

Instruction Manual

HI 93703

Portable Microprocessor Turbidity Meter



www.hannainst.com

Dear Customer,

Thank you for choosing a Hanna Instruments product.

Please read this instruction manual carefully before using the instrument.

This manual will provide you with the necessary information for correct use of the instrument, as well as a precise idea of its versatility.

If you need additional technical information, do not hesitate to e-mail us at tech@hannainst.com or view our worldwide contact list at www.hannainst.com.

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PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it to make sure that no damage has occurred during shipping. If there is any damage, notify your dealer or the nearest Hanna Customer Service Center.

HI 93703 is supplied complete with:

- Glass cuvette with cap
- Batteries (4 x 1.5V AA) and instructions

HI 93703C is a complete kit supplied with:

- 2 glass cuvettes with caps
- Batteries (4 x 1.5V AA) and instructions
- **HI 93703-0**, **HI 93703-10** and **HI 93703-05** calibration standards
- Tissue for wiping cuvettes
- Rugged carrying case

Note: Save all packing material until you are sure that the meter functions correctly. All defective items must be returned in its original packaging with the supplied accessories.

GENERAL DESCRIPTION

With **HI 93703** turbidity measurements can be performed with high precision in the field as well as in the laboratory.

HI 93703 turbidity meter is a portable, microprocessor-based instrument used to determine the turbidity of water and wastewater. The meter covers a 0 to 1000 FTU range in two scales: 0.00 to 50.00 FTU and 50 to 1000 FTU. The auto-ranging feature sets the appropriate range for the measurement.

HI 93703 has been designed according to the **ISO7027** International Standard, consequently the turbidity unit is the FTU (Formazine Turbidity Unit). FTU is equivalent to the other internationally recognized unit: NTU (Nephelometric Turbidity Unit).

The meter housing is a rugged and lightweight case, with an easy-to-read LCD.

To save battery-life, the instrument is equipped with an automatic shut-off feature which is activated after 4 minutes of non-use.

The meter is very simple to use: all operations can be carried out with only four keys and troubleshooting functions can be performed with displayed error code guides.

An exclusive positive-locking system guarantees that the cuvette is firmly placed in the cell. The keypad is water-resistant and can be wiped with a moist cloth for quick cleanups.

The one-point calibration at 10 FTU* can be easily performed using the available standard. In addition, **HI 93703** is the first portable turbidity meter that allows to store the last calibration date and to retrieve it at the user's convenience.

HANNA instruments has chosen 10 FTU * as the calibration point because it is the value that best fits the water turbidity measurements in different applications, from drinking water to wastewater treatment.

HANNA instruments uses the primary standard AMCO-AEPA-1 to avoid all formazine-related problems. Formazine is a very toxic, unstable substance, which requires particular care: its standards have to be prepared only a few minutes before performing the calibration, and cannot be reused because of their short life. Hanna Instruments standards are extremely stable, can be reused, and last up to six months, if free from contamination.

HI 93703 can be used with both standards.

* 1 FTU = 1 NTU

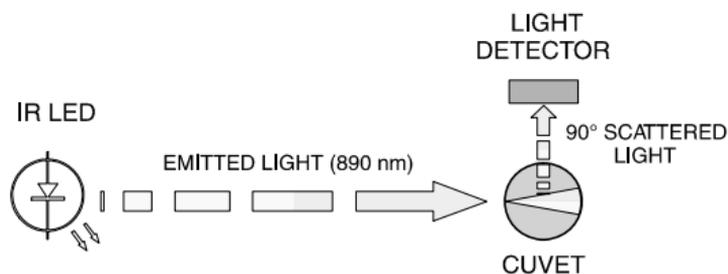
PRINCIPLE OF OPERATION

HI 93703 has been designed to perform measurements according to the ISO 7027 International Standard.

The instrument functions by passing a beam of infrared light through a vial containing the sample being measured.

The light source is a High Emission Infrared LED with a wavelength peaking at 890 nm, ensuring that the interference caused by colored samples is minimum.

A sensor, positioned at 90° with respect to the direction of light, detects the amount of light scattered by the undissolved particles present in the sample. The microprocessor converts such readings into FTU* values.

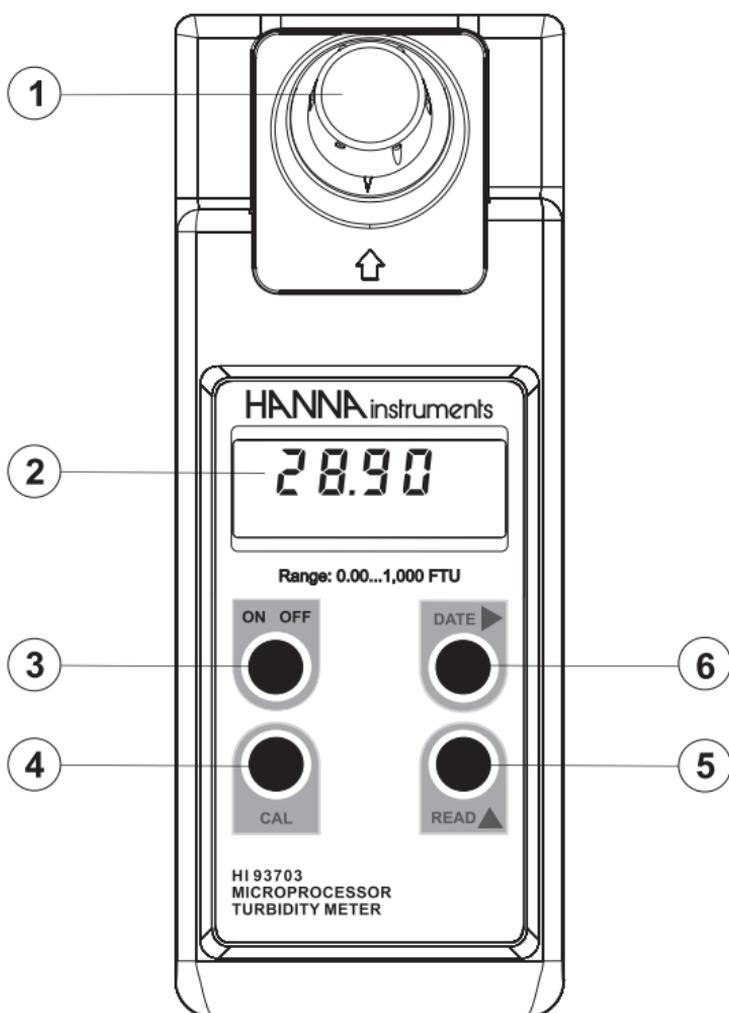


As noted above, FTU unit is equal to the NTU unit. However, there are other known measurement units for turbidity: Jackson Turbidity Unit (JTU) based on the old method of Jackson's candle, and Silica Unit (mg/L of SiO₂). For your reference the conversion table between these measurement units is shown below:

	JTU	FTU/NTU	SiO ₂ (mg/L)
JTU	1	19	2.5
FTU/NTU	0.053	1	0.13
SiO ₂ (mg/L)	0.4	7.5	1

* 1 FTU = 1 NTU

FUNCTIONAL DESCRIPTION



- 1) Measurement cell
- 2) LCD (Liquid Crystal Display)
- 3) **ON/OFF** key
- 4) **CAL** key, to enter the calibration mode
- 5) **READ/▲** key, to perform measurements and to set the date (day and month) of the last calibration
- 6) **DATE/▶** key, to display the last calibration date and to select either the month or the day of last calibration

SPECIFICATIONS

Range	0.00 to 50.00 FTU* 50 to 1000 FU*
Resolution	0.01 FTU* 1 FTU*
Accuracy	± 0.5 FTU* or $\pm 5\%$ of reading (whichever is greater)
Calibration	3 point (0, 10 and 500 FTU*)
Light Source	Infrared LED
Light Source Life	Life of the instrument
Light Detector	Silicon Photocell
Battery Type	4 x 1.5V AA alkaline
Battery Life	Approx. 60 hours of use or 900 measurements
Auto-off	After 5 minutes of non-use
Environment	0 to 50 μ C (32 to 122 μ F); RH max. 95% non-condensing
Dimensions	220 x 82 x 66 mm (8.7 x 3.2 x 2.6 ")
Weight	510 g (1.1 lb.)

* 1 FTU = 1 NTU

OPERATIONAL GUIDE

To prepare the instrument for taking measurements, first install the batteries (see Battery Replacement section on page 17) and then turn the instrument on.

To maximize the battery life the meter is automatically switched off after 5 minutes of non-use. To reactivate it, simply press the **ON/OFF** key.

MEASUREMENT PROCEDURE

- Turn the meter on by pressing the **ON/OFF** key.



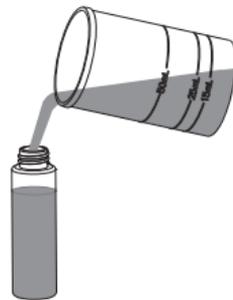
- The meter will carry out a self-test displaying a full set of figures. After the test, the LCD will change to the measurement mode.



- When the LCD displays "----" the meter is ready to measure.

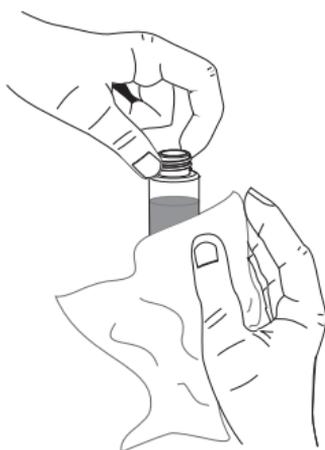


- Fill a clean cuvette up to one quarter inch (0.5 cm) from its rim with the thoroughly agitated sample.

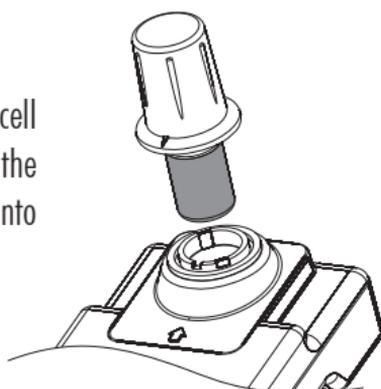


- Allow sufficient time for bubbles to escape before securing the cap.

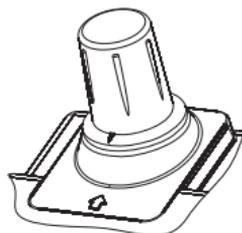
- Wipe the cuvette thoroughly with a lint-free tissue (HI 93703-70) before inserting into the measurement cell. The cuvette must be completely free of fingerprints and other oil or dirt, particularly in the area where the light goes through (approximately the bottom 2 cm/1 inch of the cuvette).



- Place the cuvette into the cell and check that the notch on the cap is positioned securely into the groove.



- The mark on the cuvette cap should point towards the LCD.



- Press the **READ/▲** key and the LCD will display a blinking "SIP" (Sampling in Process). The turbidity value will appear after approximately 25 seconds.



- Even though **HI 93703** covers a very wide range of turbidity values, for very accurate measurements of samples exceeding 40 FTU*, Standard Methods require dilution. In such cases, the correct amount of **HI 93703-0** or turbidity-free water to be added to the sample can be calculated as follows:

$$V_{os} = 3000 / T$$

where: V_{os} = volume of sample (mL) to be combined with **HI 93703-0** to obtain the final volume of 100 mL.
 T = **HI 93703** reading (exceeding 40 FTU*)

E.g.: HI 93703 reading = 200 FTU *
 $3000 / 200 = 15$ mL (V_{os})
 15 mL (V_{os}) + 85 mL (HI 93703-0) = 100 mL

At this point, take a sample of this solution and measure turbidity. The correct turbidity value of the original sample will be:

$$T_n \times 100 \text{ mL} / V_{os} = T_a$$

where: T_n = new **HI 93703** reading
 T_a = actual turbidity value of the original sample

E.g. If $T_n = 27$ FTU *
 $T_a = 27 \text{ FTU} * \times 100 \text{ mL} / 15 \text{ mL} = 180 \text{ FTU} *$

* 1 FTU = 1 NTU

HOW TO ENSURE ACCURATE MEASUREMENTS

- Each time the cuvette is used, tighten the cap to the same degree.
- Discard the sample soon after the reading is taken to avoid permanently clouding the glass.
- All glassware used to contain the standards and the samples should be maintained clean, washed with **HI 93703-50** cleaning solution and rinsed with **HI 93703-0** or turbidity-free water.
- Collect the samples in clean glass or plastic bottles, fit stoppers and perform the analysis quickly. If unavoidable, store the sample in a cool, dark place, but not for longer than 24 hours (the sample needs to be kept at room temperature prior to the analysis).
- To obtain a representative sample, gently, but thoroughly, mix it before samples are taken. Do not shake (to prevent air bubbles) and do not let the sample settle.
- It is recommended to monthly calibrate the meter with the supplied **HI 93703-10 @10 FTU*** standard or more frequently for greatest accuracy.
- Before inserting vials into the instrument, wipe them with **HI 93703-70** soft, lint-free tissue. Handle vials so that no fingerprints can get on the areas where light passes (approximately 2 cm/1 inch from the bottom of the vial).



If you experience any problems in taking measurements, please contact your dealer or the nearest Hanna Instruments Customer Service Department.

* 1 FTU = 1 NTU

SOURCES OF INTERFERENCE

- Presence of floating debris and coarse sediments which settle out rapidly will give false readings.
- The infrared light source used for **HI 93703** turbidity meter, according to ISO 7027 International Standard, can effectively minimize errors due to colored dissolved substances. This effect, named “true color”, is a common interference for most commercially available instruments operating in the range of visible light.
- Air bubbles and the effect of vibrations that disturb the surface of the sample will give false results.
- Dirty glassware could also affect readings along with scratched or edged vials.

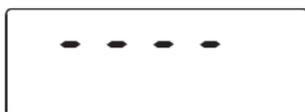
CALIBRATION

A monthly calibration is recommended. To check the date of last calibration, simply hold the **DATE/▶** key down for few seconds.

A more frequent check of the instrument is suggested by using the supplied standard solution.

CALIBRATION PROCEDURE

- Turn the meter on and wait for the display to show "----".



- Press the **CAL** key once, the "CAL" message will blink on the display for about 5 seconds.



- After the 5 seconds interval the current date is displayed for a few seconds.



- Press the **CAL** key or wait a few seconds to skip the date settings and enter calibration.



- Press **DATE/▶** key to set the date. Year info start blinking.



- Press **READ/▶** key to change the year value.



- Press **DATE/▶** key and the month value will blink.



- Press **READ/▶** key to change the month value.



- Press **DATE/▶** key and the day info will blink.



- Press **READ/▶** key to set the date value.



- Press **DATE/▶** key and time is displayed with hour item blinking.



- Press **READ/▶** key to change the hour value.



- Press **DATE/▶** key and the minute info will blink.



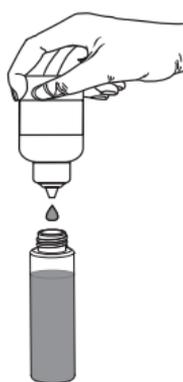
- Press **READ/▶** key to change the minutes.



- Press **DATE/▶** key and the meter will ask for the first calibration value.

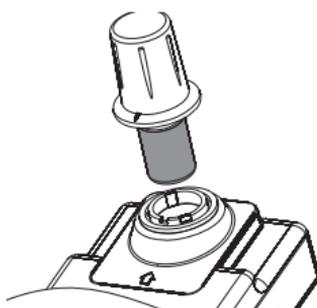


- Take the **HI 93703-0** bottle containing the ZERO FTU* Standard (or turbidity-free dilution water) and fill the measurement cuvette.



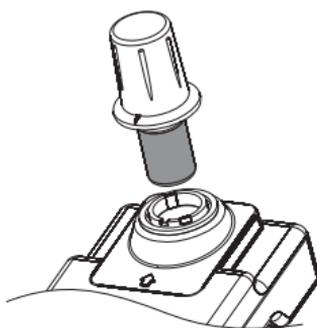
Note: In order to minimize any error introduced by the cuvette, it is recommended to use, during calibration, the same cuvette you are going to use to perform the measurement.

- Insert the cuvette with the **HI 93703-0 @ ZERO FTU*** standard solution (or turbidity-free dilution water) into the measurement cell and press the **CAL** key. A blinking "SIP" message indicates that the instrument is performing the measurement. After approximately 50 seconds the instrument will ask for the **HI 93703-10** standard solution @10 FTU* by displaying "10.0".



- Repeat the same procedure with **HI 93703-10 @10 FTU*** standard solution.

- Insert the cuvette with the **HI 93703-10 AMCO-AEPA-1** standard @10 FTU* into the measurement cell and press the **CAL** key again.



- After the second calibration point (10.00 FTU*) has been accepted, the meter will display “500”, asking for the 500 FTU* solution to be placed in the cuvette holder.



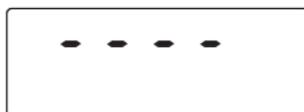
Note: At this point the user can exit the calibration mode and save the two-point calibration by pressing **READ/▲**.

To perform a three-point calibration, place the 500 FTU* standard solution in the cuvette holder.

- Press **CAL**: “SIP” and “CL” will start blinking.



- After approximately 30 seconds, the display will show “----”.



Now the meter is calibrated and ready for use.

Notes:

- If “ERR1” is displayed, the calibration data are maintained.
- Press **ON/ OFF** key to exit calibration in any moment. The display will show “----’ and meter enter measurement mode.

* 1 FTU = 1 NTU

HOW TO ENSURE ACCURATE CALIBRATION

The instructions listed below should be carefully followed during testing and during calibration:

- All glassware that comes into contact with standards should be maintained clean. Wash with **HI 93703-50** cleaning solution and rinse with **HI 93703-0** or turbidity free water.
- Rinse the vial twice with 5 ml of the liquid to be tested. This removes the effect of any previous liquid and any dust or foreign matter that may be present inside. Gently pour the liquid down the side of the vial to reduce air bubbles (no mixing is required when **HI 93703-0** and **HI 93703-10** AMCO-AEPA-1 standards are used).
- Before inserting the vial into the instrument, wipe it with **HI 93703-70** soft, lint-free tissue. Handle vials so that no fingerprints can get on the areas where light passes (approx. 2cm/1" from the bottom of the vial).



STANDARD SUSPENSION

Presently, there are only two recognized primary standards: AMCO-AEPA-1 and formazine.

HANNA instruments supplies **HI 93703** with the AMCO-AEPA-1 which has a much longer shelf life at all concentrations (approximately six months, if free from contamination). In addition, no special handling or disposal is required and a much higher stability of suspended particles has been observed.

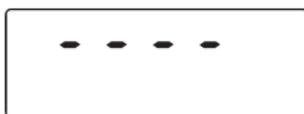
On the other hand, formazine is a very toxic substance, generated by a known carcinogen, its stability is poor (particles flocculate and settle quickly). Lower concentrations change value within a few days or hours after dilution from stock solutions.

The consistency of **HI 93703** readings by using both standards has been separately established by Advanced Polymer Systems and HANNA instruments.

Additional documentation about the formazine standard and more complex calibration procedures is available upon request.

VIEWING THE CALIBRATION DATE

- Turn the meter on and wait for the display to show "----".



- Press and hold the **DATE/▶** key and a "MM.DD" message appears for few seconds followed by the time.



BATTERY REPLACEMENT

All components have been selected to minimize current drain without compromising functionality.

In order to minimize the battery consumption, the meter is equipped with an auto-off function which switches the meter off after 5 minutes of non-use.

The power source are 4 alkaline batteries (1.5V AA) with an expected life of 60 hours, or 900 measurements.

To always grant accurate measurements, the batteries are monitored to ensure that readings are not taken when there is insufficient power.

A “**LO BAT**” indication will appear on the lower right corner of the display when the batteries are weak and require replacement. The instrument can still perform approx. 50 measurements.

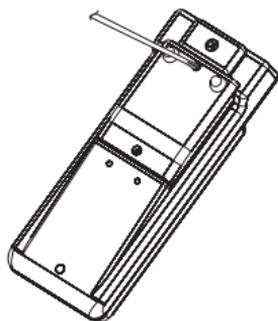


A “**-BA-**” indication will appear on the display when the batteries are too weak to perform reliable measurements. The message appears for a few seconds, and then the meter will automatically switch off. Batteries must be immediately replaced.

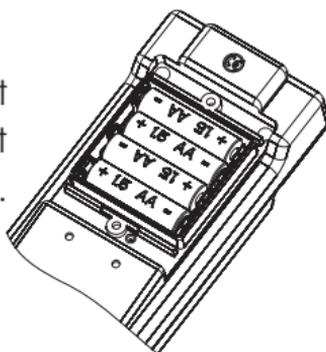


Battery replacement must only take place in a safe area and using the battery types specified in this instruction manual.

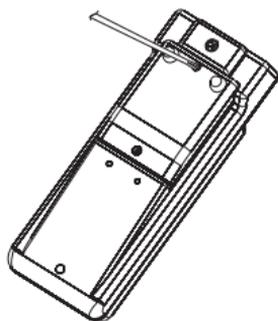
To install or replace the batteries, turn the unit off and unscrew the 2 screws located on the back of the meter.



Remove the battery cover and insert the new batteries in the compartment while paying attention to the polarity.

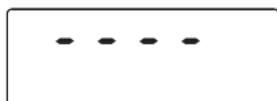


After the batteries have been installed, close the battery cover and tighten the 2 screws.



LCD AND ERROR MESSAGES

HI 93703 will display several different LCD messages to help the user throughout all operations.



The meter is in a ready state and measurement or calibration can be performed.



Calibration mode is active. If the **CAL** key is not pressed within 6 seconds, the meter will automatically switch to the measurement mode.



Calibration date setting mode is active.



0FTU* standard for calibration is required.



Calibration is in progress.



10FTU* standard for calibration is required.



Last calibration date (MM.DD).



“Sample In Progress”: measurement is being performed.

* 1 FTU = 1 NTU



Low battery: when this message appears, the instrument can still perform approx. 50 measurements.



Batteries are too weak to ensure reliable measurements. This message appears for a few seconds, then the meter will automatically switch off. Batteries must be replaced immediately.

ACCESSORIES

- HI 731318 Tissue for wiping cuvettes (4 pcs.)
- HI 731321 Spare glass cuvette (4 pcs.)
- HI 731313 Maintenance kit: rugged carrying case including HI 93703-0, HI 93703-10 and HI 93703-05 calibration standards, 1 tissue for wiping cuvettes and 2 cuvettes
- HI 93703-0 AMCO-AEPA-1 @0 FTU* calibration solution, 30 mL
- HI 93703-05 AMCO-AEPA-1 @500 FTU* calibration solution, 30 mL
- HI 93703-10 AMCO-AEPA-1 @10 FTU* calibration solution, 30 mL
- HI 93703-50 Cuvette cleaning solution, 230 mL

WARRANTY

HI 93703 is guaranteed for two years against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. This warranty is limited to repair or replacement free of charge. Damage due to accidents, misuse, tampering or lack of prescribed maintenance is not covered.

If service is required, contact the dealer from whom you purchased the instrument. If under warranty, report the model number, date of purchase, serial number and the nature of the problem. If the repair is not covered by the warranty, you will be notified of the charges incurred. If the instrument is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization number from the Technical Service department and then send it with shipping costs prepaid. When shipping any instrument, make sure it is properly packed for complete protection.

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* 1 FTU = 1 NTU

Recommendations for Users

Before using this product, make sure that it is entirely suitable for the environment in which it is used.

Operation of this instrument in residential area could cause unacceptable interferences to radio and TV equipments, requiring the operator to take all necessary steps to correct interferences.

Any variation introduced by the user to the supplied equipment may degrade the instrument's EMC performance.

To avoid electrical shock, do not use this instrument when voltages at the measurement surface exceed 24 Vac or 60 Vdc.

To avoid damages or burns, do not perform any measurement in microwave ovens.

Hanna Instruments reserves the right to modify the design, construction or appearance of its products without advance notice.



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