

**Instruction Manual**

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**HI 93703**

**Portable Microprocessor  
Turbidity Meter**



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 all the necessary information for the correct use of the instrument. If you need additional technical information, do not hesitate to e-mail us at **tech@hannainst.com**.

This instrument is in compliance with the **CE** directives.

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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.

**HI 93703** is supplied complete with:

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

**HI 93703C** is a complete kit supplied with:

- 2 glass cuvetts with caps
- Batteries (4 x 1.5V AA) and instructions
- **HI 93703-0 & HI 93703-10** cal. solutions
- **HI 93703-50** cleaning solution
- Tissue for wiping cuvetts
- 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 cuvet 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

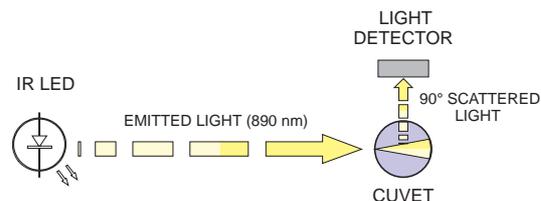
## PRINCIPLE OF OPERATION

**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.

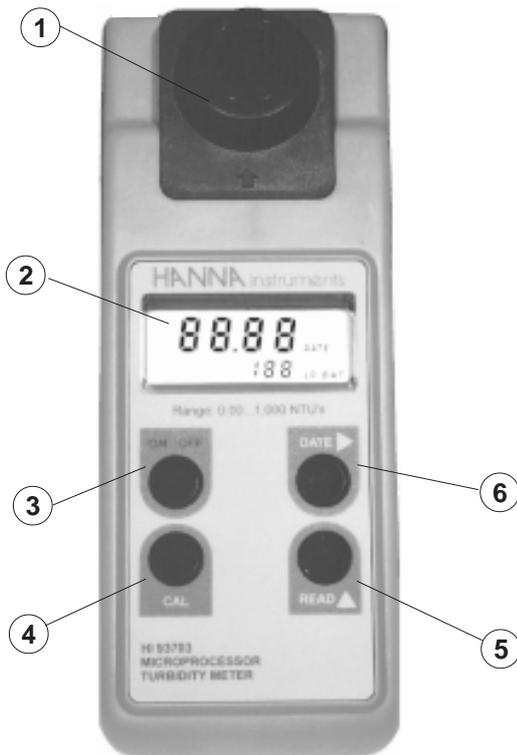


As noted above, FTU unit is equal to the NTU unit. However, there are other known measurement units for turbidity: Jackson Turbidity Unit (JTU) based on the old method of Jackson's candle, and Silica Unit (mg/L of SiO<sub>2</sub>). For your reference the conversion table between these measurement units is shown below:

|                         | JTU   | FTU/NTU | SiO <sub>2</sub> (mg/L) |
|-------------------------|-------|---------|-------------------------|
| JTU                     | 1     | 19      | 2.5                     |
| FTU/NTU                 | 0.053 | 1       | 0.13                    |
| SiO <sub>2</sub> (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

|                              |   |
|------------------------------|---|
| <b>Range</b>                 | 0.00 to 50.00 FTU *<br>50 to 1000 FTU *               |
| <b>Resolution</b>            | 0.01 and 1 FTU *                                      |
| <b>Accuracy</b>              | ±0.5 FTU* or<br>±5% of reading (whichever is greater) |
| <b>Typical EMC Deviation</b> | ±2% FS  |
| <b>Calibration</b>           | 3 point (0, 10 and 500 FTU*)                          |
| <b>Light Source</b>          | Infrared LED  |
| <b>Light Source Life</b>     | Life of the instrument                                |
| <b>Light Detector</b>        | Silicon Photocell                                     |
| <b>Battery Type</b>          | 4 x 1.5V AA alkaline                                  |
| <b>Battery Life</b>          | Approx. 60 hours of use<br>or 900 measurements        |
| <b>Auto-off</b>              | After 5 minutes of non-use                            |
| <b>Environment</b>           | 0 to 50°C (32 to 122°F);<br>RH max 95% non-condensing |
| <b>Dimensions</b>            | 220 x 82 x 66 mm<br>(8.7 x 3.2 x 2.6")                |
| <b>Weight</b>                | 510 g (1.1 lb.)                                       |

\* 1 FTU = 1 NTU

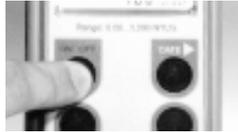
## OPERATIONAL GUIDE

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.

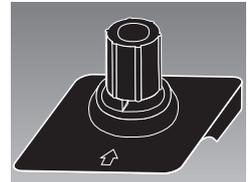
- Wipe the cuvette thoroughly with a lint-free tissue (HI 93703-70) before inserting into the measurement cell. The cuvette must be completely free of fingerprints and other oil or dirt, particularly in the area where the light goes through (approximately the bottom 2 cm/1 inch of the cuvette).



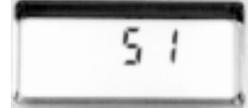
- Place the cuvette into the cell and check that the notch on the cap is positioned securely into the groove.



- 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 **HI93703** 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:

$$\text{Vos} = 3000 / T$$

where: Vos = volume of sample (mL) to be combined with HI 93703-0 to obtain the final volume of 100 mL.

$$T = \text{HI 93703 reading (exceeding 40 FTU*)}$$

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

At this point, take a sample of this solution and measure turbidity.

The correct turbidity value of the original sample will be:

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

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

\* 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 6 seconds, then the calibration mode stops.
- While the "CAL" message is still blinking, press CAL again. The instrument is now in the calibration mode and a "CL" will appear on the lower part of the display. The date of calibration can be edited now by simply pressing the DATE/⇒ key. To scroll to the correct number press the READ/↑ key. The default blinking parameter is the month, on the left hand of the display (MM.DD).



- To confirm the displayed data values and to go to the next step, press the CAL key once. A blinking "ZERO" message will appear.



- 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 @ 10FTU\* 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.



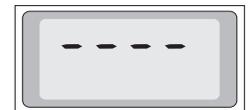
- After the second calibration point (10.00 FTU\*) has been accepted, the meter will display "500", asking for the 500 FTU\* solution to be placed in the cuvet holder.



**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 cuvet 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.

**Note:** If "ERR1" is displayed, the calibration data are maintained

\* 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. 2 cm/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.

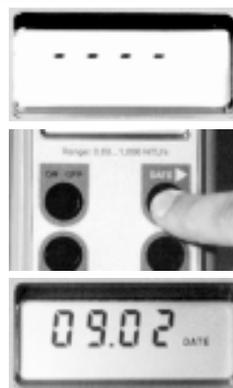
On the other hand, formazine is a very toxic substance, generated by a known carcinogen, its stability is poor (particles flocculate and settle quickly). Lower concentrations change value within a few days or hours after dilution from stock solutions.

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 while the key is held.



**Note:** The displayed date is the date that was input by the user at the beginning of the last calibration.

## 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.

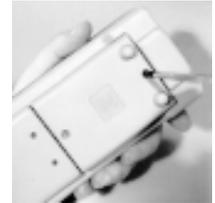


A "**-BA-**" indication will appear on the display when the batteries are too weak to perform reliable measurements. The message appears for a few seconds, and then the meter will automatically switch off. Batteries must be immediately replaced.



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

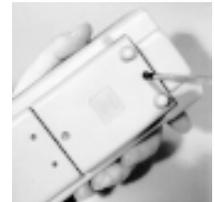
To install or replace the batteries, turn the unit off and unscrew the 2 screws located on the back of the meter.



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.



0 FTU\* standard for calibration is required.



Calibration is in progress.



10 FTU\* standard for calibration is required.



Last calibration date (MM.DD).



"Sample In Progress": measurement is being performed.



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.

\* 1 FTU = 1 NTU

\* 1 FTU = 1 NTU

## ACCESSORIES

|                    |   |
|--------------------|---|
| <b>HI 731318</b>   | Tissue for wiping cuvetts (4 pcs)   |
| <b>HI 731321</b>   | Spare glass cuvet (4 pcs)   |
| <b>HI 731313</b>   | Maintenance kit: rugged carrying case including <b>HI 93703-0</b> and <b>HI 93703-10</b> calibration solutions, <b>HI 93703-50</b> cuvet cleaning solution, 1 tissue for wiping cuvetts and 2 cuvetts |
| <b>HI 93703-0</b>  | AMCO-AEPA-1 @0 FTU* calibration solution, 30 mL   |
| <b>HI 93703-05</b> | AMCO-AEPA-1 @500 FTU* calibration solution, 30 mL   |
| <b>HI 93703-10</b> | AMCO-AEPA-1 @10 FTU* calibration solution, 30 mL  |
| <b>HI 93703-50</b> | Cuvet cleaning solution, 230 mL   |

## WARRANTY

All Hanna Instruments **meters are warranted 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. Damages due to accidents, misuse, tampering or lack of prescribed maintenance are 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 failure.

First obtain a Returned Goods Authorization number from the Customer Service department, then return the instrument with the Authorization # included along with shipment costs prepaid. If the repair is not covered by the warranty, you will be notified of the charges. When shipping any instrument, make sure it is properly packaged for complete protection.

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\* 1 FTU = 1 NTU

## CE DECLARATION OF CONFORMITY

|   |   |
|---|---|
|   |   |
|    |   |
| <b>DECLARATION OF CONFORMITY</b>  |   |
| We  |   |
| Hanna Instruments Italia Srl<br>via E. Fermi, 10<br>35030 Sarmeola di Rubano - PD<br>ITALY  |   |
| herewith certify that the turbidity meter   |   |
| <b>HI 93703</b>   |   |
| has been tested and found to be in compliance with EMC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC according to the following applicable normatives: |   |
| <b>EN 50082-1:</b> Electromagnetic Compatibility - Generic Immunity Standard<br><b>IEC 801-2</b> Electrostatic Discharge<br><b>IEC 801-3</b> RF Radiated          |   |
| <b>EN 50081-1:</b> Electromagnetic Compatibility - Generic Emission Standard<br><b>EN 55022</b> Radiated, Class B   |   |
| <b>EN61010-1:</b> Safety requirements for electrical equipment for measurement, control and laboratory use  |   |
| Date of Issue: <u>27-11-1998</u>  | <br>P. Cesa - Technical Director<br>On behalf of<br>Hanna Instruments S.r.l. |

### 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 and appearance of its products without advance notice.

## SALES & TECHNICAL SERVICE CONTACTS

### **Australia:**

Tel. (03) 9769.0666 • Fax (03) 9769.0699

### **China:**

Tel. (10) 88570068 • Fax (10) 88570060

### **Egypt:**

Tel. & Fax (02) 2758.683

### **Germany:**

Tel. (07851) 9129-0 • Fax (07851) 9129-99

### **Greece:**

Tel. (210) 823.5192 • Fax (210) 884.0210

### **Indonesia:**

Tel. (21) 4584.2941 • Fax (21) 4584.2942

### **Japan:**

Tel. (03) 3258.9565 • Fax (03) 3258.9567

### **Korea:**

Tel. (02) 2278.5147 • Fax (02) 2264.1729

### **Malaysia:**

Tel. (603) 5638.9940 • Fax (603) 5638.9829

### **Singapore:**

Tel. 6296.7118 • Fax 6291.6906

### **South Africa:**

Tel. (011) 615.6076 • Fax (011) 615.8582

### **Taiwan:**

Tel. 886.2.2739.3014 • Fax 886.2.2739.2983

### **Thailand:**

Tel. 66.2619.0708 • Fax 66.2619.0061

### **United Kingdom:**

Tel. (01525) 850.855 • Fax (01525) 853.668

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For e-mail contacts and complete list of Sales and Technical offices, please see [www.hannainst.com](http://www.hannainst.com)