

Instruction Manual

TN-100/T-100

Portable Turbidimeter



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Part of Thermo Fisher Scientific

Certificate of Compliance

*This is to certify that the TN100 Portable Turbidimeter complies with the
specifications established by the ISO 7027 International Standard
for Water Quality - Determination of Turbidity, Section 3:
Quantitative Methods using Optical Turbidimeters.*



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Preface

This manual functions in two ways: first as a step by step guide to help you operate the waterproof TN-100/ T-100 turbidimeter; second, it serves as a handy reference guide.

It contains basic instructions that you must follow during the operation, care and maintenance of the instrument. The safety protection provided by this equipment may be impaired if it is used in a manner not described in this manual. It is recommended that all operators should read this manual prior to working with this instrument.

Eutech Instruments/Oakton Instruments cannot accept any responsibility for damage or malfunction to the meter caused by improper use of the instrument.

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1. Overview

Thank you for selecting the waterproof portable TN-100/ T-100 turbidimeter. The TN-100/ T-100 allows you to measure turbidity of an aqueous sample in the field. This instrument operates on the nephelometric principle of turbidity measurement and is designed to meet the criteria specified in ISO 7027 and DIN 27027 standards (see Measurement Principle on page 19).

1.1 Unpacking TN-100/ T-100 Meter and Accessories

The table below indicates the items that you should find in your turbidimeter shipment.

Item	Quantity
1. Portable TN-100/ T-100 Turbidimeter with 4 “AAA” batteries	1
2. Instruction Manual	1
3. Instrument Carrying Case	1
4. Light Shield Cap	1
5. Calibration Set (0.02, 20.0, 100, 800 NTU Standards, 60 ml each)	1
6. Empty Vials	7
7. Silicone Oil	1
8. Lint free cloth	1

Remove TN-100/ T-100 turbidimeter from the packing carton. Carefully inspect all items to ensure that no visible damage has occurred during shipment. If the items you received do not match your order, please contact your nearest distributor immediately.

WARNING: Extra care should be taken when unpacking, opening, and handling the calibration standards and sample vials. Surface scratches or finger smudges on the vial surface may cause measurement errors. Handle these items by their caps only.

Batteries provided with the meter package are to be installed prior to use. See Section 1.4 - Battery Installation on page 4.

Figure 1 depicts the meter. The three main components of the instrument are the sample well, the display, and the keypad. The following sections describe the functionality of the display and the keypad. The proper use of the instrument and the sample well are discussed in later sections.

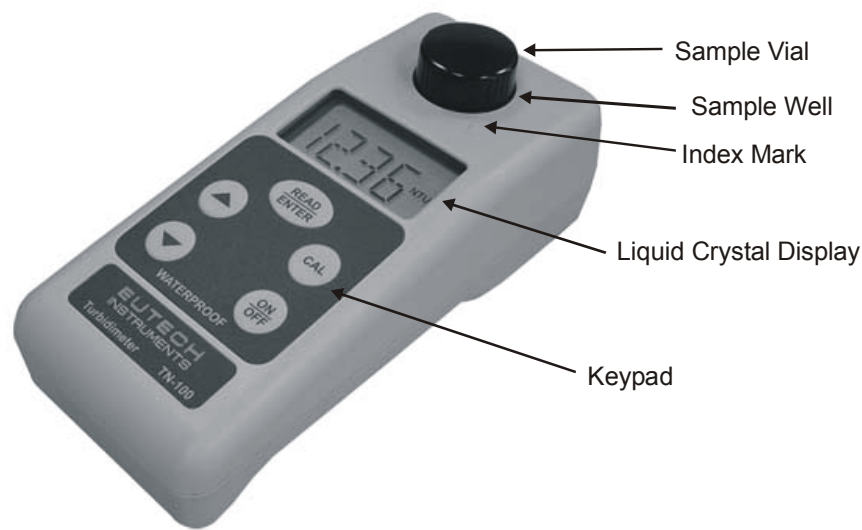


Figure 1: Parts of TN-100/T-100 Turbidimeter

1.2 Display

All the LCD segments and annunciators that can appear on the display are shown in Figure 2. The display is used for reporting the turbidity reading and to provide guidance for the operation of the instrument. In addition, the display has several other annunciators that are used to communicate error messages and provide user guidance.

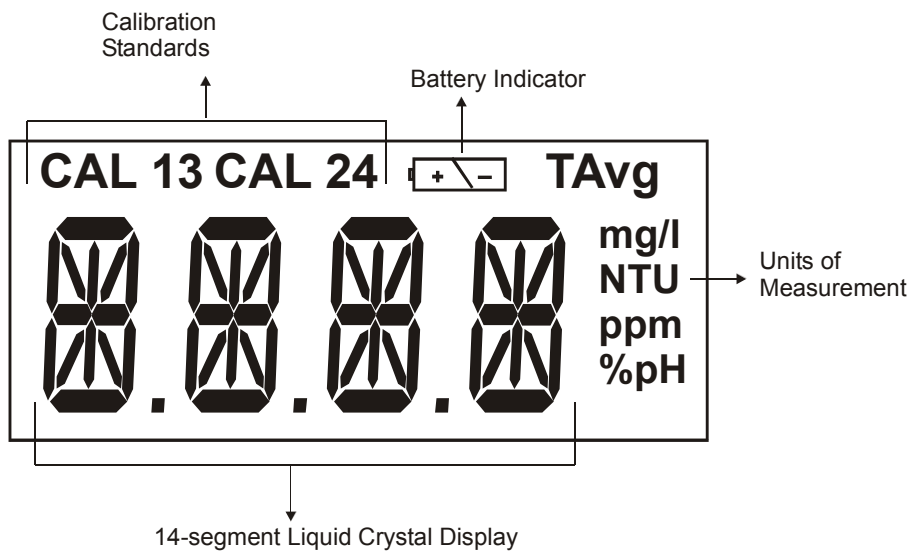


Figure 2: Customized LCD with all annunciators

1.3 Keys and Functions

The keypad has five keys: ON/OFF, CAL, ▲, ▼, and READ/ENTER.

Key	Functions
	Powers on and shuts off the meter. With the auto switch-off feature the meter automatically shuts off 20 minutes after last key press.
	Initiates the calibration mode of the meter. When pressed, the meter is set to accept the first calibration standard. It is also used to exit the calibration mode if the user does not want to follow the complete calibration procedure.
	When in measurement mode, the READ/ENTER key is used to perform a measurement. <u>Single-shot measurements:</u> When the key is pressed and released immediately (a quick key stroke of less than 0.3 seconds), the display will blink [-Rd-] for 10 times and then display the measured value. <u>Continuous measurements:</u> If the READ/ENTER key is pressed and held, the instrument will perform a continuous measurement during which the display is updated every 2 seconds. This can be used for indexing vials. (This function is not available in calibration mode). After the READ/ENTER key is released, the instrument will automatically perform a single-shot measurement.
 	Active only during calibration mode. These keys are used to select the calibration point in an incremental/ decremental manner. <i>NOTE: This meter is fitted with an auto incrementing feature, i.e. after the successful calibration of one point it auto selects the next calibration point, or automatically exits the calibration mode after the fourth calibration point.</i>

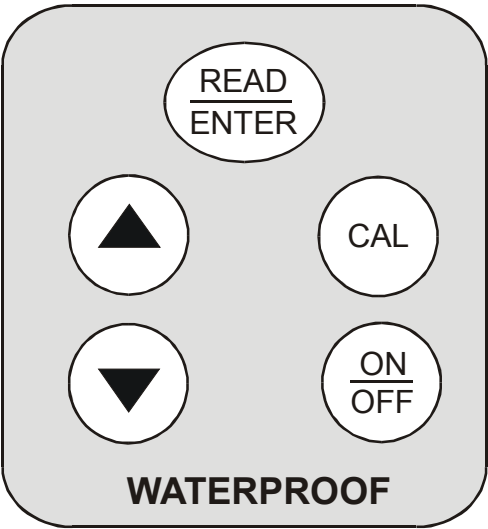


Figure 3: Keypad

1.4 Battery Installation

Four AAA-sized batteries are included in the packaging:

1. Use a Philips screwdriver to remove the two screws holding the battery cover. See Figure 4.
2. Remove the battery cover.
3. Insert the batteries. Follow the diagram inside the cover for correct polarity.
4. Replace the battery cover onto its original position using the two screws removed earlier.
5. The meter is now ready to operate.

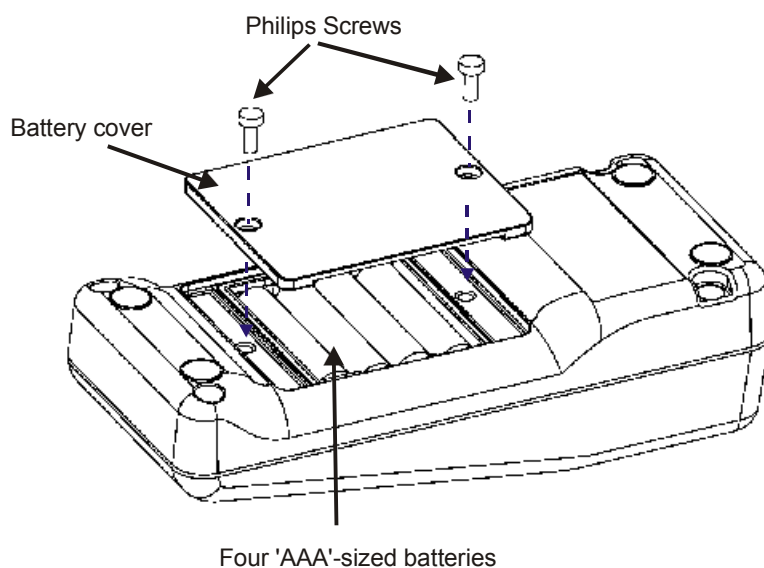


Figure 4: Battery Installation

NOTE: Dispose used batteries in accordance with your local regulations.

2. Turbidity Calibration

Calibration Overview

The TN-100/T-100 turbidity meter was calibrated and tested prior to leaving the factory. The meter kit now includes a set of prepared SDVB primary standards in plastic bottles which are EPA-approved for meter calibration. This keeps the stock solutions for the 0.02, 20.0, 100 and 800 NTU standards ready to use and offers improved precision and shelf life. A set of 4 empty vials for the standards are included in the meter kit. Before using the meter for the first time, verify the meter calibration by reading back the value for the prepared primary standard at the appropriate NTU value. This check is recommended daily to check the meter prior to measuring a sample. When the standard value drifts, retest with a vial of fresh standard solution. The 0.02 NTU standard needs to read <0.1 NTU for acceptance.

A replacement set of the 4 standards in plastic bottles is available. These 60mL bottles are identical to the bottles in the meter kit, so they can easily be carried in the case to where the measurement needs to be taken. These standards are specifically made for the TN-100/T-100 portable turbidity meters. The standards will not read to the stated NTU value in other manufacturer's turbidity meters.

2.1 Calibration Standards

We recommend that you use the following materials during calibration to achieve the accuracy stated in this manual:

- **CAL 1:** 800 NTU Calibration Standard
- **CAL 2:** 100 NTU Calibration Standard
- **CAL 3:** 20.0 NTU Calibration Standard
- **CAL 4:** 0.02 NTU Calibration Standard

It is well known that diluted Formazin is unstable. If you choose to use Formazin to calibrate the instrument, ensure that you are using a fresh stock suspension of Formazin to achieve the accuracy quoted for the instrument. Calibration standards offered are more stable than Formazin. For expiry date of calibration standard, please refer to the expiration date indicated on the cap label.

It is important that the calibration standards are not violently shaken or agitated because air entrapment in the fluid introduces an error factor during calibration which subsequently will lead to an inaccurate measurement. Also, do not store in freezing temperatures which causes irreversible shrinkage of the standards' particles thus resulting to inaccurate calibration and measurement.

2.2 Indexing

Due to the high quality of the glass vials provided, indexing is not required. You only need to align the mark on the vial with the mark on the meter. However, in order to achieve a better accuracy of the measurement, you can proceed with indexing of the vials. See Section 8.5 - Indexing a Vial on page 20 for more information.

2.3 Calibration Procedure

Preparing the Standard Vials

Each standard vial should be used with the same standard value (0.02, 20.0, 100, or 800 NTU) for the greatest accuracy. Follow the steps below at each change of solution.

1. Ensure there are no scratches or marks on the glass vial. If there are marks that could affect the turbidity measurement, select another vial.
2. Slowly and gently invert the calibration standard plastic bottle five times but do not shake the bottle as air bubbles can affect the reading.
3. Rinse a clean vial with 3-4 mLs of the calibration standard that will be used in this vial. Invert the capped vial 5 times. Uncap and dispose of the rinsate.
4. Repeat the rinsing steps and dispose of the rinsate.
5. Fill the vial with the primary standard solution to the fill line and cap the vial.
6. Clean the exterior of the vial using a lint-free cloth to remove all traces of liquid, dirt or fingerprints. Remove stubborn smudges with alcohol or a non-abrasive glass cleaner, and silicone oil can be used to fill small external scratches on the vial.
7. Repeat Steps 1-6 to prepare the other three standard solutions.

These standard vials can be used to check the meter calibration by reading back the standard value daily and also be used for calibration when needed. When the standard reading of 20.0, 100, or 800 NTU drifts more than 10% of the standard's NTU value, the solution should be replaced with another aliquot from the plastic bottle following the **Preparing the Standard Vials** steps. The 0.02 NTU standard read back value should be <0.1 NTU.

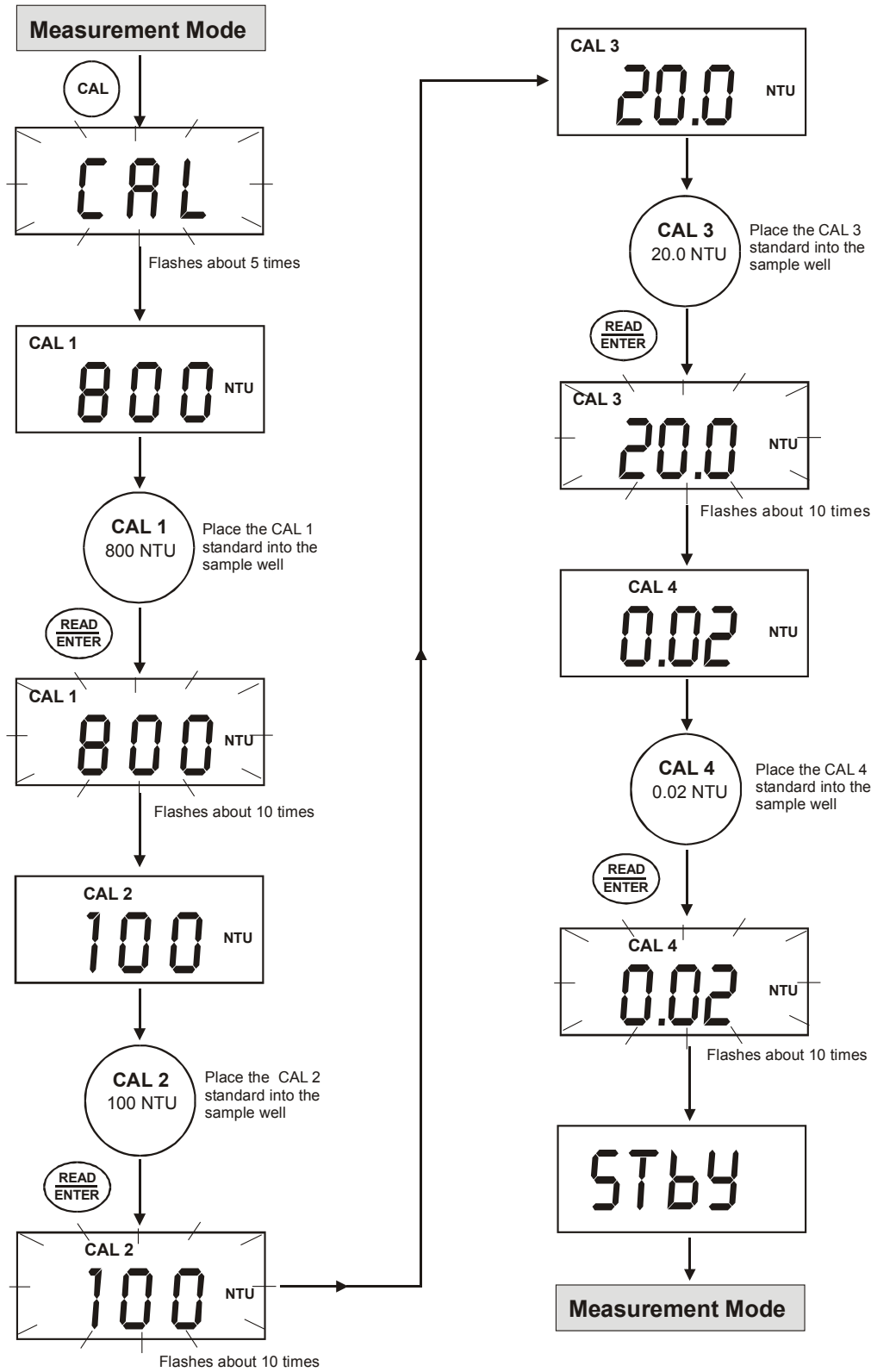


Figure 5: Calibration Sequence

2.4 Restoring Factory Calibration

The TN-100/ T-100 turbidimeter allows you to reset the meter back to the factory default calibration values. This feature is extremely useful when there are errors in calibration or when you have new calibration standards.

1. With the meter switched off, press and hold **▲** key.
2. Switch on the meter using **ON/OFF**. Release **▲** key when “URST” (User-Reset) appears in the display.
3. The display shows “URST” for about 2 seconds and then shows “No”.
4. Use **▲** or **▼** key to select between “YES” or “No”.
 - **YES** = To restore meter back to factory calibration values
 - **No** = To retain last calibrated values
5. Press **READ/ENTER** key to confirm your selection. The meter performs the reset if “YES” is selected.
6. The display flashes “--Rd—” about 10 times indicating that the meter goes to measurement mode.

Figure 6 shows the sequence for restoring factory calibration values.

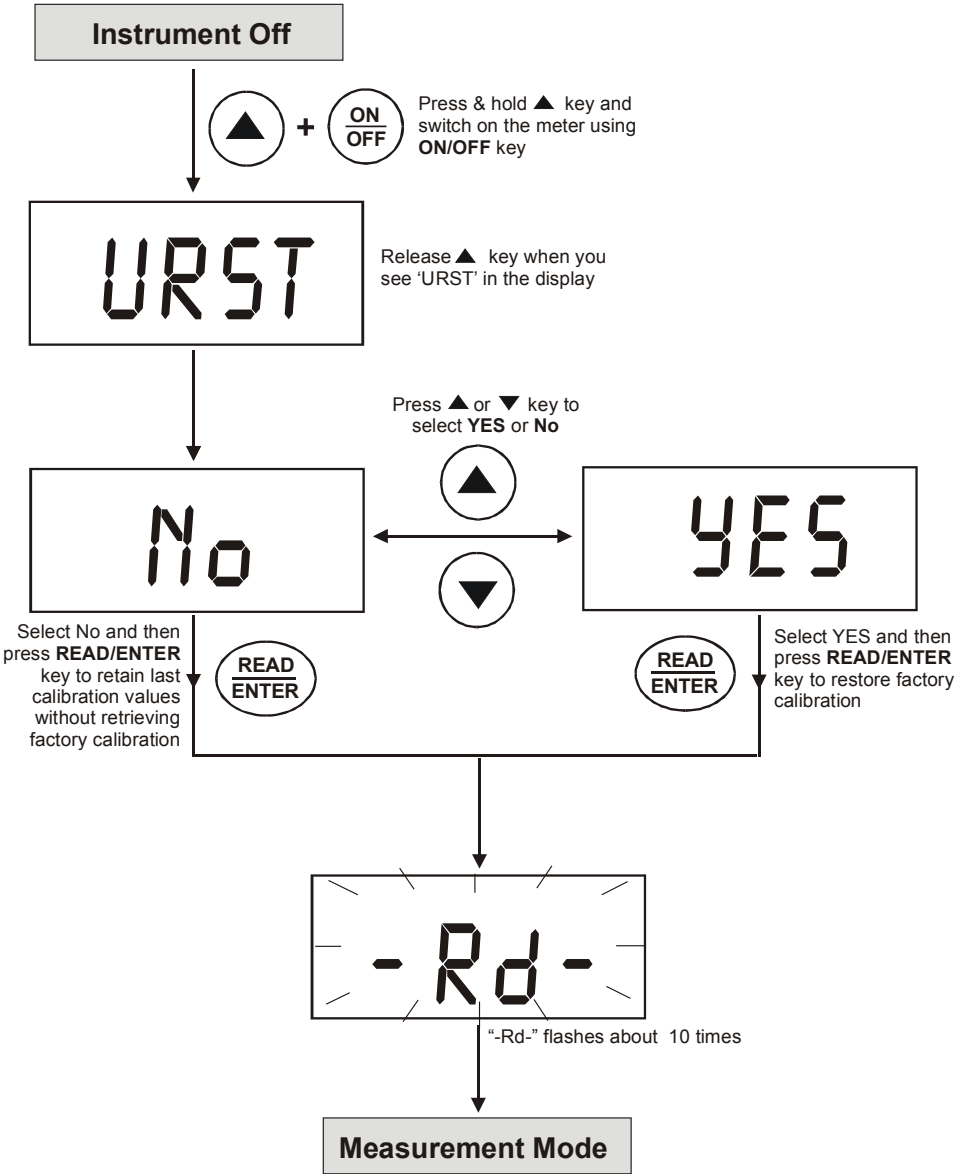


Figure 6: Restoring Factory Calibration

3. Turbidity Measurement

3.1 General Information

The waterproof TN-100/ T-100 turbidimeter allows you to measure the turbidity of a grab sample. The turbidity is reported in Nephelometric Turbidity Units (NTU). Readings above 1000 NTU are outside the range of this instrument.

NOTE: Before switching on the TN-100/ T-100 turbidimeter, a sample vial **MUST** be placed in the sample well. You can use any of the calibration standards for this purpose.

The light shield cap provided could be used to cover the vial during measurements.

When the **ON/FF** key is pressed to switch on the meter, it goes through the power-up sequence as shown in Figure 7 below.

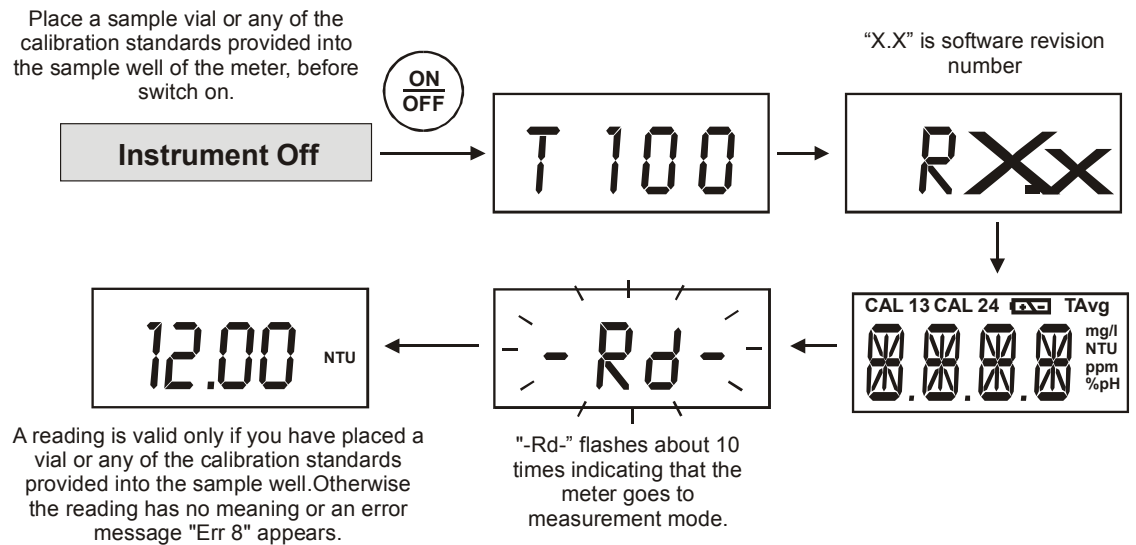


Figure 7: Power-up Sequence

3.2 Turbidity Measurement Procedure

An accurate turbidity measurement depends on good measurement techniques. Factors such as clean sample vials, positioning of vial in the sample well, covering the vial with the light shield cap, meter calibration, handling of meter, and others, have to be taken into consideration. Please see the following sections for more information.

Section 5.1: Vials – Handling, Cleaning and Care (page 16)

Section 9: Addendum 2:
Guide to Good Measurement Technique (page 21)

Preparation of Sample Vial

1. Obtain a clean and dry sample vial
2. Take care to handle the sample vial by the top.
3. Rinse the vial with approximately 10 ml of the sample water, capping the vial with the black screw cap and gently inverting it several times. Discard the used sample and repeat the rinsing procedure two more times.
4. Fill the rinsed vial with the remaining portion (approximately 10 ml) of the grab sample up to the mark indicated in the vial. Cap the vial with the supplied black screw cap.
5. Wipe the vial with the soft, lint-free cloth supplied. Ensure that the outside of the vial is dry, clean and free from smudges.
6. Apply a thin film of silicone oil (supplied) on the sample vial (see Figure 9).
7. Wipe with a soft cloth to obtain an even distribution over the entire vial's surface.

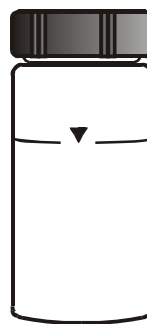


Figure 8: Sample Vial

NOTES:

1. *The purpose of oiling the vial is to fill small scratches and to mask the imperfection in the glass.*
2. *Do not apply large quantity of oil as this may collect dirt and dust*

8. The sample vial is now ready to be inserted into the sample well of the meter for measurement.

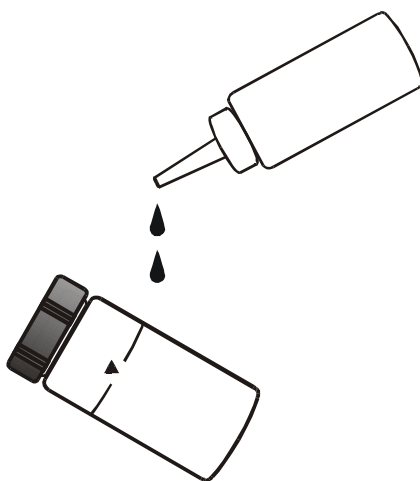


Figure 9: Apply a thin film of silicon oil

Measurement Procedure

1. Place TN-100/ T-100 turbidimeter on a flat and level surface.
2. Place the sample vial inside the sample well and align the vial's index mark with the meter's index mark. See **Figure 10**.

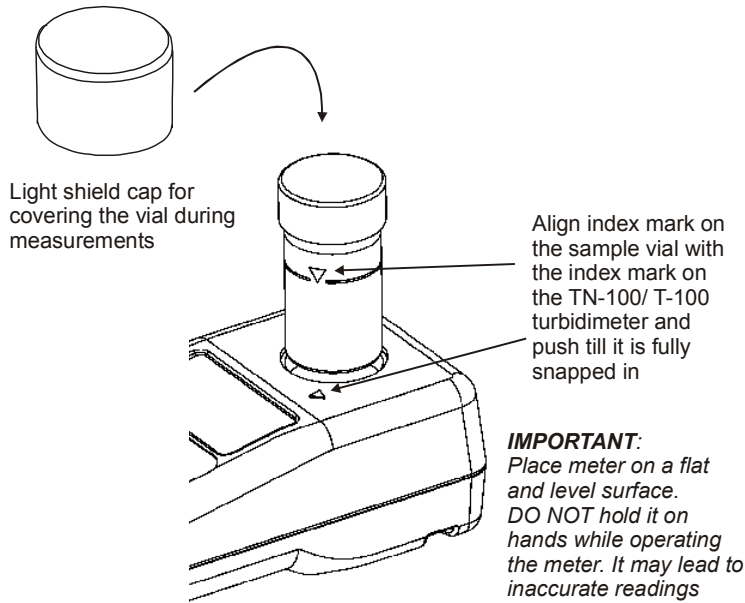


Figure 10: Align sample vial's index mark with meter's index mark

3. Push the vial until it is fully snapped in.
4. Cover the vial with the light shield cap.
5. Turn on the meter by pressing the **ON/OFF** key.
6. After the power-up sequence, the meter goes to measurement mode and the display blinks "--Rd--" for about 10 times. See Figure 11.
7. The measured reading appears in the display.
8. If necessary, place the second sample vial into the sample well. Remember to align the vial's mark with the meter's index mark.
9. Press **READ/ENTER** key. The display blinks "--Rd--" for several times and measured reading appears.
10. Repeat steps **Error! Reference source not found.** through 9 for all of your samples.

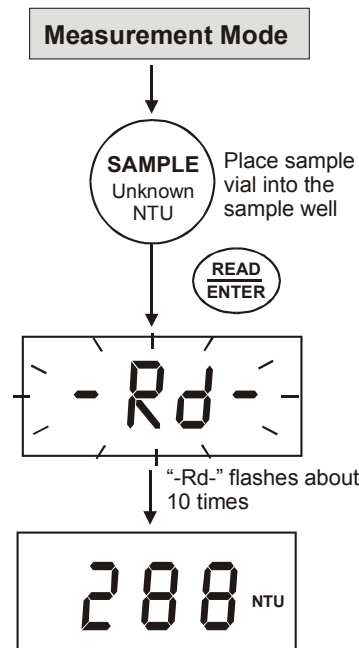


Figure 11:
Reading Turbidity Value

NOTES:

1. *NEVER pour liquid directly into the sample well of the instrument. Always use a vial. The instrument will only accurately measure the turbidity of a sample when vials sealed with the black caps are used. The black cap serves as both seal and a light shield.*
2. *NEVER attempt to clean the sample well. The optics may be damaged.*
3. *For battery conservation, the instrument automatically powers off 20 minutes after the last key pressed.*

3.3 Single-Shot or Continuous Measurement

You can use TN-100/ T-100 turbidimeter to take a single reading or perform continuous measurement. The latter is only used for indexing the vials. See **Section 8.5 - Indexing a Vial** on page 20 for more information.

For Single-shot Measurement:

1. Make sure the meter is sitting on a flat and level surface and is in measurement mode. The display shows the last measured value or "STbY" after exiting calibration mode.
2. Place sample vial in the sample well.
3. Cover the vial with the light shield cap.
4. Press **READ/ENTER** key and release immediately (<0.3 seconds). See Figure 12.
5. The display blinks "--Rd--" for about 10 times and then display the measured value.

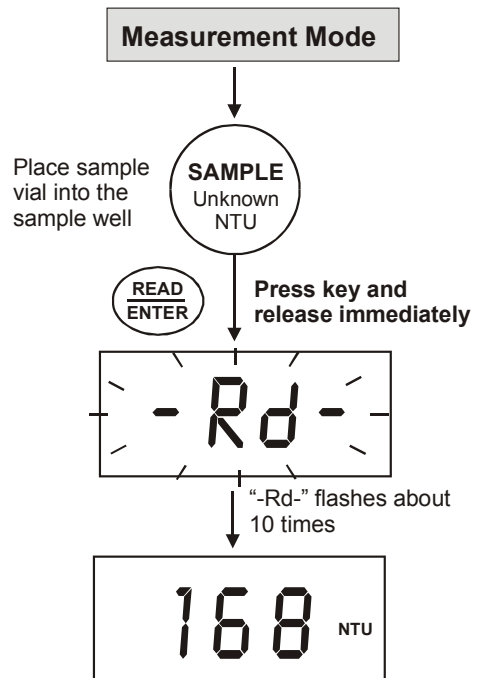


Figure 12: Single-shot Measurement

For Continuous Measurement:

1. Make sure the meter is sitting on a flat and level surface and is in measurement mode. The display shows the last measured value or "STbY"
2. Place the sample vial in the sample well.
3. Press **READ/ENTER** key and hold. See Figure 13
4. Wait for the reading to stabilize before rotating the sample vial.

NOTE: During continuous measurement, the display is updated every 2 seconds. The displayed reading may not be the actual turbidity value. For accurate measurement, use single-shot measurement.

You can rotate the sample vial for indexing purpose. See **Section 8.5** - Indexing a Vial on page 20 for more information.

5. Once you release **READ/ENTER** key, the meter automatically performs a single-shot measurement.

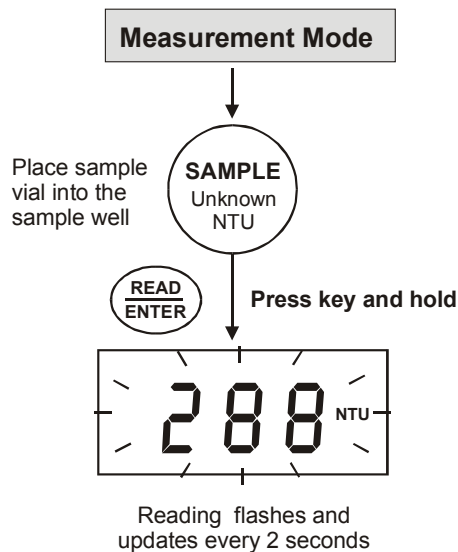


Figure 13: Continuous Measurement

NOTES:

1. After a measurement is completed and the display is updated, a 4-second recovery time occurs before the meter can perform another function. If any key is pressed during the recovery time, the meter will perform the corresponding action at the end of the recovery period.
2. When performing a measurement, if the meter detects stray light exceeding the amount equivalent to 0.02 NTU in the low range, the measurement is immediately aborted and an error message [ERR 8] is displayed. Ensure the vial sits properly into the sample well. Press the ENTER/READ key to re-do the measurement.

4. Troubleshooting Guide

The TN-100/ T-100 turbidimeter routinely performs self-diagnostics, and will automatically generate messages to provide you with specific diagnostic information. These messages are for your use and do not indicate a reduction in the performance of the instrument or a failure of any component in the instrument, unless otherwise stated in this list.

LCD Message	Description	Corrective Actions
ERR 1	Calibration Error. The meter is unable to recognize the 800 NTU Calibration Standard.	Ensure to use the correct 800 NTU calibration standard. *
ERR 2	Calibration Error. The meter is unable to recognize the 100 NTU Calibration Standard.	Ensure to use the correct 100 NTU calibration standard. *
ERR 3	Calibration Error. The meter is unable to recognize the 20.0 NTU Calibration Standard.	Ensure to use the correct 20.0 NTU calibration standard. *
ERR 4	Calibration Error. The meter is unable to recognize the 0.02 NTU Calibration Standard.	Ensure to use the correct 0.02 NTU calibration standard. *
ERR 5	Calibration Error. There is not sufficient signal to achieve the appropriate resolution in the 0-1000NTU range.	Re-do calibration with all 4 standards provided. *
ERR 6	General Calibration Failure. There is not sufficient signal to achieve the appropriate resolution in the 0-100NTU range.	Re-do calibration with all 4 standards provided. *
ERR 7	General Calibration Failure. There is not sufficient signal to achieve the appropriate resolution in the 0-20 NTU range.	Re-do calibration with all 4 standards provided. *
ERR 8	Excessive stray light detected.	Ensure the vial is fully snapped in the sample well. Use light shield cover.
	Attempting a measurement when low battery indicator is on.	Replace batteries.
ERR 9	Lamp Failure.	Return unit.
Or	When Turbidity value is above the measurement range(>1000NTU)	Dilute sample. See Section 9.7 on page 22.
	Low battery indication. The batteries need to be replaced.	Replace batteries.

* If an error message appears, take the appropriate corrective action and re-do the desired procedure. If the problem persists, contact Eutech Instruments or your dealer. See Sections on Warranty and Return of Items on page 24.

ERR 1

5. Routine Maintenance

The supplied carrying case is optimal for protecting the instrument. If you do not plan on leaving the instrument in the supplied carrying case, when not in use, ensure that the instrument has been turned off and that a clean sample vial fitted with a black cap has been placed in the sample well. This will ensure that a minimal amount of dust and/or debris will be able to settle on the optics of the instrument.

5.1 Vials – Handling, Cleaning and Care

Proper measurement of the turbidity of a sample requires the use of a vial that is free of marks, smudges, scratches and any bacterial growth.

Therefore, sample vials must be handled with absolute care to avoid contamination or damage, which might change the optical characteristics of the glass. Scratches, fingerprints, and water droplets on the sample vial or inside the sample well can cause stray light interference leading to inaccurate readings.

Cleaning the vial is accomplished by washing the interior and exterior of the vial in a detergent solution. Once cleaned, the vial should be rinsed thoroughly 8 to 10 times with clean distilled water to eliminate the possibility of detergent buildup and streaking.

Vials can also be acid washed periodically and coated with a special silicone oil to fill small scratches and mask the imperfections in the glass. Since the silicone oil required for this application should have the same refractive characteristics as glass, it is recommended that the oil be obtained from us. Care should be taken not to apply excessive oil that could attract dirt or contaminate the sample well of the meter. Once the oil has been applied to the vial, the excess oil should be removed with a lint-free cloth. The result should be a sample vial surface with a dry appearance, but with all imperfections filled with oil.

Sample vials should always be handled from the top or by the cap to avoid fingerprints or smudges. After a vial has been filled with a sample and capped, the outside surface should be wiped with a clean, lint-free absorbent cloth until it is dry. Cleaned and dried vials should be stored with the black caps on. The vials can be stored in the carrying case. During normal operation you may use any typical glass cleaner along with a lint free cloth or tissue (Kimwipes®), to clean the outside of the vials.

Condensation may appear on the vial when your sample is very cold and the relative air humidity is high. When this happens, the turbidity that you read may be higher than the actual turbidity due to the light scattered by the condensate on the vial. If you find yourself in this circumstance, you can alleviate the problem by either coating the vial with an anti-fogging agent, or by running warm water over the vial for a short period of time to warm the sample prior to measurement.

6. Accessories

The items shown below are recommended accessories and replacement parts for the instrument.

Item Description	Eutech Instruments Order Code	Oakton Instruments Order Code
Waterproof TN100 portable turbidimeter with set of 4 calibration standards (800, 100, 20.0 & 0.02 NTU), set of 7 sample vials, lint-free cloth, silicone oil, batteries – all in a rugged carrying case.	ECTN100IR (01X357301)	35635-00
Waterproof TN100 portable turbidimeter, set of 7 sample vials, lint-free cloth, silicone oil, batteries – all in a rugged carrying case.	N/A	35635-05
Calibration kit Set for TN100 (800, 100, 20.0, & 0.02 NTU), 4 x 60 mL plastic bottles, with (4) vials and labels for the vial caps.	TN100CALKIT (01X621001)	35635-52
Sample vials – pack of 3 vials	ECTN100CUVKT (01X274902)	35653-55
Sample vials – pack of 4 vials	ECTN100CUVKIT4 (01X638601)	N/A
Silicone oil – 10 mL	ECSILICONEOIL (01X358701)	NCI# 00159II

To order any accessory or replacement part, please contact the nearest distributor or Eutech Instruments/Oakton Instruments.

7. Specifications

Parameter	Specification
Measurement Method	ISO 7027 compliant nephelometric method (90°)
Measurement Range	0 to 1000 NTU
Automatic Range Selection	0.01 – 19.99 NTU 20.0 – 99.9 NTU 100 – 1000 NTU
Resolution	0.01 NTU (0 – 19.99 NTU) 0.1 NTU (20 – 99.9 NTU) 1 NTU (100 – 1000 NU)
Accuracy	<0.1 NTU for 0.02 NTU Standard ±2% of reading ± 1 LSD for 0.1 to 500 NTU; ±3% of reading ± 1 LSD for 501 to 1000 NTU.
Repeatability	± 0.01 NTU or ± 1% of reading, whichever is greater with gel samples
Response Time	< 6 seconds for full step change
Calibration Standards	0.02 NTU; 20 NTU; 100 NTU; 800 NTU
Standardization	EPA-approved polymer-based primary standards
Light Source	Infrared-emitting diode (850 nm wavelength)
Light Source Life	> 1,000,000 tests
Detector	Silicon photovoltaic
Stray Light	< 0.02 NTU
Display	4-digit 14-segments customized liquid crystal display with annunciators
Sample Cells (Vials)	Borosilicate glass with screw caps, fill line and indexing mark. 51 (H) x 25 (Dia) mm (2 x 1 in)
Sample Volume Required	10 ml (0.33 oz)
Operating Temperature Range	0°C to 50°C (32°F to 122°F)
Sample Temperature Range	0°C to 50°C (32°F to 122°F)
Operating Humidity Range	0-90% RH, non-condensing at 30°C (86°F)
Power Supply	4 x “AAA” Alkaline Batteries
Battery Life	> 1200 readings
Enclosure Type & Rating:	ABS Plastic / IP67 rated
Insulation Rating	Pollution Degree 2
Weight:	Meter: 200 g (7 oz) Meter with case: 1.25 kg (2.75 lb)
Dimensions	Meter: 6.8 (W) x 15.5 (L) x 4.6 (H) cm; (2.7 x 6.1 x 1.8 in) Meter with Case: 16 (W) x 35 (L) x 12 (H) cm; (6.3 x 13.8 x 4.7 in)