WETView 7.0

User's Guide

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WET Labs®

1. Introduction

WETView is a data acquisition and display program for acquiring and viewing the data produced by WET Labs absorption and attenuation instruments. It runs on IBM PC compatible computers. This document describes what is required to run WETView, how to install it and how to use it.

2. System Requirements and Installation

It is recommended you have at least a 90 Mhz Pentium with at least 16 Mb of memory. You will need about 3 Mb of disk space for the WETView program and related files. The speed of the processor limits how much real-time graphing can be accomplished without data loss. The size of memory limits the number of data points that can be plotted in one run. WETView requires Windows 95 or newer operating system.

The WETView CD contains five files: `SETUP.EXE`, `Wethsx.001`, `Wethsx.002`, `*.dev` and `*.cal`.

Once installed, the WETView directory contains the following files:

- `setup.exe` WETView installation executable
- `uninst.dll` File associated with uninstall utility
- `uninst.exe` The uninstall utility
- `uninst.lrm` File associated with uninstall utility
- `Wethsx.001` File associated with program file
- `Wethsx.002` File associated with program file
- `WetView.exe` WETView program
- `WETVIEW.UIR` WETView user interface resource file
- `*.DEV` Device configuration files (the actual name(s) of these files depend upon the instrument(s) that you have purchased)

2.1 Installing the Software

1. Insert the CD.
2. Open the CD and double-click on the SETUP.EXE icon. SETUP will guide you through the rest of the installation process.
3. Copy the *.dev and *.cal files to the hard disk. WETView initially looks for the .dev file in the installation directory (default is `c:\Program Files\wetlabs\wetview7`).

3. Quick Start

This section gives instructions for you to quickly get a single meter connected and displaying data. fter installing the software:

1. Connect the meter to an appropriate power supply.
2. Connect the data line to one of the communication ports on your computer.
3. Turn the meter power supply on.
4. Start the WETView program.
5. Open a device configuration file by pressing the ^O to Open button at the top of the screen (or by typing control-O). A dialog box will appear, allowing you to select a file to open.
6. Select the COM port to which you attached the meter.
7. Press the F1 to Start button at the top of the screen.
8. After several seconds, stop the acquisition by pressing the F2 to Stop button.
9. Save the newly acquired data to a file. Name the file TMP.DAT.
10. Rescale the graph by selecting the All channels button in the lower right corner of the screen. You can zoom in on one channel by press the colored button next to the channel's name on the right-hand side of the screen.
11. Open the data file you have just created by selecting File/Open .DAT file... from the File menu. Choose the file named TMP.DAT.
12. View the data in the file by pressing the "F1 to Start" button at the top of the screen.

4. Operation Overview

WETView acquires data from WET Labs' ac meters and displays collected data. WETView can perform these tasks simultaneously or independently.

4.1 Controlling WETView

You may use a mouse or keyboard commands to control WETView. The assigned function keys are:

F1	Start acquiring data
F2	Stop acquiring data
F3	Bring up Graph Options dialog
F4	Bring up Binning Options dialog
F5	Move data on graph to the left (or down)
F6	Move data on graph to the right (or up)
F7	Zoom graph in
F8	Zoom graph out

^O (control-O) Opens a device for data acquisition.

To operate controls on the screen using the keyboard, select the control by tabbing until the desired control is highlighted, then change its value. The method for changing a control's value depends on the type of control:

- For a text or numeric field, type the desired value.
- For a radio button, type a space to toggle its value.
- For a button, type Return to activate the button.

Most dialog boxes have an OK and a Cancel button. The function key F1 will select OK and the Esc key will cancel the dialog.

4.2 How Data is Collected

As data is collected, it is averaged into bins. The average of each bin is stored and can be written to a file after the acquisition is complete. The number of samples per bin is set by the user via the Options/Channels/Binning… menu item. Once the data has been averaged into bins, those bins can be further averaged into bins of bins for plotting.

Regardless of which channels are being displayed, all data acquired from an instrument is stored and can be saved to a data file.

4.3 Displaying Data

Data can be read directly from an instrument and displayed in real time, or it can be read from a previously stored data file. You may configure the X and Y ranges for graphs and select which traces are to be plotted. Collected data may be averaged into bins for display. Thus, you can average acquired data into bins of 4 samples each, and then display bins of 12 samples each by selecting a collection bin size of 4 and a display bin size of 3.

4.4 Rescaling Graphs

When data is displayed in a graph, you can rescale the graph's bounds to zoom in on a single channel by clicking on the small button associated with the channel's label (on the right side of the screen). Clicking on the All channels button will rescale the graph so that all displayed channels will be shown.

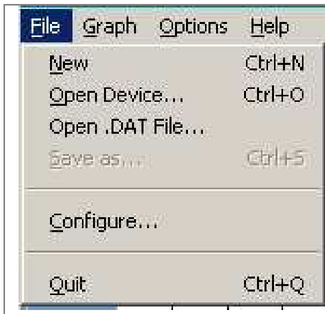
In the lower right corner of the screen are four buttons for navigating around a displayed graph. You can zoom in (magnify) a graph, or zoom out.

You can also move the bounds on the graph to shift the viewed data to the right or left on the current graph (for strip charts, these move the graph up and down).

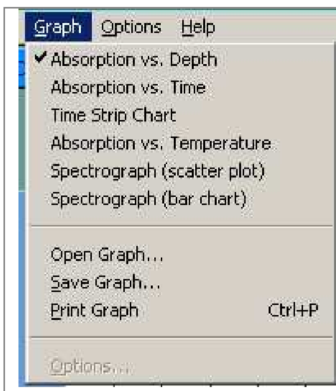
You can change other characteristics of a graph by selecting Options/Graph (or, equivalently, the Graph/Options menu item).

5. Collecting, Graphing, and Saving Data

5.1 WETView Menus



New	Clears the current graph and disconnects from the current instrument.
Open Device	Chooses which type of device to collect data from.
Open .DAT File	Opens a previously saved data file for display.
Save as	Saves the most recently acquired data into a data file.
Configure	Allows you to edit the configuration for an instrument, including the calibration constants.
Quit	Quits the WETView program.



Absorption vs. Depth	Selects the vertical graph of absorption versus depth.
Absorption vs. Time	Selects the vertical graph of absorption versus time.
Time Strip Chart	Selects the horizontal strip chart for display (absorption vs. time).
Absorption vs. Temperature	Selects the vertical graph of absorption versus temperature.
Spectrograph (Scatter plot)	Selects the scatter plot of absorption/attenuation vs. wavelength.
Spectrograph (bar chart)	Selects the spectrum display of absorption/attenuation vs. wavelength.
Open Graph...	Opens a graph file for viewing.
Save Graph...	Saves the current graph to a file.
Print Graph...	Prints the current graph to a printer.
Options...(F3)	Allows you to configure the scaling of graphical output.

Graph…	F3	Allows you to configure the scaling of graphical output.
Channels/ Binning...	F4	Allows you to set the bin size for sampling and the traces to display.

5.2 Opening a Device

Select File/Open Device… to open an instrument for data collection. (You are opening a device configuration file that describes the device to be used.)

Once you have selected an instrument, you will be asked to identify the source of the data stream. This can be either a communication port that the device is connected to or a binary file. (A binary file is created by using a communications program to read a device's data from a serial port and write it directly to a file in binary format.) Choose COM1, COM2, or .RAW File.

Once you have selected the appropriate port(s), WETView attempts to synchronize with the device on that port. If there is any error in doing this, it will be reported immediately. Possible errors are:

Port timed out	WETView timed out trying to read data from the selected port. Was the correct port selected? Are cables and connections correct?
Bad format from source	WETView did receive data from the selected port, but it did not recognize the data stream. Is the correct device connected to the selected port? Is it turned on?

Once WETView connects to the instrument, it checks to see if the serial number of the instrument matches the serial number given in the configuration file. If it doesn't match, you are warned, but can elect to continue.

Caution

If the serial numbers do not match, the calibration information stored in the configuration file probably will not be correct for the instrument, so collected data is suspect.

! **Software Error:** Current version may always display this warning regardless of matching serial numbers.

5.3 Opening and Saving a Data File

Select File/Open .DAT File… to open a WETView data file for graphing. Choose the file you want to open. Once the file is open, select Start from the Acquire menu (or type F1). Possible errors in opening the file:

File not found	The file you named does not exist. Did you type the name correctly?
Bad file format	WETView did not recognize the format of the file. Did you select a data file that was created by WETView?
Strange error opening file	WETView ran into an unanticipated error. Did you select a data file that was created by WETView?

Select File/Save as... to save the most recently acquired data to a text file. By convention, data files have the extension .DAT, though this is not required.

As WETView collects data, it writes that data to a temporary file called WETVIEW.TMP. When you request to save the data, the file is renamed to the name you specify. If you quit WETView without saving the data, the WETVIEW.TMP file is not deleted, so you can manually rename it if you wish.

Note

Because the temporary file, WETVIEW.TMP, is renamed when you save it, the file cannot be saved to a disk other than the one that contains the current directory.

5.4 Collecting Data

Press the F1 to Start button to begin acquiring data from the currently opened device. This item is highlighted only if you have a device open. The function key F1 works as well. As data is acquired, the traces you have selected (via the Options/Channels/Binning menu) are graphed. Graphing the data points uses memory and for long collection runs WETView may exhaust all available memory (this is not true for the Strip Chart graph). If WETView runs out of memory, it erases the graph and begins graphing from where it left off. All collected data is saved in a file, whether or not it was erased from the graph.

5.4.1 Changing the Data Collection Options

Select Options/Channels/Binning to select which traces to display and to set the collection and display bin sizes.

5.4.2 Ending Data Collection, Exiting WETView

Once acquisition begins, an F2 to Stop button is displayed near the top of the screen. Selecting that button with the mouse, or pressing the F2 key stops data acquisition. Select Quit to quit the WETView program.

5.5 Graphing Data

Select Graph/Open Graph... to open a previously saved graph file. By convention, WETView expects graph files to have a .GPH extension.

Select Graph/Save Graph.… to save the current graph to a file. The graph may be opened later and viewed, rescaled, and printed.

Select Graph/Print Graph.… to print the currently displayed graph.

5.5.1 Selecting the Graph to Display

WETView provides four types of graphs:

1. A vertical X-Y graph of absorption versus depth
2. A vertical X-Y graph of absorption versus time
3. A horizontal strip chart of absorption versus time
4. A vertical graph of absorption versus temperature.

There are trade-offs to be considered when choosing which display to use.

The X-Y graphs accurately plot either time and absorption or depth and absorption, whereas the strip chart accurately plots absorption, but uses a constant time base. However, the strip chart scrolls continuously as data is collected, so you can have detailed view of the most recently received data, whereas the X-Y graph is static. When the data runs off the graph, it is not visible until you stop data acquisition and rescale the graph. In either case, all data acquired is logged to the data file.

The absorption versus temperature graph is used for temperature calibration. The temperature reported is the temperature internal to the instrument, not the ambient temperature. Also, since the temperature is reported once for each set of ten data lines, all ten data lines will be plotted at the same temperature. We recommend setting the collection bin size to a multiple of 10.

5.5.2 Changing Graph Options

Select Graph/Options... to change the appearance of the currently displayed graph. For X-Y graphs, you may set the X and Y ranges and the number of divisions for each axis. For strip charts, you may set the Y range and the speed that the chart scrolls.

6. Configuration

The ac-9 measures the absorption and attenuation of 9 different wavelengths of light; the ac-s measures from 80–90. Configuration is specific to each type of device. Each of the measured quantities has a calibration offset added to it so that the resulting number is the difference between a clean water measurement and the measurement in the field. You can manually set the value of this offset for each channel; however, determining the correct value to use is not trivial.

Caution

We recommend you change **only** the instrument description and the color used for plotting it. Changing the baud rate will most likely cause WETView to be unable to communicate with the instrument. Changing the calibration constants will affect the accuracy of your results.

Usually, a "clean water calibration run" is performed. Chemically pure water is run through the instrument and the values for absorption and attenuation are averaged over a number of samples. These values are then used as the calibration offsets.

You can change the following settings for the ac-9 meter:

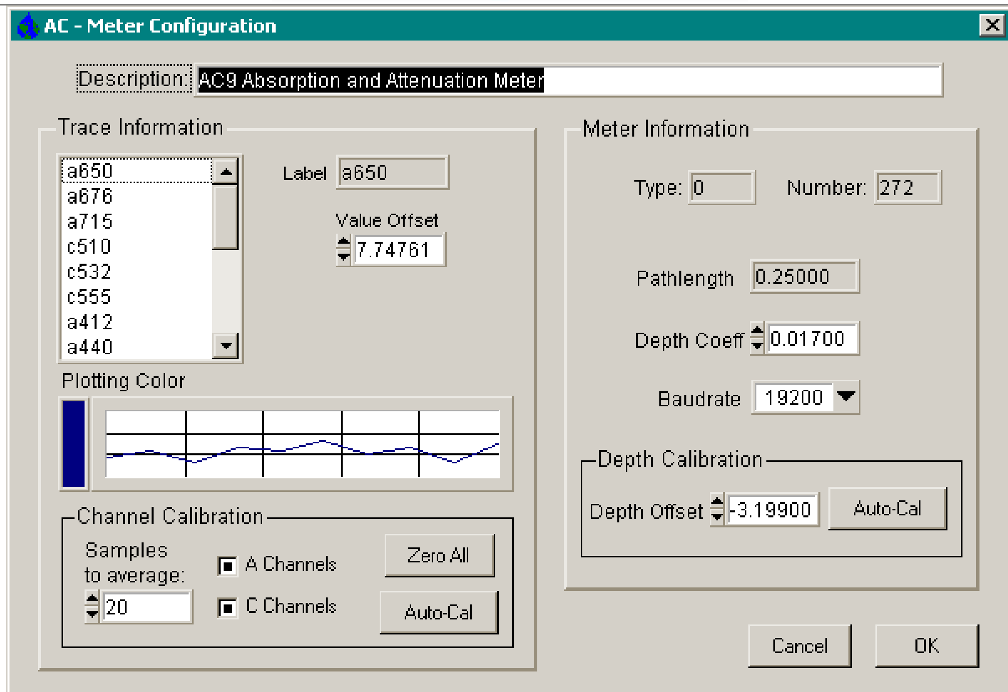
- calibration offsets for absorption measurements
- calibration offset for depth measurement

You can change the following settings for the ac-s meter:

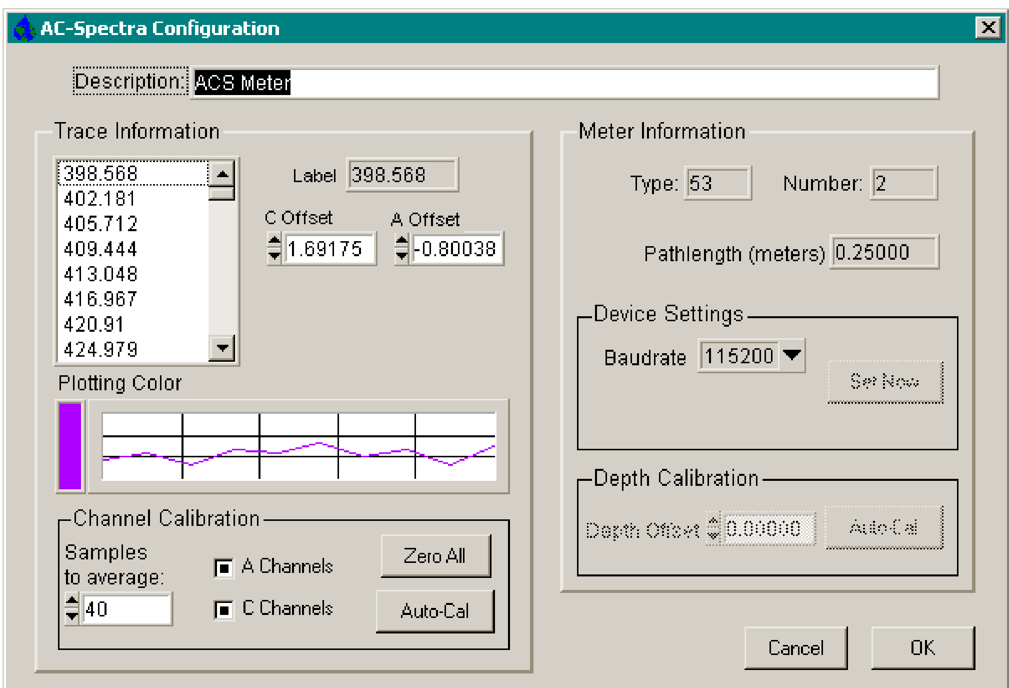
- calibration offsets for absorption/attenuation measurements

To change an instrument's calibration, a new device file must be collected. The steps of this process are outlined below.

1. Ensure the instrument is properly connected to a power supply and host computer, and that WETView is properly loaded and operational. Open the Configuration screen by selecting File/Configure…. Choose a device file. The window below (either ac-9 or ac-s) will appear.



ac-9 configuration screen



ac-s configuration screen

2. The lower left-hand corner of the window has a Channel Calibration box with control buttons for Zero All and Auto Cal.
   - The Zero All button sets all of the calibration offsets to 0.0 so you can collect the raw (uncorrected) values from the meter. Note that these values are always temperature-compensated.
   - The Auto Cal control collects and averages the new offsets for a device file. Note the option for number of samples to average. Select the number of individual samples you wish to average by using this control. The default is 10 samples.

3. Once you have selected the number of samples over which to average, you then can engage the Auto Cal control. A temporary pop-up window will notify you as the calibration takes place. After the operation is complete, exit the Configuration dialog box by pressing OK in the lower right hand corner.

4. When you exit you will be prompted as to whether you want to save the new offset values.

Caution

Unless you deliberately save a device file the offsets you have collected will not be permanently stored.

5. You may write over an older device file if you choose, but the program will ask you if you are sure you want to do this. Otherwise you may write to a new file.

6. Before you can use the new values, reload the newly made device file using File/Open Device.

Appendix A—ac-9 Meter Files

ac-9 Configuration File

Configuration files (with file extension .DEV) give calibration and other information specific to a particular unit. These files are tab-delimited text files and have the following format:

Line 1	Device name.
Line 2	Serial number: the serial number of the device that was used to collect the data.
Line 3	Version number of the following structure. This should be "2."
Line 4	Reserved for future use.
Line 5	Calibrations for depth meter: there are two values, the first is an offset and the second is a multiplier.
Line 6	RS-232 baud rate that the instrument uses
Line 7	Optical path length through water (in meters).
Line 8	Number of temperature compensation bins.
Line 9	Several values (the count is given in the preceding line); each value is the average temperature of the temperature bin.
Line 10–27	Each line describes one channel of the instrument; the first three fields are: label for identifying the channel color for plotting clean water calibration constant (offset) The rest of the line contains temperature compensation values that correspond to the temperature bins given in the previous line.
Line 28	Reserved for future use
Line 29	Extra capabilities mask. This is a list of capabilities that the meter may have in addition to the standard product. Currently, only one such capability exists: an external temperature sensor. If the first number on this line is non-zero, the meter supports such a sensor.

ac-9 WETView Data Files

WETView saves data files in tab-delimited format. The file format of WETView files is described below.

Line 1: Header line. Identifies the version of the program that created the file, and the time and date of creation.

Lines 2–30: Exactly the same format as the configuration file. These lines contain the calibration information that was used while collecting the data.

Line 31: Collection bin size. The number of samples that were averaged into each bin during collection.

Data lines

The rest of the file contains lines of data values. Each line of data starts with a zero-based time stamp. Times are given in milliseconds. The rest of the fields on the line are the data from the device. The data is given as absorption values, after referencing, calibration and temperature correction.

Reference lines

A reference line is a data line that has some extra information appended to it.

1. The first number after the data values is the temperature (deg C).
2. The second number is the sample rate (samples per second).
3. The third number is the depth (in meters, if the meter supports depth).
4. The fourth number is the external temperature, if the meter supports it.
5. The rest of the line contains channel reference values.

A full data line with references then looks like:

Time $Chan_1$ $Chan_2$ ... $Chan_n$ Temp Rate Depth ExtTemp Ref_1 Ref_2 ... Ref_n

The reference values are raw values; no scaling or calibration is applied to them. These are the values that are used in computing the data values for the following set of data lines.

There is a possible ambiguity when the collection bin size is greater than one. Since a bin contains multiple samples, some of the samples in a bin may be computed with one set of reference values and others computed with a different set. The ac-9 uses one set of references for every ten samples. If the collection bin size is six, the first bin (six samples) uses the same reference values, but the second bin uses one set of references for the first four samples and a different set for the last two samples. This makes deconvoluting to the raw data rather complicated.

If you need to deconvolute to raw data, choose a bin size of 1, 2, 5, 10 or an integer multiple of ten. This ensures that the reference values given for a bin apply to all samples in that bin.

Example

For example, given the configuration file:

```
ac9 Absorption and Attenuation Meter
04000103        ; serial number
2               ; structure version number
Reserved        ; reserved for future
5.41000 0.27000 ; depth calibration
19200           ; baud rate
0.10            ; pathlength = 10 cm
a650 Blue  1.20000 23.00000 2.43000
a560 Green  1.13000 23.00000 2.45000
a532 Brown  1.24000 23.00000 2.65000

c712 Red   1.08000 23.00000 2.31000
c676 Magenta 1.41000 23.00000 2.74000
c660 Gray  1.55000 23.00000 2.56000
a488 LtBlue 1.16000 23.00000 2.44000
a456 LtGreen 1.19000 23.00000 2.52000
a412 Yellow 1.33000 23.00000 2.54000
c650 Blue  0.98000 23.00000 2.47000
c560 Green  1.58000 23.00000 2.36000
```

```
c532 Brown  1.94000 23.00000 2.51000
a712 Red   1.32000 23.00000 2.57000
a676 Magenta 1.74000 23.00000 2.46000
a660 Gray  1.83000 23.00000 2.49000
c488 LtBlue 1.35000 23.00000 2.38000
c456 LtGreen 1.50000 23.00000 2.33000
c412 Yellow 1.11000 23.00000 2.39000
0.0035 0.004 0.015 0.02 0.015 0.02 2500 2000 1000 0.01 0.01 …
0             ; auxiliary capabilities
```

The data file for an ac-9 begins as:

```
WetView ver 5.0   06/22/93 08:17:44
ac9 Absorption and Attenuation Meter
04000103       ; serial number
2              ; structure version number
Reserved       ; reserved for future
5.41000 0.27000   ; depth calibration
19200          ; baud rate
0.10           ; pathlength = 10 cm
a650 Blue  1.20000 23.00000 2.43000
a560 Green  1.13000 23.00000 2.45000
a532 Brown  1.24000 23.00000 2.65000


c712 Red   1.08000 23.00000 2.31000
c676 Magenta 1.41000 23.00000 2.74000
c660 Gray  1.55000 23.00000 2.56000
a488 LtBlue 1.16000 23.00000 2.44000
a456 LtGreen 1.19000 23.00000 2.52000
a412 Yellow 1.33000 23.00000 2.54000
c650 Blue  0.98000 23.00000 2.47000
c560 Green  1.58000 23.00000 2.36000
c532 Brown  1.94000 23.00000 2.51000
a712 Red   1.32000 23.00000 2.57000
a676 Magenta 1.74000 23.00000 2.46000
a660 Gray   1.83000 23.00000 2.49000
c488 LtBlue 1.35000 23.00000 2.38000
c456 LtGreen 1.50000 23.00000 2.33000
c412 Yellow 1.11000 23.00000 2.39000
0.0035 0.004 0.015 0.02 0.015 0.02 2500 2000 1000 0.01 0.01 …
0        ; auxiliary capabilities
1        ; acquisition binsize
0     1.53275  1.13881  1.31256  0.51315   1.41231    2.51512 ...
160   1.53070  1.13055  1.31583  0.51229   1.41614    2.51415 ...
330   1.53627  1.13536  1.31511  0.51467   1.41151    2.51614 ...
(etc)
```

The fields for the reference line for the ac-9 are:

field #	contents
1	time in milliseconds
2	absorption for 650 nm
3	absorption for 560 nm
4	absorption for 532 nm
5	attenuation for 712 nm
6	attenuation for 676 nm

7	attenuation for 660 nm
8	absorption for 488 nm
9	absorption for 456 nm
10	absorption for 412 nm
11	attenuation for 650 nm
12	attenuation for 560 nm
13	attenuation for 532 nm
14	absorption for 712 nm
15	absorption for 676 nm
16	absorption for 660 nm
17	attenuation for 488 nm
18	attenuation for 456 nm
19	attenuation for 412 nm
20	temperature (^{o}C)
21	sample rate (samples per second)
22	depth (meters)
23	reserved
24	reference for a650
25	reference for a560
26	reference for a532
27	reference for c712
28	reference for c676
29	reference for c660
30	reference for a488
31	reference for a456
32	reference for a412
33	reference for c650
34	reference for c560
35	reference for c532
36	reference for a712
37	reference for a676
38	reference for a660
39	reference for c488
40	reference for c456
41	reference for c412

The information in a data line is exactly the same as the first 19 fields of the reference line.

ac-9 Raw Data

Below is one record of raw data that was captured from the device. It has been converted to hexadecimal, formatted and commented. Note that the two-byte and four-byte values are byte-reversed. That is, the bytes within a word are read from right to left. This reflects the way the Intel 386 and 486 processors store values in memory.

00FF00FF	registration word
7A02	record length, from this word through checksum
21010000	serial number
0000	status
DB13	sample rate
1600	depth
34FF	external temperature

`6410 171E 89 2D20 0F 0319 1B …`	first sample, time and data
`7510 171E CB 2C20 EE 0119 A3 …`	second sample, time and data
`8510 161E 84 2E20 0A 0119 F2 …`	o
`9510 131E F1 2920 DE FE18 DF …`	o
`A510 151E 9B 2B20 BC 0119 51 …`	o
`B510 151E 7A 2B20 BA 0119 9A …`	
`C510 161E 5D 2C20 99 0019 49 …`	
`D510 141E F5 2B20 85 0019 B1 …`	
`E510 121E 3F 2820 76 FF18 11 …`	
`F610 141E 05 2A20 5E 0019 35 …`	tenth sample, time and data
`7804 C8 B604 C0 A603 66 …`	3 references and temperature
`9701`	temperature
`65D00000`	checksum (FF00FF00 through refs)
`00000000`	padding (4 null bytes)

Registration word	= 00FF00FF hex
Record length	= 7A02 hex = 634 bytes
Serial number	= 00000121 This is the thirty-third ac-9 meter produced. Production numbers begin with 0100 hex.
Status	= 0000 Zero indicates normal operation.
Sample rate	= 14F9 hex = 5083 This is a count of the time used to take one sample. It is scaled by 0.0000316 to match the hardware's clock rate, then inverted to give samples per second: 1 / (5083 * 0.0000316) = 6.226
Depth	= 0016 hex = 22 This reflects the voltage read from the depth sensor. It is scaled and offset by the values from the configuration file. 22 * 0.3 + 5.3 = 11.9 meters
External Temp	= 34FF hex This word is ignored for this meter because the meter does not have an external temperature probe in it. This is determined by the last line of the configuration file: the value is zero.

For the purpose of this discussion, we skip to the third-from-last line of the data record. This is the reference line, and values here will be used in the computation of the absorption values for each channel.

Reference a610

= 7804 C8 hex = 13108344
This is the reference value for the first channel (ab610). This is a 24-bit value indicating the output from an analog to digital converter. This represents a fraction of the input voltage. To convert from counts to this fraction, the value is divided by 2^{24} (16777216).

13108344/16777216 = 0.7813

Temperature

= 0F01 hex = 271
The temperature is given as a reading from a thermistor. The manufacturer of the thermistor provides a table correlating the reading (counts) to temperature. That table fits the polynomial equation given above. Using 407 counts, we get: 10.61831

+ 0.045113 * 271

+ -4891.32 * 1/271

+ 208130.2 * $1/271^2$

+ 1171473 * $1/271^3$ = 7.69 degrees C

Absorption 610

= 171E 89 hex = 8986135
This is the signal value for the first channel (a610). This 24-bit value is converted to raw voltage in the same manner as for reference values.

8986135 / 16777216 = 0.5356 VDC

Raw absorption is computed from the signal and reference values as described above:

$$a_{raw} = \frac{-\ln\left(\frac{E_{sig}}{E_{ref}}\right)}{Z}$$

The device's optical path length is read from the configuration file.

$$a_{raw} = \frac{-\ln\left(\frac{0.5356}{0.7813}\right)}{0.25} = 1.5103 \ \text{meter}^{-1}$$

The temperature correction is then applied using the temperature from the reference line and the channel's correction table from the configuration file. The approximate correction value is linearly interpolated from the table. First, the correct temperature bin is determined by finding the two bin temperatures, T_0 and T_1, that bracket the current temperature. Then, using the values, Δ_{Tn} and Δ_{Tn+1}, from the table,

$$\Delta_T = \Delta_{Tn} + \frac{(T - T_0)}{(T_1 - T_0)} * (\Delta_{Tn+1} - \Delta_{Tn})$$

where,

Δ_T=compensation constant

T=current temperature, 7.69

T_0=first bin temperature, 5.5233

T_1=second bin temperature, 8.4553

Δ_{Tn}=first value, 0.1411

Δ_{Tn+1}=second value, 0.1028

Using these values,

$$\Delta_T = 0.1411 + \frac{(7.69 - 5.5233)}{(8.4553 - 5.5233)} * (0.1028 - 0.1411) = 0.1127\text{m}^{-1}$$

Subtracting this from the raw absorption,

$$\begin{aligned} a' &= a_{raw} - \Delta_T \\ &= 1.5103 - 0.1127 \\ &= 1.3976 \end{aligned}$$

Finally, adding in the calibration offset for a610,

$$\begin{aligned} a &= a' + C \\ &= 1.3976 + 7.6242 \\ &= 9.0218 \end{aligned}$$

Checksum = 65D00000 = 53349

The checksum is the sum of all the bytes of the record, beginning with the registration word and ending with the temperature. For this record, the checksum is 53349. This is used to verify that the record was received correctly by WETView.

Padding = 00000000

These four null bytes separate records. They are ignored. The advantage of having them is that if a character is lost in transmission, WETView will read one byte past the end of the corrupted record. If there were no padding bytes, the first byte of the next record would have been read, corrupting that record as well. With the padding bytes, however, if a character is lost in transmission, then WETView will read one byte past the end of the record, which will be a padding byte, and it can be safely discarded. The next record will be read correctly.

Appendix B—ac-s Meter Files

ac-s Configuration File

ac-s configuration files (with file extension .DEV) give calibration and other information specific to a particular meter. These files are tab-delimited text files and have the following format:

Line 1	Device name.
Line 2	Serial number. The serial number of the device that was used to collect the data.
Line 3	Version number of the following structure. This should be "3" or greater.
Line 4	Reserved for future use.
Line 5	Calibrations for depth meter: there are two values, the first is an offset and the second is a multiplier.
Line 6	Serial port baud rate the instrument uses.
Line 7	Optical path length through water (in meters).
Line 8	Number of output wavelengths.
Line 9	Number of temperature compensation bins.
Line 10	Several values (the count is given in the preceding line); each value is the average temperature for each temperature bin.
Lines 11–varies *(dependent on value in line 8)*	Each line describes one wavelength pair of the instrument; the first five fields are: label for identifying the c wavelength label for identifying the a wavelength color for plotting within WETView clean water calibration constant for attenuation, c clean water calibration constant for absorption, a The rest of the line contains temperature compensation values that correspond to the temperature bins given in the previous line. The first *n* values are for c, the next *n* values are for a, where *n* is the number of temperature bins.
Varies *(dependent on value in line 8)*	Reserved for future use.

For example:

ACS Meter
53000002 ; Serial number
3 ; structure version number
Reserved
0 1 ; Depth calibration
115200 ; Baud rate
0.25 ; Path length (meters)
80–90 ; output wavelengths
63 ; number of temperature bins

					7.632727	8.171312	8.706667	9.219706	9.727826…
C398.6	A397.5	8	1.691751	-0.80038		0.018293	0.017729	0.017763	0.016839…
C402.2	A400.9	10	1.770073	-0.41443		0.018396	0.018062	0.017715	0.016939…
C405.7	A404.5	11	1.81221	-0.09669		0.018499	0.018026	0.017409	0.016157…
C409.4	A408.2	12	1.82833	0.132231		0.015788	0.015389	0.014772	0.013682…
C413.0	A411.8	13	1.84002	0.285005		0.018766	0.01837	0.018024	0.016658…
C417.0	A415.7	15	1.850093	0.382613		0.016909	0.01643	0.015824	0.015166…
C420.9	A419.6	16	1.856859	0.453001		0.016226	0.015822	0.015416	0.014600…
⋮									
C730.6	A730.7	106	-0.28523	0.017783		0.004847	0.004845	0.004855	0.004802
C734.2	A734.4	107	-0.50568	-0.17825		0.004823	0.004771	0.004818	0.004686
C737.9	A737.9	109	-0.676	-0.32109		0.004798	0.004803	0.004837	0.004833
C741.5	A741.4	110	-0.78822	-0.40855		0.004683	0.004676	0.004701	0.004667
C745.2	A744.9	111	-0.85581	-0.45682		0.004321	0.00431	0.004344	0.004257
C748.8	A748.6	112	-0.89734	-0.47902		0.004134	0.004146	0.004179	0.004176
C752.3	A752.0	114	-0.91907	-0.48634		0.004145	0.004146	0.004201	0.004071
C755.5	A755.5	115	-0.93167	-0.48493		0.003956	0.00395	0.003961	0.003925
0	0	0	0	0	0	0	0	0	0

ac-s WETView Data Files

WETView saves data files in tab-delimited format. The file format for data files is as follows:

Line 1	Header line. Identifies the version of the program that created the file, and the time and date of creation.
Line 2–98	Exactly the same format as the configuration file. These lines contain the calibration information that was used while collecting the data.
Line 99	Acquisition bin size
Line 100	Wavelength labels
Lines 101–*n*	Data lines. Each line starts with a zero-based time stamp. Times are in milliseconds from the time the data collection starts. The first 86 columns are "c" values, followed by the "a" values. then internal temperature, , , , and.

After the data, there are eight additional columns:

1. instrument temperature (deg C)
4. filter wheel speed diagnostic
5. pressure
6. external temperature
7. four columns of dark values

A data line then looks like:

Time $c(\lambda_1)$, $c(\lambda_2)$,… $c(\lambda_n)$, $a(\lambda_1)$, $a(\lambda_2)$, … $a(\lambda_n)$ int. temp, diagnostic, pressure, ext. temp, dark, dark, dark, dark

Example data file:

```
WetView
ver 7.0         11/3/03     9:26:13
ACS Meter
53000002                          ; serial number
3                                 ; structure version number
Reserved
0                    1            ; Depth calibration
115200                            ; Baud rate
0.25                              ; Path length (meters)
80–90                             ;Output wavelengths
33                                ; number of temperature bins
                                                              0 ; temperature bins

C399.574  A397.577           8  0.834057   -0.40889          0.012469  0.012711    0.01349…
C403.161  A401.155          10  0.839778   -0.18519          0.012172  0.012505   0.012554…
C406.76   A404.773          11  0.849354  0.051999           0.011779   0.01243   0.012282…
C410.482  A408.416          12  0.855933  0.245707           0.011866  0.012792   0.012571…
```

C414.072	A412.172	13	0.867732	0.384503		0.013137	0.013593	0.01367…
C417.901	A416.138	15	0.881948	0.478344		0.01188	0.012485	0.012429…
C421.964	A420.024	16	0.902806	0.541544		0.012572	0.013131	0.013225…
C426.069	A424.002	17	0.92668	0.586729		0.013561	0.014083	0.01365…
C430.248	A428.324	18	0.944917	0.625062		0.01167	0.012394	0.01234…
C434.416	A432.434	20	0.960641	0.661356		0.012023	0.012732	0.012885…
C438.594	A436.657	21	0.973538	0.695719		0.01173	0.012489	0.012435…
C442.707	A440.827	22	0.986726	0.730411		0.011702	0.012497	0.012462…
C446.933	A445.194	23	0.997492	0.764348		0.011456	0.01212	0.012393…
C451.282	A449.474	LtBlue	1.009458	0.798393		0.012098	0.012729	0.012767…
C455.74	A453.843	26	1.023926	0.831253		0.012313	0.012988	0.013176…

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C750.235	A748.13	112	1.201872	2.112206		0.00529	0.006012	0.006551…
C753.62	A751.57	114	1.201639	2.122247		0.005119	0.005896	0.006448…
C756.521	A754.65	115	1.200377	2.132103		0.005052	0.005757	0.006322…
0	0	0	0	0	0	0	0	0…
10			; acquisition binsize				…	

	C399.574	C403.161	C406.76	C410.482	C414.072	C417.901	C421.964	C426.069…
4500	-0.00283	-0.00193	-0.00485	-0.00604	-0.00795	-0.00449	-0.00593	-0.00623…
9500	-0.00425	-0.00287	-0.00725	-0.00765	-0.00751	-0.00633	-0.00714	-0.00646…
14500	-0.00554	-0.00699	-0.00338	-0.00722	-0.00529	-0.0079	-0.00491	-0.00707…
19500	-0.00561	-0.00444	-0.00816	-0.0049	-0.00278	-0.0085	-0.00445	-0.00557…
24500	-0.00364	-0.00055	-0.0018	-0.00276	-0.00429	-0.00345	-0.00506	-0.0055 …
29500	-0.0036	-0.00869	-0.00621	-0.0041	-0.00558	-0.00591	-0.00664	-0.0048…
34500	0.00088	-0.00263	-0.00256	-0.00676	-0.00609	-0.0044	-0.00618	-0.00556…
39500	0.00213	-0.0038	-0.00233	-0.00397	-0.00695	-0.00422	-0.00369	-0.00527…

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ac-s Raw Data

Below is one record of raw data that was captured from the device. It has been converted to hexadecimal, formatted and commented.

ff00ff00	Packet registration
02D0	Record length of full packet (not including chksum) = 720
04	Packet Type 03 and above designates an ac-s meter
01	unused by ac-s
53	meter type—53 indicates an ac-s
000002	serial number
4e1a	sample to sample delta time in 25 µs counts (0.49985 sec)
01ba	Reserved
02a1	Reserved
7ae4	raw external temp counts = 26.82 °C
b9d7	raw internal temp counts = 27.93 °C
01d5	Reserved
02b0	Reserved
00071b02	time in milliseconds since power up (465666 = 7.761 mins)
01	Reserved
56	Number of output wavelengths = 80–90 decimal (86 in this example)
0405	raw $cref_1$ counts
0363	raw $aref_1$ counts
04f4	raw $csig_1$ counts
0310	raw $asig_1$ counts
0498	raw $cref_2$ counts
20bb	raw $cref_{86}$ counts
19bf	raw $aref_{86}$ counts
2c49	raw $csig_{86}$ counts
2c1c	raw $asig_{86}$ counts
2243	Checksum
00	pad byte

Registration word	= FF00FF00 hex
Record length	= 02D0 hex = 720 bytes
Packet type	= 04 Reserved for future use.
Reserved	= 01
Meter Type	= 53
Serial Number	= 000002 This is the second ac-s meter produced (production numbers begin with 0000 hex).
Status	= 4E1A Sample to sample delta time in 25 us counts (0.49985 sec)
Reserved	<2 undefined bytes> Reserved for future use.
Reserved	<2 undefined bytes> Reserved for future use.
External Temperature	= 7AE4 hex = 31460 The external temperature is derived from a voltage drop across a thermistor. The temperature is calculated from a polynomial to convert counts to temperature. The polynomial to convert counts to temperature is: $y = a \times counts^3 + b \times counts^2 + c \times counts + d$ where a = -7.1023317 E-13, b = 7.09341920 E-8, c = -3.87065673 E-3, and d = 95.8241397 which yields an external temperature of 22.14ºC
Internal Temperature	= B9D7 hex = 47575 The internal temperature is derived from a voltage drop across a thermistor. The temperature is calculated from an equation to convert the thermistor resistance to temperature. The equation for converting the raw A/D counts to volts is: volts = (5 × counts / 65535) which yields 3.6297 The volts are then converted to resistance using the equation: resistance = 10,000×volts/(4.516 – volts) which yields 40,956.7 ohms The equation to convert resistance to temperature is:

$$temp = \frac{1}{a + b \times \ln(res) + c \times (\ln(res))^3} - 273.15$$

where a = 0.00093135, b = 0.000221631, and c = 0.000000125741

which yields

$$T = \frac{1}{a + b \ln 40956 + c(\ln 40956)^3} - 273.15 = 17.91\ ^{\circ}\mathrm{C}$$

Reserved	<4 undefined bytes> Reserved for future use.
Time since power up	= 0071b02 hex = 465666ms = 7.761 minutes
Number of output wavelengths	=56 hex = 86
Data, wavelength 1	= 0405 0363 04f4 0310 hex = 1029 867 1268 784

This is the data read for the first wavelength: c reference, a reference c, and a channels, respectively. Raw absorption is computed from the signal and reference values as described above:

$$a_{raw} = \frac{-\ln\left(\frac{E_{sig}}{E_{ref}}\right)}{Z}$$

Which yields $a_{raw} = -\ln(784/867)/0.25 = 0.402\ m^{-1}$ and $c_{raw} = -\ln(1268/1029)/0.25 = -0.835\ m^{-1}$.

The channel's calibration constant and the device's optical path length are read from the configuration file.

The temperature correction is then applied using the internal temperature and the channel's correction table from the configuration file. The approximate correction value is linearly interpolated from the table. First, the correct temperature bin is determined by finding the two bin temperatures, T_0 and T_1, that bracket the current temperature. Then, using the values, Δ_{Tn} and Δ_{Tn+1}, from the table,

$$K_T = v_0 + \frac{(T - T_0)}{(T_1 - T_0)} * (v_1 - v_0)$$

where,

Δ_T = compensation constant

T = current temperature, 27.93

T_0 = first bin temperature, 27.75

T_1 = second bin temperature, 28.2625

Δ_{Tn} = first value, 0.010124

Δ_{Tn+1} = second value, 0.015096

Using these values,

Δ_T = 0.010124+(27.93-27.75)/(28.2625-27.75) * (0.015096-0.010124)

= 0.012

Subtracting this from the raw absorption,

a' = 0.402 – 0.012 = 0.039

Finally, adding in the calibration offset for a397.5,

a = *a'* + *C* = 0.039 -0.431 = -0.392

Checksum = 2243 = 8771

The checksum is the sum of all the bytes of the record, beginning with the registration word and ending with the byte just before this checksum. For this record, the checksum is 8771. This is used to verify that the record was received correctly by WETView.

Revision History

Revision	Date	Revision Description	Originator
A	02/08/00	Begin revision control	H. Van Zee
B	04/12/00	Correct calibration offset for ac-9 (DCR 20)	C. de Lespinasse
C	05/23/00	Correct data and device files for HiStar (DCR 31)	D. Hankins, H. Van Zee
D	07/12/00	Correct equation on temperature correction algorithm (DCR 47)	C. de Lespinasse
E	4/12/01	Delete references to three-spectrometer HiStar (DCR 102)	D. Hankins
E1	2/4/04	Update to include ac-s, delete HiStar references	B. Rhoades
F	2/9/04	Approved revisons in E1 (DCR 359)	D. Hankins, B. Rhoades