HI93703-11

Portable Logging Turbidity Meter with RS232

INSTRUCTION MANUAL

HANNA instruments

Dear Customer,

Thank you for choosing a Hanna Instruments product. Please read this instruction manual carefully before using the meter. For more information about Hanna Instruments and our products, visit www.hannainst.com or e-mail us at sales@hannainst.com.
For technical support, contact your local Hanna Instruments Office or e-mail us at tech@hannainst.com.

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1. PRELIMINARY EXAMINATION

Remove the meter from the packing material and examine it carefully. For further assistance, please contact your local Hanna Instruments Office or email us at tech@hannainst.com.

Each HI93703-11 is delivered in rugged carrying case and is supplied with:

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

Note: *Ensure that the meter functions correctly and save all packing material. Items that need to be returned must be returned in their original packing material with the supplied accessories.*

2. GENERAL DESCRIPTION

With HI93703-11 turbidity measurements can be performed with high precision in the field as well as in the laboratory. HI93703-11 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.

HI93703-11 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:*** *HI93703-11 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 cuvette 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 retrivial.

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.

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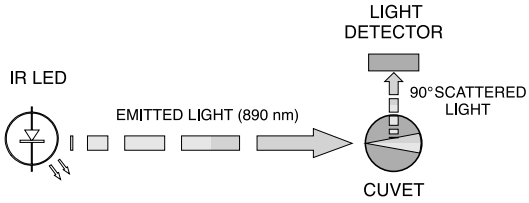
* 1 FTU = 1 NTU

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.

HI93703-11 can be used with both standards.

3. PRINCIPLE OF OPERATION

HI93703-11 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.



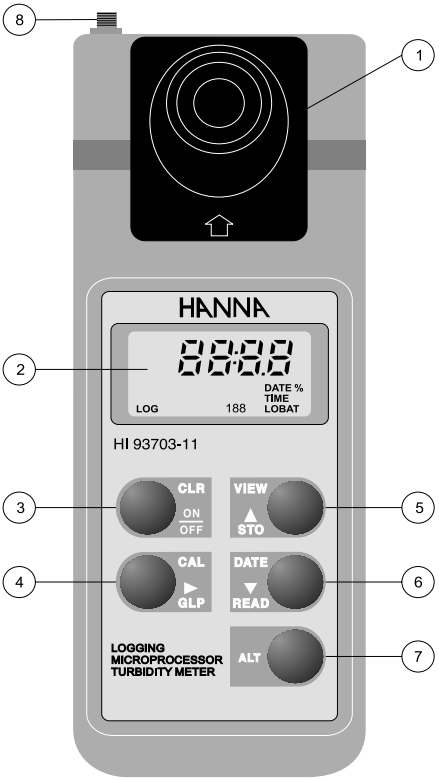
A sensor, positioned at 90° with respect to the direction of light, detects the amount of light scattered by the undissolved particles present in the sample. The microprocessor converts such readings into FTU* values.

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 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

4. 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)

5. SPECIFICATIONS

Range	0.00 to 50.00 FTU* 50 to 1000 FTU*
Resolution	0.01 and 1 FTU*
Accuracy	±0.5 FTU* or ±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
Data Logging	199 measurements, on-demand
PC Connection	Through serial port, using HI920011 connection cable and HI92000 Windows® compatible software
Battery Type	4 x 1.5V AA alkaline batteries
Battery Life	Approx. 60 hours of continuous use or 900 measurements
Auto-off	After 5 minutes of non-use
Environment	0 to 50°C (32 to 122°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

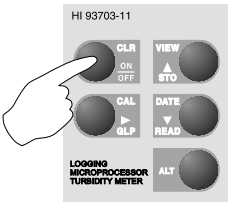
6. OPERATIONAL GUIDE

To prepare the instrument for taking measurements, first install the batteries (see Battery Replacement section) 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.

6.1. MEASUREMENT PROCEDURE

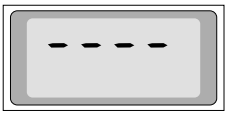
- Turn the meter on by pressing the ON/OFF key.



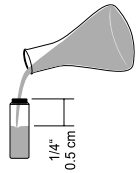
- The meter will carry out a self-test displaying a full set of figures.

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

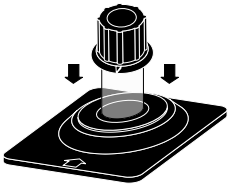


- Allow sufficient time for bubbles to escape before securing the cap.

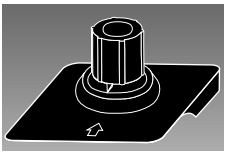
  Note: *Do not overtighten the cap.*

  Note: *Wipe the cuvette thoroughly with a lint-free tissue (HI93703-70) 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 (approx. the bottom 2 cm/1").*

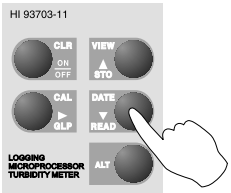
- Place the cuvette into the cell and check that the notch on the cap is positioned securely into the groove.

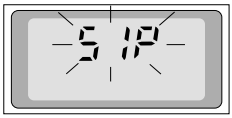


- The mark on the cuvette cap should point towards the LCD.



- Press the READ key and the LCD will display a blinking "SIP" (Sampling in Process). The turbidity value will appear after approximately 20 seconds.





Even though HI93703-11 covers a very wide range of turbidity values, for very accurate measurements of samples exceeding 40FTU*, 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:

$$Vos = 3000 / T$$

where:
Vos = volume of sample (mL) to be combined with HI93703-0 to obtain the final volume of 100 mL.
T = HI93703 reading (exceeding 40FTU*)

E.g.: HI93703 reading = 200 FTU *
3000 / 200 = 15 mL (Vos)
15 mL (Vos) + 85 mL (HI93703-0) = 100 mL

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

$$T_n \times 100\ mL / Vos = T_a$$

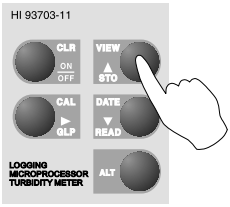
where:
T_n = new HI93703 reading
T_a = actual turbidity value of the original sample

E.g. If T_n = 27 FTU *
T_a = 27 FTU* x 100 mL / 15 mL = 180 FTU*

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

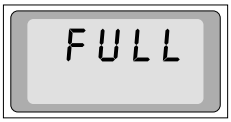
6.2. LOG-ON-DEMAND

- 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.



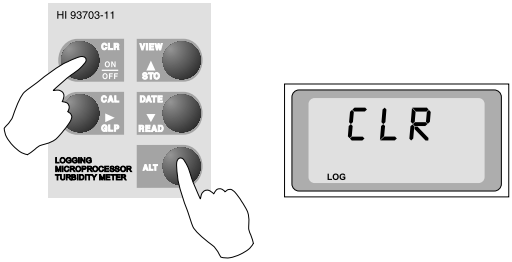
* 1 FTU = 1 NTU

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.*



6.3. CLEARING LOGGED DATA

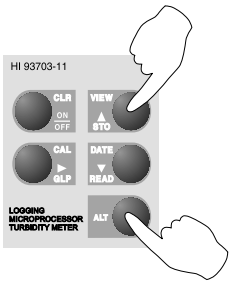
- Press the ALT & CLR buttons together. The display will show "CLR" for confirmation. Press ALT & CLR again to clear memory. To abort the operation, press any button.



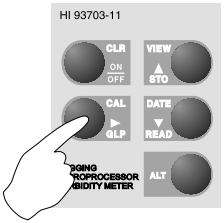
All samples previously stored will be erased from memory!

6.4. VIEWING LOGGED DATA

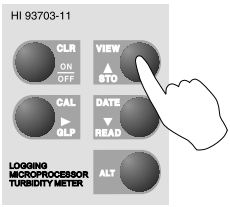
- Press the ALT & VIEW buttons together. The last sample will be displayed.



- 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 .

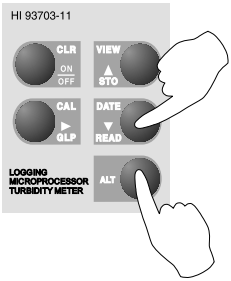


- Press ALT & VIEW again to exit this mode.

6.5. VIEWING & SETTING DATE & TIME

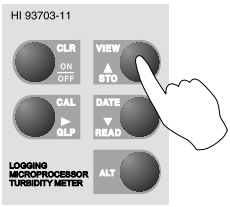
Viewing

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

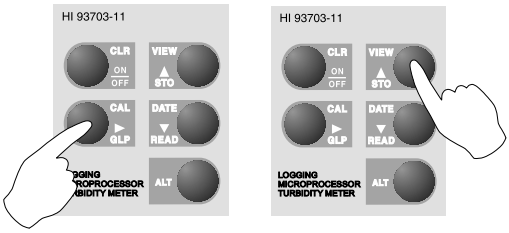


Setting

- 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.*

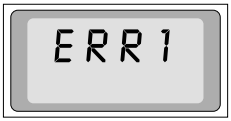
6.6. ERROR CODES

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.

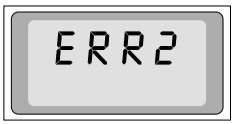
The list of error codes is as follows:

- NO cover error (check cuvette position)

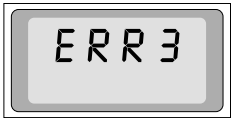
- Calibration error (check calibration standard value)



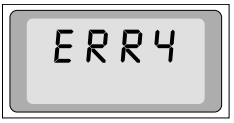
- Real Time Clock error*



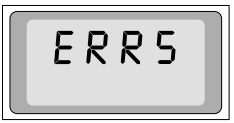
- EEPROM error*



- Internal communication error*



- Internal Bus error*



* Contact the Hanna Instruments office nearest to you.

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 the HI93703-50 cleaning solution and rinsed with HI93703-0 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 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 nearest Hanna Customer Service Center.

* 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 HI93703-11 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.

7. CALIBRATION

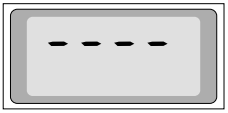
To check the date of last calibration, simply press the GLP/CAL key. Press again to toggle between date and time.

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

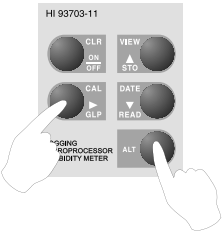
The instrument can be calibrated at two or three points and a monthly calibration is recommended.

7.1. CALIBRATION PROCEDURE

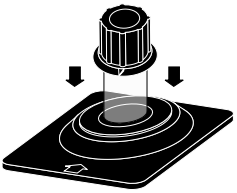
- Turn the meter on and wait for the display to show "----".



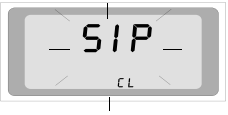
- Press the ALT & CAL buttons together. The "CAL" message will blink on the display 3 times. The meter then enters the calibration mode, displaying "0.00 cl" and prompting the user to insert the 0.00 FTU standard.



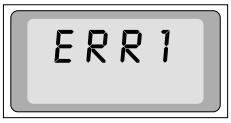
- Place the 0.00 FTU standard in the cuvette holder.



- Press CAL, SIP and CL will start blinking.

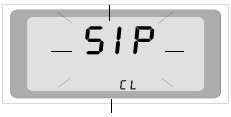


- If "ERR1" appearson the LCD, please check the standard solution.



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

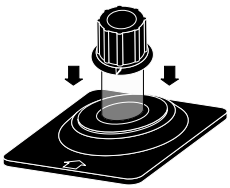
- Place the 10.00 FTU standard in the holder press CAL, SIP and CL will start blinking.



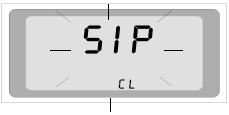
- After approximately 30 seconds the meter will display 500, asking the user to place the 500 FTU buffer solution in the cuvette 500 holder.

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

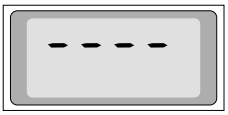
- To perform a three point calibration, place the 500 FTU standard solution in the cuvette holder.



- Press CAL, SIP and CL will start blinking.



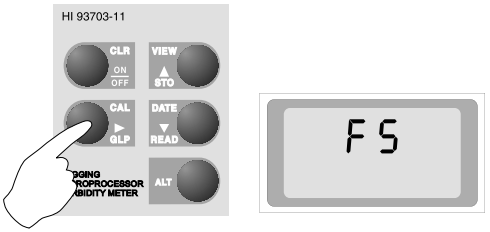
- After approximately 30 seconds the LCD will display "----". Now the instrument is calibrated and ready for use.



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

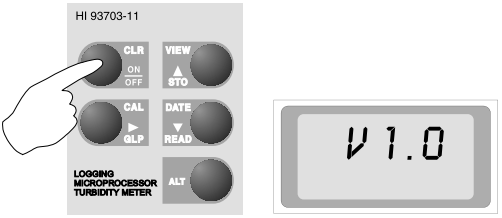
7.2. VIEWING CALIBRATION DATE

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.



7.3. 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.



7.4. ENSURE ACCURATE CALIBRATION

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

- All glassware that comes into contact with standards should be maintained clean. Wash with the HI93703-50 cleaning solution and rinse with HI93703-0 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 HI93703-0 and HI93703-10 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 2cm/1").

7.5. STANDARD SUSPENSION

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

Hanna Instruments supplies HI93703-11 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 HI93703-11 readings by using both standards has been separately established by Advanced Polymer Systems and Hanna Instruments.

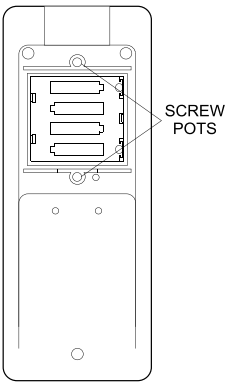
Additional documentation about the formazine standard and more complex calibration procedures is available upon request.

8. 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 "LO BAT" 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.
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.



9. PC CONNECTION

To communicate with the instrument through the HI92000 software, use the HI920011 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.*

To allow our users access to the latest version of Hanna Instruments PC compatible software, we made the products available for download at **http://software.hannainst.com**. Select the product code and click **Download Now**. After download is complete, use the **setup.exe** file to install the software.

10. ACCESSORIES

HI731318	Tissue for wiping cuvettes (4 pcs)
HI731321	Spare glass cuvette (4 pcs)
HI731313	Maintenance kit: rugged carrying case including HI93703-0 and HI93703-10 calibration solutions, HI93703-50 cuvette cleaning solution, 1 tissue for wiping cuvettes and 2 cuvettes
HI93703-0	AMCO-AEPA-1 @0 FTU* calibration solution, 30 mL
HI93703-05	AMCO-AEPA-1 @500 FTU* calibration solution, 30 mL
HI93703-10	AMCO-AEPA-1 @10 FTU* calibration solution, 30 mL
HI93703-50	Cuvette cleaning solution, 230 mL
HI92000	Windows® compatible software
HI920011	Serial cable for PC connection (5 to 9-pin)

* 1 FTU = 1 NTU

CERTIFICATION

All Hanna Instruments conform to the **CE European Directives.**

CE RoHS compliant

Disposal of Electrical & Electronic Equipment. The product should not be treated as household waste. Instead hand it over to the appropriate collection point for the recycling of electrical and electronic equipment which will conserve natural resources.

Disposal of waste batteries. This product contains batteries, do not dispose of them with other household waste. Hand them over to the appropriate collection point for recycling.

Ensuring proper product and battery disposal prevents potential negative consequences for the environment and human health. For more information, contact your city, your local household waste disposal service, the place of purchase or go to www.hannainst.com.

RECOMMENDATIONS FOR USERS

Before using this product, make sure it is entirely suitable for your specific application and for the environment in which it is used. Any variation introduced by the user to the supplied equipment may degrade the meter's performance. For yours and the meter's safety do not use or store the meter in hazardous environments.

WARRANTY

HI93703-11 is warranted for a period of two years against defects in workmanship and materials when used for its 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 your local Hanna Instruments Office. 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 meter is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization (RGA) number from the Technical Service department and then send it with shipping costs prepaid. When shipping any product, make sure it is properly packaged for complete protection.

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

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