



TURBIDIMETER

MODEL 2008 • CODE 1790

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WHAT IS TURBIDITY?

Water and other liquids vary widely in their color and clarity. Some liquids, such as bottled water, are clear, while others, such as heavily polluted industrial waste, are murky and cloudy. This murkiness is called turbidity.

Turbidity is caused by fine particles suspended in the water which cause light to scatter rather than traveling in a straight line through the water. Clay, silt, plankton and other microorganisms are all examples of particulate which cause turbidity.

Many of the causes of turbidity are not necessarily harmful to human health, but turbidity can be a sign of another, more serious problem. For instance, cloudy pool water may not be dangerous to the swimmer, but it could indicate the presence of excess carbonates, which may damage the pool itself.

Generally, as the pollutant level of water increases, the turbidity increases. The EPA's Surface Water Treatment requirements state that finished water has turbidity levels below 1 NTU.

Over time, turbidity measurements can be used to determine if the pollution level of a lake or other water body has changed. Biologists and others monitoring the health of a specific lake will track the turbidity level over time to see if runoff from construction, agriculture, or other man-made changes is polluting the water.

HOW IS TURBIDITY MEASURED?

Turbidity can be measured in many ways. Traditionally, the Jackson Candle method was used to measure turbidity, and results were expressed as Jackson Turbidity Units (JTU). In lakes and other deep waters, a Secchi Disk is commonly used to measure the turbidity. However, neither of these methods can accurately measure low turbidities, such as those encountered at a wastewater plant, so a turbidimeter must be used.

One type of turbidimeter is the nephelometer, which determines the turbidity level by measuring the amount of light scattered 90° by the suspended particles. A light of known strength is beamed through the solution, where particles will cause the light to scatter. The intensity of this scattered light is measured by a sensor located on the sides of the chamber. The meter converts these measurements to a reading, which is displayed. Nephelometers give readings in Nephelometric Turbidity Units (NTU).

Since the nephelometer measures the amount of light which is scattered by the turbid solution, it is important that no stray light interfere with the test. For this reason many turbidimeters, including the Model 2008, include a cap to cover the sample chamber during testing. Additionally, scratches, fingerprints, and water droplets on the outside of the sample tubes can cause additional light scatter, leading to inaccurate readings.

In addition to scratches and water droplets, the actual glassware itself is very important in turbidity readings, and differences between tubes and their orientation in the chamber can cause differences in test results. To assure the tubes are always placed in the chamber in the same orientation, the cap can be marked in some way, such as with a piece of tape. If this cap is always used with the same tube, by orienting the tape in the same way in the chamber each time, more accurate results can be obtained.

The Model 2008 is a versatile turbidimeter. It offers a choice of two ranges, which measure from 0 to 19.99 NTU or 0 to 199.9 NTU, allowing it to be used in treated water, natural water, or wastewater. The meter is precalibrated prior to leaving LaMotte's manufacturing facility, but it should be standardized prior to use.

SPECIFICATIONS & ACCESSORIES

RANGE	0-19.99 NTU 0-199.9 NTU
ACCURACY	± 2% of reading or 0.05 NTU, whichever is greater, referenced to LaMotte AMCO® standards
DISPLAY	0.5" LCD
WARM-UP TIME	<2 seconds
PHOTODETECTOR	Silicon photodiode, aligned 90° to the incident light path
LAMP	Tungsten, lens-end long life, operated at a color temperature of 2230° K
SAMPLE	Distance traversed by incident light and scattered light within tube is 2.5 cm
LAMP LIFE	45,000 hours
RANGE SELECTOR	4-position: Charge only, Off, 0-20 NTU, 0-200 NTU
POWER SOURCE	Ni-Cad rechargeable batteries, not user replaceable
SIZE	19 cm x 7 cm x 14 cm 7.5" x 2 $\frac{3}{4}$ " x 5 $\frac{3}{8}$ "
WEIGHT	1.1 Kg 2.4 lbs.

REPLACEMENT PARTS & ACCESSORIES

5115PT-J	Deionized Water, 100 mL
1793	AMCO® Turbidity Standard, 0.5 NTU
1794	AMCO® Turbidity Standard, 5.0 NTU
1795	AMCO® Turbidity Standard, 20.0 NTU
1796	AMCO® Turbidity Standard, 60.0 NTU
1797	AMCO® Turbidity Standard, 100.0 NTU
1798	AMCO® Turbidity Standard, 40.0 NTU
1744	AC Adapter, 9 Volt
0273	Turbidity tubes, set of 6
0943	Syringe
0598	Filter holder
1103-6	Member filters, 0.45 micron, pkg of 6

CALIBRATING

The Model 2008 has been calibrated at the factory using a primary standard manufactured by Advanced Polymer Systems, Inc., which is a suspension of uniformly sized plastic “microspheres.” These AMCO® standards require no preparation, and are stable for longer periods of time than formazin. However, with proper preparation techniques, formazin standards should be equivalent to the AMCO® standards, and can be used as primary standards for meter calibration. For proper procedures, consult the current edition of *Standard Methods for the Examination of Water and Wastewater*.

AMCO® TURBIDITY STANDARDS

Two AMCO® turbidity standards are supplied with the Model 2008; additional standards are available from LaMotte Company. Only use LaMotte AMCO® standards with the Model 2008. These standards are manufactured exclusively for LaMotte and are guaranteed to be accurate to within $\pm 1\%$, if the following procedures are observed:

1. Once the seal on the bottle is broken, the standard is good for 9 months, and must be stored between 10° and 40° C. The standards are good indefinitely prior to opening if stored under the same conditions.
2. Never put any unused standard or other possible contaminant into the bottle.
3. Do not open the standards in a dusty environment, and guard against dust and other contaminants entering the bottle while opened.
4. Rinse sample tube with standard before filling with standard to be used.
5. Cap the sample tube and standard bottle immediately after filling tube with standard.

TURBIDITY TUBES

To assure accurate readings the tubes supplied with the Model 2008 should be paired with marked caps. Mark each cap with a piece of tape, and pair with a tube. When the tubes are inserted into the chamber, the tape should always be oriented the same way, for instance, the tape should always point toward the operator. If greater accuracy is required, for instance for Surface Water requirements, the tubes supplied with the Model 2008 should be calibrated. Fill all the tubes with the same turbidity standard, preferably one at the higher end of the testing range. Insert each tube into the meter, and record the reading. This data will indicate the correction factor which should be used when comparing results in different tubes.

THE MODEL 2008 TURBIDIMETER

1. Select the AMCO® standard closest to the value of the sample.
NOTE: Only use LaMotte specific AMCO® turbidity standards with the Model 2008. Contact LaMotte for replacement standards.
2. Switch the selection knob to the proper range (0 - 20 or 0 - 200 NTU).
3. Fill turbidity tube with standard. Cap with paired, marked cap. Wipe tube with a lint-free tissue.
4. Insert tube into chamber. Cap chamber.
NOTE: The green LED will light to indicate tube is fully inserted, and the meter is working.
5. Adjust STANDARDIZE knob until display reads value of standard. The Model 2008 is now calibrated and ready for use.

TESTING

1. Fill a clean container with at least 50 mL of sample water. Set container aside to allow sample to equilibrate to air temperature, and to let gasses escape.
NOTE: Do not let dust or other airborne contaminants contact sample.
2. Rinse an empty turbidity tube with sample. Fill turbidity tube to neck with sample water.
NOTE: Pour sample down the side of tube to avoid creating air bubbles.
3. Cap with paired, marked cap. Wipe tube with a lint free tissue.
4. Insert tube into chamber. Cap chamber. Select appropriate range on selection knob. As soon as reading stabilizes, record reading as NTU.
NOTE: The green LED will light to indicate tube is fully inserted, and the meter is working.
5. If the sample has a turbidity reading of greater than 200 NTU, the sample must be diluted with turbidity-free water before being tested. Multiply result by the appropriate factor.

PREPARING TURBIDITY-FREE WATER

If the sample turbidity is higher than 200 NTU, it must be diluted with turbidity-free water, and retested. It is very important that no foreign matter be introduced into the water. Water prepared using this procedure can be stored in a clean glass jar, with a cap, in a dark area at room temperature, and used as required. Always check the water for particles or other foreign matter before using.

1. Unscrew the filter holder (0598), and place a white membrane filter (1103) on the screen inside. Make sure the membrane is centered on the screen and covers the entire surface. Replace top of filter holder.
2. Remove the plunger from the syringe and attach filter holder to bottom of syringe (0943).
3. Fill syringe with deionized or distilled water. Insert plunger and, exerting pressure, slowly force water through filter. Collect water in a suitable clear, glass storage container.
4. Remove filter holder from syringe, then remove plunger from barrel.
5. Replace filter holder, and repeat Steps 3 and 4 until desired amount of turbidity-free water has been collected.

NOTE: Periodically examine the membrane filter to assure no holes or cracks are present.

DILUTING THE SAMPLE

If the sample has a reading greater than 200 NTU's, it must be diluted with turbidity-free deionized water to bring the reading within the range of the Model 2008.

The following table gives quick reference guidelines on dilutions of various proportions. All dilutions are based on a 25 mL volume. Graduated pipets should be used for all dilutions.

SIZE OF SAMPLE	TURBIDITY-FREE WATER TO BRING VOLUME TO 25 mL	MULTIPLICATION FACTOR
25 mL	0 mL	1
12.5 mL	12.5 mL	2
2.5 mL	22.5 mL	10

EXAMPLE: Measure 12.5 mL of sample water into a graduated cylinder. Add turbidity-free water until the cylinder is filled to the 25 mL line. The sample has been diluted by one-half, and the dilution factor is therefore 2. Perform the test procedure, then multiply the reading from the display by 2 to obtain the test result.

MAINTAINING THE MODEL 2008

RECHARGING THE BATTERY

The Model 2008 is supplied with Ni-Cad rechargeable batteries. These batteries can be recharged, but can only be replaced by LaMotte personnel.

Attempting to replace the batteries yourself will void the warranty. A small indicator will appear on the left side of the display when the batteries need to be recharged.

NOTE: The Model 2008 can continue to make measurements while the battery is recharging. See Testing on page 9 for procedures.

1. Connect AC adapter to the Model 2008.
2. Set selection knob to CHARGE BATTERY. The red LED will light, indicating the batteries are recharging.

NOTE: Measurements can be made while the batteries are recharging.

3. The batteries will be completely recharged in approximately 4.5 hours. The red LED will extinguish when the batteries are recharged.

If there is no display when the selector knob is switched to 0-20 or 0-200, the battery has no charge. Plug in the adapter, switch the selector knob to "OFF", and leave the meter plugged in overnight. The battery can be recharged using the above procedure.

REPLACING THE BATTERIES

When the batteries are no longer able to hold a charge, return the instrument to LaMotte Company for new batteries. Replacing the batteries yourself voids the meter warranty.

NOTE: The use of an AC Adapter other than the one supplied by LaMotte Company may void the meter warranty and damage the meter.

REPLACING THE LAMP

The tungsten lamp included with the Model 2008 will last approximately 45,000 hours. If you suspect the lamp is dimming, insert a clean empty sample tube into the chamber. If the display is unstable, the lamp needs to be replaced. Call LaMotte Company for a return authorization number to have the lamp replaced.

CALIBRATING (WITH OTHER STANDARDS)

The Model 2008 was factory calibrated using AMCO® standards. If formazin or other standards are used, or the front panel calibration procedure does not supply sufficient range, an internal calibration procedure should be used.

NOTE: Adjusting any internal components other than those specified will void the meter warranty.

1. Select two standards to use during the calibration procedure. The lowest and highest NTU standards should be chosen. (Ex. 0.5 and 5.0)
2. Make sure all glassware is clean and scratch-free. Wipe tubes with a lint free tissue to remove all fingerprints.
3. Set the selection knob to OFF.
4. Remove the four screws from the base of the turbidimeter. Holding the meter face down, carefully lift the back off the meter.

NOTE: The back and faceplate are connected by a short ribbon-cable. Do not disconnect this cable.

5. Set the meter in an upright, operating position on a flat surface.
6. Set the STANDARDIZE knob to the 12 o'clock position.
7. Set the selection knob to the proper range for the chosen standards (0 - 20 NTU or 0 - 200 NTU).
8. Insert the tube containing the low standard into the chamber. Place cap on chamber. Use a screwdriver to adjust the zero trim pot until the display reads the proper NTU value.

CAUTION: Only adjust the zero trim pot. Do not adjust other potentiometers. See diagram on following page to determine position of zero trim pot.

NOTE: Rapid hand movements near the circuit board may cause readings to fluctuate. Allow readings to stabilize before continuing.

WARRANTY INFORMATION

9. Insert the tube containing the high standard into the chamber. Place cap on chamber. Use a screwdriver to adjust the slope trim pot until the display reads the proper NTU value.

CAUTION: Only adjust the slope trim pot. Do not adjust other potentiometers. See diagram below to determine position of slope trim pot.

NOTE: Rapid hand movements near the circuit board may cause readings to fluctuate. Allow readings to stabilize before continuing.

10. Repeat Steps 8 and 9 until both the low and high standard values are correctly displayed.

NOTE: Use the orientation mark on the caps to assure the tubes are being placed in the meter the same way each time.

11. Reattach faceplate to back. The Model 2008 is now calibrated and ready to use.

REPAIRS

If it is necessary to return the instrument for repair, contact LaMotte Company at 1-800-344-3100 for a return authorization number.

INSTRUMENT GUARANTEE

This instrument is guaranteed to be free of defects in material and workmanship for one year from date of original purchase. If, in that time, it is found to be defective, it will be repaired without charge, except for transportation expenses. This guarantee does not cover the batteries.

This guarantee is void under the following circumstances:

operator's negligence

improper application

unauthorized servicing

LIMITS OF LIABILITY

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

PACKAGING AND DELIVERY

Experienced packaging personnel at LaMotte Company assure adequate protection against normal hazards encountered during shipping. After the product leaves the manufacturer, all responsibility for its safe delivery is assured by the transporter. Damage claims must be filed immediately with the transporter to receive compensation for damaged goods.

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