STORMWATCH

MS4 WATER SCREENING KIT

Code 7449

LaMotte

WATER SCREENING TEST PROTOCOLS FOR STORMWATER MS4 GUIDANCE USING COLORIMETRIC AND TURBIDIMETRIC TECHNIQUES

OVERVIEW

According the U.S. Census bureau the world's population went from 2.5 billion in 1950 to 6 billion in 2000 and is on pace to exceed 9 billion by 2050. We will soon have 3 times the global population we had only in 1950, and with this growth comes enormous impacts on the surface of our globe. As buildings and pavement expand so do our obligations to control stormwater effluents. Urban development creates new pollution, which can either be washed or directly dumped into storm sewer systems, and ultimately into our waterways and coastal areas. Storm runoff leaving developed urban areas is significantly greater in inorganic content than runoff from the same area prior to development.

Stormwater is typically defined as water that is created as a result of a precipitation event. This water may flow through any path (gully, stream, conduit, channel, etc.) or adjacent area that is subject to overflow or flood water generated from that event. This water passes through a wide variety of natural or artificial environments, often sweeping organic and inorganic constituents into the watercourse through municipal storm drain systems. These environments can include pipeline projects, construction sites, landscaped areas, agricultural runoff, irrigation ditches, industrial sites, and a variety of other sources. In most cases this material is eventually fed into a stream, river, or other waterway, contributing to the overall pollutant load in that body of water.

While onsite sampling and offsite testing can be completed over the course of a number of days, the source of this outfall continues to contaminate the watercourse with both inorganic and organic constituents during subsequent precipitation events. A means is required by which to screen the outfall to potentially determine its source, the contribution it is making to the pollutant load, and the proper course of action to take.

Instrumentation and reagent systems are currently available to make measurements necessary to provide a preliminary screening of the outflow, and determine whether it is contributing to the overall pollutant load as it relates to inorganic constituents. In many cases these measurements can be made near the source, using handheld instrumentation and test kits, which may provide some indication as to the source and content of the outflow, or provide some indication of what additional testing is required.

EXAMPLES OF OUTFLOWS

Outflows attributable to a rainwater event can occur across a number of different environments. These include:

- Agricultural runoff
- Industrial sites
- Construction sites
- Irrigation runoff
- Parking lots and pavement
- Other

While illicit discharges of various chemical constituents into stormwater drains represent a portion of the overall problem, these are not normally defined as stormwater events. These outflows can contain a wide variety of both inorganic and organic contaminants, and must be

considered when characterizing the source of outflow. Inorganic constituents can often provide an indicator of such outflows when used in a manner that takes all indicators into account.

Where there are questions and concerns, either generated through the use of inorganic indicators, or when there are suspicions regarding organic contaminants, samples should be sent for further analysis.

While individual test measurements can be effectively used for screening outflows, long term trends are important after establishing baseline values for inorganic indicators (and organic indicators as needed).

MAKING MEASUREMENTS

Colorimetric

Colorimetric methods are based on measuring the intensity of color of a colored target chemical or reaction product. The optical absorbance is measured using light of a suitable wavelength. The concentration is determined by means of a calibration curve obtained using known concentrations of the determinant.

Turbidimetric

Turbidimetric methods (also known as nephelometry) use an instrument for measuring the concentration of suspended particulates in a liquid. A nephelometer (turbidimeter) measures suspended particulates by employing a light beam (source beam) and a light detector set to one side (90 degrees) and/or directly opposite (180 degrees) the source beam. Particle density is then a function of the light reflected and/or directed into the detectors from the particles.

Titrimetric

In volumetric titration, chemicals are analyzed by titration with a standardized titrant. The titration endpoint is identified by the development of color resulting from the reaction with an indicator, by the change of electrical potential or by the change of pH value.

Ion Selective Electrode

An ISE is a transducer (or sensor) that converts the activity of a specific ion dissolved in a solution into an electrical potential, which can be measured by a voltmeter or pH meter. The sensing part of the electrode is usually made as an ion-specific membrane, along with a reference electrode.

INDICATORS

The US EPA recommends testing for the following indicator parameters, based on the MS4 (Municipal Separate Storm Sewer System) permitting process:

Ammonia

Ammonia is a good indicator of sewage, since its concentration is much higher there than in groundwater or tap water. High ammonia concentrations may also indicate liquid wastes from some industrial sites. Ammonia is relatively simple and safe to analyze. Some challenges include the tendency for ammonia to volatilize and its potential generation from non-human sources, such as pets or wildlife.

Color

Color is a numeric computation of the color observed in a water quality sample, as measured in cobalt-platinum units (APHA, 1998). Both industrial liquid wastes and sewage tend to have elevated color values.

Unfortunately, some "clean" flow types can also have high color values. Field testing has found high color values associated for all contaminated flows, but also many uncontaminated flows, which yielded numerous false positives. Overall, color may be a good first screen for problem outfalls, but needs to be supplemented by other indicator parameters.

Conductivity

Conductivity, or specific conductance, is a measure of how easily electricity can flow through a water sample. Conductivity is often strongly correlated with the total amount of dissolved material in water, known as Total Dissolved Solids. as an indicator depends on whether concentrations are elevated in "natural" or clean waters. In particular conductivity is a poor indicator of illicit discharge in estuarine waters or in northern regions where deicing salts are used (both have high conductivity readings).

Conductivity has some value in detecting industrial discharges that can exhibit extremely high conductivity readings.

Hardness

Hardness is a measurement of the positive ions dissolved in water and primarily includes magnesium and calcium in natural waters, but is sometimes influenced by other metals. Field testing suggests that hardness has limited value as an indicator parameter, except when values are extremely high or low (which may signal the presence of some liquid wastes). Hardness may be applicable in communities where hardness levels are elevated in groundwater due to karst or limestone terrain. In these regions, hardness can help distinguish natural groundwater flows present in outfalls from tap water and other flow types.

pH

Most discharge flow types are neutral, having a pH value around 7, although groundwater concentrations can be somewhat variable. pH is a reasonably good indicator for liquid wastes from industries, which can have very high or low pH (ranging from 3 to 12). The pH of residential wash water tends to be rather basic (pH of 8 or 9).

The pH of a discharge is very simple to monitor in the field with low cost test strips or probes. Although pH data is often not conclusive by itself, it can identify problem outfalls that merit follow-up investigations using more effective indicators. Normal rainwater has a pH of approximately 5.6

Potassium

Potassium is found at relatively high concentrations in sewage, and extremely high concentrations in many industrial process waters. Consequently, potassium can act as a good first screen for industrial wastes, and can also be used in combination with ammonia to distinguish wash waters from sanitary wastes.

Turbidity

Turbidity is a quantitative measure of cloudiness in water, and is normally measured with a simple field meter. While turbidity itself cannot always distinguish between contaminated flow types, it is a potentially useful screening indicator to determine if the discharge is contaminated (i.e., not composed of tap water or groundwater).

Test Factor	Methodology	Action Level
Ammonia Nitrogen	Ammonia forms a colored complex with Nessler's Reagent in proportion to the amount of ammonia present in the sample. Rochelle salt is added to prevent precipitation of calcium or magnesium in undistilled samples.	≥50 mg/L
Color	Color is determined by a meter that has been calibrated with colored standards of known platinum cobalt concentration. True color, the color of water in which the turbidity has been removed, is measured.	≥500 color units
Conductivity	Conductivity is determined by measuring the amount of current conducted by ions in the sample.	≥2000 µS/cm
Hardness	Calcium and magnesium are titrated with EDTA at a pH controlled by the addition of a buffer. An indicator shows the equivalence point.	≤10 mg/L as $CaCO_3$ or ≥ 2, 000 mg/L as $CaCO_3$
pH	The pH meter measures the difference in potential between the electrode and the reference electrode and converts the reading to pH units.	≤5 or ≥9
Potassium	Potassium reacts with sodium tetraphenylborate to form a colloidal white precipitate in quantities proportional to the potassium concentration.	≥20 mg/L
Turbidity	The intensity of a light beam passing through a turbid sample is compared with the intensity of a light beam passing through a turbidity-free sample at 180 degrees from the light source.	≥1,000 NTU

AMMONIA NITROGEN – HIGH RANGE · SMART3 BLE COLORIMETER

Nesslerization Method · Code 3642-SC

QUANTITY	CONTENTS	CODE
30 mL	Ammonia Nitrogen Reagent #1	V-4797-G
2 x 30 mL	*Ammonia Nitrogen Reagent #2	*V-4798-G
1	Pipet, 1 mL, plastic	0354

*Reagent is a potential health hazard. **READ SDS:** lamotte.com. **Emergency information:** Chem-Tel USA 1-800-255-3924 Int'l, call collect, 813-248-0585

RANGE: 0.00–4.00 ppm Ammonia Nitrogen

MDL: 0.05 ppm

METHOD: Ammonia forms a colored complex with Nessler's Reagent in proportion to the amount of ammonia present in the sample. Rochelle salt is added to prevent precipitation of calcium or magnesium in undistilled samples.

SAMPLE HANDLING & PRESERVATION: Ammonia solutions tend to be unstable and should be analyzed immediately. Sample may be stored for 24 hours at 4°C or 28 days at –20°C.

INTERFERENCES: Sample turbidity and color may interfere. Turbidity may be removed by a filtration procedure. Color interference may be eliminated by blanking the instrument with a sample blank.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Scroll to and select **ALL TESTS** (or another sequence containing **008 Ammonia-N HR**) from **TESTING MENU**.
4. Scroll to and select **008 Ammonia-N HR** from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**. (See Note)
7. Remove tube from colorimeter. Add 8 drops of Ammonia Nitrogen Reagent #1 (V-4797). Cap and mix. Wait 1 minute.
8. Use the 1.0 mL pipet (0354) to add 1.0 mL of *Ammonia Nitrogen Reagent #2 (V-4798). Cap and mix. Allow 5 minutes for maximum color development.
9. At end of the 5 minute waiting period, immediately mix, insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result as ppm ammonia nitrogen.
10. Press ⏻ to turn colorimeter off, select Print Test to print the results, or press EXIT to exit to a previous menu or make another menu selection.

NOTE: ppm = mg/L

NOTE: It is strongly suggested that a reagent blank be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents is obtained.

NOTE: If a test result using the SMART3 BLE Colorimeter gives an over range message then the the sample must be diluted. The test should be repeated on the diluted sample to obtain a reading which is in the concentration range for the test. See page 16.

COLOR · SMART3 BLE COLORIMETER

Platinum Cobalt Method · No Reagents Required

RANGE:	0–1000 color units
MDL:	20 Cu
METHOD:	Color is determined by a meter that has been calibrated with colored standards of known platinum cobalt concentration. True color, the color of water in which the turbidity has been removed, is measured.
SAMPLE HANDLING & PRESERVATION:	Collect all samples in clean glassware. Determine color as soon as possible to avoid biological or chemical changes that could occur in the sample during storage.
INTERFERENCES:	Turbidity will interfere. Filter before testing.

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **033 Color**) from **TESTING MENU**.
4. Scroll to and select **033 Color** from menu.
5. Rinse a tube (0290) with color-free water (distilled or deionized water). Fill to 10 mL line with color-free water.
6. Insert the tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Empty tube.
8. Rinse tube with sample water. Fill to 10 mL line with water sample.
9. Insert tube with sample water, close lid and select **SCAN SAMPLE**. Record result in color units.
10. Press ⏻ to turn colorimeter off, select Print Test to print the results, or press EXIT to exit to a previous menu or make another menu selection.

NOTE: If a test result using the SMART3 BLE Colorimeter gives an over range message then the the sample must be diluted. The test should be repeated on the diluted sample to obtain a reading which is in the concentration range for the test. See page 16.

POTASSIUM · SMART3 BLE COLORIMETER

Tetraphenylboron Method Code 3639-SC

QUANTITY	CONTENTS	CODE
30 mL	*Sodium Hydroxide, 1.0N	*4004WT-G
5 g	*Tetraphenylboron Powder	*6364-C
1	Spoon, 0.05 g, plastic	0696

*Reagent is a potential health hazard. **READ SDS:** lamotte.com. **Emergency information:** Chem-Tel USA 1-800-255-3924 Int'l, call collect, 813-248-0585

RANGE: 0.0–10.0 ppm Potassium

MDL: 0.8 ppm

METHOD: Potassium reacts with sodium tetraphenylborate to form a colloidal white precipitate in quantities proportional to the potassium concentration.

SAMPLE HANDLING & PRESERVATION: Store samples in polyethylene bottles, not in soft glass where leaching of potassium from the glass may occur. Samples may be acidified to pH 2 with nitric acid, but should be neutralized before analyzing.

INTERFERENCE: Calcium and magnesium interfere at very high concentrations. Check for stray light interference (see p. 69).

PROCEDURE

1. Press and hold ⏻ until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **085 Potassium**) from **TESTING MENU**.
4. Scroll to and select 085 Potassium from menu.
5. Rinse a clean tube (0290) with sample water. Fill to the 10 mL line with sample.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Remove tube from colorimeter. Add 4 drops of *Sodium Hydroxide, 1.0N (4004WT). Cap and mix.
8. Use the 0.05 g spoon (0696) to add one measure of *Tetraphenylboron Powder (6364). Cap and shake vigorously for 20 seconds until all of the powder has dissolved. Wait 5 minutes.
9. At end of 5 minute waiting period, mix tube again to suspend any settled precipitate. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result as ppm potassium.
10. Press ⏻ to turn colorimeter off, select Print Test to print the results, or press EXIT to exit to a previous menu or make another menu selection.

NOTE: ppm = mg/L

NOTE: For best possible results, a reagent blank should be determined to account for any contribution to the test result by the reagent system. To determine the reagent blank, follow the above test procedure to scan a distilled or deionized water blank. Then follow the above procedure to perform the test on a distilled or deionized water sample. This test result is the reagent blank. Subtract the reagent blank from all subsequent test results of unknown samples. It is necessary to determine the reagent blank only when a new lot number of reagents are obtained.

For the most accurate results, the sample and reagents should be at 25±4°C.

NOTE: If a test result using the SMART3 BLE Colorimeter gives an over range message then the the sample must be diluted. The test should be repeated on the diluted sample to obtain a reading which is in the concentration range for the test. See page 16.

TURBIDITY · SMART3 BLE COLORIMETER

Absorption Method · No Reagents Required

RANGE:	0–500 FAU (Formazin Attenuation Units)
MDL:	3 FAU
METHOD:	Absorptimetric, 180° detector
SAMPLE HANDLING & PRESERVATION:	Measure sample as soon as possible after collection.
INTERFERENCES:	Check for stray light interference.

PROCEDURE

1. Press and hold  until colorimeter turns on.
2. Press ENTER to select **TESTING MENU**.
3. Select **ALL TESTS** (or another sequence containing **095 Turbidity**) from **TESTING MENU**.
4. Scroll to and select **095 Turbidity** from menu.
5. Rinse a clean tube (0290) with deionized water (turbidity free). Fill to the 10 mL line with deionized water.
6. Insert tube into chamber, close lid and select **SCAN BLANK**.
7. Rinse a second clean tube (0290) with sample water. Fill to the 10 mL line with sample. Cap tube. Wipe off excess water and fingerprints. Shake to resuspend particulate matter. Remove all bubbles before measurement.
8. Insert tube into chamber, close lid and select **SCAN SAMPLE**. Record result in FAU. Turbidity measurements should be taken as soon as possible after sample has been collected.
9. Press  to turn colorimeter off, select Print Test to print the results, or press EXIT to exit to a previous menu or make another menu selection.

NOTE: FAU = NTU

NOTE: For the most accurate results, the sample should be at 25±4°C.

NOTE: If a test result using the SMART3 BLE Colorimeter gives an over range message then the the sample must be diluted. The test should be repeated on a sample diluted with low turbidity water to obtain a reading which is in the concentration range for the test. See page 16.

TOTAL HARDNESS · DIRECT READING TITRATOR

Direct Reading Titrator, 0-200 ppm

QUANTITY	CONTENTS	CODE
15 mL	*Hardness Reagent #5	*4483-E
50	Hardness Reagent #6 Tablets	4484A-H
60mL	Hardness Reagent #7	4487DR-H
1	Test Tube, 5-10-12.9-15-20-25 mL, glass, w/cap	0608
1	Direct Reading Titrator, 0-200 Range	0382
1	Pipet, 0.5 mL, plastic	0353

*Reagent is a potential health hazard. **READ SDS:** lamotte.com.
Emergency information:
Chem-Tel USA 1-800-255-3924
Int'l, call collect, 813-248-0585

To order individual reagents or test kit components, use the specified code number.

NOTE: The Titrator is calibrated in terms of total hardness expressed as parts per million (ppm) calcium carbonate ($CaCO_3$). Each minor division on the Titrator scale equals 4 ppm $CaCO_3$.

PROCEDURE

1. Fill the test tube (0608) to 12.9 mL line with sample water.
2. Add five drops of *Hardness Reagent #5 (4483). Mix.
3. Add one Hardness Reagent #6 Tablet (4484A). Cap and swirl until tablet disintegrates. Solution will turn red if hardness is present. If solution is blue there is no measurable amount of hardness.
4. Fill the Direct Reading Titrator (0382) with Hardness Reagent #7 (4487DR). Insert Titrator in the center hole of the test tube cap.
5. While gently swirling the titration tube, slowly press the plunger to add Hardness Reagent #7 (4487DR) until the red color changes to blue. Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Record as ppm Total Hardness as $CaCO_3$.
   EXAMPLE: Plunger tip is 3 minor divisions below line 80.
   Test result is 80 plus (3 divisions x 4) equals 92 ppm.6.
6. If the plunger tip reaches the bottom line on the Titrator scale (200 ppm) before the color change occurs, refill the Titrator and continue the titration. When recording the test result, be sure to include the value of the original amount of reagent dispensed (200 ppm).
7. To convert ppm Hardness to grains per gallon (gpg), multiply by 0.058. Record as gpg Hardness as $CaCO_3$.

$$\textbf{gpg } CaCO_3 = \textbf{ppm } CaCO_3 \times 0.058$$

ANALYSIS OF HARDNESS IN SALT WATER

When waters containing very high levels of mineral salts, including sea and estuary waters are tested the sample must be diluted before titration. This test kit contains a calibrated pipet for performing the dilution described below.

1. Use the 0.5 mL pipet (0353) to transfer 0.5 mL of the salt water sample to the test tube (0608).
2. Dilute to the 12.9 mL line with distilled water (a 1 to 25.8 dilution).
3. Follow Steps 2 through 5 above. Multiply the Titrator reading by 25.8. Record as ppm Total Hardness as $CaCO_3$.

CONDUCTIVITY · TRACER

For complete instructions, see the Tracer manual.

Before first use, hold the meter by the top battery compartment and swiftly tap the back of the meter downward into your palm (not a hard surface). This assures that the internal electrolyte moves to the very tip of the electrode. The electrolyte should fill the circular junction window at

the tip of the electrode.

Before first use or after storage, soak the electrode in tap water or pH buffer solution for about 10 minutes.

CALIBRATION

Meter accuracy verification should be performed on a periodic basis as needed. **If calibration is required, the meter must be in the conductivity mode to perform all calibrations for conductivity, TDS and salinity.** The meter can perform calibrations and store the data for each of the three ranges–low, medium and high. The automatic calibration recognition procedure will recognize conductivity standards of 84µS (Low), 1413µS (Medium) or 12,880µS (12.88mS) (High). Always calibrate in the range closest to the expected measurement value. For salinity samples within the range of 1.00 to 9.99 ppt salinity, calibrate with a 12,880µS calibration standard.

1. Fill a sample cup to 20 mL line with a conductivity standard.
   NOTE: The meter allows for a 1, 2, or 3 point calibration. If calibration is done for more than one point, the lowest concentration should be done first to obtain the best accuracy. Calibrate the ranges from low to high
2. Press the ON/OFF button to turn the TRACER on. Insert the electrode into the standard. Tap or stir the sample with the Tracer to dislodge air bubbles.
3. Press and hold the CAL/RECALL button for approximately 2 seconds until the display begins to flash.
4. The meter will automatically recognize and calibrate to the conductivity standard. The display will briefly indicate "SA" and "End" and then return to the measurement mode.
   NOTE: "SA" will not appear if the calibration fails.
5. The calibration range indicator will appear on the display for each range that is calibrated during a power on cycle.

   Ⓛ **Low Range, 84 µS/cm**

   Ⓜ **Medium Range, 1413 µS/cm**

   Ⓗ **High Range, 12.88 mS/cm (12,880 µS/cm)**

MEASUREMENT

1. For small samples fill a sample cup to the 20 mL line with the test sample. Sample depth must be greater than or equal to 1.5 inches.
2. Press the ON/OFF button. (8888 and then SELF CAL will appear in the display during the initial diagnostics).
3. Press and hold the MODE/HOLD button to scroll to the µs or ms mode.
4. Immerse the TRACER electrode in the sample. Make sure the electrode is completely submersed.
5. Slowly stir the sample with the TRACER to remove air bubbles.
6. The meter will automatically auto-range to the proper range and then display the reading. The display will flash "0000" while auto-ranging.
7. Rinse the electrode in distilled water. Replace the cap.

pH · TRACER

For complete instructions, see the Tracer manual.

Before first use, hold the meter by the top battery compartment and swiftly tap the back of the meter downward into your palm (not a hard surface). This assures that the internal electrolyte moves to the very tip of the electrode. The electrolyte should fill the circular junction window at the tip of the electrode.

Before first use or after storage, soak the electrode in tap water or pH buffer solution for about 10 minutes.

For the most accurate results, allow sufficient time for the temperature of the probe to reach the temperature of the sample before calibrating. This will be indicated by a stable temperature reading on the display.

CALIBRATION

The TRACER can be calibrated at 1, 2 or 3 points. For the most accurate results with a two point calibration, calibrate the TRACER with a pH 7 buffer first, then calibrate with either a pH 4 or pH 10 buffer whichever is closest to the pH value of the sample to be tested. When performing a three point calibration, calibrate with the pH 7 buffer first, followed with the pH 4 buffer and then the pH 10 buffer.

Preparation of Buffers

1. Fill a sample cup with 20 mL of distilled or deionized water.
2. Add one buffer tablet:
   pH 4.0 Code 3983A
   pH 7.0 Code 3984A
   pH 10.0 Code 3985A
3. Use the tablet crusher (0175) to crush the tablet. Stir until the tablet has disintegrated.

NOTE: Buffers should be prepared fresh daily.

Calibration

1. Fill a sample cup to the 20 mL line with a buffer solution.
2. Press the ON/OFF button to turn the TRACER ON.
3. Place the electrode in the buffer solution. Press and hold the CAL/RECALL button until "CAL" appears in the lower display. The meter will automatically recognize the buffer and calibrate itself to that value. The circled number on the display will match the value of the buffer. NOTE: If the buffer solution is more than 1 pH unit off from 4, 7, or 10, or the electrode slope is low, the meter will assume that there is an error and the calibration will be terminated. END will be displayed.
4. During the calibration the pH value on the display will flash. When the calibration is complete, the TRACER will display "SA" and "End" and return to normal operation.
5. The appropriately circled indicator (L, M or H) will appear on the display when a calibration has been completed within one power on cycle.
6. For a two or three point calibration, repeat steps 1-5 with the remaining buffers.
7. When the TRACER is turned off, the circled indicator configuration and the calibration data will be memorized.

MEASUREMENT

1. For small samples fill a sample cup to the 20 mL line with the test sample. Sample depth must be greater than or equal to 1.5 inches.
2. Press the ON/OFF button. (8888 and then SELF CAL will appear in the display during the initial diagnostics).
3. Press and hold the MODE/HOLD button to scroll to the pH mode.
4. Immerse the TRACER electrode in the sample. Make sure the electrode is completely submersed.
5. Slowly stir the sample with the TRACER to remove air bubbles.
6. The reading will flash until it has stabilized. This may take several seconds depending on the buffer capacity of the sample.
7. Rinse the electrode in distilled water. Replace the cap.

SMART3 BLE GENERAL INFORMATION

For more information see SMART3 BLE instruction manual.

EPA COMPLIANCE

The instrument is an EPA-Accepted instrument. EPA-Accepted means that the instrument meets the requirements for instrumentation as found in test procedures that are approved for the National Primary Drinking Water Regulations (NPDWR) or National Pollutant Discharge Elimination System (NPDES) compliance monitoring programs. EPA-Accepted instruments may be used with approved test procedures without additional approval.

CERTIFICATIONS

The meter has earned the European CE Mark and UKCA Mark of Compliance for electromagnetic compatibility and safety. The Declaration of Conformity for the Smart3 BLE colorimeter is available at www.lamotte.com.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interferences in which case the user will be required to correct the interference at his own expense. Protection provided within the system may be impaired if the device is used in a manner for which it is not intended.

IP67 CERTIFICATION

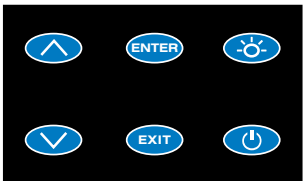
The instrumentmeets IP67 standards for protection against dust and immersion only when the USB port plug is in place. Documentation is available at www. lamotte.com.

SMART3 BLE GENERAL OPERATING PROCEDURES

THE KEYPAD

The keypad has 6 buttons which are used to perform specific tasks.

	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 & THE MENUS

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. Some of the menus are looping menus. The top and bottom menus 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. Pressing ENTER will select the menu choice that is indicated by the black bar. The EXIT button allows an exit or escape from the current menu and a return to the previous menu. Pressing  at any time will turn the meter off.

■ DEVICE CONNECTION

The meter supports connections to a Windows® based PC over USB (Code 1720-01).

COMPUTER CONNECTION

USB Type A, USB mini B, Order Cable Code 1720-01

CONNECTING VIA USB

Using the provided USB cable, the meter can be connected to a Windows based PC. Before connecting a meter via USB, download and install the free WaterLink Connect 2 Windows application from http://softwarecenter.lamotte.com.

CONNECTING VIA BLUETOOTH

The meter uses Bluetooth Low Energy technology to allow communication between the meter and the BLE Mobile Printer (Code 5-0067 only). The meter will automatically connect to the nearest Bluetooth enabled printer. Barriers to wireless signals can reduce the range of wireless devices. The meter will work best if there are no walls between it and the receiving device.

WATERLINK CONNECT 2

The meter may be interfaced with any Windows-based 64-bit computer by using the LaMotte WaterLink Connect 2 program and a USB cable. The program will store test information and results in a local database and allow for exporting this data to a comma separated value (CSV) file. The meter will send the following data: name of test, sample value, sample units, time/date stamp, and meter name. To download WaterLink Connect 2 go to http:// softwarecenter.lamotte.com/. Select "WaterLink Connect 2 FREE Download".

FIRMWARE UPDATES

Occasionally, the firmware in the meter will require updates. To do so:

1. Download and install the WaterLink Connect 2 application for Windows at http://softwarecenter.lamotte.com/.
2. Plug meter into the computer with the provided USB cable (1720-01 only) and launch WaterLink Connect 2 application from the Start Menu.
3. A prompt will appear if firmware updates are available. Select Update. Testing and data transfer will not be possible until firmware has been updated.

For assistance contact Software Support at 1-800-344-3100 option 2.

ABSORBANCE

The calibrations for the tests in each sequence have been factory set. The absorbance mode is used by technicians during the manufacture of the meter. It should not be necessary to access the absorbance mode during normal operation.

SETTING THE CLOCK

Setting the clock allows the correct time and date stamp to be stored with each reading in the data logger.

1. From the **Setup Menu** press ^ or v to scroll to **Set Clock**.
2. Press ENTER to select **Set Clock**. The year is displayed. Press ^ or v to scroll to the appropriate character. Press ENTER to select the character. Themonth, day, hour, format hour, minute, second, AM/PM will be displayed. Repeat for each.
3. Press ENTER to select the final character. The time and date will be saved and the meter will return to the **Setup Menu**.

SETTING THE DATA LOGGER

NOTE: Data from the data logger must be retrieved in the same language in which it was collected.

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. The display will show 500+ when the data logger has exceeded 500 points and the data points are being overwritten.

1. From the **Setup Menu** press ^ or v to scroll to **Logging**.

2. Press ENTER to select **Logging**.
3. Press ^ or v to scroll to the desired function.
4. Press ENTER. The screen will display **Storing...** for about 1 second and return to the **Setup Menu**.

FACTORY SETUP

The Factory Setup menu is used in manufacturing of the Smart3 BLE Colorimeter. This menu is not for use by the operator in the field.

SETTING THE 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:

1. From the **Setup Menu**, press ^ or v to scroll to **Set Power Save**.
2. Press ENTER to select **Set PWR Save**.
3. Press ^ or v to scroll to the desired function.
4. Press ENTER. The screen will display **Storing...** for about 1 second and the meter will return to the **Setup Menu**.

SETTING THE BACKLIGHT TIME

The backlight illuminates the display for enhanced viewing. The default setting is 10 seconds. 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. 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 adapter is not being used.

1. From the **Setup Menu**, press ^ or v to scroll to **Backlight Time**.
2. Press ENTER to select **Set Backlight Time**.
3. Press ^ or v to scroll to the desired setting.
4. Press ENTER. The screen will display **Storing...** for about 1 second and the meter will return to the **Setup Menu**.

SELECTING A LANGUAGE

There are eight languages available in the Smart 3 BLE: English, Spanish, French, Portuguese, Italian, Chinese, Japanese, and Turkish.

1. From the **Setup Menu**, press ^ or v to scroll to **Select Language**.
2. Press ENTER to select **Select Language**.
3. Press ^ or v to scroll to the desired language.
4. Press ENTER. The screen will display **Storing...** for about 1 second and the meter will return to the **Setup Menu**.

■ BATTERY

BATTERY OPERATION

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

To charge the battery with the wall adapter, plug the smaller end of the USB cable (USB mini B connector) into the meter and the larger end of the USB cable (USB type A connector) into the wall adapter. Plug the wall adapter into an AC outlet. Reinsert the rubber USB port plug after charging. To charge the battery from a computer, plug the smaller end of the USB cable (USB mini B connector) into the meter and the larger end of the USB cable (USB Type A connector) into a USB port on a computer. 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 6 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 adapter will charge the unit continuously.

Storing the meter above ambient room temperature will decrease the battery charge more quickly than storage at room temperature. If the meter does not turn on, it means that the battery is at a very low charge. Charging the battery with the wall adapter in this state may take up to 10 hours. At low temperatures, approaching 0 °C, the battery will charge more slowly. It will not charge at all below 0 °C. 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. When the battery icon simultaneously flashes bars 1 and 2 followed by bars 3 and 4, it is an indication that the battery is damaged and technical support should be contacted.

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 at a moderate temperature.
- Fully charge the battery before storing the unit for extended periods of time.
- Fully charge the battery at least once per year. Failure to do so may result in a permanently drained battery.
- 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.

BATTERY REPLACEMENT

The lithium-ion battery used in this unit should last for many years with normal use. When it no longer powers the unit long enough to meet testing requirements it should be replaced.

Battery Troubleshooting Chart

PROBLEM	REASON	SOLUTION
Flashing	Low battery. Readings are reliable.	Charge battery or use USB wall/ computer adapter.
"Low Battery"	Battery voltage is very low. Readings are not reliable.	Charge battery or use USB wall/ computer adapter.
"Shut Down Low Batt" Shut Down	Battery is too low to operate the unit.	Charge battery or use USB wall/ computer adapter.

■ MAINTENANCE

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.

COLORIMETER TUBES AND CHAMBER

Colorimeter tubes and colorimeter chambers which have been scratched through excessive use should be discarded and replaced with new ones. Dirty tubes should be cleaned on both the inside and outside. Fingerprints on the exterior of the tubes can cause excessive light scattering and result in errors. Handle the tubes carefully, making sure the bottom half of the tube is not handled.

LaMotte Company makes every effort to provide high quality colorimeter tubes. However, wall thicknesses and diameter of tubes may still vary slightly. This may lead to slight variations in results (e.g. if a tube is turned while in the sample chamber, the reading will likely change slightly). To eliminate this error put the tubes into the sample chamber with the same orientation every time.

The tubes that are included with the colorimeter have an index mark to facilitate this. If possible, use the same tube to SCAN BLANK and SCAN SAMPLE.

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 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.

SAMPLE DILUTION TECHNIQUES & VOLUMETRIC MEASUREMENTS

If a test result using the SMART3 BLE Colorimeter gives an over range message then the the sample must be diluted. The test should be repeated on the diluted sample to obtain a reading which is in the concentration range for the test.

Example:

Measure 1 mL of the water sample into a graduated cylinder. Add distilled or deionized water until the cylinder is filled to the 10 mL line. The sample has been diluted by one to nine, and the dilution factor is therefore 10. Perform the test procedure, then multiply the resulting concentration by 10 to obtain the test result.

The following table gives quick reference guidelines on dilutions of various proportions. All dilutions are based on a 10 mL volume, so several dilutions will require small volumes of the water sample.

Size of Sample	Deionized Water to Bring 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

If the above glassware is not available, dilutions can be made with the colorimeter tube. Fill the tube to the 10 mL line with the sample then transfer it to another container. Add 10 mL volumes of demineralized water to the container and mix. Transfer back 10 mL of the diluted sample to the tube and follow the test procedure. Continue diluting and testing until a reading, which is in the concentration range for the test, is obtained. Be sure to multiply the concentration found by the dilution factor (the number of total 10 mL volumes used).

Example:

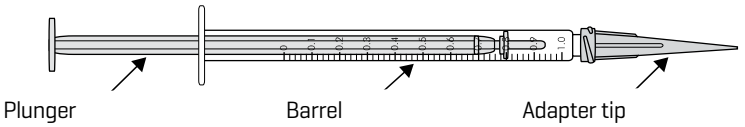
10 mL of sample is diluted with three 10 mL volumes of demineralized water; the dilution factor is four.

TRACER GENERAL INFORMATION

For more information see TRACER pH/TDS/Salt instruction manual.

DIRECT READING TITRATOR

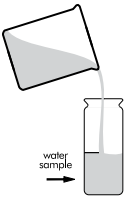
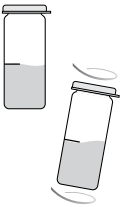
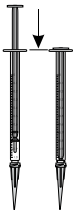
The Direct Reading Titrator consists of a plastic barrel, a plastic plunger, and a plastic adapter tip.

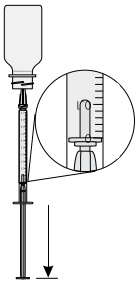
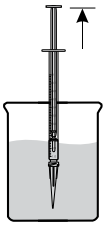
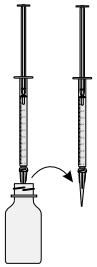


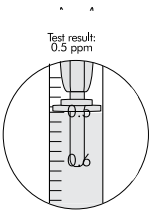
The adapter tip reduces the size of the drops that are dispensed and increases the precision of the test results. DO NOT REMOVE THE ADAPTER TIP.

INSTRUCTIONS

These are general instructions for the use of the Direct Reading Titrator. The titrator in the illustrations is an example. Refer to individual test kit instructions for test procedures and the actual range and increment values.

1. Fill the titration tube to the specified line with the water sample.	
2. Add the reagents as specified in the instructions for the individual test method.	
3. Cap the tube with the special titration tube cap. Mix by swirling.	
4. Depress the plunger of the Titrator.	
5. Insert the adapter tip into the special plastic plug in the titration solution bottle.	

6. Invert the bottle. Hold the bottle and the Titrator firmly together. Slowly pull out the plunger until the large ring on the plunger is opposite the zero (0) line on the scale.	
7. If an air bubble appears in the Titrator barrell or the adapter tip, partially fill the barrel and pump the tiration solution back into the inverted reagent bottle to expel the bubble.	
8. NOTE: When filling the Titrator from a container without a special plug, submerge the adapter tip below the surface of the solution and pull out the plunger. Remove air bubbles.	
9. Turn the bottle right side up and remove the Titrator.	

10. Insert the adapter tip into the opening of the tiration tube cap. Slowly depress the plunger to dispanse the titrating solution. Gently swirl the tube to mix the solution.	
11. Continue adding the titration solution until the specified color change occurs. If the color change does not occur when the large ring of the plunger reached the bottom of the scale, refill the Titrator to the zero line. Continue titration until the color change occurs.	
12. Read the result directly from the scale where the large ring on the Titrator meets the Titrator barrel. If the Titrator was refilled to reach the final color change, add the total amounts of titrant used to determine the final result.	
13. If no additional, tests are to be made, discard the remaining titration solution in the Titrator. Do not return the titrating solution to the reagent bottle. Thoroughly rinse the titration tube and the Titrator. **Do not remove the plunger or the adapter tip from the Titrator.**	

KIT CONTENTS

Quantity	Contents	Code
30 mL	Ammonia Nitrogen Reagent #1	V-4797-G
2 x 30 mL	Ammonia Nitrogen Reagent #2	V-4798-G
30 mL	Sodium Hydroxide, 1.0N	4004WT-G
5g	Tetraphenolboron Powder	6364-C
15 mL	Hardness Reagent #5	4483-E
50	Hardness Reagent #6 Tablets	4484A-H
60 mL	Hardness Reagent #7	4487DR-H
20	pH 4.0 Buffer Tablets	---
20	pH 7.0 Buffer Tablets	---
20	pH 10.0 Buffer Tablets	---
30 mL	Conductivity Standard, 84 µS	6312-G
30 mL	Conductivity Standard, 1413 µS	6354-G

30 mL	Conductivity Standard, 12,880 µS	6317-G
4	Colorimeter Tubes, w/caps	0290
2	Pipet, 1.0 mL, plastic	0354
1	Spoon, 0.05 g, plastic	0696
1	Test Tube, 5-10-12.9-15-20-25 mL, glass, w/cap	0608
1	Direct Reading Titrator, 0-200, plastic	0382
1	Pipet, 0.5 mL, plastic	0353
3	Sample Cup w/cap	1745-1
1	Tablet Crusher	0175
1	Graduated Cylinder, 10 mL, glass	0416
1	SMART3 BLE Colorimeter	---
1	USB Cable	1720-01
1	USB Wall Adapter	1721
1	TRACER, pH/TDS/Salt	---

WARNING: Only use the USB Cable (1720-01) that is supplied with the kit. Make no substitutions.

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