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MAN93703-11R1 08/05

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## Instruction Manual

# HI 93703-11

## Portable Logging Turbidity Meter with RS232



**HANNA**<sup>®</sup>  
instruments  
[www.hannainst.com](http://www.hannainst.com)

Dear Customer,

Thank you for choosing a Hanna product.

Please read this instruction manual carefully before using the instrument.

This manual will provide you with 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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## 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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### 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.

## 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
<b>HI 92000</b>	Windows® compatible software
<b>HI 920011</b>	Serial cable for PC connection (5 to 9-pin)

\* 1 FTU = 1 NTU

## 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 93703-11** is supplied complete with:

- Glass cuvet with cap
- Batteries (4 x 1.5V AA)
- Instruction manual

**Note:** Save all packing material until you are sure that the instrument functions correctly. Any defective item must be returned in its original packaging with the supplied accessories.

## GENERAL DESCRIPTION

With **HI 93703-11** turbidity measurements can be performed with high precision in the field as well as in the laboratory. **HI 93703-11** turbidity meter is a microprocessor-based instrument used to determine the turbidity of water and waste-water. The meter covers a 0-1000 FTU range in two scales: 0.00 to 50.00 FTU and 50 to 1000 FTU. The autoranging feature of the instrument sets the appropriate range for the measurement.

**HI 93703-11** also includes a real-time clock and log-on-demand capability. The PC communication is made through a serial port of your computer and the 5-pin socket on the meter.

**Note:** **HI 93703-11** has been designed according to the ISO 7027 International Standard, consequently the turbidity measurement units are expressed in FTU (Formazine Turbidity Unit). FTU is identical to the other internationally recognized unit: NTU (Nephelometric Turbidity Unit).

The meter is housed in 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 5-minutes of non-use. This feature is disabled when the meter is connected to the serial port of the computer.

All operations can be carried out with only five keys and troubleshooting functions can be performed with displayed error code guides.

A 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.

Two or three point calibration (0, 10, 500 FTU\*) can be easily performed using available standards, and the last calibration date is automatically stored for future retrieval.

**We have chosen 10 FTU \* as the standard calibration point because it best fits the water turbidity measurements in different applications, from drinking water to wastewater treatment.**

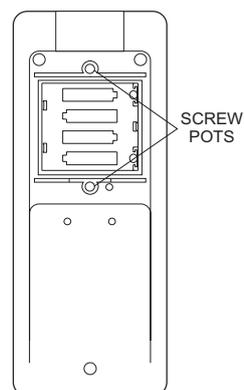
HANNA instruments® uses the primary standard AMCO-AEPA-1 to avoid all formazine-related problems. Formazine is a toxic, unstable substance, which requires particular care: its standards have to be prepared only a few minutes before performing the calibration, and cannot be reused because of their short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

**HI 93703-11** can be used with both standards.

\* 1 FTU = 1 NTU

Battery replacement must only take place in a safe area and using 1.5V AA alkaline batteries.

To install or replace the batteries, turn the unit off and remove the battery compartment cover on the rear of the meter.



Insert the new batteries while paying attention to the polarity.

After the batteries have been installed, close the battery cover and make sure the gasket is in place before tightening the 2 screws, to ensure a watertight seal.

## PC CONNECTION

To communicate with the instrument through the **HI 92000** software, use the **HI 920011** cable (optional) to connect a serial port of your computer to the 5 pin connector of the meter. When connected the meter will maintain full functionality, being able to perform a data transfer while the meter is being operated.

### Notes:

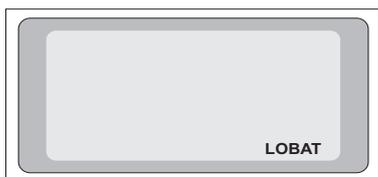
- Serial communication is not allowed when the meter is being calibrated.
- The auto shut-off feature is also disabled when the meter is connected to a computer.

## 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-shut off function which switches the meter off after 5 minutes of non-use.

The four 1.5V batteries guarantee 60 hours of working life (or 900 measurements).

In order to obtain accurate measurements, the battery level is monitored every time the meter is switched on.



In addition, a "LOBAT" indication will appear on the lower right corner of the display when the batteries are weak (<10%). All four batteries need to be replaced.

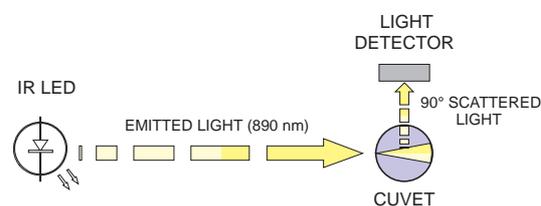


When the batteries are too weak to ensure reliable measurements, the message 0% LO BAT appears for a few seconds, and then the meter will automatically switch itself off. Replace the batteries immediately.

## PRINCIPLE OF OPERATION

HI 93703-11 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.



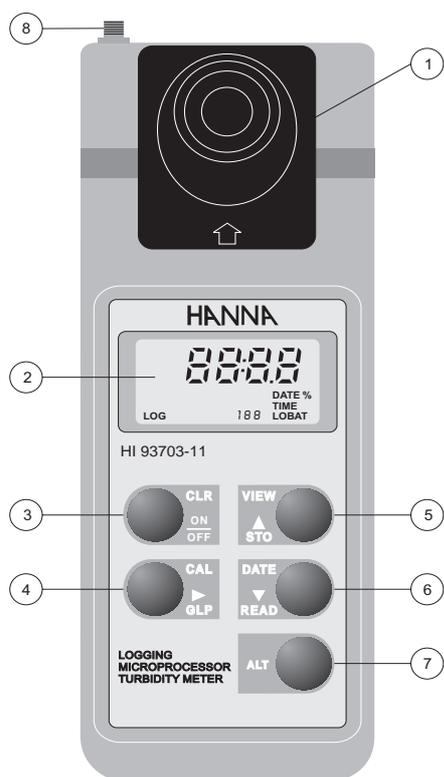
A sensor, positioned at 90° with respect to the direction of light, detects the amount of light scattered by the undissolved particles present in the sample. The microprocessor converts such readings into FTU\* values.

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/CLR key, to turn the meter ON and OFF, and to clear log memory
- 4) GLP/CAL key, to display last calibration date & time, and to enter calibration mode
- 5) STO/VIEW key, to store sample after reading, and to view log memory
- 6) READ/DATE key, to perform measurements, and to display (toggle) current date/time
- 7) ALT key, to activate the second functions (second function keys in orange)
- 8) RS232 connector (5 pin)

- All glassware that comes into contact with standards should be maintained clean. Wash with the **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 objects 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 **HI93703-70** or a soft, lint-free tissue. Handle vials so that no fingerprints can get on the areas where light passes (approx. bottom 2 cm/1").

### **STANDARD SUSPENSION**

Presently, there are only two recognized primary standards: AMCO-AEPA-1 and formazine. Hanna supplies **HI 93703-11** with the AMCO-AEPA-1 which has a much longer shelf life at all concentrations (approx. 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.

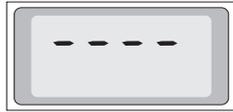
On the other hand, formazine is a toxic substance, generated by a known carcinogen, with poor stability (particles flocculate and settle quickly). Lower concentrations change value within a few days or hours after dilution.

The consistency of **HI 93703-11** 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.

\* 1 FTU = 1 NTU

- After approximately 30 seconds the LCD will display "----".

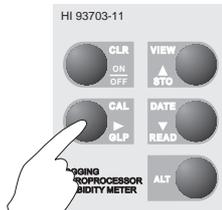


Now the instrument is calibrated and ready for use.

NOTE: If "ERR1" is displayed, the calibration data is maintained.

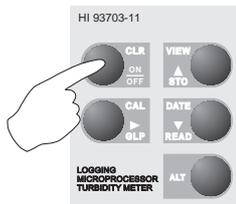
### **VIEWING CALIBRATION DATE**

To display the last calibration time and date, press the GLP button to toggle through the date and time. If the display shows "FS", the instrument has factory calibration settings loaded and no date will be displayed.



### **VIEWING FIRMWARE VERSION**

To display the firmware version press and hold the ON/OFF key for approx. ten seconds (when turning the meter on).



The firmware version will be displayed



### **ENSURE ACCURATE CALIBRATION**

The procedure below should be carefully followed during testing and calibration:

## SPECIFICATIONS

<b>Range</b>	0.00 to 50.00 FTU* 50 to 1000 FTU*
<b>Resolution</b>	0.01 and 1 FTU*
<b>Accuracy</b>	±0.5 FTU* or ±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>Data Logging</b>	199 measurements, on-demand
<b>PC Connection</b>	Through serial port, using <b>HI 920011</b> connection cable and <b>HI 92000</b> Windows® compatible software
<b>Battery Type</b>	4 x 1.5V AA alkaline batteries
<b>Battery Life</b>	Approx. 60 hours of continuous use or 900 measurements
<b>Auto-off</b>	After 5 minutes of non-use
<b>Environment</b>	0 to 50°C (32 to 122°F); RH max 95% non-condensing
<b>Dimensions</b>	220 x 82 x 66 mm (8.7 x 3.2 x 2.6")
<b>Weight</b>	510 g (1.1 lb.)

\* 1 FTU = 1 NTU

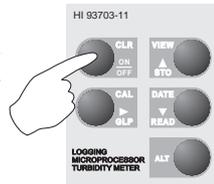
## OPERATIONAL GUIDE

To prepare the instrument for taking measurements, first install the batteries (see Battery Replacement section on page 20) and then turn the instrument on.

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

### MEASUREMENT PROCEDURE:

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



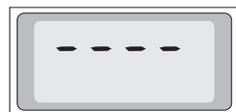
- The meter will carry out a self-test displaying a full set of figures.



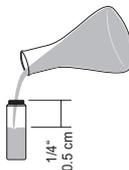
- The meter will carry out a battery test showing in percentage the battery life left.



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



- Fill a clean cuvet 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.

**Note:** do not overtighten the cap.

- If "ERR1" appears on the LCD, please check the standard solution.



- After approximately 30 seconds the meter will display 10.00, prompting the user to place the 10.00 FTU standard solution in the cuvet holder.



- Place the 10.00 FTU standard in the holder press CAL, SIP and CL will start blinking

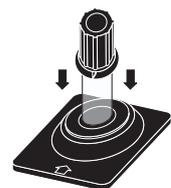


- After approximately 30 seconds the meter will display 500, asking the user to place the 500 FTU buffer solution in the cuvet holder.



**NOTE:** At this point the user can save the two point calibration setup by pressing ALT & CAL buttons, leaving the calibration mode.

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



- Press CAL, SIP and CL will start blinking



## CALIBRATION

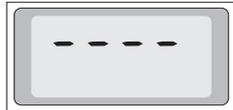
To check the date of last calibration, simply press the GLP/CAL key. Press again to toggle between date and time.

To make sure that the meter is calibrated, take a measure of a standard solution.

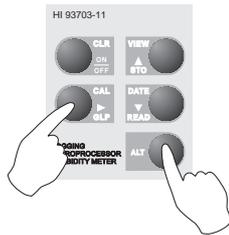
The instrument can be calibrated at two or three points and a monthly calibration is recommended.

### CALIBRATION PROCEDURE

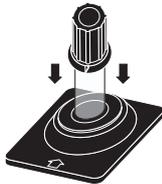
- Turn the meter on and wait for the display to show "----".



- Press the ALT & CAL buttons together. The "CAL" message will blink on the display 3 times. The meter then enters the calibration mode, displaying "0.00 cl" and prompting the user to insert the 0.00 FTU standard.



- Place the 0.00 FTU standard in the cuvet holder

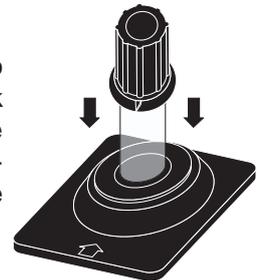


- Press CAL, SIP and CL will start blinking

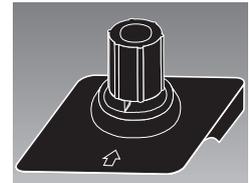


**NOTE:** Wipe the cuvet thoroughly with a lint-free tissue (HI 93703-70) before inserting into the measurement cell. The cuvet must be completely free of fingerprints and other oil or dirt, particularly in the area where the light goes through (approx. the bottom 2 cm/1").

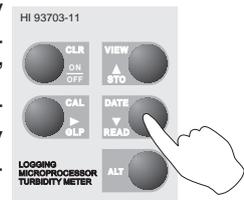
- Place the cuvet into the cell and check that the notch on the cap is positioned securely into the groove.



- The mark on the cuvet 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 approx. 20 seconds.



- Even though **HI93703-11** 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 **HI93703-0** 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 its 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

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

NOTE: Any sample taken above 1000 FTU will show out of range by blinking "1000".

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 calibrate the meter with the supplied **HI93703-10** @10 FTU\* standard at least once a month or more frequently for greater accuracy.
- Before inserting vials into the instrument, wipe them with **HI93703-70** or a soft, lint-free tissue. Handle vials so that no fingerprints get on the areas where light passes (approx. the bottom 2 cm/1 inch).

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

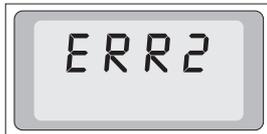
### **SOURCES OF INTERFERENCE**

- Presence of floating debris and coarse sediments which settle out rapidly will give false readings.
- The infrared light source used for **HI 93703-11** turbidity meter, complies with the ISO 7027 International Standard and can effectively minimize any errors due to colored dissolved substances. This effect, called "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 may give false results and should be avoided.
- Dirty glassware could also affect readings along with scratched or dented vials.

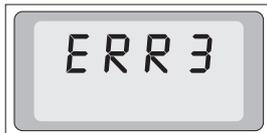
\* 1 FTU = 1 NTU

\* 1 FTU = 1 NTU

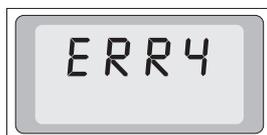
- Real Time Clock error \*



- EEPROM error\*



- Internal communication error\*



- Internal Bus error\*



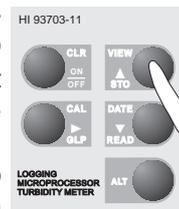
\* Contact the HANNA office nearest to you.

### **ENSURE ACCURATE MEASUREMENTS**

- Each time the cuvet 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 the **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 necessary, store the sample in a cool, dark place, for up to a maximum of 24

### **LOG-ON-DEMAND:**

- After taking a reading, press the STO button. The last sample read will be stored in memory. The display will also show on the bottom right corner the reference number of the stored sample.



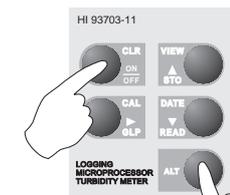
NOTE: When the maximum number of samples has been reached (199), the LCD display will show "FULL". This is a warning that you will be overwriting the oldest sample recorded.



To store the current sample, press the STO button again and this will overwrite the oldest sample in the memory. All samples are shifted (reference numbers reduced by one). Sample number one remains the oldest sample.

### **CLEARING LOGGED DATA:**

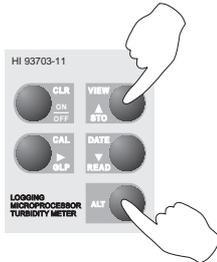
- Press the ALT & CLR buttons together. The display will show "CLR" for confirmation. Press ALT & CLR again to clear memory. To abort the operation, press any button.



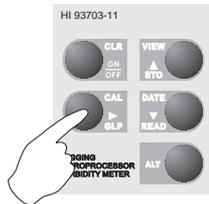
**ALL SAMPLES PREVIOUSLY STORED WILL BE ERASED FROM MEMORY!**

**VIEWING LOGGED DATA:**

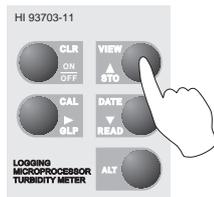
- Press the ALT & VIEW buttons together. The last sample will be displayed.



- Press the right arrow to scroll between turbidity value, date and time of the sample.



- Press the UP/DOWN arrows to view the samples and use the right arrow to scroll the date and time .



- Press ALT & VIEW again to exit this mode.

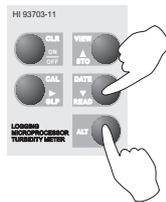
**VIEWING AND SETTING DATE AND TIME:**

**VIEWING:**

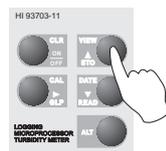
- Press ALT & DATE to toggle between date and time.

**SETTING:**

- Press and hold ALT & DATE for 3-4 seconds.

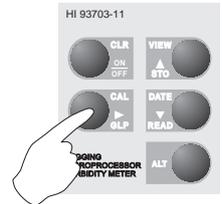


- Press UP/DOWN to correct and set the year.
- Press right arrow to scroll to

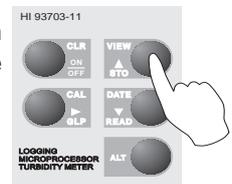


month and day, use UP/ DOWN to set.

- Press right arrow again to scroll to time, use UP/ DOWN to set.



- Press right arrow again to save and exit date and time setup.



**Note: Press ALT & DATE to leave this mode without saving.**

**ERROR CODES:**

Every time the meter is switched on, the Real Time Clock and EEPROM are tested, and if an error is found the corresponding error code will be displayed.

The list of error codes is as follows:

- NO cover error  
(check cuvet position)



- Calibration error  
(check calibration standard value)

