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Turbidity

Introduction

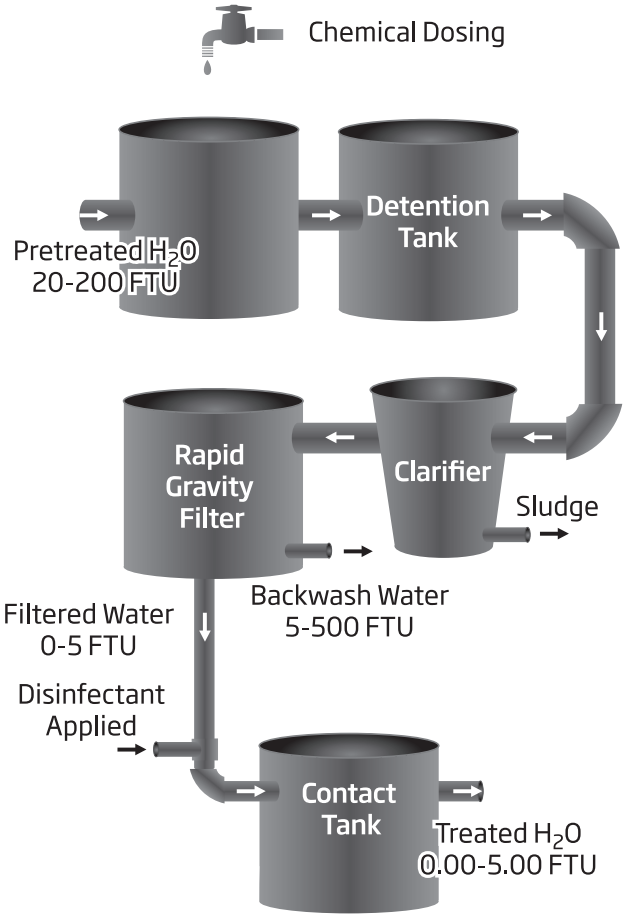
Introduction to Turbidity

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

The unit of measure adopted by the ISO Standard is the FNU (Formazine Nephelometric Unit) and by EPA is NTU (Nephelometric Turbidity Unit). The other two methods used to test for turbidity and their measurement units are the JTU (Jackson Turbidity Unit) and the Silica unit (mg/L SiO_2). See the conversion table below for reference.

	JTU	FTU (NTU/FNU)	SiO_2 (mg/L)
JTU	1	19	2.5
FTU (NTU/FNU)	0.053	1	0.13
SiO_2 (mg/L)	0.4	7.5	1

Treatment Process of Drinking Water



Purification of Drinking Water

Turbidity is one of the most important parameters used to determine the quality of drinking water. Public water suppliers are required to treat their water to remove turbidity. In the United States, for systems that use conventional or direct filtration methods, turbidity cannot be higher than 1.0 nephelometric turbidity units (NTU) at the plant outlet and all samples for turbidity must be less than or equal to 0.3 NTU for at least 95 percent of the samples in any month. Adequately treated surface water does not usually present a turbidity problem. The World Health Organization indicates 5 FTU as the reference turbidity value of water for trade. This value has been established based on the aesthetic characteristics of water. From a hygienic point of view, 1 FTU is the recommended value. Many drinking water utilities strive to achieve levels as low as 0.1 NTU.

Turbidity is an indicator and will not give results for a specific pollutant. It will, however, provide information on the degree of overall contamination. The flow chart for the water treatment process of drinking water shows the turbidity reference values for each phase.

Monitoring for Natural Water Supplies

In natural water, turbidity measurements are taken to gauge general water quality and its compatibility in applications where there are aquatic organisms. It has been found that there is a strong correlation between the turbidity level and the BOD value. Moreover, by definition, turbidity obstructs light, thus reducing the growth of marine plants, eggs and larvae, which are usually found in the lower levels of an aquatic ecosystem.

Wastewater Treatment and Turbidity

Historically, turbidity is one of the main parameters monitored in wastewater. In fact, the monitoring and treatment process was once solely based on the control of turbidity. Currently, the measurement of turbidity at the end of the wastewater treatment process is necessary to verify that the values are within regulatory standards. Generally speaking, the turbidity value has to be between 0 and 50 FTU, with an accuracy of ±3 FTU, depending on the phase of the wastewater treatment process. By monitoring the turbidity level, it can be determined if the different stages of the process, particularly in the filtration and purification stages, have been completed correctly.

The HANNA Solution

There are three analytical test methods for turbidity: ISO 7027 "Water Quality: Determination of Turbidity", US EPA Method No. 180.1, "Turbidity", and "Standard Methods" No. 2130B

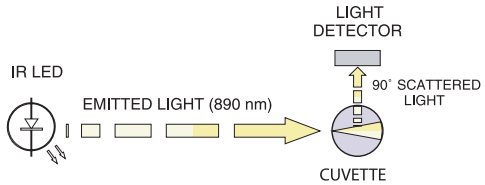
The USEPA and Standard Methods recommend a particular wavelength in the visible range of the spectrum and the European system requiring an infrared light source (ISO 7027). In order to satisfy these different requirements, HANNA has developed products that meet both standards.

The Infrared Method (ISO 7027)

HI 88713 and HI 98713 operate by passing a beam of infrared light through a vial containing the sample to be tested. The light source is a High Emission Infrared LED. A sensor, positioned at 90° with respect to the direction of the light, detects the amount of light scattered by the undissolved particles present in the sample. A microprocessor converts these readings into FTU (FNU) values.

The USEPA (Environmental Protection Agency) Approved Method

Instruments featuring EPA approved methods are designed to meet or exceed the criteria specified by the USEPA Method 180.1 and Standard Method 2130 B.



Turbidity Bench Meters Principal of Operation

The USEPA Method 180.1 specify the key parameters for the optical system to measure turbidity for drinking, saline and surface water, in a 0 to 40 NTU range, using the nephelometric method.

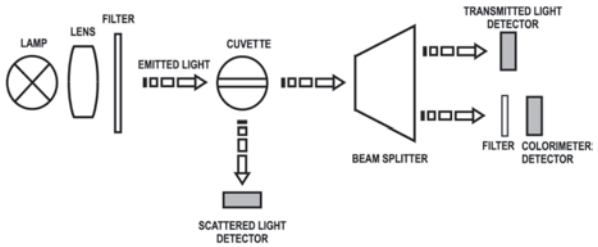
HI 83414 and HI 88703 are designed to meet or exceed the criteria specified by the USEPA Method 180.1 and Standard Method 2130 B. The light beam that passes through the sample is scattered in all directions. The intensity and pattern of the scattered light is affected by many variables, such as wavelength of the incident light, particle size and shape, refractive index and color. The optical system includes a tungsten filament lamp, a scattered light detector (90°) and a transmitted light detector (180°).

In the ratio turbidimeter range, the microprocessor of the instrument calculates the NTU value from the signals that reach the two detectors by using an effective algorithm. This algorithm corrects and compensates for interferences of color, making the HI 83414 and HI 88703 color-compensated. The optical system and measuring technique also compensate for the lamp intensity fluctuations–minimizing the need of frequent calibration.

In the non-ratio turbidimeter range, the NTU value is calculated from the signal on the scattered light detector (90°). This method offers a high linearity on the low range but is more sensitive to lamp intensity fluctuations.

The lower detection limit of a turbidimeter is determined by stray light. Stray light is the light detected by the sensors that is not caused by light scattering from suspended particles. The optical system of HI 83414 and HI 88703 is designed to have very low stray light, providing accurate results for low turbidity samples.

Portable Turbidity Meters



Principal of Operation

The USEPA Method 180.1 specifies the key parameters for the optical system to measure turbidity for drinking, saline and surface water in a 0 to 40 NTU range, using the nephelometric method. The HI 93414 and HI 98703 Portable Turbidimeter are designed to meet or exceed the criteria specified by the USEPA Method 180.1 and Standard Method 2130 B.

The ISO 7027 standard specifies the key parameters for the optical system to measure turbidity for drinking and surface water, using the formazin based metric method. The HI 98713 portable turbidimeter is designed to meet or exceed the criteria specified by the ISO 7027 standard.

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 like wavelength of the incident light, particle size, shape, refractive index and color.

HI 93414 and HI 98703's optical system includes a tungsten filament lamp, a scattered light detector (90°) and a transmitted light detector (180°). For the colorimeter range the optical system is based on the turbidimeter tungsten lamp and a separate detector with a narrow band interference filter @ 525 nm to guarantee both high performance and reliable results for colorimetric measurements.

HI 98713's optical system includes an infrared LED, a scattered light detector (90°) and a transmitted light detector (180°). By using an effective algorithm, the instrument's microprocessor calculates the FTU value from the signals that reach the two detectors. This algorithm corrects and compensates for interferences of color, making the HI 98713 turbidimeter color-compensated.

The optical system and measuring technique allow the compensation of lamp intensity (HI 98703, HI 93414) or LED intensity (HI 98713) fluctuations, minimizing the need of frequent calibration.

The lower detection limit of a turbidimeter is determined by the so called "stray light". Stray light is the light detected by the sensors that is not caused by light scattering from suspended particles. The optical system of HI 98713 turbidimeter is designed to have very low stray light, providing accurate results for low turbidity samples when special care is taken.

Product Spotlights

HI 83414

Turbidity and Free/Total Chlorine Benchtop Meter,EPA Compliant

12.6

HI 83414 is a highly accurate dual parameter instrument that reflects HANNA's years of experience. The HI 83414 successfully combines turbidity and colorimetric measurements to test the most important parameters of drinking water: turbidity and free/total chlorine. The meter is especially designed for water quality measurements, providing reliable and accurate readings on low turbidity and chlorine values. The HI 83414 meets and exceeds the requirements of USEPA and Standard Methods both for turbidity and colorimetric measurements.

HI 88713

Turbidity Benchtop Meter, ISO

12.13

HI 88713 is based on an optical system which guarantees accurate results, long term stability and minimizes stray light and color interferences. It also compensates for variations in intensity of the LED, limiting the need for frequent calibration.

Depending on the measured sample and needed accuracy, normal, continuous or signal averaging measurement can be selected.

A two, three, four or five-point calibration can be performed using the supplied standards. Calibration points can be modified when user prepared standards are used.

HI 93414

Turbidity and Free/Total Chlorine Portable Meter with CAL CHECK™ Technology, EPA Compliant

12.10

The HI 93414 measures the most important parameters of drinking water: turbidity and free/total chlorine. Designed for water quality measurements, HI 93414 provides reliable and accurate readings on low turbidity and chlorine values. The HI 93414 meets and exceeds the requirements of USEPA and Standard Methods both for turbidity and colorimetric measurements.

This instrument incorporates an optical system which guarantees accurate results. The optical system, consisting of a tungsten filament lamp, three detectors (scattered, transmitted for turbidimeter range and one for colorimeter range), and a narrow band interference filter @ 525 nm assures long term stability and minimizes stray light and color interferences. It also compensates for variations in intensity of the lamp, making no need for frequent calibration. The 25 mm round cuvettes made from special optical glass guarantee repeatability and consistency of measurements.

GUIDE	Turbidity	pH	Free Chlorine	Total Chlorine	Bromine (Br)	Iodine (I)	Cyanuric Acid (CYS)	Iron, Low Range (Fe, LR)	Ratio Mode	Non-Ratio Mode	FNU Mode	FAU Mode	NTU Ratio Mode	NTU Non-Ratio Mode	Max. Calibration Points	CAL CHECK™	Logging	EPA Compliant	GLP	PC Connectivity	Fast Tracker™	ISO	Backlit LCD	Auto-off	Page
EPA Compliant Meters																									
HI 83414	•		•	•					•	•					5	•	•	•	•	•			•	•	12.6
HI 88703	•								•	•					5		•	•	•	•			•	•	12.9
HI 93414	•		•	•											4	•	•	•	•	•	•		•	•	12.10
HI 98703	•														4		•	•	•	•	•		•	•	12.12
ISO Meters																									
HI 88713	•										•	•	•	•	5		•		•	•		•	•		12.13
HI 98713	•														4		•		•	•	•	•	•	•	12.14
HI 93703	•														3				•			•			12.15
HI 93703-11	•														3		•		•			•			12.15
Specific Application Meters																									
HI 93102	•	•	•	•	•	•	•	•							2			•							12.16
HI 83749	•														4		•	•	•	•	•		•	•	12.17
HI 847491	•														4		•		•	•	•		•	•	12.18
HI 847492	•														4		•		•	•	•		•	•	12.18
HI 847493	•														4		•		•	•	•		•	•	12.18

HI 83414

Turbidity and Free/Total Chlorine Benchtop Meter, EPA Compliant

- **HI 83414 features four measuring ranges:**
  - Ratio, non ratio, free chlorine, total chlorine
- **Meets USEPA requirements**
- **Exclusive chlorine CAL CHECK™ calibration validation**
- **GLP Features**
- **Two, three, four or five point turbidity calibration**
- **USB PC connectivity**
- **Backlit LCD**
- **Log and recall up to 200 measurements**
- **Auto-off**
- **On-screen tutorial and help modes**

HI 83414 is a highly accurate dual parameter instrument that reflects HANNA's years of experience. The HI 83414 successfully combines turbidity and colorimetric measurements to test the most important parameters of drinking water: turbidity and free/total chlorine. The meter is specially designed for water quality measurements, providing reliable and accurate readings on low turbidity and chlorine values. The HI 83414 meets and exceeds the requirements of USEPA and Standard Methods both for turbidity and colorimetric measurements.

With the powerful CAL CHECK™ function, reliable performance can be validated at any moment by using the exclusive HANNA ready-made, NIST traceable standards. A one-point calibration can be performed using the same CAL CHECK™ standard.

This instrument features an optical system to guarantee accurate results, assure long term stability and minimize stray light and color interferences. They also compensate for variations in intensity of the lamp for less frequent calibration.

The 525 nm interference filter of the colorimeter assures accurate and repeatable results. Repeatability of the measurements are ensured with 25 mm round cuvettes made from special optical glass.

Turbidity measurements can be made in the 0.00 to 4000 NTU (Nephelometric Turbidity Units) range when ratiometric measurements are used and in the 0.00 to 40.0 NTU range when non ratio method is used. The HI 83414 has an EPA compliance reading mode which rounds the reading to meet EPA reporting requirements. Alternative EBC and Nephelos measuring units are available. Depending on the measured sample and needed accuracy, normal measurement, continuous measurement or signal averaging measurement can be selected.

A two, three, four or five-point calibration can be performed by using the supplied (<0.1, 15, 100, 750 and 2000 NTU) standards. If user prepared standards are used, the calibration points can be modified. Free or total chlorine measurements can be made in the 0.00 to 5.00 mg/L (ppm) range.

HI 83414 features complete GLP (Good Laboratory Practice) functions that allow traceability of the calibration conditions. The last calibration points, time and date can be checked.

This meter also incorporates a user-friendly interface with an easy to understand, graphic LCD. All messages are in plain text making them easy to read. Comprehensive contextual help is available at the press of a button. All messages and help screens are available in several languages. Confirmation and error acoustic signals help the user during instrument operation. Furthermore, a tutorial mode of operation guides the user step by step through the analysis process.

The logging function offers complete measurement information. Up to 200 measurements can be stored in the internal memory and consulted at any time. For further storage or analysis options, data can be downloaded to a PC using the USB port.

Turbidity Standards

The nephelometric turbidity meter is designed to be routinely standardized with a known light scattering standard. As with all analytical standards or reference materials, a turbidity standard should be able to perform the following: provide traceability, demonstrate the accuracy of results, calibrate the equipment and methodology, monitor the user performance, validate tests and facilitate comparability to ensure that when the correct procedures have been followed the same analysis of the same materials will produce results that agree with each other whenever they are performed.

Standards and reference materials should be produced and characterized in a technically competent manner, should be homogenous, stable, certified and have available a known uncertainty of measurement. Presently, there are at least two standards recognized and approved by the USEPA, Standard Methods, ASTM and other regulatory agencies, these are formazin and AMCO AEPA-1.

Formazin

Formazin is an aqueous suspension of an insoluble polymer formed by the condensation reaction between hydrazine sulphate and hexamethylenetetramine. Although formazin was suggested as a turbidity standard as early as 1926 it has many limitations such as it's high toxicity, low shelf life, quick rate of settling and easy agglomeration. Also, the diluent for formazin standards must be turbidity free water. This is often difficult to obtain, particularly in a field situation.

AMCO AEPA-1 Standard

Fortunately, since 1982, there is a standard available which overcomes the shortcomings of formazin. This has been developed by the American company, Advanced Polymer Systems, and is a suspended mixture of styrene divinylbenzene polymer spheres.

These standards have the following characteristics:

Stability. AMCO APEA-1 turbidity standards are a stabilized suspension of cross linked styrene divinylbenzene copolymer microbeads in ultrapure water. These beads are chemically inert and keep their chemical balance in a water medium regardless of concentration.

The size scatter of the beads only ranges from 0.06 to 0.2 microns. This small size accounts for random Brownian movement of these beads in suspension, keeping them in constant motion and totally dispersed within the ultra pure water matrix.

Physical properties. Particle size, uniform shape and refractive index make these spheres ideal to characterize light absorption and scatter for 90° behavior in the UV-VIS range. In addition the bead's spherical shape and size impedes the agglomeration or precipitation of the standard. For these reasons the AMCO AEPA-1 standards are very stable.

Reliability. These standards are prepared and bottled in a clean room facility. They are tested for accuracy and stability, fully validated before bottling, and free from any toxic or carcinogenic chemicals or compounds.

HANNA turbidity calibration standards are prepared from NIST traceable primary standard reference materials. All prepared standards are compared to formazin turbidity standard solutions. The values reported on HANNA Certificate of Analysis are the results obtained at the date of analysis. The evaluation of these data is based on Standard Methods.

HI 83414 • Turbidity and Free/Total Chlorine Benchtop Meter, EPA Compliant

HI 731331

HI 731318

HI 92000

ORDERING INFORMATION

HI 83414-01 (115V) and **HI 83414-02** (230V) are supplied with sample cuvettes and caps (5), calibration cuvettes for turbidimeter and colorimeter (HI 83414-11), silicone oil (HI 93703-58), tissue for wiping cuvettes, scissors, power cord and instruction manual.

REAGENTS AND STANDARDS

HI 93414-11	CAL CHECK™ Calibration set for free & total chlorine
HI 93701-01	Reagents for 100 free chlorine tests
HI 93701-03	Reagents for 300 free chlorine tests
HI 93711-01	Reagents for 100 total chlorine tests
HI 93711-03	Reagents for 300 total chlorine tests
HI 88703-11	Turbidity calibration standards (<0.1, 15, 100, 750 and 2000 NTU)

ACCESSORIES

HI 93703-50	Cuvette cleaning solution, 230 mL
HI 93703-58	Silicone oil (15 mL)
HI 731318	Tissue for wiping cuvettes (4)
HI 731331	Glass cuvettes (4)
HI 731335N	Caps for cuvettes (4)
HI 740234	Replacement lamp for EPA turbidimeter
HI 92000	Windows® compatible software
HI 920013	USB cable for PC connection

HI 83414 TURBIDITY SPECIFICATIONS	
Range– Non Ratio Mode	0.00 to 9.99; 10.0 to 40.0 NTU; 0.0 to 99.9; 100 to 268 Nephelos 0.00 to 9.80 EBC
Resolution– Non Ratio Mode	0.01; 0.1 NTU; 0.1; 1 Nephelos; 0.01 EBC
Range–Ratio Mode	0.00 to 9.99; 10.0 to 99.9; 100 to 4000 NTU 0.0 to 99.9; 100 to 26800 Nephelos 0.00 to 9.99; 10.0 to 99.9; 100 to 980 EBC
Resolution–Ratio Mode	0.01; 0.1; 1 NTU; 0.1; 1 Nephelos; 0.01; 0.1, 1 EBC
Range Selection	automatic
Accuracy @25°C/77°F	±2% of reading plus 0.02 NTU (0.15 Nephelos; 0.01 EBC) ±5% of reading above 1000 NTU (6700 Nephelos; 245 EBC)
Repeatability	±1% of reading or 0.02 NTU (0.15 Nephelos; 0.01 EBC) whichever is greater
Stray Light	< 0.02 NTU (0.15 Nephelos; 0.01 EBC)
Light Detector	silicon photocell
Method	Nephelometric method (90°) or Ratio Nephelometric Method (90° & 180°), Adaptation of the USEPA Method 108.1 and Standard Method 2130 B
Measuring Mode	normal, average, continuous
Turbidity Standards	<0.1, 15, 100, 750 and 2000 NTU
Calibration	two, three, four or five-point calibration

HI 83414 FREE AND TOTAL CHLORINE SPECIFICATIONS	
Range	**Free Cl_2:** 0.00 to 5.00 mg/L (ppm) **Total Cl_2:** 0.00 to 5.00 mg/L (ppm)
Resolution	0.01 mg/L (ppm) from 0.00 to 3.50 mg/L (ppm) 0.10 above 3.50 mg/L (ppm)
Accuracy @25°C/77°F	±0.03 mg/L or ±3% of reading (whichever is greater)
Detector	silicon photocell with 525 nm narrow band interference filters
Method	adaptation of the USEPA Method 330.5 and Standard Method 4500-Cl G.
Standards	1.00 mg/L free/total chlorine
Calibration	one-point calibration

HI 83414 GENERAL SPECIFICATIONS	
Light Source/ Life	tungsten filament lamp / greater than 100,000 readings
Display	40 x 70 mm graphic LCD (64 x 28 pixels) with backlight
Log Memory	200 records
PC Interface	USB
Environment	0°C (32°F) to 50°C (122°F); max 95% RH non-condensing
Power Supply	230 V/50 Hz or 115 V/60 Hz 20 W auto-off after 15 minutes of non-use
Dimensions	230 x 200 x 145 mm (9 x 7.9 x 5.7")
Weight	2.5 Kg (88 oz.)

Precision Turbidity Benchtop Meter, EPA Compliant

- **Two measuring ranges:**
  Ratio turbidity, non-ratio turbidity
- **Meets USEPA requirements**
- **GLP features**
- **Two, three, four or five point turbidity calibration**
- **USB PC connectivity**
- **Log up to 200 measurements**
- **Contextual help and tutorial mode**

The HI 88703 turbidity benchtop meter is specially designed for water quality measurements, providing reliable and accurate readings on low turbidity ranges.

This instrument has an EPA compliance reading mode which rounds the reading to meet EPA reporting requirements. Alternative EBC and Nephelos measuring units are available. Depending on the measured sample and needed accuracy, normal, continuous or signal averaging measurement can be selected.

A two, three, four or five-point calibration could be performed by using the supplied standards. When user prepared standards are used, calibration points can be modified.

H 88703 features complete GLP (Good Laboratory Practice) functions that allows traceability of the calibration conditions. The last calibration points, time and date can be checked.

Up to 200 measurements can be stored in internal memory. Data can be transferred to a PC via optional HI 920013 USB cable and HI 92000 Windows® compatible software.

SPECIFICATIONS	HI 88703
Range–Non Ratio Mode	0.00 to 9.99; 10.0 to 40.0 NTU; 0.0 to 99.9; 100 to 268 Nephelos 0.00 to 9.80 EBC
Resolution–Non Ratio Mode	0.01; 0.1 NTU 0.1; 1 Nephelos 0.01 EBC
Range–Ratio Mode	0.00 to 9.99; 10.0 to 99.9; 100 to 4000 NTU 0.0 to 99.9; 100 to 26800 Nephelos 0.00 to 9.99; 10.0 to 99.9; 100 to 980 EBC
Resolution–Ratio Mode	0.01; 0.1; 1 NTU 0.1; 1 Nephelos 0.01; 0.1, 1 EBC
Range Selection	automatic
Accuracy @25°C/77°F	±2% of reading plus 0.02 NTU (0.15 Nephelos; 0.01 EBC) ±5% of reading above 1000 NTU (6700 Nephelos; 245 EBC)
Repeatability	±1% of reading or 0.02 NTU (0.15 Nephelos; 0.01 EBC) whichever is greater
Stray Light	< 0.02 NTU (0.15 Nephelos; 0.01 EBC)
Light Detector	silicon photocell
Light Source/ Life	tungsten filament lamp / greater than 100,000 readings
Display	40 x 70 mm graphic LCD (64 x 28 pixels) with backlight
Method	Nephelometric method (90°) or Ratio Nephelometric Method (90° & 180°), Adaptation of the USEPA Method 108.1 and Standard Method 2130 B
Measuring Mode	normal, average, continuous
Turbidity Standards	<0.1, 15, 100, 750 and 2000 NTU
Calibration	two, three, four or five-point calibration
Log Memory	200 records
PC Interface	USB
Environment	0°C (32°F) to 50°C (122°F); max 95% RH non-condensing
Power Supply	230 V/50 Hz or 115 V/60 Hz 20 W; auto-off after 15 minutes of non-use
Dimensions	230 x 200 x 145 mm (9 x 7.9 x 5.7")
Weight	2.5 Kg (88 oz.)

ORDERING INFORMATION

HI 88703-01 (115V) and **HI 88703-02** (230V) is supplied with sample cuvettes and caps (5), calibration cuvettes, silicone oil (HI 93703-58), tissue for wiping cuvettes, power cord and instruction manual.

STANDARDS

HI 88703-11 Turbidity calibration standards (<0.1, 15, 100, 750 and 2000 NTU)

ACCESSORIES

HI 93703-50 Cuvette cleaning solution, 230 mL
HI 93703-58 Silicone oil (15 mL)
HI 731318 Tissue for wiping cuvettes (4)
HI 731331 Glass cuvettes (4)
HI 731335N Caps for cuvettes (4)
HI 740234 Replacement lamp for EPA turbidimeter
HI 92000 Windows® compatible software
HI 920013 USB cable for PC connection

HI 93414

Turbidity and Free/Total Chlorine Portable Meter with CAL CHECK™ and Fast Tracker™ Technology, EPA Compliant

- High accuracy at low ranges
- Exclusive chlorine CAL CHECK™ calibration validation
- Exclusive Fast Tracker™ system
- User replaceable light source
- Two, three or four point turbidity calibration
- USB and RS232 PC connectivity
- GLP features
- Logging for up to 200 readings
- User friendly, backlit display with guidance codes
- Auto-off
- Battery % on startup
- Continuous current time on display

The HI 93414 measures the most important parameters of drinking water: turbidity and free/total chlorine. Designed for water quality measurements, HI 93414 provides reliable and accurate readings on low turbidity and chlorine values. The HI 93414 meets and exceeds the requirements of USEPA and Standard Methods both for turbidity and colorimetric measurements.

This instrument incorporates an optical system which guarantees accurate results. The optical system, consisting of a tungsten filament lamp, three detectors (scattered, transmitted for turbidimeter range and one for colorimeter range), and a narrow band interference filter @ 525 nm assures long term stability and minimizes stray light and color interferences. It also compensates for variations in intensity of the lamp, making no need for frequent calibration. The 25 mm round cuvettes made from special optical glass guarantee repeatability and consistency of measurements.

Turbidity measurements can be made in the 0.00 to 1000 NTU (Nephelometric Turbidity Units) range. The instrument has an EPA compliance reading mode which rounds readings to meet EPA reporting requirements. Depending on the measured sample and needed accuracy, normal measurement, continuous measurement or signal averaging measurement can be selected. Free or total chlorine measurements can be made in the 0.00 to 5.00 mg/L (ppm) range.

At startup, the meter displays the percentage of remaining battery life and, if too low, a 'low battery' warning message is displayed.

With the powerful CAL CHECK™ function, performance of the instrument can be validated at any time by using the exclusive HANNA ready-made NIST traceable standards. Calibration can be performed at any time for turbidity and colorimetric range. For turbidity, a two, three or four-point calibration is available using supplied (<0.1, 15, 100 and 750 NTU adjustable calibration points) or user prepared standards. For colorimeter measurements, a one-point calibration can be performed.

HI 93414 has complete GLP (Good Laboratory Practice) functions that allow traceability of the calibration conditions. The last calibration points, time and date can be checked at the touch of a button. HI 93414 has a user-friendly interface with an easy to read, large (LCD). Displayed codes guide the user step by step with routine operation and through calibration. Confirmation and error acoustic signals aid the user during instrument operation.

For advanced field applications, the HI 93414 is equipped with Fast Tracker™–Tag Identification System (T.I.S.) that makes data collecting and management simpler than ever. Fast Tracker™ allows users to record the time and location of a specific measurement or series of measurements.

With it's logging function, up to 200 measurements along with it's tagged locations can be stored in internal memory and consulted at any time. Data can be later transferred to a PC via RS232 or USB interface and HANNA HI 92000 software (optional).

Peace of mind.

CAL CHECK™ Calibration Validation

With HANNA's exclusive CAL CHECK™ validation function users are able to verify the performance of the instrument at any time. Using HANNA's exclusive ready-made, NIST traceable standards, validation is user friendly and ensures that the meter is properly calibrated.

iButton® Tags are Easy to Install

Install tags near your sampling points for quick and easy iButton® readings. Each tag contains a computer chip with a unique identification code encased in stainless steel. You can install a practically unlimited amount of tags.

HI 93414 TURBIDITY	
Range	0.00 to 9.99; 10.0 to 99.9 and 100 to 1000 NTU
Range Selection	automatic
Resolution	0.01 NTU from 0.00 to 9.99 NTU; 0.1 NTU from 10.0 to 99.9 NTU; 1 NTU from 100 to 1000 NTU
Accuracy @25°C/77°F	±2% of reading plus 0.02 NTU
Repeatability	±1% of reading or 0.02 NTU, whichever is greater
Stray Light	< 0.02 NTU
Light Detector	silicon photocell
Method	Ratio Nephelometric Method (90°), ratio of scattered and transmitted light; adaptation of the USEPA Method 180.1 and Standard Method 2130 B
Measuring mode	normal, average, continuous
Turbidity Standards	<0.1, 15, 100 and 750 NTU
Calibration	two, three or four-point calibration

HI 93414 FREE AND TOTAL CHLORINE	
Range	**free Cl_2:** 0.00 to 5.00 mg/L; **total Cl_2:** 0.00 to 5.00 mg/L
Resolution	0.01 mg/L from 0.00 to 3.50 mg/L; 0.10 above 3.50 mg/L
Accuracy @25°C/77°F	±0.03 mg/L ±3% of reading (whichever is greater)
Detector	silicon photocell with 525 nm narrow band interference filter
Method	adaptation of the USEPA Method 330.5 and Standard Method 4500-Cl G. the reaction between chlorine and DPD reagent causes a pink tint in the sample.
Standards	1 mg/L free chlorine, 1 mg/L total chlorine
Calibration	one-point calibration

HI 93414 GENERAL SPECIFICATIONS	
Light Source	tungsten filament lamp
Lamp Life	greater than 100,000 readings
Log Memory	200 records
Serial Interface	USB or RS 232
Environment	up to 50°C (122°F); RH max 95% non-condensing
Power Supply	1.5V AA alkaline batteries (4) or AC adapter; auto-off after 15 minutes of non-use
Dimensions / Weight	224 x 87 x 77 mm (8.8 x 3.4 x 3.0") / 512 g (18 oz.)

ORDERING INFORMATION

HI 93414-01 (115V) and **HI 93414-02** (230V) is supplied with sample cuvettes and caps (5), calibration cuvettes for turbidimeter, calibration cuvettes for colorimeter, silicone oil, cuvette wiping tissue, scissors, batteries, AC adapter, instructions and rugged carrying case.

REAGENTS AND STANDARDS

HI 93414-11	CAL CHECK™ Calibration set for Free & Total Chlorine
HI 93701-01	Reagents for 100 Free Chlorine tests
HI 93701-03	Reagents for 300 Free Chlorine tests
HI 93711-01	Reagents for 100 Total Chlorine tests
HI 93711-03	Reagents for 300 Total Chlorine tests
HI 98703-11	Turbidity calibration standards

ACCESSORIES

HI 93703-50	Cuvette cleaning solution, 230 mL
HI 920005	Tag holders with tags (5)
HI 98703-58	Silicone oil, 15 mL
HI 93703-60	Caps for cuvettes (4)
HI 731318	Cuvette cleaning cloth (4)
HI 731331	Glass cuvettes (4)

HI 92000	Windows® compatible software
HI 920011	5 to 9 pin RS232 connection cable
HI 920013	USB cable for PC connection

HI 98703

Turbidity Meter with Fast Tracker™ Technology, EPA Compliant

- **High accuracy at low ranges (below 0.05 NTU)**
- **Two, three or four point calibration**
- **USB and RS232 PC connectivity**
- **Log up to 200 records**
- **GLP Features**
- **User friendly, backlit display with guidance codes**
- **Battery % on startup**
- **Continuous current time on display**

FastTracker™
A new revolution in organized data management

Exclusive Fast Tracker™
For advanced field applications, the HI 98703 is equipped with Fast Tracker™– Tag Identification System (T.I.S.) that makes data collecting and management simpler than ever. Fast Tracker™ allows users to record the time and location of a specific measurement or series of measurements.

The HI 98703 meets and exceeds the requirements of the USEPA Method 180.1 for wastewater and Standard Method 2130 B for drinking water. The instrument has an EPA compliance reading mode which rounds readings to meet EPA reporting requirements. Users will appreciate the accuracy and sensitivity of this instrument, particularly at very low turbidity levels.

This instrument incorporates complete GLP (Good Laboratory Practice) functions that allow traceability of the calibration conditions. The last calibration points, time and date can be checked at the touch of a button.

With it's logging function, up to 200 measurements along with it's tagged locations can be stored in internal memory and consulted at any time. Data can be later transferred to a PC via RS232 or USB interface and HANNA HI 92000 software (optional).

ORDERING INFORMATION

HI 98703-01 (115V), **HI 98703-02** (230V) and **HI 98703-03** (AUS plug) are supplied with sample cuvettes and caps (5), HI 98703-11 calibration cuvettes, HI 93703-58 silicone oil, cuvette cleaning cloth, batteries, AC adapter, instruction manual and rugged carrying case.

STANDARDS

HI 98703-11 Turbidity calibration standards

ACCESSORIES

HI 93703-50 Cuvette cleaning solution, 230 mL
HI 920005 Tag holders with tags (5)
HI 98703-58 Silicone oil, 15 mL
HI 93703-60 Caps for cuvettes (4)
HI 731318 Cuvette cleaning cloth (4)
HI 731331 Glass cuvettes (4)
HI 92000 Windows® compatible software
HI 920011 5 to 9 pin RS232 connection cable
HI 920013 USB cable for PC connection

SPECIFICATIONS	HI 98703
Range	0.00 to 9.99; 10.0 to 99.9 and 100 to 1000 NTU
Range Selection	automatic
Resolution	0.01 NTU from 0.00 to 9.99 NTU; 0.1 NTU from 10.0 to 99.9 NTU; 1 NTU from 100 to 1000 NTU
Accuracy @25°C/77°F	±2% of reading plus 0.02 NTU
Repeatability	±1% of reading or 0.02 NTU, whichever is greater
Stray Light	< 0.02 NTU
Light Detector	silicon photocell
Light Source	tungsten filament lamp
Lamp Life	greater than 100,000 readings
Method	Ratio Nephelometric Method (90°), ratio of scattered and transmitted light; Adaptation of the USEPA Method 180.1 and Standard Method 2130 B
Measuring mode	normal, average, continuous
Turbidity Standards	<0.1, 15, 100 and 750 NTU
Calibration	two, three or four-point calibration
LOG Memory	200 records
Serial Interface	USB or RS232
Environment	up to 50°C (122°F); RH max 95% non-condensing
Power Supply	1.5V AA alkaline batteries (4) or AC adapter; auto-off after 15 minutes of non-use
Dimensions / Weight	224 x 87 x 77 mm (8.8 x 3.4 x 3.0") / 512 g (18 oz.)

Turbidity Benchtop Meter, ISO

- **Graphic display, backlit LCD**
- **Two, three, four or five point calibration**
- **GLP features**
- **Log up to 200 records**
- **Contextual help and tutorial mode**
- **USB PC connectivity**

The HI 88713 turbidity bench meter meets and exceeds the requirements of the ISO 7027 standard.

HI 88713 is based on an optical system which guarantees accurate results, long term stability and minimizes stray light and color interferences. It also compensates for variations in intensity of the LED, limiting the need for frequent calibration.

Depending on the measured sample and needed accuracy, normal, continuous or signal averaging measurement can be selected.

A two, three, four or five-point calibration can be performed using the supplied standards. Calibration points can be modified when user prepared standards are used.

The HI 88713 turbidity bench meter has complete GLP (Good Laboratory Practice) functions that allow traceability of the calibration conditions.

The HI 88713 turbidity bench meter has a user-friendly interface with an easy to understand, graphic LCD. Comprehensive contextual help is available at a simple key press. Furthermore, a tutorial mode of operation guides the user step by step through the analysis process.

Up to 200 measurements can be stored in internal memory. Data can be transferred to a PC via optional HI 920013 USB cable and HI 92000 Windows® compatible software.

SPECIFICATIONS		HI 88713
Range	FNU Mode	0.00 to 9.99; 10.0 to 99.9; 100 to 1000 FNU
	FAU Mode	10.0 to 99.9; 100 to 4000 FAU
	NTU Ratio Mode	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
	NTU Non-Ratio Mode	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
Range Selection		automatic
Resolution	FNU Mode	0.01; 0.1; 1 FNU
	FAU Mode	0.1; 1 FAU
	NTU Ratio Mode	0.01; 0.1; 1 NTU / 0.01; 0.1; 1 EBC
	NTU Non-Ration Mode	0.01; 0.1; 1 NTU / 0.01; 0.1; 1 EBC
Accuracy @25°C/77°F	FNU Mode	±2% of reading plus stray light
	FAU Mode	±10% of reading
	NTU Ratio Mode	±2% of reading plus stray light / ±5% of reading above 1000 NTU
	NTU Non-Ratio Mode	±2% of reading plus stray light
Repeatability		±1% of reading or stray light, whichever is greater
Stray Light		< 0.1 NTU (0.05 EBC)
Light Detector		silicon photocell
Light Source		IR LED
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
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 / Weight		230 x 200 x 145 mm (9 x 7.9 x 5.7") / 2.5 Kg (88 oz.)

ORDERING INFORMATION

HI 88713-01 (115V) and **HI 88713-02** (230V) are supplied with sample cuvettes and caps (6), calibration cuvettes, silicone oil, tissue for wiping cuvettes, power adapter and instruction manual.

STANDARDS

HI 88713-11 Turbidity calibration standards (<0.1, 15, 100, 750 FNU and 2000 NTU)

ACCESSORIES

HI 93703-50 Cuvette cleaning solution, 230 mL
HI 98703-58 Silicone oil (15 mL)
HI 731318 Tissue for wiping cuvettes (4)
HI 731331 Glass cuvettes (4)
HI 731335N Caps for cuvettes (4)
HI 92000 Windows® compatible software
HI 920013 USB cable for PC connection

HI 98713

Portable Turbidity Meter with Fast Tracker™ Technology, ISO

- **Two, three or four point calibration**
- **USB and RS 232 PC connectivity**
- **Log up to 200 records**
- **GLP Features**
- **User friendly, backlit LCD display with guidance codes**
- **Battery % on startup**
- **Continuous current time on display**

The HI 98713 meets and exceeds the requirements of the ISO 7027 for water quality and provides a reliable and accurate readings on low turbidity values. An effective algorithm calculates and converts the detectors output in FNU. Depending on the needed accuracy, normal, continuous, or signal averaging can be selected.

The optical system–The Infrared Method (ISO 7027), consists of a infrared LED and two detectors (scattered and transmitted light), that assures long term stability and minimizes stray light and color interferences. HI 98713 also compensates for variations in intensity of the LED, minimizing the need for frequent calibration.

This instrument incorporates complete GLP (Good Laboratory Practice) functions that allow traceability of the calibration conditions. The last calibration points, time and date can be checked at the touch of a button.

With it's logging function, up to 200 measurements along with it's tagged locations can be stored in internal memory and consulted at any time. Data can be later transferred to a PC via RS232 or USB interface and HANNA HI 92000 software (optional).

ORDERING INFORMATION

HI 98713-01 (115V) and **HI 98713-02** (230V) is supplied with sample cuvettes and caps (5), HI 98713-11 calibration cuvettes, HI 93703-58 silicone oil, cuvette cleaning cloth, batteries, AC adapter, instructions and rugged carrying case.

SOLUTIONS

HI 98713-11	Turbidity calibration standards
HI 93703-50	Cuvette cleaning solution, 230 mL

ACCESSORIES

HI 920005	Tag holders with tags (5)
HI 98703-58	Silicone oil (15 mL)
HI 93703-60	Caps for cuvettes (4)
HI 731318	Cuvette cleaning cloth (4)
HI 731331	Glass cuvettes (4)
HI 92000	Windows® compatible software
HI 920011	5 to 9 pin RS232 connection cable
HI 920013	USB cable for PC connection

FastTracker™
A new revolution in organized data management

Exclusive Fast Tracker™
For advanced field applications, the HI 98713 is equipped with Fast Tracker™–Tag Identification System (T.I.S.) that makes data collecting and management simpler than ever. Fast Tracker™ allows users to record the time and location of a specific measurement or series of measurements.

SPECIFICATIONS	HI 98713
Range	0.00 to 9.99; 10.0 to 99.9 and 100 to 1000 FNU
Range Selection	automatic
Resolution	0.01 FNU from 0.00 to 9.99 FNU; 0.1 FNU from 10.0 to 99.9 FNU; 1 FNU from 100 to 1000 FNU
Accuracy @25°C/77°F	±2% of reading plus 0.1 FNU
Repeatability	±1% of reading or 0.1 FNU, whichever is greater
Stray Light	< 0.1 FNU
IR Detector	silicon photocell
Light Source	860 nm infrared LED
Lamp Life	greater than 100,000 readings
Method	adaptation of ISO 7027, ratio method with 90° and 180° detector
Turbidity Standards	<0.1, 15, 100 and 750 FNU
Calibration	two, three or four-point calibration
Log Memory	200 records
Serial Interface	USB or RS232
Environment	up to 50°C (122°F); RH max 95% non-condensing
Power Supply	1.5V AA alkaline batteries (4) or AC adapter; auto-off after 15 minutes of non-use
Dimensions / Weight	224 x 87 x 77 mm (8.8 x 3.4 x 3.0") / 512 g (18 oz.)

HANNA instruments

With Great Products, Come Great Results™

Logging Turbidity Meters, ISO

HI 93703 series are microprocessor based turbidity meters that provide laboratory accuracy for field turbidity measurements.

The HI 93703 is easy to calibrate (with 3 point calibration) using AMCO-EPA standards and is ISO 7027 compliant.

HANNA instruments has chosen 10 FTU* as the calibration point because it is the value that best fits the water turbidity measurements in different applications, from drinking water to wastewater treatment. HANNA instruments uses the primary standard AMCO-AEPA-1 to avoid all formazine-related problems. Formazine is a very toxic, unstable substance which requires particular care: its standards have to be prepared only a few minutes before performing the calibration, and cannot be reused because of their short life. HANNA AMCO-AEPA-1 standards are extremely stable, can be reused, and last up to six months if free from contamination. HI 93703 can be used with both standards.

The HI 93703-11 enhanced version features a real-time clock, logging for up to 199 measurements and PC compatibility via the RS232 interface and Windows® compatible HI 92000 software.

Both versions meet the requirements of GLP (Good Laboratory Practice) protocols for last calibration data storage.

SPECIFICATIONS	HI 93703
Range	0.00 to 50.00 FTU* 50 to 1000 FTU*
Resolution	0.01 FTU* (0.00 to 50.00 FTU) 1 FTU (50 to 1000 FTU)
Accuracy @25°C/77°F	±0.5 FTU or ±5% of reading (whichever is greater)
Calibration	three points (0 FTU, 10 FTU and 500 FTU)
Light Source	infrared LED
Light Detector	silicon photocell
Battery Type / Life	1.5V AA (4) /approximately 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.)

	HI 93703-11 Same as HI 93703 with additional features:
Data Logging	199 measurements, on-demand
PC Connection	through serial port and HI 92000 Windows® compatible software (not included)
Real Time Clock	yes

*HI 93703 has been designed according to the ISO 7027 International Standard, consequently the turbidity unit is the FTU (Formazine Turbidity Unit). FTU is equivalent to the other internationally recognized unit: NTU (Nephelometric Turbidity Unit).

ORDERING INFORMATION

HI 93703 is supplied complete with glass cuvette, batteries and instructions.
HI 93703-11 is supplied complete with glass cuvette, batteries and instructions.
HI 93703C, kit including HI 93703 and HI 731313 maintenance kit.

SOLUTIONS

HI 93703-0	AMCO-AEPA-1@ 0 FTU calibration solution, 30 mL
HI 93703-05	AMCO-AEPA-1 @ 500 FTU calibration solution, 30 mL
HI 93703-10	AMCO-AEPA-1 @ 10 FTU calibration solution, 30 mL

ACCESSORIES

HI 731313	Maintenance kit: rugged carrying case including HI 93102-0 and HI 93102-20 calibration solutions, HI 93703-50 cuvette cleaning solution, cuvettes (2) and cuvette cleaning cloth
HI 731318	Cuvette cleaning cloth (4)
HI 731321	Spare glass cuvettes (4)
HI 92000	Windows®compatible software
HI 920011	Serial cable (5 to 9 pin) for PC connection

HI 93102

Complete Tool for Water Analysis: Turbidity, Cl_2, pH, Br, Fe, I and CYS

- **USEPA Compliance**

  In the turbidimetric mode, the HI 93102 uses the nephelometric principle according to USEPA's 180.1 method and the Standard Method 2130B.

- **Custom Calibration Points**

  Advanced electronics allow operators to calibrate the meter at a selectable point in from 0.00 to 50.00 NTU.

- **Logging Capability**

  The HI 93102 makes it possible to log and retrieve up to 25 different samples.

The most important parameters needed for water analysis, especially in drinking water, can be measured with HANNA's HI 93102 portable meter. This instrument not only measures turbidity, but also pH, total and free chlorine, bromine, iodine, iron, and cyanuric acid (CYS). Achieve laboratory results in the field quickly and easily.

Measurements are made quickly and repeatedly through a sophisticated, yet easy-to-use microprocessor. In colorimetric mode, users can select between factory preprogrammed calibration or calibrating the meter on their own, and measure either concentration or relative absorbance of the sample. Up to 25 measured samples can be stored in memory together with time and date. Miniaturization of the electronics has made it possible to offer unsurpassed accuracy and quality in a portable unit weighing just one pound!

ORDERING INFORMATION

HI 93102 is supplied with measurement cuvette cap, batteries and instruction manual.

ACCESSORIES

HI 731318	Cuvette cleaning cloth (4 pcs)
HI 731321	Spare measurement cuvettes (4 pcs)
HI 93701-01*	Reagent kit for 100 tests (Free Cl_2)
HI 731327	Rugged carrying case with calibration solutions HI 93102-0 and HI 93102-20, HI 93703-50 cleaning solution, HI 731318 cuvette cleaning cloth and 2 measurement cuvettes
HI 93710-01*	Reagent kit for 100 tests (pH)
HI 93711-01*	Reagent kit for 100 tests (T. Cl_2)
HI 93716-01*	Reagent kit for 100 tests (Br)
HI 93718-01*	Reagent kit for 100 tests (I)
HI 93722-01*	Reagent kit for 100 tests (CYS)
HI 93746-01**	Reagent kit, 100 pkt for 50 tests (Fe LR)
HI 93102-0	AMCO-EPA-1 cal. sol. @ 0 NTU (30 mL)
HI 93102-20	AMCO-EPA-1 cal. sol. @ 20 NTU (30 mL)

* set of 300 tests available, -03
** set of 150 tests available, -03

SPECIFICATIONS		HI 93102
Range	Turbidity	0.00 to 9.99 NTU† / 0.00 to 50.0 NTU†
	Br	0.00 to 8.00 mg/L (ppm)
	Free Chlorine	0.00 to 2.50 mg/L (ppm)
	Total Chlorine	0.00 to 3.50 mg/L (ppm)
	CYS	0 to 80 mg/L (ppm)
	I	0.0 to 12.5 mg/L (ppm)
	Fe LR	0.00 to 1.00 mg/L (ppm)
	pH	6.5 to 8.5 pH
Resolution	Turbidity	0.01 and 0.1 NTU†
	Br	0.01 mg/L (ppm)
	Chlorine	0.01 mg/L (ppm)
	CYS	1 mg/L (ppm)
	I	0.1 mg/L (ppm)
	Fe LR	0.01 mg/L (ppm)
	pH	0.1 pH
Accuracy @25°C/77°F	Turbidity	±0.5 NTU or ±5% of reading (whichever is greater)
	Br	±0.08 mg/L (ppm) ±3% of reading
	Chlorine	±0.03 mg/L (ppm) ±3% of reading
	CYS	±1 mg/L (ppm) ±15% of reading
	I	±0.1 mg/L (ppm) ±5% of reading
	Fe LR	±0.02 mg/L (ppm) ±8% of reading
	pH	±0.1 pH
Calibration		two points; selectable between 0.00 - 50.0 FTU (0.00 and 20.0 FTU recommended)
Light Source		pure green LED
Light Detector		silicon photocell
Battery Type / Life		1.5V AA (4) / approximately 60 hours of continuous use or 1000 measurements; automatic shut-off selectable after 10, 20, 30, 40, 50 or 60 minutes
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 NTU (Nephelometric Turbidity Unit) = FTU (Formazine Turbidity Unit)

HANNA instruments

With Great Products, Come Great Results™

Portable Turbidity Meter and Bentonite Monitoring

FastTracker™

- **GLP Features**
- **Fast Tracker™ with iButton™ tags**
- **Continuous measurement mode**
  Verifies the settling rate of suspended matter.
- **Signal Average (AVG) mode**
  Accumulates multiple readings giving a final average value.
- **Backlit LCD**
- **USB**

Wines with low phenol contents, such as rosé, light reds and whites should be checked for protein stability before bottling. HANNA is offers a quick test to verify the risk of future protein haze formation. If protein instability is detected, a subsequent test can help define the right amount of bentonite to be added for improving protein stability. It is important not to overdose bentonite to avoid stripping wine flavor, body, and significant loss of color, especially in young red wines. Moreover, adding only the necessary amount of bentonite to obtain the desired protein stability also saves costs.

The HI 83749 measures turbidity of samples from 0.00 to 1200 NTU (Nephelometric Turbidity Units) and is USEPA compliant. In the USEPA measurement mode the instrument rounds the readings to meet USEPA reporting requirements.

SPECIFICATIONS	HI 83749
Range	0.00 to 9.99 NTU*; 10.0 to 99.9 NTU; 100 to 1200 NTU automatic range selection
Resolution	0.01 NTU from 0.00 to 9.99 NTU; 0.1 NTU from 10.0 to 99.9 NTU; 1 NTU from 100 to 1200 NTU
Accuracy @25°C/77°F	±2% of reading plus 0.05 NTU
Repeatability	±1% of reading plus 0.05 NTU
Stray Light	< 0.05 NTU
Light Source	tungsten filament lamp
Light Detector	silicon photocell
Method	Ratio Nephelometric
Display	60 x 90 mm backlit LCD
Calibration	two, three or four points
LOG Memory	200 records
Serial Interface	RS 232 or USB 1.1
Environment	0 to 50°C; max 95% RH non-condensing
Battery Type	1.5V AA batteries (4) / 12 VDC adapter
Auto Shut-off	after 15 minutes of non-use
Dimensions	224 x 87 x 77 mm (8.7 x 3.3 x 3.1")
Weight	512 g (17.6 oz.)

* NTU (Nephelometric Turbidity Units)

ORDERING INFORMATION

HI 83749-01 (115V), **HI 83749-02** (230V) and **HI 83749-03** (AUS plug) are supplied with sample cuvettes and caps (6), calibration cuvettes (HI 83749-11) (4), bentocheck reagent (HI 83749-0) and silicone oil (HI 93703-58), 1000 µL automatic pipette with two tips and instructions sheet, 25 mL glass vials with caps (4), 1 mL syringe with two tips, funnel, filter paper (25), cuvette cleaning cloth, 12 VDC adapter, batteries, instructions and rugged carrying case.

OPTIONAL REAGENTS

HI 83749-11	Turbidity calibration standards
HI 83749-20	Bentocheck solution, 100 mL

ACCESSORIES

HI 731312	Red wine decolorization kit (25 pcs)
HI 93703-58	Silicone oil (15 mL)
HI 731331	Glass cuvettes (4)
HI 731335N	Caps for cuvettes (4)
HI 93703-50	Cuvette cleaning solution, 230 mL
HI 731318	Cuvette cleaning cloth (4)
HI 740220	25 mL glass vial with cap (2)
HI 731341	Automatic pipette 1000 µL
HI 731351	Tips fo automatic pipette 1000 µL (25)
HI 740233	Filter paper type II (100)
HI 740142P	1 mL graduated syringe (10)
HI 740144P	Tips for 1 mL syringe (10)
HI 740234	Replacement lamp for EPA turbidimeter
HI 92000	Windows® compatible software
HI 920011	RS232 connection cable
HI 920005	iButton tag holders with tags (5)

HI 847491 • HI 847492 • HI 847493

Haze Meters for Beer Quality Analysis

- **Utilizes Fast Tracker–Tag ID System**
- **LED optical system**
- **PC compatible via USB**
- **GLP Features**
- **Log on demand**
- **Large, backlit LCD**

FastTracker™
A new revolution in organized data management

The HI 847491, HI 847492, and HI 847493 are auto diagnostic haze in beer meters. Each instrument features a different measuring unit or light source to comply with different standard requirements.

HI 847491 is designed according to the ISO standard for haze in beer measurements.

HI 847492 is designed, according to the ASBC (American Society of Brewing Chemists) standard for haze in beer measurements.

HI 847493 is designed, according with the MEBAK (Central European Brewing Commission) standard requirements, for haze in beer measurements.

These instruments compensate a beer color to guarantee accurate readings during the brewering process. The optical system consists of an LED and multiple detectors. A two, three or four point calibration can be easily performed at any time using the supplied or user prepared standards.

These meters have all the necessary GLP (Good Laboratory Practice) features to allow maximum traceability of data. Features include a real time clock, log on demand (up to 200 measurements), and Fast Tracker™ – Tag Identification System.

These meters also incorporate a continuous measurement mode to measure the settling rate of suspended matter, and a signal average (AVG) mode to accumulate multiple readings giving a final average value. The average mode is particularly useful to measure samples with suspended particles with different dimensions.

All three meters feature a user-friendly interface, with a large backlit LCD. Acoustic signals and display codes to guide the user step-by-step through routine operations.

Why this instrument is so important...

Beer haze may be defined as an insoluble or semisoluble particulate matter which is small enough to form a colloidal suspension in beer. These particles scatter transmitted light and are observed as a degradation in the transparency of the beer.

The beer clarity is a parameter constantly controlled in brewery, and to assure a consistent product quality, the brewmaster needs more than visual inspection.

Several substances can cause haze in beer, but the most frequently encountered problem is due to a cross-linking of polyphenol and protein.

A range of stabilization treatments are available for avoiding haze problems. The products have to be controlled on several steps during brewing process, in particular after filtration and before the beer enters the single tanks.

BEER HAZE TABLE

GRADE	EBC	ASBC
Brilliant	0.0 to 0.5	0.0 to 34.5
Almost Brilliant	0.5 to 1.0	34.5 to 69
Very Slightly Hazy	1.0 to 2.0	69 to 138
Slightly Hazy	2.0 to 4.0	138 to 276
Hazy	4.0 to 8.0	276 to 552
Very Hazy	> 8.0	> 552

Methods

Many methods were used to measure turbidity over the years. The Jackson Candle Turbidimeter was used to measure turbidity as Jackson turbidity units (JTU). The method is visual and are not considered very accurate. To obtain more accurate readings a nephelometer should be used as a turbidity reading instrument.

The HI 847491 reports the measurements in FNU (Formazin Nephelometric Units), HI 847492 reports the measurements in FTU (Formazin Turbidity Units). FTU units are equal to NTU units (Nephelometric Turbidity Units). The HI 847493 reports the measurements in EBC (European Brewery Convention). The conversion table between these measurement units is shown below:

HI 731318 Cuvette Cleaning Cloth

HI 920005 Tag holders with tags

	NTU/FNU/FTU	EBC	ASBC	HELM
1 NTU/1 FNU/1 FTU	1	0.25	17.5	0.1
1 EBC	4	1	69	40
1 ASBC	0.057	0.014	1	0.579
1 HELM	10	0.025	1.725	1

SPECIFICATIONS	HI 847491	HI 847492	HI 847493
Range	0.00 to 9.99 FNU 10.0 to 99.9 FNU 100 to 1000 FNU	0.00 to 9.99 FTU 10.0 to 99.9 FTU 100 to 1000 FTU	0.00 to 9.99 EBC 10.0 to 99.9 EBC 100 to 250 EBC
Range Selection	automatic		
Resolution	0.01 FNU from 0.00 to 9.99 FNU; 0.1 FNU from 10.0 to 99.9 FNU; 1 FNU from 100 to 1000 FNU	0.01 FTU from 0.00 to 9.99 FTU; 0.1 FTU from 10.0 to 99.9 FTU; 1 FTU from 100 to 1000 FTU	0.01 EBC from 0.00 to 9.99 EBC; 0.1 EBC from 10.0 to 99.9 EBC; 1 EBC from 100 to 250 EBC
Accuracy @25°C/77°F	±2% of reading plus 0.05 FNU	±2% of reading plus 0.05 FTU	±2% of reading plus 0.02 EBC
Repeatability	±1% of reading or 0.02 FNU, whichever is greater	±1% of reading or 0.02 FTU, whichever is greater	±1% of reading 0.01 EBC, whichever is greater
Stray Light	< 0.1 FNU	< 0.1 FTU	< 0.03 EBC
Light Source	IR LED @ 860 nm	LED @ 580 nm	LED @ 650 nm
Light Detector	silicon photocell		
Method	Ratio Nephelometric method.		
Display	60 x 90 mm backlit LCD		
Calibration	two, three or four point calibration		
Log Memory	200 records		
Serial Interface	RS232 or USB		
Environment	0 to 50°C (32 to 122°F); RH max 95% non-condensing		
Power Supply	1.5V AA alkaline batteries (4) or AC adapter		
Auto-off	after 15 minutes of non-use		
Dimensions	224 x 87 x 77 mm (8.8 x 3.4 x 3.0")		
Weight	512 g (18 oz.)		

ORDERING INFORMATION

HI 847491-01 (115V) and **HI 847491-02** (230V) are supplied with HI 98501-1 Checktemp® thermometer, Checktemp® instruction manual, sample cuvettes and caps (6), calibration cuvettes (HI 847491-11) (4), 25 mL glass vials with caps (4), cuvette cleaning cloth, batteries, AC adapter, instrument quality certificate, instructions and rugged carrying case.

HI 847492-01 (115V) and **HI 847492-02** (230V) is supplied with HI 98501-1 Checktemp® thermometer, Checktemp® instruction manual, sample cuvettes and caps (6), calibration cuvettes (HI 847492-11) (4), 25 mL glass vials with caps (4), cuvette cleaning cloth, batteries, AC adapter, instrument quality certificate, instructions and rugged carrying case.

HI 847493-01 (115V), **HI 847493-02** (230V) and **HI 847493-03** (AUS plug) is supplied with sample cuvettes and caps (6), calibration cuvettes (HI 847493-11) (4), 25 mL glass vials with caps (4), cuvette cleaning cloth, batteries, AC adapter, instrument quality certificate, instructions and rugged carrying case.

ACCESSORIES

HI 93703-58	Silicone oil, 15 mL
HI 847491-11	Turbidity calibration standards (HI 847491)
HI 847492-11	Turbidity calibration standards (HI 847492)
HI 847493-11	Turbidity calibration standards (HI 847493)
HI 731331	Glass cuvettes (4)
HI 731335N	Caps for cuvettes (4)
HI 93703-50	Cuvette cleaning solution, 230 mL
HI 731318	Cuvette cleaning cloth (4)
HI 740220	25 mL glass vial with cap (2)
HI 92000	Windows® compatible software
HI 920011	RS232 connection cable
HI 920005	5 tag holders with tags
HI 740027P	1.5V AA battery (12)

Accessories

HI 731313	Maintenance kit: rugged carrying case including HI 93102-0 and HI 93102-20 calibration solutions, HI 93703-50 cuvette cleaning solution, cuvettes (2) and cuvette cleaning cloth
HI 731318	Cuvette cleaning cloth (4)
HI 731321	Spare glass cuvettes (4)
HI 731331	Glass cuvettes (4)
HI 731335N	Caps for cuvettes (4)
HI 740220	25 mL glass vial with cap (2)
HI 740027P	1.5V AA battery (12)
HI 740234	Replacement lamp for EPA turbidimeter
HI 847491-11	Calibration standard cuvette (HI 847491)
HI 847492-11	Calibration standard cuvette (HI 847492)
HI 847493-11	Calibration standard cuvette (HI 847493)
HI 92000	Windows® compatible software
HI 920005	Tag holders with tags (5)
HI 920011	5 to 9 pin RS232 connection cable
HI 920013	USB cable for PC connection
HI 93703-50	Cuvette cleaning solution, 230 mL
HI 98703-51	Dispersing agent, 20 mL
HI 93703-57	Glycerol, 30 mL (4)
HI 98703-58	Silicone oil, 15 mL
HI 93703-59	Activated charcoal (10 g)
HI 93703-60	Caps for cuvettes (4)

Turbidity Standard Solutions

The HANNA **turbidity calibration solutions** are referenced to the AMCO AEPA-1 standards, at 0, 10, 20 and 500 FTU.

They are preferred to the formazine based standards, as they are non-toxic, stable, reusable and long lasting.

CODE	DESCRIPTION	PACKAGE
HI 93102-0	AMCO-AEPA-1 calibration solution at 0 NTU	30 mL bottle
HI 93102-20	AMCO-AEPA-1 calibration solution at 20 NTU	30 mL bottle
HI 93124-0	standard solution at 0 EBC	30 mL bottle
HI 93124-1	standard solution at 2.5 EBC	30 mL bottle
HI 93124-2	standard solution at 125 EBC	30 mL bottle
HI 93703-0	AMCO-AEPA-1 calibration solution at 0 FTU	30 mL bottle
HI 93703-05	AMCO-AEPA-1 calibration solution at 500 FTU	30 mL bottle
HI 93703-10	AMCO-AEPA-1 calibration solution at 10 FTU	30 mL bottle

Typical sources of turbidity in drinking water include the following:

- **Waste discharge**
- **Runoff from watersheds, especially those that are disturbed or eroding**
- **Algae or aquatic weeds and products of their breakdown in water reservoirs, rivers, or lakes**
- **Humic acids and other organic compounds resulting from decay of plants, leaves, etc. in water sources**
- **High iron concentrations which give water a rust-red coloration (mainly in ground water and ground water under the direct influence of surface water).**
- **Air bubbles and particles from the treatment process**

Simply stated, turbidity is the measure of relative clarity of a liquid. Clarity is important when producing drinking water for human consumption, and in many manufacturing uses.

Once considered as a mostly aesthetic characteristic of drinking water, significant evidence exists that controlling turbidity is a competent safeguard against pathogens in drinking water.

Turbidity measurement is a quick and inexpensive test that can help operators diagnose and treat water problems. Proper calibration technique and the use of high quality turbidity standards, such as the AMCO AEPA standards, ensure that measurements can be fully validated, are in compliance with regulatory requirements, are traceable to Primary Reference Materials and, most importantly, are comparable. The user can be certain that their measurements irrespective of instrument are all traceable in an unbroken chain to the same NIST Primary Standard.