



# 2020we/wi TURBIDIMETER



1970-EPA  
1970-ISO

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## INTRODUCTION

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### ■ TURBIDITY

#### **What is Turbidity?**

Turbidity is an aggregate property of the solution, which is water in most cases. Turbidity is not specific to the types of particles in the water. The particles could be suspended or colloidal matter, and they can be inorganic, organic or biological. At high concentrations, turbidity is perceived as cloudiness, haze or an absence of clarity in the water. Turbidity is an optical property that results when light passing through a liquid sample is scattered. The scattering of light results in a change in the direction of the light passing through the liquid. This is most often caused when the light strikes particles in solution and is scattered backward, sideways and forward. If the turbidity is low, much of the light will continue in the original direction. Light scattered by the particles allows the particle to be "seen" or detected in solution just as sunlight allows dust particles in the air to be seen.

In the past 10 years, turbidity has become more than just a measure of water clarity. Because of the emergence of pathogens such as *Cryptosporidium* and *Giardia*, turbidity now holds the key to assuring proper water filtration. In 1998, the EPA published the IESWTR (interim enhanced surface water treatment rule) mandating turbidities in combined filter effluent to read at or below 0.3 NTU. By doing so, the EPA hoped to achieve a 2 log (99%) removal of *Cryptosporidium*. There is presently consideration to lower this to 0.1 NTU. The trend has been to check the calibration of on-line turbidimeters with hand-held field units. The optical design and low detection limit of the 2020we/wi allows very accurate readings for such calibrations.

The meter also allows the user to choose the units of measure for expressing turbidity. While nephelometric turbidity unit (NTU) has been the standard for years, FNU (formazin nephelometric unit) and FAU (formazin attenuation unit) are now being used in ISO 7027 units. American Society of Brewing Chemists (ASBC) units and European Brewery Convention (EBC) units allow the brewing industry to check process waters.

#### **How is Turbidity Measured?**

Turbidity is measured by detecting and quantifying the scattering of light in water (solution). Turbidity can be measured in many ways. There are visual methods and instrumental methods. Visual methods are more suitable for samples with high turbidity. Instrumental methods can be used on samples with both high and low levels of turbidity.

Two visual methods are the Secchi Disk method and the Jackson Candle method. The Secchi Disk method is often used in natural waters. A black and white Secchi Disk is lowered into the water until it can no longer be seen. It is then raised until it can be seen again. The average of these two distances is known as the "Secchi Depth". The Jackson Candle method uses a long glass tube over a standard candle. Water is added or removed from the tube until the candle flame becomes

indistinct. The depth of the water measured with a calibrated scale is reported as Jackson Turbidity Units (JTU). The lowest turbidity that can be determined with this method is about 25 NTU. There are two common methods for instruments to measure turbidity. Instruments can measure the attenuation of a light beam passing through a sample and they can measure the scattered light from a light beam passing through a sample. In the attenuation method, the intensity of a light beam passing through a turbid sample is compared with the intensity passing through a turbidity-free sample at 180° from the light source. This method is good for highly turbid samples. The most common instrument for measuring scattered light in a water sample is a nephelometer. A nephelometer measures light scattered at 90° to the light beam. Light scattered at other angles may also be measured, but the 90° angle defines a nephelometric measurement. The light source for nephelometric measurements can be one of two types to meet EPA or ISO specifications. The EPA specifies a tungsten lamp with a color temperature of 2,200–3,000 K. The units of measurement for the EPA method are nephelometric turbidity units (NTU). The ISO specifies a light emitting diode (LED) with a wavelength of  $860 \pm 30$  nm and a spectral bandwidth less than or equal to 60 nm. The units of measurement for the ISO method are formazin nephelometric units (FNU). The 2020we meets the EPA specification and the 2020wi meets the ISO specification. The nephelometric method is most useful for low turbidity.

The 2020we/wi is a nephelometer that is capable of measuring turbidity by both the attenuation method and the nephelometric method. It uses a detector placed at 180° to the light source for high turbidity samples. It uses a detector placed at 90° to the light source for the nephelometric method for low turbidity samples. The 2020we/wi has a signal averaging option to improve the stability of readings on low turbidity samples.

The 2020we/wi has two different turbidity calibrations, formazin and Japan Standard. The formazin calibration is the EPA and ISO approved method of calibrating nephelometers. This calibration can be used with user prepared formazin standards or commercially purchased formazin standards. LaMotte Company approved AMCO™ standards labeled for use with the 2020we/wi can also be used with the formazin calibration. Stablcal® standards below 50 NTU should not be used to calibrate the 2020we/wi.

The Japan Standard calibration is a calibration for a Japanese Water Works standard. It is based on Japanese formulated polystyrene turbidity standards. This calibration should only be used to meet Japanese Water Works requirements. The Japanese polystyrene standards can only be purchased in Japan. Formazin, AMCO and Stablcal® standards cannot be used with this calibration.

### **Taking Turbidity Water Samples**

Clean plastic or glass containers may be used for turbidity samples. Ideally, samples should be tested soon after collection and at the same temperature as when collected.

## ■ SAMPLE DILUTION TECHNIQUES

If a test result is out of the range of the meter, it must be diluted. The test should then be repeated on the diluted sample. The following table gives quick reference guidelines for dilutions of various proportions.

Amount of Sample	Deionized Water to Bring Final Volume to 10 mL	Multiplication Factor
10 mL	0 mL	1
5 mL	5 mL	2
2.5 mL	7.5 mL	4
1 mL	9 mL	10
0.5 mL	9.5 mL	20

All dilutions are based on a final volume of 10 mL, so several dilutions will require small volumes of the water sample. Graduated pipets should be used for all dilutions. If volumetric glassware is not available, dilutions can be made with the colorimeter tube. Fill the tube to the 10 mL line with the sample and then transfer it to another container. Add 10 mL volumes of deionized water to the container and mix. Transfer 10 mL of the diluted sample to the colorimeter tube and follow the test procedure. Repeat the dilution and testing procedures until the result falls within the range of the calibration. Multiply the test result by the dilution factor. For example, if 10 mL of the sample water is diluted with three 10 mL volumes of deionized water, the dilution factor is four. The test result of the diluted sample should be multiplied by four.

## OPTIONS & SET UP

### ■ FACTORY DEFAULT SETTINGS

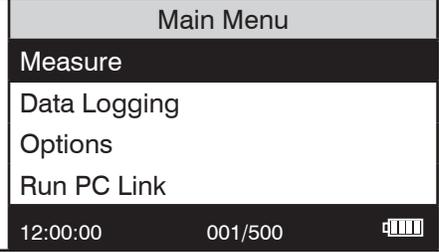
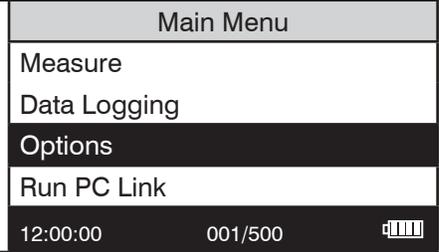
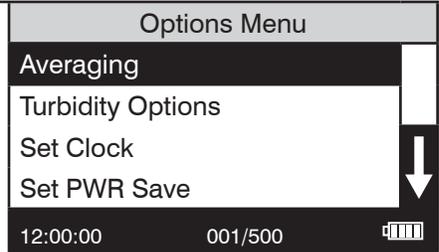
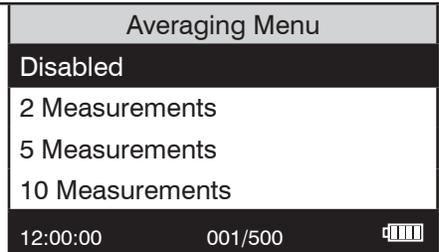
Settings that have user options have been set at the factory to default settings.

The factory default settings are:

Averaging	Disabled
Turbidity Units	NTU
Turbidity Calibration	Formazin
Date Format	MM-DD-YYYY
Power Save	5 minutes
Backlight	10 seconds
Language	English

■ **AVERAGING**

The averaging option allows the user to average multiple readings. This option will improve the accuracy of samples with readings that may tend to drift with time. When the two, five or ten measurement option has been selected the final average is displayed. The averaging option is available only for turbidity. The default setting is disabled. To change the setting:

<p>1. Press and briefly hold  to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the <b>Main Menu</b> will appear.</p>	 <p>Main Menu</p> <p>Measure</p> <p>Data Logging</p> <p>Options</p> <p>Run PC Link</p> <p>12:00:00 001/500 </p>
<p>2. Press  to scroll to <b>Options</b>.</p>	 <p>Main Menu</p> <p>Measure</p> <p>Data Logging</p> <p><b>Options</b></p> <p>Run PC Link</p> <p>12:00:00 001/500 </p>
<p>3. Press  to select <b>Options</b>.</p>	 <p>Options Menu</p> <p><b>Averaging</b></p> <p>Turbidity Options</p> <p>Set Clock</p> <p>Set PWR Save</p> <p>12:00:00 001/500 </p>
<p>4. Press  to select <b>Averaging</b>.</p>	 <p>Averaging Menu</p> <p><b>Disabled</b></p> <p>2 Measurements</p> <p>5 Measurements</p> <p>10 Measurements</p> <p>12:00:00 001/500 </p>

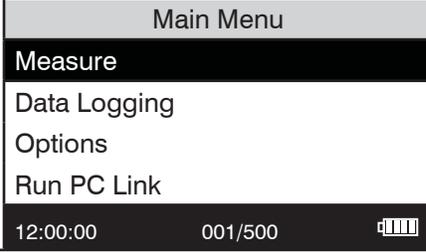
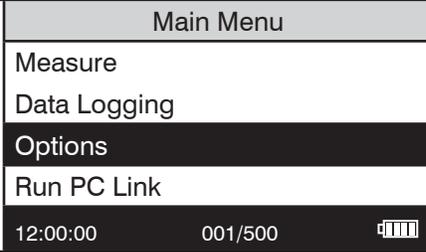
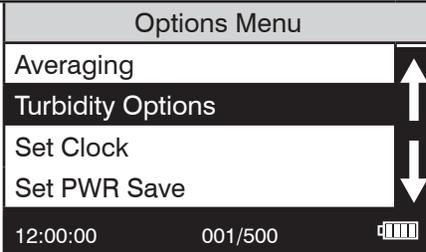
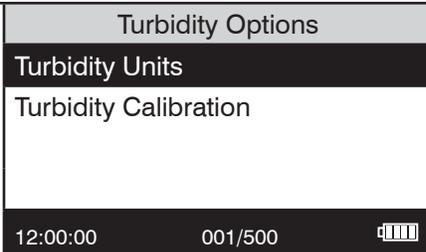
5. Press  or  to scroll to the desired option.	<b>Averaging Menu</b>
	Disabled 2 Measurements 5 Measurements 10 Measurements 12:00:00 001/500 
6. Press  to save the selection. The screen will display <b>Storing...</b> for about 1 second and return to the <b>Options Menu</b> .	<b>Options Menu</b>
	Averaging Turbidity Options Set Clock Set PWR Save 12:00:00 001/500 

NOTE: When the **Averaging** option is enabled, more time will be required to display a reading and more power will be used.

## ■ TURBIDITY OPTIONS

The default units are NTU and the default calibration curve is formazin.  
To change the settings:

### Selecting Turbidity Units

<p>1. Press and briefly hold  to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the <b>Main Menu</b> will appear.</p>	 <p>Main Menu</p> <p>Measure</p> <p>Data Logging</p> <p>Options</p> <p>Run PC Link</p> <p>12:00:00 001/500 </p>
<p>2. Press  to scroll to <b>Options</b>.</p>	 <p>Main Menu</p> <p>Measure</p> <p>Data Logging</p> <p>Options</p> <p>Run PC Link</p> <p>12:00:00 001/500 </p>
<p>3. Press  to select <b>Options</b>. Press  to scroll to <b>Turbidity Options</b>.</p>	 <p>Options Menu</p> <p>Averaging</p> <p>Turbidity Options</p> <p>Set Clock</p> <p>Set PWR Save</p> <p>12:00:00 001/500 </p>
<p>4. Press  to select <b>Turbidity Options</b>.</p>	 <p>Turbidity Options</p> <p>Turbidity Units</p> <p>Turbidity Calibration</p> <p>12:00:00 001/500 </p>

5. Press <b>ENTER</b> to select <b>Turbidity Units</b> .	Set Turbidity Units		
	NTU		
	ASBC		
	EBC		
	12:00:00	001/500	

**Available units are:**

NTU (Nephelometric Turbidity Units) (2020we only)

FNU (Formazin Nephelometric Units) (2020wi only)

ASBC (American Society of Brewing Chemists)

EBC (European Brewery Convention)

NOTE: The meter will automatically switch to the attenuation mode above approximately 600 NTU or FNU. Measurements will be made with the 180° detector as indicated by AU or FAU on the display.

6. Press <b>▲</b> or <b>▼</b> to scroll to the desired units.	Set Turbidity Units		
	NTU		
	ASBC		
	EBC		
	12:00:00	001/500	

7. Press <b>ENTER</b> to save the selection. The screen will display <b>Storing...</b> for about 1 second and return to the <b>Turbidity Options</b> menu. Press <b>EXIT</b> to return to a previous menu.	Turbidity Options		
	Turbidity Units		
	Turbidity Calibration		
	12:00:00	001/500	

**Selecting a Turbidity Calibration Curve**

1. Press and briefly hold  to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the <b>Main Menu</b> will appear.	Main Menu		
	Measure		
	Data Logging		
	Options		
	Run PC Link		
	12:00:00	001/500	

2. Press <b>▼</b> to scroll to <b>Options</b> .	Main Menu		
	Measure		
	Data Logging		
	<b>Options</b>		
	Run PC Link		
	12:00:00	001/500	

3. Press <b>ENTER</b> to select <b>Options</b> . Press <b>▼</b> to scroll to <b>Turbidity Options</b> .	Options Menu		
	Averaging		↑
	<b>Turbidity Options</b>		
	Set Options		↓
	Set PWR Save		
	12:00:00	001/500	

4. Press <b>ENTER</b> to select <b>Turbidity Options</b> .	Turbidity Options		
	<b>Turbidity Units</b>		
	Turbidity Calibration		
	12:00:00	001/500	

5. Press <b>▼</b> to scroll to <b>Turbidity Calibration</b> .	Turbidity Options		
	Turbidity Units		
	<b>Turbidity Calibration</b>		
	12:00:00	001/500	

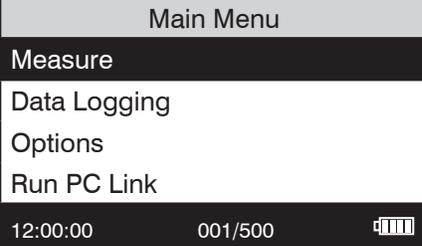
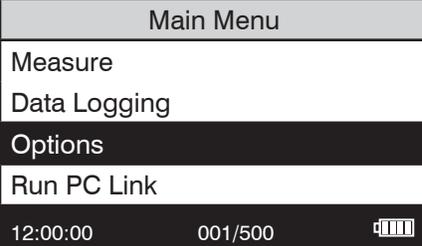
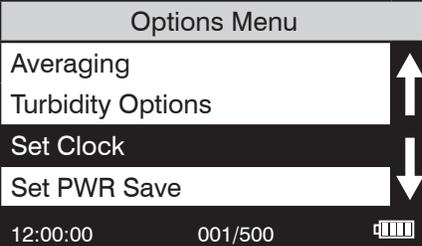
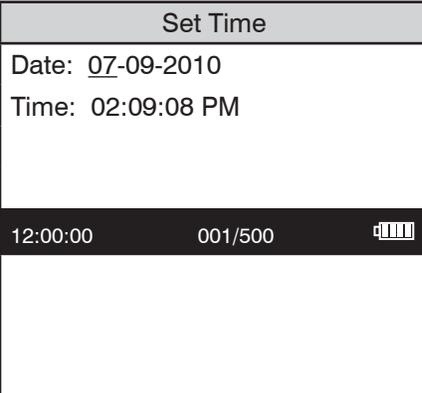
6. Press <b>ENTER</b> to select <b>Turbidity Calibration</b> .	Turbidity Calibration		
	<b>Formazin</b>		
	Japan Standard		
	12:00:00	001/500	

7. Scroll to the desired calibration option. Select a calibration option based on the composition of the standards that will be used to calibrate the meter.	Turbidity Calibration		
	Formazin		
	Japan Standard		
	12:00:00	001/500	

NOTE: Stabcal® standards below 50 NTU should not be used to calibrate the 2020we/wi. The diluent has a different refractive index than traditional formazin standards and will affect the results.

8. Press <b>ENTER</b> to save the selection. The screen will display <b>Storing...</b> for about 1 second and return to the <b>Turbidity Options</b> menu. Press <b>EXIT</b> to return to a previous menu.	Turbidity Options		
	Turbidity Units		
	Turbidity Calibration		
	12:00:00	001/500	

## ■ SETTING THE CLOCK

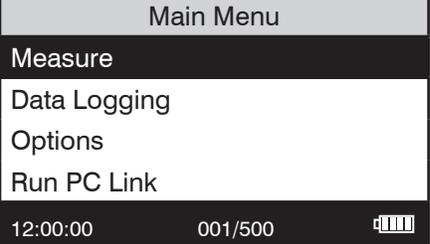
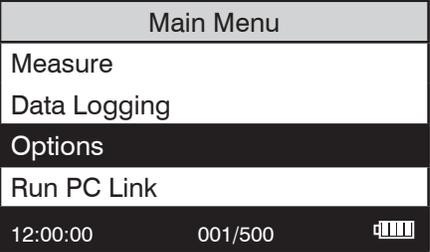
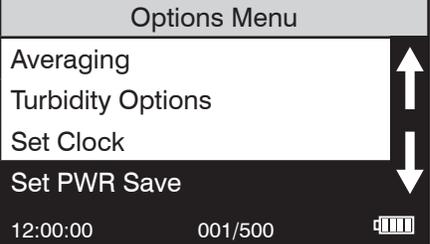
<p>1. Press and briefly hold  to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the <b>Main Menu</b> will appear.</p>	 <p>Main Menu</p> <p>Measure</p> <p>Data Logging</p> <p>Options</p> <p>Run PC Link</p> <p>12:00:00 001/500 </p>
<p>2. Press  to scroll to <b>Options</b>.</p>	 <p>Main Menu</p> <p>Measure</p> <p>Data Logging</p> <p>Options</p> <p>Run PC Link</p> <p>12:00:00 001/500 </p>
<p>3. Press  to select <b>Options</b>. Press  to scroll to <b>Set Clock</b>.</p>	 <p>Options Menu</p> <p>Averaging</p> <p>Turbidity Options</p> <p>Set Clock</p> <p>Set PWR Save</p> <p>12:00:00 001/500 </p>
<p>4. Press  to select <b>Set Clock</b>. The date is displayed as month-day-year. The time is displayed as hours:minutes:seconds AM/PM. Press  or  to the appropriate character and press  to select. The cursor will move to the next character. Set all characters in the same manner. This is a scrolling menu.</p>	 <p>Set Time</p> <p>Date: 07-09-2010</p> <p>Time: 02:09:08 PM</p> <p>12:00:00 001/500 </p>

5. Press **ENTER** to select the final character. The time and date will be saved and the screen will return to the **Options Menu**.

Options Menu	
Averaging	↑
Turbidity Options	↑
Set Clock	↓
Set PWR Save	↓
12:00:00	001/500 

## ■ SETTING POWER SAVE

The power saving Auto Shutoff feature will turn the meter off when a button has not been pushed for a set amount of time. The default setting is disabled. To change the setting:

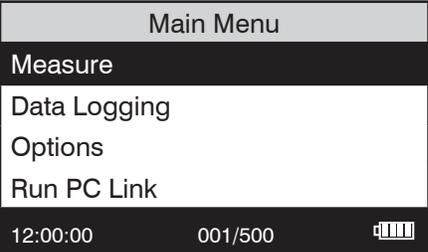
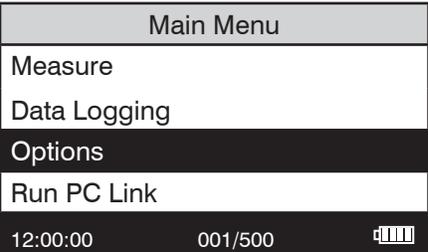
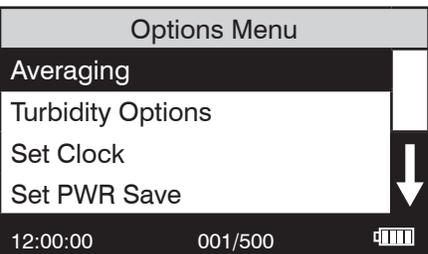
<p>1. Press and briefly hold  to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the <b>Main Menu</b> will appear.</p>	
<p>2. Press  to scroll to <b>Options</b>.</p>	
<p>3. Press  to select <b>Options</b>.</p>	
<p>4. Press  to scroll to <b>Set PWR Save</b>.</p>	

5. Press <b>ENTER</b> to select <b>PWR Save</b> .	Auto Shutoff
	Disable 5 Minutes 15 Minutes 30 Minutes 12:00:00 001/500 
6. Press <b>▼</b> <b>▼</b> to scroll to desired setting.	Auto Shutoff
	Disable 5 Minutes 15 Minutes 30 Minutes 12:00:00 001/500 
7. Press <b>ENTER</b> to save the selection. The screen will display <b>Storing...</b> for about 1 second and return to the <b>Options Menu</b> .	Options Menu
	Averaging Turbidity Options Set Clock Set PWR Save 12:00:00 001/500 

### ■ SETTING THE BACKLIGHT TIME

The backlight illuminates the display for enhanced viewing. If Button Control is chosen the backlight button on the key pad will act as an on/off switch and the backlight will remain on or off when the meter is being used. When one of the other settings – 10, 20 or 30 seconds – is chosen, the display will be illuminated for the specified amount of time after any button is pressed. As a precaution, the backlight will not illuminate during turbidity measurements to avoid interference from stray light.

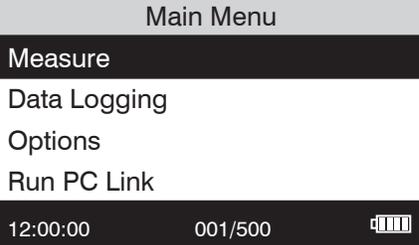
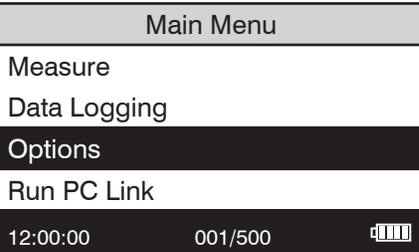
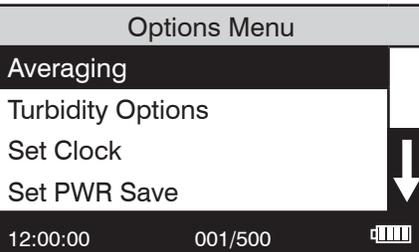
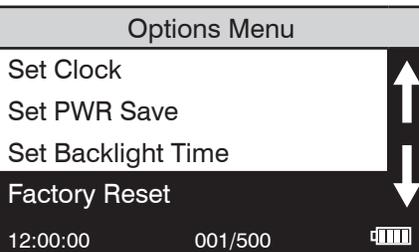
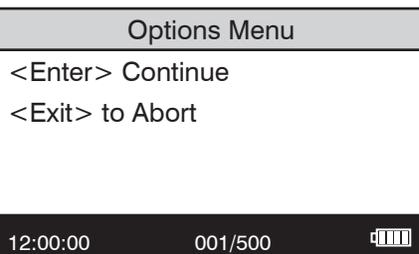
**NOTE:** The backlight feature uses a significant amount of power. The longer the backlight is on, the more frequently the battery will have to be charged if the USB/Wall Charger is not being used.

<p>1. Press and briefly hold  to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the <b>Main Menu</b> will appear.</p>	
<p>2. Press  to scroll to <b>Options</b>.</p>	
<p>3. Press  to select <b>Options</b>.</p>	

4. Press  to scroll to <b>Set Backlight Time</b> .	<table border="1"> <thead> <tr> <th colspan="2">Options Menu</th> </tr> </thead> <tbody> <tr> <td>Turbidity Options</td> <td rowspan="4"> </td> </tr> <tr> <td>Set Clock</td> </tr> <tr> <td>Set PWR Save</td> </tr> <tr> <td><b>Set Backlight Time</b></td> </tr> <tr> <td>12:00:00</td> <td>001/500 </td> </tr> </tbody> </table>	Options Menu		Turbidity Options	 	Set Clock	Set PWR Save	<b>Set Backlight Time</b>	12:00:00	001/500 			
Options Menu													
Turbidity Options	 												
Set Clock													
Set PWR Save													
<b>Set Backlight Time</b>													
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5. Press  to select <b>Set Backlight Time</b> .	<table border="1"> <thead> <tr> <th colspan="2">Backlight Time</th> </tr> </thead> <tbody> <tr> <td>Button Control</td> <td></td> </tr> <tr> <td><b>10 Seconds</b></td> <td></td> </tr> <tr> <td>20 Seconds</td> <td></td> </tr> <tr> <td>30 Seconds</td> <td></td> </tr> <tr> <td>12:00:00</td> <td>001/500 </td> </tr> </tbody> </table>	Backlight Time		Button Control		<b>10 Seconds</b>		20 Seconds		30 Seconds		12:00:00	001/500 
Backlight Time													
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6. Press   to scroll to desired setting.	<table border="1"> <thead> <tr> <th colspan="2">Backlight Time</th> </tr> </thead> <tbody> <tr> <td>Button Control</td> <td></td> </tr> <tr> <td>10 Seconds</td> <td></td> </tr> <tr> <td><b>20 Seconds</b></td> <td></td> </tr> <tr> <td>30 Seconds</td> <td></td> </tr> <tr> <td>12:00:00</td> <td>001/500 </td> </tr> </tbody> </table>	Backlight Time		Button Control		10 Seconds		<b>20 Seconds</b>		30 Seconds		12:00:00	001/500 
Backlight Time													
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30 Seconds													
12:00:00	001/500 												
7. Press  to save the selection. The screen will display <b>Storing...</b> for about 1 second and return to the <b>Options Menu</b> .	<table border="1"> <thead> <tr> <th colspan="2">Options Menu</th> </tr> </thead> <tbody> <tr> <td>Turbidity Options</td> <td rowspan="4"> </td> </tr> <tr> <td>Set Clock</td> </tr> <tr> <td>Set PWR Save</td> </tr> <tr> <td><b>Set Backlight Time</b></td> </tr> <tr> <td>12:00:00</td> <td>001/500 </td> </tr> </tbody> </table>	Options Menu		Turbidity Options	 	Set Clock	Set PWR Save	<b>Set Backlight Time</b>	12:00:00	001/500 			
Options Menu													
Turbidity Options	 												
Set Clock													
Set PWR Save													
<b>Set Backlight Time</b>													
12:00:00	001/500 												

## ■ FACTORY RESET

Performing a Factory Reset will restore the factory default settings. All user-level calibrated settings will be lost.

<p>1. Press and briefly hold  to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the <b>Main Menu</b> will appear.</p>	
<p>2. Press  to scroll to <b>Options</b>.</p>	
<p>3. Press  to select <b>Options</b>.</p>	
<p>4. Press  to scroll to <b>Factory Reset</b>.</p>	
<p>5. Press  to select to <b>Factory Reset</b>.</p>	

6. Press **ENTER** to complete the Factory Reset. The screen will momentarily display **Writing**. The screen will display **Done** and return to the **Options Menu**. To retain the current user level calibration settings, press **EXIT** to abort the Factory Reset.

## Options Menu

# Done

&lt;Enter&gt; Continue

12:00:00

001/500



7. Press **ENTER** to return to the **Options Menu**.

## Options Menu

Set Clock

Set PWR Save

Set Backlight Time

Factory Reset

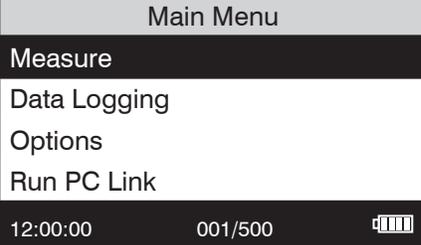
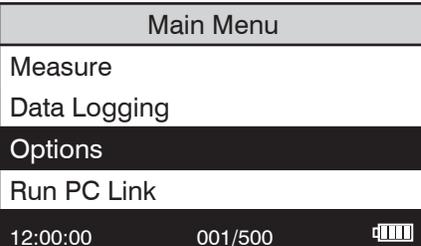
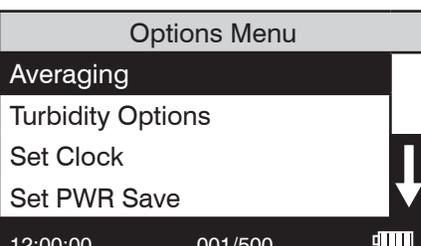
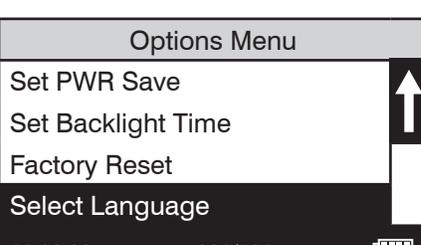
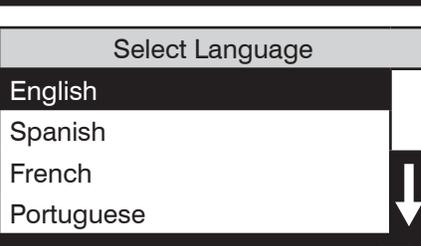
12:00:00

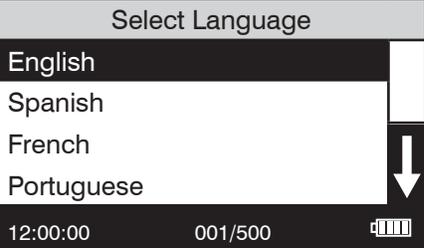
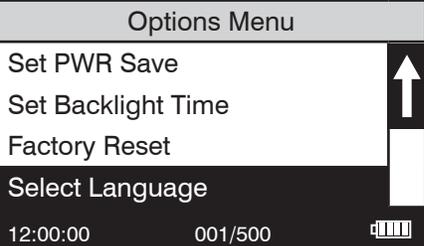
001/500



## ■ SELECTING A LANGUAGE

There are seven languages available in the 2020we/wi: English, Spanish, French, Portuguese, Italian, Chinese, and Japanese (Kana).

<p>1. Press and briefly hold  to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the <b>Main Menu</b> will appear.</p>	
<p>2. Press  to scroll to <b>Options</b>.</p>	
<p>3. Press  to select <b>Options</b>.</p>	
<p>4. Press  to scroll to <b>Select Language</b>.</p>	
<p>5. Press  to select to <b>Select Language</b>.</p>	

6. Press  or  to scroll to desired language.	 <p>The screenshot shows a menu titled "Select Language" with four options: English, Spanish, French, and Portuguese. The "English" option is highlighted with a black background. A white arrow on the right side of the menu points downwards. At the bottom of the screen, the time is 12:00:00, the battery level is 001/500, and there is a battery icon.</p>
7. Press  to select desired language. The screen will momentarily display, <b>Storing...</b> for about 1 second and return tot the <b>Options Menu</b> .	 <p>The screenshot shows a menu titled "Options Menu" with four options: Set PWR Save, Set Backlight Time, Factory Reset, and Select Language. The "Select Language" option is highlighted with a black background. A white arrow on the right side of the menu points upwards. At the bottom of the screen, the time is 12:00:00, the battery level is 001/500, and there is a battery icon.</p>

NOTE: If the meter unintentionally switches to another language, use the procedure above to reset the meter to the desired language. For example, to reset the meter to English:

1. Turn the meter on.
2. Press down arrow twice. Press ENTER.
3. Press down arrow seven times. Press ENTER.
4. Press ENTER.

## DATA LOGGING

The default setting for the data logger is enabled. The meter will log the last 500 data points. The counter in the center bottom of the display will show how many data points have been logged.

<p>1. Press and briefly hold  to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the <b>Main Menu</b> will appear.</p>	<table border="1"> <thead> <tr> <th colspan="3">Main Menu</th> </tr> </thead> <tbody> <tr> <td>Measure</td> <td></td> <td></td> </tr> <tr> <td>Data Logging</td> <td></td> <td></td> </tr> <tr> <td>Options</td> <td></td> <td></td> </tr> <tr> <td>Run PC Link</td> <td></td> <td></td> </tr> <tr> <td>12:00:00</td> <td>001/500</td> <td></td> </tr> </tbody> </table>	Main Menu			Measure			Data Logging			Options			Run PC Link			12:00:00	001/500	
Main Menu																			
Measure																			
Data Logging																			
Options																			
Run PC Link																			
12:00:00	001/500																		
<p>2. Press  to scroll to <b>Data Logging</b>.</p>	<table border="1"> <thead> <tr> <th colspan="3">Main Menu</th> </tr> </thead> <tbody> <tr> <td>Measure</td> <td></td> <td></td> </tr> <tr> <td>Data Logging</td> <td></td> <td></td> </tr> <tr> <td>Options</td> <td></td> <td></td> </tr> <tr> <td>Run PC Link</td> <td></td> <td></td> </tr> <tr> <td>12:00:00</td> <td>001/500</td> <td></td> </tr> </tbody> </table>	Main Menu			Measure			Data Logging			Options			Run PC Link			12:00:00	001/500	
Main Menu																			
Measure																			
Data Logging																			
Options																			
Run PC Link																			
12:00:00	001/500																		
<p>3. Press  to select <b>Data Logging</b>.</p>	<table border="1"> <thead> <tr> <th colspan="3">Logging</th> </tr> </thead> <tbody> <tr> <td>Display Test Log</td> <td></td> <td></td> </tr> <tr> <td>Enable Logging</td> <td></td> <td></td> </tr> <tr> <td>Disable Logging</td> <td></td> <td></td> </tr> <tr> <td>Erase Log</td> <td></td> <td></td> </tr> <tr> <td>12:00:00</td> <td>001/500</td> <td></td> </tr> </tbody> </table>	Logging			Display Test Log			Enable Logging			Disable Logging			Erase Log			12:00:00	001/500	
Logging																			
Display Test Log																			
Enable Logging																			
Disable Logging																			
Erase Log																			
12:00:00	001/500																		
<p>4. Press  to display the last data point and the time that it was logged.</p>	<table border="1"> <thead> <tr> <th colspan="3">Record Number 2</th> </tr> </thead> <tbody> <tr> <td>Turbidity - WB (F)</td> <td></td> <td></td> </tr> <tr> <td>655 AU</td> <td></td> <td></td> </tr> <tr> <td>12:26:58 PM</td> <td>08-03-2010</td> <td></td> </tr> <tr> <td>12:00:00</td> <td>001/500</td> <td></td> </tr> </tbody> </table>	Record Number 2			Turbidity - WB (F)			655 AU			12:26:58 PM	08-03-2010		12:00:00	001/500				
Record Number 2																			
Turbidity - WB (F)																			
655 AU																			
12:26:58 PM	08-03-2010																		
12:00:00	001/500																		

5. Press  or  to scroll through the data points in the log.	Record Number 1
	Turbidity - WB (F) 95.4 NTU 12:26:44 PM 08-03-2010
	12:00:00 001/500 
6. Press  to return to the <b>Logging</b> menu. Press  or  to scroll to disable the logging options or erase the log. Press  to select the option. The screen will display <b>Storing...</b> for about 1 second and return to the <b>Logging Menu</b> .	Logging
	Display Test Log
	<b>Enable Logging</b>
	Disable Logging
	Erase Log
	12:00:00 001/500 

## CALIBRATION & ANALYSIS

### ■ CALIBRATION

#### Turbidity Standards

Only use AMCO or formazin standards with the 2020we/wi. StablCal® standards below 50 NTU should not be used to calibrate the 2020we/wi. The diluent used in the StablCal® standards has a different refractive index than traditional formazin standards and will affect the results. The concentration of the calibration standard should be similar to the expected concentration of sample that will be tested. The following standards are available from LaMotte Company:

- 1480 0 NTU Standard, 60 mL (EPA or ISO)
- 1450 1 NTU Standard, 60 mL (EPA)
- 1453 1 NTU Standard, 60 mL (ISO)
- 1451 10 NTU Standard, 60 mL (EPA)
- 1454 10 NTU Standard, 60 mL (ISO)
- 1452 100 NTU Standard, 60 mL (EPA)
- 1455 100 NTU Standard, 60 mL (ISO)

#### Turbidity Calibration Procedure

The default units are NTU and the default calibration curve is formazin as indicated by (F) in the Menu bar. For the most accurate results, a user calibration should be performed. The Japan Standard calibration mode, as indicated by (J) in the Menu bar, should be used only with Japanese Polystyrene Standards (0-100 NTU). To change the settings see the Set Up Instructions on page 9.

For the most accurate results, perform a calibration over the smallest range possible. Use a calibration standard that, along with the blank, brackets the range of samples that will be tested. For example, if the samples that are to be tested are expected to be below 1 NTU, more accurate results will be obtained by calibration with a blank and a 1 NTU standard as opposed to a blank and a 100 NTU standard.

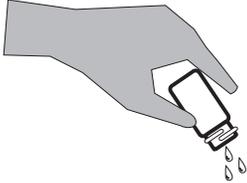
It is recommended that the meter be calibrated daily.

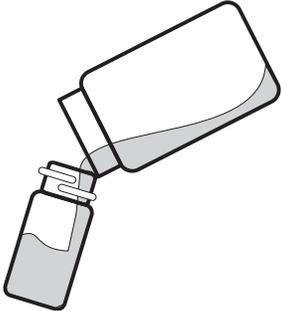
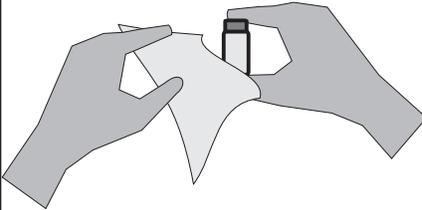
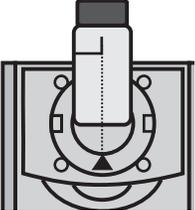
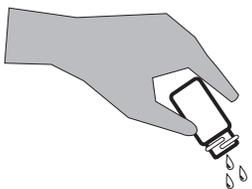
1. Press and briefly hold  to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the <b>Main Menu</b> will appear.	Main Menu	
	Measure	
	Data Logging	
	Options	
	Run PC Link	
	12:00:00	001/500 

2. Press <b>ENTER</b> to select <b>Measure</b> .	Measure Menu
	Turbidity - No Blank
	Turbidity - With Blank
	12:00:00      001/500 

3. Press <b>▼</b> to scroll to <b>Turbidity - With Blank</b> .	Measure Menu
	Turbidity - No Blank
	Turbidity - With Blank
	12:00:00      001/500 

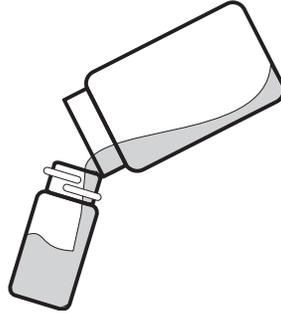
4. Press <b>ENTER</b> to select <b>Turbidity - With Blank</b> .	Turbidity WB (F)
	Scan Blank
	Scan Sample
	12:00:00      001/500 

5. Rinse a clean tube (0290) three times with the blank. If samples are expected to read below 1 NTU the meter should be blanked with a 0 NTU Primary Standard or prepared turbidity-free (<0.1 NTU) water. For the most accurate results, use the same tube for the blank and the sample.	
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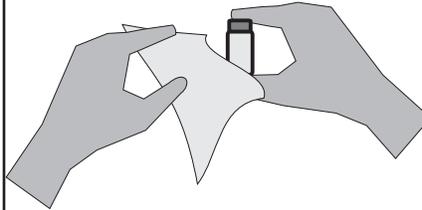
<p>6. Fill the tube to the fill line with the blank. Pour the blank down the inside of the tube to avoid creating bubbles. Cap the tube.</p>	
<p>7. Wipe the tube thoroughly with a lint-free cloth.</p>	
<p>8. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.</p>	
<p>9. Press <b>ENTER</b> to scan the blank. The screen will display <b>Blank Done</b> for about 1 second and then return to the <b>Turbidity - With Blank Menu</b>.</p>	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">Turbidity WB (F)</p> <hr/> <p>Scan Blank</p> <p style="background-color: black; color: white; padding: 2px;">Scan Sample</p> <p style="font-size: small;">12:00:00      001/500      </p> </div>
<p>10. Rinse a clean tube (0290), or the same tube, three times with the standard.</p>	

Calibration

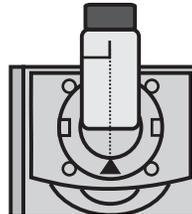
11. Fill the tube to the fill line with the standard. Pour the standard down the inside of the tube to avoid creating bubbles. Cap the tube.



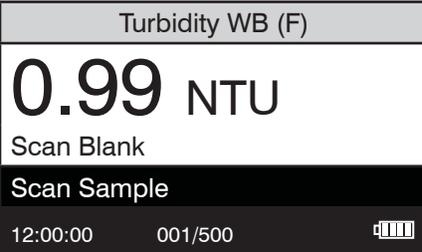
12. Wipe the tube thoroughly with a lint-free cloth.



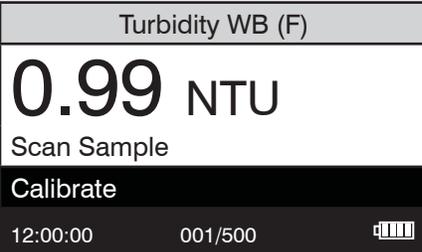
13. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.



14. Press **ENTER** to scan the standard. The screen will display **Reading** for about 1 second. The result will appear on the screen.



15. Press **▼** to scroll to **Calibrate**.



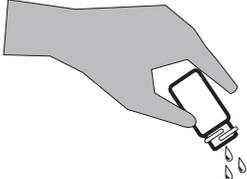
<p>16. Press <b>ENTER</b> to select <b>Calibrate</b>. A reverse font (dark background with light characters) will appear to indicate that the reading can be adjusted.</p>	<table border="1"> <tr><td colspan="2">Turbidity WB (F)</td></tr> <tr><td><b>0.99</b></td><td><b>NTU</b></td></tr> <tr><td colspan="2">Scan Sample</td></tr> <tr><td colspan="2">Calibrate</td></tr> <tr><td>12:00:00</td><td>001/500 </td></tr> </table>	Turbidity WB (F)		<b>0.99</b>	<b>NTU</b>	Scan Sample		Calibrate		12:00:00	001/500		
Turbidity WB (F)													
<b>0.99</b>	<b>NTU</b>												
Scan Sample													
Calibrate													
12:00:00	001/500												
<p>17. Press <b>▲</b> or <b>▼</b> to scroll to the concentration of the standard, 1.00 in the example. Note: The allowable adjustment is <math>\pm 10\%</math>.</p>	<table border="1"> <tr><td colspan="2">Turbidity WB (F)</td></tr> <tr><td><b>1.00</b></td><td><b>NTU</b></td></tr> <tr><td colspan="2">Scan Sample</td></tr> <tr><td colspan="2">Calibrate</td></tr> <tr><td>12:00:00</td><td>001/500 </td></tr> </table>	Turbidity WB (F)		<b>1.00</b>	<b>NTU</b>	Scan Sample		Calibrate		12:00:00	001/500		
Turbidity WB (F)													
<b>1.00</b>	<b>NTU</b>												
Scan Sample													
Calibrate													
12:00:00	001/500												
<p>18. Press <b>ENTER</b> to select <b>Calibrate</b>. Two menu choices will be offered, <b>Set Calibration</b> and <b>Factory Setting</b>.</p>	<table border="1"> <tr><td colspan="2">Calibrate Menu</td></tr> <tr><td><b>1.00</b></td><td><b>NTU</b></td></tr> <tr><td colspan="2">Set Calibration</td></tr> <tr><td colspan="2">Factory Setting</td></tr> <tr><td>12:00:00</td><td>001/500 </td></tr> </table>	Calibrate Menu		<b>1.00</b>	<b>NTU</b>	Set Calibration		Factory Setting		12:00:00	001/500		
Calibrate Menu													
<b>1.00</b>	<b>NTU</b>												
Set Calibration													
Factory Setting													
12:00:00	001/500												
<p>19. Press <b>ENTER</b> to select <b>Set Calibration</b> and save the calibration. Press <b>▲</b> or <b>▼</b> to scroll and select <b>Factory Setting</b> to revert to the factory calibration. The meter will momentarily display <b>Storing...</b> and return to the <b>Turbidity -Without Blank</b> menu. The calibration has now been saved and the meter can be used for testing.</p>	<table border="1"> <tr><td colspan="2">Turbidity WB (F)</td></tr> <tr><td colspan="2"> </td></tr> <tr><td colspan="2">Scan Blank</td></tr> <tr><td colspan="2">Scan Sample</td></tr> <tr><td>12:00:00</td><td>001/500 </td></tr> <tr><td colspan="2"> </td></tr> </table>	Turbidity WB (F)				Scan Blank		Scan Sample		12:00:00	001/500		
Turbidity WB (F)													
Scan Blank													
Scan Sample													
12:00:00	001/500												

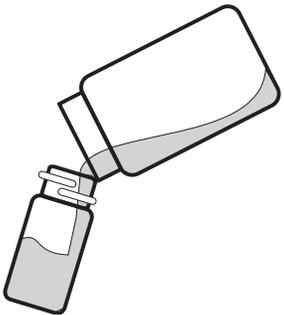
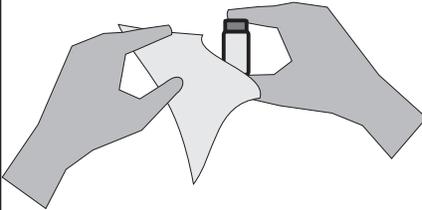
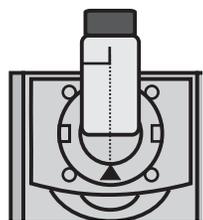
NOTE: For the greatest accuracy during the calibration procedure, be sure that after the meter is blanked and the blank is scanned as a sample, the reading is 0.00. If not, reblank the meter and scan the blank again until it reads 0.00. When scanning the calibration standards as the sample, scan the calibration standard three times removing the tube from the chamber after each scan. The readings should be consistent. Use the last consistent reading to calibrate the meter. If the readings are not consistent, avoid using an aberrant reading to calibrate the meter.

## ■ ANALYSIS WITHOUT BLANKING PROCEDURE

To obtain the most accurate results the meter should be blanked before measuring a sample. The blanking step is not as critical for samples above 10 NTU. The meter should always be blanked before reading samples below 10 NTU.

Analysis

<p>1. Press and briefly hold  to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the <b>Main Menu</b> will appear.</p>	<div style="background-color: #cccccc; padding: 2px;">Main Menu</div> <div style="background-color: #333; color: white; padding: 2px;">Measure</div> <div style="padding: 2px;">Data Logging</div> <div style="padding: 2px;">Options</div> <div style="padding: 2px;">Run PC Link</div> <div style="background-color: #333; color: white; padding: 2px;">12:00:00      001/500      </div>
<p>2. Press  to select <b>Measure</b>.</p>	<div style="background-color: #cccccc; padding: 2px;">Measure Menu</div> <div style="background-color: #333; color: white; padding: 2px;">Turbidity - No Blank</div> <div style="padding: 2px;">Turbidity - With Blank</div> <div style="background-color: #333; color: white; padding: 2px;">12:00:00      001/500      </div>
<p>3. Press  to select <b>Turbidity - No Blank</b>.</p>	<div style="background-color: #cccccc; padding: 2px;">Turbidity NB (F)</div> <div style="padding: 2px;">Scan Blank</div> <div style="background-color: #333; color: white; padding: 2px;">Scan Sample</div> <div style="background-color: #333; color: white; padding: 2px;">12:00:00      001/500      </div>
<p>4. Rinse a clean tube (0290) three times with the sample.</p>	

<p>5. Fill the tube to the fill line with the sample. Pour the sample down the inside of the tube to avoid creating bubbles. Cap the tube.</p>	
<p>6. Wipe the tube thoroughly with a lint-free cloth.</p>	
<p>7. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.</p>	
<p>8. Press <b>ENTER</b> to select <b>Scan Sample</b>. The screen will display <b>Reading</b> for about 1 second. The result will appear on the screen.</p>	<div style="text-align: center;"> <p>Turbidity NB (F)</p> <h1>10.22 NTU</h1> <p>Scan Blank</p> <p>Scan Sample</p> <p>12:00:00      001/500      </p> </div>

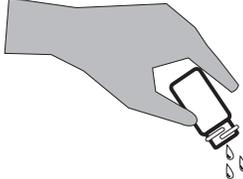
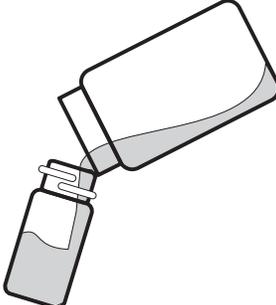
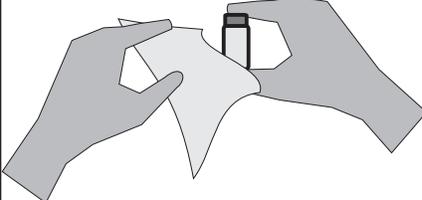
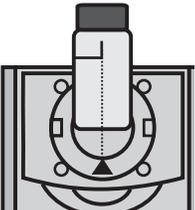
Analysis

## ■ ANALYSIS WITH BLANKING PROCEDURE

To obtain the most accurate results the meter should be blanked before measuring a sample. The blanking step is not as critical for samples above 10 NTU. The meter should always be blanked before reading samples below 10 NTU.

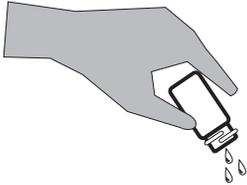
Analysis

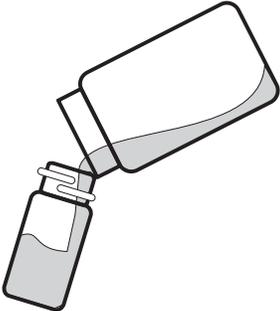
<p>1. Press and briefly hold  to turn the meter on. The LaMotte logo screen will appear for about 3 seconds and the <b>Main Menu</b> will appear.</p>	<table border="1"> <thead> <tr> <th colspan="2">Main Menu</th> </tr> </thead> <tbody> <tr> <td>Measure</td> <td></td> </tr> <tr> <td>Data Logging</td> <td></td> </tr> <tr> <td>Options</td> <td></td> </tr> <tr> <td>Run PC Link</td> <td></td> </tr> <tr> <td>12:00:00</td> <td>001/500 </td> </tr> </tbody> </table>	Main Menu		Measure		Data Logging		Options		Run PC Link		12:00:00	001/500 
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<p>2. Press  to select <b>Measure</b>.</p>	<table border="1"> <thead> <tr> <th colspan="2">Measure Menu</th> </tr> </thead> <tbody> <tr> <td>Turbidity - No Blank</td> <td></td> </tr> <tr> <td>Turbidity - With Blank</td> <td></td> </tr> <tr> <td>12:00:00</td> <td>001/500 </td> </tr> </tbody> </table>	Measure Menu		Turbidity - No Blank		Turbidity - With Blank		12:00:00	001/500 				
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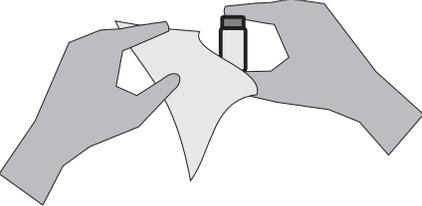
<p>5. Rinse a clean tube (0290) three times with the blank. If samples are expected to read below 1 NTU the meter should be blanked with a 0 NTU Primary Standard or prepared turbidity-free (&lt;0.1 NTU) water. For the most accurate results, use the same tube for the blank and the sample.</p>	
<p>6. Fill the tube to the fill line with the blank. Pour the blank down the inside of the tube to avoid creating bubbles. Cap the tube.</p>	
<p>7. Wipe the tube thoroughly with a lint-free cloth.</p>	
<p>8. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.</p>	

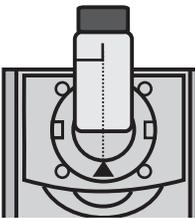
Analysis

<p>9. Press <b>ENTER</b> to scan the blank. The screen will display <b>Blank Done</b> for about 1 second and then return to the <b>Turbidity - With Blank</b> menu.</p>	Turbidity WB (F)
	<p>Scan Blank</p> <p><b>Scan Sample</b></p> <p>12:00:00      001/500      </p>

<p>10. Rinse a clean tube (0290), or the same tube, three times with the sample.</p>	
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<p>11. Fill the tube to the fill line with the standard. Pour the standard down the inside of the tube to avoid creating bubbles. Cap the tube.</p>	
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<p>12. Wipe the tube thoroughly with a lint-free cloth.</p>	
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<p>13. Open the meter lid. Insert the tube into the chamber. Align the index line on the tube with the index arrow on the meter. Close the lid.</p>	
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14. Press <b>ENTER</b> to scan the standard. The screen will display <b>Reading</b> for about 1 second. The result will appear on the screen.	Turbidity WB (F)	
	<b>0.99</b> NTU	
	Scan Blank	
	Scan Sample	
	12:00:00	001/500 

NOTE: The meter will remember the last scanned blank reading. It is not necessary to scan a blank each time the test is performed. To use the previous blank reading, instead of scanning a new one, scroll to Scan Sample and proceed. For the most accurate results, the meter should be blanked before each test and the same tube should be used for the blank and the reacted sample.

### ■ DILUTION PROCEDURES

If a sample is encountered that is more than 4000 NTU, a careful dilution with 0 NTU or very low turbidity water will bring the sample into an acceptable range. However, there is no guarantee that halving the concentration will exactly halve the NTU value. Particulates often react in an unpredictable manner when diluted.

#### Turbidity-Free Water

The definition of low turbidity and turbidity-free water has changed as filter technology has changed and nephelometric instruments have become more sensitive. At one time turbidity-free water was defined as water that had passed through a 0.6 micron filter. Now 0.1 micron filters are available and higher purity water is possible. Water that has been passed through a 0.1 micron filter could be considered particle free and therefore turbidity free, 0 NTU water. Turbidity is caused by scattered light. Therefore, low turbidity water is water without any particles that scatter a measurable amount of light. But water that passed through a 0.1 micron filter may still have detectable light scatter with modern instruments. This light scattering can be the result of dissolved molecules or sub-micron sized particles that can not be filtered out of the water. Because there may still be a small amount of scattered light from dissolved molecules, high purity water is often called low turbidity water and assigned a value of 0.01 or 0.02 NTU. However, because this water is used as a baseline to compare to sample water, the difference between the sample and the low turbidity or turbidity-free water will be the same whether it is called 0.00 NTU or 0.02 NTU. For design simplicity the 2020we/wi uses the term turbidity-free water and the value of 0.00 NTU.

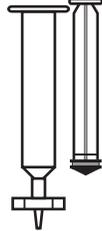
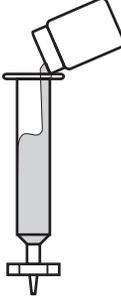
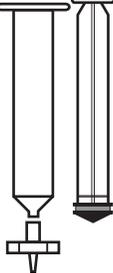
### ■ PREPARATION OF TURBIDITY-FREE WATER

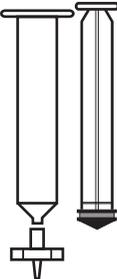
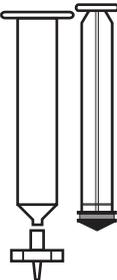
A 0 NTU Standard (Code 1480) is included with the meter. An accessory package (Code 4185) is available for preparing turbidity-free water for blanking the meter and dilution of high turbidity samples.

The preparation of turbidity-free water requires careful technique.

Introduction of foreign matter will affect the turbidity reading. A filtering device with a special membrane filter is used to prepare turbidity-free water. The filter, filter holder and syringe must be conditioned by forcing at least two syringes full of deionized water through the filtering apparatus to remove foreign matter. The first and second rinses should be discarded. Turbidity-free water as prepared with the following procedure may be stored in the dark at room temperature in a clean glass bottle with a screw cap and used as required. The storage container should be rinsed thoroughly with filtered deionized water before filling. The water should be periodically inspected for foreign matter in bright light.

**Analysis**

<p>1. Remove the plunger from the syringe (0943). Attach the filter to the bottom of the syringe.</p>	
<p>2. Pour approximately 50 mL of deionized water into the barrel of the syringe. Insert the plunger. Exert pressure on the plunger to slowly force the water through the filter. Collect water in the clean storage container. Rinse walls of the container then discard this rinse water.</p>	
<p>3. Remove the filter from the syringe. Remove the plunger from the barrel. (This step is required to prevent rupturing the filter by the vacuum that would be created when the plunger is removed.)</p>	

<p>4. Replace the filter and repeat step 2 for a second rinse of the syringe and storage container.</p>	
<p>5. Remove the filter from the syringe. Remove the plunger from the barrel. Replace the filter and fill the syringe with approximately 50 mL of deionized water. Filter the water into the storage container and save this turbidity-free water.</p>	
<p>6. Repeat Step 5 until the desired amount of turbidity-free water has been collected.</p>	

#### TESTING TIPS

1. Samples should be collected in a clean glass or polyethylene container.
2. Samples should be analyzed as soon as possible after collection.
3. Gently mix sample by inverting before taking a reading but avoid introducing air bubbles.
4. For the most precise results, follow the recommended procedure for wiping a filled tube before placing it in the meter chamber. Invert tube very slowly and gently three times to mix the sample. Surround the tube with a clean, lint-free cloth. Press the cloth around the tube. Rotate the tube in the cloth three times to assure that all areas of the tube have been wiped.
5. Discard tubes that have significant scratches and imperfections in the light pass zones. (Central zone between bottom and fill line).
6. When reading very low turbidity samples, do not use tubes or caps that have been used previously with high turbidity samples.
7. Use the averaging option for low level measurements of turbidity.

8. The meter should be placed on a surface that is free from vibrations. Vibrations can cause high readings.
9. Turbidity readings will be affected by electric fields around motors.
10. Carbon in the sample will absorb light and cause low readings.
11. Excessive color in a sample will absorb light and cause low readings. The user should verify if a certain level of color will cause a significant error at the level of turbidity being tested.
12. Observe shelf life recommendations for turbidity standards.
13. Do not use silicone oil on tubes when testing turbidity with the 2020we/wi.
14. When testing at low concentrations use the same tube for the blank and the sample.
15. Always insert tube into the meter chamber with the same amount of pressure and to the same depth.
16. Occasionally clean the chamber with a damp lint-free wipe, followed by a Windex® dampened wipe. A clean chamber and tubes are essential for reliable results.
17. For the greatest accuracy during the calibration procedure, be sure that after the meter is blanked and the blank is scanned as a sample, the reading is 0.00. If not, reblank the meter and scan the blank again until it reads 0.00. When scanning the calibration standards as the sample, scan the calibration standard three times removing the tube from the chamber after each scan. The readings should be consistent. Use the last consistent reading to calibrate the meter. If the readings are not consistent, avoid using an aberrant reading to calibrate the meter.
18. Calibrate the meter daily.
19. Calibrate the meter with a 1.0 NTU Standard if samples are expected to be 1.0 NTU or less. Calibrate the meter with a 10.0 NTU Standard if samples are expected to be 1.0 NTU or greater.

## TROUBLESHOOTING GUIDE

### ■ TROUBLESHOOTING

<i>PROBLEM</i>	<i>REASON</i>	<i>SOLUTION</i>
"Blank?"	Sample is reading lower than the blank.	With samples of very low concentration reblank or record as zero. On samples of higher concentration reblank and read again.
 Flashing	Low battery. Readings are reliable.	Charge battery or use USB wall/computer charger.
"Low Battery"	Battery voltage is very low. Readings are not reliable.	Charge battery or use USB wall/computer charger.
"Shut Down Low Batt" Shut Down	Battery is too low to operate the unit.	Charge battery or use USB wall/computer charger.
"Over range"	Sample is outside of acceptable range.	Dilute sample and test again.
"Error1"	High readings with 90° and 180° detectors.	Dilute sample by at least 50% and retest.
Lost in meter menus	Reset to factory default settings.	Follow Procedure on page 9 or page 26.
Unusually large negative or positive readings when performing calibration	Incorrect standards used to calibrate meter.	Use fresh 0.0 standard in clean tube. Reset meter to factory default settings. Recalibrate meter.

### ■ STRAY LIGHT

The accuracy of readings on the 2020we/wi should not be affected by stray light. Make sure that the sample compartment lid is always fully closed when taking readings. The backlight will interfere with turbidity readings. The meter will temporarily disable the backlight while turbidity measurements are being taken.

## **GENERAL OPERATING INFORMATION**

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### **■ OVERVIEW**

The 2020we/wi is a portable, microprocessor controlled, direct reading nephelometer. Turbidity is measured directly by either EPA Method 180.1 or ISO Method 7027. It has a graphical liquid crystal display and 6 button keypad. These allow the user to select options from the menu driven software, to directly read test results or to review stored results of previous tests in the data logger. The menus can be displayed in seven different languages.

The 2020we/wi uses a state of the art, multi-detector optical configuration that assures long term stability of calibrations, high precision and accuracy and low detection limits. All readings are determined by sophisticated digital signal processing algorithms, minimizing fluctuations in readings and enabling rapid, repeatable measurements. The microprocessor and optics enable a dynamic range and auto-ranging over several ranges. Energy efficient LED light sources are used for ISO turbidity. EPA turbidity uses a tungsten filament light source that meets or exceeds EPA specifications and is designed for a uniform light spot image and stable output.

A USB computer/wall charger or Lithium battery powers the 2020we/wi.

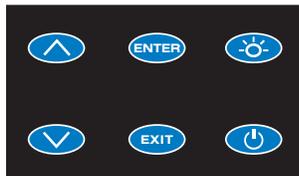
A USB port on the back of the meter allows an interface of the meter with a Windows-based computer for real-time data acquisition and data storage using a PC. The 2020we/wi may be interfaced with any Windows-based computer by using the LaMotte SMARTLink 3 Program.

### **GENERAL OPERATING INFORMATION**

The operation of the 2020we/wi is controlled by the menu driven software and user interface. A menu is a list of choices. This allows a selection of various tasks for the 2020we/wi to perform, such as, scan blank and scan sample. The keypad is used to make menu selections that are viewed on the display.

## ■ The Keypad

	This button will scroll up through a list of menu selections.
	The button is used to select choices in a menu viewed in the display.
	This button controls the backlight on the display.
	This button will scroll down through a list of menu selections.
	This button exits to the previous menu.
	This button turns the meter on or off.

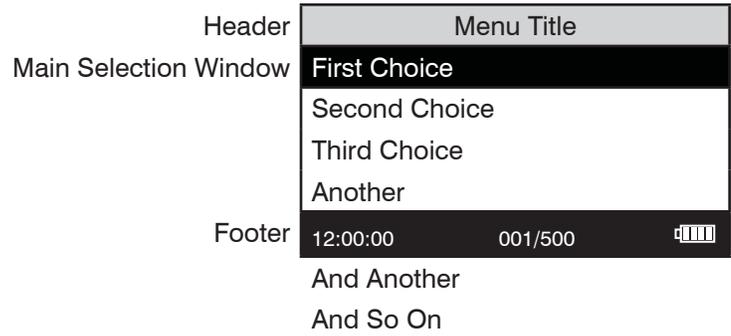


## ■ THE DISPLAY & MENUS

The display allows menu selections to be viewed and selected. These selections instruct the 2020we/wi to perform specific tasks. The menus are viewed in the display using two general formats that are followed from one menu to the next. Each menu is a list of choices or selections.

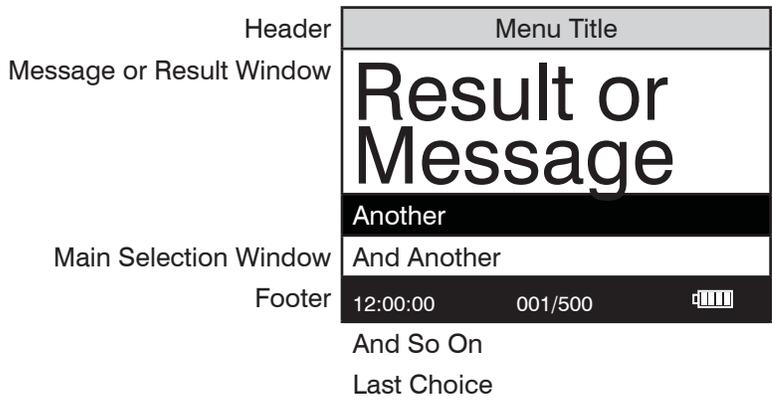
The display has a header line at the top and a footer line at the bottom. The header displays the title of the current menu. The footer line displays the time and the date, the data logger status and the battery status. The menu selection window is in the middle of the display between the header and the footer.

The menu selection window displays information in two general formats. In the first format only menu selections are displayed. Up to 4 lines of menu selections may be displayed. If more selections are available they can be viewed by pressing the arrow buttons   to scroll the other menu selections into the menu selection window. Think of the menu selections as a vertical list in the display that moves up or down each time an arrow button   is pressed. Some menus in the 2020we/wi are looping menus. The top and bottom menu choices are connected in a loop. Scrolling down past the bottom of the menu will lead to the top of the menu. Scrolling up past the top of the menu will lead to the bottom of the menu.



A black bar will indicate the menu choice. As the menu is scrolled through, the black bar will highlight different menu choices. Pressing the **ENTER** button will select the menu choice that is indicated by the black bar.

In the second format the menu choice window takes advantage of the graphical capabilities of the display. Large format graphic information, such as test results or error messages or the LaMotte logo is displayed. The top two lines of the display are used to display information in a large, easy to read format. The menus work in the same way as previously described but two lines of the menu are visible at the bottom of the display.



As described previously, the **EXIT** button allows an exit or escape from the current menu and a return to the previous menu. This allows a rapid exit from an inner menu to the main menu by repeatedly pushing the **EXIT** button. Pushing at any time will turn the 2020we/wi off.

The display may show the following messages:

	Battery Status
	More choices are available and can be viewed by scrolling up and/or down through the display.
Header	Identifies the current menu and information on units and reagent systems if applicable.
Footer	In the data logging mode the number of the data point is displayed and the total number of data points in the memory will be shown. The footer also shows current time and battery status

### ■ NEGATIVE RESULTS

There are always small variations in readings with analytical instruments. Often these variations can be observed by taking multiple readings of the same sample. These variations will fall above and below an average reading. Repeated readings on a 0.00 sample might give readings above and below 0.00. Therefore, negative readings are possible and expected on samples with concentrations at or near zero. This does not mean there is a negative concentration in the sample. It means the sample reading was less than the blank reading. Small negative readings can indicate that the sample was at or near the detection limit. This is a normal variation that results in a negative reading. A large negative reading, however, is not normal and indicates a problem. Some instruments are designed to display negative readings as zero. In this type of instrument, if the meter displayed zero when the result was actually a large negative number there would be no indication that a problem existed. For this reason, the 2020we/wi displays negative numbers for turbidity.

### ■ TUBES

The 2020we/wi uses one type of tube (Code 0290). There is no need for a special turbidity tube.

The handling of the tubes is of utmost importance. Tubes must be clean and free from lint, fingerprints, dried spills and significant scratches, especially the central zone between the bottom and the sample line.

Scratches, fingerprints and water droplets on the tube can cause stray light interference leading to inaccurate results when measuring turbidity. Scratches and abrasions will affect the accuracy of the readings. Tubes that have been scratched in the light zone through excessive use should be discarded and replaced with new ones.

Tubes should always be washed on the inside and outside with mild detergent prior to use to remove dirt or fingerprints. The tubes should be

allowed to air-dry in an inverted position to prevent dust from entering the tubes. Dry tubes should be stored with the caps on to prevent contamination.

After a tube has been filled and capped, it should be held by the cap and the outside surface should be wiped with a clean, lint-free absorbent cloth until it is dry and smudge-free. Handling the tube only by the cap will avoid problems from fingerprints. Always set the clean tube aside on a clean surface that will not contaminate the tube. It is imperative that the tubes and light chamber be clean and dry. The outside of the tubes should be dried with a clean, lint-free cloth or disposable wipe before they are placed in the meter chamber.

Tubes should be emptied and cleaned as soon as possible after reading a sample to prevent deposition of particulates on the inside of the tubes. When highly accurate results are required, reduce error by designating tubes to be used only for very low turbidity and very high turbidity testing.

Variability in the geometry of the glassware and technique is the predominate cause of variability in results. Slight variations in wall thickness and the diameter of the tubes may lead to slight variations in the test results. To eliminate this error the tubes should be placed in the chamber with the same orientation each time.

## **COMPUTER CONNECTION**

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### **■ PC LINK**

The 2020we/wi may be interfaced with any Windows-based computer by using the LaMotte SMARTLink 3 Program and USB Cable. The program will store test information and results in a database.

### **■ OUTPUT**

USB

### **■ COMPUTER CONNECTION**

USB Type A, USB mini B, Order Cable Code 1720.

## **BATTERY OPERATION**

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The 2020we/wi may be operated on battery power or using a computer/ AC wall adapter. If using the meter as a bench top unit, use the AC wall adapter if possible to extend the battery life. The meter will remain on when the USB adapter is used.

The battery icon will show no bars and flash when the unit first turns on. Then the indicator will indicate the battery status by showing 0, 1, 2, 3 or 4 bars.

It will take 5 hours to fully charge a low battery. The battery icon will flash when the battery is charging. The battery icon will show four bars and stop flashing when it is fully charged. The charging circuit will automatically switch to a float charge when the battery is fully charged. The charger may remain connected. Some computers will NOT supply

power to their USB ports during standby operation. The wall charger will charge the unit continuously.

The battery icon will show no bars and continuously flash if the battery is getting low but the unit will still operate normally. A “Low Battery” message on the status bar of the display will replace the time when the battery voltage is too low for proper operation and accuracy may be degraded. A “Shutdown Low Batt” message on the display will appear for a few seconds before the power is switched off when the battery is too low to operate the unit.

To extend the battery life:

- Shut down the unit with the power switch when not taking measurements or use the power save option to have the unit automatically turn off after 5 minutes.
- Store the unit in a cool dry place.
- Fully charge the battery before storing the unit for extended periods of time.
- Limit backlight use. The unit consumes 3X normal power with the backlight on. Set the backlight time option to 10 seconds, or select “Button Control” and keep the backlight off.

## **MAINTENANCE**

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### **■ CLEANING**

Clean the exterior housing with a damp, lint-free cloth. Do not allow water to enter the light chamber or any other parts of the meter. To clean the light chamber and optics area, point a can of compressed air into the light chamber and blow the pressurized air into the light chamber. Use a cotton swab dampened with Windex® window cleaner to gently swab the interior of the chamber. Do not use alcohol; it will leave a thin residue over the optics when dry.

### **■ REPAIRS**

Should it be necessary to return the meter for repair or servicing, pack the meter carefully in a suitable container with adequate packing material. A return authorization number must be obtained from LaMotte Company by calling 800-344-3100 (US only) or 410-778-3100, faxing 410-778-6394, or emailing [tech@lamotte.com](mailto:tech@lamotte.com). Often a problem can be resolved over the phone or by email. If a return of the meter is necessary, attach a letter with the return authorization number, meter serial number, a brief description of problem and contact information including phone and FAX numbers to the shipping carton. This information will enable the service department to make the required repairs more efficiently.

### **■ METER DISPOSAL**

Waste Electrical and Electronic Equipment (WEEE)

Natural resources were used in the production of this equipment. This equipment may contain materials that are hazardous to health and the environment. To avoid harm to the environment and natural resources, the use of appropriate take-back systems is recommended. The crossed out wheeled bin symbol on the meter encourages the use of these systems when disposing of this equipment.



Take-back systems will allow the materials to be reused or recycled in a way that will not harm the environment. For more information on approved collection, reuse, and recycling systems contact local or regional waste administration or recycling services.

## **GENERAL INFORMATION**

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### **■ PACKAGING AND DELIVERY**

Experienced packaging personnel at LaMotte Company assure adequate protection against normal hazards encountered in transportation of shipments.

After the product leaves LaMotte Company, all responsibility for safe delivery is assured by the transportation company. Damage claims must be filed immediately with the transportation company to receive compensation for damaged goods.

### **■ GENERAL PRECAUTIONS**

**READ THE INSTRUCTION MANUAL BEFORE ATTEMPTING TO SET UP OR OPERATE THE METER.** Failure to do so could result in personal injury or damage to the meter. The meter should not be used or stored in a wet or corrosive environment. Care should be taken to prevent water from wet tubes from entering the meter chamber.

**NEVER PUT WET TUBES IN THE METER.**

### **■ SAFETY PRECAUTIONS**

Read the label on all reagent containers. Some labels include precautionary notices and first aid information. Certain reagents are considered potential health hazards and are designated with a \* in the instruction manual. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to [www.lamotte.com](http://www.lamotte.com). To obtain a printed copy, contact LaMotte by e-mail, phone or FAX. Additional information for all LaMotte reagents is available in the United States, Canada, Puerto Rico, and the US Virgin Islands from Chem-Tel by calling 1-800-255-3924. For other areas, call 813-248-0585 collect to contact Chem-Tel's International access number. Each reagent can be identified by the four-digit number listed on the upper left corner of the reagent label, in the contents list and in the test procedures.

## ■ LIMITS OF LIABILITY

Under no circumstances shall LaMotte Company be liable for loss of life, property, profits, or other damages incurred through the use or misuse of their products.

## ■ SPECIFICATIONS - 2020we/wi

Instrument Type:	Nephelometer
Standard:	EPA 180.1, 2020we; ISO7027, 2020wi
Units of Measure:	NTU (Nephelometric Turbidity Units) (2020we only) FNU (Formazin Nephelometric Units) (2020wi only) ASBC (American Society of Brewing Chemists) EBC (European Brewery Convention)
Range:	0-4000 NTU, 0-4000 FNU, 0-10,500 ASBC, 0-150 EBC
Range Selection:	Automatic
Resolution: (display)	0.01 NTU, 0–10.99 NTU Range 0.1 NTU, 11.0–109.9 NTU Range 1 NTU, 110–4000 NTU Range
Accuracy:	From 0-2.5 NTU the accuracy is $\pm 0.05$ NTU. From 2.5-100 NTU the accuracy is $\pm 2\%$ . Above 100 NTU the accuracy is $\pm 3\%$ .
Detection Limit:	0.05 NTU
Light Source:	Tungsten lamp 2300°C $\pm 50$ °C, 2020we; IR LED 850 nm $\pm 10$ nm, spectral bandwidth 50 nm, 2020wi
Detector	Photodiode, centered at 90°, maximum peak 400-600 nm, TC-3000we Photodiode, centered at 90°, TC-3000wi
Response Time:	<2 seconds
Signal Averaging:	Yes
Sample Chamber:	Accepts 25 mm flat-bottomed test tubes
Sample:	10 mL in capped tube
Display:	Graphic Liquid Crystal Display
Software:	<i>Auto Shut-off:</i> 5, 10, 30 min, disabled <i>Calibration:</i> Field adjustable, 2-points <i>Data Logging:</i> 500 points
Languages:	English, Spanish, French, Portuguese, Italian, Chinese, Japanese (Kana)
Temperature:	Operation: 0–50 °C; Storage: -40–60 °C

Operation Humidity Range:	0–90 % RH, non-condensing
Auto Shut-off:	5, 10, 30 min, disabled
Waterproof:	IP67
Power Source†:	USB computer/wall charger or Lithium ion rechargeable battery 2200 mAH, 3.7V
Battery Life:	~380 tests (backlight on) to 1000 tests (backlight off) (with signal averaging disabled)
Dimensions:	(W x L x H) 8.84 x 19.05 x 6.35 cm; 3.5 x 7.5 x 2.2 inches
Weight:	362 g, 13 oz (meter only)
USB Interface	mini B

†CE Mark: The device complies to the product specifications for the Low Voltage Directive.

## ■ STATISTICAL & TECHNICAL DEFINITIONS RELATED TO PRODUCT SPECIFICATIONS

**Method Detection Limit (MDL):** “The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.”<sup>1</sup> Note that, “As Dr. William Horwitz once stated, ‘In almost all cases when dealing with a limit of detection or limit of determination, the primary purpose of determining that limit is to stay away from it.’”<sup>2</sup>

**Accuracy:** Accuracy is the nearness of a measurement to the accepted or true value.<sup>3</sup> The accuracy can be expressed as a range, about the true value, in which a measurement occurs (i.e.  $\pm 0.5$  ppm). It can also be expressed as the % recovery of a known amount of analyte in a determination of the analyte (i.e. 103.5 %).

**Resolution:** Resolution is the smallest discernible difference between any two measurements that can be made.<sup>4</sup> For meters this is usually how many decimal places are displayed. (i.e. 0.01). Note that the resolution may change with concentration or range. In some cases the resolution may be less than the smallest interval, if it is possible to make a reading that falls between calibration marks. A word of caution, that resolution has very little relationship to accuracy or precision. The resolution will always be less than the accuracy or precision but it is not a statistical measure of how well a method of analysis works. The resolution can be very, very good and the accuracy and precision can be very bad! This is not a useful measure of the performance of a test method.

**Repeatability:** Repeatability is the within-run precision.<sup>5</sup> A run is a

single data set, from set up to clean up. Generally, one run occurs on one day. However, for meter calibrations, a single calibration is considered a single run or data set, even though it may take 2 or 3 days.

**Reproducibility:** Reproducibility is the between-run precision.<sup>6</sup>

**Detection Limit (DL):** The detection limit (DL) for the 2020we/wi is defined as the minimum value or concentration that can be determined by the meter, which is greater than zero, independent of matrix, glassware, and other sample handling sources of error. It is the detection limit for the optical system of the meter.

<sup>1</sup> CFR 40, part 136, appendix B

<sup>2</sup> Statistics in Analytical Chemistry: Part 7 – A Review, D. Coleman and L Vanatta, American Laboratory, Sept 2003, P. 31.

<sup>3</sup> Skoog, D.A., West, D. M., *Fundamental of Analytical Chemistry*, 2<sup>nd</sup> ed., Holt Rinehart and Winston, Inc, 1969, p. 26.

<sup>4</sup> Statistics in Analytical Chemistry: Part 7 – A Review, D. Coleman and L Vanatta, American Laboratory, Sept 2003, P. 34.

<sup>5</sup> Jeffery G. H., Basset J., Mendham J., Denney R. C., *Vogel's Textbook of Quantitative Chemical Analysis*, 5<sup>th</sup> ed., Longman Scientific & Technical, 1989, p. 130.

<sup>6</sup> Jeffery G. H., Basset J., Mendham J., Denney R. C., *Vogel's Textbook of Quantitative Chemical Analysis*, 5<sup>th</sup> ed., Longman Scientific & Technical, 1989, p. 130

■ **CONTENTS & ACCESSORIES**

	2020we Kit EPA Version Code 1970-EPA	2020wi Kit ISO Version Code 1970-ISO
<i>Contents</i>	<i>Code</i>	<i>Code</i>
0 NTU Standard, 60 mL	1480	1480
1 NTU Standard, 60 mL	1450	1453
10 NTU Standard, 60 mL	1451	1454
Water Sample Bottle, 60 mL	0688	0688
Tubes, 4	—	—
Cable, USB, 3 ft.	1720	1720
USB Wall Plug	1721	1721

<b>Accessories</b>	
<i>Code</i>	<i>Description</i>
1452	100 NTU Standard, 60 mL (EPA)
1455	100 NTU Standard, 60 mL (ISO)
0290-6	Tubes, Code 0290, Set of 6
4185	Turbidity-Free Water Kit
2-2097	Filters, 0.1 micron, Pack of 50
1901-CD	SMARTLink 3 Software

### ■ EPA COMPLIANCE

The 2020we meter meets or exceeds EPA design specifications for NPDWR and NPDES turbidity monitoring programs as specified by the USEPA method 180.1.

### ■ ISO Compliance

This 2020wi meter meets or exceeds ISO design criteria for quantitative methods of turbidity using optical turbidimeters as specified by ISO 7027.

### ■ CE COMPLIANCE

The 2020we and 2020wi meters have been independently tested and have earned the European CE Mark of compliance for electromagnetic compatibility and safety. To view certificates of compliance, go to the LaMotte website at [www.lamotte.com](http://www.lamotte.com).

NOTE: The device complies to the product specifications for the Low Voltage Directive.

### ■ WARRANTY

LaMotte Company warrants this instrument to be free of defects in parts and workmanship for 2 years from the date of shipment. If it should become necessary to return the instrument for service during or beyond the warranty period, contact our Technical Service Department at 1-800-344-3100 for a return authorization number or visit [www.lamotte.com](http://www.lamotte.com) for troubleshooting help. The sender is responsible for shipping charges, freight, insurance and proper packaging to prevent damage in transit. This warranty does not apply to defects resulting from action of the user such as misuse, improper wiring, operation outside of specification, improper maintenance or repair, or unauthorized modification. LaMotte Company specifically disclaims any implied warranties or merchantability or fitness for a specific purpose and will not be liable for any direct, indirect, incidental or consequential damages. LaMotte Company's total liability is limited to repair or replacement of the product. The warranty set forth above is inclusive and no other warranty, whether written or oral, is expressed or implied.



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