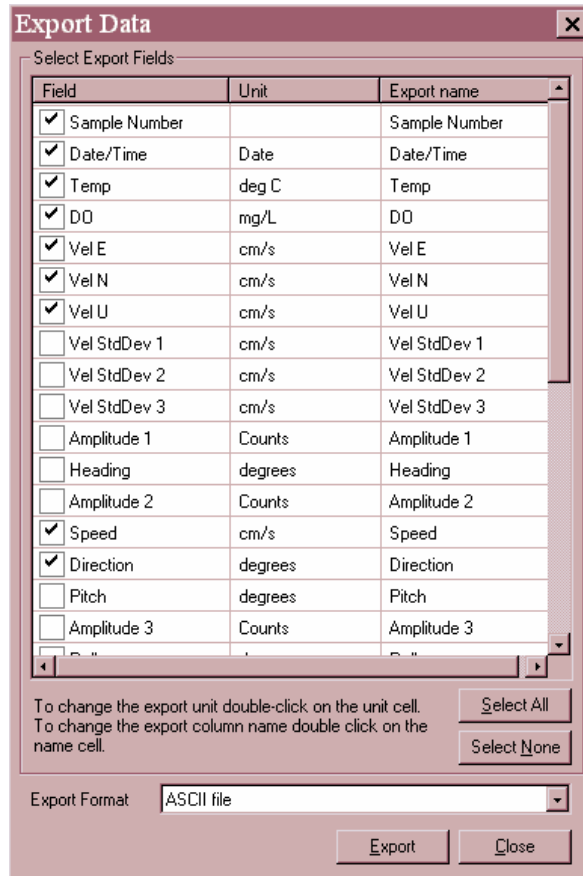
8-2. Exporting Data to a Spreadsheet

Data files that have been uploaded and saved to a computer may be exported to a spreadsheet using ADVantage 6600.

1. Open a saved file.
2. Click on **Export Data** from the toolbar, or choose **File>Export Data** from the menu at the top of the screen. The window shown at the right will appear.
3. Choose which parameters you would like to export from the data file. A checkmark next to a parameter indicates it will be exported. Choose **Select All** to export all the parameters.
4. Verify the export format selected is ASCII
5. Click on **Export**. The following window will appear.



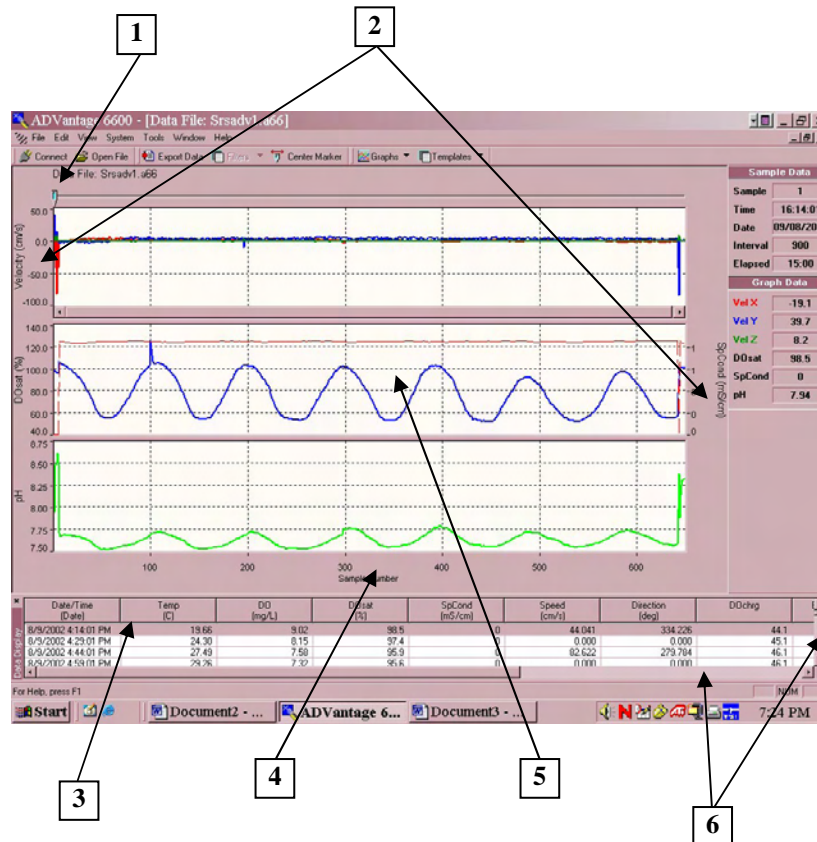
6. Choose an output style. **Comma delimited** will allow the ASCII file to be opened in Microsoft Excel with no further modifications or formatting required. **Tab delimited** will require using the Import Wizard when opening the file in Microsoft Excel. If you would like each column of data to be labeled with the parameter name, verify the box for **Write column names on first line** contains a checkmark. Click on **OK**.



- The software will now ask you to choose a name for the new file and select a destination folder that you would like it saved to. When completed, click on **Save**. Your data will be exported and saved in the new format.

Note: When data is exported from ADVantage 6600, the original file with a .a66 extension is not automatically deleted and is never changed in anyway.

8-3. Using the Visual Data Display



1	Left Click and Hold	Moves marker to change data point being displayed at right of screen (tabular data) and highlighted in table.
2	Right Click	Changes parameter displayed on y-axis of graph.
	Double Left Click	Displays options to change the scaling of parameter displayed on graph from Auto to Manual (user input).
3	Left Click	Displays menu with options to Hide a parameter, change the Unit of a parameter, change the number of Decimals displayed in parameter data, or change the Properties of a parameter.
4	Right Click	Changes parameter displayed on x-axis of graph.
	Double Left Click	Displays option box to change the number of samples displayed on graphs.
5	Left Click	Reduces the number of samples displayed on graphs (i.e. zoom in).
	Right Click	Increases the number of samples displayed on graphs (i.e. zoom out).
6	Right Click	Displays menu for more scrolling options.

8-4. Toolbars

ADVantage 6600 software utilizes toolbars for some of the most often used functions during data collection and post processing. To display or hide a toolbar, from the menu at the top of the screen choose **View>Toolbars**. A checkmark appears next to the menu item when the toolbar is displayed.

8-4.1. Main Toolbar



- Connect** Opens a new Serial Connection or Network Connection to an ADV6600 sonde.
- Open File** Opens a new data file for viewing or post processing.

8-4.2. Data Toolbar



- Export Data** Opens the Export window to export data to an ASCII file.
- Filters** Future feature – not presently activated.
- Center Marker** Moves the graph marker to the center of the graphical plot currently displayed (even if marker is not contained in present viewing window).

8-4.3. Display Toolbar



- Graphs** Allows user to change the number of graphs displayed (minimum = 1, maximum = 4).
- Templates** Allows user to **Save** a data display as a template, **Delete** a saved template, or load the **Default** template settings to replace the current display template.

8-4.4. Data Collection Toolbar



Utilities	Future feature – not presently activated.
Setup	Displays the setup features of a file including file comments, averaging interval, sampling interval, velocity range, and coordinate system.
Start/Stop	Used to start or stop data collection.
Record	Used to begin or end recording during real-time data collection. Automatically defaults to begin recording.
Next Sample	Displays both a visual and numerical countdown of remaining time to the next sample collection.
Browse	Future feature - not presently activated.
File Size	Displays the size of a file being created as data is collected in real-time.

8-5. Menu Features

8-5.1. File

Connect	Opens the New Session window to connect with an ADV6600 instrument.
Open File	Opens the File window to view a saved data file.
Close Session	Closes the sonde connection or data file window currently open.
Print	Used to print a hard copy of the graphical display.
Print Preview	Provides visual display of printable graphs before printing hard copy.
Print Setup	Opens the print setup window which allows a user to setup a printer, select paper size, paper source, and switch between landscape or portrait orientation for printing.

- Report** Opens the Report window for viewing of **File Summary, User Settings, System Options, Output Parameters, and Advanced Settings** (each individually selectable) and gives the user the option to print.
- Export Data** Opens the Export window to export data to an ASCII file.
- Recent File List** Displays a list of the five most recently opened files for quick access.
- Exit** Exits the ADVantage 6600 software.

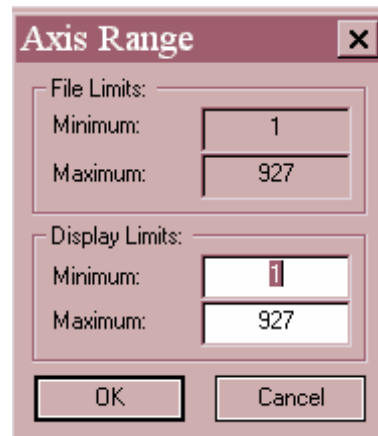
8-5.2. Edit

- Copy Graphs to Clipboard** Allows visual display of graphs to be copied and placed in other computer applications such as word processing documents.

8-5.3. View

- Select Graph Variables** Used to select the variables shown on the four graphs (same as right mouse button over axis). Each graph is capable of displaying up to two variables on the y-axis.
- Number of Visible Graphs** Allows the user to select the number of visible data graphs on the screen.
- Show Components** When velocity is selected on a graph, allows the user to remove one or more of the velocity components from the plot.

- Number of Samples Displayed** When selected, the Axis Range, shown at right, appears. This window shows the number of samples in a file and allows a user to choose how many are plotted on the graph. Up to 1000 samples may be plotted at a time.



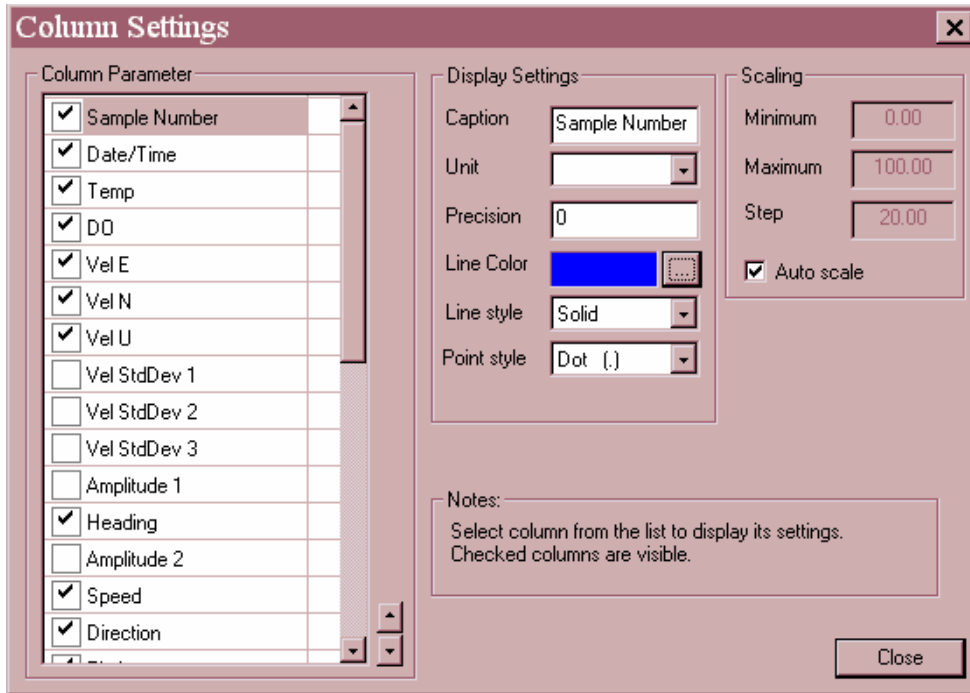
- Display Sample X-Axis as** Allows user to select the X-axis of the graphs. Choices are sample number, elapsed time, or date/time.

- Toolbars** Displays or hides a selected toolbar.

- Data Display** Displays or hides the Sample Data and Graph Data shown in the far right column of the screen.

Tabular Data Displays or hide the Tabular Data at the bottom of the screen.

Variable Settings When selected, the Column Settings window appears. A user may select or deselect parameters to be displayed in the table, change the parameter settings, or manually adjust the scaling of a parameter.



Velocity Coordinate System Allows the user to select between different velocity coordinate systems for data viewing.

8-5.4. System

Change Connection Opens the New Session window to connect with an ADV6600 instrument.

User Setup Displays the settings of the instrument, including file name, comments, averaging interval and sampling interval. Also, during connection with an instrument, allows access to the Sonde Menu.

Hardware Configuration	Displays hardware specifications of the instrument used during data collection.
File Information	Displays information about a data file, including file size, start time, end time, number of samples, parameters collected and comments entered about the file.
Recorder	Opens the Recorder window to upload data files and format the memory.
Compass Calibration	Used to perform a compass calibration as described in Calibration and Diagnostics .
Beam Check	Used to verify all aspects of the ADV operation as described in Calibration and Diagnostics .
Set Pressure Offset	Used to calibrate the pressure offset of the instrument.
Set Time	Resets the instrument date and time to match the computer's settings.
Advanced	Allows access into the system terminal, updates firmware, or loads a preset probe configuration.

8-5.5. Tools

Load Template	A template determines the basic structure for a data file and contains settings such as how many graphs are displayed, which parameters are displayed, etc. This feature is used to load a previously saved display template and convert the view of the current data file to that of the template.
Save Current Template	Allows a user to modify the view of an existing data file and then save the settings as a template for viewing future data files.
Delete Template	Allows an existing template to be deleted.
Settings	Allows workspaces to be activated or deactivated. Also allows the user to choose between Metric or English units for display of data.
Screen Display	Changes the background colors of the screen display.

8-5.6. Window

ADVantage 6600 software allows for multiple data files to be open simultaneously while also communicating with one or more sondes. To switch between data files/ADV6600 connections choose **Window** from the menu bar at the top of the screen and select the data file or connection you wish to view.

- | | |
|----------------------|---|
| Cascade | Use this command to arrange multiple opened windows in an overlapped fashion. |
| Tile | Use this command to arrange multiple opened windows in non-overlapped tiles. |
| Arrange Icons | Use this command to arrange the icons for minimized windows at the bottom of the main ADVantage 6600 window. If there is an open document window at the bottom of the main window, then some or all of the icons may not be visible because they will be underneath this document window. |

8-5.7. Help

- | | |
|-----------------------------|--|
| Help Topics | Offers a list of available help topics. |
| About ADVantage 6600 | Displays the version number and date of this software application. |

Section 9. Principles of Operation

9-1. Acoustic Doppler Velocimeter (ADV)

The ADV6600 measures the velocity of water using a physical principle called the Doppler effect. If a source of sound is moving relative to a receiver, the frequency of the sound at the receiver is shifted from the transmit frequency.

$$F_{\text{doppler}} = -F_{\text{source}} (V / C)$$

where:

F_{doppler} = Change in received frequency (Doppler shift)

F_{source} = Frequency of transmitted sound

V = Velocity of source relative to receiver

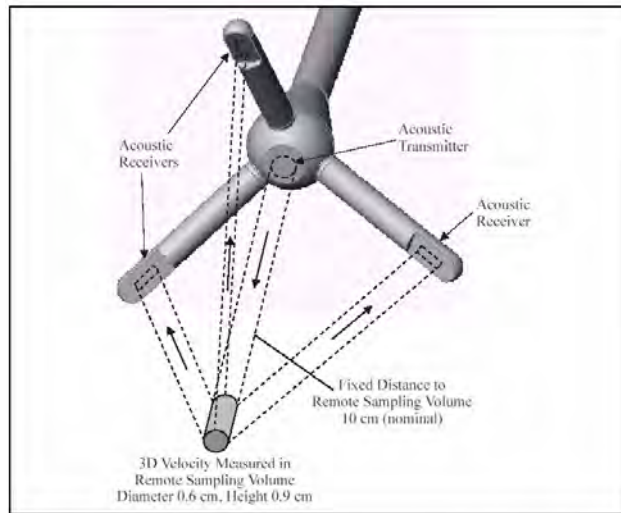
C = Speed of sound

The velocity (V) represents the relative speed between source and receiver (motion that changes the distance between the two).

- If the distance between the two objects is decreasing, frequency increases.
- If the distance is increasing, frequency decreases.
- Motion perpendicular to the line connecting source and receiver does not introduce a Doppler shift.

The ADV6600 is a **bistatic** Doppler current meter. Bistatic means separate acoustic transducers are used for transmitter and receiver. The transmitter generates sound concentrated in a narrow beam. The receivers are sensitive to sound coming from a narrow beam. The receivers are mounted such that the beams intersect at a volume of water located a fixed distance from the tip of the probe, typically 6.8 cm (4 in). The beam intersection determines the location of the **sampling volume**, which is the volume of water in which measurements are made.

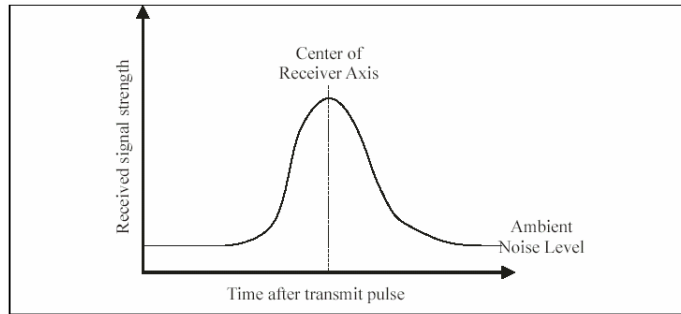
The ADV6600 measures velocity by emitting a short pulse of sound at a known frequency from the transmitter. The sound travels through the water along the transmitter beam axis. As the pulse passes through the sampling volume, sound is reflected in all directions by particulate matter



Section 9. Principles of Operation

(sediment, small organisms, bubbles, etc.). Some portion of the reflected energy travels back along the receiver beam axes. The reflected signal is sampled by the acoustic receivers. The ADV6600 processor measures the change in frequency for each receiver. The Doppler shift is proportional to the velocity of the particles along the bistatic axis of the receiver and transmitter. The bistatic axis is located halfway between the transmit and receive axes. Knowing the relative orientation of the bistatic axes of all receivers allows the ADV6600 to calculate 3D water velocity in the sampling volume.

Profile of signal strength versus time for the ADV6600. The horizontal axis shows time after the transmit pulse. The vertical axis shows the returned signal strength measured by one receiver. As the transmit pulse travels through the water, sound is reflected in all directions. Immediately following the transmit pulse, reflections come from outside the receiver beam; the receiver measures only the ambient noise level. As the pulse propagates along the transmit axis, it moves closer to the receiver beam; the receiver sees an increase in signal strength. Signal strength reaches a maximum at the intersection of the transmit and receive beams. By sampling the return signal at its peak, the ADV6600 makes measurements in the sampling volume defined by the intersection of transmit and receive beams.



9-2. Velocity Data Coordinate System

The ADV6600 supports two coordinate systems for velocity data:

- ENU (East-North-Up, or Earth coordinates)
- XYZ

9-2.1. ENU

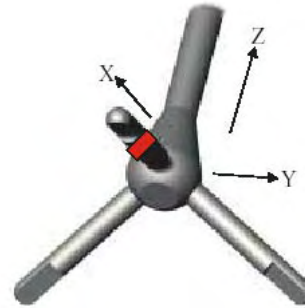
The primary advantage of using the internal compass/tilt sensor is the ability to report velocity data in ENU (East/North/Up or Earth) coordinates – independent of the rotational orientation of the ADV6600. An ADV6600 mounted with an unknown orientation will provide velocity data consistent with the direction and speed of the water current itself.

Velocity data in each sample are averaged using continually updated compass data. If the ADV6600 changes orientation during a sample, velocity data will be averaged in Earth coordinates and will not be contaminated by instrument motion. Using any other coordinate system for the ADV6600 (beam or XYZ) eliminates the Earth coordinate system vector averaging and can cause contamination of the data if the instrument moves during the course of an averaging interval.

9-2.2. XYZ

Using the XYZ coordinate system, velocity measurements are stored using a right-handed Cartesian coordinate system relative to the Argonaut-ADV probe. The ADV6600 is a 3D Down-Looking Probe – Down-Looking Operation with the following characteristics:

- The positive Z-axis is defined as vertically up in the direction of the probe's mounting stem (which for this probe is the same as the axis of the transmit transducer).
- The positive X-axis is defined perpendicular to the probe's mounting stem in the direction of receiver arm #1 (which is marked with a red band and a small dimple (indicator) near the socket of Beam 1).
- The positive Y-axis is defined based on the X and Z-axes to make a right-handed coordinate system.



Down-Looking

9-3. Effect of Salinity Variation on Velocity Accuracy

Salinity variations in the water being monitored can affect the accuracy of velocity measurements because the speed of sound in water is dependent on its density. The accuracy effect is approximately 2 % for each 12 ppt salinity difference between the true value and that present in the software of the ADV6600. The default value in the software is 34.5 ppt, making the system ideal for seawater applications. However, for freshwater studies, this salinity effect can cause an error of up to 6 % in measured velocities unless it is corrected. If errors of this magnitude are important in your studies, you can correct your salinity default for use in velocity calculations by contacting YSI Technical Support for instructions.

-

9-4. Pressure

The ADV6600 may include an optional strain gauge pressure sensor. The strain gage sensor outputs data as an analog voltage. Sensor data are sampled by the ADV6600 electronics using a 12-bit A/D converter. Data are converted to a 2-byte integer, scaling the A/D counts by 16 (giving a total count range of 0-65520, with a step size of 16 counts).

The pressure data, stored in counts, must be converted to physical units (decibars) using the following formula:

$$\text{dBar} = \text{PressOffset} + (\text{PressScale} \times \text{Counts}) + (\text{PressScale}_2 \times (\text{Counts}^2))$$

Where:

dBar = measured pressure (decibar)

PressOffset = offset calibration constant (decibar)

PressScale = 1st order calibration constant (decibar/count)

PressScale_2 = 2nd order calibration constant (decibar/count²)

Counts = measured pressure (counts)

The three pressure calibration constants are measured at the factory and included with each system (in memory). When using the ADVantage 6600 software to access ADV6600 data files, the conversion from counts to decibars is done automatically.

9-4.1. Effect of Atmospheric Pressure Variations

The pressure sensors used by the ADV6600 are not vented to the atmosphere. Pressure data may change with variations in atmospheric pressure. Large atmospheric variations can cause pressure variations as large as 0.1 to 0.2 decibars. This is equivalent to 10 to 20 cm (4 to 8 in) of water level. If an external measure of barometric pressure is available, this can be used to correct pressure data in post processing.

9-5. Temperature

Procedure from *Standard Methods for the Examination of Water and Wastewater*: 2550

The ADV6600 utilizes a thermistor of sintered metallic oxide that changes predictably in resistance with temperature variation. The algorithm for conversion of resistance to temperature is built into the sonde software, and accurate temperature readings in degrees Celsius, Kelvin, or Fahrenheit are provided automatically. No calibration or maintenance of the temperature sensor is required.

9-6. Conductivity

Procedure from *Standard Methods for the Examination of Water and Wastewater*: 2510

The ADV6600 utilizes a cell with four pure nickel electrodes for the measurement of solution conductance. Two of the electrodes are current driven, and two are used to measure the voltage drop. The measured voltage drop is then converted into a conductance value in milliSiemens (millimhos). To convert this value to a conductivity value in milliSiemens per cm (mS/cm), the conductance is multiplied by the cell constant that has units of reciprocal cm (cm⁻¹). The cell constant for the sonde conductivity cell is approximately 5.0/cm. For most applications, the cell constant is automatically determined (or confirmed) with each deployment of the system when the calibration procedure is followed. Solutions with conductivity of 1.00, 10.0, 50.0, and 100.0

Section 9. Principles of Operation

mS/cm, which have been prepared in accordance with recommendation 56-1981 of the Organization International De Metrologie Legale (OIML), are available from YSI. The instrument output is in mS/cm or $\mu\text{S/cm}$ for both conductivity and specific conductance. The multiplication of cell constant times conductance is carried out automatically by the software.

9-6.1. Effect of Temperature

The conductivity of solutions of ionic species is highly dependent on temperature, varying as much as 3% for each change of one degree Celsius (temperature coefficient = 3%/°C). In addition, the temperature coefficient itself varies with the nature of the ionic species present.

Because the exact composition of a natural media is usually not known, it is best to report conductivity at a particular temperature, e.g. 20.2 mS/cm at 14 °C. However, in many cases, it is also useful to compensate for the temperature dependence in order to determine at a glance if gross changes are occurring in the ionic content of the medium over time. For this reason, the sonde software also allows the user to output conductivity data in either raw or temperature compensated form. If Conductivity is selected, values of conductivity that are *NOT* compensated for temperature are output to the report. If Specific Conductance is selected, the sonde uses the temperature and raw conductivity values associated with each determination to generate a specific conductance value compensated to 25°C. The calculation is carried out as in equation (1) below, using a temperature coefficient of 1.91%/°C (TC = 0.0191):

$$\text{Specific Conductance (25°C)} = \frac{\text{Conductivity}}{1 + \text{TC} * (\text{T} - 25)}$$

As noted above, unless the solution being measured consists of pure KCl in water, this temperature compensated value will be somewhat inaccurate, but the equation with a value of TC = 0.0191 will provide a close approximation for seawater and for solutions of many common salts such as NaCl and NH₄Cl.

9-7. Salinity

Procedure from *Standard Methods for the Examination of Water and Wastewater*: 2520

Salinity is determined automatically from the sonde conductivity and temperature readings according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (ed. 1989). The use of the Practical Salinity Scale results in values that are unitless, since the measurements are carried out in reference to the conductivity of standard seawater at 15 °C. However, the unitless salinity values are very close to those determined by the previously used method where the mass of dissolved salts in a given mass of water (parts per thousand) was reported. Hence, the designation “ppt” is reported by the instrument to provide a more conventional output.

9-8. TDS

Procedure from *Standard Methods for the Examination of Water and Wastewater*: 2540

The electrical conductivity of environmental water is due to the presence of dissolved ionic species. Thus, the magnitude of the conductivity (or specific conductance) value can be used as a rough estimate of amount (in g/L) of these ionic compounds which are present. The ADV6600 software provides a conversion from specific conductance to total dissolved solids (TDS) by the use of a simple multiplier. The ADV6600 default value for conversion of specific conductance in mS/cm to TDS in g/L is 0.65. However, this multiplier is highly dependent on the nature of the ionic species present and should be determined for the water at the site where measurements will be taken.

9-8.1. Calculation of the TDS Constant

Use the following protocol to determine a TDS conversion factor:

1. Determine the specific conductance of a water sample from the site;
2. Filter a portion of water from the site;
3. Completely evaporate the water from a carefully measured volume of the filtered sample to yield a dry solid;
4. Accurately weigh the remaining solid;
5. Divide the weight of the solid (in grams) by the volume of water used (in liters) to yield the TDS value in g/L for this site; Divide the TDS value in g/L by the specific conductance of the water in mS/cm to yield the conversion multiplier. Be certain to use the correct units.

The ADV6600 assigns a default conversion factor of 0.65 for TDS from specific conductance in the sonde firmware. After you have determined your specific conversion constant as described above, enter it by first accessing the Sonde Menu and then selecting **Advanced|Sensor**. Type the correct number for the TDS Constant, change the value, and then press **Enter** to confirm the new value. Remember that if you want TDS data to be stored during an ADV6600 sampling or monitoring study, it **MUST** be active in the Report with the proper units selected.

9-9. Dissolved Oxygen

Procedure from *Standard Methods for the Examination of Water and Wastewater*: 4500-O G.

The ADV6600 employs the patented YSI Rapid Pulse system for the measurement of dissolved oxygen (DO). Use of this technology provides major advantages for the *monitoring* of DO without significantly compromising the accuracy of *sampling* applications. Standard electrochemical

detectors of DO are highly flow-dependent and therefore require external stirring of the medium being evaluated. This stirring must be supplied either by an auxiliary stirrer (which can consume much of the battery reserve in a portable system) or by manually agitating the sonde when carrying out spot sampling applications (which can be inconvenient). These disadvantages are overcome by the Rapid Pulse dissolved oxygen technology that is associated with the ADV6600 because it needs no stirring to yield accurate readings. In addition, because of the nature of the technology, some effects of fouling of the sensor are minimized.

The Rapid Pulse system utilizes a Clark-type sensor that is similar to other membrane-covered steady-state dissolved oxygen probes. The system still measures the current associated with the reduction of oxygen which diffuses through a Teflon membrane, and this current is still proportional to the partial pressure (not the concentration) of oxygen in the solution being evaluated. The membrane isolates the electrodes necessary for this reduction from the external media, encloses the thin layer of electrolyte required for current flow, and prevents other non-gaseous, electrochemically active species from interfering with the measurement. However, as the user will note from examination of the probe, the sensor consists of three electrodes (a cathode, anode, and reference electrode) while a steady state Clark probe usually has only two electrodes (a cathode and a combined anode-reference electrode). In addition, the geometry of the sensor is novel, consisting of a thin linear gold cathode placed between two silver rectangles which serve as anode and reference electrodes. These sensor changes were required to implement the Rapid Pulse method for DO measurement as described in the following section.

9-9.1. Method of Operation

Standard Clark dissolved oxygen sensors, which are marketed by YSI and other manufacturers, are continuously polarized at a voltage sufficiently negative to cause oxygen to be reduced to hydroxide ion at the cathode and silver metal to be oxidized to silver chloride at the anode. The oxygen diffuses through the Teflon membrane. The current associated with this process is proportional to the oxygen present in the solution outside the membrane. However, as this electrochemical reaction proceeds, oxygen is consumed (or depleted) in the medium, resulting in a decrease in measured current (and apparent oxygen content) if the external solution is not stirred rapidly. To minimize this oxygen depletion, the probe electrodes in the YSI Rapid Pulse system are rapidly and reproducibly polarized (on) and depolarized (off) during a measurement sequence. The Rapid Pulse system thus measures the charge or coulombs (current summed over a specific time period) associated with the reduction of oxygen during a carefully controlled time interval. The coulombs due to charging of the cathode (capacitance), but not to reduction of oxygen, are subtracted during integration after the cathode has been turned off. The net charge, like the steady state current in a standard system, is proportional to the oxygen partial pressure in the medium. Because oxygen is only being reduced 1/100th of the total measurement time, even if the probe is pulsed in this manner continuously, oxygen consumption outside the membrane is kept to a minimum, and the stirring dependence of the system is greatly reduced.

One key to the practicality of Rapid Pulse oxygen system is the fact that the “on time” is very short. This allows the “off time” to also be relatively short and still maintain the off to on ratio of 100

which is necessary to obtain relatively flow independent measurements. The second important aspect of the Rapid Pulse technology is the integration (summing of the current) over the total pulse (on and off). Because the charging current of the electrodes is subtracted in this process, the net signal is due only to the reduction of oxygen. From a practical point of view, this means that when there is zero oxygen partial pressure outside the membrane, the Rapid Pulse signal will also be zero; this in turn allows the system to be calibrated with a single medium (air or water) of known oxygen pressure.

9-9.2. Effect of Temperature

The DO readings of steady state oxygen systems are greatly affected by temperature (approximately 3% per degree Celsius) due to the effect of temperature on the diffusion of oxygen through the membrane. The Rapid Pulse system exhibits a greatly reduced effect of temperature (approximately 1% per degree Celsius), but this factor still must be accounted for if DO readings acquired at temperatures different from that at calibration are to be accurate. The sonde software automatically carries out this compensation.

In addition, the relationship between the measured partial pressure of oxygen (percent saturation) and the solubility of oxygen in mg/L is very temperature dependent. For example, air saturated water (100 percent saturated) contains 9.09 mg/L at 20 °C, but only 7.65 mg/L at 30 °C. The sonde software compensates for both of these temperature-related factors after instrument calibration. The temperature compensation for the percent saturation reading is empirically derived, while the conversion from percent saturation and temperature to a solubility in mg/L is carried out using formulae available in *Standard Methods for the Examination of Water and Wastewater* (ed. 1989).

9-9.3. Flow Dependence

As noted above, oxygen readings acquired using the Rapid Pulse technology are much less affected by sample flow than steady state probes. However, there is a finite stirring dependence exhibited by the Rapid Pulse system if measurements are taken when the probe is being pulsed continuously. Our tests indicate that, under these sampling conditions, observed dissolved oxygen readings can be 2-3 percent lower than the true readings in very still water. Minimal movement of the water (which occurs during most environmental measurements) removes this effect.

This small flow dependence of the sensor is greatly reduced in longer term monitoring deployments where the sampling interval is longer, e.g. 15 minutes. Under these conditions, the sensor is pulsed for only approximately 40 seconds every 15 minutes, and normal diffusion of oxygen in the medium re-establishes the oxygen which has been depleted in the previous warm-up/read sequence.

9-10. pH

Procedure from *Standard Methods for the Examination of Water and Wastewater*: 4500-H+

The ADV6600 employs a field replaceable pH electrode for the determination of hydrogen ion concentration. The probe is a combination electrode consisting of a proton selective glass reservoir filled with buffer at approximately pH 7 and a Ag/AgCl reference electrode that utilizes electrolyte that is gelled. A silver wire coated with AgCl is immersed in the buffer reservoir. Protons (H⁺ ions) on both sides of the glass (media and buffer reservoir) selectively interact with the glass, setting up a potential gradient across the glass membrane. Since the hydrogen ion concentration in the internal buffer solution is invariant, this potential difference, determined relative to the Ag/AgCl reference electrode, is proportional to the pH of the media.

Our testing of the 6561 pH, 6565 and 6566 pH/ORP sensors indicates that they should provide long life, good response time, and accurate readings in most environmental waters, including freshwater of low ionic strength. Thus, no special sensor is required (nor offered) for water of low conductivity.

9-10.1. Effect of Temperature

The software of the ADV6600 calculates pH from the established linear relationship between pH and the millivolt output as defined by a variation of the Nernst equation:

$$E = E_o + \frac{2.3RT}{nF} * \text{pH}$$

where E = millivolts output
E_o = a constant associated with the reference electrode
T = temperature of measurement in degrees Kelvin
R, n, and F are invariant constants

Thus, in simplified $y = mx + b$ form, it is (mv output) = (slope)x(pH) + (intercept). In order to quantify this simple relationship, the instrument must be calibrated properly using commercially available buffers of known pH values. In this procedure, the millivolt values for two standard buffer solutions are experimentally established and used by the sonde software to calculate the slope and intercept of the plot of millivolts vs. pH. Once this calibration procedure has been carried out, the millivolt output of the probe in any media can readily be converted by the sonde software into a pH value, *as long as the calibration and the reading are carried out at the same temperature*. This last qualifier is almost never met in actual environmental measurements since temperatures can vary several degrees during a deployment simply from a diurnal cycle. Thus, a mechanism must be in place to compensate for temperature or, in other words, to accurately convert the slope and intercept of the plot of pH vs. millivolts established at T_c (temperature of calibration) into a slope and

intercept at T_m (temperature of measurement). Fortunately, the Nernst equation provides a basis for this conversion.

According to the Nernst equation as shown above, the slope of the plot of pH vs. millivolts is *directly proportional* to the absolute temperature in degrees Kelvin. Thus, if the slope of the plot is experimentally determined to be 59 mv/pH unit at 298 K (25 C), then the slope of the plot at 313 K (40 C) must be $(313/298) * 59 = 62$ mv/pH unit. At 283 K (10 C), the slope is calculated to be 56 mv/pH unit $((283/298) * 59)$. Determination of the slope of pH vs. mv plots at temperatures different from T_c is thus relatively simple. In order to establish the intercept of the new plot, the point where plots of pH vs. mv at different temperatures intersect (the isopotential point) must be known. Using standard pH determination protocol, the sonde software assigns the isopotential point as the mv reading at pH 7 and then calculates the intercept using this assumption. Once the slope and intercept to the plot of pH vs. mv are assigned at the new temperature, the calculation of pH under the new temperature conditions is straightforward, and is automatically carried out by the sonde software.

9-11. ORP

Procedure from *Standard Methods for the Examination of Water and Wastewater*: 2580

The ADV6600 determines the Oxidation-Reduction Potential (ORP) of the media by measuring the difference in potential between an electrode which is relatively chemically inert and a reference electrode. To measure ORP with an ADV6600, a combination pH/ORP probe must be in place in the sonde bulkhead and ORP must be accessed via the ISE2 channel of the ADV6600. The ORP sensor consists of a platinum button found on the tip of the probe. The potential associated with this metal is read versus the Ag/AgCl reference electrode of the combination sensor that utilizes gelled electrolyte. ORP values are presented in millivolts and are not compensated for temperature.

ORP readings usually stabilize much more rapidly in standards (e.g., Zobell solution) than in most environmental water. Be certain to consider this factor when determining ORP in field studies.

9-11.1. Effect of Temperature

ORP readings for the same solution can vary up to 100 mv depending on the temperature. However, no standard compensation algorithms exist for this parameter. Be sure to take this factor into account when reporting ORP values and checking sensor calibration.

9-12. Nitrate

WARNING: Nitrate sensors can only be used at depths of less than 50 feet (15 meters). Use of the sensors at greater depths is likely to permanently damage the sensor membrane.

The ADV6600 nitrate probe consists of a silver/silver chloride wire electrode in a custom filling solution. The internal solution is separated from the sample medium by a polymer membrane, which selectively interacts with nitrate ions. When the probe is immersed in water, a potential is established across the membrane that depends on the relative amounts of nitrate in the sample and the internal filling solution. This potential is read relative to the Ag/AgCl reference electrode of the pH probe. As for all ISEs, the linear relationship between the logarithm of the nitrate activity (or concentration in dilute solution) and the observed voltage, as predicted by the Nernst equation, is the basis for the determination.

Under ideal conditions, the Nernst equation predicts a response of 59 mV for every 10-fold rise in nitrate activity at 25°C. However, in practice, empirical calibration of the electrode is necessary to establish the slope of the response. Typical slopes are 53-58 mV per decade for YSI sensors. This slope value is determined by calibration with two solutions of known nitrate concentration (typically 1 mg/L and 100 mg/L NO₃-N). The slope of the plot of log (nitrate) vs. voltage is also a function of temperature, changing from its value at calibration by a factor of the ratio of the absolute temperatures at calibration to that at measurement. The point where this new plot of log (nitrate) vs. voltage intersects the calibration plot is called the isopotential point, that is, the nitrate concentration at which changes in temperature cause no change in voltage. Our experience with ISEs indicates that for best accuracy, the isopotential point should be determined empirically. To do so, the user employs a third calibration point where the voltage of the lower concentration standard is determined at a temperature at least 10°C different from the first two calibration points. The slope, offset, and isopotential point drift slowly, and you should recalibrate the probe periodically.

All ion selective electrodes are subject to the interaction of species with the sensor membrane, which are similar in nature to the analyte. For example, chloride ion binds in this way to the nitrate membrane and produces positive nitrate readings even when no nitrate is present in the medium. Fortunately, most fresh water does not usually contain significant quantities of ions that produce a large interference on the nitrate reading, such as azide, perchlorate, and nitrite. It usually does contain some chloride and carbonate ions, but the interference from these ions is relatively small. For example, if the all of the ionic content of water with a conductivity of 1.2 mS/cm (Sal = 0.6) were due to the presence of sodium chloride, the nitrate reading would be erroneously high by about 1.6 mg/L. If the conductivity in this sample were all due to sodium bicarbonate, the sensor output would indicate the presence of only 0.2 mg/L of non-existent nitrate from the interference.

Even though the interference from chloride is relatively small and thus tolerable at low salinity, the large quantity of this species in salt or brackish water creates interference so great as to make the sensor unsuitable for these media.

Despite the potential problems with interference when using ISEs, it is important to remember that almost all-interfering species produce an artificially high nitrate reading. Thus, if the sonde

indicates the presence of only small quantities of nitrate, it is unlikely that the reading is erroneously low because of interference. Unusually high nitrate readings (which could be due to interfering ions) should be confirmed by laboratory analysis after collection of water samples.

Ion selective electrodes have the greatest tendency to exhibit calibration drift over time of all the sensors available on the ADV6600. This drift should not be a major problem for sampling studies where the instrument can be frequently calibrated. However, if a nitrate sensor is used in a longer-term deployment study with the sonde, the user should be aware that drift is almost certain to occur. The extent of the drift will vary depending on the age of the probe, the flow rate at the site, and the quality of the water. For all monitoring studies using ion selective electrodes, the user should acquire a few “grab samples” during the course of the deployment for analysis in the laboratory by chemical means or with another nitrate sensor which has been recently calibrated. Remember that the typical accuracy specification for the sensor (+/- 10 % of the reading or 2 mg/L, whichever is larger) refers to sampling applications where only minimal time has elapsed between calibration and field use.

9-13. Ammonium and Ammonia

WARNING: *Ammonium sensors can only be used at depths of less than 50 feet (15 meters). Use of the sensors at greater depths is likely to permanently damage the sensor membrane.*

The ADV6600 ammonium probe employs a silver/silver chloride (Ag/AgCl) wire electrode in a custom filling solution. Nonactin membrane separates the internal solution from the sample medium and this membrane selectively interacts with ammonium ions. When the probe is immersed in water, a potential is established across the membrane that depends on the relative amounts of ammonium in the sample and the internal filling solution. This potential is read relative to the reference electrode of the sonde pH probe. As for all ISEs, there is a linear relationship between the logarithm of the ammonium activity (or concentration in dilute solution) and the observed voltage. The Nernst equation describes this relationship.

Under ideal conditions, the Nernst equation predicts a response of 59 mV for every 10-fold rise in ammonium activity at 25°C. In practice, however, empirical calibration of the electrode is necessary to establish an accurate slope of the response. Typical empirical slopes are 53-58 mV per decade for YSI sensors. This slope value is determined by calibration with two solutions of known ammonium concentration (typically 1 mg/L and 100 mg/L $\text{NH}_4^+\text{-N}$).

The slope of the plot of log (ammonium) vs. voltage is also a function of temperature. The slope changes by a factor that is the ratio of the absolute temperature of calibration to absolute temperature of measurement. The point where this new plot of log (ammonium) vs. voltage intersects the calibration plot is called the isopotential point, that is, the ammonium concentration at which changes in temperature cause no change in voltage. Our experience with ISEs indicates that for best accuracy, the isopotential point should be determined empirically. To do so, use a third calibration point where the voltage of the lower concentration standard is determined at a

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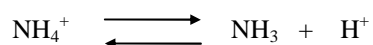
temperature at least 10°C different from the first two calibration points. The slope, offset, and isopotential point drift slowly, and the probe should be recalibrated periodically.

All ion selective electrodes are subject to interference from ions, which are similar in nature to the analyte. For example, sodium and potassium ions bind to the ammonium membrane and produce positive readings even when no ammonium is present. Fortunately, fresh water does not usually contain enough interfering ions to produce large errors. For example, a common conductivity for freshwater is about 1.2 mS/cm (Sal = 0.6). Even if the ionic content were due to sodium chloride, the ammonium reading would be erroneously high, about 0.4 mg/L.

However, brackish or seawater has enough sodium and potassium to cause interference so great as to make the sensor unsuitable for these media.

The sensor used in the ADV6600 detects only ammonium ions (NH_4^+), the predominant form of total ammonium nitrogen in most environmental samples. However, using the concurrently determined values of pH, temperature, and conductivity, the sonde software can also provide the user with the concentration of free ammonia (NH_3) in the sample under investigation.

Ammonium ions and free ammonia are in equilibrium in any solution according to the following equation:



The value of the equilibrium constant associated with this reaction, $K = [\text{NH}_3][\text{H}^+]/[\text{NH}_4^+]$, and its variation with temperature and salinity, is well known. This information allows the free ammonia concentration $[\text{NH}_3]$ to be automatically calculated by the sonde software and displayed if this parameter is activated.

Despite the potential problems with interference when using ISEs, it is important to remember that almost all interfering species produce an artificially high ammonium reading. Thus, if the sonde indicates the presence of only small quantities of ammonium, it is unlikely that the reading is erroneously low because of interference. Unusually high ammonium readings (which could be due to interfering ions) should be confirmed by laboratory analysis after collection of water samples.

Of all the sensors available on the ADV6600, ion selective electrodes have the greatest tendency to exhibit calibration drift over time. This drift should not be a major problem for sampling studies where the instrument can be frequently calibrated. However, if an ammonium sensor is used in a longer-term deployment study with the ADV6600, the user should be aware that drift is almost certain to occur. The extent of the drift will vary depending on the age of the probe, the flow rate at the site, and the quality of the water. For all monitoring studies using ion selective electrodes, the user should acquire a few “grab samples” during the course of the deployment for analysis in the laboratory by chemical means or with another ammonium sensor which has been recently calibrated. Remember that the typical accuracy specification for the sensor (+/- 10 % of the reading or 2 mg/L,

whichever is larger) refers to sampling applications where only minimal time has elapsed between calibration and field use.

9-14. Chloride

The ADV6600 chloride probe employs a solid state membrane attached to a conductive wire. When the probe is immersed in water, a potential is established across the membrane that depends on the amount of chloride in the medium. This potential is read relative to the reference electrode of the sonde pH probe. As for all ISEs, there is a linear relationship between the logarithm of the chloride activity (or concentration in dilute solution) and the observed voltage. The Nernst equation describes this relationship.

Under ideal conditions, the Nernst equation predicts a response of 59 mV for every 10-fold rise in chloride activity at 25°C. However, in practice, empirical calibration of the electrode is necessary to establish the slope of the response. Typical slopes are 45-55 mV per decade for YSI sensors. This slope value is determined by calibration with two solutions of known chloride concentration (typically 10 mg/L and 1000 mg/L Cl⁻).

The slope of the plot of log (chloride) vs. voltage is also a function of temperature, changing from its value at calibration by a factor of the ratio of the absolute temperatures at calibration to that at measurement. The point where this new plot of log (chloride) vs. voltage intersects the calibration plot is called the isopotential point, that is, the chloride concentration at which changes in temperature cause no change in voltage. Our experience with ISEs indicates that for best accuracy, the isopotential point should be determined empirically. To do so, the user employs a third calibration point where the voltage of the lower concentration standard is determined at a temperature at least 10°C different from the first two calibration points. The slope, offset and isopotential point drift slowly, and the probe should be recalibrated periodically.

All ion selective electrodes are subject to the interaction of species with the sensor membrane, which are similar in nature to the analyte. These interfering species thus include other halide ions (fluoride, bromide, and iodide) as well as other anions.

Despite the potential problems with interference when using ISEs, it is important to remember that almost all interfering species produce an artificially high chloride reading. Thus, if the sonde indicates the presence of only small quantities of chloride, it is unlikely that the reading is erroneously low because of interference. Unusually high chloride readings (which could be due to interfering ions) should be confirmed by laboratory analysis after collection of water samples.

Of all the sensors available on the ADV6600, ion selective electrodes have the greatest tendency to exhibit calibration drift over time. This drift should not be a major problem for sampling studies where the instrument can be frequently calibrated. However, if a chloride sensor is used in a longer-term deployment study with the ADV6600, the user should be aware that drift is almost certain to occur. The extent of the drift will vary depending on the age of the probe, the flow rate at the site,

and the quality of the water. For all monitoring studies using ion selective electrodes, the user should acquire a few “grab samples” during the course of the deployment for analysis in the laboratory by chemical means or with another chloride sensor which has been recently calibrated. Remember that the typical accuracy specification for the sensor (+/- 15 % of the reading or 5 mg/L, whichever is larger) refers to sampling applications where only minimal time has elapsed between calibration and field use.

9-15. Turbidity

Procedure from *Standard Methods for the Examination of Water and Wastewater*: 2130 B.

Turbidity is the measurement of the content of suspended solids (cloudiness) in water and is typically determined by shining a light beam into the sample solution and then measuring the light that is scattered off of the particles which are present. For turbidity systems capable of field deployment, the usual light source is a light emitting diode (LED) which produces radiation in the near infrared region of the spectrum. The detector is usually a photodiode of high sensitivity. The angle between the emitted and detected light varies (usually between 90 and 180 degrees) depending on the probe used. The International Standards Organization (ISO) recommends the use of a light source with a wavelength between 830 and 890 nm and an angle of 90 degrees between the emitted and detected radiation (ISO 7027).

The turbidity system available as an option for the ADV6600 consists of a probe which conforms to the above ISO recommendations. The output of the sonde turbidity sensor is processed via the sonde software to provide readings in nephelometric turbidity units (NTUs).

Two turbidity probes are available for use with the ADV6600. The probes are detailed briefly below; both are equipped with a mechanical wiper to periodically clean the sensor. These wiper systems make the probe ideal for long term monitoring, but they also work well for spot sampling applications.

- The Model 6026 probe has been offered by YSI since 1995 and is characterized by relatively small optics, a factor that results in minimal penetration of the light beam into the sample and thus allows the use of shorter probe guards on the sonde in which it is installed. If a 6026 sensor is selected in the Sensor menu of the ADV6600, the turbidity will automatically be reported in the units “turbid NTU”.
- The Model 6136 is a new (2002) turbidity probe from YSI that is characterized by relatively large optics. Since these larger optics result in deeper penetration of the light beam into the sample, the use of a longer probe guard is required, a slight disadvantage. However, the larger optical cell volume of the sensor has two significant advantages:

- (1) There is less background noise associated with the turbidity readings

- (2) The absolute values of the readings are significantly closer to those from typical laboratory turbidimeters (such as the Hach 2100AN) which use a large cell volume.

If a 6136 sensor is selected in the Sensor menu of the ADV6600, the turbidity will automatically be reported in the units “turbid+ NTU”.

In environmental water that contains suspended particles of varying size and density, the readings for the two probes will differ with the 6026 almost always showing higher readings and the extent of the difference generally being proportional to the overall turbidity. For example, if both probes are calibrated and then placed in a turbid river, the 6026 might read 400 NTU while the 6136 would read 300 NTU. The absolute difference in the sensor readings would shrink as the turbidity dropped. Thus, if the 6026 read 30 NTU, the 6136 would likely read approximately 21 NTU.

9-15.1. Effect of Fouling

It is important to remember that field optical measurements are particularly susceptible to fouling. Fouling may be caused not only from long term build up of biological and chemical debris, but also by short term formation of bubbles from outgassing of the environmental water. These bubbles can generally be removed in short term sampling application by simply agitating the sonde manually. For studies longer than a few hours where the user is not present at the site, the quality of the turbidity data obtained with a turbidity sensor that has no capability of mechanical cleaning is likely to be poor. All YSI turbidity probes for the ADV6600 are equipped with a mechanical wiper that makes them ideal for unattended applications. The wiper functions automatically during sampling studies. The number of wiper movements can be set in the sonde software. Generally one movement is sufficient for most environmental applications, but in media with particularly heavy fouling, additional cleaning cycles may be necessary.

9-15.2. Effect of Temperature

While the effect of temperature on the turbidity sensor is small, this factor is automatically taken into account by the ADV6600 software providing temperature compensated readings. Temperature coefficients of 0.3%/degree C and 0.6%/degree C are automatically activated for the 6026 and 6136, respectively, when these sensors are activated in the **Sensor** menu.

9-15.3. Effect of Particle Size

The output of turbidity sensors is susceptible not only to the overall cloudiness of the environmental medium, but also to the particle size of the suspended solids which pass across the optics on the probe face. Thus, although the turbidity of an environmental sample may appear to the eye to be relatively stable, the displayed turbidity can vary significantly depending on the nature of the

particles in the optical path at the instant of measurement. For example, in long-term studies this effect can be seen with spikes of up to 10 NTU sometimes observed. This apparent jumpiness is not observed for freshly prepared turbidity standards, since the particle size in these suspensions is homogeneous. The sonde turbidity system allows the user to either observe these real turbidity events, while obtaining somewhat jumpy readings, or to activate the **Turb Spike Filter**, which allows for a better presentation of the average turbidity during deployment.

9-16. Chlorophyll

Chlorophyll, in various forms, is bound within the living cells of algae, phytoplankton, and other plant matter found in environmental water. Chlorophyll is a key biochemical component in the molecular apparatus that is responsible for photosynthesis, the critical process in which the energy from sunlight is used to produce life-sustaining oxygen. In general, the amount of chlorophyll in a collected water sample is used as a measure of the concentration of suspended phytoplankton, the magnitude of which can significantly affect the overall quality of the water.

The use of the measurement of phytoplankton as an indicator of water quality is described in Section 10200 A. of *Standard Methods for the Examination of Water and Wastewater*. The classical method of determining the quantity of chlorophyll at a particular site is to collect a fairly large water sample and analyze it in the laboratory. The procedure involves filtration of the sample to concentrate the chlorophyll containing organisms, mechanical rupturing of the collected cells, and extraction of the chlorophyll from the disrupted cells into the organic solvent, acetone. The extract is then analyzed by either a spectrophotometric method using the known optical properties of chlorophyll or by high performance liquid chromatography (HPLC). This general method is detailed in Section 10200 H. of *Standard Method* and has been shown to be accurate in multiple tests and applications as long as a competent laboratory analyst carries out the protocol. The procedure is generally accepted for reporting in scientific literature. The method is time-consuming, however, and usually requires an experienced, efficient analyst to generate consistently accurate and reproducible results. It also does not lend itself readily to continuous monitoring of chlorophyll, and thus phytoplankton, since the collection of samples at reasonable time intervals, e.g., every hour, would be extremely tedious.

YSI has developed the YSI 6025 chlorophyll sensor for the determination of chlorophyll in spot sampling and continuous monitoring applications. It is based on an alternative method for the measurement of chlorophyll which overcomes these disadvantages, albeit with the potential loss of accuracy. In this procedure, chlorophyll is determined *in vivo*, i.e., without disrupting the cells as in the extractive analysis. The YSI 6025 chlorophyll sensor is designed for these *in vivo* applications and its use allows the facile collection of large quantities of chlorophyll data in either spot sampling or continuous monitoring applications. It is important to remember, however, that the results of *in vivo* analysis will not be as accurate as results obtained from the certified extractive analysis procedure.

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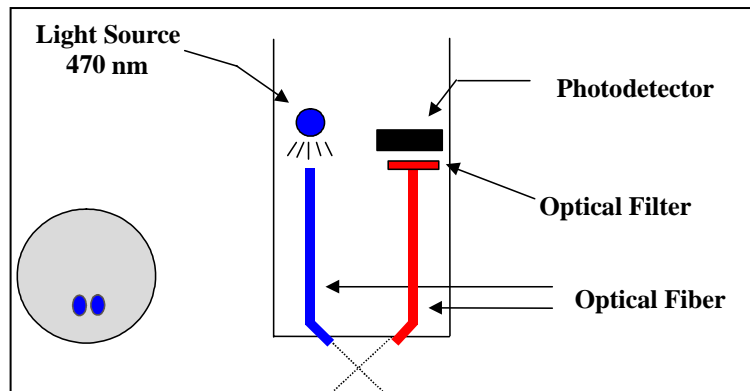
The limitations of the *in vivo* method are outlined below and should be carefully considered before making chlorophyll determinations with your ADV6600 chlorophyll sensor. Some of the sources of inaccuracy can be minimized by combining the data from the YSI 6025 with data from extractive analysis of a few samples acquired during a sampling or monitoring study. However, the *in vivo* studies will never replace the standard procedure. Rather, the estimates of chlorophyll concentration from the easy-to-use YSI chlorophyll system are designed to complement the more accurate (but more difficult to obtain) results from more traditional methods of chlorophyll determination.

9-16.1. *In Vivo* Measurement

One key characteristic of chlorophyll is that it fluoresces, that is, when irradiated with light of a particular wavelength, it emits light of a higher wavelength (or lower energy). The ability of chlorophyll to fluoresce is the basis for all commercial fluorometers capable of measuring the analyte *in vivo*. Fluorometers of this type have been in use for some time. These instruments induce chlorophyll to fluoresce by shining a beam of light of the proper wavelength into the sample, and then measuring the higher wavelength light which is emitted as a result of the fluorescence process. Most chlorophyll systems use a light emitting diode (LED) as the source of the irradiating light that has a peak wavelength of approximately 470 nm. LEDs with this specification produce radiation in the visible region of the spectrum with the light appearing blue to the eye. On irradiation with this blue light, chlorophyll resident in whole cells emits light in the 650-700 nm region of the spectrum. To quantify the fluorescence the system detector is usually a photodiode of high sensitivity that is screened by an optical filter that restricts the detected light. The filter prevents the 470 nm exciting light from being detected when it is backscattered off of particles in the water. Without the filter, turbid (cloudy) water would appear to contain fluorescent phytoplankton, even though none were present. The following diagram can be used to better understand the principles of the YSI system.

Most commercial fluorometers fit into two categories. In the first category are benchtop instruments that generally have superior optical flexibility and capability but are relatively expensive and are often difficult to use in the field. In the second category are sonde-type fluorometers that have a fixed optical

configuration, but are less expensive, can be more easily used in the field, and are usually compatible with data collection platforms. The use of a pump is recommended for some sonde fluorometers and this can result in the need for large capacity batteries for field use.



The unique YSI chlorophyll system available as an option for use with the ADV6600 consists of a probe which is similar in concept to the sonde-type fluorometers, but is much smaller, making it compatible with the probe ports of the YSI 6820, 6920, 600 OMS, and 6600 sondes. The output of the sensor is automatically processed via the sonde software to provide readings in either generic fluorescence units (percent full scale; % FS) or $\mu\text{g/L}$ of chlorophyll. No pump is required for the YSI system allowing the sensor to operate off of the internal batteries in the ADV6600. Like the YSI 6026 and 6136 turbidity probes, the YSI 6025 chlorophyll probe is equipped with a mechanical wiper to periodically clean the optical face either by manual or automatic activation. With these features, the YSI chlorophyll sensor provides the same level of performance as the sonde fluorometers, but is much easier to use and can be deployed in environmental water for several weeks without the need for service. In addition, the probe will be a component in sondes that can acquire up to ten other parameters simultaneously with chlorophyll, rather just providing the single parameter.

9-16.2. Effect of Fouling

Field optical measurements are particularly susceptible to fouling, not only from long term build up of biological and chemical debris, but also to shorter term formation of bubbles from outgassing of the environmental water. These bubbles can sometimes be removed in short term sampling applications by simply agitating the sonde manually. For studies longer than a few hours where the user is not present at the site, the quality of the chlorophyll data obtained with a fluorescence sensor that has no capability of mechanical cleaning is likely to be compromised. The YSI 6025 probe is equipped with a mechanical wiper that makes it ideal for unattended applications. The wiper can be activated in real-time during discrete sampling operations or will function automatically just before each sample is taken during long term unattended monitoring studies. The number of wiper movements and the frequency of the cleaning cycle for the unattended mode can be set in the sonde software. Generally, one wiper movement is sufficient for most environmental applications, but in media with particularly heavy fouling, additional cleaning cycles may be necessary.

9-16.3. Effect of Temperature

While the effect of temperature on the chlorophyll sensor itself is very small, YSI experiments have indicated that the fluorescence of phytoplankton suspensions can show significant temperature dependence. For example, the apparent chlorophyll content of our laboratory test samples of algae increased from 185 to 226 $\mu\text{g/L}$ when the temperature was dropped from 21 °C to 1 °C even though no change in phytoplankton content took place. In the absence of compensation, this effect would obviously result in errors in field chlorophyll readings if the site temperature were significantly different from the calibration temperature. This temperature error can be reduced by employing a chlorophyll temperature compensation routine (“Chl tempco”) resident in the sonde software.

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From our studies, it appears that entry of a value of 1 to 2 % per degree C for “Chl tempco” is appropriate to partially account for changes in the fluorescence of environmental phytoplankton with temperature. This value can be estimated in the above example as follows:

$$\begin{aligned}\text{Change in Temperature} &= 21-1 = 20 \text{ }^\circ\text{C} \\ \text{Change in Fluorescence} &= 226-185 = 41 \text{ } \mu\text{g/L} \\ \text{\% Change in Fluorescence} &= (41/185) \times 100 = 22.1 \\ \text{Chl Tempco Factor} &= 22.1/20 = 1.11 \text{ \% per degree }^\circ\text{C}\end{aligned}$$

Note that the use of this empirically derived compensation does not guarantee accurate field readings since each species of phytoplankton is likely to be unique with regard to the temperature dependence of its fluorescence. Changes in fluorescence with temperature are a key limitation of the *in vivo* fluorometric method (see below) which can only be reduced, not eliminated, by this compensation. In general, the best way to minimize errors is to calibrate with phytoplankton standards of known chlorophyll content that are as close as possible in temperature to that of the environmental water under investigation.

9-16.4. Effect of Particle Size

The output of the YSI fluorescence sensor is susceptible not only to the overall phytoplankton concentration in the environmental medium, but also to the size and rate of movement of the suspended particles that pass across the optics on the probe face. Thus, although the phytoplankton content of an environmental sample may appear to the eye to be relatively stable, the displayed chlorophyll reading can vary significantly depending on the nature of the particles in the optical path at the instant of measurement. In a discrete sample study of environmental water, for example, the variability of the output can be significant. This apparent jumpiness is not observed in dye standards, since these are homogeneous solutions containing no suspended matter.

9-16.5. Effect of Turbidity

As described above, the filters in front of the photodiode in the YSI 6025 chlorophyll probe prevent most of the 470 nm light which is used to excite the chlorophyll molecules from reaching the detector after being backscattered off of non-fluorescent particles (turbidity) in environmental water. However, the filter system is not perfect and a minor interference on chlorophyll readings from suspended solids may result. Laboratory experiments indicate that a suspension of typical soil measured with a YSI 6026 sensor will have a turbidity interference characterized by a factor of about 0.03 $\mu\text{g/L}$ per NTU. For example, the turbidity of the water must be above 100 NTU to produce an apparent chlorophyll reading equal to 3 $\mu\text{g/L}$. In very cloudy water, the user may wish to use the independently-determined turbidity value and the above compensation factor to correct measured chlorophyll values using, for example, a spreadsheet.

9-16.6. Limitations of *In Vivo* Measurement

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As noted above, the measurement of chlorophyll from *in vivo* fluorescence measurements will always be less reliable than determinations made on molecular chlorophyll that has been extracted from the cells using the procedures described in *Standard Methods*. This section describes some of the known problems with *in vivo* chlorophyll measurement.

Interferences from other fluorescent species

The analytical methods described in *Standard Methods* for chlorophyll involve disruption of the living organisms present in suspension, followed by extraction of molecular chlorophyll into a homogeneous solution in an organic solvent. Acidification of the extract helps to minimize the interference caused by a number of other, non-chlorophyll species. In addition, readings can be taken at various wavelengths on a spectrophotometer to differentiate between the various forms of chlorophyll (a, b, c) and pheophytin a.

In contrast to this fairly controlled situation, all *in vivo* sensors operate under whole-cell, heterogeneous conditions where the sensor will measure, at least to some degree, everything which fluoresces in the region of the spectrum above 630 nm when irradiated with 470 nm light. Therefore, the sensor is really quantifying overall fluorescence under these optical conditions, rather than chlorophyll specifically. While it is probable that most of the fluorescence is due to suspended plant and algal matter and that much of the fluorescence from this biomass is due to chlorophyll, it is impossible to exclude interference from other fluorescent species using the approach described above.

Note that *in vivo* fluorometers usually cannot differentiate between the different forms of chlorophyll.

Lack of calibration reagents

The usual reagents which are used for the calibration of fluorometric measurements for chlorophyll after extraction into organic solvents are purchased as “purified chlorophyll a” from chemical supply vendors such as Sigma. These standards are not soluble in aqueous media and, even if they were, their fluorescence is unlikely to be the same as when the chlorophyll is present in the whole living cell. Therefore, for even a semi-quantitative calibration, the user needs a “substitute” standard such as rhodamine WT (see above) to provide a method for estimating the sensitivity of the sensor. Field readings based on this type of calibration will provide only an estimate of chlorophyll in environmental water where the measurement is taken on whole cell suspensions *in vivo*. The calibration standard that provides the best measure of accuracy for *in vivo* chlorophyll sensors is a portion of a phytoplankton suspension that has been analyzed for chlorophyll by the extractive procedure. We recommend the use of this procedure and further recommend that the phytoplankton suspension be taken from the site being monitored so that the species producing the fluorescence in the standard are as close as possible to the field organisms. To truly assess data reliability in a long term monitoring study, grab samples should be taken periodically, e.g. weekly, and analyzed in the laboratory as the study progresses. These data can then be used to “postcalibrate” the readings logged to the instrument during the study, perhaps using a spreadsheet for the simple mathematical treatment. In any case, getting quantitative chlorophyll data from any *in vivo* fluorometric sensor is much more difficult than with most other environmental sensors. For this reason, it is difficult to

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provide an accuracy specification for chlorophyll measurement made with *in vivo* fluorometers and therefore no accuracy specification is quoted for the YSI 6025.

Effect of cell structure, particle size, and organism type on *in vivo* readings

Even if the only fluorescent species present for *in vivo* measurements were chlorophyll, and reliable calibration standards were available, its absolute quantification would probably still be difficult because samples are not homogeneous. Differing species of algae with differing shape and size will likely fluoresce differently even if the type and concentration of chlorophyll are identical and this significantly limits the accuracy of *in vivo* measurements.

Effect of temperature on phytoplankton fluorescence

As noted above, YSI experiments indicate that phytoplankton fluorescence increases as temperature decreases. Thus, readings taken on a phytoplankton suspension at cold temperature would erroneously indicate the presence of more phytoplankton than when the suspension is read at room temperature. Unless this effect is taken into account, most field readings will be somewhat in error, since the field temperature will differ from the temperature of calibration. The use of the “Chl Tempco” factor found in the Advanced Sensor menu will help to reduce this error, but must be used with caution since each species of phytoplankton is likely to have a slightly different temperature dependence.

Effect of light on phytoplankton fluorescence

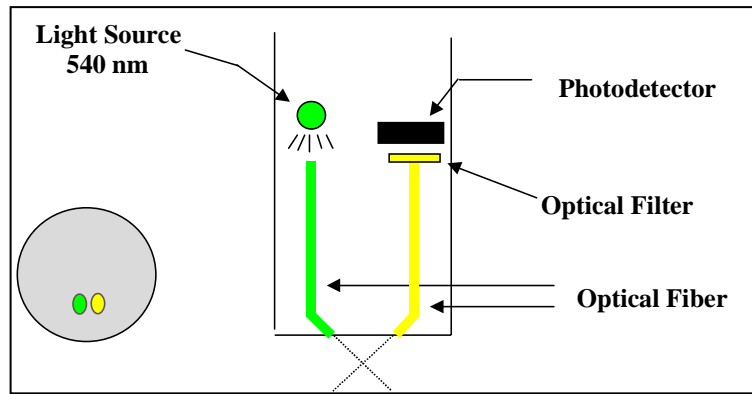
It is well documented in the literature that the fluorescence of chlorophyll resident in phytoplankton can be inhibited by light. This “photoinhibition” is confirmed by empirical data that indicate that, at constant phytoplankton level, the fluorescent signal can change significantly on a diurnal schedule, showing less fluorescence during the day and more fluorescence at night. Data showing this diurnal cycle is shown in **Appendix I, Chlorophyll Measurements**. It is clear that this effect would produce errors in the absolute values of chlorophyll unless it was accounted for by the user.

The chlorophyll section of Standard Methods substantiates these limitations along with application notes that are offered by current fluorometer manufacturers. The limitations result in the realization that any *in vivo* “chlorophyll” sensor will be much less quantitative than any of the other sensors offered for use with our sondes.

9-17. Rhodamine WT

Rhodamine WT is a red dye that is commonly used in stream flow studies. The amount of the species at various points (horizontal and vertical) in the water under examination is determined by utilizing the fact that rhodamine WT fluoresces when irradiated with the proper wavelength of light. Thus the YSI 6130 rhodamine WT sensor works on the same principles as described for the 6025 chlorophyll sensor.

As for chlorophyll, rhodamine WT fluoresces, that is, when irradiated with light of a particular wavelength, it emits light of a higher wavelength (or lower energy). The ability of rhodamine WT to fluoresce is the basis for all commercial fluorometers capable of measuring the analyte *in situ*. Fluorometers of this



type have been in use for some time. These instruments induce rhodamine WT to fluoresce by shining a beam of light of the proper wavelength into the sample, and then measuring the higher wavelength light which is emitted as a result of the fluorescence process. Most rhodamine systems use a light emitting diode (LED) as the source of the irradiating light that has a peak wavelength of approximately 540 nm. LEDs with this specification produce radiation in the visible region of the spectrum with the light appearing green to the eye. On irradiation with this green light, rhodamine WT in the water emits visible light with a higher wavelength than that of the exciting beam, i.e. the rhodamine fluoresces. To quantify this fluorescence, the system detector is usually a photodiode of high sensitivity that is screened by an optical filter that restricts the detected light. The filter minimizes (a) the exciting light being detected when it is backscattered off of particles in the water and (b) the interference from other fluorescent species such as the chlorophyll in phytoplankton. Without the filter, turbid (cloudy) water or water with high levels of phytoplankton would appear to contain rhodamine WT, even though none were present. The following diagram can be used to better understand the principles of the YSI rhodamine WT system.

Field optical measurements are particularly susceptible to fouling, not only from long term build up of biological and chemical debris, but also to shorter term formation of bubbles from outgassing of the environmental water. These bubbles can generally be removed in short term sampling application by simply agitating the sonde manually. However, for studies longer than a few hours where the user is not present at the site, the quality of the data obtained with a rhodamine WT sensor that has no capability of mechanical cleaning may be compromised. Like the 6026 /6136 turbidity and 6025 chlorophyll probes described above, the 6130 rhodamine WT probe is equipped with a mechanical wiper that makes it ideal for unattended applications. The wiper can be activated in real-time during discrete sampling operations or will function automatically during long term unattended sampling studies. The number of wiper movements and the frequency of the cleaning cycle for the unattended mode can be set in the sonde software. Generally one movement is sufficient for most environmental application, but in media with particularly heavy fouling, additional cleaning cycles may be necessary.

9-17.1. Calibration and Effect of Temperature

The sonde software offers the option of 1 point, 2 point, or 3 point calibrations procedures. For most applications, a 2-point calibration at 0 and 100 $\mu\text{g/L}$ is sufficient. However, for maximum accuracy over the entire 0-200 $\mu\text{g/L}$ range of the sensor, a 3-point calibration procedure can slightly enhance the accuracy of the sensor. Note that YSI does not offer rhodamine WT standards, but does suggest a vendor for user-production of standards and, later in this section, provides instructions for preparing a solution which is 100 $\mu\text{g/L}$ in Rhodamine WT.

While the effect of temperature on the rhodamine sensor and electronics is small, the fluorescence of rhodamine WT changes significantly with temperature. The combination of the two factors is automatically taken into account by the sonde software providing temperature compensated readings.

9-17.2. Effect of Turbidity

As described above, the filters in front of the photodiode in the YSI 6130 rhodamine probe prevent most of the green light which is used to excite the rhodamine molecules from reaching the detector after being backscattered off of non-fluorescent particles (turbidity) in environmental water. However, the filter system is not perfect and a minor interference on rhodamine WT readings from suspended solids may result. Laboratory experiments indicate that a suspension of typical soil measured with a YSI 6026 sensor will have turbidity interference characterized by a factor of about 0.03 $\mu\text{g/L}$ per NTU. For example, the turbidity of the water must be above 100 NTU to produce an apparent rhodamine WT reading equal to 3 $\mu\text{g/L}$. In very cloudy water, the user may wish to use the independently-determined turbidity value and the above compensation factor to correct measured chlorophyll values using, for example, a spreadsheet.

9-17.3. Effect of Chlorophyll

While the green LED used in the rhodamine WT sensor is not ideal for excitation of the chlorophyll in phytoplankton, some fluorescence of environmental chlorophyll will always be induced by the rhodamine sensor. Because the filter system for the rhodamine photodiode is not perfect in excluding chlorophyll fluorescence, a minor interference on rhodamine WT readings from phytoplankton may result. Laboratory experiments indicate that a suspension of phytoplankton measured with a YSI 6025 sensor will have chlorophyll interference characterized by a factor of about 0.10 $\mu\text{g/L}$ Rhodamine WT per $\mu\text{g/L}$ of chlorophyll. For example, the chlorophyll content of the water must be above 30 $\mu\text{g/L}$ chlorophyll to produce an apparent rhodamine WT reading equal to 3 $\mu\text{g/L}$. In water with a high algal content, the user may wish to use the independently-determined chlorophyll value and the above compensation factor to correct measured rhodamine values using, for example, a spreadsheet.

Section 10. Care, Maintenance, and Storage

10-1. Protection from Biological Fouling

The ADV6600 can be deployed without any additional modifications. However, when deployment is to occur in a very severe fouling environment, measures can be taken to reduce fouling, increase *in situ* time, and minimize service and cleaning requirements.

This section discusses some of the various ways in which the ADV6600 can be prepared to prevent biological fouling.

Please note: *The use of anti-fouling paint products on any part of a sonde, probe, or a combination thereof, is entirely at the discretion of the owner and/or user of said equipment. YSI, Inc. will in no way be held responsible or liable for sondes, probes, or other pieces of equipment that may become damaged as a result of the application of anti-fouling paint products. Please proceed with caution if you choose to do so.*

10-1.1. Sonde Housing

The use of anti-fouling paint on the sonde body is not recommended. As an alternative, it may be wrapped in Saran Wrap™, or another similar product, and secured with electrical tape. The growth of undesirable animal and plant life will still occur, but will be easily removed when the sonde is unwrapped.

The endcap assembly, probe guard and bulkhead area may be painted with two thin coats of anti-fouling paint. Avoid getting any paint on the cable connector and do not allow paint around the edges of the battery compartment cover. Also avoid getting paint on the threads of the probe guard where it attaches to the sonde. When applying paint to the bulkhead area, cover all surfaces around the probe ports, but do not allow paint on the threads of the bulkhead or in the probe ports and connectors.

10-1.2. ADV

The ADV has excellent resistance to biological fouling and can operate reliably even with moderate biological growth on the transducers. Although the biological growth may cause a loss in signal strength, it does not affect the accuracy of velocity measurements. In extreme fouling situations, the ADV probe may also be coated with anti-fouling paint to prevent biological growth.

Warning! *Thick layers of anti-fouling paint on the transducers will decrease acoustic signal strength and could potentially introduce seeding requirements.*

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Within the United States, it is recommended to use an anti-fouling paint called Interlux Tri-Lux II for coating the ADV sensor. This paint contains a biocide, a copper derivative, which allows its use on all metals; see contact information for the manufacturer below.

Courtaulds Coatings
2270 Morris Avenue
Union, NJ 07083 USA
Phone: (908) 686-1300
Fax: (908) 686-8545
Internet: www.yachtpaint.com

Normal anti-fouling paints, which use cuprous oxide based biocides, cannot be used on some metals as they cause galvanic corrosion. Outside the United States, anti-fouling paints containing TBT can be used on metal systems with a suitable primer.

When painting metal parts, a suitable conversion layer must be applied to the metal for adhesion and to isolate the metal from the anti-fouling paint. Interlux 360 Underwater Metal Primer (same manufacturer as above) is suggested. The primer should be applied to all exposed metal surfaces **except** sacrificial zinc anodes. Then follow with an application of the anti-fouling paint to all surfaces of the sensor that require protection **except** sacrificial zinc anodes.

Apply only one coat of anti-fouling paint to the transducers. Each layer causes some loss in signal strength and multiple layers can potentially affect system performance. Ensure that the paint has a smooth, even surface with no air bubbles.

10-1.3. Conductivity/Temperature Probe

The process of painting the 6560 temperature/conductivity probe will be slightly more tedious than the process for doing so to the other probes. The outer body of the probe should be painted from above the stainless steel nut to the top of the probe. However, do not allow the paint to get on the stainless steel nut or on the shaft that retains the nut on the probe body. Also, do not allow the paint to touch the temperature probe.

Warning! *DO NOT allow paint to run or drip onto the conductivity electrodes within the two small holes of the conductivity cell! If paint should get onto the electrodes, the probe will malfunction!*

The next step is to paint the inside of the conductivity cell. Again, extreme care must be taken not to get paint on the electrodes themselves! A thin coat of paint should be applied onto the inner wall of the two small holes that comprise the conductivity cell. However, painting the inside of the conductivity cell will slightly change the volume of the cell and thereby negate any previous calibration. Therefore, after you



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have completed painting the conductivity cell of your probe, it will need to be recalibrated so that the cell constant is reflective of the fact that paint has been applied within the cell.

Once the first coat of paint has dried, a second thin coat should be applied to all of the aforementioned areas of the probe.

10-1.4. DO Probe

Paint the 6562 DO probe above the stainless steel nut to a point approximately 1/8 inch below the o-ring that secures the membrane. Do not allow the paint to get on the stainless steel nut or on the shaft that retains the nut on the probe body. Apply two thin coats of paint.



10-1.5. pH and pH/ORP Probes

Apply the paint above the stainless steel nut. Do not allow the paint to get on the stainless steel nut or on the shaft that retains the nut on the probe body. On the 6561 and 6565 guarded probes, the inside and outside of the guard around the pH bulb may be painted. Take great care not to get any paint on the glass bulb. For the 6566 probe, apply the paint up to 1/8 inch below the bulb-end of the probe.

Caution! Do not get any paint on the pH junction (white area at the top of the probe) or the glass bulb!

10-1.6. ISE Probes

It is not recommended that anti-fouling paint be applied to these sensors.

10-1.7. Optical Probes

Two thin coats of paint may be applied to the body of an optical probe from a point just above the stainless steel nut to approximately 1/8-inch below the face of the probe. However, be very careful to keep the paint off of the face of the probe and off of the shaft that retains the stainless steel nut on the probe body.

The wiper assembly of the turbidity probe only will also benefit from a thin layer of paint applied to its side and top surfaces. However, paint **MUST NOT** be applied to the bottom surfaces of the wiper (the surfaces that face the probe), or anywhere on the wiper's brush. Also, avoid painting the wiper's stainless steel set screw.

Warning! Do NOT paint the wipes of any of the optical probes! The designated color of the wiper must be visible to the optics for proper wiper parking!

10-2. Sonde Care and Maintenance

When caring for your ADV6600, remember that the sonde is sealed at the factory, and there is never a need to gain access to the interior circuitry of the ADV6600. If an attempt to disassemble the ADV6600 is made the manufacturer's warranty is void.

10-2.1. O-Rings

The ADV6600 sonde utilizes user-accessible o-rings as seals to prevent water from entering the battery compartment and the sensor ports. If the o-rings and sealing surfaces on the ADV6600 are not maintained properly, it is possible that water can enter the battery compartment and/or sensor ports of the ADV6600. This can cause severe damage to the battery terminals or probe ports resulting in loss of battery power during deployment, false readings and corrosion to the probes.

When the battery compartment lid is removed, the o-rings that provide the seal should be carefully inspected for contamination (e.g. hair, grit, etc.) and cleaned if necessary using the instructions provided below. The same inspection should be made of the o-rings associated with the probes and port plugs when they are removed. If no dirt or damage to the o-rings is evident, then they should be lightly greased without removal from their groove.

However, if there is any indication at all of damage, the o-ring should be replaced with an identical item from the maintenance kit supplied with your sonde. At the time of o-ring replacement, the entire o-ring assembly should be cleaned as described below. Following the recommended procedures will assure that no problems will occur with water influx into your ADV6600.

To remove the o-rings:

Use a small, flat-bladed screwdriver or similar blunt-tipped tool to remove the o-ring from its groove. Check the o-ring and the groove for any excess grease or contamination. If contamination is evident, clean the o-ring and nearby plastic parts with lens cleaning tissue or equivalent lint-free cloth. Alcohol can be used to clean the plastic parts, but use only water and mild detergent on the o-ring itself. Also, inspect the o-rings for nicks and imperfections.

CAUTION: Using alcohol on o-rings may cause a loss of elasticity and may promote cracking. Do not use a sharp object to remove the o-rings. Damage to the o-ring or the groove itself may result.

To re-install the o-rings:

Before re-installing the o-rings, make sure that you are using a clean workspace, clean hands and are avoiding contact with anything that may leave fibers on the o-ring or grooves. Even a very small bit of contamination (hair, grit, etc.) may cause a leak.

1. Place a small amount of o-ring lubricant between your thumb and index finger (More grease is NOT BETTER!)

2. Draw the o-ring through the grease while pressing the fingers together. Use this action to place a VERY LIGHT covering of grease to all sides of the o-ring.
3. Place the o-ring into its groove making sure that it does not twist or roll.
4. Use the previously grease-coated finger to once again lightly go over the mating surface of the o-ring.

***CAUTION:** Do not over-grease the o-rings. The excess grease may collect grit particles that can compromise the seal. Excess grease can also cause the waterproofing capabilities of the o-ring to diminish, potentially causing leaks into the compartment. If excess grease is present, remove it using lens cloth or lint-free cloth.*

10-2.2. Probe Ports

Whenever a probe is installed, removed or replaced, it is extremely important that the entire ADV6600 and all probes be thoroughly dry. This will prevent water from entering the exposed sonde port. After removal of a probe or port plug, examine the connector inside the ADV6600 port. If any moisture is present, use compressed air to completely dry the connector. If the connector is corroded, replacement by an Authorized YSI Service Center may be required.

Before a probe or port plug is reinstalled, lightly grease the O-ring with lubricant supplied in the YSI 6570 Maintenance Kit.

10-2.3. Cables and Connectors

The cable connector port at the top of the sonde should be covered at all times. While communicating with the sonde, a cable should be installed and tightened into place using the provided locking sleeve. This will assure that a proper connection is being made and prevent moisture and contaminants from entering the connector area.

When a communications cable is not connected to the cable connector port, the pressure cap supplied with the instrument should be securely tightened into place. If moisture should enter the connector, dry the connector completely using compressed air, a clean cloth, or paper towel.

Inspect all cables and connectors for damage on a regular basis; replace if necessary. In areas where cables may be subject to physical damage, additional protection can be added to the cable. One common method is to split a garden hose and wrap it around the cable.

10-3. Probe Care and Maintenance

10-3.1. ADV

Biological growth on the transducers does not affect velocity measurements, but can decrease acoustic signal strength and potentially inhibit the ADV from performing in clear water. Periodic cleaning of the ADV transducers may be needed to maintain optimal performance in areas of high biological activity. To remove growth, clean with a stiff brush. The transducer epoxy is very durable and will not be easily damaged, except by a direct impact. ** Caution: avoid direct impact of the transducers as permanent and non-warranty damage can occur.

10-3.2. Conductivity/Temperature Probe

The openings that allow fluid access to the conductivity electrodes must be cleaned regularly. The small cleaning brush included in the 6570 Maintenance Kit is ideal for this purpose. Dip the brush in clean water and insert it into each hole 15-20 times.

In the event that deposits have formed on the electrodes, dip the cell in cleaning solution and agitate for two to three minutes. Any one of the foaming acid tile cleaners, such as Dow Chemical Bathroom Cleaner, will clean the cell adequately. Remove the cell from the cleaning solution and rinse well with deionized or distilled water before using the brush to dislodge any contaminants from inside the electrode chamber. After cleaning, check the response and accuracy of the conductivity cell with a calibration standard. Re-calibrate as necessary.

The temperature portion of the probe requires no maintenance

10-3.3. DO Probe

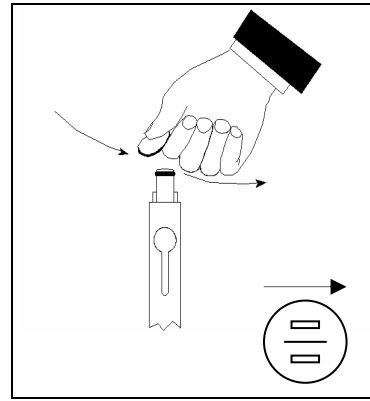
For best results, it is recommended that the electrolyte solution and membrane on the dissolved oxygen probe be changed prior to each sonde deployment and at least once every 2-4 weeks during sampling applications. They should also be changed if (a) bubbles are visible under the membrane; (b) significant deposits of dried electrolyte are visible on the membrane or the O-ring; and (c) if the probe shows unstable readings or other probe-related symptoms. See Section 2 for instructions on changing the DO membrane.

After removing the used membrane from the tip of the 6562 probe, examine the electrodes at the tip of the probe. If either or both of the silver electrodes are black in color, the probe should be resurfaced using the fine sanding disks provided in the 6035 reconditioning kit.

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To resurface the probe:

1. First dry the probe tip completely with lens cleaning tissue.
2. Holding the probe in a vertical position, place one of the sanding disks under your thumb, and stroke the probe face in a direction parallel to the gold electrode (located between the two silver electrodes). The motion is similar to that used in striking a match. Usually 10-15 strokes of the sanding disk are sufficient to remove black deposits on the silver electrodes. However, in extreme cases, more sanding may be required to regenerate the original silver surface.
3. After cleaning, thoroughly rinse the entire tip of the probe with distilled or deionized water.
4. Install a new membrane.



IMPORTANT: Be sure to: (1) Use only the fine sanding disks provided in the 6035 maintenance kit in the resurfacing operation and (2) Sand in a direction parallel to the gold electrode. Not adhering to either of these instructions can seriously damage the electrodes.

10-3.4. pH and pH/ORP Probes

Cleaning is required whenever deposits or contaminants appear on the glass and/or platinum surfaces of these probes or when the response of the probe becomes slow.

Remove the probe from the sonde. Initially, simply use clean water and a soft clean cloth, lens cleaning tissue, or cotton swab to remove all foreign material from the glass bulb and/or platinum button. Use a moistened cotton swab to carefully remove any material that may be blocking the reference electrode junction of the sensor. Re-install the sensor and re-calibrate.

CAUTION: When using a cotton swab, be careful **NOT** to wedge the swab tip between the guard and the glass sensor.

If good pH and/or ORP response is not restored by the above procedure, perform the following additional procedure:

1. Soak the probe for 10-15 minutes in clean water containing a few drops of commercial dishwashing liquid.
2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the cleaning solution.
3. Rinse the probe in clean water, wipe with a cotton swab saturated with clean water, and rinse again with clean water.
4. Re-install the sensor and re-calibrate.

If good pH and/or ORP response is still not restored by the above procedure, perform the following additional procedure:

1. Soak the probe for 30-60 minutes in one molar (1 M) hydrochloric acid (HCl). This reagent can be purchased from most distributors. Be sure to follow the safety instructions included with the acid.
2. Rinse the probe in clean water, wipe with a cotton swab saturated with clean water, and rinse again with clean water.
3. Soak the probe in clean water for about an hour with occasional stirring until all traces of the acid are removed from the probe crevices.
4. Re-install the sensor and re-calibrate.

If biological contamination of the reference junction is suspected or if good response is not restored by the above procedures, perform the following additional cleaning step:

1. Soak the probe for approximately 1 hour in a 1 to 1 dilution of commercially available chlorine bleach.
2. Rinse the probe with clean water
3. Soak the probe for at least 1 hour in clean water with occasional stirring to remove residual bleach from the junction. If possible, soak the probe in clean water for a period of time longer than 1 hour in order to be certain all traces of chlorine bleach are removed.
4. Rinse the probe with clean water.
5. Re-install the sensor and recalibrate.

10-3.5. ISE Probes

The Chloride, Ammonium, and Nitrate probes should be cleaned whenever deposits or contaminants appear on the ion selective membranes located on the tips of the sensor modules. If possible, the module should be cleaned while installed in the sonde bulkhead. Use clean water and a moist piece of lens cleaning tissue to *gently* wipe the sensor membranes until no more contaminants are present.

NOTE: The ion selective membranes are fragile. To avoid serious damage to the sensor, be certain to: (1) Use only moist, high quality lens cleaning tissue for the cleaning procedure (not paper towels or other coarse materials); and (2) Stroke the probe face very gently with the tissue during the procedure.

10-3.6. Optical Probes

The optical probes require only minimal maintenance. After each deployment, the optical surface on the tip of the turbidity probe should be inspected for fouling and cleaned if necessary by gently wiping the probe face with moist lens cleaning paper. In addition, it is recommended to replace the wiper and/or wiper pad periodically. The frequency of this replacement depends on the quality of

water under examination. A replacement wiper is supplied with the probes, along with the small hex driver required for its removal and reinstallation. Follow the instructions supplied with the probe to ensure proper installation of the new wiper assembly. Additional wipers and pads are available from YSI.

10-4. Short-term Storage

Proper storage of a sonde between periods of usage will not only extend the life of the sensors, but will also ensure that the unit will be ready to use as quickly as possible in your next deployment. The key for short-term storage is to use a minimal amount of water so that the air in the chamber remains at 100% humidity. No matter what sensors are installed in the instrument, it is important to keep them moist without actually immersing them in liquid. Complete immersion in liquid could cause drift or result in a shorter lifetime of a sensor.

Place approximately 1/2 inch of water in the calibration and/or storage cup that was supplied with the instrument and place the ADV6600 with all of the probes installed into the cup. The use of a moist sponge instead of water is also acceptable, as long as its presence does not compromise the attachment of the calibration cup to the ADV6600. The calibration cup should be sealed to prevent evaporation. Any type of water can be used: Distilled, deionized, or tap water. If the storage water is inadvertently lost during field sampling studies, environmental water can be used temporarily to provide the humidity. **Be sure to check the vessel periodically to make certain that water is still present.**

10-5. Long-term Storage

10-5.1. ADV6600

Because batteries can degrade over time and release battery fluid, it is extremely important to remove the batteries from the ADV6600 prior to long term storage. Failure to remove batteries can result in corrosive damage to the battery terminals if the batteries happen to leak.

10-5.2. ADV

No special precautions are required. Sensor can be stored dry or wet, as long as solutions in contact with the probe are not corrosive (for example, chlorine bleach). Care must be taken not to point-impact the transducers (i.e. do NOT use ADV probe arms as a stand for the ADV6600). Also, care must be taken to avoid bending or otherwise changing the angle of attack of the transducers as this can result in leakage and/or changes in calibration (requiring the probe to be sent back to the factory).

10-5.3. Temperature Probe

No special precautions are required. Sensor can be stored dry or wet, as long as solutions in contact with the probe are not corrosive (for example, chlorine bleach).

10-5.4. Conductivity Probe

No special precautions are required. Sensor can be stored dry or wet, as long as solutions in contact with probe and conductivity electrodes are not corrosive (for example, chlorine bleach). However, it is recommended that the sensor be cleaned with the provided brush prior to long term storage.

10-5.5. DO Probe

Rapid Pulse dissolved oxygen sensors should always be stored with a membrane and electrolyte in place and in such a way that the drying out of the electrolyte on the probe face is minimized. For long-term storage, the medium should be water rather than the moist air used in interim storage. Two long-term storage methods are equally acceptable:

1. Remove all probes other than dissolved oxygen, conductivity, ADV, and temperature from the ADV6600 and seal the vacant ports with the provided port plugs. Leave the electrolyte and membrane in place on the dissolved oxygen sensor. Fill the calibration cup with water (tap, deionized, or distilled are equally acceptable) and insert the sonde. Make certain the water level is high enough to completely cover the DO sensor. Seal the vessel to prevent evaporation of the water. At the end of the storage time, remove the existing membrane and replace it using new electrolyte.
2. Remove the dissolved oxygen sensor from the ADV6600 leaving the electrolyte and membrane in place. Store the probes in water (tap, deionized, or distilled are equally acceptable) in a beaker, flask, or other vessel of the user's choice. **Be sure not to damage the membrane or the probe tip when placing the probe on the bottom of the vessel.** If possible cover the vessel with parafilm or plastic wrap to minimize evaporation of the water during long-term storage. Monitor the water level in the storage vessel periodically and replenish if loss due to evaporation occurs. At the end of the storage time, remove the existing membrane and replace it with a new one.

10-5.6. pH and ORP Probes

Remove the probe from the ADV6600 and seal the vacant port with the provided plug. Place the probe in the storage vessel (plastic boot or bottle), which was in place on delivery, with a solution of two molar (2M) potassium chloride (KCl). Make certain that the vessel is sealed to prevent evaporation of the storage solution.

The key to pH probe storage, short or long-term, is to make certain that the reference electrode junction does not dry out. Junctions that have been allowed to dry out due to improper storage procedures can usually be re-hydrated by soaking the sensor for several hours (overnight is recommended) in a solution of two molar (2M) potassium chloride (KCl). If potassium chloride solution is not available, soaking the sensor in tap water or commercial pH buffers may restore probe function. However in some cases the sensor may have been irreparably damaged by the dehydration and will require replacement. It is also important to remember not to store the pH sensor in distilled or deionized water as the glass sensor may be damaged by exposure to this medium.

10-5.7. ISE Probes

The active element in the ammonium and nitrate ion selective electrode (ISE) sensors is a polyvinyl chloride (PVC) membrane that is impregnated with the reagent that provides specificity for either ammonium or nitrate. The useful life of the sensor will be reduced if the probe is stored in water. For long periods of time, storage in dry air is recommended. Remove the probe from the ADV6600 and cover the vacant port with the provided plug. Place the sensor back in the storage boot that was provided, and set aside in room air.

The chloride ISE sensor utilizes a solid state membrane that provides specificity. For long-term storage, the module should be removed from the ADV6600, wiped clean with moist lens cleaning tissue, and placed in its storage boot to prevent abrasion.

10-5.8. Optical Probes

No special precautions are necessary for long-term storage of the chlorophyll, rhodamine WT, and turbidity probes. However, the user may wish to remove the probe from the ADV6600, replace it with a port plug, and store the probe in dry air to minimize any cosmetic degradation of the probe body and to maximize the life of the wiper.

Section 11. Troubleshooting

This section contains troubleshooting information that will be helpful to identify the causes of the most common difficulties that may occur while operating the ADV6600.

11-1. Calibration Errors

There are only three possible calibration error messages, two of which may be related to sensor performance.

11-1.1. High DO Charge

This message indicates a malfunction in the DO sensor that is generally due deposits or tarnishing of the electrode surface. The charge associated with the DO sensor must be in the range **25 to 100** or the error message will appear when calibration is attempted.

If this error message is encountered, remove the membrane from the DO probe from the ADV6600 and resurface it according to the instructions in Section 10 Care, Maintenance and Storage. After resurfacing the probe, confirm that the DO charge value is within the acceptable range. Allow the sensor to pulse in the Run mode for at least 5 minutes, during which time the DO charge may be expected to drop in value if the sensor is still functional. If resurfacing does not result in a lowering of the charge, contact YSI Technical Support (Section 13 for additional help).

11-1.2. Out of Range

This message indicates the output of the sensor being calibrated does not conform to the normal range for this parameter. This problem could be due to either a malfunctioning sensor or to a calibration solution that is out of specification. If this error message is encountered, first ensure that your calibration standards for pH, ORP, ammonium, nitrate, chloride, conductivity, rhodamine, chlorophyll and turbidity have not been contaminated and that your DO sensor is in air (DO % Cal) or in a solution of known dissolved oxygen concentration (DO mg/L). Also be certain that you have entered the correct value for the calibration solution. If the calibration error message continues to occur, contact YSI Technical Support (Section 13 to determine whether the sensor in question needs to be factory-serviced or replaced).

11-1.3. Illegal Entry

This message indicates that your keyboard input does not conform to the accepted format for this parameter. For example, you may have entered the letter "O" instead of a numerical "0" for a calibration value. Return to the desired parameter in the Calibrate menu and repeat the calibration entry, being certain to enter only numbers.

11-2. Communication Problems

11-2.1. Cannot Communicate With ADV6600

In the event you are unable to establish communication with the ADV6600, the following list may be helpful in resolving the problem:

- Make sure that all cables are securely connected and locking sleeves are installed. Check pins at both ends. Ensure they are straight, dry and clean
- If you are using internal battery power, change to new batteries.
- If you are using external power, make certain that the YSI 6651 power supply is operating properly. Note that the YSI 6038 power supply which is used with other YSI 6-series products CANNOT be used with the ADV6600.
- Verify the computer serial port is functioning correctly. If possible, switch to another com port or try using a different computer.
- Verify the baud rate, serial port, and other communication parameters are set up correctly.

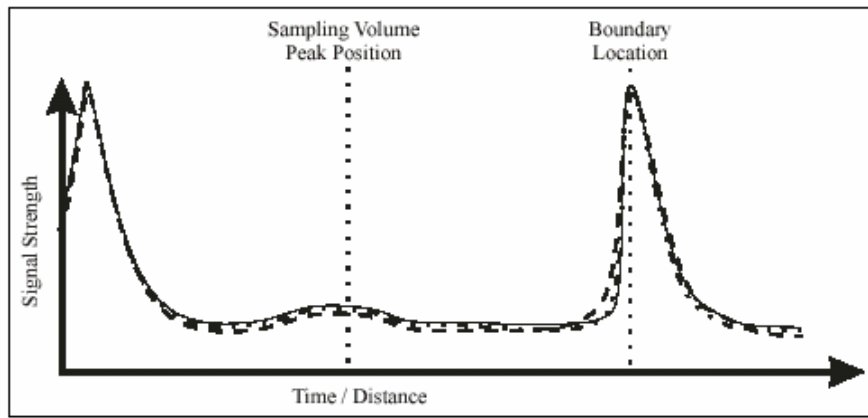
11-2.2. Data Missing From Unattended Deployment

The ADV6600 internal recorder was designed for extremely high reliability; recorder failures are very rare. Most data losses that occur are due to absence of power to the ADV6600 system. If you have a deployment that appears to be missing data, look at the battery voltage recorded with each sample. Check that these values are reasonable based on the type of power supply used, the sensors enabled, and the length of the deployment. If you cannot determine what happened, please contact YSI Technical Support (Section 11).

11-3. ADV Performance Problems

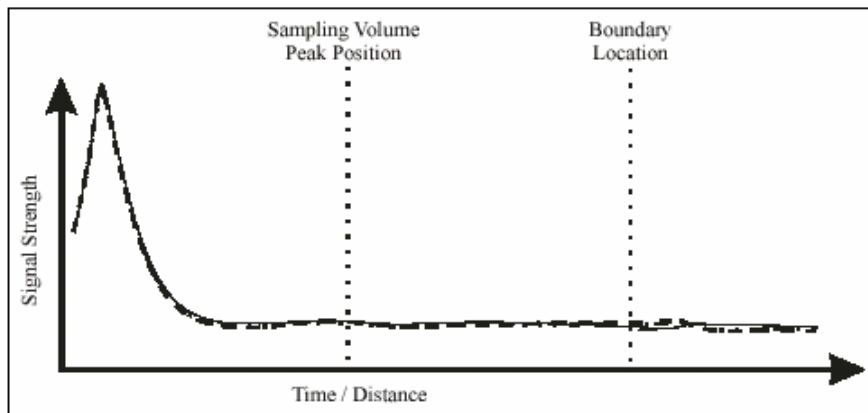
11-3.1. Beam Check Data Output

Beam Check can be used to detect almost any problem that can occur with the ADV sensor of the ADV6600. This section describes the program output for some of the most common situations.



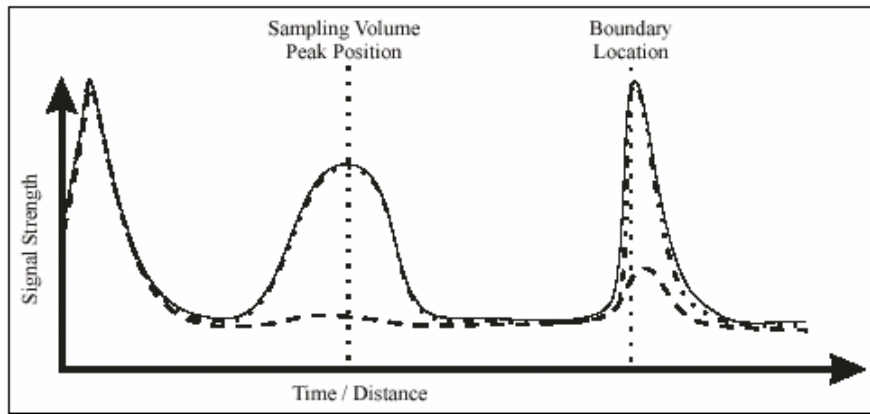
Low scattering strength

If there is insufficient scattering material (e.g., very clear water), the sampling volume peak will be small or non-existent. This situation can be confused with a malfunctioning transmitter unless the boundary is in view.



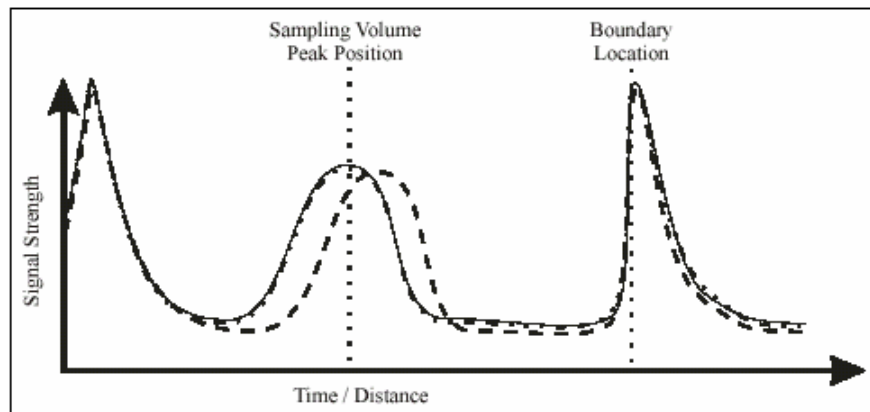
Malfunctioning transmitter

This appears as a flat response with signal strength at the normal noise level. This can be confused with a disconnected probe or low scattering levels. Note the absence of a boundary reflection to distinguish this from low scattering levels.



Malfunctioning receiver(s)

The signal from each receiver should have about the same strength at the sampling volume location. If the differences exceed 10 to 20 counts, try the following: (1) Clean each transducer, and (2) Make sure the beams are not physically blocked (i.e. biological growth or and air bubble being entrapped).

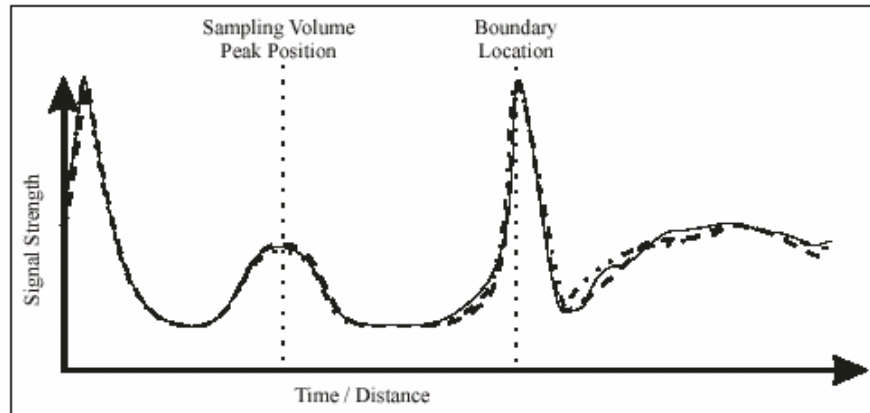


Damaged receiver arm

If the sampling volume in one receiver is offset along the horizontal axis, the receiver arm has been bent. Often, bent probes can be repaired quickly at the factory by unbending the arm and recalibrating the probe (this procedure MUST be done at the factory).

Excessive Noise

If the electronics noise level is more than 10 counts above its normal level (60-70 counts), it may be a sign that something is wrong with the sensor or installed environment. The noise level may also be higher than normal because of external electromagnetic interference, or because water has condensed on the receiver electronics. Coil any extra probe cable to minimize the noise.



High signal strength past the boundary

If the signal strength does not fall off rapidly past the boundary, the additional acoustic noise can potentially increase the noise in velocity measurements. This additional acoustic noise is most commonly seen in small tanks, particularly those made of acrylic or glass. To improve the readings, cover the boundary with a piece of cloth, a rubber mat, or a sheet of acoustic-absorbing material.

11-3.2. Noisy Velocity Data

If the velocity data from the ADV6600 does not appear reasonable, the following list may be helpful in establishing the source of the problem.

- Verify there is enough scattering material in the water. If necessary, seeding material can be introduced to increase signal strength. See Section 11.3.3 below
- Run a diagnostic check on the ADV as described in Section 5. This will address all aspects of ADV operation, especially interference, signal strength (scattering/seeding issues) and probe operation.
- Verify the velocity range setting is appropriate for the operating environment.
- Verify the probe is not fouled with debris.
- Verify the ADV6600 mounting is stable and that instrument motion is not causing noise in the velocity data.
- Look at the compass/tilt sensor data (if installed). Look for large tilt values or how compass/tilt data changes with time to see if the instrumentation has moved.

Section 11. Troubleshooting

- Be certain the sampling volume of the instrument is sufficiently spaced from boundary and that there is nothing blocking or partially blocking one or more acoustic beams.
- Consider any possible influences of the deployment environment; particularly flow interference from nearby underwater structures.
- Consider the orientation of the probe with respect to the flow direction to be sure the probe is not causing flow interference in the sampling.

11-3.3. Seeding for Scattering Environments

In most applications, there is sufficient scattering material naturally present for ADV operation. However, if the velocity data appears “noisy”, a lack of scattering material in the water may be the cause. This can be confirmed by running the Beam Check portion of the ADVantage 6600 software. The data can be recorded to a file and sent to YSI Customer Support for further interpretation and comment.

An ideal seeding material should have the following qualities:

- Neutrally buoyant (to remain in suspension for a long period of time).
- Mean particle diameter of 10-20 μm (for peak sensitivity of the acoustic signal).
- Inexpensive, readily available, with no adverse effects on the sampling environment.

The best seeding material we have located (from an acoustics point of view) are hollow glass spheres with a mean diameter of approximately 10 μm and a mean density close to that of water. Quantities can be purchased from the manufacturer at the address below:

Potters Industries Phone: (610) 651-4700
Valley Forge, PA USA Internet: www.pottersbeads.com
Part name: Potters Spherical

For most applications, a more practical seeding material is lime or pulverized limestone (the chalk commonly used on athletic fields). Large bags are inexpensive and readily available from most hardware stores. While not perfect, the acoustic performance is sufficient for most applications.

Caution: repeated addition will gradually increase the pH in a sample.

11-4. Water Quality Sensor Problems

The following table provides information on problems you may have with 6600 sensors and actions that may be taken to cure the problem. The **REF** column lists sections in this manual where additional relevant information may be found.

Section 11. Troubleshooting

SYMPTOM	POSSIBLE CAUSE	ACTION	REF
Dissolved Oxygen reading unstable or inaccurate	Probe not properly calibrated	Follow DO cal procedures	
	Membrane not properly installed or may be punctured	Follow 6562 setup procedure	
	DO probe electrodes require cleaning	Follow DO cleaning procedure. Use 6035 maintenance kit	
	Water in probe connector	Dry connector; reinstall probe	
	Algae or other contaminant clinging to DO probe	Rinse DO probe with clean water	
	Barometric pressure entry is incorrect	Repeat DO cal procedure	
	Cal at extreme temperature	Recalibrate at (or near) sample temperature	
	DO Charge too high (>100) 1. Anodes polarized (tarnished) 2. Probe left on continuously	Enable DO charge parameter in the Sonde report menu. Run sonde, if charge is over 100, recondition probe with 6035 Maintenance Kit. Follow DO cleaning procedure.	
	DO Charge too low (<25) Insufficient electrolyte.	Replace electrolyte and membrane.	
	DO probe has been damaged	Replace 6562 probe	
Internal failure	Return sonde for service		

pH, ORP, Chloride, Ammonium, or Nitrate readings are unstable or inaccurate. Error messages appear during calibration.	Probe requires cleaning,	Follow probe cleaning procedure	
	Probe requires calibration	Follow cal procedures	
	pH probe reference junction has dried out from improper storage.	Soak probe in tap water or buffer until readings become stable	
	Water in probe connector	Dry connector; reinstall probe	
	Probe has been damaged	Replace probe	
	Calibration solutions out of spec or contaminated with other solution	Use new calibration solutions	
	ORP fails Zobell check	Take into account temperature dependence of Zobell solution readings	
	Internal failure	Return sonde for service	

Section 11. Troubleshooting

SYMPTOM	POSSIBLE CAUSE	ACTION	REF
Conductivity unstable or inaccurate. Error messages appear during calibration.	Conductivity improperly calibrated.	Follow cal procedure	
	Conductivity probe requires cleaning	Follow cleaning procedure	
	Conductivity probe damaged	Replace probe	
	Calibration solution out of spec or contaminated	Use new calibration solution	
	Internal failure	Return sonde for service	
	Calibration solution or sample does not cover entire sensor.	Immerse sensor fully.	

Installed probe has no reading	The sensor has been disabled	Enable sensor	
	Water in probe connector	Dry connector; reinstall probe	
	Probe has been damaged	Replace the 6560 probe	
	Report output improperly set up	Set up report output	
	Internal failure	Return sonde for service.	

Temperature, unstable or inaccurate	Water in connector	Dry connector; reinstall probe	
	Probe has been damaged	Replace the 6560 probe	

Turbidity probe unstable or inaccurate. Error messages appear during calibration	Probe requires cleaning or maintenance	Follow probe cleaning and maintenance procedures	
	Probe requires calibration	Follow cal procedures	
	Probe has been damaged	Replace probe	
	Water in probe connector	Dry connector; reinstall probe	
	Calibration solutions out of spec	Use new calibration solutions	
	Wiper is not turning or is not synchronized.	Activate wiper. Assure rotation. Make sure setscrew is tight.	
	Wiper is fouled or damaged.	Clean or replace wiper.	
	Internal failure.	Return probe for service.	

Section 12. Warranty and Service Information

Thank you for purchasing a YSI ADV6600. This instrument was thoroughly tested at the factory and found to be in excellent working condition. If the shipping crate appears damaged, or if the system is not operating properly, please contact YSI immediately.

In case your system is not functioning properly, first try to identify the source of the problem (see the appropriate section of the manual for operational and troubleshooting advice). If additional support is required, we encourage you to contact us immediately. If a problem is detected, we will work to resolve the problem as quickly as possible. Many problems may be resolved without a system being returned for service.

12-1. Warranty

The ADV6600 sonde is warranted for one year against defects in workmanship and materials when used for its intended purpose and maintained according to instructions. All cables are warranted for one year. The ADV, dissolved oxygen, temperature/conductivity, turbidity, chlorophyll, rhodamine WT, pH, pH/ORP, and chloride probes are warranted for one year. Ammonium and nitrate probes are warranted for six months. Damage due to accidents, misuse, tampering, or failure to perform prescribed maintenance is not covered. The warranty period for chemicals and reagents is determined by the expiration date printed on their labels. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the YSI Authorized Service Center of choice. Repair or replacement will be made and the product returned transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

12-2. Limitation of Warranty

This Warranty does not apply to any YSI product damage or failure caused by: (i) failure to install, operate or use the product in accordance with YSI's written instructions; (ii) abuse or misuse of the product; (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure; (iv) any improper repairs to the product; (v) use by you of defective or improper components or parts in servicing or repairing the product; or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI's LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND

EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

12-3. Authorized Service Center

Please send all instrumentation for repair to:

YSI Repair Center
1725 Brannum Lane
Yellow Springs, Ohio 45387
Phone: (937) 767-7241
E-Mail: environmental@ysi.com

12-4. Cleaning Instructions

Before they can be serviced, equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected. Biological contamination is presumed for any instrument, probe, or other device that has been used with body fluids or tissues, or with wastewater. Radioactive contamination is presumed for any instrument, probe or other device that has been used near any radioactive source.

If an instrument, probe, or other part is returned or presented for service without the Cleaning Certificate portion of the Product Return Form completed, and if in our opinion it represents a potential biological or radioactive hazard, our service personnel reserve the right to withhold service until appropriate cleaning, decontamination, and certification has been completed. We will contact the sender for instructions as to the disposition of the equipment. Disposition costs will be the responsibility of the sender.

When service is required, either at the user's facility or at YSI, the following steps must be taken to insure the safety of our service personnel.

- ☞ In a manner appropriate to each device, decontaminate all exposed surfaces, including any containers. 70% isopropyl alcohol or a solution of 1/4-cup bleach to 1-gallon tap water is suitable for most disinfecting. Instruments used with wastewater may be disinfected with .5% Lysol if this is more convenient to the user.
- ☞ The user shall take normal precautions to prevent radioactive contamination and must use appropriate decontamination procedures should exposure occur.

- ☞ If exposure has occurred, the customer must certify that decontamination has been accomplished and that no radioactivity is detectable by survey equipment. Cleaning must be certified on any product before returning it to YSI.

12-5. Packing Instructions and Product Return Form

Any system being returned for service must be shipped back in its original shipping container using original packing material and all delivery cost to YSI covered by the customer (including all taxes and duties). If the system is returned without appropriate packaging, the customer will be required to cover the cost of a new packaging crate and material.

- ☞ Clean and decontaminate items to insure the safety of the handler.
- ☞ Complete and include the Product Return Form found on the following page.
- ☞ Place the product in a plastic bag to keep out dirt and packing material.
- ☞ Use a large carton, preferably the original, and surround the product completely with packing material.
- ☞ Insure for the replacement value of the product.



Customer Information

Organization _____

Contact Name _____

Phone Number _____

Country _____

RA Number _____

YSI Customer Number _____

Fax Number _____

Date Shipped _____

Reason for Return / Description of Problem

Method of Payment (Please Check One)

- COD
- Prepayment
- Purchase Order
Number _____
- Visa/MasterCard/American Express
Name _____
Number _____
Expiration Date _____

Shipping Address

Company _____

Address _____

City, State, Zip _____

Cleaning Certificate

Model Number _____

Lot/Serial Number _____

Contaminant(s) (if known):

Cleaning Agent(s) Used:

Radioactive Decontamination Certified

- Yes (use only if product has been
- No exposed to radiation)

Cleaning Certified By:

Name _____

Date _____

Billing Address

Company _____

Address _____



City, State, Zip _____

Country _____

Section 13. Additional Support

YSI Environmental offers a wide range of customer assistance and technical support functions to ensure that you have the information required to purchase and use our products.

Contact YSI's Technical Support Team if you need assistance or have questions regarding any YSI Environmental Product. This team provides information concerning product quotes, sales, product application, and product repair support. Business hours are Monday through Friday, 8AM to 5PM, Eastern Standard Time.

Phone: 800-897-4151 or 937-767-7241

Fax: 937-767-1058

E-Mail: environmental@ysi.com

World Wide Web: <http://www.ysi.com>

Appendix A. Accessories and Calibration Standards

A-1. Probes and Probe Replacement Parts

YSI Model Number	Description
6560	Conductivity/Temperature Probe
6562	Rapid Pulse DO Probe
6561	pH Probe
6565	Combination pH/ORP Probe
6882	Chloride Probe
6883	Ammonium Probe
6884	Nitrate Probe
6025	Chlorophyll Probe, wiped
6130	Rhodamine WT Probe, wiped
6136	Turbidity Probe, wiped
6624	Chlorophyll/Rhodamine WT Wiper Kit
6627	Turbidity Wiper Kit for 6136
6144	Optical Wiper Pad Kit
6035	Probe Reconditioning Kit for 6562 Dissolved Oxygen Probe
5775	DO Membrane Kit

A-2. Optional Accessories and Replacement Parts

YSI Model Number	Description
655423	Probe Installation Tool
6570	Maintenance Kit (contains: syringe, probe installation tool, conductivity tube brush, o-ring lubricant, o-rings for
655453	Calibration Cup Assembly
655503	Gasket, Calibration Cup
655504	Calibration Clamp
655505	Calibration Clamp Holder
065840	Port Plug, Standard Port, Cond./Temp., DO, pH (Requires 065807)
065807	O-Ring, Standard Port, Cond./Temp., DO, pH (Requires 065840)
065839	Port Plug Assembly, Standard Port, Cond./Temp., DO, pH (Includes both 065807 and 065840)
063636	Port Plug, ISE Port (Requires 062768)
062768	O-Ring, ISE Port (Requires 063636)
062646	Port Plug, Optical Port (Requires 062749)
062749	O-Ring, Optical Port (Requires 062646)
062698	Port Plug Assembly, Optical Port (Includes both 062646 and 062749)
SO6048-08142	Pressure Cap/Dummy Plug Assembly (for cable connection on sonde)
SO6035-04012	Battery Lid Assembly
SO6035-04013	O-ring Kit for ADV6600 Battery Lid Assembly
6658	Deployment Clamp Kit (2 Clamps)
6650	Spare Deployment Clamp
655443	Probe Guard
6651	12 VDC Power Supply with 90 to 264 VAC input
SO6045-04066	RS-232/SDI-12 Switch Cover
6655	Storage/Carrying Case, Soft Sided
6657	Storage/Carrying/Shipping Case, Hard Sided
655507	Operations Manual

Appendix A. Accessories and Calibration Standards

YSI Model Number	Description
6656	ADVantage 6600 Windows Software
6200	Data Acquisition System and Accessories Contact Endeco/YSI Massachusetts (800-363-3269) for options and ordering information.

A-3. Optional Accessories and Replacement Parts

YSI Model Number	Description
6652	3 m Field Cable
6653	10m Field Cable
6654	20m Field Cable
6661	30 m Field Cable
6662	40 m Field Cable
6663	50 m Field Cable
6664	60 m Field Cable
6095B	Field Cable to Female DB-9 (PC) Serial with Power Connector)
6096	Field Cable to Flying Lead (wire) adapter, 15 ft. (5m)
6111	Field Cable to Female DB-9 (PC) and Flying Lead (wire) adapter 2 ft. (0.6m)
6103	MS-8 Dust Cover (caps connector when not in use)

A-4. Reagents

YSI Model Number	Description
3161	Conductivity Calibrator Solution, 1,000 $\mu\text{S}/\text{cm}$ (quart)
3163	Conductivity Calibrator Solution, 10,000 $\mu\text{S}/\text{cm}$ (quart)
3165	Conductivity Calibrator Solution, 100,000 $\mu\text{S}/\text{cm}$ (quart)
3167	Conductivity Calibrator Solution, 1,000 $\mu\text{S}/\text{cm}$ (box of 8 pints)
3168	Conductivity Calibrator Solution, 10,000 $\mu\text{S}/\text{cm}$ (box of 8 pints)
3169	Conductivity Calibrator Solution, 50,000 $\mu\text{S}/\text{cm}$ (box of 8 pints)
3821	pH 4 Buffer (box of 6 pints)
3822	pH 7 Buffer (box of 6 pints)
3823	pH 10 Buffer (box of 6 pints)
3682	Zobell Solution, ORP Calibrator (125 mL)
3841	1 mg/L Ammonium-Nitrogen Standard Solution (500 mL)
3842	10 mg/L Ammonium-Nitrogen Standard Solution (500 mL)
3843	100 mg/L Ammonium-Nitrogen Standard Solution (500 mL)
3885	1 mg/L Nitrate Standard Solution (500 mL)
3886	10 mg/L Nitrate Standard Solution (500 mL)
3887	100 mg/L Nitrate Standard Solution (500 mL)
3845	0 NTU Turbidity Standard (1 liter)
6080	0 NTU Turbidity Standard (1 gallon)
6072	10 NTU Turbidity Standard (1 gallon)
6073	100 NTU Turbidity Standard (500 mL)
6073G	100 NTU Turbidity Standard (1 gallon)
6074	800 NTU Turbidity Standard (1 gallon)

Appendix B. Specifications

Sensor	Range	Resolution	Accuracy
Velocity	±0.001 to 6 m/s (±0.003 to 19 ft/s)	0.01 m/s	± 1% of measured velocity, ± 0.001 m/s
Non-Vented Pressure	10m, 30m, 50m	0.025% Full Scale	± 0.25 % Full Scale
Temperature	-5 to 45 °C	0.01 °C	± 0.15 °C
Dissolved Oxygen, % Saturation	0 to 500 % air saturation	0.1 % air saturation	0-200 % air saturation, ± 2 % of the reading or 2 % air saturation, whichever is greater 200-500 % air saturation, ± 6 % of reading
Dissolved Oxygen, mg/L	0 to 50 mg/L	0.01 mg/L	0 to 20 mg/L, ± 2 % of the reading or 0.2 mg/L, whichever is greater 20 to 50 mg/L, ± 6 % of the reading
Conductivity*	0 to 100 mS/cm	0.001 mS/cm to 0.1 mS/cm (range dependent)	± 0.5% of reading + 0.001 mS/cm
Salinity	0 to 70 ppt	0.01 ppt	± 1% of reading or 0.1 ppt, whichever is greater
pH	0 to 14 units	0.01 units	± 0.2 units
ORP	-999 to +999 mV	0.1 mV	± 20 mV
Turbidity	0 to 1000 NTU	0.1 NTU	± 5% reading or 2 NTU (whichever is greater), relative to calibration standards
Chlorophyll	0 to 400 µg/L Chl; 0-100 % Full Scale	0.1 µg/L Chl; 0.1 % FS	No specification provided

* Report outputs of specific conductance (conductivity corrected to 25 C), resistivity, and total dissolved solids are also provided. These values are automatically calculated from conductivity according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (Ed 1989).

Appendix B. Specifications

Sensor	Range	Resolution	Accuracy
Rhodamine WT	0 to 200 µg/L as true dye; 1,000 µg/L as dye tracer	0.1 µg/L	± 5 % of the reading or 1 ug/L, whichever is greater
Nitrate-Nitrogen	0-200 mg/L-N	0.001 mg/L-N to 1 mg/L-N, range dependent	± 10% of reading or 2 mg/L, whichever is greater
Ammonium/ Ammonia- Nitrogen	0-200 mg/L-N	0.001 mg/L-N to 1 mg/L-N, range dependent	± 10% of reading or 2 mg/L, whichever is greater
Chloride	0-1000 mg/L	0.001 mg/L to 1 mg/L, range dependent	± 15% of reading or 5 mg/L, whichever is greater

ADV Sampling Volume: ~ 0.25cc located ~ 6.8 cm from probe tip
Operating Medium: Fresh, sea or polluted water
Operating Temperature: -5 to +45 °C
Operating Depth: 0 to 200 feet (60 meters), sonde and all sensors except Nitrate, Ammonia, and Chloride which are 0 to 50 feet (15 meters)
Storage Temperature: -40 to +60 °C for sonde and all sensors except pH and pH/ORP
-20 to +60 °C for pH and pH/ORP sensors
Size: 4 in. diameter; 24.5 in. length (10.1cm x 62.5 cm)
Weight with Batteries and probe guard installed: 8.8 lb. (4.0 kg)
Power: 8 Standard Alkaline C-cells, 72Wh capacity, or External 12-15 VDC
Power Consumption: 0.92 W (continuous operation); 0.001 W (standby)
Battery Life At least 30 days for the following conditions: 1 min averaging interval; 15 min sample interval; 20 C; all water quality sensors active
Computer Interface: RS-232, SDI-12
Internal Memory: 4 Mb
Software: IBM Compatible PC with Pentium processor or above
Windows® 98, NT, 2000, ME, or XP
32 MB memory
5 MB available disk space
CD-ROM Drive
RS-232 Serial Port
Monitor capable of 800 x 600 resolution or better

Appendix C. Required Notice

The Federal Communications Commission defines this product as a computing device and requires the following notice.

This equipment generates and uses radio frequency energy and if not installed and used properly, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class A or Class B computing device in accordance with the specification in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna
- Relocate the computer with respect to the receiver
- Move the computer away from the receiver
- Plug the computer into a different outlet so that the computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet, prepared by the Federal Communications Commission, helpful: "How to Identify and Resolve Radio-TV Interference Problems". This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock No.0004-000-00345-4.

Appendix D. Frequently Asked Questions

D-1. System Description and General Questions

Can you give me a brief description of the ADV6600?

Basically, the ADV6600 water quality monitor is the marriage of two instruments – SonTek’s Argonaut Acoustic Doppler Velocimeter (ADV), which measures water velocity (speed and direction) and YSI’s 6-series of sondes, which measure water quality.

The appearance of the ADV6600 is similar to other YSI 6-series sondes. Additionally, both the 6-series sondes and Doppler sensor function in a similar fashion to that of their “parent” instruments.

Along with the ADV sensor, the sonde can be equipped with conductivity/temperature, dissolved oxygen, pH, pH/ORP, two optical sensors (turbidity, chlorophyll, and rhodamine WT), and two ion selective electrodes (ammonium, nitrate, and chloride). The unit uses the same water quality probes as the current 6-series sondes from YSI. Sensors from other 6-series sondes may be swapped with those on the ADV6600. The ADV sensor is not removable and cannot be attached to other sondes.

A non-vented pressure (depth) sensor is available as an option with the instrument, and is available in three sensor ranges (Shallow Water: 0-10 m, Mid-Depth: 0-30 m, and Deep-Water: 0-50 m).

What are the advantages of the ADV6600?

The ADV6600 allows the simultaneous measurement and recording of water velocity and water quality parameters.

Having the water velocity and quality seamlessly integrated has the following key benefits.

- The data for all parameters is stored in a single data file.
- There are no integration issues with the single combined system.
- All parameters are recorded at the same time, rate, and from similar locations.
- The user is able to easily correlate changes in water quality parameters with the movement of water.
- The ADV6600 is compact and lightweight.
- The power consumption of the ADV6600 is low, allowing for extended deployments from the onboard power source.

Is it possible to get the ADV6600 in an “EDS” configuration where the dissolved oxygen membrane is mechanically cleaned by a brush attached to the turbidity sensor?

No. In the released configuration of the ADV6600, the EDS wiper arm would impact the ADV stem, preventing the wiper from making a complete rotation.

Will the ADV6600 have CE certification?

No. At release, the instrument will not bear the CE sticker. In the future, changes may be made to the internal circuitry to allow the instrument to meet CE requirements.

I know that the ADV6600 can be purchased with a pressure sensor. Does the system software convert this data into water depth or level (accounting for barometric pressure, temperature, and conductivity)?

No. At release, the only output will be in pressure units such as psi or dbar and the system is not designed for long-term deployments that require a high level of depth or level accuracy. Further, the pressure sensor cannot be vented to automatically remove the effects of barometric pressure changes on the overall reading. Although the pressure sensor can measure even slight changes in water level, the data is not automatically corrected for offsets due to barometric, temperature, or conductivity. Users may choose to export the pressure data to an Excel spreadsheet and manually compensate for temperature, conductivity, and atmospheric pressure changes to allow for an accurate reading of the water level (given that the necessary information is available).

What battery life can I expect from the ADV6600?

The 8 alkaline C cells will provide approximately 30 days of operational time with all water quality sensors active while taking a 1-minute measurement every 15 minutes (i.e., averaging interval = 1 minute, sampling interval = 15 minutes). Using longer sampling intervals will extend battery life (but not at a rate that is directly proportional to the difference in sampling interval). Using the same one minute averaging interval as above, YSI predicts a battery life of approximately 50 and 80 days at 30-minute and 60-minute sampling intervals, respectively. Battery life will also be extended significantly if only one optical probe is utilized.

Appendix D. Frequently Asked Questions

Can I use my existing YSI and/or SonTek field cables when communicating with the ADV6600?

No. The ADV6600 is a hybrid instrument and requires a hybrid cable. You must purchase new field cables for the ADV6600 from YSI. These cables are issued in three standard lengths (3 m, 10 m, and 20 m) or are available in greater lengths on request. The ADV6600 interface cable ends in an MS-8 connector so that all YSI cable adapters are compatible and can be used.

How will I communicate with the ADV6600 to set it up for field studies and download data?

Communicating with the ADV6600 is done through our ADVantage 6600 Windows-based software which is provided as a standard item with each ADV6600 sonde. The ADVantage 6600 program allows you to set up the instrument, run diagnostics, and use the powerful data analysis capability similar to that found in our EcoWatch for Windows software.

Can I interact with the ADV6600 using a YSI 650 handheld display?

No. At release, you will be required to interface with the ADV6600 via a laptop or desktop computer running Windows 98 or later. There are presently no plans to allow the users to interface to the ADV6600 using a YSI 650. However, it is likely that software will be available in the future that will allow an interface with handheld, Pocket PC devices. Users should also be aware of the present availability of field rugged, watertight laptop PCs such as the Panasonic ToughBook™ that are ideal for field interface to the ADV6600.

Will the ADV6600 output data for my water quality sensors and the ADV sensor separately?

The ADV6600 is designed to concurrently collect data from both the water quality and the ADV sensors. Although the system can be configured to collect data from only one of these two sensor packages, the memory within the ADV6600 is large enough to log data from both the water quality and ADV sensors for most studies. Note that, if the user wants to view data from only one of the sensor packages, the ADVantage 6600 program can be used to extract selected sensor data from the reports, plots, and export format.

D-2. What does the system measure?

What is the difference between velocity and speed?

Speed is the distance traveled by an object (such as a suspended particulate in water moving down a river) divided by the time it took to cover that distance. Velocity is the measurement of how fast this same object is going, but also includes the direction the particulate is traveling. In other words, there is a directional component for velocity but not for speed.

As mentioned above, the ADV6600 measures the velocity of particles in the water. However, the user may also elect to display speed and direction separately if these parameters are preferred.

What is the difference between velocity and flow?

For water, *velocity* (as described above) is the speed and direction of travel. *Flow* is the volume or quantity of water divided by the time it took for the volume to pass a specific point. Flow is sometimes referred to as flux and can be computed as the mean velocity multiplied by the area the water is moving through.

Therefore, water velocity is measured in meters per second (m/s; a speed unit). The water flow is measured in cubic meters per second (m³/s; a volume and speed unit).

How does the ADV sensor measure the velocity of water?

Doppler current meters, such as the ADV sensor in the ADV6600, do not measure movement of water, but actually the movement of particles or “scatterers” (such as suspended sediment, biological matter, or bubbles) in the water. It is assumed that the movement of the particles in the water is representative of the movement of the water itself, and this assumption turns out to be valid in virtually all cases.

Acoustic pulses transmitted from the ADV sensor impact these particles and, using a physical principle known as the Doppler Shift, reflections of the Doppler radiation from the particles in the water column are used to determine the water velocity. The different orientation of each of the receivers (one on each arm of the ADV sensor) allows the system to calculate the velocity of the water in 3 dimensions.

Critical points on water velocity measurement:

Appendix D. Frequently Asked Questions

- The sensor **must** be totally submerged to successfully measure the water velocity. If the ADV sensor comes out of the water during a measurement, the ADV will collect invalid data even though there will be no damage to the system.
- The sensor measures the velocity at a distance approximately 6.8 cm in front of the sensor head. There must be no objects or boundaries (water surface, river bottom) blocking either the transmitter or receivers. Intermittent blockage of the transmitter/receivers can certainly occur in field or lab environments. This blockage can be caused by ropes, cables, weeds, or similar extraneous objects, moving back and forth in front of the ADV sensor and within the system's measurement area. Users should be aware that invalid or biased data will be collected during periods of blockage.

Since the acoustic energy from the ADV is reflected from particles in the water, will variations in the turbidity of the water cause inaccuracy in the velocity readings? Is there a minimum level of turbidity (or suspended particles) for the ADV sensor to function properly?

Doppler current meters will not work in a body of water where no particles (other than the water molecules themselves) are present. Fortunately, natural streams almost always have some sort of particulate matter present, even if it is just tiny air bubbles. Doppler technology is such that even a very small amount of particles in the water is enough for good measurements. As such, Doppler technology is almost certain to function properly at most environmental sites.

Because the scattering ability of particles is dependent not only on their number, but also on their shape, distribution, and type, YSI cannot give an exact turbidity value in NTUs that is a minimum requirement for acceptable Doppler performance. However, the “beam check” procedure (see later), which should be performed before the initial deployment of the ADV6600 at every site, will confirm that the water contains enough particles for acceptable Doppler measurements.

Will biological fouling of the Doppler emitter and receivers compromise performance?

Moderate fouling of the Doppler emitter and receivers will have no significant effect on the velocity data (other than flow disturbance that may be caused by such fouling). For sites where the fouling is extreme (e.g., estuarine applications where barnacles form readily), anti-fouling paint may be used on the ADV sensor without affecting the quality of velocity measurements. Note, however, that long algal or plant fragments which have been caught on the Doppler sensor arms during deployment and which can move back and forth into the beam path in a random motion will likely cause the velocity data to be grossly compromised.

D-3. Installing the System

How should I deploy my ADV6600 for long term monitoring studies of water current and quality?

An ADV6600 can collect valid velocity data when deployed using the following methods.

- Mounted directly to a vertical pole
- Mounted vertically in a PVC pipe that is attached to a pole, bridge abutment, or similar structure
- Deployed vertically using a rope or chain as a tether

There are, however, significant factors of which you need to be aware that will affect the quality and accuracy of the ADV data.

- Significant rotations of the system can create with the compass (described in the following section) that can temporarily compromise velocity measurements.
- There must be sufficient scatterers in the water so that accurate velocity measurements can be made (described in the preceding section). A Beam Check should be performed at all sites before a deployment, and is a must at sites where the water is very clear.
- There must be minimal magnetic interference to avoid influencing compass readings (see compass section). If possible, all mounting fixtures should be made of stainless steel, aluminum, or plastic. If the mounting fixture must contain magnetic (ferrous) material, it needs to be stationary in relation to the ADV6600, i.e., the interfering material and the ADV6600 should be attached to one another. A compass calibration and verification should be performed before each deployment at the site with the sonde in the mounting apparatus.
- The ADV sensor needs to be submerged to make accurate velocity measurements.
- Flow interference (caused by the mount, pilings, rocks, weeds, etc.) will affect velocity measurements. For this reason, deployment location must be considered carefully to be sure that the sampling area of the ADV is free from these disturbances for the entire deployment.
- The system can be deployed on the inside of a pipe but the Doppler sensor must be located below the bottom of the pipe at least as far as it extends below the probe guard (see picture in Section 5-1.2 above) for proper performance.
- It is important to select a deployment site that is representative of the flow that you are trying to measure. Environmental stability (i.e., not subject to massive changes in conditions) is preferable but not required.
- If data will be collected in the internal memory of the ADV6600 during an autonomous deployment, the recorder must be enabled.

A few examples of good deployment conditions are:

1. Mounting the ADV6600 to a rigid aluminum post or pole that has been sunk into the bottom of the water body with no ferrous objects nearby. The system will be submerged at all times.
2. Placing the ADV6600 in a piece of 6-inch PVC pipe that is suspended in the water with a weight on the bottom of the pipe to minimize movement. Remember that the Doppler sensor must extend below the bottom of the pipe.
3. Placing the ADV6600 in a piece of 6-inch PVC pipe that is mounted to a rigid post as in (1) above. Again, remember that the Doppler sensor must extend below the bottom of the pipe.

For any of the above common deployment methods, the sonde can either be logging to internal memory using on-board battery power or be logging to an on-site data collection platform (DCP) that is also supplying power to the ADV6600.

If the sonde rotates during a non-rigid deployment, won't the direction readings be meaningless?

Each ADV6600 is equipped with an internal compass that automatically compensates for rotation of the sonde during deployments. However significant and sharp changes in rotation can cause temporary inaccuracies in the measurement of the water velocity.

Some points to keep in mind regarding non-fixed deployments:

- The compass is sampled once per second, so rapid rotation of the system can yield inaccurate compass measurements, and therefore inaccurate velocity measurements.
- Rapid or abrupt movement of the system can cause inaccurate velocity measurements.
- Some slight regular oscillation is acceptable because this movement will be averaged out over the long term. Keep in mind that a longer averaging interval will help to reduce the effect of regular oscillations.
- Some rotation of the system will be averaged out over the entire averaging interval, helping to reduce any "noise" in the measurement.
- The variation in the three rotations (heading, pitch, and roll) is recorded to the system as Heading Standard Deviation, Pitch Standard Deviation, and Roll Standard Deviation, and can be used to determine how "active" the movement of the ADV6600 was during the deployment.

Can I deploy my ADV6600 by attaching it to a metal pole or mount, or by putting it in a pipe that is attached to a metal pole and still get accurate direction readings?

Ideally, the pole or mount should be non-ferrous/non-magnetic (i.e., aluminum, 316L stainless steel, or plastic) such that it will have no effect on the compass readings. If a magnetic (ferrous) material such as iron or steel pipe must be used, the ADV should be offset from the pole as much as possible to minimize magnetic interference from the support. If at all possible, a compass calibration also needs to be performed by rotating the entire ADV6600 and its mount so that compensation for the ferrous material can be maximized.

Does the ADV6600 have to be deployed vertically, or can it be placed on its side for a deployment?

The ADV6600 must be deployed vertically with the ADV sensor in the “down” position.

Do I need to clean or wash the ADV sensor before deployment?

It is good practice to clean the ADV sensor with water to remove any material that may have collected on either the transmitter or receivers. A Beam Check test will indicate whether cleaning of the ADV sensor is absolutely necessary.

After starting a logging study, can I calibrate sensors without stopping the study?

No. Unlike YSI 6-series products, the ADV6600 firmware automatically stops a logging study when interaction is established via a computer running ADVantage 6600 software. In practical terms, this means that all calibration must take place before starting a logging study.

D-4. Applications

For what applications can I use an ADV6600?

In general, the ADV6600 is designed for use in two types of applications:

1. Monitoring of current (water speed and direction) and water quality parameters with the instrument powered by batteries or a data collection platform with no user present.

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2. Spot sampling/profiling of these current and water quality parameters with the unit attached to a laptop computer and the user present at the site during measurements.

For both of these applications, the primary reason for the user to purchase an ADV6600 – rather than the SonTek Argonaut-ADV or YSI 6600 sondes individually – will be to correlate and combine water current and water quality parameter data.

Common monitoring applications include:

- Monitoring of streams with variable flow, where changes in the speed parameter as a function of environmental events (rainfall, etc.) are of primary interest.
- Monitoring of estuaries with reciprocal tidal flow, where changes in both speed and direction are of primary interest.
- Monitoring of the velocity of wastewater streams to determine flow paths.
- Correlation of time of travel (TOT) measurements using the YSI rhodamine WT sensor with stream velocity.
- Computer model verification of the movement of water and associated water quality parameters in an estuary or bay system.

Common spot sampling applications include:

- Short studies to determine general water characteristics of a given area before, during, or after a weather event.
- Computer model verification of the movement of water and associated quality parameters in an estuary or bay system.
- Spot sampling during construction or dredging activities in order to define impacts on the environment or to confirm compliance with standards.

I want to measure flow in a river. Is the ADV6600 the right instrument for me?

Probably not. The ADV6600 (like the SonTek Argonaut-ADV) measures velocity at a single point, so it can be difficult to correlate this single-point velocity with the overall flow of a river. In order to measure flow, users will usually be advised to purchase any of SonTek's flow measurement products (such as the Argonaut-SL or Argonaut-SW). These systems generate values of flow from a computed water level and a mean river velocity and can be integrated with the YSI 6-series line of instruments.

Can the ADV6600 be deployed from a buoy?

Yes. The standard compass that is present in each ADV6600 will automatically compensate for rotary movement of the buoy, or of the sonde that is attached to the buoy by a rope or cable. However, the same precautions mentioned above regarding averaging and abrupt movements apply. Further, the buoy needs to be made of non-ferrous material, or the ADV6600 needs to be positioned beyond the influence of the magnetic disturbance. YSI has a custom designed clamp available for attaching the sonde to cables that extend below the buoy.

D-5. Collecting and Analyzing Data

What is the fastest rate at which I can collect data from the system?

The lowest possible sample interval for the ADV6600 is one minute. As such, the most rapid data display frequency is once per minute. The sampling interval may be decreased in the future such that the system can record data more rapidly than once per minute.

Can I combine my ADV6600 with a data collection platform (DCP) that is using telemetry so that I can view my data without visiting the site? If so, how do I set up the system?

It is easy to establish communication between the ADV6600 and a data collection platform using the standard SDI-12 or RS232 protocols that are built into the ADV6600. If you are interested in seamless setup of the interface, you might consider the purchase of a YSI 6200 DCP. However, if you already have DCPs from well-established manufacturers, you should have no problems interfacing them to an ADV6600.

If you are using SDI-12 protocol, the ADVantage 6600 software can be used to configure and set up the system prior to deployment. Before connecting the cable from the ADV6600 to the DCP, change the switch at the end of the field cable to the SDI-12 position. Don't forget to move the switch back to the RS232 position before connecting the ADV6600 to your computer.

After starting a logging study, can I download the data to my PC in the field without stopping the study?

No. Unlike YSI 6-series products, the ADV6600 firmware automatically stops a logging study when interaction is established via a computer running the ADVantage 6600 program.. This means that if data is uploaded from an instrument in the field, the user must restart another study before redeployment of the ADV6600.

If I download data to my PC periodically in the field and restart the logging, will the data from sequential studies be in the same file?

No. Once restarted due to user intervention or cycling of the power, the ADV6600 firmware will automatically create a new file.

Can I delete a single file from the internal recorder of the ADV6600?

No. The ADV6600 uses flash memory, which requires that all data be removed from the recorder during the erasure process. As such, individual files can not be removed.

D-6. Software and Firmware

How do I upgrade the internal firmware in the ADV6600?

There are two separate firmware types in the ADV6600, one firmware for the ADV sensor and another for the water quality sensors (YSI 6-series sensors).

To upgrade the ADV firmware:

The ADVantage 6600 software has a built-in module for upgrading the ADV firmware. To access this module first connect to your system, and then select **System | Advanced | Update Firmware** from the menu. Firmware upgrades are available from the YSI website.

To upgrade the Water Quality sensor firmware:

The YSI Code Updater software can be downloaded from the YSI website. This is a self-contained program that operates with all YSI sondes. Install this program on your computer, connect your system to the PC, and run the Code Updater software.

What operating systems are compatible with ADVantage 6600 software?

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A Microsoft Windows operating system is required, and it must be Windows 98 or later. As such, Windows 98, Windows 2000, and Windows XP are all compatible with ADVantage 6600. Windows 2000 and XP are not required, but are the recommended choice of operating system.

What are the minimum requirements for me to run the ADVantage 6600 software on my computer?

The minimum requirements to run the ADVantage 6600 software are:

- Microsoft Windows 98/2000/NT/ME/XP
- 100-MHz Pentium processor (200-MHz or better recommended)
- 32 MB available memory (64 MB or better recommended)
- 50 MB available disk space (100 MB or better recommended)
- Monitor capable of 800 x 600 resolution, 16-bit color (1024 x 768 recommended)

Can I use the terminal mode of EcoWatch for Windows to interface with the ADV6600?

No. Only ADVantage 6600 will provide a fully functional interface to the ADV6600.

Can I use EcoWatch for Windows or any of the SonTek programs to analyze the data from the ADV6600?

No. Because of the hybrid nature of the ADV6600, its data format is different from that for YSI 6-series sondes (ADV6600 files are designated with an .A66 extension). As such, the data format is not directly compatible with EcoWatch for Windows. Note, however, that (a) ADVantage 6600 has a user-friendly data analysis capability that is easy to learn, and (b) it is easy to export data to a form that is compatible with spreadsheets for users who prefer to perform data analysis using a program such as Microsoft Excel. It is possible to open some spreadsheet-compatible files with EcoWatch for Windows, but some of the flexibility and power of the EcoWatch program is lost using this method.

Since I may have multiple files from the same site if I perform periodic field uploads of data, can I use ADVantage 6600 software to later merge these files into a single file for analysis?

No. The released version of ADVantage 6600 has no data merging capabilities. However, the user is able to merge files in a spreadsheet or other data analysis program. The ability to merge data files may be incorporated into future versions of the software.

D-7. Calibration and Maintenance

Prior to a deployment, how can I be sure that I will collect valid ADV velocity data?

When connected to a computer through ADVantage 6600 software, you can easily perform a qualitative “beam check” test. The test should be done in the environment in which the data will be collected (i.e., the system should be deployed in the mount). It is strongly recommended that a Beam Check be performed and recorded before and after each deployment (before cleaning or changing the location of the ADV6600). This procedure is fairly quick, and the results can be either printed or stored to a computer file for use in QC/QA programs. It is important to note that the ability of YSI Technical Support personnel to aid in data analysis and troubleshooting will be significantly compromised if a beam check file from the site is not available.

The beam check test will answer the following questions::

- Are there sufficient scatterers in the water to collect data.?
- Is the system operating correctly?
- Is the distance to the boundary (if present) sufficient.
- Are there obstructions within the sampling area?

If you cannot attach a cable to your instrument in the field, it is imperative that you at least perform a beam check in the laboratory before taking your ADV6600 to the deployment site to assure the Doppler system itself is functioning correctly.

After starting a study and logging data, can I calibrate sensors without stopping the study?

No. Unlike YSI 6-series products, the ADV6600 firmware automatically stops a logging study when interaction is established via a computer running ADVantage 6600 software. This means that all calibrations must take place before starting a logging study. After completing calibration of the sensors, the study would need to be restarted (if the system will be left for further deployment).

Is periodic calibration of the ADV sensor by the user required?

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No. The ADV sensor does not require calibration. However, if the arms of the ADV sensor are bent or damaged, the system should be sent back to the factory for possible recalibration or repair.

It is recommended that Beam Check be run when the other sensors of the ADV6600 are calibrated. Note, however, that if at all possible, the final Beam Check should be performed while the ADV6600 is in its final deployment location as described above. It is critical that users run Beam Check and perform a compass calibration before a deployment and users should keep clear records documenting that these operations were carried out.

Is calibration of the YSI sensors different for the ADV6600 from other YSI 6-series sondes?

In terms of software, the calibration protocols for the sensors are identical. However, because the Doppler sensor occupies so much of the calibration cup, users will probably want to calibrate the pH, ORP, ISE, and conductivity sensors with the sonde suspended from a ring-stand in the **inverted** position. Even under these conditions, the volumes of calibration reagents are larger for the ADV6600 than for other 6-series sondes. YSI supplies a large chain clamp standard with each ADV6600 that should be ideal for attaching the inverted sonde to the ring-stand. The ring-stand or other sturdy frame must be supplied by the user, but YSI Customer Service can provide advice on purchasing this item.

Do I have to calibrate the internal compass?

The internal compass or compass/tilt sensor is similar to other compasses in that it can be affected by the environmental magnetic field and any objects that may influence the earth's magnetic field (such as metal structures). To reduce the effect of this interference on the compass, it is necessary to perform a compass calibration. This is done through the ADVantage 6600 software and should be done every time the ADV6600 is deployed. If possible, the calibration should be done with the ADV6600 mounted in the deployment frame and at the deployment site, but for some deployments this may not be practical. If so, the compass should at least be calibrated in the field in a simulated frame to minimize direction errors at the site. .

If a mounting apparatus is used in the deployment of the system, it is preferable to use a non-ferrous and rigid material (such as aluminum or PVC piping).

D-8. Technical Support

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YSI offers a wide range of customer assistance and technical support functions to ensure that you have the information required to use our products. Contact YSI Environmental if you need assistance or have questions regarding any YSI Environmental Product. Business hours are Monday through Friday, 8 AM to 5 PM ET.

YSI Environmental, Incorporated
1725 Brannum Lane
Yellow Springs, OH 45387
Toll Free: 800-897-4151
Phone: 937-767-7241
Fax: 937-767-1058
E-Mail: environmental@ysi.com
www.ysi.com/environmental

Appendix E. Chlorophyll Measurements

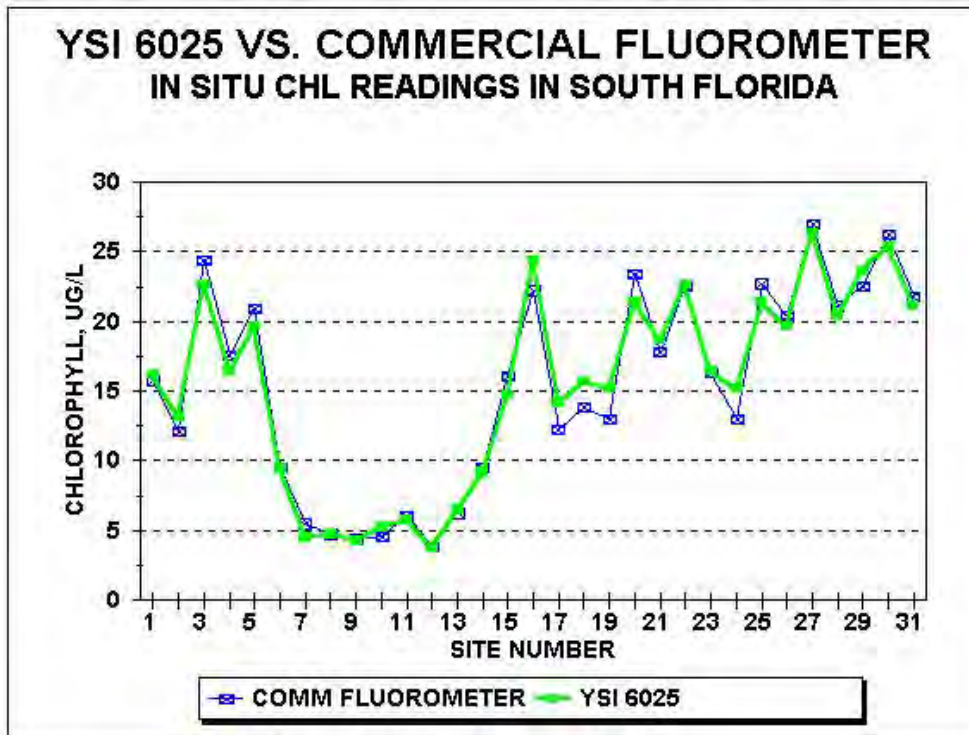
This section is designed to help the user attain the maximum possible benefit from the YSI 6025 chlorophyll system by supplementing the discussions of chlorophyll provided in other sections of this manual. It does not deal with specific instructions for operation of the sondes at the level presented elsewhere in the manual.

What is the YSI 6025 chlorophyll probe designed to measure?

The YSI sensor is designed to estimate the phytoplankton content of environmental water. Phytoplankton concentrations can be useful in predicting detrimental algal blooms and, indirectly, in determining nutrient loading in environmental applications. The phytoplankton content is estimated by detecting the fluorescence from the chlorophyll in these species *in vivo*, i.e., without disrupting the living cells. Note, however, that the sensor directly measures the fluorescence of all species in the water sample that occurs when they are irradiated with blue light (centered at about 470 nm). Usually most of the fluorescence is due to the chlorophyll in the phytoplankton, but it is important to remember that any compounds which are present in the water sample (either in chemical or biological form), and fluoresce under the optical constraints of the sensor, will contribute to the readings.

What level of accuracy can be expected in my chlorophyll determinations with the YSI 6025?

YSI feels that the user will attain about the same accuracy with the YSI 6025 as with other commercial fluorometers that are designed to carry out *in vivo* determinations of environmental chlorophyll. As for all measurements of this type, the accuracy will be less than that attained if the user collects water samples and analyzes them in the laboratory by disrupting cells and quantifying by spectrophotometric or HPLC analysis of the extracted molecular chlorophyll as described in *Standard Methods*. The relative accuracy of the *in vivo* measurement will be completely dependent on which method of calibration the user employs. No matter what calibration technique is used, however, the readings from the YSI 6025 should approximately track the chlorophyll trends in the environmental water being analyzed. For example, if the user deploys the sensor and acquires readings over time at a standard sampling interval (e.g., every 15 minutes), the changes in the chlorophyll data will usually reflect increases or decreases in the phytoplankton content at the site over a long period of time. If the user makes horizontal or vertical profiling spot readings in the same body of water, then the sensor output will usually indicate the presence of more or less phytoplankton at the various sampling sites. The figure below shows the tracking of the chlorophyll content at various sites by both the YSI 6025 and a good quality single parameter commercial fluorometer.



It is important for the user to remember that, because of the limitations defined in this appendix and in the **Principles of Operation**, YSI is unable to quote an accuracy specification for the *in vivo* measurement of chlorophyll.

If the sensor is post-calibrated using the values from laboratory analysis of grab samples, will my field data be totally accurate?

No, they will only be as accurate as possible within the limitations of the fluorometry method. The limitations for all *in vivo* chlorophyll determinations will almost certainly compromise the accuracy of your data even if you employ the best calibration method possible. For example, different phytoplankton species are likely to fluoresce differently *in vivo* even if the actual chlorophyll content is the same. Thus, unless the biological species are perfectly homogeneous with regard to site in a sampling study and with regard to time in a monitoring study, inaccuracy will occur if only a single phytoplankton calibration is performed. In addition, the fluorescence intensity of many phytoplankton types shows a diurnal cycle even though the same amount of material is present. Under this limitation, the time of day at which calibration samples are taken would have to be identical to the

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time of field measurement for the chlorophyll values determined by the two methods to agree consistently. This level of synchronization is usually not practical.

The key point to remember is that *in vivo* chlorophyll determinations made with any fluorometer are likely to be less accurate than those measured by laboratory analysis of individual samples. The advantage of the *in vivo* method is its convenience and ability to readily track changes in relative phytoplankton values via indirect fluorescence readings.

Can I use a dye standard to calibrate my 6025 chlorophyll sensor to increase the accuracy?

The use of the dye solutions will usually not significantly enhance the accuracy of your field readings relative to extractive analysis of grab samples. The primary utility of the dye is to check for sensor drift during deployment by reanalyzing the dye solution after sonde recovery. The use of the 2-point dye calibration procedure may make it easier to quantify the pre-deployment dye value and, if so, may be preferable. Remember, however, that no real enhancement of sensor accuracy is attained by using dye as a calibration standard.

Will chlorophyll values determined *in vivo* with the YSI 6025 be reportable for compliance purposes?

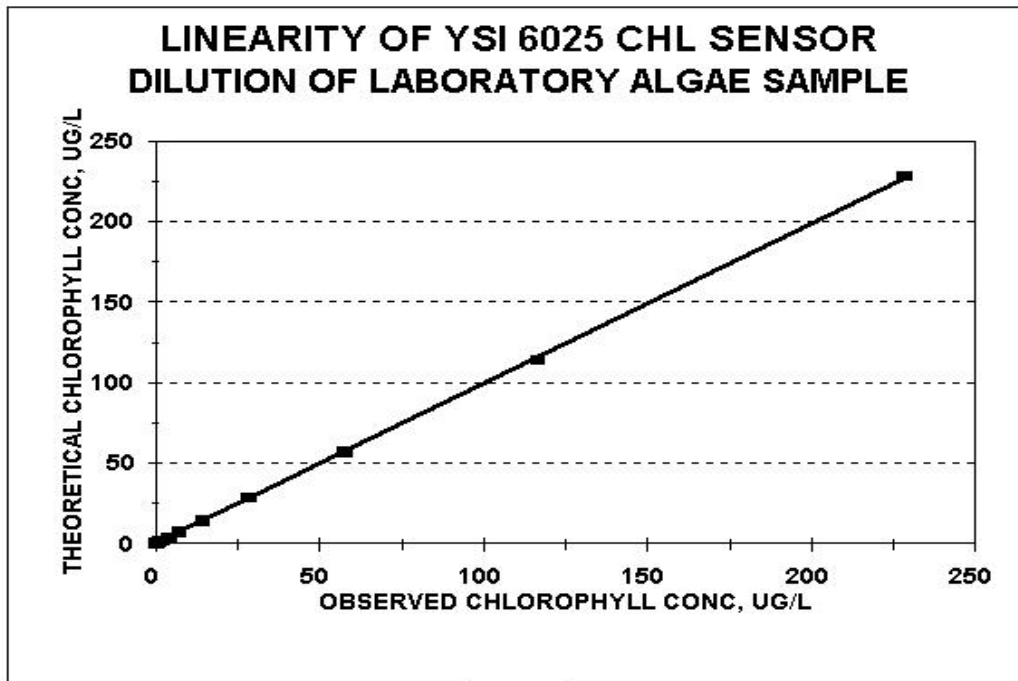
Probably not. Because of the limitations on the method there is always inaccuracy in the *in vivo* method. It might be possible to work with a particular regulatory agency to develop specific correlation protocols between *in vivo* and laboratory-determined chlorophyll values for a particular site, but generation of this methodology is left to the user.

The *Standard Methods* procedure generates values designated as “chlorophyll a”. Is this species the reporting unit for the YSI 6025?

No. The different types of chlorophyll cannot be differentiated by the YSI 6025, or by virtually any *in vivo* fluorometer. The values from the YSI 6025 should be reported either as relative fluorescence units or in ug/L of general chlorophyll as long as the method of determination (and its limitations) is specified.

Is the YSI 6025 sensor linear with regard to changes in phytoplankton content?

Yes. The sensor is very linear as evidenced by the following plot that shows the results of a serial dilution of a laboratory algae sample. This linearity on a particular algal species maximizes the ability of the sensor to track relative phytoplankton changes from site to site or during a monitoring study.



Are there precautions that I should take when acquiring samples for laboratory analysis?

Yes. The key is to obtain a sample which is representative of the water being measured by the YSI 6025 *in vivo*. The mistake most often made is to simply immerse an open bottle in the environmental water. Under these conditions, any macroscopic surface plant or algal matter (which also contains chlorophyll) will also be introduced into the sample even though it is not present in the subsurface zone where the probe is measuring fluorescence. If this happens, your laboratory analysis will always be erroneously high relative to the *in vivo* chlorophyll data from the YSI 6025.

For surface sampling you can minimize this effect greatly by placing the sealed bottle a foot or more below the water surface and only then removing the cap and allowing the container to fill. The cap should then be reinstalled before removing the bottle from the water. A better technique is to acquire commercially available water sampling devices that are designed specifically to acquire a representative sample at a particular depth.

You should also take precautions to stabilize your samples for transport back to the laboratory. The samples should be kept cool and in the dark (e.g., in an ice chest) until the

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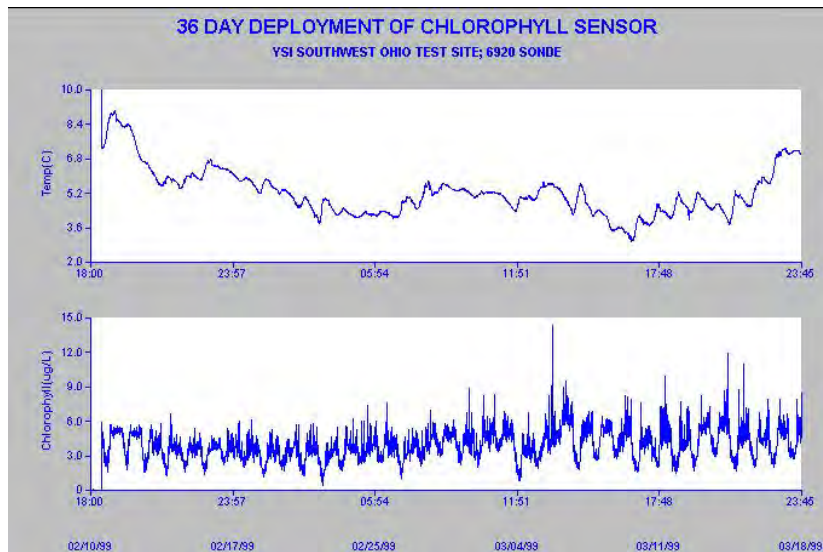
analytical procedure has begun. Some users prefer to filter the sample in the field and keep the filter pads on ice in the dark during transport.

My environmental sites have a lot of visible floating algae, but my YSI 6025 chlorophyll sensor shows very low readings. What is causing this paradox?

The YSI 6025 is not designed to measure macroscopic algal or plant material that floats on the surface. Rather it measures the fluorescence from the microscopic phytoplankton that is suspended below the surface of the water. It is fairly common to see mats of floating algae on environmental water that has low subsurface phytoplankton concentrations.

What sort of “noise” level is expected for unattended monitoring studies?

All environmental water is somewhat heterogeneous with regard to phytoplankton content and this factor will cause some noise or jumpiness in long term monitoring studies for chlorophyll. The extent of the noise will be dependent on the your site. The data from a typical 36-day deployment at a YSI test site (lake in southwestern Ohio) is shown in the figure below as a reference.



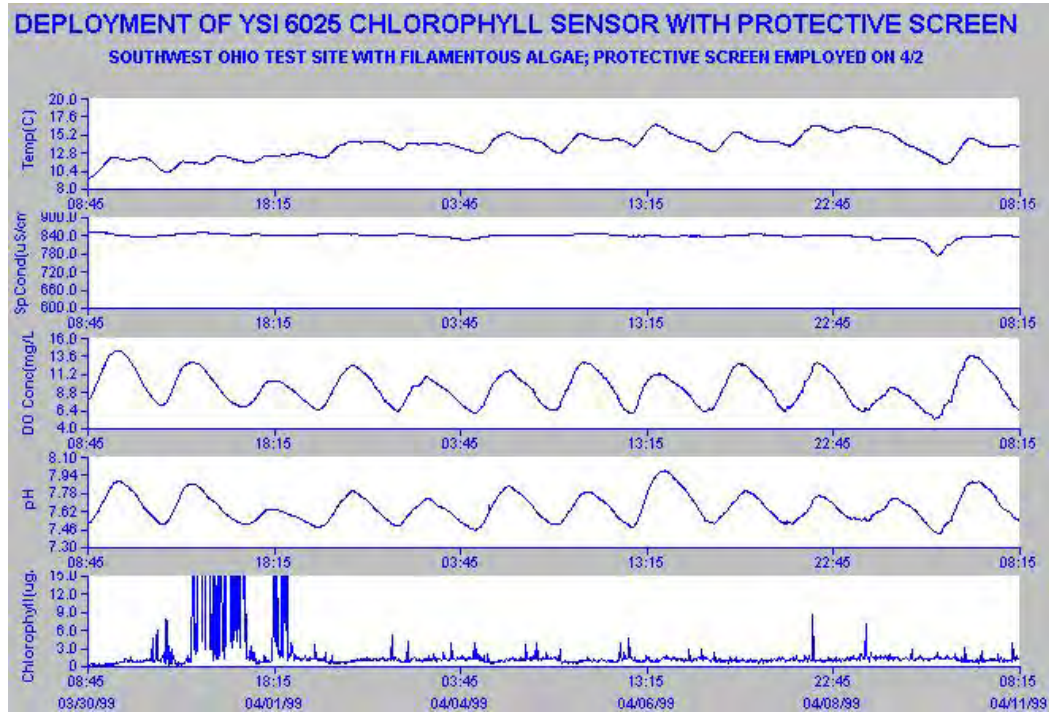
Note, however, that you may observe less or more noise at your site with no compromise in sensor performance. Occasional spikes during a monitoring study are normal and usually simply indicate the transient passage of a large phytoplankton particle over the optical face during the time of sampling.

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If you consistently observe periods in your monitoring study where the data is clearly unreliable due to a large number of very high spikes, then you may have to take additional precautions to minimize the effect.

My unattended monitoring data shows a large number of chlorophyll spikes that clearly do not reflect the average phytoplankton content of the water. What is causing this effect and is there anything I can do to minimize it?

This effect, shown in the initial chlorophyll readings in the figure below, can be caused by the presence of subsurface macroscopic filamentous algae.



The flexible algal strands can become attached to the wiper arm and sometimes are resident on the probe optics even after a cleaning cycle. The key to decreasing the spiking effect is to minimize the free algae, which is present in the probe compartment of the sonde. This can sometimes be accomplished by encasing the sonde guard in standard fiberglass window screen wire which is available at most hardware stores and then anchoring the screen with rubber bands as shown in the picture below.



Note the significant improvement in the overall noise level of the readings after the screen was installed on 4/2/99. However, there is no guarantee that this solution will completely solve spiking problems caused by macro algal species. In some applications, it may be necessary to clean the sonde and probes at a frequent interval to minimize the number of erroneous readings.

Another factor that can contribute to repeated spikes in the user's chlorophyll data is wiper malfunction so that the wiper assembly parks over the probe optics. This problem is usually due to the edges of the fluorescent wiper becoming coated with non-fluorescent material such as sediment that, in turn, prevents the sonde software from detecting the wiper movement. If the spikes are due to this factor, then the problem will be corrected by manually cleaning the wiper edges so that the fluorescent surface is restored.

Do I have to worry about the effect of variable temperature on my field readings?

This factor is definitely a consideration depending on the level of reliability you require if the water at your site is at a significantly different temperature from that of calibration. YSI studies show that, while the optics and electronics of the sensor show very little temperature effect, the fluorescence of phytoplankton samples does vary significantly with temperature. Generally, the chlorophyll in biological samples shows increased fluorescence at lower temperatures with a factor of 1-2 % per degree Celsius. In practice, this means that if, for example, the calibration temperature is 25 C and the water

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temperature at the site is 10 C, the observed chlorophyll readings will be erroneously high by 15-30 %. The “Chl Tempco” factor in the **Advanced> Sensor** menu can be used to partially compensate for this error, if the user has some knowledge of the temperature effect on the particular phytoplankton at the site. The factor can be empirically determined by bringing a sample of the environmental water to the laboratory and determining its fluorescence at ambient temperature and low temperature. (Simply cool the sample in a refrigerator for the latter reading.) The calculated factor can then be entered into the sonde software.

Appendix F. Percent Air Saturation

The term “Percent Air Saturation” (abbreviated in many applications to “Percent Saturation”) is a common parameter for expressing the state of the oxygenation of environmental water and is widely used by YSI and other manufacturers during the calibration of oxygen sensors. However, because the parameter can be expressed by two different conventions, there can be confusion around the use of the term. This section is designed to minimize that confusion by defining each of these conventions and providing instructions for configuration of the ADV6600 sonde so that you will have a choice as to which of the conventions is used.

Note: No matter which of the conventions is employed (in YSI or competitive instrumentation), the values of dissolved oxygen in mg/L will be identical and unaffected by the choice of DO % convention.

F-1. “DOsat %” Convention

The first convention has been used for many years in YSI handheld and laboratory instruments and in 6-series sondes. The “% saturation” value at the time of calibration in air reflects the value of the barometer or altitude that was input in the calibration protocol. If the parameter “DOsat %” is active in your 6-series Report menu, then this convention is being used. Effectively, this convention provides a value of water oxygenation that can be carried out by air exposure, with the value referenced to having the air at exactly 1 atmosphere (760 mm Hg or 101.3 kPa). A “DOsat %” value of 89 means that the water contains 89 % of the oxygen that could be dissolved if the water was introduced with air that had a total pressure of 1 atm.

For example, when performing an air calibration in the mountains at a typical barometric pressure of 630 mmHg, the YSI “DOsat %” value at calibration would read 82.9 % ($630/760 * 100$). Assume the sensor did not drift electrochemically and the sonde was taken to a location where the atmospheric pressure was exactly 760 mm Hg (e.g., sea level). The “DOsat %” reading in air (or air-saturated water) would change to 100 % ($760/760 * 100$) because there is more total oxygen in the air at the lower elevation.

Note that the percent oxygen in the air is effectively independent of the barometer or altitude. Assume the water at both sites has a temperature of 20° C, where water exposed to water-saturated air at exactly 760 mm Hg is 9.09 mg/L. The mg/L value would be 7.54 mg/L ($0.892 * 9.09$) in the mountains and 9.09 mg/L ($1.00 * 9.09$) at sea level. Thus, to calculate mg/L values at any site after calibration using this convention, the observed “DOsat %” values are simply multiplied by the Standard Methods or ISO table values that correspond to 100 % at various temperatures and salinity.

F-2. "DOsat % Local" Convention

The second convention has been used for many years by other multiparameter instrument companies and by many European handheld instrument manufacturers. The "%saturation" value is always set to exactly 100 % at the time of calibration regardless of the barometer value or altitude that was input. The software of the instrument "remembers" the barometric pressure input at the time of calibration for use in later calculation of the DO concentration in mg/L. Effectively, this convention provides a value of water oxygenation that can be carried out by air exposure with the value referenced to the local air pressure. The 100 % value at calibration for this convention basically reflects the fact that this is the most oxygen that can be dissolved in water for this location at the time of calibration. In late 2001, this dissolved oxygen convention was added to the YSI 6-series software through the use of the parameter "DOsat %Local".

For example, when performing an air calibration in the mountains at a typical barometric pressure of 630 mmHg, the "DOsat %Local" value at calibration would read 100.0 % and the value of 630 mmHg would be stored in instrument memory. Assume the sensor did not drift electrochemically and the sonde was taken to a location where the atmospheric pressure was exactly 760 mm Hg (e.g., sea level). The "DOsat %Local" reading in air (or air-saturated water) would change to 120.6 % ($760/630 * 100$) because there is more total oxygen in the air at the lower elevation.

The mg/L value for water saturated air or air-saturated water, assuming a temperature of 20 C at both sites, would change from 7.54 mg/L ($1.00 * 630/760 * 9.09$) in the mountains to 9.09 mg/L ($1.206 * 630/760 * 9.09$) at sea level. Thus, to calculate mg/L values at any site after calibration using this convention, the "DOsat %Local" value is multiplied by the ratio of the barometric pressure at calibration to 1 atm (table conditions) and then by the table value as shown above. Observe that the same mg/L values are obtained at both sites for the "DOsat %" and "DOsat %Local" conventions even though the "percent saturation" values are significantly different.

It is important to note that the convention specified for "%saturation" by the British (and EU) standard requires that the local barometric pressure be read for every DO data point taken after calibration. Under this convention, a sensor should always read 100 % saturation when in water-saturated air or air-saturated water. Since the software of most instruments does not "know" the barometer at any time after calibration, neither of the conventions described above complies with the British standard.

F-3. Effects of DO mg/L Calibration

When a user performs a mg/L calibration, no barometer input is required. Values of “DOSat %” will be calculated by taking the input mg/L value and dividing by the theoretical mg/L value at 1 atmosphere (found in the Std. Methods Table) to yield the reported “DOSat %” value. For example, if a value of 7 mg/L is entered at a temperature value of 21 C (where 100 % saturation at 1 atmosphere is 8.915), the “DOSat %” value will be $(7/8.915)$ or 78.5. DOSat % values for field readings are calculated in exactly the same way.

Values of “DOSat %Local” reported after the calibration will be based on the barometer reading input by the user at the time of the last “DO %” calibration. If the user requires the best possible accuracy for “DOSat %Local” values after calibration then a “DO %” calibration (with correct barometer input) should be performed immediately before the “DO mg/L” calibration. If a “DO %” calibration has never been carried out, then the software will assume that the barometer at the last calibration was exactly 760 mm Hg.

Thus, after the calibration procedure is complete “DOSat %” values calculated as described above are then multiplied (in the software) by a factor of $(760/BP)$ to yield the corresponding “DOSat %Local” values. For example, assume that the temperature of the calibration standard is 21 C (where air saturation at 760 mm Hg is 8.915 mg/L) and that the oxygen content of the solution has been determined to be 7 mg/L by Winkler titration. Assume also that the local barometric pressure was entered as 700 mm at the last “DO %” calibration. After the new “DO mg/L” calibration, the “DO mg/L” value will be set to 7.00, the “DOSat %” value will be set to $(7/8.915)*100 = 78.5$, and the “DOSat %Local” will be set to $(760/700)*78.5 = 85.2$.

NOTE: As pointed out above, it is important to realize that unless the barometric pressure is known for every DO reading after calibration, the values of “DOSat %” and “DOSat %Local” will be incorrect if the barometric pressure has changed since calibration. Thus, even if the barometer had been input at the time of a mg/L calibration (a method used by some instrument manufacturers, the values of “DOSat %Local” will still not be exactly accurate after calibration.

F-4. Activation of the “DOSat % Local” Parameter

On receipt of your ADV6600 sonde the “DOSat %Local” parameter will NOT appear in your Report menu. To activate the parameter, complete the following procedure:

8. Connect the ADV6600 to a computer.
9. Launch the ADVantage 6600 Software for Windows.
10. Choose **Connect to System**. Verify the **COM** setting and **Baud Rate**. Click on **Connect**.

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11. Select **Change System Settings**. A Quick Setup dialog box will appear.
12. Click on **Sonde Menu**. A window will appear displaying the Main Menu of the 6600 firmware.
13. To activate the parameter, it is necessary to exit the menu structure of the sonde software to the command line prompt (“#”). The “#” sign appears after you press **Esc** from the Main menu and then answer **Y** to exit the menu.
14. Once the “#” prompt is shown on the display, type **dolocal 1** and press **Enter**. The screen will show “OK” to indicate that the action was successful and return another “#” sign.
15. Type **menu** at the second “#” sign and press **Enter** to return to the sonde software menu structure.

After the above action, the parameter “DOSat %Local” will be present in your Report menu. If you want to remove the parameter, return to the “#” prompt, type **dolocal 0**, and press

Appendix G. Quick Start Deployment Guide

1-Installing the ADVantage 6600 Software

A CDROM containing the installation is included in the case with your ADV6600.

Insert the CDROM into your computer.

Use Windows Explorer or My Computer to view files on the CDROM.

Double click *SETUP.EXE* program file to run.

Follow the on-screen instructions for installation.

2-Connecting your ADV6600 to a Computer

Assemble the cable by attaching the 6095 MS-8 to DB-9 adapter.

Connect the cable to the serial port on the back of your computer.

Make sure that the SDI-12 switch on your cable is set to the RS232 position.

Remove the dummy plug from the back of the ADV6600 housing.

Insert the cable into the top of the ADV6600.

3-Starting the ADV6600 Software

To start the ADV6600 software click on the windows Start Menu and select

Programs > YSI Software> ADVantage 6600.

The program will start and automatically display the New Session dialog box.

4-Communicating with your ADV6600

Select the Connect to System topic, then Serial Connection and choose the appropriate Communications Port and Baud Rate. (Typically: COM1 and 9600 baud).

The screen will display a number of options for communicating with your system.

These options are also available on the Toolbar and in the Menu.

Change System Settings – Described in detail in Section 5.

Start realtime data collection or begin a regular deployment - Described in detail in Section 6.

Recorder - (Download data files) Described in detail in the manual.

5-Changing the System Settings on your ADV6600

Select **Change System Settings** from the On-Screen Menu.

The system will then wakeup and transfer the current settings. The Quick Setup dialog box will then display the current settings stored on your ADV6600.

The following buttons are available in the Quick Setup dialog box:

Update - Transfer your new settings to the ADV6600 and return to the main screen.

Cancel - Cancel your changes and return to the main screen.

Sonde Menu – Menu for calibrating and selection of probes installed in the ADV6600.

Output Fields - Select the parameters that you want to be collected by the ADV6600 and stored in the data files that are collected. Initially it is best to use the default settings for the selected variables.

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To reduce the amount of space taken up by files on the recorder you can uncheck parameters.

Recorder - Using the on-board system recorder is described in the Downloading the Data (Section 7).

The following fields will be available for you to change:

File Name - The File Name will be used as the prefix for the name of the data file stored on the recorder. There is a maximum of 5 characters (Default: DEF).

Comments - Three lines of text have been allocated to describe the specifications for each deployment. It is recommended that each deployment have its own unique set of comments.

Averaging Interval - The period of time (in seconds) over which the ADV6600 averages data before computing a sample. (Default 60).

Sampling Interval - The time interval between sequential samples (in seconds). Defined as the time from the start of one sample to the start of the next sample. The Sampling Interval must be greater than or equal to the Averaging interval. (Default: 900).

Velocity Range - Please refer to your manual for more information (Default: AUTO).

Coordinate System - Please refer to your manual for more information (Default: ENU).

Enable Internal Recorder? – This should be checked for all regular deployments (Default: Checked).

Record to a file on this computer when Start button is pressed (Default: Checked)

The amount of remaining recorder space left on your ADV6600 will also be displayed. Please keep in mind the length of your deployment and the amount of space that will be required on the recorder to store this data. It is highly recommended that you format the recorder (available when you press the Recorder button) before a long deployment to ensure that the maximum recorder space is available.

6-Starting the Deployment

Select **Start realtime data collection or begin a regular deployment** from the On-Screen Menu.

Data will be collected at your specified sampling rate from the **Changing the System Settings on your ADV6600**.

Wait for a few samples to be displayed on the screen (if practical)

Close the Program.

You will be prompted as to whether you want to **Stop Data Collection?** Select **No**.

Disconnect the serial cable from the System.

Insert the dummy plug into the connection on the end of your ADV6600.

At the end of your deployment you will need to recover your data files from the ADV6600.

This step is covered in more detail in the manual.



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