



# TN400 Portable Turbidity Meter

## Instruction Manual



**APERA INSTRUMENTS LLC**

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# 1 OVERVIEW

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Thank you for purchasing Apera Instruments TN400 Portable Turbidity Meter (hereafter referred to as the instrument).

The instrument uses infrared light emitting diode (LED 860±30nm) as the light source and 90° scattering method, which is compliant with ISO 7027 and DIN EN 27027 standards for the determination of turbidity for water solutions. TN400 allows you to measure the turbidity of an aqueous sample both in laboratory and in the field.

The instrument is an outstanding combination of the most advanced electronic technology and software design. With built-in microprocessor chips, elegant design, easy to use, the meter has the following remarkable characteristics:

- Smart functions, such as automatic calibration, operating instructions, automatic power-off, low voltage display, etc.
- Large TFT color screen, with blue background in measuring mode, green background in calibration mode, and text and graphics in operational directive.
- Operation guidance and reminders in the process of calibration, measurement and parameter setting.
- Average measurement mode automatically takes 10 times consecutive readings, calculate and display the average. It improves the accuracy of the measurement, especially suitable for sample solutions with rapid settling and continuous measurement changes.
- The instrument meets IP67 water-resistant grade and is suitable for use in harsh environments.
- Everything comes in a rugged carrying case, including accessories such as calibration solutions, test vials, and more, convenient for use and carry.

## 2 TECHNICAL SPECIFICATIONS

### 2.1 Technical Parameters

Measuring Method	ISO 7027 and DIN EN 27027 compliant nephelometric method ( 90° )
Light Source	Infrared light emitting diode (860±30nm)
Measuring Range	0 ~ 1000 NTU, automatic range selection: 0.01~19.99 NTU 20.0~99.9 NTU 100~1000 NTU
Accuracy	≤ ±2 % of reading + stray light
Repeatability	≤ ± 1% of reading or 0.02 NTU (FTU), the greater of the two
Resolution	0.01 / 0.1 / 1 NTU(FNU)
Stray Light	≤0.02 NTU(FNU)
Calibration Standards	AMCO Polymer or Formazin Solution: 0, 20, 100, 400 and 800 NTU (FNU)
Detector	Silicon photovoltaic
Measurement Mode	Normal measurement and average measurement mode
Display	TFT color screen
Sample Vials	Φ25×60 mm, high borosilicate glass with lid
Sample Volume	18 ml
Power Supply	4× “AA” Alkaline Batteries
Operating Condition	Temperature: 0 to 50°C (32°F to 122°F); Relative humidity: 0 to 90% at 30°C, 0 to 80% at 40°C, 0 to 70% at 50°C, no condensation
Storage Condition	Instrument: -40~60°C (-40~140 °F) Calibration Solution: 5~30°C (41~86 °F)
Instrument sealing grade	IP67
Certificates	CE
Limited Warranty	2 years
Dimension and Weight	Meter: (90×203×80) mm/385g Test Kit: (310×295×110) mm/1.5kg

## 3 INSTRUMENT DESCRIPTION

### 3.1 Instrument Overview



Diagram-1

①	Flip cover of the sample vial holder (Close the cover when measuring)	⑥	Dust proof plug (Take off the plug when measuring)
②	Housing	⑦	Sample vial holder
③	Display	⑧	Calibration vials or sample vials
④	Keypad	⑨	Positioning mark (Align the mark with the mark on the calibration vial or sample vial)
⑤	Battery cover		

### 3.2 Meter and Accessories

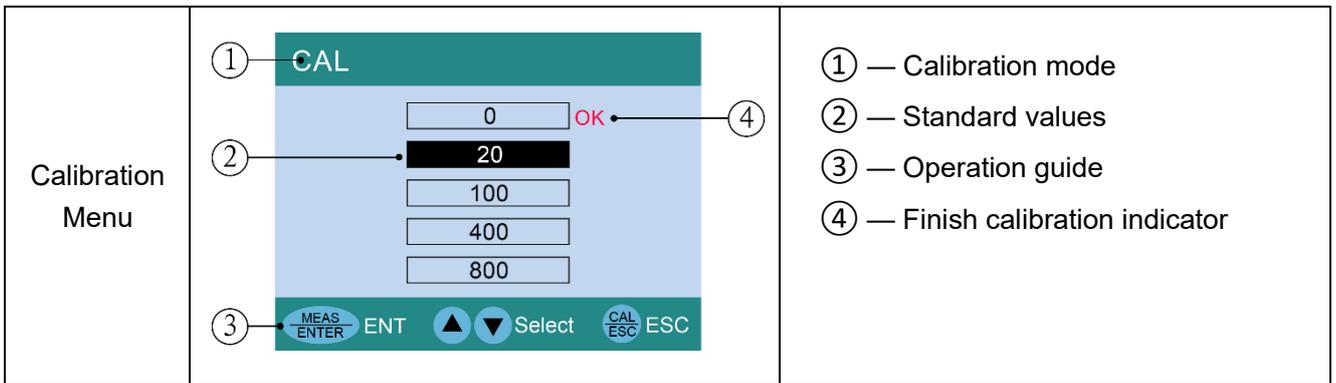


①	Calibration Solutions: 0.0, 20.0, 100, 400, 800 NTU
②	Carrying case
③	TN400 Turbidimeter
④	Microfiber cloth
⑤	Screwdriver (to remove battery cover)
⑥	Silicone oil (10 ml)
⑦	AA Alkaline battery×4
⑧	Sample vial×6
⑨	Instruction manual

Diagram-2

### 3.3 Display Mode

Measuring Mode		<ul style="list-style-type: none"> <li>① — Measurement mode</li> <li>② — Measurements and unit</li> <li>③ — Operational guide</li> <li>④ — Battery icon</li> </ul>
Calibration Mode		<ul style="list-style-type: none"> <li>① — Calibration solution</li> <li>② — Measurements and unit</li> <li>③ — Progress bar</li> <li>④ — Operational guide</li> </ul>



### 3.4 Keypad



Diagram- 3

Key	Functions
	<ul style="list-style-type: none"> <li>● Power on/off</li> <li>● The meter will automatically shut off 10 mins after last key press</li> </ul>
	<ul style="list-style-type: none"> <li>● In measurement mode: press to enter calibration mode</li> <li>● In calibration mode: press to exit calibration mode</li> <li>● In measurement mode: long press to switch measurement units NTU-FTU</li> </ul>
	<ul style="list-style-type: none"> <li>● In measuring mode: Short press the key to perform single-shot measurement; long press the key to perform continuous measurement</li> <li>● In calibration mode: press the key to confirm the calibration.</li> </ul>
	<ul style="list-style-type: none"> <li>● In calibration mode, press the key to select standard solution.</li> </ul>

### 3.5 Power Supply

1. The instrument adopts 4 pieces of AA alkaline battery. Make sure there is no mixture of new & old batteries or different models of batteries.

2. Battery capacity indication

Battery capacity icon: , please replace new batteries when

 icon displays to ensure measuring accuracy; when  icon displays, the battery must be replaced, otherwise the instrument can't work properly. To extend battery life, user can setup auto-power off timer in Parameter Setup P6 according to usage requirements

3. Use the screwdriver to remove the four screws on the battery cover and open the battery cover. Insert 4 pieces of "AA" alkaline battery. Please make sure the polarity is correct. Put on the battery cover and screw tightly.

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## 4 METER CALIBRATION

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### 4.1 Preparation for Calibration

#### a) Calibration Point

The instrument has 5 calibration points: 0 NTU, 20 NTU, 100 NTU, 400 NTU, and 800 NTU. Among them, 0 NTU point uses AMCO 0.0 NTU calibration solution or laboratory distilled water, and the remaining 4 calibration points use AMCO polymer solutions. Note that the cap of the 0.0 NTU solution vial can be opened. Once the solution is invalidated, users can replace the 0.0 NTU calibration solution or laboratory distilled water. The AMCO 0.0 NTU calibration solution can be purchased from the supplier; For the remaining 4 calibration solutions, their vial caps are sealed and cannot be opened. Simply dispose the solutions after they are expired and buy new ones from your supplier to replace. See the detail in Section 7 Replacement Parts.

#### b) Replace zero turbidity solution

- Replace with 0.0 NTU calibration solution: open the vial cap, pour out the original solution, add 1/2 distilled water, close the cap and shake the vial to rinse it and pour out the water. Repeat it 3 times. Shake off the distilled water in the vial. Pour in new 0.0 NTU calibration solution and tighten the vial cap.
- Replace with laboratory distilled water: open the vial cap, pour out the original solution, add 1/2 distilled water, close the cap and shake the vial to rinse it and pour out the water. Repeat it 3 times. Shake off the distilled water in the vial. Pour in new laboratory distilled water and tighten the vial cap.
- The accuracy of 0.0 NTU calibration solution and laboratory distilled water is same. But 0.0 NTU calibration solution has 6 to 12 months of shelf-life, distilled water can be contaminated easily after air contact and lose the validity in a couple of days.

AMCO 0.0 NTU solution is provided in factory configuration. For purchase details, please refer to Section 7 Replacement Parts.

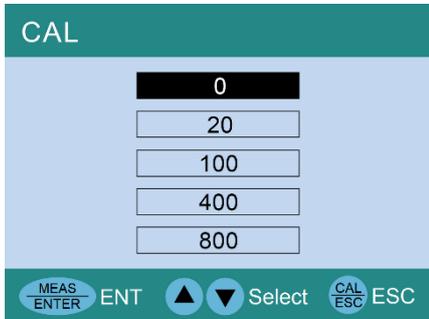
#### c) Clean vial surface

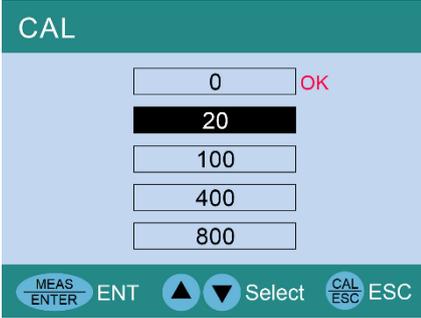
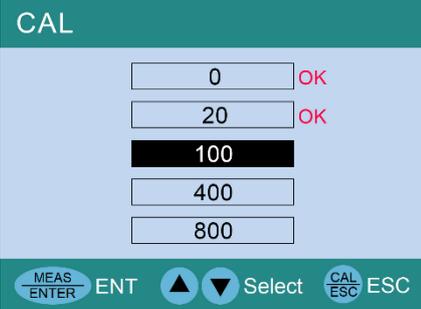
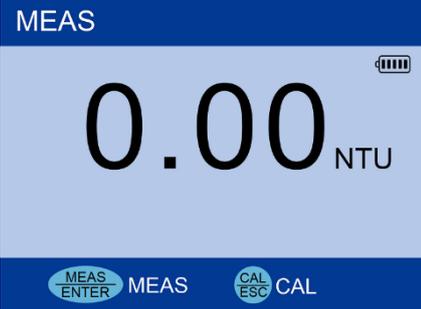
Apply a small drop of silicone oil on the surface of the vial and wipe it off with a micro-fiber cloth to evenly distribute the silicone oil on the surface so as to cover smudges or scratches, which helps light scattering. But please pay special attention to the following points:

- ① The silicone oil applied should not be too much. After wiping with micro-fiber cloth, please wipe with filter paper or high-quality tissue paper to clean off. Excessive residual silicone oil on the vial surface will affect the measurement accuracy.
- ② It's not necessary to use silicone oil for each calibration and measurement. Apply silicone oil every several days or once a week. In between, just clean the surface with filter paper or high-quality tissue paper.
- ③ Clean the calibration vial and sample vial together and keep the steps and actions consistent to achieve same degree of cleanliness.
- ④ Stability of calibration solutions

The U.S EPA approved AMCO polymer standard calibration solution is very uniform and stable. It does not precipitate, drift or condense. It can be used directly without shaking or flipping the vial (to make the solution even). For polymer calibration solutions that have not been used for a long time, slowly flip the vial twice and let it stand for 2 minutes. Be careful not to shake the solution vigorously, as this will create air bubbles which destabilize the measurement; For 0.0 NTU calibration solution, do NOT shake or flip. If using Formazin calibration solution, as it tends to precipitate easily, each time users must flip and shake the vial to make the solution even. But sediment can still occur during tests and make the measurement unstable. Operating experience is important in using Formazin calibration solutions.

## 4.2 Calibration Procedure (Take 0 NTU and 20 NTU as an example)

1) Instrument warm up: Power on the instrument, and then wait for 3 minutes.	
2) Open the flip cover and place the 0.0 NTU calibration vial. Align the arrow on the vial lid with the one on the sample vial holder and close the flip cover.	
3) Press  to enter the calibration menu, the cursor is at 0 NTU. Press  to start calibration.	

<p>4) After calibration is done, press  to confirm. The instrument will return to the calibration menu (see Diagram on the right side). The OK sign indicates that 0 NTU has been calibrated and prompt to calibrate 20 NTU.</p>	
<p>5) Place the 20.0 NTU calibration vial in the sample vial holder, press  to start 20 NTU calibration. After calibration is done, press  to confirm. The instrument will return to the calibration menu (see diagram on the right side). The OK sign indicates that 20 NTU has been calibrated.</p>	
<p>6) If you want to continue to calibrate 100, 400 and 800 NTU, place the 100 NTU calibration vial in the sample vial holder and press  to calibrate. After calibration is done, press  to confirm; repeat the steps to calibrate 400 NTU and 800 NTU. After calibration is done, press  to return to measurement mode.</p>	
<p>7) Press  to exit calibration mode, the instrument will return to measurement mode as shown in Diagram on the right side.</p>	

### 4.3 Notes for Calibration

a) **Calibration point verification:** The calibration point can be verified after the calibration is completed. If the calibration point has a large error, enter the calibration mode and repeat the calibration. For calibration point accuracy, users can refer to the following standards:

Calibration point	Accuracy for reference
0 NTU	≤0.05 NTU
20 NTU	≤±0.2 NTU
100 NTU	≤±2 NTU
400 NTU and 800 NTU	≤±5 NTU

- b) **Calibration point selection:** The instrument has been calibrated at full range before leaving the factory. Users can select 2 or more points as needed to calibrate, as long as the target measurement range is in between of the two calibration points. In calibration setup mode, press  or  to select the calibration point.
- c) **Low turbidity calibration requirement**
- For low turbidity measurements (measurement less than 2 NTU), please test 0.0 NTU calibration solution. If the accuracy is not meeting your requirements, calibrate the instrument at 0.0 NTU and 20.0 NTU before test; then use 1# or 2# vial for measurement.
  - Using the same sample vial to calibrate and measure can eliminate the error caused by different vials, thus achieving higher accuracy. For example, add distilled water to 1# vial for zero point calibration and then add sample solution to 1# vial for measurement. Note that the test vial should be rinsed thoroughly when changing solutions.
- d) **High turbidity calibration requirement:** For turbidity measurement greater than 2 NTU, it is recommended to calibrate once a week, or to test a calibration solution close to the sample solution. If the error is large, the instrument needs to be recalibrated.
- e) The instrument does not automatically recognize the calibration solution. If the wrong solution is selected for calibration, the measurement will be completely wrong. To fix this problem, simply recalibrate the meter selecting the correct calibration solutions.
- f) Place the instrument on a flat and level surface. Do not hold the instrument in hand while operating.
- g) If using Formazin standards for calibration, please note that the diluted Formazin standard is unstable. Please make sure to use freshly made Formazin standard to ensure calibration accuracy.

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## 5 TURBIDITY MEASUREMENT

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### 5.1 Sample Vial Handling

- 1) There are 6 sample vials contained in the case, marked 1#~6# on the cap and bottom of the vial. Please note the number of sample vial should be same as that of vial cap, and do not mix up. Please always use 1#~2# sample vial to measure samples with turbidity less than 2 NTU. 3#~6# sample vials are used for measurement of other solutions.
- 2) Sample vials have been meticulously cleaned and disinfected before they leave factories. They can be used directly for the first time. Before subsequent uses, sample vials should be thoroughly cleaned: wash the interior and exterior of the vial in a detergent solution. Repeatedly rinse with clean distilled water or deionized water. Rinse sample vial with sample solution twice. Fill sample vial with sample solution then screw the vial cap tightly.

### 5.2 Measurement Preparation

- 1) Collect sample solution in a clean container, fill sample solution to the 4/5 position of the sample vial

(approximately 18ml), see Diagram-4, tighten the vial cap.

- 2) Before measuring, gently shake the sample vial to make sample solution even and wait for air bubbles to disappear, see Diagram-5, wait for 2~5 minutes until bubbles eliminate.
- 3) Wipe the sample vial surface with a microfiber cloth. Ensure that the vial is dry, clean and free from smudges.
- 4) Apply 1 drop of silicone oil on the surface of the vial. Wipe with a microfiber cloth to obtain an even distribution over the entire surface in order to eliminate scratches and smudges and improve light scattering, see Section 4.1(c) for details.

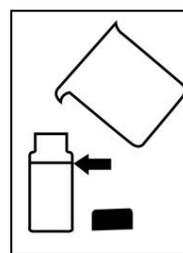


Diagram- 4

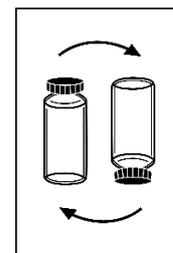


Diagram- 5

### 5.3 Measurement Modes

#### a) Normal Measurement Mode

Press  button, the display shows progress bar (see diagram-6). It will display measured value after 8 seconds. Please press  button again for repeated measurement.

#### b) Average Measurement Mode

Long press  button, release it until you hear a beep, then the instrument enters average reading mode. In this mode, the instrument will perform 10 times of continuous measurement, displaying 1 data every 8 seconds, and will display the average value at the end, see diagram 6. The average measurement mode can be used for observing the stabilizing process of turbidity, and can also be used for testing rapid-settling solutions.



Diagram 6

### 5.4 Notes for Measurement

- a) **Keep the sample stable:** After the vial is placed into the sample cell, it is recommended to wait for 1 to 2 minutes before calibration, as the solution will experience some shaking when the vial moves, which may affect measurement accuracy.
- b) **Sample vial cleaning requirement:** Sample vials must be rigorously cleaned and free from smudges or scratches. When wiping, user should grip the cap and bottom to avoid leaving fingerprints on the surface of the vial. Its surface should be applied with a drop of silicone oil be wiped with a micro-fiber cloth. After that, please clean with filter paper or high-quality tissue paper. See section 4.1(c) for details.
- c) **Mixing and Degassing:** Samples should not be vigorously shaken or vibrated. It is recommended that users gently shake the sample vial to make solution evenly distributed. Air bubbles in solution

will cause big error to turbidity measurement. So, the vial should be left stand still for 2 to 5 minutes to eliminate potential air bubbles before measuring. We recommend using the same mixing procedure and the same waiting time for degassing before comparing measurements.

d) **Other Requirements**

- On the premise of ensuring evenly distributed samples, sample solution should be measured immediately to prevent temperature changing and precipitates from affecting measurements.
- Avoid sample dilution for measurement as much as possible.
- Avoid operating under direct sunlight.
- Do not pour solution into the sample vial holder. Sample vials must be used for measurement.
- Please do not wash the sample vial holder as it may damage the optical structure.

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## **6 WARRANTY**

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We warrant this instrument to be free from defects in material and workmanship and agree to repair or replace free of charge, at the option of APERA INSTRUMENTS, LLC, any malfunctioned or damaged product attributable to the responsibility of APERA INSTRUMENTS, LLC for a period of TWO YEARS for the instrument from the delivery.

This limited warranty does NOT cover any issues due to:

- Accidental damage
- Improper use
- Normal wear and tear
- Transportation
- Storage
- Failure to follow the product instructions
- Unauthorized maintenance, modifications, combination or use with any products, materials, processes, systems or other matter
- Unauthorized repair
- External causes such as accidents, abuse, or other actions or events beyond our reasonable control.

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## 7 REPLACEMENT PARTS

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Model	Name	Description	Quantity
T500-2	AMCO 0.0 NTU calibration solution	0.0 NTU/100mL	1 bottle
T200-1	20/100/400/800 NTU AMCO polymer	Compatible with TN400&TN480	4 bottles
T500-3	Sample vials with lid	Φ25×60mm, 1#~6#	6 pcs
TN400-S3	Silicone oil	10mL	1 bottle

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