A2101

WATER ACTIVITY METER

INSTRUCTION MANUAL

1. INTRODUCTION

The A2101 is used to measure the water activity of food or pharmaceutical products within the range of 0.01 to 1.00 Aw. Accuracy is 0.015 Aw or better with 0.003 Aw repeatability. The A2101 includes the following:

- AwQuick indicator with AC adapter
- AwVC ventilated humidity-temperature probe
- WP14 (shallow) and WP40 (deep) sample holders
- One pack each of PS14 and PS40 disposable sample cups (100 cups per pack)
- Four boxes of certified humidity standards (5, 10, 35 and 80%RH / 5 vials per box).

The A2101 has two main modes of operation:

a) **Measuring Mode** (accelerated water activity measurement): the data provided by the humidity-temperature probe is processed by the AwQuick indicator and the water activity of the product sample is computed in typically 4 to 6 minutes, well before actual equilibration of the product sample can take place. When stable temperature conditions are provided, the calculation of Aw typically agrees within 0.005 Aw or better with the result provided by a conventional measurement of water activity (see below).

b) **Recording Mode** (conventional water activity measurement): the data provided by the humidity-temperature probe is recorded by the AwQuick indicator. Equilibration of the product sample (both humidity and temperature) is automatically detected to end the recording process. Ventilation of the product sample by the probe allows most products to equilibrate in 30 to 45 minutes as opposed to the 60 to 90 minutes typical of non ventilated probes. After recording the equilibration of a product sample, the data can be transferred to a PC and imported into a spreadsheet program such as Microsoft's Excel.

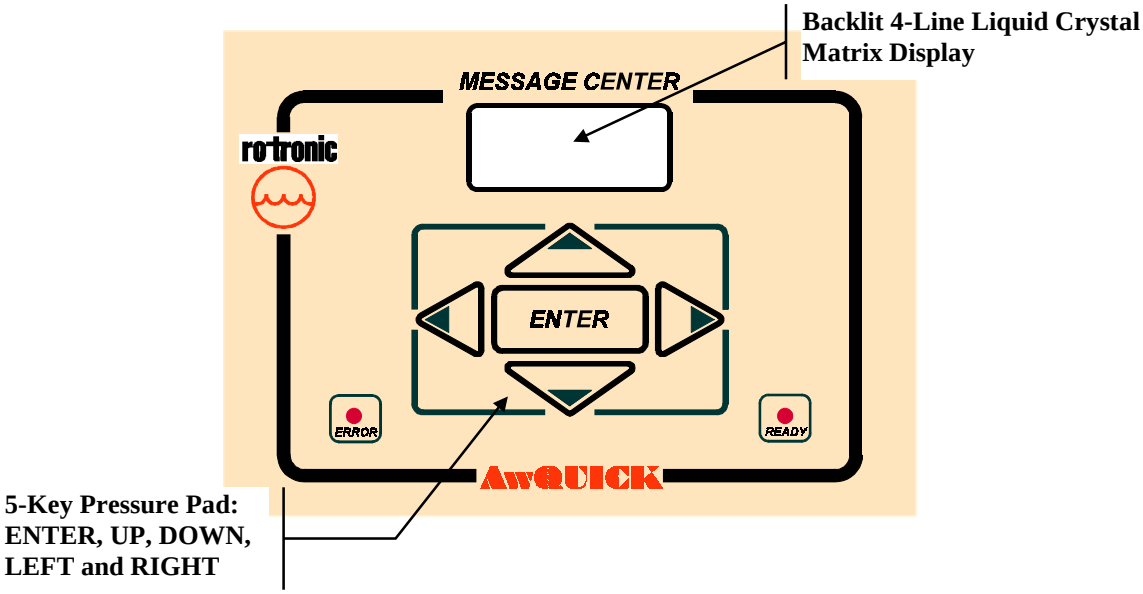
Because temperature stability is essential to the correct measurement of water activity, the AwQuick will provide a warning in both modes when the temperature conditions can degrade the accuracy of measurements. See Appendix 1 for more details.

In both modes, the defaults settings of the A2101 will provide good results for the vast majority of products. These settings can be changed either manually or automatically to meet specific requirements. In particular, the Measuring Mode can be optimized for up to 20 different types of product.

Performance of the A2101 is easily maintained in the field with the Rotronic certified humidity standards or with saturated salt solutions. The AwQuick indicator permits calibration of humidity at 5 different reference values which can be freely chosen.

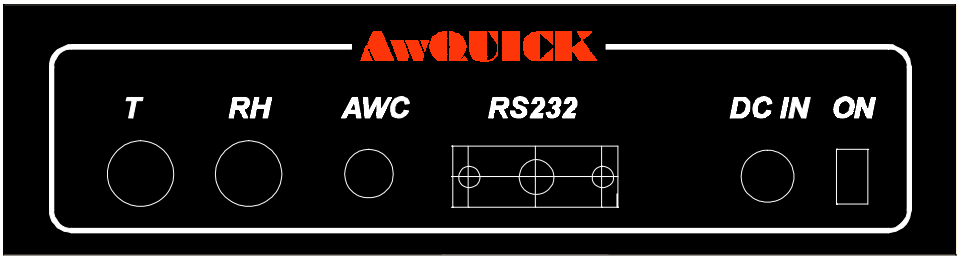
2. PHYSICAL DESCRIPTION

2.1 AwQuick Front Panel



The front panel also includes a Green LED (Ready) and a Red LED (Error). All instructions to the AwQuick are entered with the five keys of the pressure pad. The display repeats the instructions and shows the results.
☞ *Press and hold the UP or the DOWN key for a faster change.*

2.2 AwQuick Back Panel



The back panel includes the following (from left to right when facing the panel):

- **T**: Temperature Analog Output Phono Plug (0..1 VDC = 0..100°C)
- **RH**: Humidity Analog Output Phono Plug (0..1 VDC = 0…1.000 Aw)
- **AWC**: 5-Pin Connector for the Rotronic Hygromer™ AwVC probe
- **RS232**: 9-Pin Connector for downloading Data to a PC.
- **DC IN**: Connector for the A/C adapter (9 VDC)
- **ON**: On/Off sliding Switch

2.3 Keyboard

The keyboard features 5 keys: ENTER (center), UP and DOWN (upper and lower keys), LEFT and RIGHT (left and right keys).

The ENTER, LEFT and RIGHT keys are one step keys: they must be pressed and released once for each command. The UP and DOWN keys have a repeat feature. These keys can be either briefly pressed and released (one step command) or they can be pressed continuously to move rapidly across menus and selections.

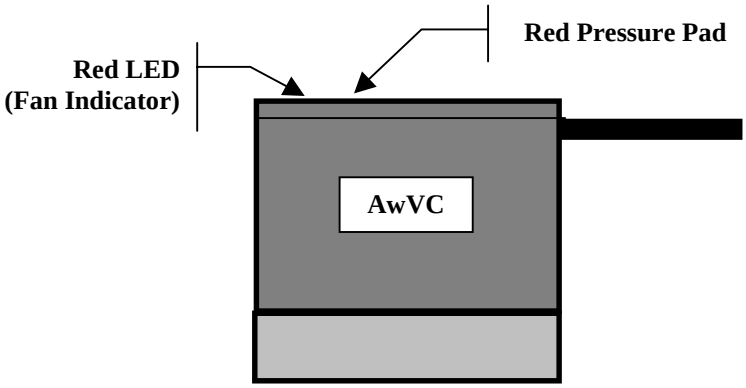
2.4 Sounder

The AwQuick has a sounder to acknowledge each keyboard entry with a short beep. Two long beeps signal the end of a process (instrument ready). Several short beeps signal a potential problem.

2.5 AwVC Humidity-Temperature Probe

The AwVC humidity-temperature probe uses a Rotronic Hygromer™ C94 capacitive humidity sensor to measure humidity and a Pt100 RTD to measure temperature. The probe is powered from the AwQuick indicator and provides two linearized analog voltage signals (0..1 VDC equals 0 to 100°C and 0.000 to 1.000 Aw). Both signals are available on the Phono plugs located on the back panel of the AwQuick.

The AwVC uses a small fan to circulate air past the product sample and accelerate equilibration of the product sample. **When powering up the system, be sure to turn on the fan by pressing once on the red pressure pad located on top of the probe**. A blinking LED located on top of the probe indicates that power is being applied to the fan. **The AwVC probe will not measure properly if the fan is blocked or is not powered.**



During measurements, the AwVC probe is placed on top of the sample holder. An O-Ring located on the bottom of the AwVC provides adequate sealing of the product sample.

3. IMPORTANT GUIDELINES

The A2101 water activity meter is straightforward and easy to use. To ensure accurate and repeatable results, please follow these basic guidelines:

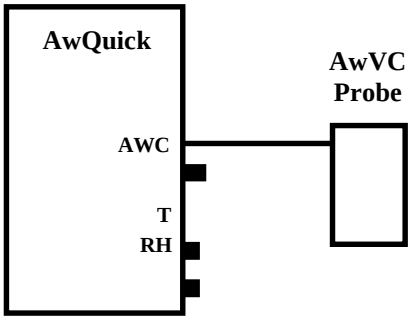
- **Measure water activity only in a temperature stable area (*).**
- **Prior to measurements, place each product sample in a disposable sample cup with the cover on. Place the cups in the same area as the probe. Allow for sufficient time for the samples to come to the temperature of the probe (usually room temperature **).**
- **Avoid warming up the probe, the sample holder or the product sample by touching or holding for too long in your hand.**

(*) Do not measure on a bench that is located near a heater, an AC vent or an open window. Avoid direct exposure of the probe and/or product samples to sun light .

(**) A frequent mistake is to measure product samples which have been kept overnight in a refrigerator without first allowing them to come to room temperature. Another mistake is to measure hot samples coming straight from the manufacturing process. To measure water activity at a temperature other than room temperature, place both the probe and the product samples in an incubator set at the desired temperature.

4. SETTING UP THE SYSTEM

- Connect the AwVC probe to the AwQuick back panel:



Note: the Phono plugs (T and RH) may be connected to a voltmeter to directly read the probe output signals.

- Connect the 9 VDC AC adapter to the supply voltage connector (back panel).

• Turn the power on with the On/Off switch (back panel). **Turn on the probe fan by pressing once on the red pressure pad located on top of the probe**. Check that the red LED on the top of the probe is flashing. Holding you hand close to the bottom of the probe, you should feel a very slight breeze.

The AwQuick begins with an internal test. The results of this test as well as the version number are briefly shown on the display. At the end of this process, the green LED (Ready) should be steadily on. The red LED (Error) stays on only if a problem was detected during the test, indicating that the unit should be sent back for repair. The AwQuick is now ready and the display shows:

MAIN MENU

PRESS ENTER TO
MEASURE Aw

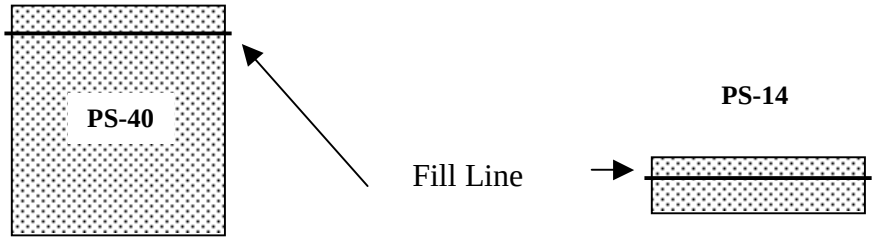
The AwQuick is a menu driven indicator which defaults to the Measurement Mode upon being powered. The other menus are described later on in this manual. Menu selections are made by using either the UP or the DOWN key, followed by pressing the ENTER key.

5. PREPARATION OF THE PRODUCT SAMPLES

The A2101 is supplied with two different sample holders (WP-14: shallow / WP-40: deep) and with two packs of 100 disposable sample cups (PS-14: shallow / PS-40: deep). Use the shallow sample cups (PS-14) and the shallow sample holder (WP-14) for calibrating the probe with the Rotronic certified humidity standards or with saturated salt solutions. In general, use the shallow cups for a liquid, a paste or a powder. Use the deep sample cups (PS-40) and the deep sample holder (WP-40) for products in bulk (large chunks).

The disposable sample cups serve two purposes:
(a) provide a means storing product samples prior to measurements so that they can come to the same temperature as the probe
(b) prevent contamination across samples.

Prior to measurements, fill a number of disposable sample cup with the products to be measured. The cups should be filled up to the fill line (see below).



Do not overfill the cups as the product would soil the probe during measurements. Close each cup with its cover to protect the sample from room humidity and place the cups in the same general area as the probe. **Allow for enough time for the samples to come to the temperature of the probe (usually room temperature)**.

Note: *the cover of the disposable sample cups does not provides adequate sealing for a long term storage of the samples. If the samples are to be stored in the cups for more than a few hours, use a tape to seal the cover.*

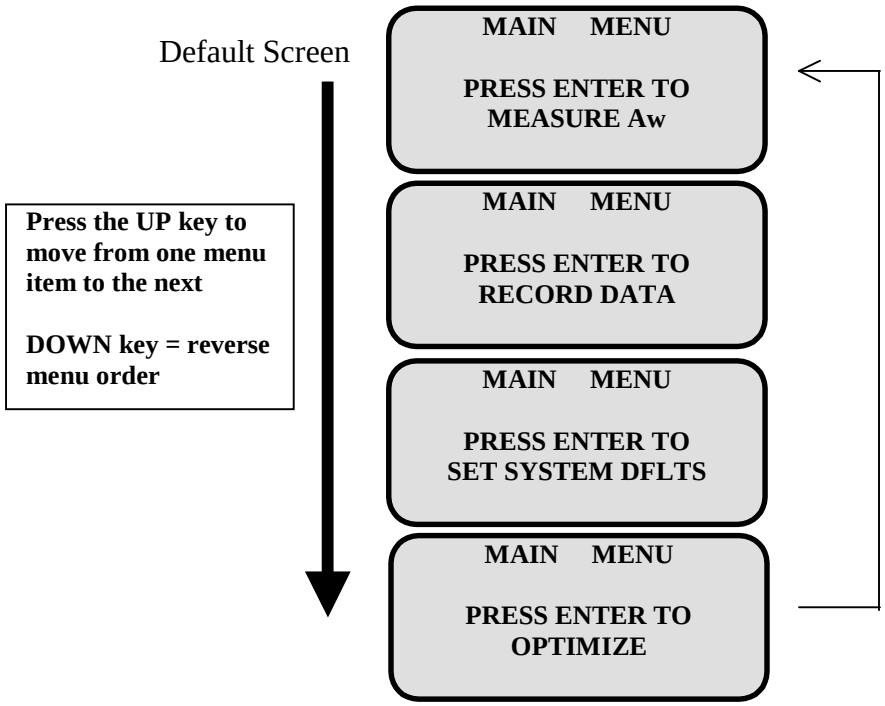
6. THEORY OF OPERATION

The A2101 water activity meter is the combination of a ventilated humidity and temperature probe (AwVC) with a microprocessor based indicator (AwQuick).

The AwVC probe measures humidity with the HYGROMER™ C94 capacitive relative humidity sensor and temperature with a precision RTD.

The AwQuick is a menu driven indicator that permits both the conventional measurement of water activity (Recording Mode) and the much faster measurement of water activity based on computations (Measuring Mode). The Measuring Mode is the default operating mode of the AwQuick.

6.1 The Main Menu



6.2 Measuring Mode (Computed Water Activity)

In the Measuring Mode, the AwQuick indicator monitors the data provided by the probe and computes the value of water activity, based on a mathematical model of the equilibration process. When successive computations agree with one another, the measurement is automatically ended and the results are displayed.

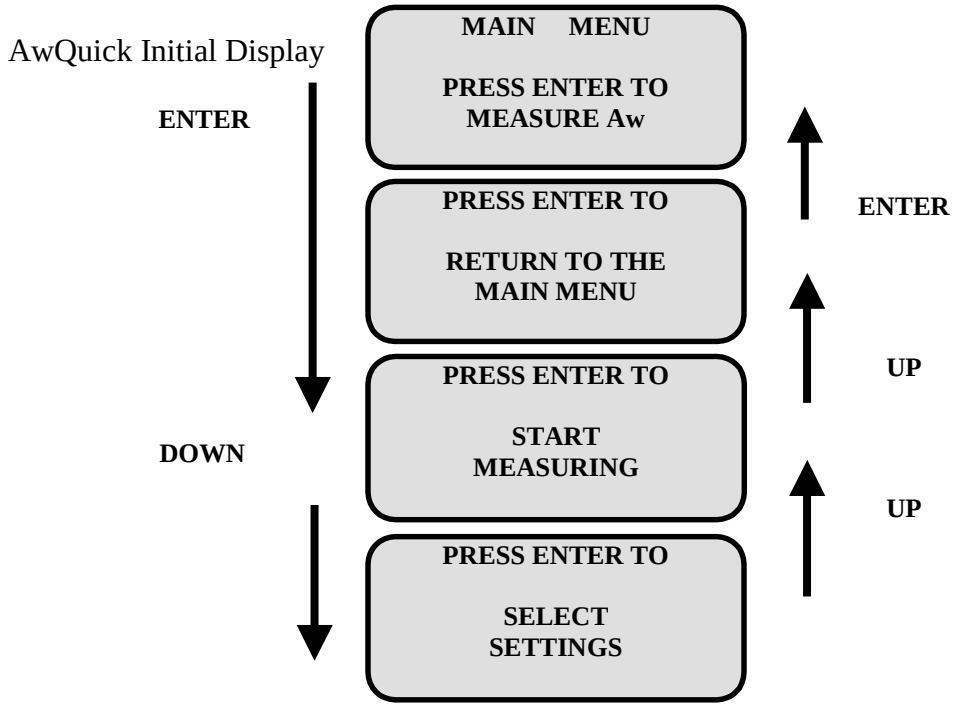
Comparisons with conventional water activity measurement show that the computed result typically agrees within 0.005 Aw or better. Usually, computations take only 10% of the time required by full product equilibration.

During the early stages of the measurement, the humidity data is often influenced by room humidity and temperature may have been disturbed as a result of handling both the probe and sample. Initial data is usually not representative and should not be used to compute the value of water activity . The **DWELL TIME** is the period of time during which data is disregarded by the AwQuick. By default, the AwQuick uses a Dwell Time of 3 minutes.

Temperature stability is essential when measuring water activity. The AwQuick indicator monitors temperature and provides a warning each time the temperature data appears to be problematic

The default settings of the AwQuick work well with most products. Exceptionally, when results need to be improved, the AwQuick indicator can be automatically or manually optimized for up to 20 different products (see 6.5 OPTIMIZE).

6.2.1 Measure Menu



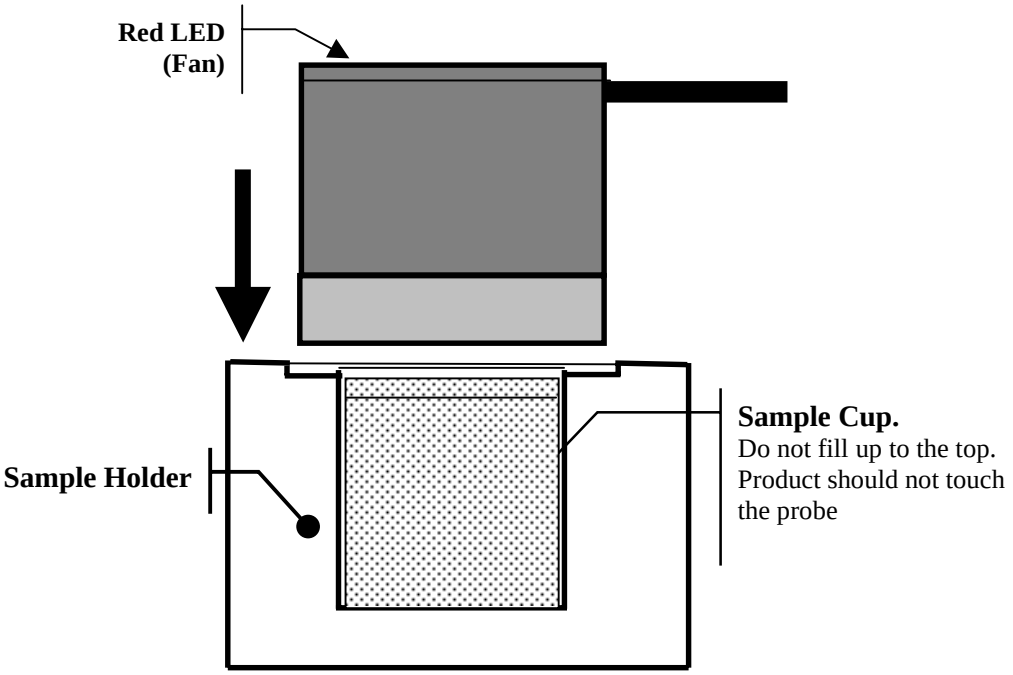
6.2.2 Start Measuring

The AwQuick stands ready to measure

PRESS ENTER TO

START MEASURING

When the samples are ready (sample temperature is about the same as the probe), remove the cover from the first sample cup and place the cup inside the matching sample cup holder. Put the probe on top of the sample holder. Make sure that the probe rests properly on the sample holder so that the O-ring located at the bottom of the probe can seal the sample. **Verify that the red LED at the top of the probe is flashing** (fan indicator).



Immediately after placing the probe on top of the sample holder, press the ENTER key on the AwQuick to start the measurement. The green LED (Ready) starts flashing and the following screen appears:

ENTER key:
If so desired, the measurement can be interrupted at any time by pressing the ENTER key.

DWELL 0:03

ENTER TO STOP
0.484 Aw 23.9°

Alternating with:

DWELL 0:03
TS
ENTER TO STOP
TIME: 00:02:10

Note: if temperature is not stable during measurements, the indicator TS will appear on the LC display. In that case, the red LED is on and the AwQuick gives several short beeps (see 6.2.3 Data Validation).

At the end of the Dwell Time:

Note: Aw is the current value of water activity and D (in %RH) is the absolute value of the difference between the current and previous values.

```
MEASURING Aw
D= 0.50  Aw= 0.809
ENTER TO STOP
0.794 Aw        23.9°
```

Alternating with:

Note: the indicator TS may appear. The red LED is on and the AwQuick gives several short beeps (see 6.2.3 Data Validation).

```
MEASURING Aw
TS+
ENTER TO STOP
TIME: 00:03:20
```

When the measurement is completed, the green LED stops blinking and the AwQuick gives two long beeps.

The display shows the results:

```
AwQuick RESULTS
        Aw = 0.896
AVG TEMP.  =  24.0°
      TIME     0:05
```

The last 3 lines of the display are the water activity, the average temperature during measurement and the time (in hours and minutes) taken by the measurement. Note the results before pressing the ENTER key..

If the temperature was not stable during the measurements, a warning is given and the red LED is turned on. Press the ENTER key again:

```
UNSTABLE
TEMPERATURE
```

Press the ENTER key to exit

```
PRESS ENTER TO

START
MEASURING
```

The AwQuick is ready for the next product sample.

6.2.3 Data Validation

In the Measure Mode, lack of temperature stability may extend the length of measurement and create substantial errors. The AwQuick indicator will provide the following warnings:

• The indicator **TS** appears on the display when the temperature data is not stable. Temperature stability is evaluated for the first time after 2 minutes of measurement. By default, the AwQuick considers that temperature is not stable when it changes by more than ±0.03°C / minute (this value can be increased in the Set Defaults Menu, see 6.4.4 T_STAB). A sign (+ or -) next to TS indicates a positive or a negative temperature trend.

• The red LED is turned on and the AwQuick emits a series of short beeps.

When the AwQuick gives these warnings, we recommend that you end the measurement by pressing the ENTER key and investigate the problem before measuring again. Lack of temperature stability may be the result of any of the following: (a) inadequate room conditions (such as an open window, an A/C system that quicks on and off, etc.) or (b) temperature difference between the product sample, the sample holder and the probe.

6.2.4 Select Settings

For the vast majority of products, the default settings provide accurate measurements in 4 to 6 minutes. To access other settings (see Optimize Menu), press the DOWN key when in the measure menu until the following screen appears:

```
PRESS ENTER TO

SELECT
SETTINGS
```

ENTER key:

This display appears unless another product was previously selected.

```
DEFAULT SETTINGS
DWL TIME     00:03
MAX TIME    32:00
REF TEMP     25.0°
```

DOWN key to access other settings

ENTER key to select these settings and exit

```
1  PRODUCT  # 1
DWL TIME     00:03
MAX TIME    32:00
REF TEMP    25.0°
```

DWL TIME : Dwell Time associated with the settings
MAX TIME : Maximum time allowed for measuring of recording
REF TEMP : Reference temperature associated with the settings
(last menu item of the Optimize Menu 6.5.2 to change this value).

6.3 Recording Mode (Conventional Aw Measurement)

The Recording Mode is used to do a full length measurement of product equilibration and to transfer the recorded data to a PC. .After an initial time period of 10 minutes, the AwQuick constantly monitors the stability of the humidity and temperature data. The recording of data is automatically ended when both the humidity and the temperature data are stable.

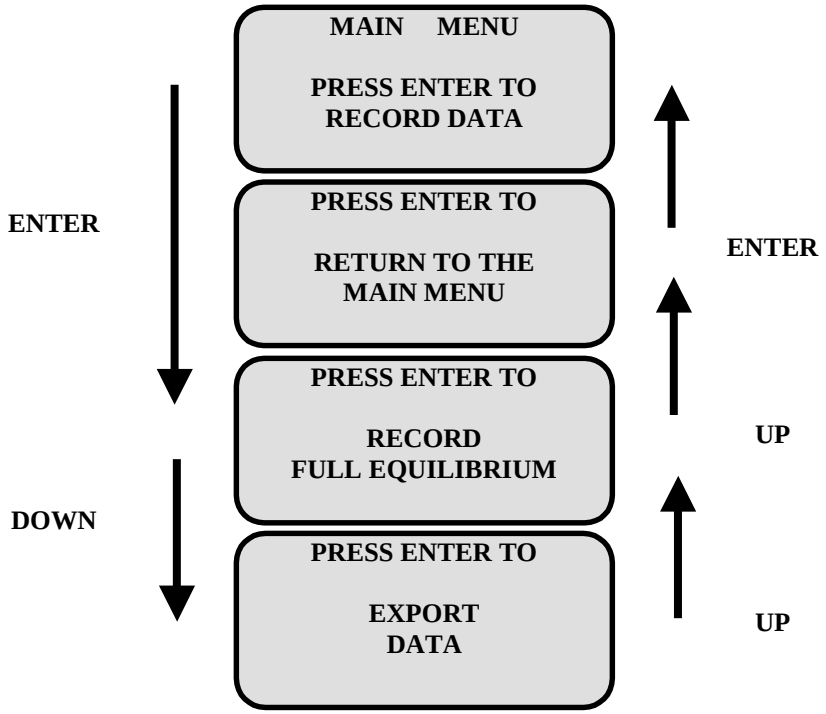
6.3.1 Record Menu

AwQuick Initial (default) Display

```
MAIN     MENU

PRESS ENTER TO
MEASURE Aw
```

UP key:



6.3.2 Record Full Equilibrium

PRESS ENTER TO

RECORD
FULL EQUILIBRIUM

Pressing the ENTER key starts the measurement (after placing a product sample in the probe as previously shown). During the recording of data, the green LED (Ready) keeps flashing.

RECORDING DATA

ENTER TO STOP
48.4% 23.9°

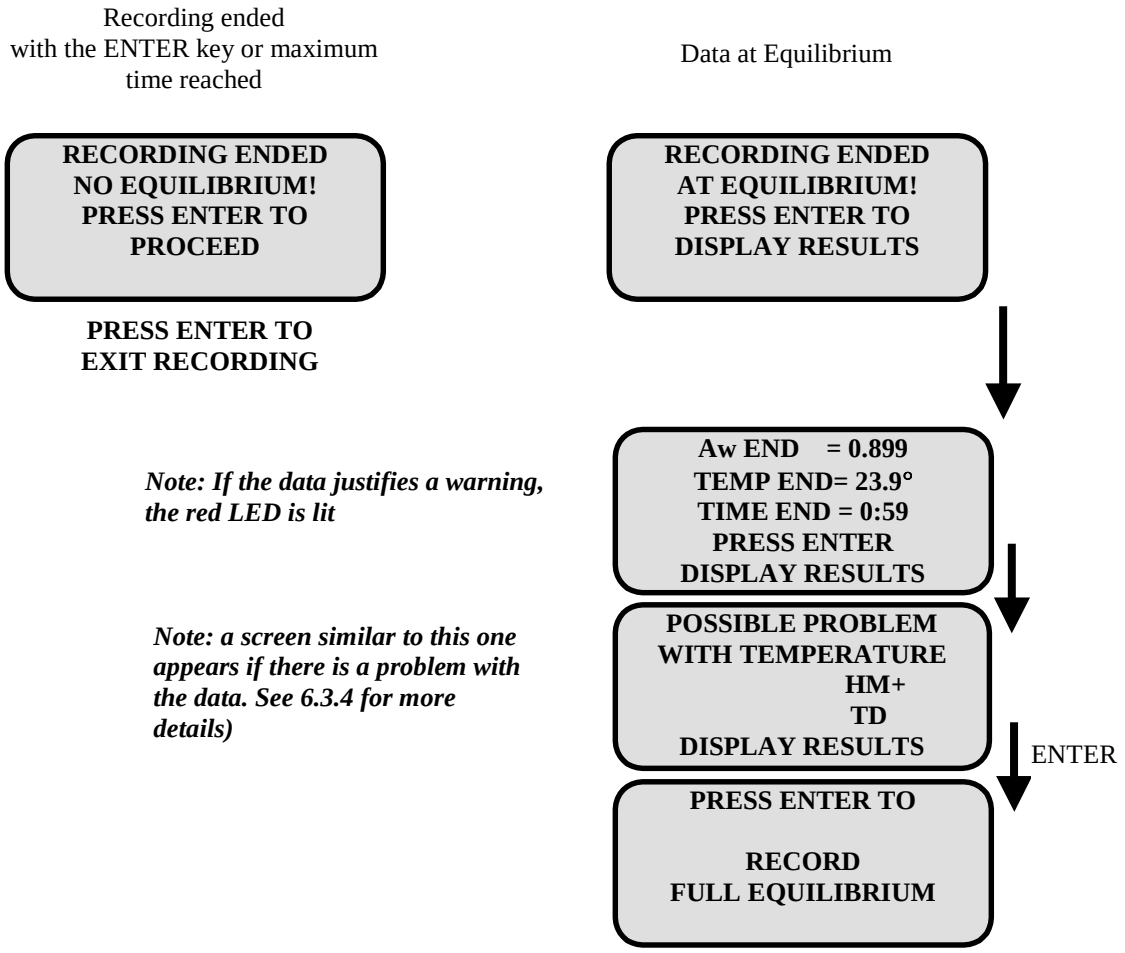
After 10 minutes of recording, the AwQuick begins evaluating the stability of the data. Data validation indicators **HS, HM, TS, TD** may appear on the second line of the display: (see 6.3.3 and 6.3.4).

The last line of the display alternatively shows the data being read or the time elapsed (hh:mm:ss) since the beginning of the recording.

The data recording process can be ended at any time by pressing the ENTER key.

RECORDING DATA
HS+ TS+
ENTER TO STOP
88.1% 23.6°

At the end of the recording, the AwQuick beeps and displays one of the following messages:

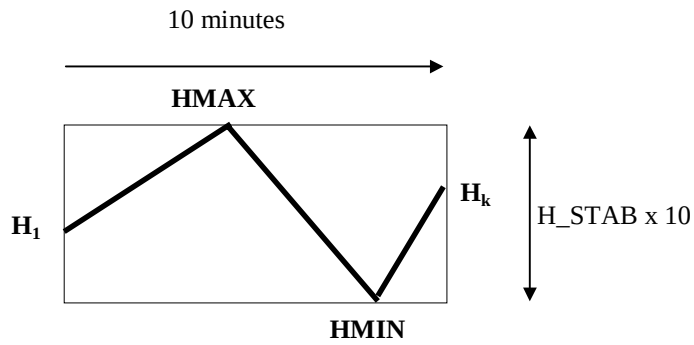


6.3.3 Equilibration Criteria

The AwQuick automatically ends the recording of the humidity and temperature data when the equilibration criteria are met.

When recording data, the AwQuick collects new data every 10 seconds. As soon as 10 minutes worth of data has been recorded, the AwQuick begins to evaluate the stability of the both the humidity and temperature data. This is done by computing the rate of change of the data (%RH / minute or C / minute) over a 10-minute period of time. The rate at which the data is changing (in absolute terms) is compared with two reference values **H_STAB** (%RH / minute) and **T_STAB** (°C / minute). As new data is being recorded, the AwQuick keeps evaluating the stability of the data over the latest 10 minutes. The values **H_STAB** (%RH / minute) and **T_STAB** (°C / minute) can be specified in the Set Default Menu.

Taking humidity as an example, the data is evaluated with a “box” defined as follows:



In the above graph, HMAX and HMIN are the humidity extremes during a 10-minute time interval. These values can be different from H_1 (first value in the interval) and H_k (last value of the interval).

The difference $[H_k-H_1]$ is the overall change over the 10-minute interval and is used to provide a trend indication (positive of negative sign) for the interval (see below).

Rather than using the difference $[H_k-H_1]$, the AwQuick uses the values HMAX and HMIN to evaluate the stability of the humidity data over the 10-minute time interval. This makes it possible to detect situations where the data goes through a maximum or a minimum during the 10-minute interval, without any overall change ($[H_k-H_1]=0$).

With a time interval of 10 minutes and H_STAB = 0.01%RH/minute, the difference between HMAX and HMIN must be less than 0.1 %RH for the interval to be evaluated as stable.

A 10-minute time interval of data is considered as stable when humidity is changing at a rate that is less than **H_STAB** and temperature is changing at a rate that is less than **T_STAB**. When both conditions are met without interruption during a period of time of 5 minutes, the recording is automatically ended. By definition, the humidity measured by the probe at equilibrium conditions is the water activity of the product.

6.3.4 Trend Indication and Data Validation

As soon as 10 minutes worth of data has been recorded, the AwQuick shows the trend of both the humidity and temperature data on the second line of the LC display:

• The display shows the letters **HS** when the humidity data of the current interval is not stable (stability is defined according to the criteria discussed above). A sign (+ or -) next to HS indicates a positive or a negative trend.

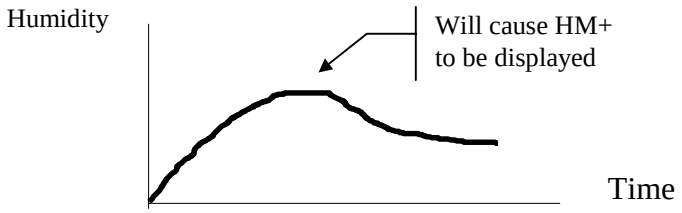
• The display shows the letters **TS** when the temperature data of the current interval is not stable (stability is defined according to the criteria discussed above). A sign (+ or -) next to TS indicates a positive or a negative trend. When measuring water activity,

temperature stability is essential. For a proper measurement of Aw, the letters **TS** should not appear on the display during most of the recording.

Both **HS** and **TS** disappear when the data stabilizes.

Depending on the data, the AwQuick may also display additional indications:

• The display shows the letters **HM** when the humidity data goes through either a maximum or a minimum during the recording. A sign (+ or -) next to HM indicates is the data went through a maximum (+) or a minimum (-).



A humidity maximum or a minimum usually the result of an inversion in the trend of temperature during the equilibration process. This can be caused by an initial temperature difference between the product sample and the probe or by an excessive change in room temperature.

• The display shows the letters **TD** when the overall change in temperature since the beginning of the recording has exceeded the maximum permitted (default value: 0.4°C).

When any of the above condition has been detected, the AwQuick gives a warning at the end of the recording, after displaying the results. The red LED (Error) is turned on and a message such as the following may be displayed:

POSSIBLE PROBLEM
WITH TEMPERATURE
HM+

Both **HM** and **TD** point to a potential temperature problem during the recording of data. In both cases, the recording should be repeated with better temperature conditions. If the problem persists, the data should be transferred to a PC and examined.

6.3.5 Export Data (to a PC)

Connect the AwQuick to a serial port on the PC (COM1 or COM2) with a 9-pin connector serial cable. If you are using a mouse that is not connected to a dedicated port, you will need two COM ports: one for the mouse and one for communications.

In Windows 95, HyperTerminal (Programs / Accessories) or in Windows 3.1, Terminal (accessories group) provide a convenient means of downloading and saving the data recorded by the AwQuick.

You may also use other communications software such as SMARTCOM, XTALK, PROCOMM, etc. Follow the instructions provided with your communications software and adjust the settings for **DIRECT connection** (as opposed to communicating via a modem) to the **COM port** (COM1, COM2, etc.) corresponding to the serial port to which the AwQuick is connected. Most communication software also feature a "**log to file**" or a "**capture to file**" function. This function should be activated to save the transferred data to a disk.

The following instructions are valid for Microsoft's Windows 95 Hyper Terminal.

In the start menu, click on programs, accessories and double click on Hyper Terminal. In the Hyper Terminal window, double click on the icon Hyperterm.exe. to start Hyper Terminal.

Hyperterminal displays the connection Description window. In the Name box enter AwQuick and select an appropriate icon. The next window is Phone Number. In the box Connect Using, choose Direct to Com1 (or Com2). The next window is Port Settings. Enter the following:

Bits per second:	4800
Data Bits:	8
Parity:	none
Stop Bits:	1
Flow Control:	Xon / Xoff

In the File menu, select Properties, click on the Settings tab and on the ASCII Setup button. Under ASCII Sending, clear the box Send line ends with line feeds and check the box Echo typed characters locally and specify a 100 millisecond line delay. Clear all boxes under ASCII Reading..

☞ *The same basic selections apply to other communications software.*

In the Transfer menu, select Capture Text. In the capture text dialog box, enter the drive, the directory and the name of the text file that is to record the data transferred by the

AwQuick (example TEST.TXT)..Click on the Start button. The PC is now in stand by and is ready to receive data from the AwQuick.

On the AwQuick, press ENTER

PRESS ENTER TO

EXPORT
DATA

DATA INTERVAL
10 Seconds
< > To Change
ENTER To Cont.

When the data interval is left at 10 seconds, all of the recorded data will be exported to the computer (the log interval of the AwQuick is 10 seconds). In the case of very long data recordings this may make the data file exported to the computer too large to process with a spread sheet program (for graphing purposes). Pressing the LEFT or RIGHT keys changes the data transfer interval to 20 or 30 seconds (every 2nd or 3rd sample).

ENTER key

TO START EXPORT
PRESS ENTER

ENTER key:

TO STOP EXPORT
PRESS ENTER
Sending # 23
0.894 23.4

The display shows the sample number and the data being transferred. The same information should appear on the PC screen. Upon reaching the end of the recorded data, the AwQuick displays:

DATA TRANSFER
COMPLETED
PRESS ANY KEY TO
CONTINUE

ENTER key:

PRESS ENTER TO

RECORD
FULL EQUILIBRIUM

In Hyper Terminal, Transfer menu, select Capture Text and click on Stop to close the text file. You may now exit Hyper Terminal.

Once the data has been saved to a text file, the file can be directly opened in Microsoft's EXCEL to examine and graph the data. Microsoft's EXCEL automatically provides step by step assistance to open the file and convert it to the spread sheet format (Test Import Wizard).

In EXCEL, choose the "File" menu and select "Open". Enter the drive, directory and the name of the data file. Once the file has been opened, make the following selections in the first screen of the Text Import Wizard:

. Delimited
. Start Import at Row 15

Click on the NEXT button. Select "Space" as the delimiter. Click again on the NEXT button. The screen shows the data and the first column (empty) is highlighted. Select "Do Not Import (skip)". Click on the FINISH button.

The data is now organized in 3 columns (A, B and C): decimal minutes, humidity (%RH) and temperature (°C). Highlight columns A, B and C. Click on the "Increase Decimals" button (Tool Bar) and then on the "Decrease Decimals" button to get the desired number of decimals in each columns.

You are now ready to make a graph selection.

6.4 System Defaults

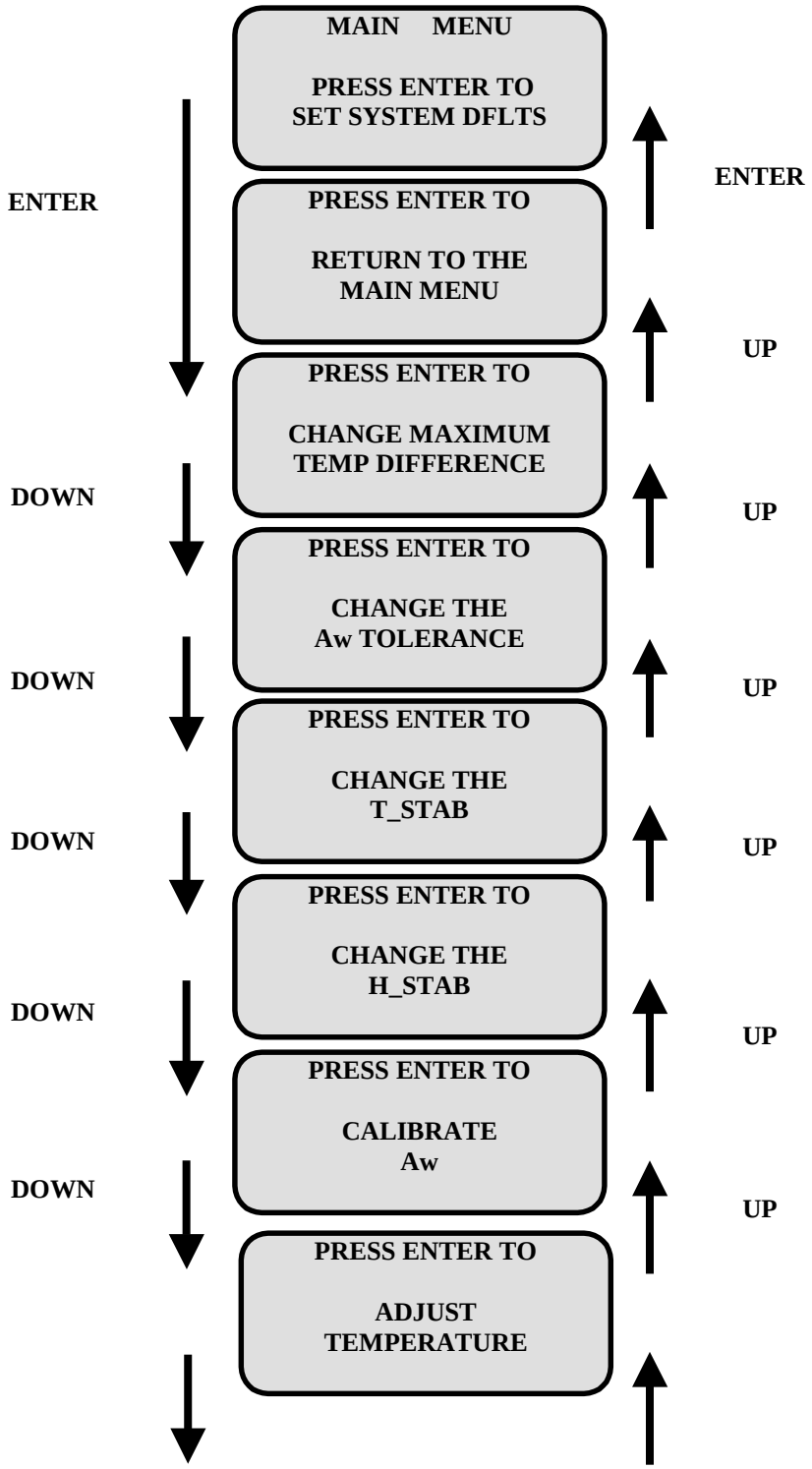
The system defaults menu is used for the following:

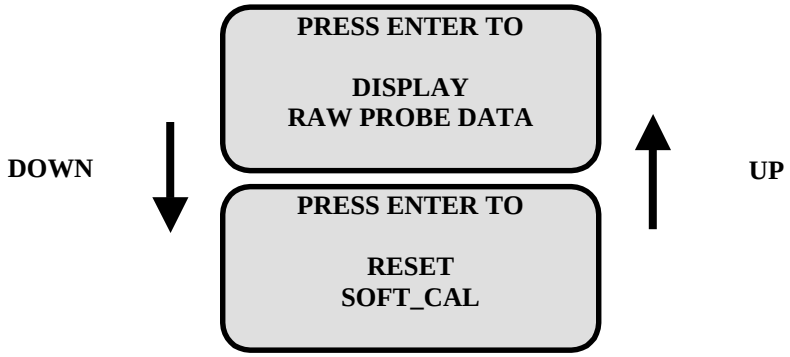
- Change system settings that are used either in the Measuring Mode or in the Recording Mode.

- Calibrate the system

- Display the raw probe data.

6.4.1 System Defaults Menu





6.4.2 Changing the System Defaults

Note: Factory default (or recommended values) are printed on bold characters. Follow the screen instructions to change any value.

• **Maximum Temperature Difference**: **0.4°C** (range: 0.0 to 99.9)

In the Recording Mode, this is the difference allowed between the temperature maximum and minimum over the entire data recording (TD).

• **Aw Tolerance**: **0.001 Aw** (range: 0.05 to 0.001)

The Aw tolerance is used in Optimize Menu to compute the Dwell Time (see 6.2).

• **T_STAB**: **0.02°C/minute** (range: 0.005 to 1.0)

In the Recording Mode, T_STAB is the rate of change that is used to define conditions of temperature equilibrium (indicator TS).

T_STAB is also used in the Measuring Mode. Values of less than 0.03°C / minute are disregarded during measurements and the AwQuick automatically allows a rate of change of up to 0.03°C / minute.

• **H_STAB**: **0.01%RH/minute** (range: 0.005 to 1.0)

In the Recording Mode, H_STAB is the rate of change that is used to define conditions of humidity equilibrium (HS). ***Note that H_STAB is in %RH/min.***

H_STAB is not used in the Measuring Mode.

The last 4 menu items: CALIBRATE Aw, ADJUST TEMPERATURE, DISPLAY RAW PROBE DATA and RESET SOFT_CAL are described in 7. CALIBRATION AND MAINTENANCE.

6.5. Optimize

6.5.1 General

The Optimize menu is primarily used to determine the Dwell Time that should be used during measurements when a specific product does not work well with the default value of 3 minutes.

The Optimization process consists of the following steps:

a) Use the “Select a Setting” menu choice and give a name to one of the product settings records. Up to 20 records can be saved.

b) Place a sample of the product in the probe and use the unattended data recording feature to automatically find the water activity of the product.

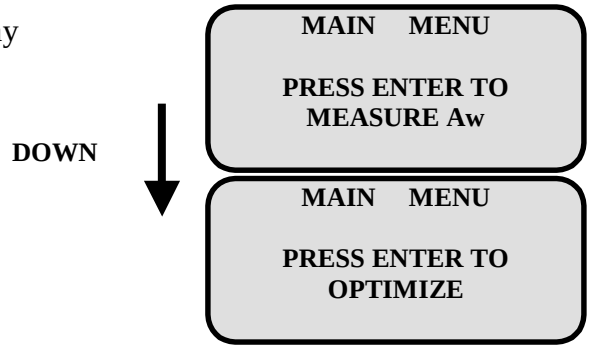
c) Use the recorded data to find out the value of the Dwell Time that gives optimum results during measurements.

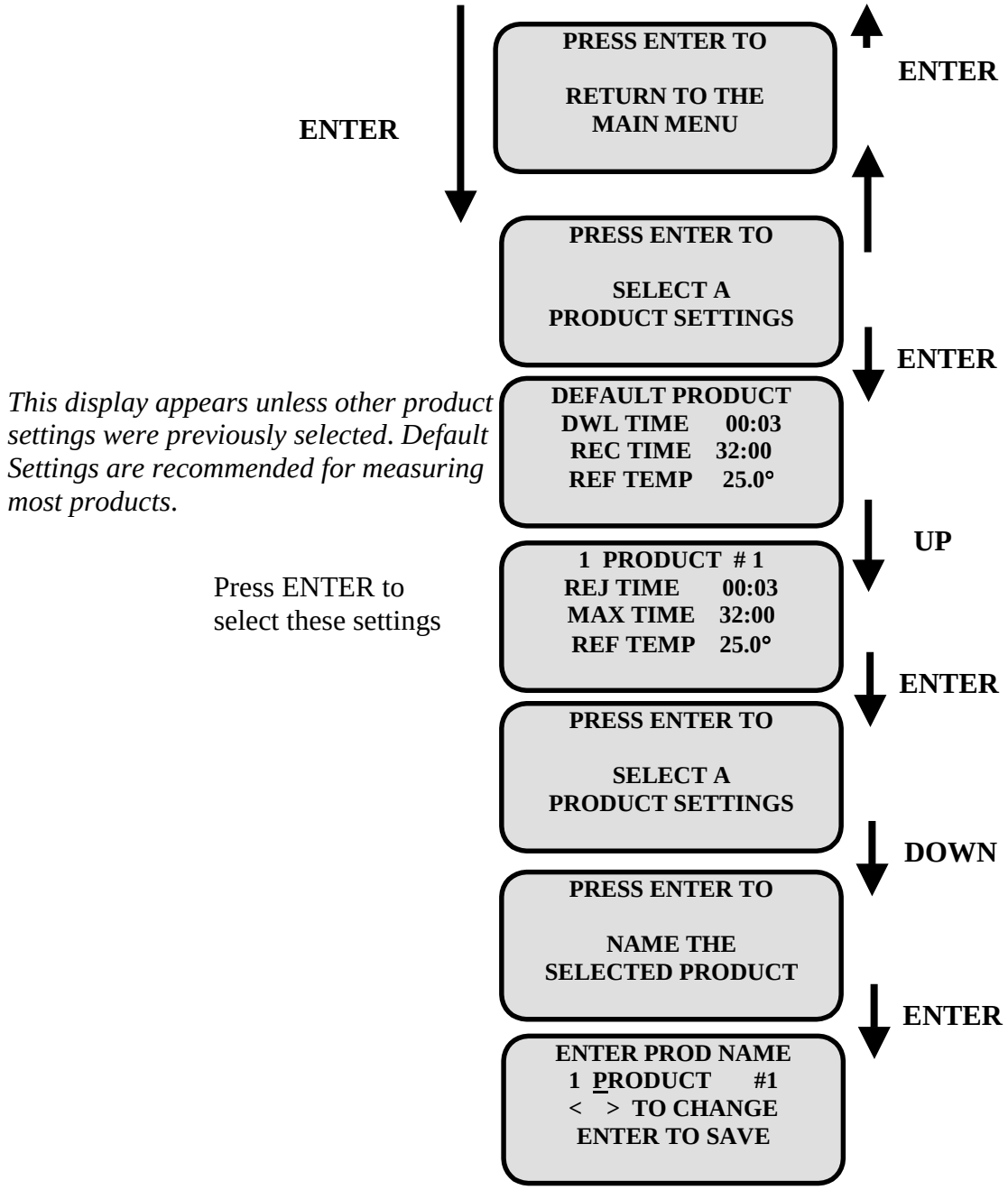
When recording the equilibration of a product sample, temperature stability is essential. If the temperature conditions at the beginning and at the end of the optimization process are very different, the result may be an excessively long Dwell Time and future measurements will take longer than they should. To prevent this, choose a small value (such as 0.3°C) for the Maximum Temperature Difference in the Set Defaults menu (see 6.4.2).

You may also want to experiment a little with the Aw tolerance - or difference between the measurements and the effective water activity. The default tolerance is 0.001 Aw. Use the Recompute Dwell Time menu item (see 6.2) to find out if the Dwell Time can be shortened by increasing the tolerance.

6.5.2 Optimize Menu Flow Chart

AwQuick Initial Display





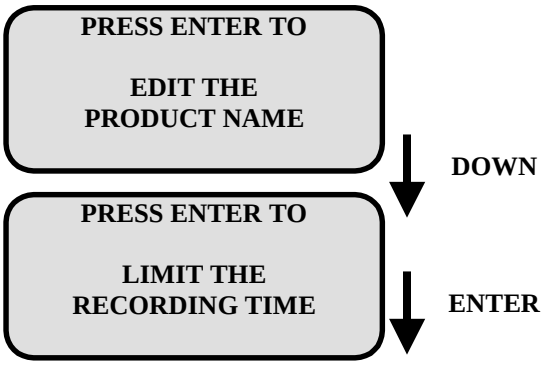
The second line of the display shows the product number (1 to 20) followed by a space and the product name (by default: PRODUCT #xx). The following explains how to enter a product name of your choice. Any name with up to 13 characters can be entered.

A cursor is located immediately under the letter P of the word PRODUCT. This indicates that the first character (now the letter P) can now be changed to another character. Press a number of times the UP or the DOWN key, until the desired character is displayed. Characters are in the standard ASCII sequence and include numbers, symbols and a blank space. To change the next character, press once the RIGHT key to move the cursor to the

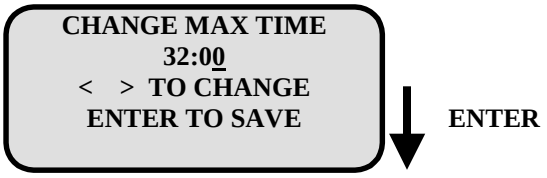
next position on the display. Display the new character as previously explained. Move the cursor until you have entered the full product name.

ENTER key (memorizes the new name):

DOWN key:

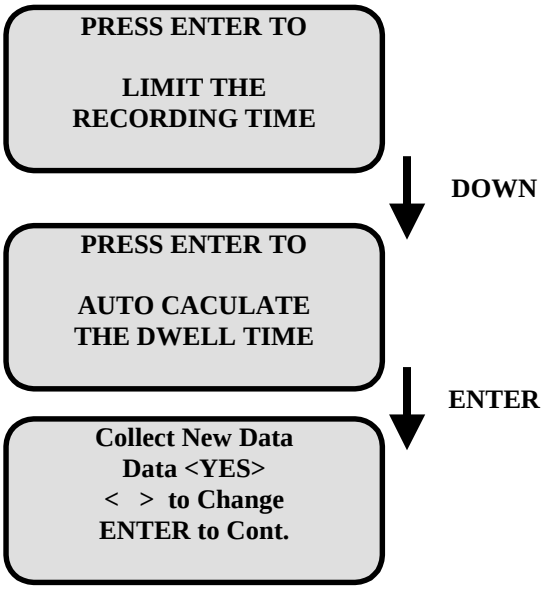


Normally, there is no need to change the default maximum recording time of 32 hours. Before this time is reached, the learn mode will automatically stop recording as soon as the data stability requirements are satisfied.



Use the UP, DOWN, LEFT and RIGHT keys to select a shorter maximum recording time.

ENTER key (memorizes new value):



Press either the LEFT or RIGHT key to change <YES> to <NO>. If <YES> was selected, new data will be recorded and any previously recorded data will be erased. The normal selection is <YES>. If <NO> was selected, the AwQuick will use any data that is now in memory and run the optimization process, based on this data.

☞ *To protect data in memory against accidental erasure, "collect new data" is set by default to <NO> when data is present in the memory. If you have pressed the ENTER key by mistake, press the ENTER key again to run the learn process on the recorded data and exit.*

Optimize With New Data

Collect New Data
Data <YES>
< > to Change
ENTER to Cont.

Put in the product sample before pressing the ENTER key!

RECORDING DATA

ENTER TO STOP
0.781 Aw 23.4°

The last line of the display alternatively shows the data being read or the time elapsed (hh:mm:ss) since the beginning of the recording.

The data recording process can be ended at any time by pressing the ENTER key.

As soon as enough data is available, the second line of the display shows the trend of the data and provides any warning regarding the data (see 2.8).

RECORDING DATA
HS+ TS+
ENTER TO STOP
88.1% 23.6°

Optimize With Data already in Memory

Collect New Data
Data <No>
< > to Change
ENTER to Cont.

DATA FROM MEMORY

0.781 Aw 23.4°

DATA FROM MEMORY

88.1% 23.6°

At the end of the recording, the AwQuick beeps and displays one of the following messages:

Recording ended with the ENTER key or maximum time reached or end of recording

RECORDING ENDED
NO EQUILIBRIUM!
PRESS ENTER TO
PROCEED

EXITS OPTIMIZE
Make the necessary adjustments and repeat Optimize

Data at Equilibrium

RECORDING ENDED
AT EQUILIBRIUM!
PRESS ENTER TO
DISPLAY RESULTS

Note: If the data requires a warning, the red LED is lit

Aw END = 0.899
TEMP END= 23.9°
TIME END = 0:59
PRESS ENTER
DISPLAY RESULTS

Note: a screen similar to this one appears if there is a problem with the data.

POSSIBLE PROBLEM
WITH TEMPERATURE
HM+
TD
DISPLAY RESULTS

ENTER

READY TO COMPUTE
DWELL TIME
PRESS ENTER TO
PROCEED
DISPLAY RESULTS

To compute the Dwell Time, the AwQuick runs the Measure Mode a number of times, using the data in memory. Each result is compared with the value of water activity at the end of the recorded data and checked using the Aw tolerance specified in the Set Defaults menu. This process ends automatically and this is indicated both by the sounder and a steady green LED.

At least one measurement was successfully made

```
DWL TIME  =  00:04
       Aw  =  0.898
   Aw END  =  89.9%
     TIME  =  00:08
```

PRESS ENTER TO EXIT

The data did not permit any measurement

```
BAD DATA
CANNOT OPTIMIZE
   Aw END  =  89.9%
RECORD NEW DATA
```

EXITS OPTIMIZE
Make the necessary adjustments and repeat Optimize

- DWL TIME (hours and minutes) is the dwell time found with the optimize process. This value is stored in the selected product settings.
- Aw is the measurement corresponding to the dwell time.
- Aw END is the last recorded value of water activity.
- TIME (hours and minutes) is the time taken by the measurement.

You may want to try to shorten the DWELL TIME by relaxing the Aw tolerance (trade off accuracy for speed). To do this, proceed as follows:

DOWN key:

UP, DOWN, LEFT or RIGHT key to change the value.

```
PRESS ENTER TO

OPTIMIZE
THE DWELL TIME
Aw TOLERANCE
```

↓ ENTER

```
CHANGE THE
AW TOLERANCE
PRESS ENTER
KEY TO CONTINUE
```

↓ ENTER

```
Aw TOLERANCE
   0.001
<   >  TO CHANGE
ENTER TO SAVE
```

↓ ENTER

```
DWL TIME  =  00:02
       Aw  =  0.897
   Aw END  =  0.899
     TIME  =  00:04
```

↓ ENTER

```
PRESS ENTER TO

OPTIMIZE
THE DWELL TIME
Aw TOLERANCE
```

This process should be repeated until you are satisfied with the trade off between time to measure and accuracy.

The last two items in the Optimize menu permit manual changes to the currently selected product record.

DOWN key:

PRESS ENTER TO

MANUAL ENTRY OF THE DWELL TIME

DOWN key:

PRESS ENTER TO

MANUAL ENTRY OF THE REF. TEMP.

7. CALIBRATION AND MAINTENANCE

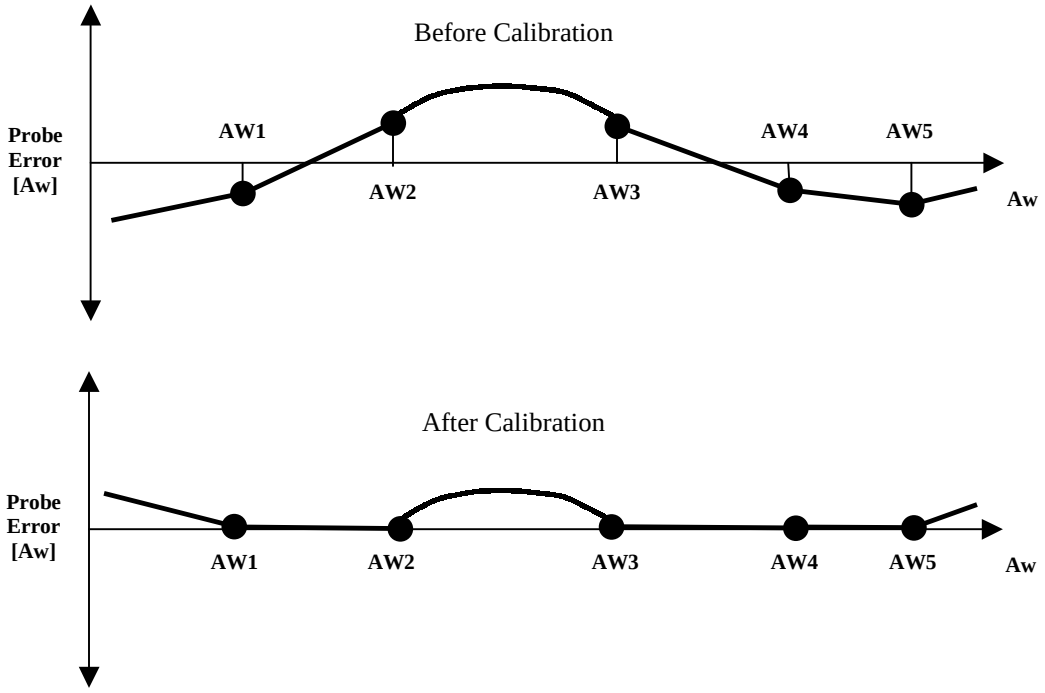
The AwQuick features SoftCal: a system calibration entirely by means of software. SoftCal permits humidity (Aw) calibration at up to 5 values. SoftCal can also be used to add or subtract an offset value from temperature.

7.1 Principle of the Humidity Calibration

SoftCal uses a total of 5 humidity calibration points: AW1 to AW5. Calibration is done one point at a time and consists in measuring the full equilibration of a known product sample (the reference). The reference can be a Rotronic certified humidity standard or a saturated salt solution. When the reference sample reaches equilibrium, the AwQuick automatically displays the direct (raw) reading from the probe and asks for the value of the reference. SoftCal uses the difference between the raw probe reading and the reference value to compute a linear correction of the probe signal.

Each calibration point can be freely chosen between 0.000 and 1.000 Aw. The only restriction is that calibration points should be at least 0.01 Aw apart from one another. Calibration can be done in any order. SoftCal automatically sorts the calibration points in ascending order after completing each individual point.

The effect of SoftCal can be illustrated as follows:



Note that SoftCal has its maximum effect on measurements between AW1 and AW5. The effect of SoftCal on measurements below AW1 and above AW5 cannot be controlled and depends on the original probe error. Also note that SoftCal is a linear correction of the probe signal and that it cannot fully eliminate non linear probe errors (here between AW2 and AW3).

As can be seen from the above illustration, calibrating at each of the 5 points allowed by SoftCal results in the best accuracy. To obtain the best accuracy over the full measuring range, calibration should be done at values close to 0.05, 0.10, 0.35 and 0.80 and 0.95Aw. These are the factory calibration points. When measurements are limited to a partial range of water activity (for example Aw > 0.8), accuracy over that range can be improved by using 3 to 4 calibration points within that range. Note that this will usually degrade accuracy outside of the partial range.

When calibrating, SoftCal asks which calibration point (AW1 to AW5) should be replaced. If the new calibration point is within 0.01 Aw of an existing calibration point, this calibration point will be automatically replaced with the new value, regardless of which calibration point was manually selected for replacement. Example: AW5 is manually selected for replacement. If the new value is within 0.01 Aw of AW4, the new value replaces AW4 and the original AW5 is maintained.

Calibration can be aborted by pressing the ENTER key before reaching equilibrium. When a calibration point is aborted, SoftCal offers the choice of immediately redoing the

calibration point or exiting SoftCal. To save time when redoing a calibration point, leave the reference sample in the probe and start again the calibration process.

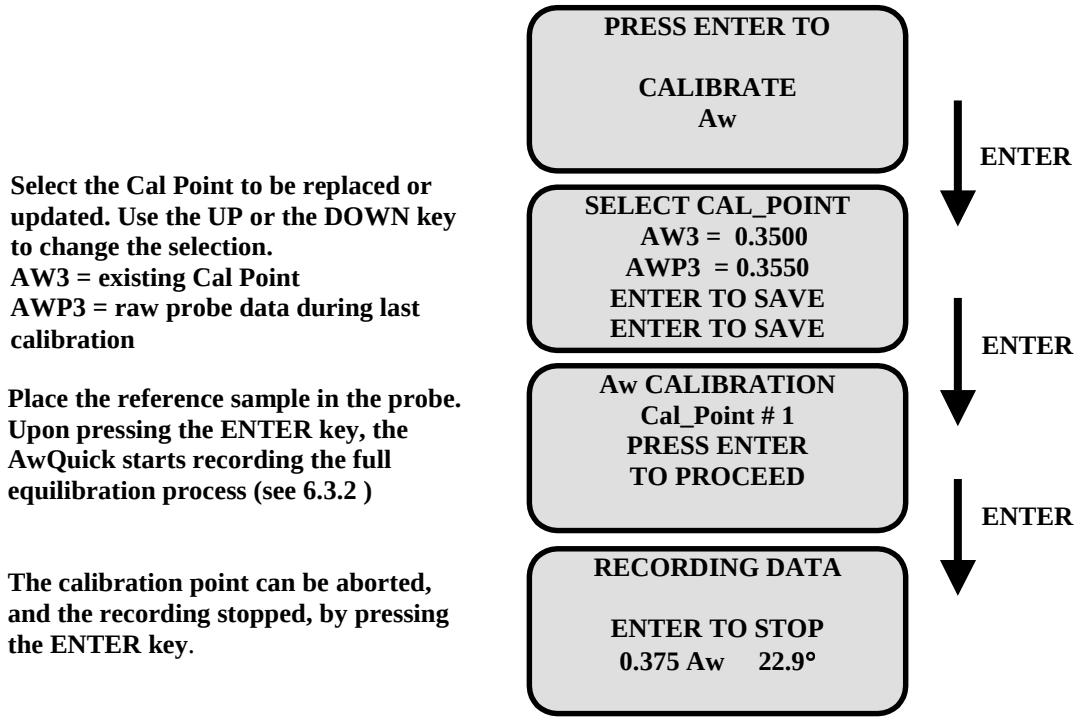
After reaching equilibrium, SoftCal will offer to redo the calibration point if there was a problem with temperature.

Finally, all calibration points can be cancelled at one time by resetting SoftCal. After resetting SoftCal, there is no correction of the direct (raw) probe data. **SoftCal should always be reset whenever the probe has been sent back for service without the AwQuick indicator**.

7.2 Aw Calibration Procedure

Note: **During calibration, it is important that the probe fan be on**. The probe will not measure properly without the fan being on.

Go to the SYSTEM DEFAULTS menu (see 6.4.1) and select the following screen::



Stopped with the ENTER key

REDO CAL_POINT ?
YES
< > To Change
ENTER To Cont.

RECORDING ENDED
NO EQUILIBRIUM
PRESS THE ENTER
KEY TO CONTINUE

If YES was chosen
Returns to the screen
Cal_Point # 1

If NO was chosen

PRESS ENTER TO

CALIBRATE
Aw

Ended normally at equilibrium

Aw = 0.352
TEMP END= 23.9°
TIME END = 0:25
PRESS ENTER
DISPLAY RESULTS

RECORDING ENDED
AT EQUILIBRIUM!
PRESS ENTER TO
DISPLAY RESULTS

ENTER AW1
0.3519
< > TO CHANGE
ENTER TO SAVE
DISPLAY RESULTS

Use the RIGHT, LEFT, UP and DOWN keys to enter the value of the reference (in this example: 0.3500). Press the ENTER key to save the value.

The AwQuick now displays the current calibrated probe readings. These should match the reference value AW1 entered earlier. **Note that a lack of temperature stability may result in a small difference.** Press ENTER to continue.

CAL_POINT DONE

ENTER TO STOP
0.350 Aw 23.9°
DISPLAY RESULTS

Press ENTER to exit to the Set Defaults Menu or to do the next point.

PRESS ENTER TO

CALIBRATE
Aw
DISPLAY RESULTS

7.3 Temperature Adjustment

SoftCal permits to apply an offset value (positive or negative) to the temperature data provided by the probe.

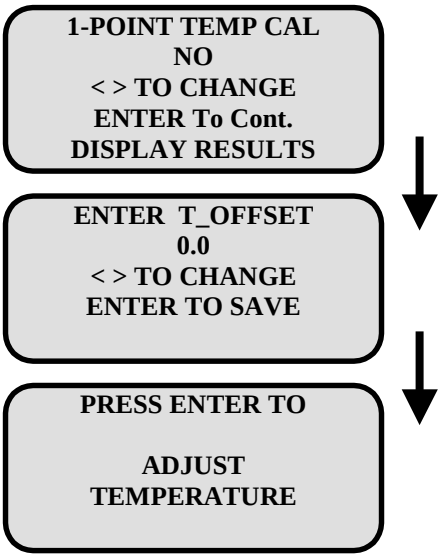
Go to the following screen of the Set Defaults Menu and press ENTER..

PRESS ENTER TO

ADJUST
TEMPERATURE

This is optional and you should normally leave the selection to NO (default).
Press the ENTER key.

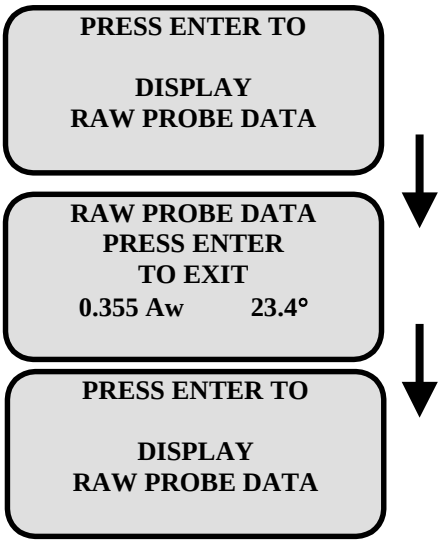
Use the UP and DOWN keys to change the offset value.
For negative values, press DOWN when 0.0 is being displayed.



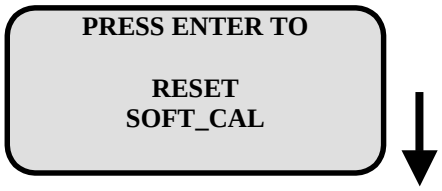
7.4 Display Raw Probe Data

The output from the probe can be read with the AwQuick indicator by using the following item of the Set Defaults menu. This is useful for comparing the calibrated data with the direct probe data.

:



7.4 Review Calibration Points and Reset SoftCal

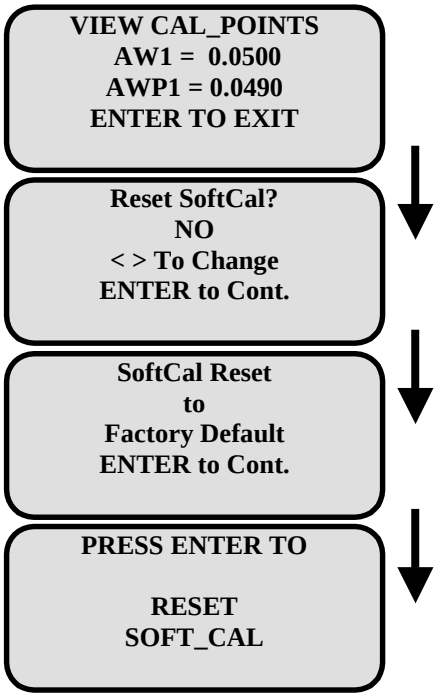


Use the UP or the DOWN key to review the calibration points.

AW1 = existing Cal Point
AWP1 = raw probe data during last calibration

The default selection is <NO>.
Press either the LEFT or RIGHT key to change <NO> to <YES>. If <YES> was selected, SoftCal will be reset after pressing the ENTER key

After resetting SoftCal the probe data is no longer corrected.



7.5 Maintenance of the AwVC probe

Both the frequency of humidity calibration and the number of calibration points depend on the specific requirements of each user. For the best accuracy, choose calibration points that match your application. Users who must calibrate frequently may do one calibration point per work day. By rotating the calibration points, system calibration can be fully updated on a weekly basis.

In general, we do not recommend using the temperature adjustment unless room temperature is extremely stable. The probe and reference thermometer should be ventilated together. The RTD used to measure temperature is very stable and should not, in principle, require any calibration after leaving the factory.

Do not forget to reset SoftCal each time that the probe has been returned for service without the AwQuick indicator.

From time to time you should check and clean the bottom of the probe (including the O-ring) as well as the upper side of the sample holder. Verify that the filter is clean and that you can feel air coming through it. The part number for a replacement filter is R83/W37.

APPENDIX 1: WATER ACTIVITY MEASUREMENT

1. Water Activity Definition

Hygroscopic products may absorb water in different ways: sorption with formation of a hydrate, binding by surface energy, diffusion of water molecules in the material structure, capillary condensation, formation of a solution, etc. Depending on the absorption process, water is bound to the product with more or less strength. Moisture content can include both an immobilized part (e.g. water of hydration) and an active part. The active part is the amount of moisture which, under normal circumstances, that can be exchanged between the product and its environment.

Water activity Aw (or equilibrium relative humidity %ERH) measures the vapor pressure generated by the moisture present in a hygroscopic product.

Aw = p / ps and %ERH = 100 x Aw, where:

p : partial pressure of water vapor at the surface of the product
ps : saturation pressure, or the partial pressure of water vapor above pure water at the product temperature

Water activity reflects the active part of the moisture content as opposed to the entire moisture content of a product.

Water activity is usually defined under static conditions of equilibrium. Under such conditions, the partial pressure of water vapor (p) at the surface of the product is equal to the partial pressure of water vapor in the immediate environment of the product. Any exchange of moisture between the product and its environment is driven by a difference between these two partial pressures.

2. Effect of Temperature

At room conditions, the water activity of most products does not change very much with temperature. For a temperature change of 1°C, a change of only 0.0005 to 0.005 Aw (0.05 to 0.5 %RH) seems typical. This shows that the partial pressure (p) at the surface of most hygroscopic products varies with temperature in about the same manner as the partial pressure (ps) above pure water

Based on this, it can be reasonably argued that it is not critical to measure water activity at exactly 25 C, as long as measurements are done within the normal range of room temperature. In any case, even the best humidity instruments do not measure with an accuracy better than ±1%RH (0.01 Aw) and a repeatability of ±0.3%RH (0.003 Aw).

As opposed to this, it is essential to measure water activity under stable and uniform temperature conditions. Since the partial water vapor pressure above a product and the partial water vapor pressure above pure water vary with temperature in a about the same manner, it can be said that the partial water vapor pressure above a product changes by about 6% for a 1°C change in product temperature (at room temperature). Therefore, even a small change in temperature automatically causes the product to exchange moisture with its environment, until the partial water vapor pressures at the surface of the product and in the environment are equal again. Since water activity is defined under conditions of static equilibrium, it follows that temperature should be constant during measurements.

3. Conventional Water Activity Measurement

Conventional water activity measurement consists in waiting for the full equilibration of the measured product. Typical water activity instruments use a small sealed container (or sample holder) in which a sample of the product is placed. During the measurement, the water vapor pressure of the air trapped in the sample holder equilibrates slowly with that of the product. Usually, this process is monitored by measuring the humidity of the air above the product.

Under stable temperature conditions, the full natural equilibration of most products typically requires from 45 to 60 minutes and can take as long as a couple of hours. Because humidity changes at an extremely slow pace towards the end of the process, determining when the measurement is truly ended can be tricky.

Ventilating the product sample during measurement reduces the time required for full equilibration by facilitating the exchange of moisture between the sample, the air above the sample and the humidity sensor. Tests made on many different products show that ventilation produces a time reduction of at least 50%. For example, chocolate syrup equilibrates in about 35 minutes as opposed to 60-70 minutes without ventilation. As an additional benefit, measurements also tend to be more repeatable.

4. Computed Water Activity Measurement

The slowness of the full equilibration process makes it apparent why there is strong interest in methods that can shorten the time required to measure Aw down to a few minutes. It should be clear that even with ventilation, and regardless of the method used to measure humidity (chilled mirror or relative humidity sensor), full equilibration of a product generally takes much longer than 3 to 6 minutes. The exception is when the product is already at room humidity or is close to room humidity.

In principle, giving the value of water activity in only a few minutes requires monitoring the equilibration process and using some computation to anticipate the result. For the vast majority of products, the computed result agrees with the result of a full equilibration within 0.005 Aw or better.

APPENDIX 2: ROTRONIC HUMIDITY STANDARDS

The Rotronic certified standards cover the following values: 5, 10, 20, 35, 50, 65, 80 and 95%RH, corresponding to 0.05, 0.10, 0.20, 0.35, 0.50, 0.65, 0.80 and 0.95 Aw. The standards are available in boxes of 5 glass ampoules of the same value, which can be stored indefinitely. Standards in the range of 5 to 95 %RH are non-saturated aqueous salt solutions that are precisely titrated at our factory for the right concentration. A Material Safety Data Sheet is available for each standard

To use the standards, proceed as follows:

Note: Do not use the deep sample holder to calibrate with the Rotronic standards since the amount of solution would not be sufficient.

- Place one fiber disc (each box of Rotronic standards includes 5 discs) in a shallow disposable cup (PS-14). The purpose of the disc is to make it easier to get the liquid out of the vial.
- Tap the top of the ampoule so that all liquid drops to the bottom of the vial. Snap off the top of the vial and empty contents by tapping the vial on the center of the fiber disc. **Since the vial is made of glass, exercise proper caution (gloves, safety glasses) when snapping off the top.**
- For optimum results, use two ampoules when calibrating the AwVC probe.
- Put the disposable sample cup in the shallow sample holder (WP-14) and place the AwVC on top of the sample holder (the fan should be on).

At equilibrium, adjust the readings to match the mean value (Mean Value of Samples) indicated on the certificate provided with the box of standards.

SPECIFICATIONS

General

Typical Time per Sample	4 to 6 minutes
Typical System Accuracy	±0.015 Aw or better
Typical System Repeatability	0.003 Aw

AwQuick Indicator

Operation	9 V AC Adapter (800 mA) DC(+)
Center	
Operating Limits	0..50°C (32..122°F) / 0..90%RH
Display	backlit 4-line LC matrix 0.000..1.000 Aw and 0.0..100.0°C
Data Logging	memory capacity: 64 k sampling rate: 10 sec max. number of data points: 11,520 max. recording time: 32 hours
Serial Output	RS 232
Housing Material	ABS
Housing Dimensions	8.5 x 10 x 4 1/8” (215 x 253 x 104 mm
Weight	Appr. 2.5 lb. (1.14 kg)

AwVC Ventilated Probe

Humidity sensor	Rotronic Hygromer™ C94
Temperature sensor	Pt100 RTD 1/3 DIN
Humidity Range	0.000..1.000 Aw
Accuracy at 25°C (77°F)	±0.010 Aw and ±0.2°C
Repeatability	0.003 Aw and 0.1°C
Housing Dimensions	59 x 67 mm
Weight	Appr. 430 g (0.95 lb.)