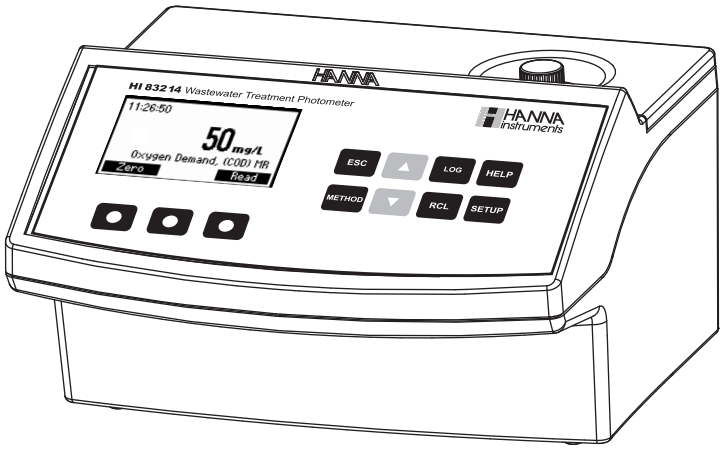
Instruction Manual

HI 83214

Multiparameter Bench Photometer for Wastewater Treatment



HANNA® instruments

www.hannainst.com

Dear Customer,

Thank you for choosing a Hanna product. Please read this instruction manual carefully before using the meter. This manual will provide you with the necessary information for the correct use of the instrument. If you need additional technical information, do not hesitate to e-mail us at tech@hannainst.com.

TABLE OF CONTENTS

PRELIMINARY EXAMINATION 3
ABBREVIATIONS 3
GENERAL DESCRIPTION 3
SPECIFICATIONS 4
PRECISION AND ACCURACY 4
PRINCIPLE OF OPERATION 4
FUNCTIONAL DESCRIPTION 6
TIPS FOR AN ACCURATE MEASUREMENT 8
HEALTH & SAFETY 12
METHOD REFERENCE TABLE 13
OPERATIONAL GUIDE 15
SETUP 17
HELP MODE 19
AMMONIA LOW RANGE 20
AMMONIA HIGH RANGE 22
CHLORINE, FREE 24
CHLORINE, TOTAL 26
NITRATE 28
NITROGEN, TOTAL LR 30
NITROGEN, TOTAL HR 35
OXYGEN DEMAND, CHEMICAL LR 40
OXYGEN DEMAND, CHEMICAL MR 43
OXYGEN DEMAND, CHEMICAL HR 46
PHOSPHORUS, REACTIVE 49
PHOSPHORUS, ACID HYDROLYZABLE 51
PHOSPHORUS, TOTAL LR 55
PHOSPHORUS, REACTIVE HR 59
PHOSPHORUS, TOTAL HR 62
ERRORS AND WARNINGS 66
DATA MANAGEMENT 67
STANDARD METHODS 67
ACCESSORIES 68
WARRANTY 69
HANNA LITERATURE 69

PRELIMINARY EXAMINATION

Please examine this product carefully. Make sure that the instrument is not damaged. If any damage occurred during shipment, please notify your Local Hanna Office.

Each Meter is supplied complete with:

- Ten Sample Vials
- Cloth for wiping vials (1 pcs.)
- Scissors
- Instruction Manual

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

ABBREVIATIONS

°C:	degree Celsius
°F:	degree Fahrenheit
COD:	Chemical Oxygen Demand
EPA:	US Environmental Protection Agency
µg/L:	micrograms per liter (ppb)
mg/L:	milligrams per liter (ppm)
g/L:	grams per liter (ppt)
mL:	milliliter
LR:	low range
MR:	medium range
HR:	high range

GENERAL DESCRIPTION

HI 83214 is a multiparameter bench photometer. It measures 15 colorimetry based methods.
The reagents are in liquid or powder form and are supplied in bottles, ready-to-use vials or packets. The amount of reagent is precisely dosed to ensure maximum repeatability.

HI 83214 bench photometer can be connected to a PC via an USB cable. Its software companion is **HI 92000** Windows® Compatible Software that helps the user to manage all the results.

HI 83214 has a powerful interactive user support that assists the user during the analysis process.
Each step in the method is help supported on the LCD. Help functions are accessed easily by pressing the **HELP** key. A tutorial mode is also available.

SPECIFICATIONS

Light Life	Life of the instrument
Light Detector	Silicon Photocell
Environment	0 to 50 °C (32 to 122 °F); max 90% RH non-condensing
Power Supply	External 12 Vdc power adaptor
Dimensions	235 x 212 x 143 mm (9.2 x 8.34 x 5.62")
Weight	1.5 Kg (3.3 lb)

For specifications related to each method (e.g. range, resolution etc.) refer to the related measurement section.

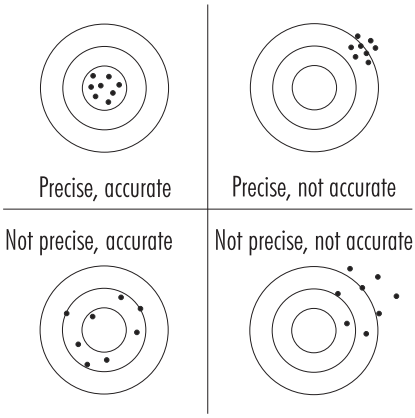
PRECISION AND ACCURACY

Precision is how closely repeated measurements agree with each other. Precision is usually expressed as standard deviation (SD).

Accuracy is defined as the nearness of a test result to the true value.

Although good precision suggests good accuracy, precise results can be inaccurate. The figure explains these definitions.

For each method, the precision is expressed in the related measurement section.



PRINCIPLE OF OPERATION

Absorption of light is a typical phenomenon of interaction between electromagnetic radiation and matter. When a light beam crosses a substance, some of the radiation may be absorbed by atoms, molecules or crystal lattices.

If pure absorption occurs, the fraction of light absorbed depends both on the optical path length through the matter and on the physical-chemical characteristics of substance according to the Lambert-Beer Law:

$$-\log I/I_o = \varepsilon_\lambda \, c \, d$$

or

$$A = \varepsilon_\lambda \, c \, d$$

Where:

-log I/I_o = Absorbance (A)

I_o = intensity of incident light beam

I = intensity of light beam after absorption

ε_λ = molar extinction coefficient at wavelength λ

c = molar concentration of the substance

d = optical path through the substance

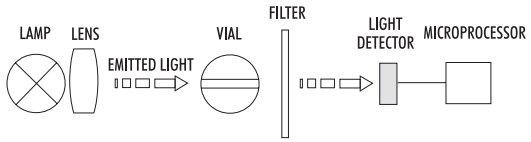
Therefore, the concentration "c" can be calculated from the absorbance of the substance as the other factors are known.

Photometric chemical analysis is based on the possibility to develop an absorbing compound from a specific chemical reaction between sample and reagents.

Given that the absorption of a compound strictly depends on the wavelength of the incident light beam, a narrow spectral bandwidth should be selected as well as a proper central wavelength to optimize measurements.

The optical system of **HI 83214** is based on special subminiature tungsten lamps and narrow-band interference filters to guarantee both high performance and reliable results.

Three measuring channels (at three different wavelengths) allow a wide range of tests.



Instrument block diagram (optical layout)

A microprocessor-controlled special tungsten lamp emits radiation which is first optically conditioned and beamed through the sample contained in the vial. The optical path is fixed by the diameter of the vial. Then the light is spectrally filtered to a narrow spectral bandwidth, to obtain a light beam of intensity I_o or I.

The photoelectric cell collects the radiation I that is not absorbed by the sample and converts it into an electric current, producing a potential in the mV range.

The microprocessor uses this potential to convert the incoming value into the desired measuring unit and to display it on the LCD.

The measurement process is carried out in two phases: first the meter is zeroed and then the actual measurement is performed.

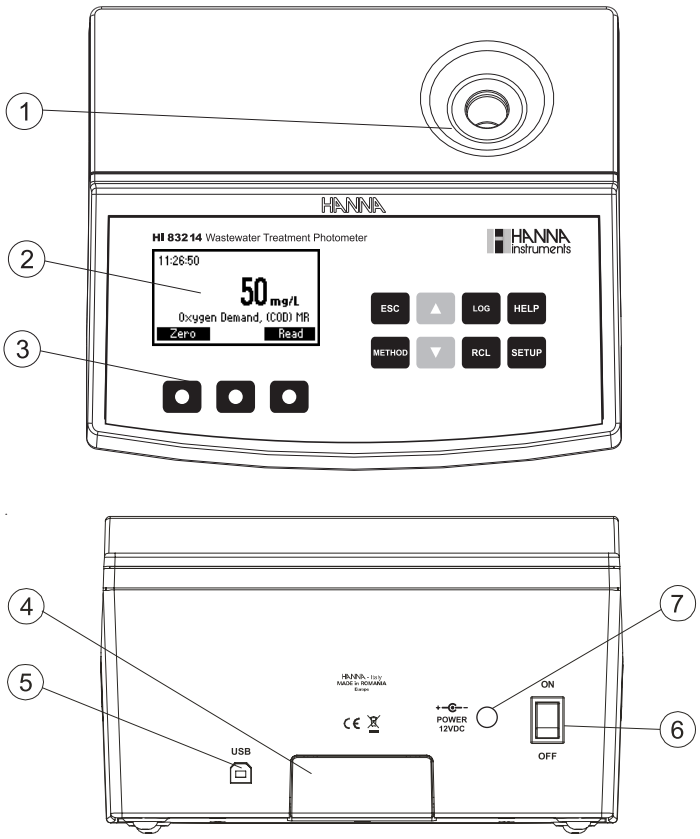
The vial has a very important role because it is an optical element and thus requires particular attention. It is important that both the measurement and the calibration (zeroing) vials are optically identical to provide the same measurement conditions. Most methods use the same vial for both, so it is important that measurements are taken at the same optical point. Instrument measurement principle ensures this.

It is necessary that the surface of the vial is clean and not scratched. This is to avoid measurement interference due to unwanted reflection and absorption of light. It is recommended not to touch the vial walls with hands.

Furthermore, in order to maintain the same conditions during the zeroing and the measuring phases, it is necessary to cap the vial to prevent any contamination.

FUNCTIONAL DESCRIPTION

INSTRUMENT DESCRIPTION



1) Vial holder
2) Liquid Crystal Display (LCD)
3) Keypad
4) Bottom lid
5) USB connector
6) ON/OFF power switch
7) Power supply connector

KEYPAD DESCRIPTION

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

Press to perform the function displayed above it on the LCD.

Press to exit the current screen.

Press to access the method menu.

Press to move up in a menu or a help screen, to increment a set value, or to access second level functions.

Press to move down in a menu or a help screen, to decrement a set value, or to access second level functions.

Press to log the current reading.

Press to recall the log.

Press to display the help screen.

Press to access the setup screen.

TIPS FOR AN ACCURATE MEASUREMENT

The instructions listed below should be carefully followed during testing to ensure most accurate results.

COLLECTING AND MEASURING SAMPLES

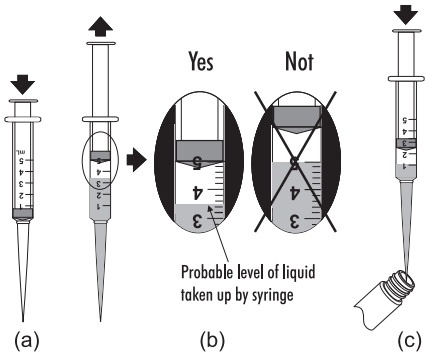
- In order to add the exact amount of sample or liquid reagent to the reagent vials it is strongly recommended to use the available Hanna automatic fixed-volume pipettes or class A laboratory pipettes (symbolized like a generic pipette tip in the following method related chapters):

pipette code	volume
HI 731340	200 µL
HI 731341	1000 µL
HI 731342	2000 µL

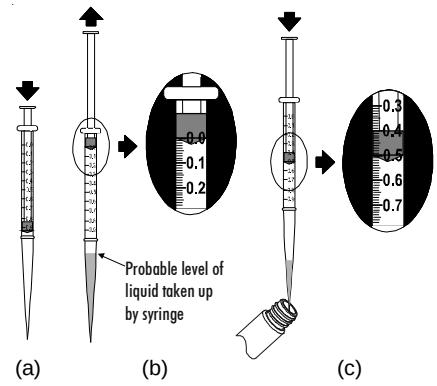
For correct use of the automatic pipette, please follow the related Instruction Sheet.

Alternatively, the optional **HI 740142** 1 mL graduated syringe or **HI 740226** 5 mL graduated syringe can be used. For the correct use of the syringes, see instructions below.

1. In order to measure exactly 5 mL of reagent with the 5 mL syringe:
   (a) push the plunger completely into the syringe and insert the tip into the solution
   (b) pull the plunger up until the lower edge of the seal is exactly on the 5 mL mark
   (c) take out the syringe and clean the outside of the syringe tip. Be sure that no drops are hanging on the tip of the syringe, if so eliminate them. Then, keeping the syringe in vertical position above the vial, push the plunger completely down into the syringe. Exactly 5 mL has been added to the vial



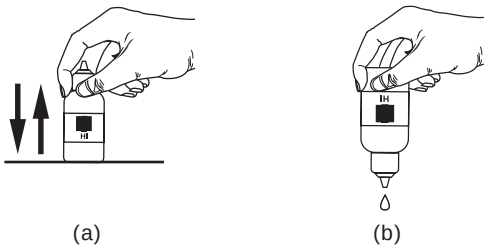
2. In order to measure exactly 0.5 mL of reagent with the 1 mL syringe:
   (a) push the plunger completely into the syringe and insert the tip into the solution
   (b) pull the plunger up until the lower edge of the seal is exactly on the 0.0 mL mark
   (c) take out the syringe and clean the outside of the syringe tip. Be sure that no drops are hanging on the tip of the syringe, if so eliminate them. Then, keeping the syringe in vertical position above the vial, push the plunger down into the syringe until the lower edge of the seal is exactly on the 0.5 mL mark. Now the exact amount of 0.5 mL has been added to the vial, even if the tip still contains some solution



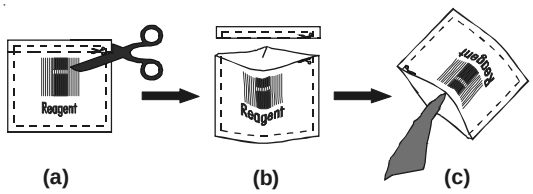
- Color or suspended matter in large amounts may cause interference, therefore, these should be removed by treatment with active carbon and by prior filtration.

USING LIQUID AND POWDER REAGENTS

- Proper use of the dropper:
  (a) to get good reproducible results, tap the dropper on the table for several times and wipe the outside of the dropper tip with a cloth
  (b) always keep the dropper bottle in a vertical position while dosing the reagent

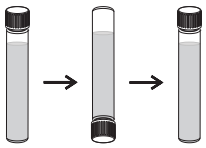


- Proper use of the powder reagent packet:
  (a) use scissors to open the powder packet
  (b) push the edges of the packet to form a spout
  (c) pour out the content of the packet

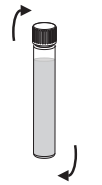


USING VIALS

- Never insert hot vials in the instrument, the vial holder may become damaged.
- In order to avoid reagent leaking and to obtain most accurate results, it is recommended to close the vial tightly with the supplied cap after addition of reagents or sample.
- Shaking the vial can generate bubbles in the sample, causing higher readings. To obtain accurate measurements, remove such bubbles by swirling or by gently tapping the vial.
- Proper mixing is very important for reproducibility of the measurements. The right way of mixing a vial is specified for each method in the related chapter.
  (a) **invert the vial** a couple of times or for a specified time: hold the vial in the vertical position with the cap up. Turn the vial upside-down and wait for all of the solution to flow to the cap end, then return the vial to the upright vertical position and wait for all of the solution to flow to the vial bottom. This is one inversion. The correct speed for this mixing technique is 10 complete inversions in 30 seconds.

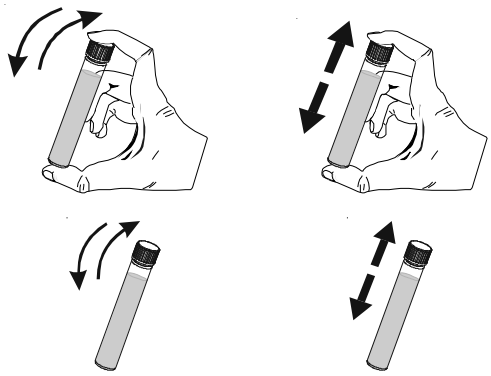


This mixing technique is indicated with "invert to mix" and the following icon:



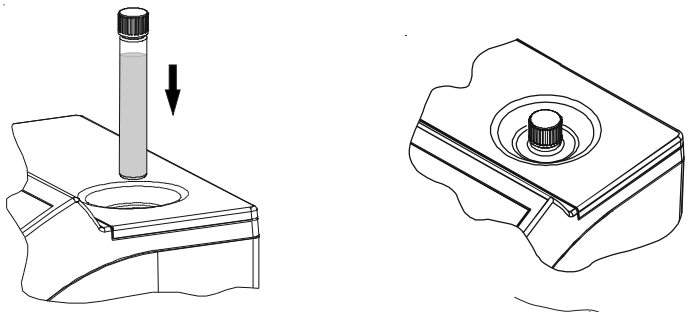
invert to mix

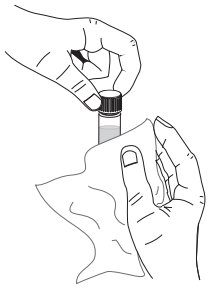
(b) **shake the vial**: move the vial up and down. The movement may be gentle or vigorous.
This mixing technique is indicated with "shake gently" or "shake vigorously" and one of the following icons:



shake gently *shake vigorously*

Pay attention to push the cuvette completely down in the holder.





- Whenever the vial is placed into the measurement cell, it must be dry on the outside, and completely free of fingerprints, oil or dirt. Wipe it thoroughly with HI 731318 or a lint-free cloth prior to insertion.
- Do not let the reacted sample stand too long after reagent is added. For best accuracy, respect the timings described in each specific method.
- It is possible to take multiple readings in a row, but it is recommended to take a new zero reading for each sample and to use the same vial for zeroing and measurement where possible (for most precise results follow the measurement procedures carefully).
- All the reaction times reported in this manual are at 25 °C (77 °F). In general, the reaction time should be increased for temperatures lower than 20 °C (68 °F), and decreased for temperatures higher than 25 °C (77 °F).

DIGESTION

- Some analytical methods require digestion of the sample. Use the **HI 839800 test tube heater** for digestion. The optional **HI 740217 safety shield** is strongly recommended. For correct use of the reactor follow the Reactor Instruction Manual. At the end of the digestion period the vials are still hot, allow the vials to cool to room temperature in the optional **HI 740216 test tube cooling rack**.

REAGENT BLANK CORRECTION

- Some methods require a "reagent blank correction". The blank and the sample are prepared exactly in the same way, with the only difference that for the blank deionized water is used instead of sample. A blank vial may be used more than once; stability and storing conditions are described for each method in the related chapter.

INTERFERENCES

- In the method related measurement sections we have reported the most common interferences that may be present in an average wastewater matrix. It may be that for a particular treatment process other compounds do interfere with the method of analysis.

HEALTH & SAFETY

- The chemicals contained in the reagent kits may be hazardous if improperly handled.
- Read the appropriate Material Safety Data Sheet (MSDS) before performing tests.

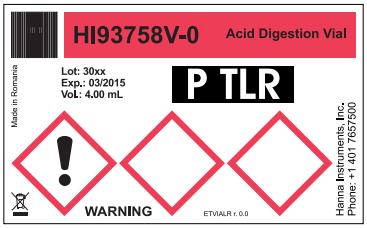
- Safety equipment: Wear suitable eye protection and clothing when required, and follow instructions carefully.
- Reagent spills: If a reagent spill occurs, wipe up immediately and rinse with plenty of water. If reagent contacts skin, rinse the affected area thoroughly with water. Avoid breathing released vapors.
- Reagent vial disposal: Reagents vials may contain different waste pollutants. After use dispose of the reagent vials according to the local regulations.

METHOD REFERENCE TABLE

Method	Method reagent set code	Method description	Page
1	HI 93764A-25	Ammonia LR	20
2	HI 93764B-25	Ammonia HR	22
3	HI 93701-01 HI 93701-03	Chlorine, Free	24
4	HI 93711-01 HI 93711-03	Chlorine, Total	26
5	HI 93766-50	Nitrate	28
6	HI 93767A-50	Nitrogen, Total LR	30
7	HI 93767B-50	Nitrogen, Total HR	35
8	HI 93754A-25	Oxygen Demand, Chemical (COD) LR	40
9	HI 93754B-25	Oxygen Demand, Chemical (COD) MR	43
10	HI 93754C-25	Oxygen Demand, Chemical (COD) HR	46
11	HI 93758A-50	Phosphorus, Reactive	49
12	HI 93758B-50	Phosphorus, Acid Hydrolyzable	51
13	HI 93758C-50	Phosphorus, Total LR	55
14	HI 93763A-50	Phosphorus, Reactive HR	59
15	HI 93763B-50	Phosphorus, Total HR	62

VIALS IDENTIFICATION

Vials related to different parameters can be distinguished by means of the letter printed on the vial (beside the Hanna logo) and the color of the printing:



Method reagent set code	Method description	Code specific letter on the label	Label rectangle color
HI 93764A-25	Ammonia LR	A LR	white
HI 93764B-25	Ammonia HR	A HR	green
HI 93701-01 HI 93701-03	Chlorine, Free	(no letter)	white
HI 93711-01 HI 93711-03	Chlorine, Total	(no letter)	white
HI 93766-50	Nitrate	N	white
HI 93767A-50	Nitrogen, Total LR	N LR	green (digestion vial) red (reagent vial)
HI 93767B-50	Nitrogen, Total HR	N HR	red (digestion vial) green (reagent vial)
HI 93754A-25	Oxygen Demand, Chemical (COD) LR	COD A	red
HI 93754B-25	Oxygen Demand, Chemical (COD) MR	COD B	white
HI 93754C-25	Oxygen Demand, Chemical (COD) HR	COD C	green
HI 93758A-50	Phosphorus, Reactive	P R	red
HI 93758B-50	Phosphorus, Acid Hydrolyzable	P AH	white
HI 93758C-50	Phosphorus, Total LR	P TLR	red
HI 93763A-50	Phosphorus, Reactive HR	P RHR	green
HI 93763B-50	Phosphorus, Total HR	P THR	green

OPERATIONAL GUIDE

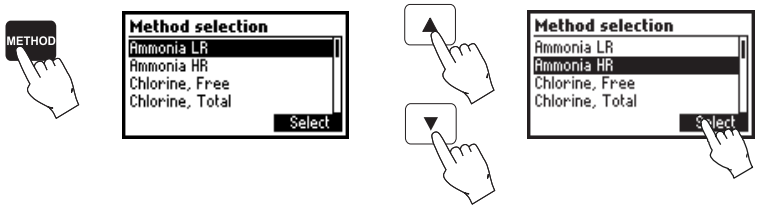
POWER CONNECTION

Connect the AC/DC adaptor that is supplied with the instrument.

Note: Always turn the meter off before unplugging it to ensure no data is lost.

METHOD SELECTION

- Turn the instrument ON via the ON/OFF power switch.
- The meter will perform an autodiagnostic test. During this test, the Hanna Instrument logo will appear on the LCD. After 5 seconds, if the test was successful, the last method used will appear on the display.
- In order to select the desired method press the **METHOD** key and the screen with the list of methods will appear.
- Press the ▲ ▼ keys to highlight the desired method. Press **Select**.

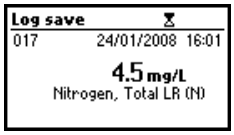


- After the desired method is selected, follow the measurement procedure described in the related chapter.
- Before performing a test carefully read all the instructions related to the selected method.

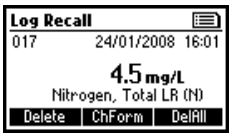
DATA MANAGEMENT

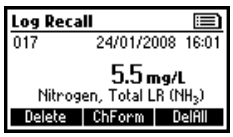
You can keep track of your results using the instrument's data log function. Up to 200 individual measurements can be stored in the data log. Storing, viewing and deleting the data is possible using **LOG**, **RCL**, ▼ or ▲ keys.

Storing data: You can store only a valid measurement. To store a valid measurement press **LOG**. The measurement will be stored with date and time stamps.



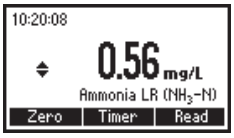
Viewing and deleting: You can view and delete the data log by pressing the **RCL** key. You can delete the last saved measurement. Additionally, you can delete the data records all at once.

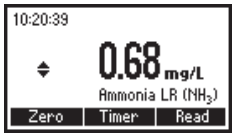




CHEMICAL FORM

Chemical form conversion factors are pre-programmed into the instrument and are method specific. In order to view the displayed result in the desired chemical form press ▲ or ▼ to toggle between the available chemical forms for the selected method.





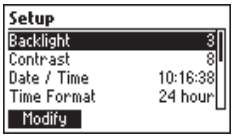
SETUP

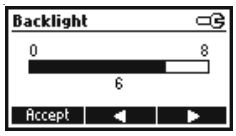
In the Setup mode the instrument's parameters can be changed. Some parameters affect the measuring sequence and others are general parameters that change the behavior or appearance of the instrument.

Press **SETUP** to enter the setup mode.
Press **ESC** or **SETUP** to return to the main screen.
A list of setup parameters will be displayed with currently configured settings. Press **HELP** for additional information.
Press the ▲ ▼ keys to select a parameter and depending on the parameter type, select the new value as follows:

Backlight

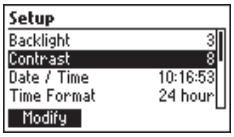
Values: **0** to **8**.
Press the **Modify** key to access the backlight value.
Use the ◀ ▶ functional keys or the ▲ ▼ keys to increase or decrease the value.
Press the **Accept** key to confirm or **ESC** to return to the setup menu without saving the new value.

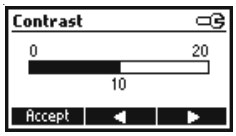




Contrast

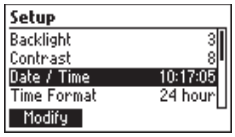
Values: **0** to **20**.
This option is used to set the display's contrast.
Press the **Modify** key to change the display's contrast.
Use the ◀ ▶ functional keys or the ▲ ▼ keys to increase or decrease the value.
Press the **Accept** key to confirm the value or **ESC** to return to the setup menu without saving the new value.

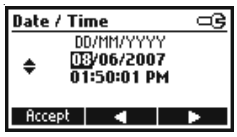




Date / Time

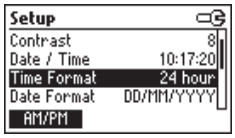
This option is used to set the instrument's date and time.
Press the **Modify** key to change the date/time.
Press the ◀ ▶ functional keys to highlight the value to be modified (year, month, day, hour, minute or second). Use the ▲ ▼ keys to change the value.
Press the **Accept** key to confirm or **ESC** to return to the setup without saving the new date or time.





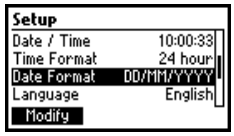
Time format

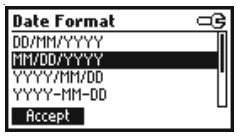
Option: **AM/PM** or **24 hour**.
Press the functional key to select the desired time format.



Date format

Press the **Modify** key to change the Date Format.
Use the ▲ ▼ keys to select the desired format.
Press the **Accept** key to confirm or **ESC** to return to the setup menu without saving the new format.



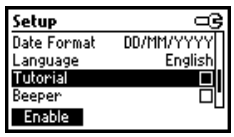


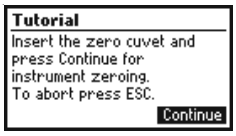
Language

Press the corresponding key to change the language.
If the new language cannot be loaded, the previously selected language will be reloaded.

Tutorial

Option: **Enable** or **Disable**.
If enabled this option will provide the user short guides related to the current issue, on the screen.
Press the functional key to enable/disable the tutorial mode.



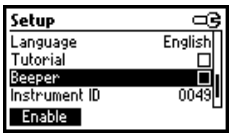


Beeper

Option: **Enable** or **Disable**.

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.

Press the functional key to enable/disable the beeper.



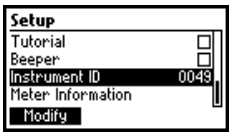
Instrument ID

Option: **0000** 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 the **Modify** key to access the instrument ID screen. Press the ▲ ▼ keys in order to set the desired value.

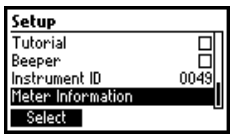
Press the **Accept** key to confirm the value or **ESC** to return to the setup menu without saving the new value.



Meter information

Press the **Select** key to view the instrument model, firmware version, language version and instrument serial number.

Press **ESC** to return to the Setup mode.



HELP MODE

HI 83214 offers an interactive contextual help mode that assists the user at any moment.

To access the help screens press **HELP**.

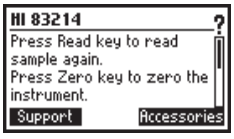
The instrument will display additional information related to the current screen. To read all the available information, scroll the text using the ▲ ▼ keys.

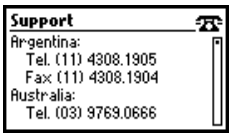
Press the **Support** key to access a screen with Hanna service centers and their contact details.

Press the **Accessories** key to access a list of instrument reagents and accessories.

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

To exit help mode press **HELP** key again and the meter will return to the previously selected screen.





AMMONIA LOW RANGE

SPECIFICATIONS

Range	0.00 to 3.00 mg/L (as NH_3-N)
Resolution	0.01 mg/L
Accuracy	±0.10 mg/L or ±5 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 420 nm
Method	Adaptation of the *ASTM Manual of Water and Environmental Technology, D1426-92,* Nessler method. The reaction between ammonia and reagents causes a yellow tint in the sample.

REQUIRED REAGENTS

Code	Description	Q.ty/test	Q.ty/set
HI 93764A-0*	Reagent Vial	1 vial	25 vials
HI 93764-0	Nessler Reagent	4 drops	1 bottle

* *Reagent Vial identification*: **A LR**, white label.

Note: Store the unused vials in a cool and dark place.

REAGENT SET

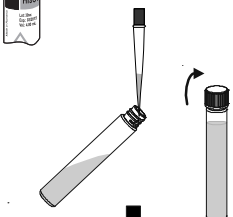
HI 93764A-25 Reagents for 25 tests

For other accessories see page 68.

MEASUREMENT PROCEDURE

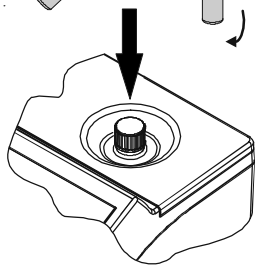
- Select the ***Ammonia LR*** method following one of the procedures described in the "Method Selection" section (see page 15).

- Remove the cap from a Reagent Vial.



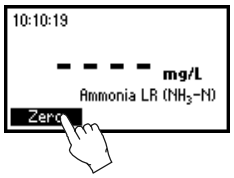
- Add exactly 5.0 mL of sample to the vial, while keeping the vial at a 45-degree angle.

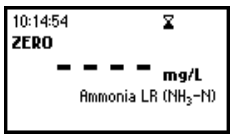
- Replace the cap and mix by inverting the vial a couple of times. This is the blank.



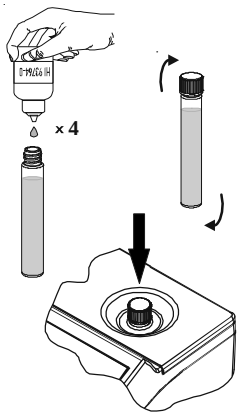
- Place the vial into the holder and push it completely down.

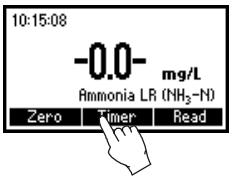
- Press the **Zero** key. The display will show "**-0.0-**" when the meter is zeroed and ready for measurement.

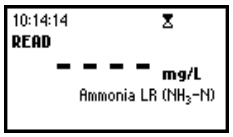




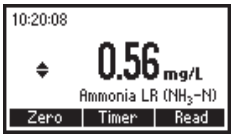
- Remove the vial.
- Remove the cap and add 4 drops of HI 93764-0 Nessler Reagent.
- Replace the cap tightly and mix by inverting the vial a couple of times. This is the sample.
- Place the vial into the holder and push it completely down.
- Press **Timer** and the display will show the countdown prior to the measurement and the message "**Reaction Time**". Alternatively, wait for 3 minutes and 30 seconds and press **Read**. The instrument will perform the reading.

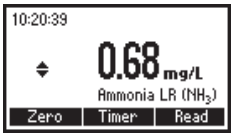






- The instrument displays concentration in **mg/L of ammonia nitrogen (NH_3-N)**. Press ▲ or ▼ to convert the result in mg/L ammonia (NH_3).





INTERFERENCES

Interference may be caused by:

- Organic compounds like: chloramines, various aliphatic and aromatic amines, glycine or urea above 10 ppm. To eliminate these interferences distillation is required.
- Organic compounds like: aldehydes, alcohols (e.g. ethanol) or acetone above 0.1 %. To eliminate these interferences distillation is required.
- Sulfide: may cause turbidity.

AMMONIA HIGH RANGE

SPECIFICATIONS

Range	0 to 100 mg/L (as NH_3-N)
Resolution	1 mg/L
Accuracy	±1 mg/L or ±5 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 420 nm
Method	Adaptation of the *ASTM Manual of Water and Environmental Technology, D1426-92,* Nessler method. The reaction between ammonia and reagents causes a yellow tint in the sample.

REQUIRED REAGENTS

Code	Description	Q.ty/test	Q.ty/set
HI 93764B-0*	Reagent Vial	1 vial	25 vials
HI 93764-0	Nessler Reagent	4 drops	1 bottle

* *Reagent Vial identification*: **A HR**, green label.

Note: Store the unused vials in their container in a cool and dark place.

REAGENT SET

HI 93764B-25 Reagents for 25 tests

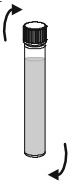
For other accessories see page 68.

MEASUREMENT PROCEDURE

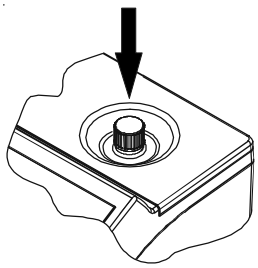
- Select ***Ammonia HR*** method following one of the procedures described in the "Method Selection" section (see page 15).
- Remove the cap from a Reagent Vial.

- Add exactly 1.0 mL of sample to the vial, while keeping the vial at a 45-degree angle.

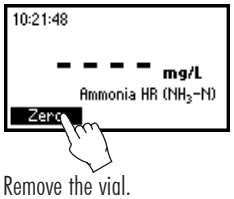
- Replace the cap and mix by inverting the vial a couple of times. This is the blank.

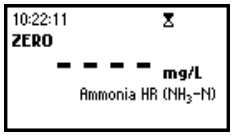


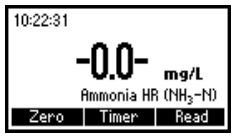
- Place the vial into the holder and push it completely down.



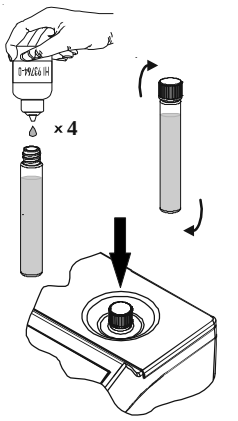
- Press the **Zero** key. The display will show "**-0.0-**" when the meter is zeroed and ready for measurement.

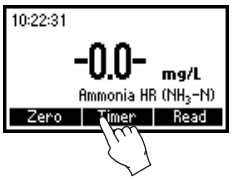


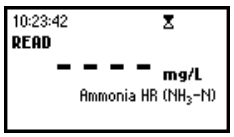




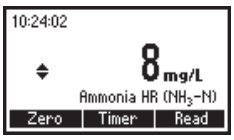
- Remove the vial.
- Remove the cap and add 4 drops of HI 93764-0 Nessler Reagent.
- Replace the cap tightly and mix by inverting the vial a couple of times. This is the sample.
- Place the vial into the holder and push it completely down.
- Press **Timer** and the display will show the countdown prior to the measurement and the message "**Reaction Time**". Alternatively, wait for 3 minutes and 30 seconds and press **Read**. The instrument will perform the reading.

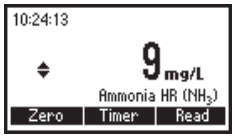






- The instrument displays concentration in **mg/L of ammonia nitrogen (NH_3-N)**. Press ▲ or ▼ to convert the result in mg/L ammonia (NH_3).





INTERFERENCES

Interference may be caused by:

- Organic compounds like: chloramines, various aliphatic and aromatic amines, glycine or urea above 100 ppm. To eliminate these interferences distillation is required.
- Organic compounds like: aldehydes, alcohols (e.g. ethanol) or acetone above 1 %. To eliminate these interferences distillation is required.
- Sulfide: may cause turbidity.

CHLORINE, FREE

SPECIFICATIONS

Range	0.00 to 5.00 mg/L Cl_2
Resolution	0.01 mg/L
Accuracy	±0.03 mg/L or ±4 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 525 nm
Method	Adaptation of the EPA method 330.5 and *Standard Methods for the Examination of Water and Wastewater, 20th edition,* 4500-Cl G, DPD method. The reaction between free chlorine and the DPD reagent causes a pink tint in the sample.

REQUIRED REAGENTS

Code	Description	Q.ty/test
HI 93701-0	DPD Powder Reagent	1 packet

REAGENT SETS

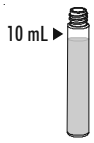
HI 93701-01 Reagents for 100 tests

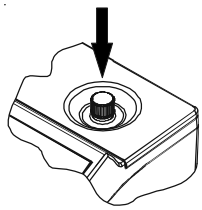
HI 93701-03 Reagents for 300 tests

For other accessories see page 68.

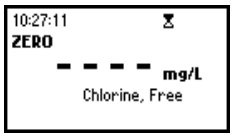
MEASUREMENT PROCEDURE

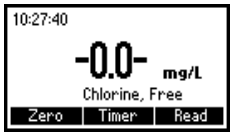
- Select **Chlorine, Free** method following one of the procedures described in the "Method Selection" section (see page 15).
- Take an empty vial.
- Fill the vial with 10 mL of unreacted sample, then replace the cap. This is the blank.
- Place the vial into the holder and push it completely down.



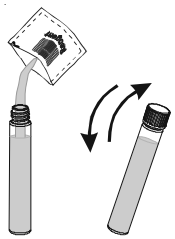


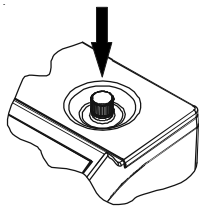
- Press the **Zero** key. The display will show "**-0.0-**" when the meter is zeroed and ready for measurement.



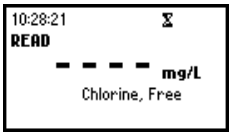


- Remove the cap and add the content of one packet of HI 93701-0 Free Chlorine Reagent.
- Replace the cap and shake gently to mix for about 20 seconds. This is the sample.
- Place the vial into the holder and push it completely down.





- Press **Timer** and the display will show the countdown prior to the measurement and the message "**Reaction Time**". Alternatively, wait for 1 minute and press **Read**. The instrument will perform the reading.



- The instrument displays concentration in **mg/L of free chlorine**.

INTERFERENCES

Interferences may be caused by:

Bromine (Br_2)

Iodine (I_2)

Oxidized forms of Chromium and Manganese

Ozone (O_3)

Alkalinity above 250 mg/L $CaCO_3$ or acidity above 150 mg/L $CaCO_3$ will not reliably develop the full amount of color or it may rapidly fade. To resolve this, neutralize the sample with diluted HCl or NaOH.

In case of water with hardness greater than 500 mg/L $CaCO_3$, shake the sample for approximately 2 minutes after adding the powder reagent.

CHLORINE, TOTAL

SPECIFICATIONS

Range	0.00 to 5.00 mg/L Cl_2
Resolution	0.01 mg/L
Accuracy	±0.03 mg/L or ±4 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 525 nm
Method	Adaptation of the EPA method 330.5 and *Standard Methods for the Examination of Water and Wastewater, 20th edition,* 4500-Cl G, DPD method. The reaction between chlorine and the DPD reagent causes a pink tint in the sample.

REQUIRED REAGENTS

Code	Description	Q.ty/test
HI 93711-0	DPD Powder Reagent	1 packet

REAGENT SETS

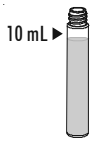
HI 93711-01 Reagents for 100 tests

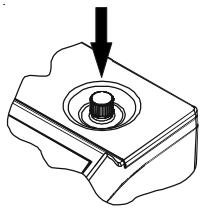
HI 93711-03 Reagents for 300 tests

For other accessories see page 68.

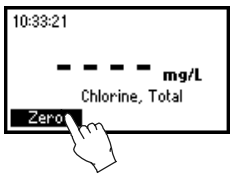
MEASUREMENT PROCEDURE

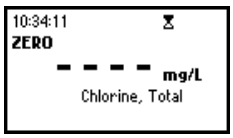
- Select ***Chlorine, Total*** method following one of the procedures described in the "Method Selection" section (see page 15).
- Take an empty vial.
- Fill the vial with 10 mL of unreacted sample, then replace the cap. This is the blank.
- Place the vial into the holder and push it completely down.

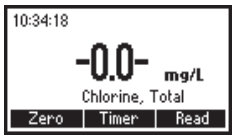




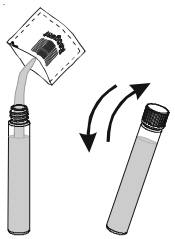
- Press the **Zero** key. The instrument will perform a zero sequence and after a few seconds the display will show "**-0.0-**". Now the meter is zeroed and ready for measurement.

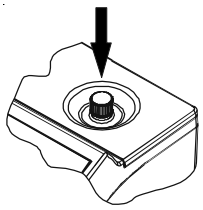




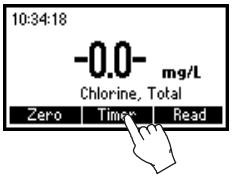


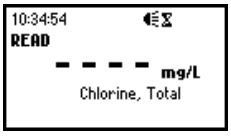
- Remove the cap and add the content of one packet of HI 93711-0 Total Chlorine Reagent.
- Replace the cap and shake gently to mix for about 20 seconds. This is the sample.
- Place the vial into the holder and push it completely down.



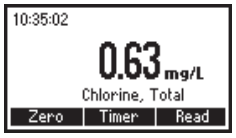


- Press **Timer** and the display will show the countdown prior to the measurement and the message "**Reaction Time**". Alternatively, wait for 2 minutes and 30 seconds and press **Read**. The instrument will perform the reading.





- The instrument directly displays concentration in **mg/L of total chlorine**.



INTERFERENCES

Interferences may be caused by:
Bromine (Br_2)
Iodine (I_2)
Oxidized forms of Chromium and Manganese
Ozone (O_3)

Alkalinity above 250 mg/L $CaCO_3$ or acidity above 150 mg/L $CaCO_3$ will not reliably develop the full amount of color or it may rapidly fade. To resolve this, neutralize the sample with diluted HCl or NaOH.

In case of water with hardness greater than 500 mg/L $CaCO_3$, shake the sample for approximately 2 minutes after adding the powder reagent.

NITRATE

SPECIFICATIONS

Range	0.0 to 30.0 mg/L NO_3^--N
Resolution	0.1 mg/L
Accuracy	±1.0 mg/L or ±5 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 420 nm
Method	Chromotropic acid method. The reaction between nitrate and the reagents causes a yellow tint in the sample.

REQUIRED REAGENTS

Code	Description	Q.ty/test	Q.ty/set
HI 93766V-0*	Reagent Vial	1 vial	50 vials
HI 93766-0	Nitrate Reagent	1 packet	50 packets

* *Reagent Vial identification*: **N**, white label.

Note: Store the unused vials in a cool and dark place.

REAGENT SET

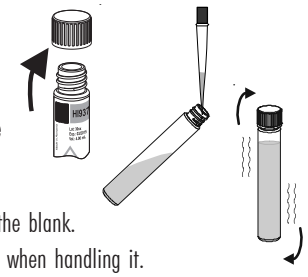
HI 93766-50 Reagents for 50 tests

For other accessories see page 68.

MEASUREMENT PROCEDURE

Before using the reagent kit carefully read all the instructions and the Material Safety Data Sheet (MSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

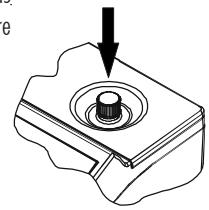
- Select the ***Nitrate*** method following one of the procedures described in the "Method Selection" section (see page 15).
- Remove the cap from a Reagent Vial.



- Add exactly 1.0 mL of sample to the vial, while keeping the vial at a 45-degree angle.
- Replace the cap tightly and invert the vial 10 times. This is the blank.

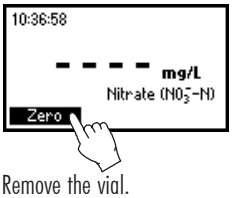
  Warning: The vial will become hot during mixing, be careful when handling it.

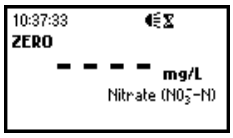
  Note: The method is technique sensitive: to obtain reproducible results it is strongly recommended to follow carefully the "invert" procedure described on page 10.

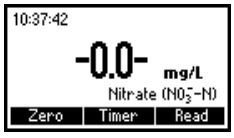


- Place the vial into the holder and push it completely down.

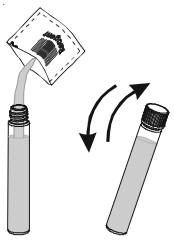
- Press the **Zero** key. The display will show "**-0.0-**" when the meter is zeroed and ready for measurement.





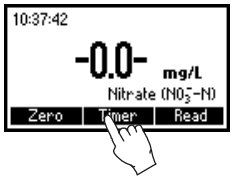


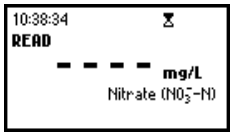
- Remove the vial.
- Remove the cap and add the content of one packet of HI 93766-0 Nitrate Reagent.
- Replace the cap tightly and <u>invert the vial</u> 10 times. This is the reacted sample.



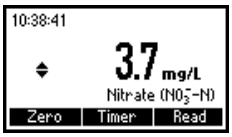
<u>**Note**</u>: The method is technique sensitive: to obtain most reproducible results it is strongly recommended to follow carefully the "invert" procedure described on page 10.

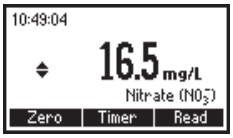
- Place the vial into the holder and push it completely down.
- Press **Timer** and the display will show the countdown prior to the measurement and the "**Reaction Time**" message. Alternatively, wait for 5 minutes and press **Read**. The instrument will perform the reading.





- The instrument displays concentration in **mg/L of nitrate-nitrogen (NO_3^--N)**. Press ▲ or ▼ to convert the result in mg/L of nitrate (NO_3^-).





<u>INTERFERENCES</u>

Interference may be caused by:

Barium (Ba^{2+}) above 1 mg/L

Chloride (Cl^-) above 1000 mg/L

Nitrite (NO_2^-) above 50 mg/L

Samples containing up to 100 mg/L nitrite may be measured after the following treatment: add 400 mg of urea to 10 mL of sample, mix until completely dissolved, then proceed with the usual measurement procedure.

NITROGEN, TOTAL LOW RANGE

SPECIFICATIONS

Range	0.0 to 25.0 mg/L N
Resolution	0.1 mg/L
Accuracy	±1.0 mg/L or ±5 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 420 nm
Method	Chromotropic acid method. A persulfate digestion converts all forms of nitrogen to nitrate. Then the reaction between nitrate and the reagents causes a yellow tint in the sample.

REQUIRED REAGENTS

Code	Description	Q.ty/test	Q.ty/set
HI 93767A-B*	Digestion Vial	1 vial	50 vials
DEIONIZED120	Deionized Water	2 mL	1 bottle
PERSULFATE/N	Potassium Persulfate	1 packet	50 packets
BISULFITE/N	Sodium Metabisulfite	1 packet	50 packets
HI 93767-0	Total Nitrogen Reagent	1 packet	50 packets
HI 93766V-0LR**	Reagent Vial	1 vial	50 vials

* *Digestion Vial identification*: **N LR**, green label.

** *Reagent Vial identification*: **N LR**, red label.

Notes: Store the unused vials in their container in a cool and dark place.

REAGENT SET

HI 93767A-50 Reagents for up to 49 tests. Contains:

Box 1: HI 93767A-50 Reagent Set

Box 2: HI 93767A&B-50 Reagent Set, for Total Low Range Nitrogen.

For other accessories see page 68.

REQUIRED ACCESSORIES

HI 839800-01 Hanna reactor (115 VAC)

HI 839800-02 Hanna reactor (230 VAC)

HI 740216 Test tube cooling rack (25 holes)

HI 740217 Laboratory bench safety shield

For other accessories see page 68.

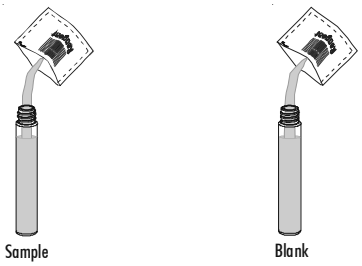
MEASUREMENT PROCEDURE

Before using the reagent kit carefully read all the instructions and the Material Safety Data Sheet (MSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

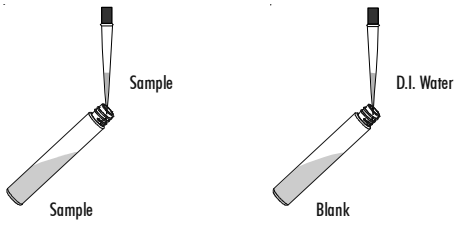
Reagent Blank Correction: This method requires a reagent blank correction. A single blank vial may be used more than once; the blank vial is stable up to one week if stored in a dark place at room temperature. Always use the same lot of reagents for blank and samples. For most accurate measurement run a blank for each set of measurements.

- Preheat the Hanna Reactor HI 839800 to 105 °C (221°F). For correct use of the reactor follow Reactor Instruction Manual.
  The optional HI 740217 safety shield is strongly recommended.
  DO NOT USE AN OVEN OR MICROWAVE samples may leak and generate a corrosive and possibly explosive atmosphere.
- Remove the caps from two Digestion Vials (**green label**).

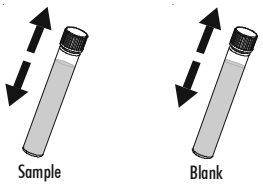
- Add the content of one packet of Potassium Persulfate for Total Nitrogen analysis to each vial.



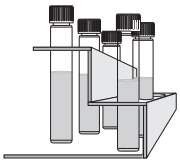
- Add exactly 2.0 mL of sample to one vial (sample vial), and 2.0 mL of deionized water to the other vial (blank vial), while keeping the vials at a 45-degree angle.



- Replace the cap tightly and shake the vials vigorously for about 30 seconds until all the powder is completely dissolved.

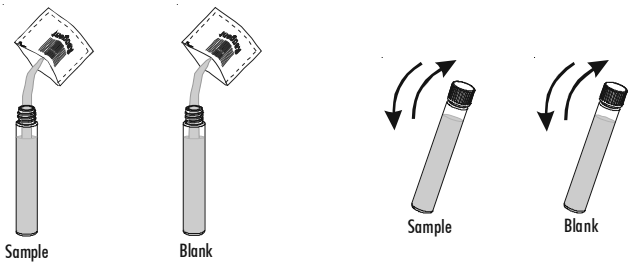


- Insert the vials into the reactor and heat them for 30 minutes at 150 °C.
  Note: To obtain most accurate results, it is strongly recommended to remove the vials from the reactor after 30 minutes.

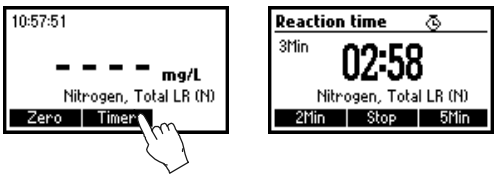


- At the end of the digestion period switch off the reactor, place the vials in the test tube rack and allow to cool to room temperature.
  Warning: The vials are still hot, be careful in handling them.

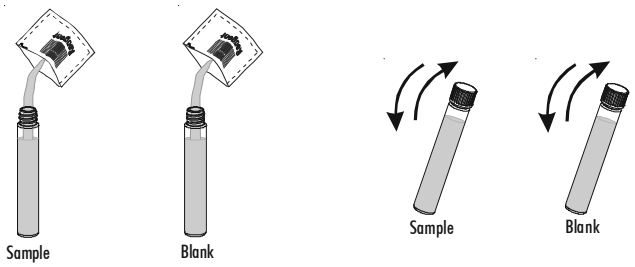
- Select ***Nitrogen, Total LR*** method following one of the procedures described in the "Method Selection" section (see page 15).
- For this method the instrument provides 3 reaction timers which can be used throughout the procedure.
- Remove the cap from the vials and add the content of one packet of Sodium Metabisulfite for Total Nitrogen analysis to each vial. Replace the cap tightly and shake gently the vials for 15 seconds.



- Press **Timer** to start the 3 minutes timer or wait for 3 minutes (without shaking the vials) to allow the reaction to complete.



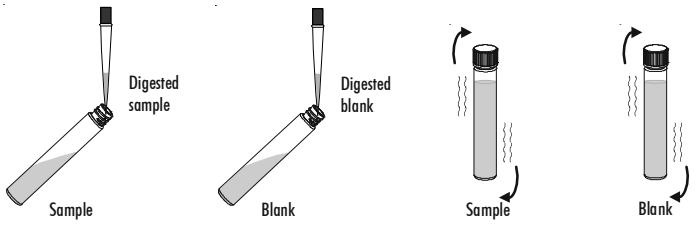
- Remove the cap from the vials and add the content of one packet of HI 93767-0 Total Nitrogen Reagent to each vial. Replace the cap tightly and shake gently the vials for 15 seconds.



- Press **Start** to activate the 2 minutes timer or wait for 2 minutes (without shaking the vials) to allow the reaction to complete.

- Remove the caps from two Reagent Vials (**red label**).

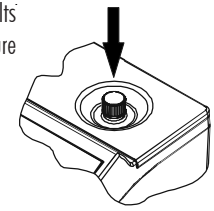
- Add exactly 2.0 mL of digested sample (sample vial) to one Reagent Vial (sample vial), and 2.0 mL of digested blank (blank vial) to the other Reagent Vial (blank vial), while keeping the vials at a 45-degree angle.
- Replace the cap tightly and invert the vials 10 times.



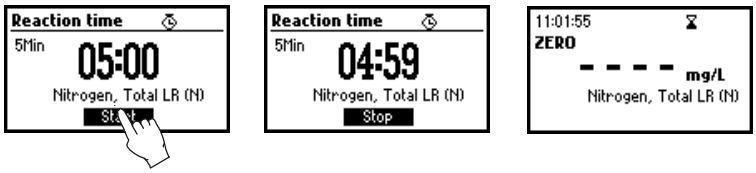
Warning: The vials will become hot during mixing, be careful when handling them.

Note: The method is technique sensitive: to obtain most reproducible results it is strongly recommended to follow carefully the "invert" procedure described on page 10.

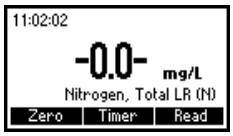
- Place the blank vial into the holder and push it completely down.



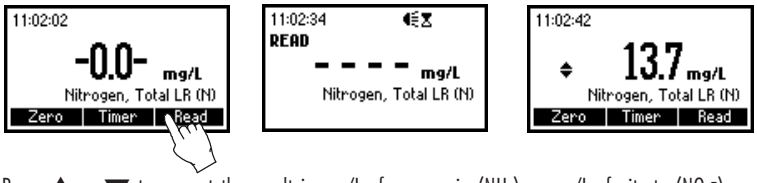
- Press **Start** and the display will show the countdown prior to the measurement and the "**Reaction Time**" message. Alternatively, wait for 5 minutes and press **Zero**.



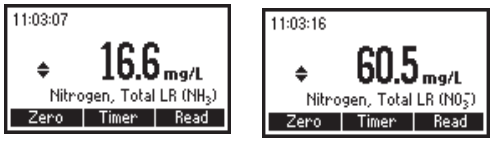
- The display will show "**-0.0-**" when the meter is zeroed and ready for measurement.



- Remove the blank vial.
- Place the sample vial into the holder and push it completely down.
- Press **Read.** The instrument will perform the reading. The instrument displays concentration in **mg/L of total nitrogen (N)**.



- Press ▲ or ▼ to convert the result in mg/L of ammonia (NH_3) or mg/L of nitrate (NO_3^-).



The method detects all organic and inorganic forms of nitrogen present in the sample.

INTERFERENCES

Interference may be caused by:
Bromide (Br^-) above 60 mg/L
Chloride (Cl^-) above 1000 mg/L
Chromium (Cr^{3+}) above 0.5 mg/L

NITROGEN, TOTAL HIGH RANGE

SPECIFICATIONS

Range	10 to 150 mg/L N
Resolution	1 mg/L
Accuracy	±3 mg/L or ±4 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 420 nm
Method	Chromotropic acid method. A persulfate digestion converts all forms of nitrogen to nitrate. Then the reaction between nitrate and the reagents causes a yellow tint in the sample.

REQUIRED REAGENTS

Code	Description	Q.ty/test	Q.ty/set
HI 93767B-B*	Digestion Vial	1 vial	50 vials
DEIONIZED120	Deionized Water	0.5 mL	1 bottle
PERSULFATE/N	Potassium Persulfate	1 packet	50 packets
BISULFITE/N	Sodium Metabisulfite	1 packet	50 packets
HI 93767-0	Total Nitrogen Reagent	1 packet	50 packets
HI 93766V-0HR**	Reagent Vial	1 vial	50 vials

* *Digestion Vial identification*: **N HR**, red label.

** *Reagent Vial identification*: **N HR**, green label.

Note: Store the unused vials in their container in a cool and dark place.

REAGENT SET

HI 93767B-50 Reagents for up to 49 tests. Contains:

Box 1: HI 93767B-50 Reagent Set

Box 2: HI 93767A&B-50 Reagent Set, for Total High Range Nitrogen.

For other accessories see page 68.

REQUIRED ACCESSORIES

HI 839800-01 Hanna reactor (115 VAC)

HI 839800-02 Hanna reactor (230 VAC)

HI 740216 Test tube cooling rack (25 holes)

HI 740217 Laboratory bench safety shield

For other accessories see page 68.

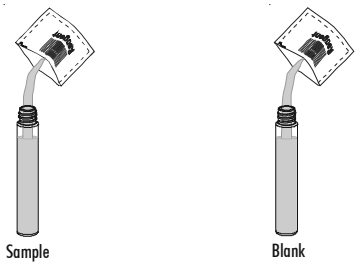
MEASUREMENT PROCEDURE

Before using the reagent kit carefully read all the instructions and the Material Safety Data Sheet (MSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

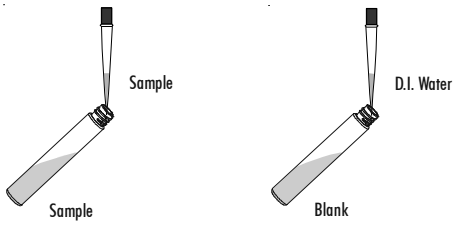
Reagent Blank Correction: This method requires a reagent blank correction. A single blank vial may be used more than once; the blank vial is stable up to one week if stored in a dark place at room temperature. Always use the same lot of reagents for blank and samples. For most accurate measurement, run a blank for each set of measurements.

- Preheat the Hanna Reactor HI 839800 to 105 °C (221°F). For correct use of the reactor follow Reactor Instruction Manual.
  Use of the optional HI 740217 safety shield is strongly recommended.
  DO NOT USE AN OVEN OR MICROWAVE samples may leak and generate a corrosive and possibly explosive atmosphere.
- Remove the caps from two Digestion Vials (**red label**).

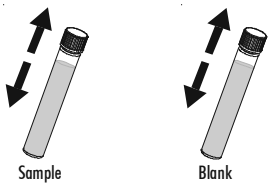
- Add the content of one packet of Potassium Persulfate for Total Nitrogen analysis to each vial.



- Add exactly 0.5 mL of sample to one vial (sample vial), and 0.5 mL of deionized water to the other vial (blank vial), while keeping the vials at a 45-degree angle.



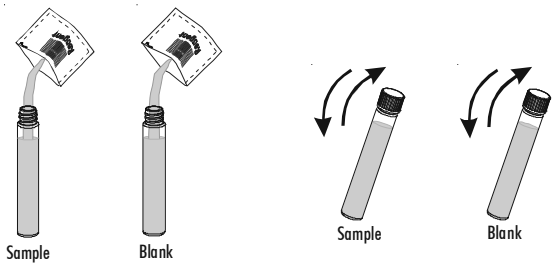
- Replace the cap tightly and shake vigorously the vials for about 30 seconds until all the powder is completely dissolved.



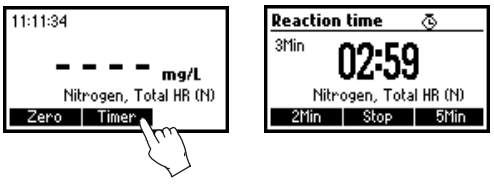
- Insert the vials into the reactor and heat them for 30 minutes at 105 °C.
  Note: To obtain most accurate results, it is strongly recommended to remove the vials from the reactor after 30 minutes.

- At the end of the digestion place the vials in the test tube rack and allow to cool to room temperature.
  Warning: As the vials are still hot, be careful in handling them.

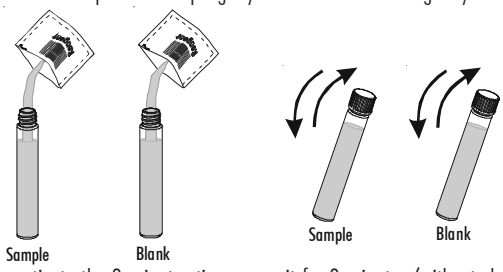
- Select ***Nitrogen, Total HR*** method following one of the procedures described in the "Method Selection" section (see page 15).
- For this method the instrument provides 3 reaction timers which can be used throughout the procedure.
- Remove the cap from the vials and add the content of one packet of Sodium Metabisulfite for Total Nitrogen analysis to each vial. Replace the cap tightly and shake gently the vials for 15 seconds.



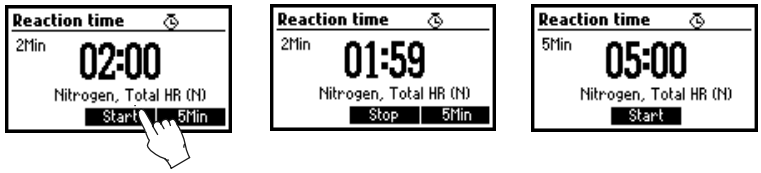
- Press **Timer** to start the 3 minutes timer or wait for 3 minutes (without shaking the vials) to allow the reaction to complete.



- Remove the cap from the vials and add the content of one packet of HI 93767-0 Total Nitrogen Reagent to each vial. Replace the cap tightly and shake the vials gently for 15 seconds.

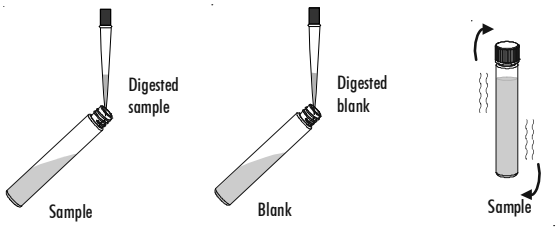


- Press **Start** to activate the 2 minutes timer or wait for 2 minutes (without shaking the vials) to allow the reaction to complete.



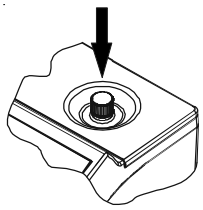
- Remove the cap from two Reagent Vials (**green label**).

- Add exactly 2.0 mL of digested sample (sample vial) to one Reagent Vial (sample vial), and 2.0 mL of digested blank (blank vial) to the other vial (blank vial), while keeping the vials at a 45-degree angle.
- Replace the cap tightly and invert the vials 10 times.



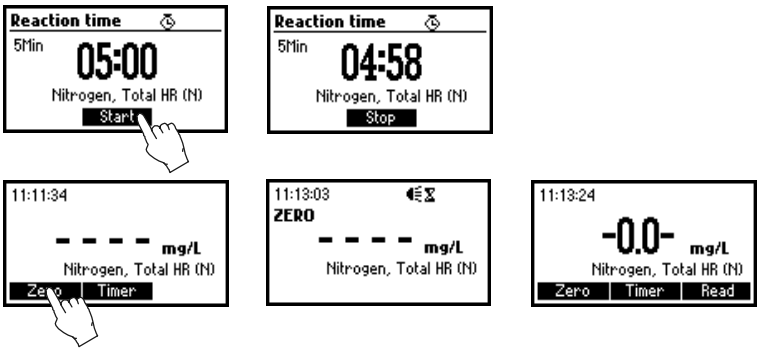
Warning: The vials will become hot during mixing, be careful when handling them.

Note: The method is technique sensitive: to obtain most reproducible results it is strongly recommended to follow carefully the "invert" procedure described on page 10.

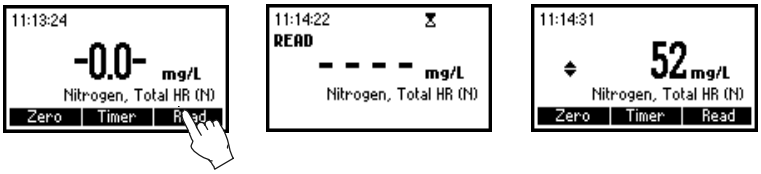


- Place the blank vial into the holder and push it completely down.

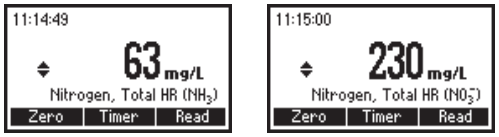
- Press **Start** and the display will show the countdown prior to the measurement and the "**Reaction Time**" message. Alternatively, wait for 5 minutes and press **Zero**.



- The instrument will perform a zero sequence and after a few seconds the display will show "**-0.0-**". Now the meter is zeroed and ready for measurement.
- Remove the blank vial and place the sample vial into the holder and push it completely down.
- Press **Read**. The instrument will perform the reading. The instrument displays the concentration in **mg/L of total nitrogen (N)**.



- Press ▲ or ▼ to convert the result in mg/L of ammonia (NH_3) or mg/L of nitrate (NO_3^-).



The method detects all organic and inorganic forms of nitrogen present in the sample.

INTERFERENCES

Interference may be caused by:
Bromide (Br^-) above 240 mg/L
Chloride (Cl^-) above 3000 mg/L
Chromium (Cr^{3+}) above 0.5 mg/L

OXYGEN DEMAND, CHEMICAL LOW RANGE

SPECIFICATIONS

Range	0 to 150 mg/L COD
Resolution	1 mg/L
Accuracy	±5 mg/L or ±5 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 420 nm
Method	Adaptation of the USEPA 410.4 approved method for the COD determination on surface waters and wastewaters. Oxidizable organic compounds reduce the dichromate ion (orange) to the chromic ion (green). The amount of remaining dichromate is determined.

REQUIRED REAGENTS

Code	Description	Q.ty/test	Q.ty/set
COD-LR*	Reagent Vial	1 vial	25 vials
DEIONIZED120	Deionized Water	2.0 mL	optional

* *Reagent Vial identification*: **COD A**, red label.

Note: Store the unused vials in their container in a cool and dark place.

REAGENT SET

HI 93754A-25 Reagents for up to 24 tests

REQUIRED ACCESSORIES

HI 839800-01 Hanna reactor (115 VAC)
HI 839800-02 Hanna reactor (230 VAC)
HI 740216 Test tube cooling rack (25 holes)
HI 740217 Laboratory bench safety shield
For other accessories see page 68.

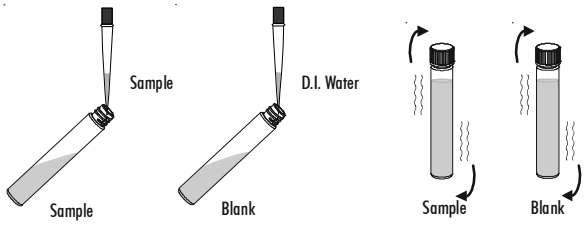
MEASUREMENT PROCEDURE

Before using the reagent kit carefully read all the instructions and the Material Safety Data Sheet (MSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

Reagent Blank Correction: This method requires a reagent blank correction. A single blank vial may be used more than once. The blank vial is stable for several months (room temperature). For most accurate measurement, run a blank for each set of measurements and always use the same lot of reagents for blank and samples.

- Choose a homogeneous sample. Samples containing settleable solids need to be homogenized with a blender.
- Preheat the Hanna Reactor HI 839800 to 150 °C (302 °F). For correct use of the reactor follow Reactor Instruction Manual.
  The optional HI 740217 safety shield is strongly recommended.
  <u>DO NOT USE AN OVEN OR MICROWAVE</u> samples may leak and generate a corrosive and possibly explosive atmosphere.
- Remove the caps from two Reagent Vials.

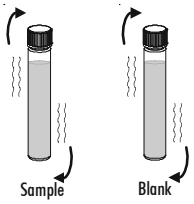
- Add exactly 2.0 mL of sample to one vial (sample vial), and 2.0 mL of deionized water to the other vial (blank vial), while keeping the vials at a 45-degree angle. Replace the cap tightly and mix by inverting each vial a couple of times.



<u>Warning</u>: The vials will become hot during mixing, be careful when handling them.

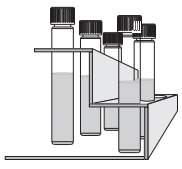
- Insert the vials into the reactor and heat them for 2 hours at 150 °C.

- At the end of the digestion period switch off the reactor. Wait for twenty minutes to allow the vials to cool to about 120 °C.
- Invert each vial several times while still warm, then place them in the test tube rack.



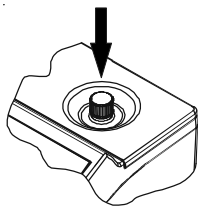
<u>Warning</u>: The vials are still hot, be careful when handling them.

- Leave the vials in the tube rack to cool to room temperature. Do not shake or invert them, or else the samples may become turbid.



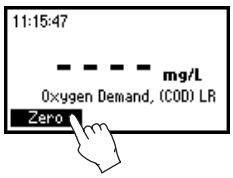
- Select ***Oxygen Demand, (COD) LR*** method following one of the procedures described in the "Method Selection" section (see page 15).

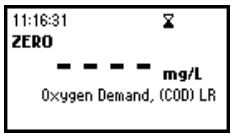
- Place the blank vial into the holder and push it completely down.

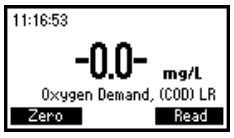


- Press the **Zero** key. The instrument will perform a zero sequence and after a few seconds the display will show "**-0.0-**". Now the meter is zeroed and ready for measurement.

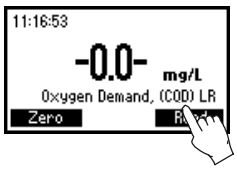
- Remove the blank vial.

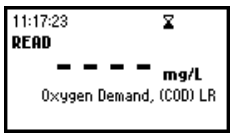


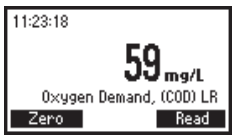




- Place the sample vial into the holder and push it completely down.
- Press **Read**. The instrument will perform the reading.
- The instrument displays concentration in **mg/L of oxygen demand**.







INTERFERENCES

Interference may be caused by:
Chloride (Cl^-) above 2000 mg/L.
Samples with higher chloride concentration should be diluted.

OXYGEN DEMAND, CHEMICAL MEDIUM RANGE

SPECIFICATIONS

Range	0 to 1500 mg/L COD
Resolution	1 mg/L
Accuracy	±15 mg/L or ±4 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 610 nm
Method	Adaptation of the USEPA 410.4 approved method for the COD determination on surface waters and wastewaters. Oxidizable organic compounds reduce the dichromate ion (orange) to the chromic ion (green). The amount of chromic ion formed is determined.

REQUIRED REAGENTS

Code	Description	Q.ty/test	Q.ty/set
COD-MR*	Reagent Vial	1 vial	25 vials
DEIONIZED120	Deionized Water	2.0 mL	optional

* *Reagent Vial identification*: **COD B**, white label.

Note: Store the unused vials in their container in a cool and dark place.

REAGENT SET

HI 93754B-25 Reagents for up to 24 tests

REQUIRED ACCESSORIES

HI 839800-01 Hanna reactor (115 VAC)
HI 839800-02 Hanna reactor (230 VAC)
HI 740216 Test tube cooling rack (25 holes)
HI 740217 Laboratory bench safety shield
For other accessories see page 68.

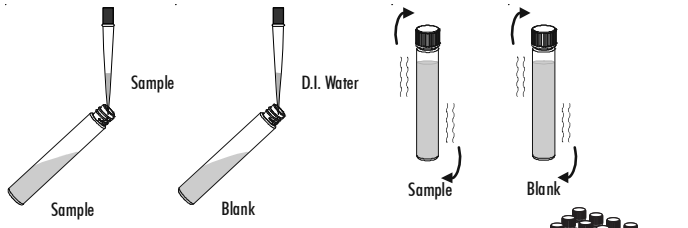
MEASUREMENT PROCEDURE

Before using the reagent kit carefully read all the instructions and the Manual Safety Data Sheet (MSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

Reagent Blank Correction: This method requires a reagent blank correction. A single blank vial may be used more than once. The blank vial is stable for several months (room temperature). For most accurate measurement, run a blank for each set of measurements and always use the same lot of reagents for blank and samples.

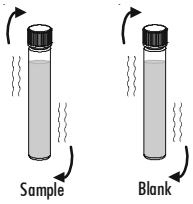
- Choose a homogeneous sample. Samples containing settleable solids need to be homogenized with a blender.
- Preheat the Hanna Reactor HI 839800 to 150 °C (302 °F). For correct use of the reactor follow Reactor Instruction Manual.
  Use of the optional HI 740217 safety shield is strongly recommended.
  DO NOT USE AN OVEN OR MICROWAVE samples may leak and generate a corrosive and possibly explosive atmosphere.
- Remove the caps from two Reagent Vials.

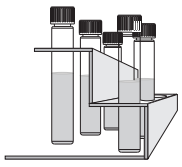
- Add exactly 2.0 mL of sample to one vial (sample vial), and 2.0 mL of deionized water to the other vial (blank vial), while keeping the vials at a 45-degree angle. Replace the cap tightly and mix by inverting each vial a couple of times.



Warning: The vials will become very hot during mixing, be careful when handling them.

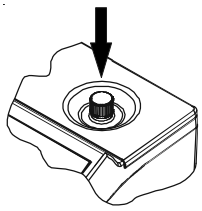
- Insert the vials into the reactor and heat them for 2 hours at 150 °C.
- At the end of the digestion period switch off the reactor. Wait for twenty minutes to allow the vials to cool to about 120 °C.
- Invert each vial several times while still warm, then place them in a test tube rack.
  Warning: The vials are still hot, be careful when handling them.



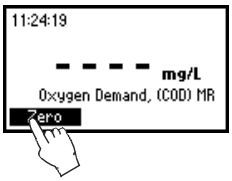


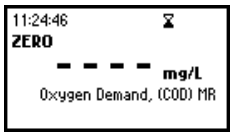
- Leave the vials in the tube rack to cool to room temperature. Do not shake or invert them, the samples may become turbid.

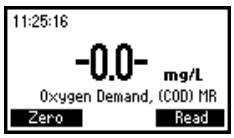
- Select the ***Oxygen Demand, (COD) MR*** method following one of the procedures described in the "Method Selection" section (see page 15).



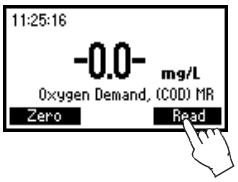
- Place the blank vial into the holder and push it completely down.
- Press the **Zero** key. The instrument will perform a zero sequence and after a few seconds the display will show "**-0.0-**". Now the meter is zeroed and ready for measurement.
- Remove the blank vial.

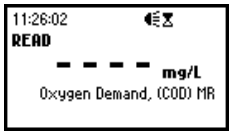


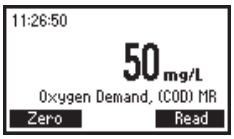




- Place the sample vial into the holder and push it completely down.
- Press **Read.** The instrument will perform the reading.
- The instrument displays concentration in **mg/L of oxygen demand** on the LCD.







INTERFERENCES

Interference may be caused by:
Chloride (Cl^-) above 2000 mg/L.
Samples with higher chloride concentration should be diluted.

OXYGEN DEMAND, CHEMICAL HIGH RANGE

SPECIFICATIONS

Range	0 to 15000 mg/L COD
Resolution	10 mg/L
Accuracy	±150 mg/L or ±3 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 610 nm
Method	Adaptation of the USEPA 410.4 approved method for the COD determination on surface waters and wastewaters. Oxidizable organic compounds reduce the dichromate ion (orange) to the chromic ion (green). The amount of chromic ion formed is determined.

REQUIRED REAGENTS

Code	Description	Q.ty/test	Q.ty/set
COD-HR*	Reagent Vial	1 vial	25 vials
DEIONIZED120	Deionized Water	0.2 mL	optional

* *Reagent Vial identification*: **COD C**, green label.

Note: Store the unused vials in their container in a cool and dark place.

REAGENT SET

HI 93754C-25 Reagents for up to 24 tests

REQUIRED ACCESSORIES

HI 839800-01 Hanna reactor (115 VAC)
HI 839800-02 Hanna reactor (230 VAC)
HI 740216 Test tube cooling rack (25 holes)
HI 740217 Laboratory bench safety shield
For other accessories see page 68.

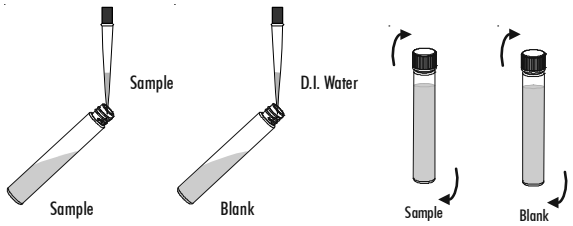
MEASUREMENT PROCEDURE

Before using the reagent kit carefully read all the instructions and the Material Safety Data Sheet (MSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

Reagent Blank Correction: This method requires a reagent blank correction. A single blank vial may be used more than once. The blank vial is stable for several months (room temperature). For most accurate measurement, run a blank for each set of measurements and always use the same lot of reagents for blank and samples.

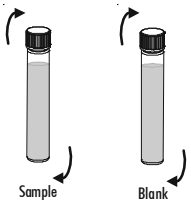
- Choose a homogeneous sample. Samples containing settleable solids need to be homogenized with a blender.
- Preheat the Hanna Reactor HI 839800 to 150 °C (302 °F). For correct use of the reactor follow Reactor Instruction Manual.
  Use of the optional HI 740217 safety shield is strongly recommended.
  DO NOT USE AN OVEN OR MICROWAVE samples may leak and generate a corrosive and possibly explosive atmosphere.
- Remove the caps from two Reagent Vials.

- Add exactly 0.2 mL of sample to one vial (sample vial), and 0.2 mL of deionized water to the other vial (blank vial), while keeping the vials at a 45-degree angle. Replace the cap tightly and mix by inverting each vial a couple of times.

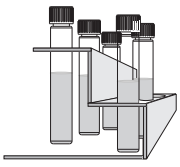


Warning: The vials will become very hot during mixing, be careful when handling them.

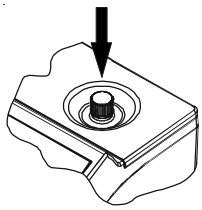
- Insert the vials into the reactor and heat them for 2 hours at 150 °C.
- At the end of the digestion period switch off the reactor. Wait for twenty minutes to allow the vials to cool to about 120 °C.



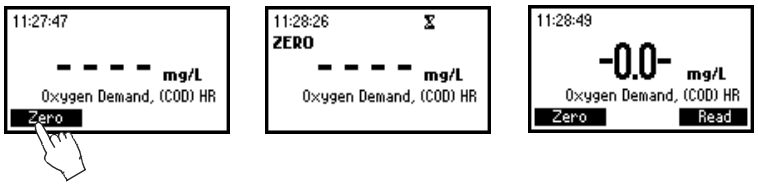
- Invert each vial several times while still warm, then place them in the test tube rack.
  Warning: The vials are still hot, be careful when handling them.
- Leave the vials in the tube rack to cool to room temperature. Do not shake or invert them anymore otherwise the samples may become turbid.



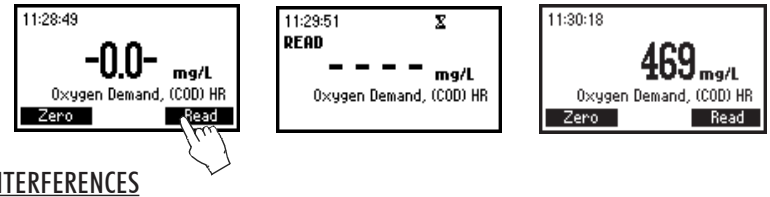
- Select the ***Oxygen Demand, (COD) HR*** method following one of the procedures described in the "Method Selection" section (see page 15).



- Place the blank vial into the holder and push it completely down.
- Press the **Zero** key. The instrument will perform a zero sequence and after a few seconds the display will show "**-0.0-**". Now the meter is zeroed and ready for measurement.
- Remove the blank vial.



- Place the sample vial into the holder and push it completely down.
- Press **Read**. The instrument will perform the reading.
- The instrument directly displays concentration in **mg/L of oxygen demand**.



INTERFERENCES

Interference may be caused by:
Chloride (Cl^-) above 20000 mg/L.
Samples with higher chloride concentration should be diluted.

PHOSPHORUS, REACTIVE

SPECIFICATIONS

Range	0.00 to 1.60 mg/L P
Resolution	0.01 mg/L
Accuracy	±0.05 mg/L or ±5 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 610 nm
Method	Adaptation of the EPA method 365.2 and *Standard Methods for the Examination of Water and Wastewater, 20th edition*, 4500-P E, ascorbic acid method. The reaction between orthophosphate and the reagent causes a blue tint in the sample.

REQUIRED REAGENTS

Code	Description	Q.ty/test	Q.ty/set
HI 93758A-0*	Reagent Vial	1 vial	50 vials
HI 93758-0	Phosphorus Reagent	1 packet	50 packets

* *Reagent Vial identification*: **P R**, red label.

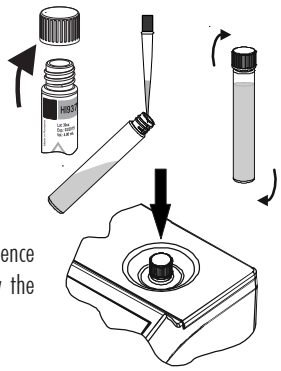
REAGENT SET

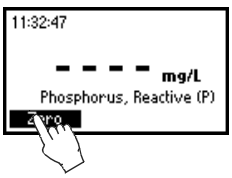
HI 93758A-50 Reagents for 50 tests

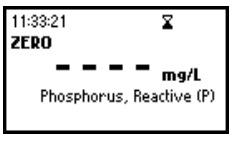
For other accessories see page 68.

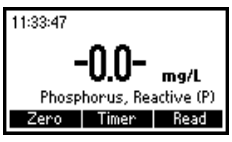
MEASUREMENT PROCEDURE

- Select the ***Phosphorus, Reactive*** method following one of the procedures described in the "Method Selection" section (see page 15).
- Remove the cap from a Reagent Vial.
- Add exactly 5.0 mL of sample to the vial, while keeping the vial at a 45-degree angle.
- Replace the cap and mix by inverting the vial a couple of times. This is the blank.
- Place the vial into the holder and push it completely down.
- Press the **Zero** key. The instrument will perform a zero sequence and after a few seconds the display will show "**-0.0-**". Now the meter is zeroed and ready for measurement.



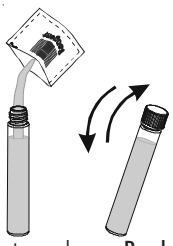


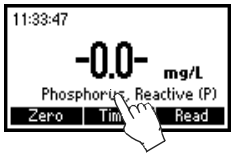




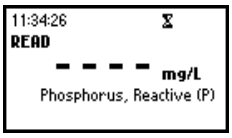
- Remove the vial.

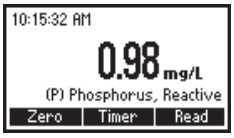
- Remove the cap and add the content of one packet of HI 93758-0 Phosphorus Reagent.
- Replace the cap tightly and shake gently to mix for 2 minutes until most of the powder is dissolved. This is the reacted sample.
- Place the vial into the holder and push it completely down.
- Press **Timer** and the display will show the countdown prior to the measurement and the "**Reaction Time**" message. Alternatively, wait for 3 minutes and press **Read**.



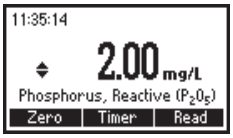


- The instrument will perform the reading. The instrument displays concentration in **mg/L of phosphorus (P)**.





- Press ▲ or ▼ to convert the result in mg/L of phosphate (PO_4^{3-}) or mg/L of P_2O_5.



Note: For accurate measurements
1) wash glassware only with phosphate-free detergents
2) clean all glassware with 1 : 1 hydrochloric acid solution and rinse with deionized water.

INTERFERENCES

Interference may be caused by:

Arsenate at any level

Silica above 50 mg/L

Sulfide above 6 mg/L.

To eliminate sulfide: add Bromine Water drop-wise until a pale yellow color develops; remove Bromine Water excess by adding Phenol solution drop-wise.

Turbidity and suspended matter in large amounts may cause interference because the reaction conditions may dissolve suspended matter or cause desorption of phosphates from particles. Turbidity or suspended matter should be removed before measurement by treatment with active carbon and by prior filtration.

PHOSPHORUS, ACID HYDROLYZABLE

SPECIFICATIONS

Range	0.00 to 1.60 mg/L P
Resolution	0.01 mg/L
Accuracy	±0.05 mg/L or ±5 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 610 nm
Method	Adaptation of the EPA method 365.2 and *Standard Methods for the Examination of Water and Wastewater, 20th edition,* 4500-P E, ascorbic acid method. A mild acid digestion converts condensed inorganic forms of phosphates to orthophosphate. Then the reaction between orthophosphate and the reagents causes a blue tint in the sample.

REQUIRED REAGENTS

Code	Description	Q.ty/test	Q.ty/set
HI 93758V-0AH*	Reagent Vial	1 vial	50 vials
HI 93758B-0	NaOH Solution 1.20 N	2 mL	1 bottle
HI 93758-0	Phosphorus Reagent	1 packet	50 packets

* *Reagent Vial identification*: **P AH**, white label.

Note: Store the unused vials in their container in a cool and dark place.

REAGENT SET

HI 93758B-50 Reagents for 50 tests

For other accessories see page 68.

REQUIRED ACCESSORIES

HI 839800-01 Hanna reactor (115 VAC)
HI 839800-02 Hanna reactor (230 VAC)
HI 740216 test tube cooling rack (25 holes)
HI 740217 Laboratory bench safety shield

For other accessories see page 68.

MEASUREMENT PROCEDURE

Before using the reagent kit carefully read all the instructions and the Material Safety Data Sheet (MSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

- Preheat the Hanna Reactor HI 839800 to 150 °C (302 °F). For correct use of the reactor follow Reactor Instruction Manual.

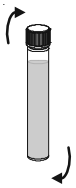
  The optional HI 740217 safety shield is strongly recommended.

  DO NOT USE AN OVEN OR MICROWAVE samples may leak and generate a corrosive and possibly explosive atmosphere.

- Remove the cap from a Reagent Vial.

- Add exactly 5.0 mL of sample to the vial, while keeping the vial at a 45-degree angle.

- Replace the cap and mix by inverting the vial a couple of times.



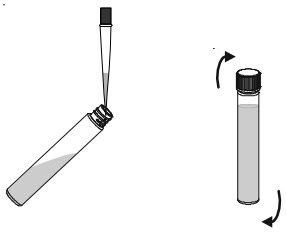
- Insert the vial into the reactor and heat it for 30 minutes at 150 °C.

- At the end of the digestion place the vials carefully in the test tube rack and allow to cool to room temperature.
  Warning: The vials are still hot, be careful when handling them.

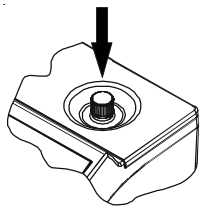
- Select the ***Phosphorus, Acid Hydrolyzable*** method following one of the procedures described in the "Method Selection" section (see page 15).

- Remove the cap from the vial and add exactly 2.0 mL of Sodium Hydroxide (NaOH) Solution 1.20 N, while keeping the vial at a 45-degree angle.

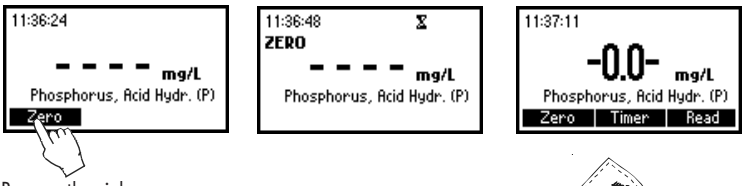
- Replace the cap tightly and mix by inverting the vial a couple of times. This is the blank.

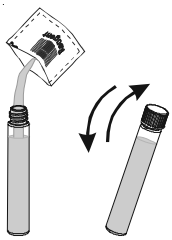


- Place the vial into the holder and push it completely down.

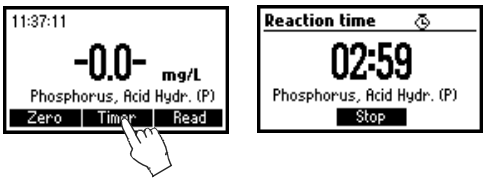


- Press the **Zero** key. The instrument will perform a zero sequence and after a few seconds the display will show "**-0.0-**". Now the meter is zeroed and ready for measurement.

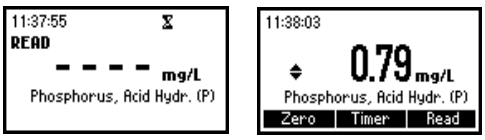




- Remove the vial.
- Remove the cap and add the content of one packet of HI 93758-0 Phosphorus Reagent.
- Replace the cap tightly and shake gently to mix for 2 minutes until most of the powder is dissolved. This is the sample.
- Place the vial into the holder and push it completely down.
- Press **Timer** and the display will show the countdown prior to the measurement and the "**Reaction Time**" message. Alternatively, wait for 3 minutes and press **Read**.

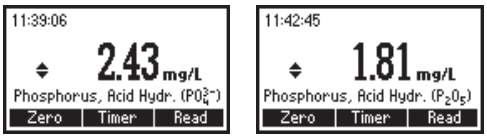


- The instrument will perform the reading. The instrument displays concentration in **mg/L of phosphorus (P)**.



The method detects free (orthophosphate) and condensed inorganic forms (meta-, pyro- and other polyphosphates) of phosphates present in the sample.

- Press ▲ or ▼ to convert the result in mg/L of phosphate (PO_4^{3-}) or mg/L of P_2O_5.



Note: For accurate measurements
1) wash glassware only with phosphate-free detergents
2) clean all glassware with 1 : 1 hydrochloric acid solution and rinse with deionized water.

INTERFERENCES

Interference may be caused by:

Arsenate at any level

Silica above 50 mg/L

Sulfide above 9 mg/L.

To eliminate sulfide: add Bromine Water drop-wise until a pale yellow color develops; remove Bromine Water excess by adding Phenol solution drop-wise.

Turbidity and suspended matter in large amounts may cause interference because the strongly acidic reaction conditions may dissolve suspended matter or cause desorption of phosphates from particles. Before measurement, turbidity or suspended matter should be removed by treatment with active carbon and by prior filtration.

PHOSPHORUS, TOTAL LOW RANGE

SPECIFICATIONS

Range	0.00 to 1.15 mg/L P
Resolution	0.01 mg/L
Accuracy	±0.05 mg/L or ±6 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 610 nm
Method	Adaptation of the EPA method 365.2 and *Standard Methods for the Examination of Water and Wastewater, 20th edition*, 4500-P E, ascorbic acid method. A persulfate digestion converts organic and condensed inorganic forms of phosphates to orthophosphate. Then the reaction between orthophosphate and the reagents causes a blue tint in the sample.

REQUIRED REAGENTS

Code	Description	Q.ty/test	Q.ty/set
HI 93758V-0*	Reagent Vial	1 vial	50 vials
HI 93758C-0	NaOH Solution 1.54 N	2 mL	1 bottle
HI 93758-0	Phosphorus Reagent	1 packet	50 packets
PERSULFATE/P	Potassium Persulfate	1 packet	50 packets

* *Reagent Vial identification*: **P TLR**, red label.

Note: Store the unused vials in their container in a cool and dark place.

REAGENT SET

HI 93758C-50 Reagents for 50 tests

For other accessories see page 68.

REQUIRED ACCESSORIES

HI 839800-01 Hanna reactor (115 VAC)
HI 839800-02 Hanna reactor (230 VAC)
HI 740216 test tube cooling rack (25 holes)
HI 740217 Laboratory bench safety shield

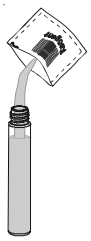
For other accessories see page 68.

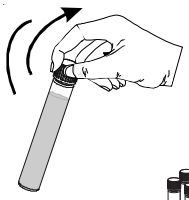
MEASUREMENT PROCEDURE

Before using the reagent kit carefully read all the instructions and the Material Safety Data Sheet (MSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

- Preheat the Hanna Reactor HI 839800 to 150 °C (302 °F). For correct use of the reactor follow Reactor Instruction Manual.
  Use of the optional HI 740217 safety shield is strongly recommended.
  DO NOT USE AN OVEN OR MICROWAVE samples may leak and generate a corrosive and possibly explosive atmosphere.

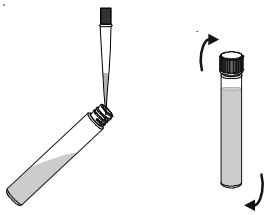
- Remove the cap from a Reagent Vial.
- Add exactly 5.0 mL of sample to the vial, while keeping the vial at a 45-degree angle.
- Add the content of one packet of Potassium Persulfate for Phosphorus analysis. Replace the cap and shake gently the vial until all the powder is completely dissolved.



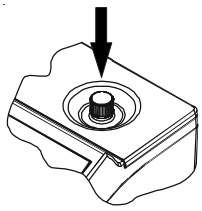


- Insert the vial into the reactor and heat it for 30 minutes at 150 °C.

- At the end of the digestion place the vials carefully in the test tube rack and allow to cool to room temperature.
  Warning: The vials are still hot, be careful when handling them.
- Select the ***Phosphorus, Total*** method following one of the procedures described in the "Method Selection" section (see page 15).

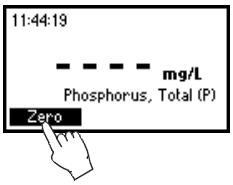


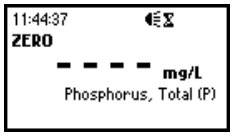
- Remove the cap from the vial and add exactly 2.0 mL of Sodium Hydroxide (NaOH) Solution 1.54 N, while keeping the vial at a 45-degree angle.
- Replace the cap tightly and mix by inverting the vial a couple of times. This is the blank.

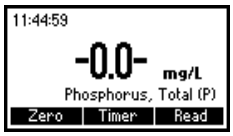


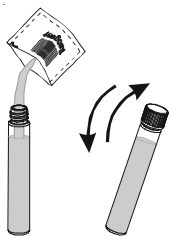
- Place the vial into the holder and push it completely down.

- Press the **Zero** key. The instrument will perform a zero sequence and after a few seconds the display will show "**-0.0-**". Now the meter is zeroed and ready for measurement.

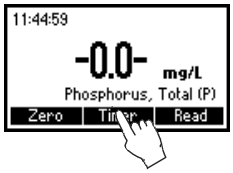




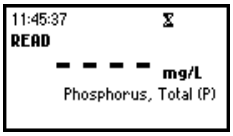


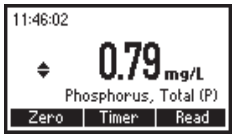


- Remove the vial.
- Remove the cap and add the content of one packet of HI 93758-0 Phosphorus Reagent.
- Replace the cap tightly and shake gently to mix for about 2 minutes until all the powder is completely dissolved. This is the sample.
- Place the vial into the holder and push it completely down.
- Press **Timer** and the display will show the countdown prior to the measurement and the "**Reaction Time**" message. Alternatively, wait for 3 minutes and press **Read**.



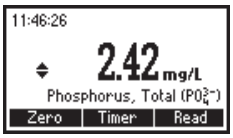
- The instrument will perform the reading. The instrument displays concentration in **mg/L of phosphorus (P)**.

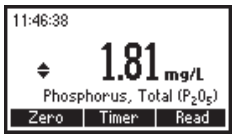




The method detects free (orthophosphate) and condensed inorganic forms (meta-, pyro- and other polyphosphates) of phosphates present in the sample.

- Press ▲ or ▼ to convert the result in mg/L of phosphate (PO_4^{3-}) or mg/L of P_2O_5.





Note: For accurate measurements
1) wash glassware only with phosphate-free detergents
2) clean all glassware with 1 : 1 hydrochloric acid solution and rinse with deionized water.

INTERFERENCES

Interference may be caused by:

Arsenate at any level

Silica above 50 mg/L

Sulfide above 90 mg/L.

Turbidity and suspended matter in large amounts may cause interference because the strongly acidic reaction conditions may dissolve suspended matter or cause desorption of phosphates from particles. Before measurement, turbidity or suspended matter should be removed by treatment with active carbon and by prior filtration.

PHOSPHORUS, REACTIVE HIGH RANGE

SPECIFICATIONS

Range	0.0 to 32.6 mg/L P
Resolution	0.1 mg/L
Accuracy	±0.5 mg/L or ±5 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 420 nm
Method	Adaptation of the *Standard Methods for the Examination of Water and Wastewater, 20th edition,* 4500-P C, vanadomolybdophosphoric acid method. The reaction between orthophosphate and the reagents causes a yellow tint in the sample.

REQUIRED REAGENTS

Code	Description	Q.ty/test	Q.ty/set
HI 93763A-0*	Reagent Vial	1 vial	50 vials
DEIONIZED120	Deionized Water	5 mL	1 bottle

* *Reagent Vial identification*: **P RHR**, green label.

Note: Store the unused vials in their container in a cool and dark place.

REAGENT SET

HI 93763A-50 Reagents for up to 49 tests

For other accessories see page 68.

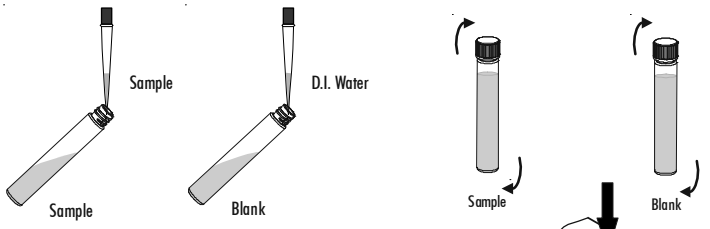
MEASUREMENT PROCEDURE

Reagent Blank Correction: This method requires a reagent blank correction. A single blank vial may be used more than once; the blank vial is stable up to two weeks (room temperature). For most accurate measurement, run a blank for each set of measurements and always use the same lot of reagents for blank and samples.

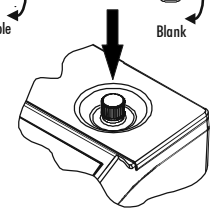
- Select the ***Phosphorus, Reactive High Range*** method following one of the procedures described in the "Method Selection" section (see page 15).
- Remove the caps from two Reagent Vials.

- Add exactly 5.0 mL of sample to one vial (sample vial), and 5.0 mL of deionized water to the other vial (blank vial), while keeping the vials at a 45-degree angle.

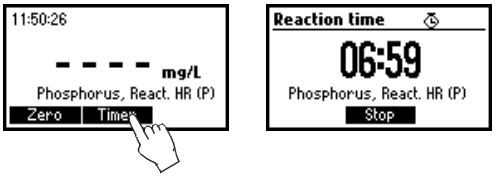
- Replace the cap and mix by inverting each vial a couple of times.



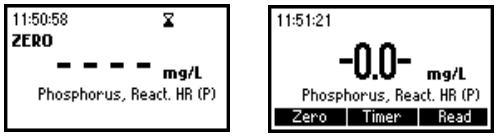
- Place the blank vial into the holder and push it completely down.



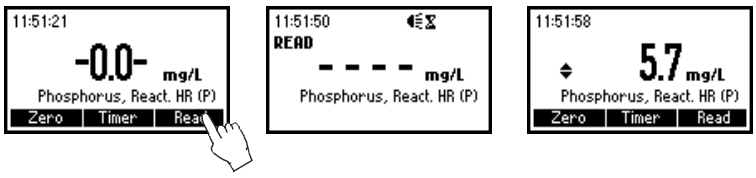
- Press **Timer** and the display will show the countdown prior to the measurement and the "**Reaction Time**" message. Alternatively, wait for 7 minutes and press **Zero**.

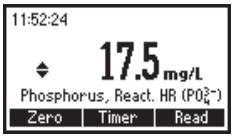


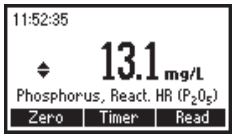
- The instrument will perform a zero sequence and after a few seconds the display will show "**-0.0-**". Now the meter is zeroed and ready for measurement.
- Remove the blank vial.



- Place the sample vial into the holder and push it completely down.
- Press **Read**. The instrument will perform the reading. The instrument displays concentration in **mg/L of phosphorus (P)**.
- Press ▲ or ▼ to convert the result in mg/L of phosphate (PO_4^{3-}) or mg/L of P_2O_5.







Note: For accurate measurements
1) wash glassware only with phosphate-free detergents
2) clean all glassware with 1 : 1 hydrochloric acid solution and rinse with deionized water.

INTERFERENCES

Interference may be caused by:

Bismuth

Fluoride

pH: the sample should have a neutral pH

Sulfide: to eliminate sulfide add Bromine Water drop-wise until a pale yellow color develops; remove Bromine Water excess by adding Phenol solution drop-wise.

Temperature: the method is temperature sensitive.
It is recommended to run measurements at T = 20 to 25 °C:
T < 20 °C causes a negative error
T > 25 °C causes a positive error

Turbidity and suspended matter in large amounts may cause interference because the strongly acidic reaction conditions may dissolve suspended matter or cause desorption of phosphates from particles. Before measurement, turbidity or suspended matter should be removed by treatment with active carbon and by prior filtration.

PHOSPHORUS, TOTAL HIGH RANGE

SPECIFICATIONS

Range	0.0 to 32.6 mg/L (P)
Resolution	0.1 mg/L
Accuracy	±0.5 mg/L or ±5 % of reading @ 25 °C, whichever is greater
Light Source	Tungsten lamp with narrow band interference filter @ 420 nm
Method	Adaptation of the *Standard Methods for the Examination of Water and Wastewater, 20th edition,* 4500-P C, vanadomolybdophosphoric acid method. A persulfate digestion converts organic and condensed inorganic forms of phosphates to orthophosphate. Then the reaction between orthophosphate and the reagents causes a yellow tint in the sample.

REQUIRED REAGENTS

Code	Description	Q.ty/test	Q.ty/set
HI 93758V-0HR*	Reagent Vial	1 vial	50 vials
HI 93758C-0	NaOH Solution 1.54 N	2 mL	1 bottle
HI 93763B-0	Molybdovanadate Reagent	0.5 mL	1 bottle
DEIONIZED120	Deionized Water	5 mL	1 bottle
PERSULFATE/P	Potassium Persulfate	1 packet	50 packets

* *Reagent Vial identification*: **P THR**, green label.

Note: Store the unused vials in their container in a cool and dark place.

REAGENT SET

HI 93763B-50 Reagents for up to 49 tests

For other accessories see page 68.

REQUIRED ACCESSORIES

HI 839800-01 Hanna reactor (115 VAC)
HI 839800-02 Hanna reactor (230 VAC)
HI 740216 test tube cooling rack (25 holes)
HI 740217 Laboratory bench safety shield

For other accessories see page 68.

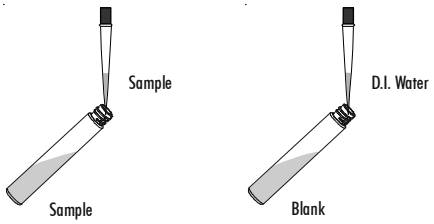
MEASUREMENT PROCEDURE

Before using the reagent kit carefully read all the instructions and the Material Safety Data Sheet (MSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

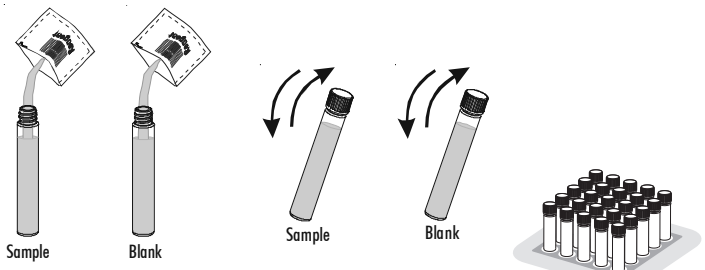
Reagent Blank Correction: This method requires a reagent blank correction. A single blank vial may be used more than once; the blank vial is stable up to one day (room temperature). For most accurate measurement, run a blank for each set of measurements and always use the same lot of reagents for blank and samples.

- Preheat the Hanna Reactor HI 839800 to 150 °C (302 °F). For correct use of the reactor follow Reactor Instruction Manual.
  The optional HI 740217 safety shield is strongly recommended.
  DO NOT USE AN OVEN OR MICROWAVE samples may leak and generate a corrosive and possibly explosive atmosphere.
- Remove the caps from two Reagent Vials.

- Add exactly 5.0 mL of sample to one vial (sample vial), and 5.0 mL of deionized water to the other vial (blank vial), while keeping the vials at a 45-degree angle.



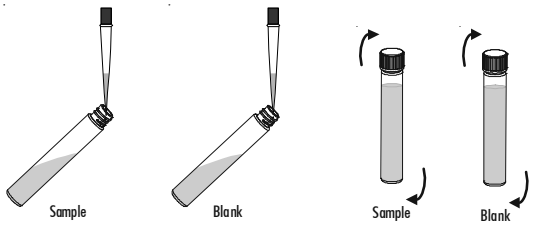
- Add the content of one packet of Potassium Persulfate for Phosphorus analysis to each vial. Replace the cap tightly and shake gently the vials until all the powder is completely dissolved.



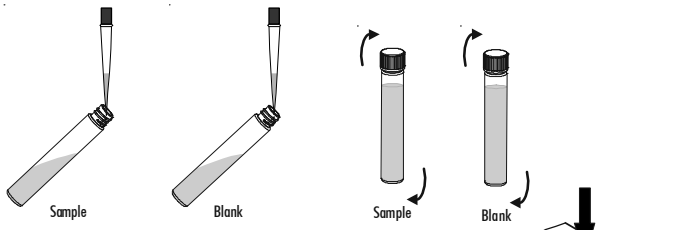
- Insert the vials into the reactor and heat them for 30 minutes at 150 °C.

- At the end of the digestion place the vials carefully in the test tube rack and allow to cool to room temperature.
  Warning: The vials are still hot, be careful when handling them.

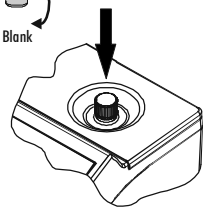
- Select the ***Phosphorus, Total High Range*** method following one of the procedures described in the "Method Selection" section (see page 15).
- Remove the cap from the vials and add exactly 2.0 mL of Sodium Hydroxide (NaOH) Solution 1,54 N to each vial, while keeping the vials at a 45-degree angle. Replace the cap tightly and mix by inverting the vials a couple of times.



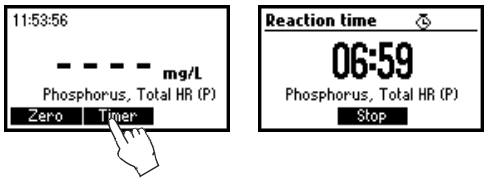
- Remove the cap from the vials and add exactly 0.5 mL of HI 93763B-0 Molybdovanadate Reagent to each vial, while keeping the vial at a 45-degree angle. Replace the cap tightly and mix by inverting the vials a couple of times.



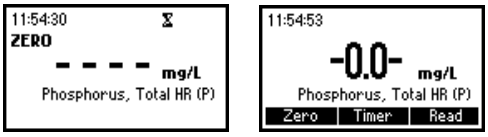
- Place the blank vial into the holder and push it completely down.



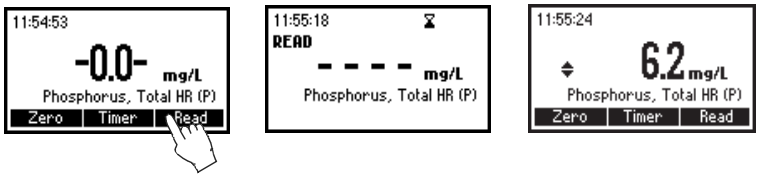
- Press **Timer** and the display will show the countdown prior to the measurement and the "**Reaction Time**" message. Alternatively, wait for 7 minutes and press **Zero**.



- The instrument will perform a zero sequence and after a few seconds the display will show "**-0.0-**". Now the meter is zeroed and ready for measurement.

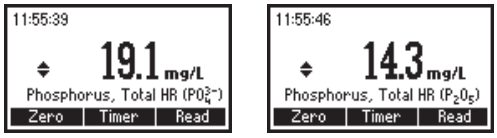


- Remove the blank vial.
- Place the sample vial into the holder and push it completely down.
- Press **Read**. The instrument will perform the reading. The instrument displays concentration in **mg/L of phosphorus (P)**.



The method detects free (orthophosphate), condensed inorganic forms (meta-, pyro- and other polyphosphates) and organic forms of phosphates present in the sample.

- Press ▲ or ▼ to convert the result in mg/L of phosphate (PO_4^{3-}) or mg/L of P_2O_5.



Note: For accurate measurements
1) wash glassware only with phosphate-free detergents
2) clean all glassware with 1 : 1 hydrochloric acid solution and rinse with deionized water.

INTERFERENCES

Arsenate
pH: the sample should have a neutral pH
Temperature: the method is temperature sensitive.
It is recommended to add the Molybdovanadate Reagent and to run measurements at T = 20 to 25 °C:
T < 20 °C causes a negative error
T > 25 °C causes a positive error
Turbidity and suspended matter in large amounts may cause interference because the strongly acidic reaction conditions may dissolve suspended matter or cause desorption of phosphates from particles. Before measurement, turbidity or suspended matter should be removed by treatment with active carbon and by prior filtration.

ERRORS AND WARNINGS

The instrument shows clear messages when erroneous conditions appear and when measured values are outside the expected range. These messages are described bellow.

No Light: The light source is not functioning properly.

Light Leak: There is too much light when dark current is measured.

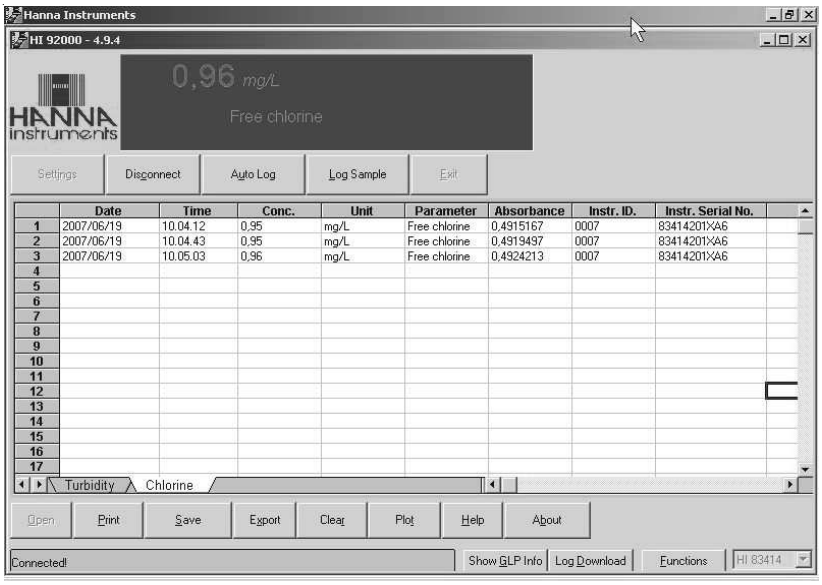
Inverted vials: The sample and the zero vials are inverted to each other.

Light Low: The instrument cannot adjust the light level. Please check that the sample does not contain any debris.

Light High: There is too much light to perform a measurement. Please check the preparation of the zero cuvette.

DATA MANAGEMENT

The analyzed data can be managed using Hanna's product **HI92000**, Windows® Compatible Software.



STANDARD METHODS

Description	Range	Method
Ammonia LR	0.00 to 3.00 mg/L	Nessler
Ammonia HR	0 to 100 mg/L	Nessler
Chlorine, Free	0.00 to 5.00 mg/L	DPD
Chlorine, Total	0.00 to 5.00 mg/L	DPD
Nitrate	0.0 to 30.0 mg/L	Chromotropic Acid
Nitrogen, Total LR	0.0 to 25.0 mg/L	Chromotropic Acid
Nitrogen, Total HR	10 to 150 mg/L	Chromotropic Acid
COD LR	0 to 150 mg/L	Dichromate, Mercuric Sulfate
COD MR	0 to 1500 mg/L	Dichromate, Mercuric Sulfate
COD HR	0 to 15000 mg/L	Dichromate, Mercuric Sulfate
Phosphorus, Reactive	0.00 to 1.60 mg/L	Ascorbic Acid
Phosphorus, Acid Hydrolyzable	0.00 to 1.60 mg/L	Ascorbic Acid
Phosphorus, Total LR	0.00 to 1.15 mg/L	Ascorbic Acid
Phosphorus, Reactive HR	0.0 to 32.6 mg/L	Vanadomolybdophosphoric Acid
Phosphorus, Total HR	0.0 to 32.6 mg/L	Vanadomolybdophosphoric Acid

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ACCESSORIES

REAGENT SETS

HI 93701-01 100 free chlorine tests
HI 93701-03 300 free chlorine tests
HI 93711-01 100 total chlorine tests
HI 93711-03 300 total chlorine tests
HI 93754A-25 25 COD LR tests
HI 93754B-25 25 COD MR tests
HI 93754C-25 25 COD HR tests
HI 93758A-50 50 reactive phosphorus tests
HI 93758B-50 50 acid hydrolyzable phosphorus tests
HI 93758C-50 50 total phosphorus LR tests
HI 93763A-50 50 reactive phosphorus HR tests
HI 93763B-50 50 total phosphorus HR tests
HI 93764A-25 25 ammonia LR tests
HI 93764B-25 25 ammonia HR tests
HI 93766-50 50 nitrate tests
HI 93767A-50 50 total nitrogen LR tests
HI 93767B-50 50 total nitrogen HR tests

OTHER ACCESSORIES

HI 839800-01 Hanna Reactor (115 VAC)
HI 839800-02 Hanna Reactor (230 VAC)
HI 731318 Cloth for wiping vials (4 pcs.)
HI 731340 200 µL automatic pipette
HI 731341 1000 µL automatic pipette
HI 731342 2000 µL automatic pipette
HI 731350 tips for 200 µL automatic pipette (25 pcs.)
HI 731351 tips for 1000 µL automatic pipette (25 pcs.)
HI 731352 tips for 2000 µL automatic pipette (4 pcs.)
HI 740142 1 mL graduated syringe
HI 740143 1 mL graduated syringe (6 pcs.)
HI 740144 Pipette tip (6 pcs.)
HI 740157 Plastic refilling pipette (20 pcs.)
HI 740216 Test tube cooling rack (25 holes)
HI 740217 Laboratory bench safety shield
HI 92000 Windows® Compatible Software
HI 920013 PC Connection Cable
HI 93703-50 Vial cleaning solution (230 mL)

WARRANTY

All Hanna Instruments meters are warranted for two years against defects in workmanship and materials when used for its intended purpose and maintained according to the instructions.

This warranty is limited to repair or replacement free of charge.

Damages due to accident, misuse, tampering or lack of prescribed maintenance are not covered.

If service is required, contact your dealer. If under warranty, report the model number, date of purchase, serial number and the nature of the failure. If the repair is not covered by the warranty, you will be notified of the charges incurred.

If the instrument is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization Number from the Customer Service Department and then send it with shipment costs prepaid. When shipping any instrument, make sure it is properly packaged for complete protection.

To validate your warranty, fill out and return the enclosed warranty card within 14 days from the date of purchase.

HANNA LITERATURE

Hanna publishes a wide range of catalogs and handbooks for an equally wide range of applications. The reference literature currently covers areas such as:

- Water Treatment
- Process
- Swimming Pools
- Agriculture
- Food
- Laboratory

and many others. New reference material is constantly being added to the library.

For these and other catalogs, handbooks and leaflets contact your dealer or the Hanna Customer Service Center nearest to you. To find the Hanna Office in your vicinity, check our home page at www.hannainst.com.

Recommendations for Users

Before using these products, make sure that they are entirely suitable for your specific application and for the environment in which they are used.

Operation of these instruments may cause unacceptable interferences to other electronic equipments, this requiring the operator to take all necessary steps to correct interferences.

Any variation introduced by the user to the supplied equipment may degrade the instruments' EMC performance.

To avoid damages or burns, do not put the instrument in microwave ovens. For yours and the instrument safety do not use or store the instrument in hazardous environments.

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