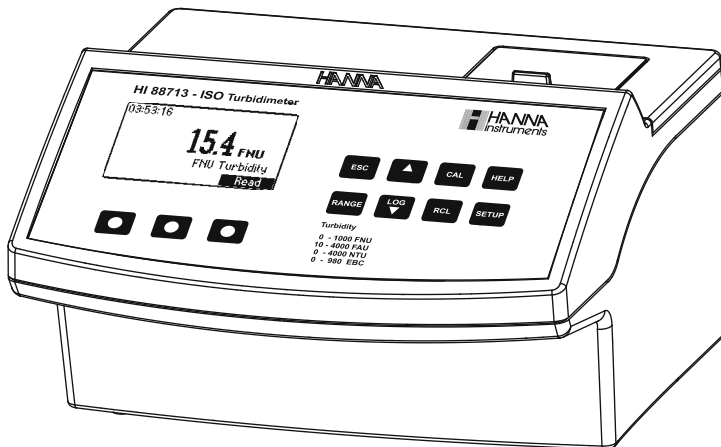


Instruction Manual

HI88713 ISO Turbidity Meter



Dear Customer,

Thank you for choosing a Hanna Instruments product. This manual will provide you with the necessary information for correct use of the instrument.

Please read this instruction manual carefully before using the instrument.

If you need additional technical information, do not hesitate to e-mail us at tech@hannainst.com or see the back side of this manual for our worldwide sales and technical service contacts.

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

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PRELIMINARY EXAMINATION

Please examine this Product carefully. Make sure the instrument is not damaged. If any damage has occurred during the shipment, please contact your local Hanna Instruments Office.

This **HI88713** Turbidity bench meter is supplied complete with:

- Six Sample Cuvettes and Caps
- Calibration Cuvettes
- Silicone Oil
- Cloth for wiping the cuvettes
- AC/DC power adapter
- Instruction Manual
- Instrument Quality Certificate

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

GENERAL DESCRIPTION

The **HI88713** Turbidity bench meter is a high accuracy, meter that benefits from Hanna Instruments' years of experience as manufacturer of analytical instruments.

The **HI88713** Turbidity bench meter meets and exceeds the requirements of **ISO 7027** standard.

The instrument is based on a state-of-the-art optical system which guarantees accurate results, assures long term stability and minimizes stray light and color interferences. It also compensates for variations in intensity of the LED, making no need for frequent calibration.

The 25 mm round cuvettes made from special optical glass guarantees reproducibility and consistency of the measurements.

Turbidity measurements can be made in four modes: FNU (Formazin Nephelometric Units) ratio mode FAU (Formazin Attenuation Units) NTU (Nephelometric Turbidity Units) NTU non-ratio mode. Alternative EBC (European Brewery Comitee) measuring units are available when measuring in NTU modes. Normal measurement, continuous measurement or signal averaging measurement can be selected, depending on the sample and desired accuracy.

A two, three, four or five-point calibration can be performed by using the supplied (<0.1, 15, 100, 750 FNU and 2000 NTU) standards, user prepared form in standards can also be used in all modes. Calibration points can be modified when they are used.

The **HI88713** Turbidity bench meter features G.L.P. (Good Laboratory Practice) functions that allow traceability of the calibration conditions. The last calibration points as well as time and date

The **HI88713** Turbidity bench meter has a user-friendly interface with an easy to understand, graphical LCD. Comprehensive contextual help is available at a simple key press. All messages and help screens are available in several languages. Furthermore, a tutorial mode guides the user step by step through the analysis process.

The **HI88713** features a logging function that can hold up to 200 measurements in the internal memory. Data can be viewed directly on the screen or it can be downloaded to a PC for further analysis using the **HI92000** Windows® compatible software.

ABBREVIATIONS

NTU	Nephelometric Turbidity Units	LCD	Liquid Crystal Display
FAU	Formazin Attenuation Units	RTC	Real Time Clock
FNU	Formazin Nephelometric Units	RH	Relative Humidity
ISO	International Organization for Standardization	ID	Identification
		EBC	European Brewery Comitee

PRINCIPLE OF OPERATION

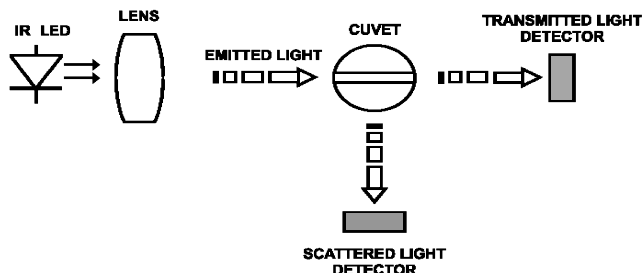
Turbidity is the optical property that causes light to be scattered and absorbed, rather than transmitted. The scattering of the light as it passes through a liquid is caused by the suspended solids. The higher the turbidity, the greater the amount of scattered light. The molecules in a very pure fluid scatter light to a certain degree, no solution will have zero turbidity.

The **ISO 7027 Method** specifies the key parameters for the optical system and the method to measure the turbidity of water.

The **HI88713** Turbidity bench meter is designed to meet or exceed the criteria specified by the **ISO 7027**, **DIN 38404** and **NF EN 27027**.

The light beam that passes through the sample is scattered in all directions. The intensity and pattern of the scattered light is affected by many variables including the wavelength of the incident light, particle size and shape, refractive index and color.

The optical system of the **HI88713** turbidity bench meter uses an IR LED, a scattered light detector (90°) and a transmitted light detector (180°).



For the ratio turbidity mode, the microprocessor of the instrument calculates the NTU value, from the signals that reaches the two detectors, by using an effective algorithm. The optical system and measuring technique compensate the color interference and also the LED intensity fluctuations, minimizing the need of frequent calibration.

For the FNU and NTU non ratio modes the turbidity is calculated from the signal that reaches the scattered light detector (90°).

In FAU mode the turbidity is calculated from the signal that reaches the direct light detector, while in NTU ratio mode the turbidity is obtained from signal ratio on scatter and transmitted light detectors. The non ratio methods are more sensitive to the LED intensity fluctuations.

The lower detection limit of a turbidimeter is determined by the “stray light”. Stray light is the light that reaches the detectors and is not caused by light scattering from suspended particles.

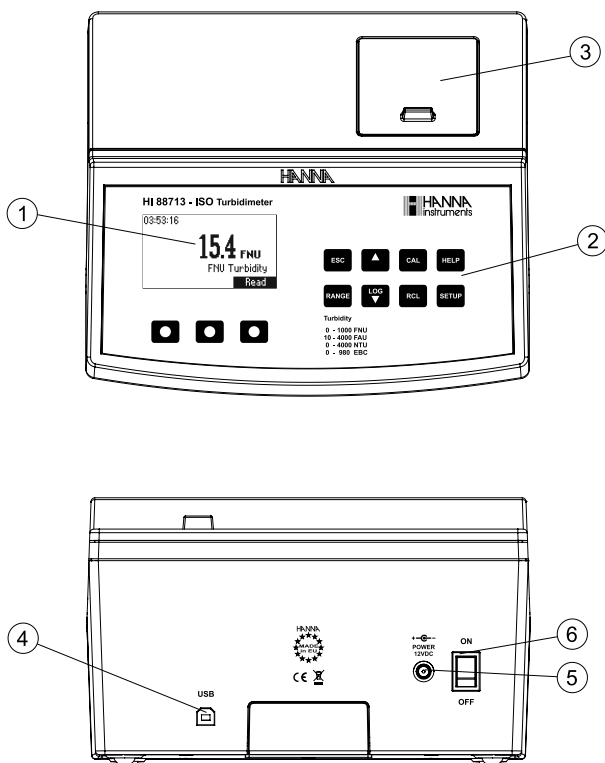
The optical system of **HI88713** instrument is designed to have very low stray light, providing accurate results for low turbidity samples. However, special care must be taken when measuring low turbidities (see page 9 “General Tips for an Accurate Measurement” for sample preparation and measuring techniques).

MEASUREMENT UNITS

The meter is using specific units according to the selected measurement mode. For NTU modes the EBC unit option is available $1 \text{ EBC} = 0.245 \text{ NTU}$. When measuring in NTU modes a conversion to EBC units is also available $0.245 \text{ NTU} = 1 \text{ EBC}$.

FUNCTIONAL DESCRIPTION

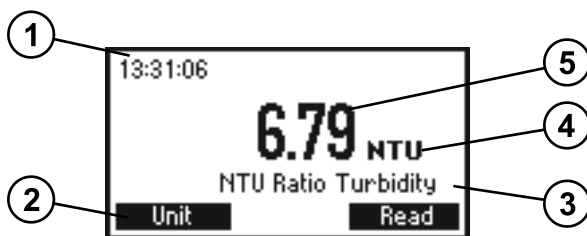
INSTRUMENT DESCRIPTION



- 1) Liquid Crystal Display (LCD). The LCD has backlight for better visibility in dark environments.
- 2) Keypad. Splash proof resistant.
- 3) Cuvette Lid.
- 4) USB connector
- 5) 12 Vdc power input
- 6) ON/OFF switch

DISPLAY DESCRIPTION










The display contains the following fields:



- 1) Current time
- 2) Functional keys
- 3) Selected mode
- 4) Measuring units
- 5) Measured value

KEYPAD DESCRIPTION

The keypad contains 8 direct keys and 3 functional keys with the following functions:

-  Press to perform the function displayed above it. The function are screen releated.
-  Press to exit the current screen.
-  Press to access measurement modes.
-  Press to scroll up in a menu and help or to increment a set value.
-  Press to scroll down in a menu and help or to decrement a set value. Press to log the current reading.
-  Press to access calibration menu.
-  Press to recall the log.
-  Press to display the help screen.
-  Press to access the setup menu.

SPECIFICATIONS

FNU mode

Range	0.00 to 9.99; 10.0 to 99.9; 100 to 1000 FNU
Resolution	0.01; 0.1; 1 FNU
Accuracy	±2% of reading plus straylight

FAU mode

Range	10.0 to 99.9; 100 to 4000 FAU
Resolution	0.1; 1 FAU
Accuracy	±10% of reading

NTU ratio mode

Range	0.00 to 9.99; 10.0 to 99.9; 100 to 4000 NTU 0.00 to 9.99; 10.0 to 99.9; 100 to 980 EBC
Resolution	0.01; 0.1; 1 NTU 0.01; 0.1; 1 EBC
Accuracy	±2% of reading plus straylight ±5% of reading above 1000 NTU

NTU non ratio mode

Range	0.00 to 9.99; 10.0 to 99.9; 100 to 1000 NTU 0.00 to 9.99; 10.0 to 99.9; 100 to 245 EBC
Resolution	0.01; 0.1; 1 NTU 0.01; 0.1; 1 EBC
Accuracy	±2% of reading plus straylight

Range selection	Automatic
Repeatability	±1% of reading or straylight, whichever is greater
Stray Light	< 0.1 NTU (0.05 EBC)
Light Detector	Silicon Photocell
Method	ISO 7027 Method
Measuring mode	Normal, Average, Continuous.
Turbidity Standards	<0.1, 15, 100, 750 FNU and 2000 NTU
Calibration	Two, three, four or five-point calibration
Light Source	IR LED
Lamp life	Instrument life
Display	40 x 70mm graphic LCD (64x128 pixels) with backlight
LOG Memory	200 records
Serial Interface	USB
Environment	0 °C (32 °F) to 50 °C (122 °F); max 95% RH non-condensing
Power supply	12 Vdc power input
Dimensions	230 x 200 x 145 mm (9 x 7.9 x 5.7") L x W x H
Weight	2.5 Kg (88 oz.)

GENERAL TIPS FOR AN ACCURATE MEASUREMENT

The **HI88713** is a highly accurate bench top turbidity meter. Special care must be taken during calibration and sample preparation to optimize the instrument performance and to fully benefit from its features. It is very important for the analyst to use proper measurement techniques for accurate, precise and repeatable readings. The instructions listed below should be carefully followed during calibration and measurement to ensure optimum accuracy.

GENERAL RULES

- Always put the instrument on a flat, rugged surface when taking measurements.
- Do not operate in direct sunlight.
- Keep the lid of the instrument closed when it is not used to prevent dust or dirt entering inside.
- Always close the cuvette lid during measurement.
- Always use cuvettes without scratches or cracks because they can cause inaccurate readings.
- Always cap the cuvettes to prevent the sample from spilling
- To prevent contamination of the optical system, do not use too much oil.
- When using multiple cuvettes, they should be indexed and matched, when possible.

CUVETTE

The cuvette is part of the optical system in all measurements. The light reaches the sample by passing through the cuvette glass. As a result, the measurement can be affected by the glass imperfections, dirt, dust, scratches, or fingerprints present on the cuvette surface. Special care must be taken in preparing and handling the cuvette.

Note: If you are using multiple cuvettes, always match the cuvettes.

CUVETTE HANDLING

The cuvettes should be free of scratches or cracks. Any cuvette with visible scratches should be discarded. The cuvettes should be periodically washed with acid. After washing, the cuvettes should be rinsed well with distilled or deionized water, multiple times. Allow cuvettes to air-dry and store them for long periods of time with their caps, to avoid dirt entering inside. Always handle the cuvette by touching only the cap or its top side (over the horizontal line).

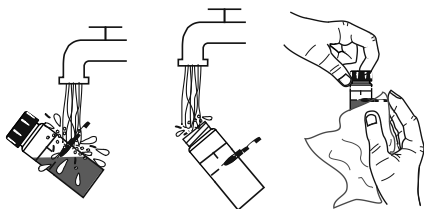
Always store the cuvettes in separate boxes or with separators between them to avoid scratches on the surface.

CUVETTE PREPARATION

Whenever a cuvette is used, it must be clean inside and outside. When it is placed into the instrument, it must be dry outside, completely free of fingerprints or dirt.

CUVETTE PREPARATION

Whenever a cuvette is used, it must be clean inside and outside. When it is placed into the instrument, it must be dry outside, completely free of fingerprints or dirt.



If the cuvette is not indexed, use the factory marking to align the cuvette with the marking on the cuvette holder.

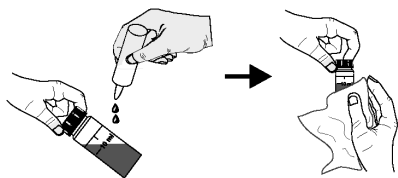
CUVETTE OILING

To hide minor imperfections and scratches, the cuvettes should be oiled outside with the supplied silicone oil. This is very important, especially for low turbidity samples (< 1 FNU), otherwise scratches can contribute and alter turbidity readings.

The silicone oil has the same refractive index as the glass and will not alter the turbidity readings. It is important to apply only a thin layer of silicone oil.

Warning: Do not apply silicone oil in excess because it may retain dirt or contaminate the cuvette holder of the instrument, altering the turbidity readings.

It is very important to apply the silicone oil on a clean, dry cuvette. Apply a few drops of oil and wipe the cuvette thoroughly with a lint-free cloth. Wipe off the excess oil till you obtain a thin, uniform layer. If the procedure is correctly followed, the cuvette should appear nearly dry with no visible oil.



Note: The supplied cloth for oiling should be stored together with the silicone oil bottle and cuvettes, taking care to avoid contamination with dirt. After a few oiling procedures, the cloth will contain enough oil to wipe the bottle with it without adding more oil. From time to time add some drops of oil on the cuvette to provide the necessary oil quantity in the cloth.

INDEXING A CUVETTE

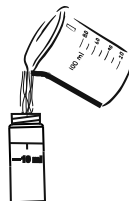
It is very important for low turbidity readings to always insert the cuvette into the instrument in the same position. All cuvettes are factory indexed. The factory mark on the cuvette can be used to align the cuvette with sign on the cuvette holder.

To further reduce the effect of glass imperfections, the cuvette can be indexed and use this new index as the position mark. For indexing one cuvette or matching multiple cuvettes, the continuous reading mode is suggested. In this mode multiple successive readings are taken without turning off the lamp. The turbidity is immediately displayed, reducing considerably the measurement time.

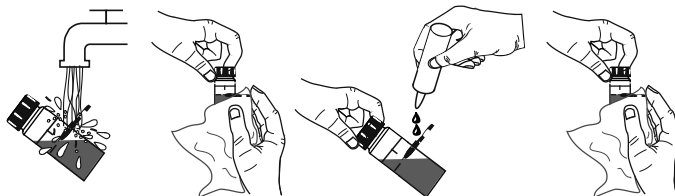
Note: The instrument can not perform continuous readings if the average mode is on.

In order to index a cuvette follow the next steps:

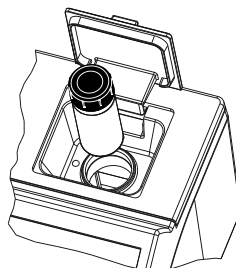
- Fill the cuvette with high quality water (<0.1 FNU) up to the 10 mL mark.



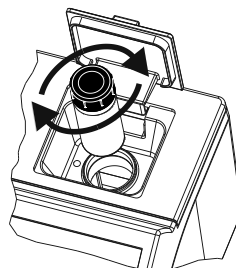
- Clean and oil the cuvette as described in the previous section.



- Turn the instrument ON.
- Insert the cuvette into the instrument and press "Read" functional key. Record the reading.

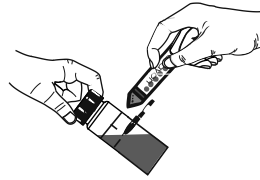


- Open the instrument lid, slightly rotate the cuvette and take a new reading.



- Repeat the previous step until you read the lowest value.
- Alternatively, press and hold the "Read" key to make continuous readings. After the first value is displayed, open the lid and start rotating the cuvette until the lowest value is displayed.

- Mark this position on the white band at the top of the cuvette with a water resistant pencil.
- Always use this position to align the cuvette with the mark on the cuvette holder.

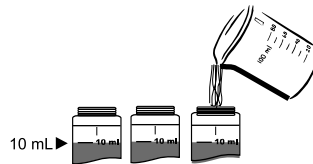


MATCHING MULTIPLE CUVETTES

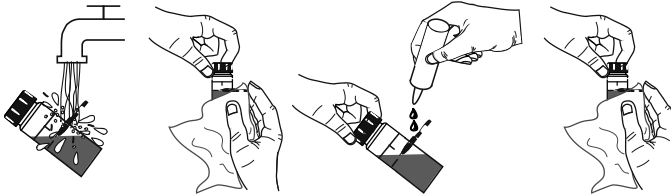
Precise measurements require the use of a single cuvette. If it is not possible, cuvette selection and matching must be performed before taking measurements.

In order to match multiple cuvettes follow the next steps:

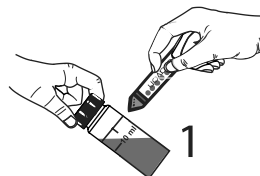
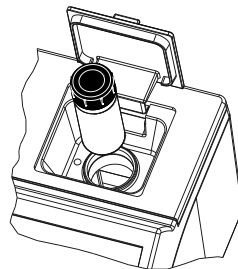
- Fill multiple cuvettes with high quality water ($<0.1\text{FNU}$) up to the 10 mL mark.



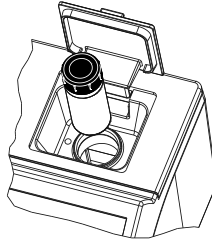
- Clean and oil the cuvettes as described before.



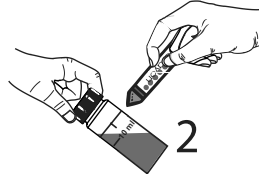
- Turn the instrument ON.
- Insert the first cuvette into the instrument and press “Read” functional key. Record the reading.
- Open the instrument lid, slightly rotate the cuvette and take a new reading.
- Repeat the previous step until you read the lowest value.
- Mark this position on the white band at the top of the cuvette with a water resistant pencil.



- Insert the second cuvette into the instrument and take a reading.



- Open the instrument lid, slightly rotate the cuvette and take a new reading.



- Repeat the last step for the second cuvette until the reading is within 0.01 FNU of the value obtained for the first cuvette.
- Alternatively, press and hold the “Read” functional key, after the first value is displayed, open the lid and start rotating the cuvette until the read value matches the first cuvette.
- Mark this position on the second cuvette with a water resistant pencil.
- Follow the same procedure for all the cuvettes you need.

Note: If the cuvette is indexed, use the index to position it in the instrument.

SAMPLING TECHNIQUE

When taking turbidity measurements it is very important to select a representative sample. For consistent results, follow the next tips when sampling:

- Gently mix the water before taking the sample.
- If the sample is taken from a pipe, discard the first few liters.
- If measuring a non uniform source, collect samples from different places and mix them.

When measuring the collected sample, keep in mind the following:

- Samples should be analyzed immediately after collection because the turbidity can change in time.
- To avoid dilution of the sample it is better to rinse the cuvette with a quantity of sample and then discard. Then you can fill the cuvette with sample.
- Pay attention that cold samples do not condense on the sample cell.

REMOVING AIR BUBBLES

Any air bubbles present in the sample will cause high turbidity readings. To obtain accurate measurements, remove the air bubbles using one of these methods:

- Application of a partial vacuum;
- Addition of a surfactant, such as Triton X-100;
- Use of an ultrasonic bath;
- Heating the sample.

Sometimes it is necessary to combine two or more methods for efficient air bubble removal.

Note: Each method can alter the sample turbidity, if misused, so they have to be used with caution.

APPLICATION OF VACUUM

Vacuum works by decreasing the atmospheric pressure. The bubbles from the solution come out to the surface. Application of vacuum is a very simple procedure and any vacuum can be used. The simplest equipment is a syringe and a rubber stopper.

Notes:

- Pay attention that the vacuum equipment be clean and oil-free.
- It is not recommended to apply vacuum to a viscous sample that contains volatile components. The vacuum can disrupt the volatile components and increase the bubbles in the sample.

ADDITION OF SURFACTANT

Surfactant changes the surface tension of the water. This causes the bubbles to be released from the sample. This method is effective for samples that are supersaturated with air.

The procedure consists in the addition of a drop of surfactant in the cuvette before adding the sample to be analyzed.

A common surfactant used for degassing is Triton X-100.

Warning: Changing the surface tension will cause a rapid settling of particles that cause turbidity.

To avoid this problem, analyze the sample as soon as possible.

Do not shake the sample vigorously because the surfactant may foam. Always rinse the cuvette before adding a new sample to avoid surfactant accumulation.

Surfactant contribution to the turbidity readings is negligible.

Note: Surfactant addition should be used for degassing only when other methods are ineffective.

USE OF AN ULTRASONIC BATH

The ultrasonic waves are very effective in removing air bubbles from samples. However, ultrasonic waves should be used with care because they can alter the samples turbidity characteristics, by modifying the shape and size of particles which cause turbidity. The ultrasonic waves can also break the existing air bubbles, leading to a complication in the degassing process.

In order to avoid excess application of the ultrasonic waves use the ultrasonic bath until all visible air bubbles are removed, and then measure the turbidity. This is the most used procedure for degassing. If you are not sure that all air bubbles were removed, apply ultrasonic waves again for a short period of time and then measure the turbidity. Repeat this procedure until the turbidity is increasing instead of decreasing, sign that turbidity of the sample was altered.

In order to degas a sample, fill a clean cuvette with sample and immerse it (1/2 to 2/3 immersed) in an ultrasonic bath. Follow the degassing procedure described above. Only after the degassing procedure is finished the cuvette can be capped.

HEATING THE SAMPLE

This procedure can be very effective however it should be handled with care because it can alter the turbidity of the sample. When heating a sample, the volatile components from the sample can vaporize, the suspended components can dissolve or the sample characteristics can change.

The heating procedure should be used with extreme care.

Use a warm water bath and immerse the cuvette filled with sample into the bath. Heat the sample only until the visible bubbles are removed.

Note: Always cool the heated sample to the original temperature before measurement.

The heating procedure can be used in combination with vacuum or ultrasonic waves application for a more effective air bubble removal.

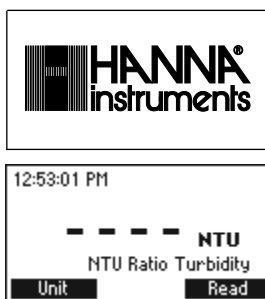
STARTUP

The **HI88713** Turbidity bench meter is supplied with all necessary accessories.

Unpack the instrument and place it on a flat surface. Do not place the instrument in direct sunlight.

Insert the 12 Vdc power plug into its input on the back of the instrument.

Switch on the instrument. On the LCD, the Hanna Instruments Logo will appear for a short time, followed by the main screen for turbidity measurements.



The instrument loads the selected language. If no language can be loaded the instrument will work in the "safe mode". In "safe mode" all the messages are displayed in English and tutorial and help information are not available.

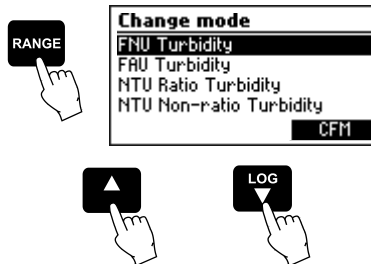
RANGE SELECTION

The **HI88713** bench-top Turbidity meter has four measuring modes: FNU, FAU, NTU Ratio and NTU Non Ratio. When the instrument is in the main screen, the selected mode is displayed in the right side of the LCD, on the message line.

To change the mode, press the **RANGE** key.

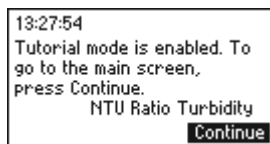
When the display shows the Change mode screen, use the **UP** or **DOWN** key to select a new mode .

Press "**CFM**" key to select the new mode. The instrument returns to the main screen.

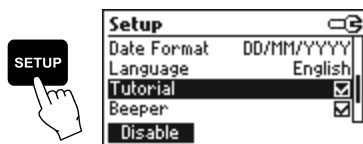


TUTORIAL MODE

The **HI88713** bench-top Turbidity meter has a unique Tutorial Mode that provides additional information to help the unexperienced user during the measurements. The instrument displays a screen, with explanations and confirmation button, when a preparation or other operation has to be performed by the operator. The instrument resumes the measuring sequence when the operator confirms that the requested operation was done.



To disable this mode, when in the main screen, press the **SETUP** key to enter the setup, and then press **DOWN** key until the "Tutorial" line is highlighted. Press the "**Disable**" key then press **ESC** to return to the main screen.



HELP MODE

The **HI88713** bench-top Turbidity meter offers an interactive contextual help that assists the user at any moment.

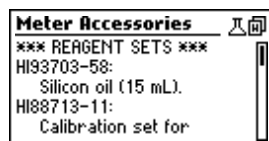
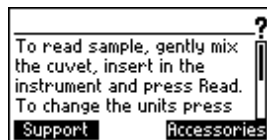
To access help screens, just press **HELP**.

A screen with additional information will appear. To read all available information, scroll down or up text using the **UP** or **DOWN** key.

Press the **"Support"** key to access a list of the Hanna Instruments support centers and their contact information. Press the **"Accessories"** key to view a list of the instruments accessories.

To exit support or accessories screens, press **ESC**, and the instrument will return to the previous help screen.

To exit help mode just press the **HELP** key again and the meter will display the previous screen.



MEASUREMENT PROCEDURE

When taking turbidity measurements, several basic rules should be followed:

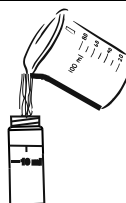
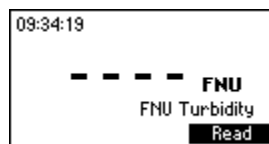
- Always use cuvettes without scratches or cracks because they can cause inaccurate readings.
- Always cap the cuvettes to prevent spillage of the sample from spilling the instrument.
- Always close the cuvette cover during measurement.
- To prevent contamination of the optical system, do not use too much silicon oil.

To take turbidity measurements:

- Turn the instrument **ON** by pressing **ON/OFF**.

When dashes are displayed on the LCD, the instrument is ready. The current time appears in the upper left corner of the display and the mode name appears on the right side of the LCD, in the message line.

- Fill a clean, dry cuvette with 10 mL of sample up to the mark, only handle the cuvette by the top.

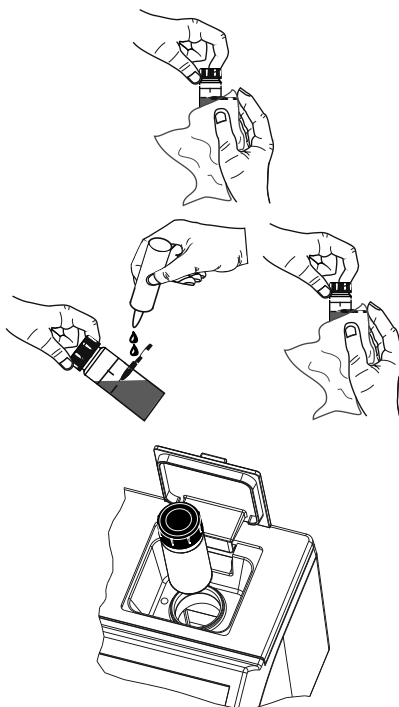


- Replace the cap.
- Wipe the cuvette thoroughly with a lint-free cloth to remove any fingerprints, dirt or water spots.
- Apply silicone oil on the cuvette and wipe with a lint-free cloth to obtain an even film over the entire surface of the cuvette.

Note: It is very important to oil the cuvette, especially for low turbidity values (< 1 FNU) to hide the glass imperfections which can influence the reading.

- Place the cuvette into the instrument. Align the mark from the cuvette with the sign on the instrument top
- Close the lid.

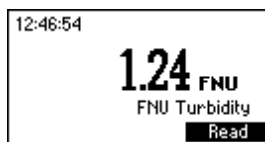
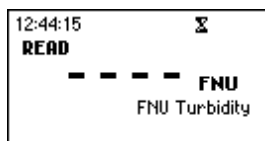
Note: If you have a cuvette with indexing mark, place the cuvette into the instrument with the indexing mark aligned with the sign on the instrument top.



NORMAL MEASUREMENT

This type of measurement is best suited for regular readings, when the sample is stable and normal accuracy is required. In normal mode, the measurement takes about 10 seconds and the lamp is ON for a minimum period of time (about 7 seconds).

- Press “Read” functional key to take the measurement.
The display will show “READ” in the left side and blinking dashes. The dashes and light icon will appear during different measurement phases.
- The result is displayed in the selected units.



CONTINUOUS MEASUREMENT

This measurement mode is suitable when many measurements have to be taken in a short period of time. The mode is useful to evaluate a very fast settling sample. This measurement mode is recommended for indexing cuvettes.

- Press “Read” functional key and keep it pressed to take continuous readings.

The display will show “READ” in the left side and blinking dashes. The dashes and light icon will appear during different measurement phases. The first value is displayed after 10 seconds and then a new reading is displayed each second as long as the “Read” functional key is kept pressed. When a new value is displayed, the measurement value will briefly blink.

The last value remains on the display after the “Read” functional key is released.

AVERAGED MEASUREMENT

This measurement mode is useful when samples that cause unstable readings are analyzed. By averaging several readings, noise effect is reduced and accurate measurements can be taken.

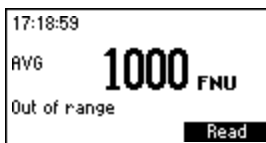
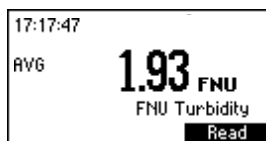
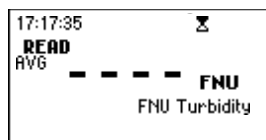
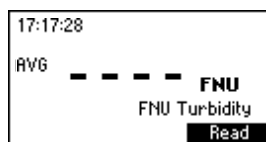
This mode can also be selected when high accuracy measurements are needed. In the average mode 10 measurements are averaged in a short period of time (about 20 seconds).

To use the averaged reading mode first enter setup and enable the Average reading mode. The “AVG” text will be displayed in the left side of the screen.

- Press “Read” functional key to take the measurement.

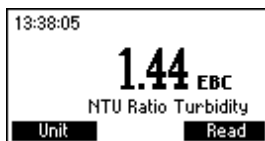
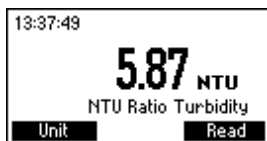
The display will show “READ” in the left side and blinking dashes. The dashes and light icon will appear during different measurement phases. The first value is displayed after 10 seconds and then a new average of the available readings is displayed each second. When a new value is displayed, the measurement value will blink briefly. The last averaged value remains on the display at the end of the measurement.

The **HI88713** Turbidity bench meter automatically selects the correct turbidity range to display the results with the highest accuracy. In FNU and NTU Non-Ratio Turbidity Modes, if the measured value is higher than 1000 FAU, the display will show the maximum value blinking and the message “Out of range” on the message line. For FAU Turbidity and NTU Ratio Turbidity modes, if the measured value is higher than 4000 FNU/NTU (980 EBC), the display will show the maximum value blinking and the message “Out of range” on the message line.



UNITS CHANGE (only for NTU Ratio and NTU Non-Ratio modes)

To change the units for NTU Ratio and Non-Ratio modes, simply press the “Unit” functional key when a measurement is available. The EBC value is obtained by multiply with 0.245 the NTU value.



CALIBRATION PROCEDURE

The **HI88713** Turbidity bench meter is supplied with 5 AMCO Hanna standards (<0.1 FNU, 15 FNU, 100 FNU, 750 FNU and 2000 NTU) that are specially designed for NTU ratio mode.

The calibration can be done using the supplied calibration solutions for NTU Ratio mode or user prepared standards for all modes. Turbidity standards have a shelf life and should not be used after the expiration date. Alternatively, formazin standards can be used. It is recommended that the turbidity value of the prepared calibration solutions to be close to the default calibration points.

The first calibration point should be near 0 FNU, the second point can be chosen between 10 and 20 FNU, the third point between 50 and 150 FNU, the fourth point between 600 and 900 FNU and the fifth point between 1500 and 2500 NTU.

FORMAZIN PREPARATION

In order to prepare formazin 4000 NTU stock solution, follow the next procedure:

Solution I : Dissolve 1.000 gram of hydrazine sulfate, $(\text{NH}_2)_2\text{H}_2\text{SO}_4$, in distilled, deionized water and dilute to 100 mL in a volumetric flask.

Warning: Handle hydrazine sulfate with care because it is a carcinogen reagent. Avoid inhalation, ingestion, or skin contact. Formazin solution can also contain some hydrazine traces.

Solution II : Dissolve 10.000 grams of hexamethylenetetramine, $(\text{CH}_2)_6\text{N}_4$, in distilled, deionized water and dilute to 100 mL in a volumetric flask.

Stock solution: Mix 10 mL Solution I and 10 mL Solution II in a flask. Let the stock solution stays 48 hours at $25 \pm 3^\circ\text{C}$ ($77 \pm 5^\circ\text{F}$). This will result in a 4000 NTU formazin suspension. It is very important for the formation of the formazin polymer to maintain the same temperature.

The stock solution (4000 NTU) can be stored up to one year in proper conditions. Store formazin in amber glass bottle or any UV-light blocking bottle.

To obtain a high quality formazin always use pure reagents and high-purity water.

To prepare the calibration standards, dilute the stock solution with the same high-purity water you used for the preparation of the stock solution. The diluted formazin solutions are not stable. They should be used immediately after preparation and discard immediately after use.

CALIBRATION

For best results, the measurement techniques must be followed during calibration. If formazin standards are used, mix the cuvettes gently for about 1 minute and then allow the standard to settle for 1 more minute before calibration.

Calibration can be performed in up to five points, independently, for each mode. The calibration points are:

FNU mode:	0, 15, 100, 750	FNU
FAU mode:	15, 100, 750, 2000	FAU
NTU ratiometric mode:	0, 15, 100, 750, 2000	NTU
NTU non-ratiometric mode:	0, 15, 100, 750	NTU

Before making the calibration, assure that you are in the correct mode.

To enter calibration, press CAL key while in main screen. The first screen of GLP information is displayed. Press "Cal" functional key to start calibration.

It is possible to interrupt calibration procedure at any time by pressing CAL or ESC key.



Calibration		
SN 88713002GA7		
User Cal date&time: 13/11/2007 18:35		
FNU Turbidity		
Cal	GLP	Delete

Calibration		
SN 88713002GA7		
User Cal date&time: 13/11/2007 18:38		
FAU Turbidity		
Cal	GLP	Delete

Calibration		
SN 88713002GA7		
User Cal date&time: 13/11/2007 18:40		
NTU Ratio Turbidity		
Cal	GLP	Delete

Calibration		
SN 88713002GA7		
User Cal date&time: 15/11/2007 09:52		
NTU Non-ratio Turbidity		
Cal	GLP	Delete

FIRST POINT CALIBRATION

Calibration		
Point 1: 0.00 FNU		
FNU Turbidity		
Skip	Read	

Calibration		
Point 1: 15.0 FAU		
FAU Turbidity		
End	Read	

Calibration		
Point 1: 0.00 NTU		
NTU Ratio Turbidity		
Skip	Read	

Calibration		
Point 1: 0.00 NTU		
NTU Non-ratio Turbidity		
Skip	Read	

- The first calibration point is displayed on the LCD.

This point is used for FNU and NTU modes to check the quality of the water used for dilution and to confirm that the optical system is not dirty. In this case, if the value of the first point is over 0.15 FNU (NTU), a warning "Cal Point1 high !" is displayed when the calibration is saved and a warning "Out of calibration range" is displayed when measurements under 10.0 FNU (NTU) are performed.

Note: The reading of the first point could be skipped for FNU and NTU modes by pressing “Skip” functional key. In this case, the 0.00 value will be used for calibration.

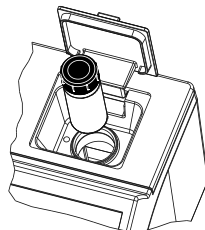
- Place the cuvette for first calibration point:
 - <0.1 FNU (NTU) calibration cuvette for all modes except FAU mode.
 - 15 NTU formazin prepared standard for FAU mode.

Note: For the FAU mode, if necessary, press UP or DOWN key to edit the calibration point value to match the exact value of the standard.

- Close the lid and press “Read” functional key. The display will show the value blinking and the light icon during measurement.

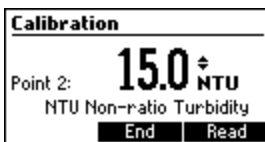
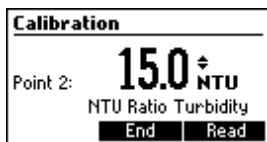
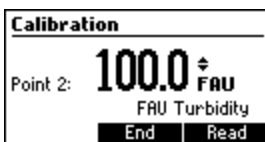
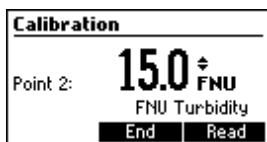
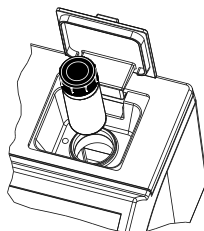
Note: If the Average mode was previously selected, the measurement in calibration mode will be done using the average.

- At the end of the measurement, the second proposed calibration point is displayed.



SECOND POINT CALIBRATION

- Remove the first calibration cuvette.
- Place the cuvette for second calibration point:
 - 15 NTU (FNU) calibration cuvette for NTU ratiometric mode.
 - 15 NTU formazin prepared standard for NTU non-ratio and FNU modes.
 - 100 NTU formazin prepared standard for FAU mode.



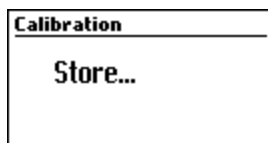
Note: If necessary, press UP or DOWN key to edit each calibration point value to match the exact value of the standard as measured with a reference turbidimeter.



- Close the lid and press “Read” functional key. The display will show the value blinking and the light icon during measurement.

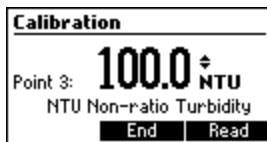
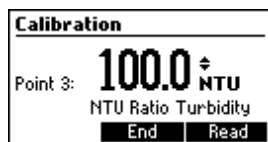
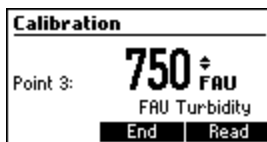
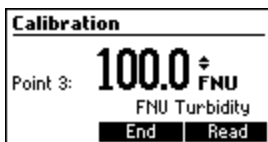
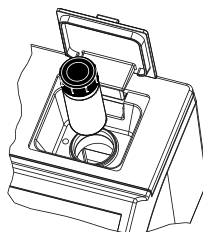
- At the end of the measurement, the third proposed calibration point is displayed.

- At this moment it is possible to exit calibration by pressing “End” functional key.
- If the calibration is terminated, the display will briefly show “Store...” and the two point calibration is saved. The instrument returns to the main screen.



THIRD CALIBRATION POINT

- Remove the second standard cuvette.
- Place the cuvette for third calibration point:
 - 100 FNU (NTU) calibration cuvette for NTU ratio metric mode.
 - 100 NTU formazin prepared standard for NTU non-ratio and FNU modes.



- 750 NTU formazin prepared standard for FAU mode.

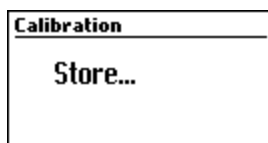
Note: If necessary, press UP or DOWN key to edit each calibration point value to match the exact value of the standard as measured with a reference turbidimeter.

- Close the lid and press “Read” functional key. The display will show the value blinking and the light icon during measurement.

- At the end of the measurement, the fourth proposed calibration point is displayed.

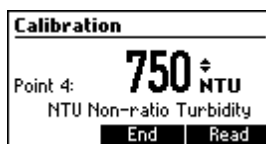
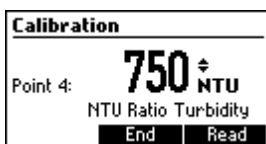
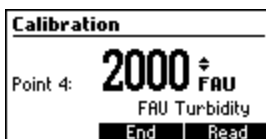
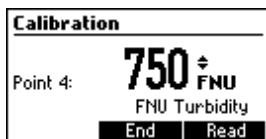
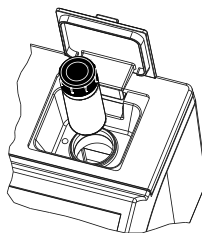
- At this moment it is possible to exit calibration by pressing “End” functional key.

- If the calibration is terminated, the display will briefly show “Store...” and the three point calibration is saved. The instrument returns in the main screen.



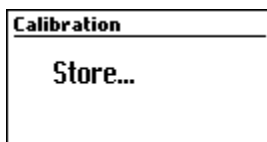
FOUR-POINT CALIBRATION

- Remove the third standard cuvette.
- Place the cuvette for third calibration point:
 - 750 FNU (NTU) calibration cuvette for NTU ratio mode.
 - 750 NTU formazin prepared standard for NTU non-ratio and FNU modes.
 - 2000 NTU formazin prepared standard for FAU mode.



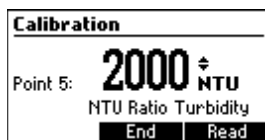
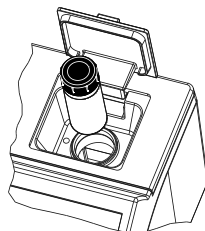
Note: If necessary, press UP or DOWN key to edit each calibration point value to match the exact value of the standard as measured with a reference turbidimeter.

- Close the lid and press "Read" functional key. The display will show the value blinking and the light icon during measurement.
- The "Store..." message is displayed for FAU, FNU and NTU non-ratio modes and the calibration is saved. The instrument returns to the main screen.
- The fifth proposed calibration point, 2000 NTU for NTU Ratio mode, is displayed.
- At this moment it is possible to exit calibration by pressing "End" functional key.
- If the calibration is terminated, the display will briefly show "Store..." and the four point calibration is saved. The instrument returns in the main screen.



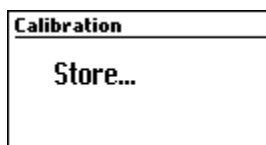
FIFTH CALIBRATION POINT (NTU Ratio Turbidity only)

- Remove the fourth standard cuvette.
- Place the 2000 NTU calibration cuvette (or the fifth prepared formazin standard) into the holder, with the cuvette mark aligned to the sign on the instrument top.



Note: If necessary, press UP or DOWN key to edit the calibration point value to match the exact value of the standard as measured with a reference turbidimeter.

- Close the lid and press “Read” functional key. The display will show the value blinking and the light icon during measurement.
- At the end of the measurement, the calibration is saved and the display will briefly show “Store...”. The instrument returns in the main screen.



CALIBRATION ERROR MESSAGES

If the value of the standard read during the calibration is too far from the set value, the instrument will display a standard low or a standard high message.

Check if the correct standard is used or prepare a fresh standard, if formazine is used, and repeat the reading of the standard.



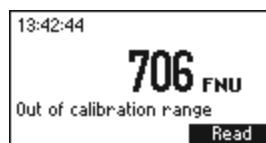
If the calculated calibration coefficients are outside a certain range a calibration error message is displayed.



OUT CAL RANGE FUNCTION

The instrument has a mechanism to prevent taking measurements in a range where the calibration does not assure the best results. The message “Out of Calibration Range” is displayed on the message line in the following situations:

- When the first calibration point is over 0.15 FNU and the reading is under 10 FNU.
- When two point calibration was performed and the reading value is over 40 FNU.
- When a three point calibration was performed and the reading is over 150% of the the third point value.
- When a four point calibration was performed and the reading is over 200% of the the fourth point value.



GOOD LABORATORY PRACTICE (GLP)

The **H188713** Turbidity bench meter has a built in complete GLP information. The calibration date and the calibration points are displayed in a comprehensive mode for each range.

To display the GLP information, simply press CAL key. A screen with instrument serial number and with information about the calibration is displayed. For further information, press the “GLP” functional key.

The GLP contains:

- Instrument serial number
- The last user calibration date, in selected format and time in hh.mm format. If no calibration was performed, the “Not calibrated” message is displayed and the meter uses only the factory calibration.
- Parameter as NTU Ratio Turbidity, NTU Non Ratio Turbidity, FAU Turbidity or FNU Turbidity.
- The value of each calibration point (up to 5 points for NTU ratio mode; 4 points for FNU, FAU and NTU non-ratio modes). If the first calibration point was skipped, the 0.00 value is displayed.

Calibration		
SN 88713xxxxxx		
User Cal date&time:		
06/11/2007 13:18		
NTU Ratio Turbidity		
Cal	GLP	Delete

GLP	
CalPoint1:	0.00NTU
CalPoint2:	15.0NTU
CalPoint3:	100.0NTU
CalPoint4:	750NTU
Cal	Delete

RESTORE FACTORY CALIBRATION

To restore the factory calibration for the currently selected range, press CAL key when in the main screen. The first screen for the GLP is displayed. Press “Delete” functional key to initiate the calibration delete procedure and then press “CFM” functional key to delete the user calibration and restore the Factory calibration.

Note: Only the user calibration for the current selected range is deleted.

Calibration		
SN 88713xxxxxx		
User Cal date&time:		
06/11/2007 13:18		
NTU Ratio Turbidity		
Cal	GLP	Delete

Calibration Delete	
Delete user calibration?	
NTU Ratio Turbidity	
CFM	

LOG AND LOG RECALL

The **HI88713** Turbidity bench meter has a powerful log function that could store up to 200 records. Each record contains:

- the measuring mode,
- the reading value,
- the measuring unit,
- the date and time of the measurement,
- the current log number.

Notes:

- The log can be saved only after a measurement is completed.
- A measurement can be saved only once.

LOG SAVE

To log a record, simply press LOG key after the measurement is completed. A record number is assigned to each logged measurement. Each reading can be stored only once.



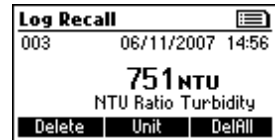
LOG RECALL

The log can be consulted at any time by simply pressing RCL key.

To exit log consulting, press RCL key again.

The log content is displayed one record at a time, starting with the most recent one. The information regarding one record is displayed in one screen.

To browse the log press the UP or DOWN key.



LOG DELETE

The last log or all logs can be deleted.

To delete the last log, simply press "Delete" functional key when the last log is displayed. The log will be deleted and the next log is immediately displayed.

To delete all logs, press "DelAll" functional key. A confirmation screen is displayed. Press "CFM" functional key to confirm the action. The log will be deleted and the instrument returns in the main screen.

Note: The records for all parameters are deleted when this action is performed.



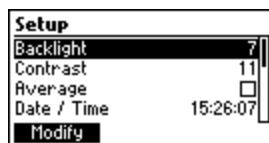
SETUP

The instrument's parameters can be changed in the Setup mode. Some parameters affect the measuring sequence and others are general parameters that change the behaviour or appearance of the instrument. The setup mode may be accessed from the main screen by pressing the SETUP key.

Press ESC or SETUP to return to the main screen.

A list of setup parameters will be displayed with currently configured setting. Press HELP for additional information.

Press the UP or DOWN key to select the parameter and depending to the parameter type, select the new value as follows.



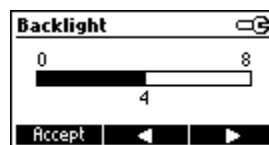
Backlight

Values: 0 to 8.

Press "Modify" functional key to access the backlight value.

Use the "Right" or "Left" functional key (alternatively, the UP or DOWN key) to increase or decrease the display backlight.

Press "Accept" functional key to confirm or ESC to return to the setup menu without saving the new value.



Contrast

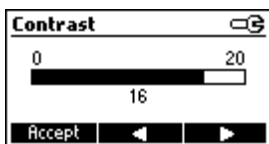
Values: 0 to 20.

This option is used to set the display's contrast.

Press "Modify" functional key to change the display's contrast.

Use the "Right" or "Left" functional key (alternatively, the UP or DOWN key) to increase or decrease the value.

Press "Accept" functional key to confirm the value or ESC to return to the setup menu without saving the new value.



Average

Option: Enabled or Disabled.

This option is used to enable/disable averaged measuring mode. If enabled, the instrument takes 10 readings and display the resulting average value. The partial average is displayed during measurement.

Press the "Enable" functional key to enable or disable this option.



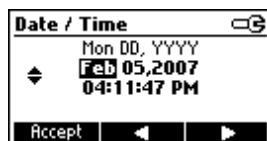
Date / Time

This option is used to set the instrument's date and time.

Press "Modify" to change the date/time.

Press "Left" or "Right" functional key to highlight the value to be modified (year, month, day, hour, minute or second). Use the UP or DOWN key to change the value.

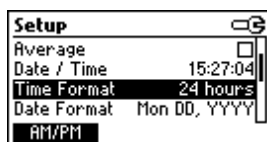
Press "Accept" functional key to confirm the new value or ESC to return to the setup without saving the new time or date.



Time format

Option: AM/PM or 24 hours.

Press the "AM/PM" functional key to select the new value.

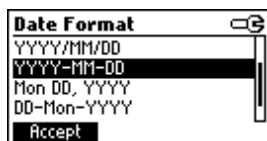
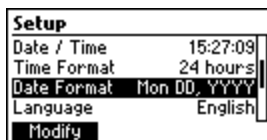


Date format

Press "Modify" functional key to change the Date Format.

Use the UP or DOWN key to select the desired format.

Press "Accept" functional key to confirm the value or ESC to return to the setup menu without saving the new format.



Language

Option: English, Italiano or Español

Press the corresponding function key to change the option.

If the new selected language cannot be loaded, the previously selected language will be reloaded.



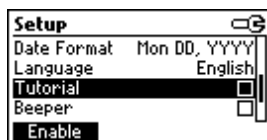
Tutorial

Option: Enabled or Disabled.

This option is used to enable/disable tutorial mode.

If enabled this option will provide the user short guides on the screen.

Press the "Enable" functional key to select this option.



Beeper

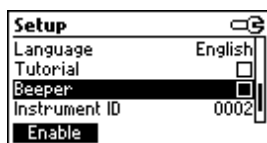
Option: Enabled or Disabled.

This option is used to enable/disable the beeper.

Press the “Enable” functional key to enable or disable this option.

When enabled, a short beep is heard every time a key is pressed.

A long beep alert sounds when the pressed key is not active or an error condition is detected.

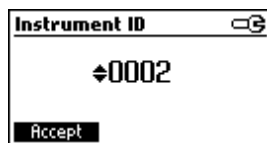


Instrument ID

Option: 0 to 9999.

This option is used to set the instrument's ID (identification number). The instrument ID is used while exchanging data with a PC.

Press “Modify” functional key to access the instrument ID screen. Press the UP or DOWN key in order to set the desired value. Press “Accept” functional key to confirm the value or ESC to return to the setup menu without saving the new value.



Meter information

Press “Select” functional key to view the Instrument model, firmware version, language version and instrument serial number.

Press ESC to return to the Setup mode.



PC INTERFACE

Log data download from the instrument to the PC can be done with the **HI92000** Windows® compatible software (optional). **HI92000** also offers graphing and on-line help features. Data can be exported to the most popular spreadsheet programs for further analysis.

To connect your instrument to a PC, use a standard USB cable. Make sure that your instrument is switched off. Plug one connector to the instrument's USB socket and the other to the USB port of your PC. Please refer to the **HI92000** software to download the data from the instrument.

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.

ACCESSORIES

REAGENT SETS

- HI93703-58 Silicon oil (15 mL)
HI88713-11 Calibration set for turbidimeter(<0.1, 15, 100 750 FNU and 2000 NTU)

OTHER ACCESSORIES

- HI731318 Tissue for wiping cuvettes (4 pcs.)
HI731331 Glass cuvettes (4 pcs.)
HI731335N Caps for cuvettes (4 pcs.)
HI92000 Windows® compatible software
HI93703-50 Cuvettes cleaning solution (230 mL)
HI7402341 Replacement LED for HI88713, HI98713 (1 pc.)

CERTIFICATION

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

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 meter, 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

HI88713 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 meter, make sure it is properly packaged for complete protection.

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