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MANC214R3 10/04

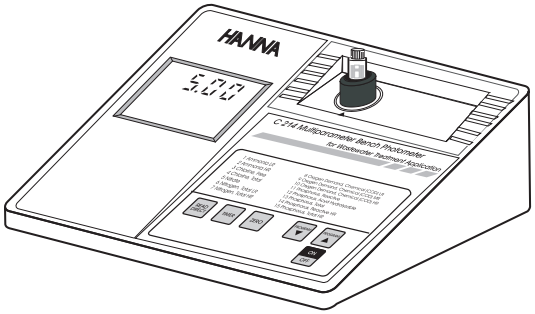
Instruction Manual

C 214

Multiparameter Bench Photometer

for

Wastewater Treatment Application



HANNA instruments
www.hannainst.com

CE
These Instruments are in Compliance with the CE Directives

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. These instruments are in compliance with CE directives.

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WARRANTY

All Hanna Instruments meters are warranted for two years against defects in workmanship and materials when used for 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 Instruments reserves the right to modify the design, construction and appearance of its products without advance notice.

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.

CE DECLARATION OF CONFORMITY

HANNA instruments

CE

DECLARATION OF CONFORMITY

We

Hanna Instruments Italia Srl
Viale Delle Industrie, 12/A
35010 Villafranca Padovana- PD
ITALY

herewith certify that the Multiparameter Bench Photometer:

C 214

Has been tested and found to be in compliance with EMC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC according to the following applicable normatives:

EN 50082-1: Electromagnetic Compatibility - Generic Immunity Standard
IEC 61000-4-2 Electrostatic Discharge
IEC 61000-4-3 RF Radiated

EN 50081-1: Electromagnetic Compatibility - Generic Emission Standard
EN 55022 Radiated, Class B

EN61010-1: Safety requirements for electrical equipment for measurement, control and laboratory us

Date of Issue: 19-12-2002

A. Marsilio - Engineering Manager
On behalf of
Hanna Instruments Italia S.r.l.

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.

PRELIMINARY EXAMINATION

Please examine this product carefully. Make sure that the instrument is not damaged. If any damage occured during shipment, please notify your Dealer.

Each Meter is supplied complete with:

- Five Sample Vials
- Two 9 V Batteries
- 12 VDC Transformer (**HI 710005** or **HI 710006**)
- 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
COD: Chemical Oxygen Demand
EPA: US Environmental Protection Agency
°F: degree Fahrenheit
g/L: grams per liter. g/L is equivalent to ppt (part per thoushand)
HR: high range
LR: low range
mg/L: milligrams per liter. mg/L is equivalent to ppm (part per million)
mL: milliliter
MR: medium range
µg/L: micrograms per liter. µg/L is equivalent to ppb (part per billion)

GENERAL DESCRIPTION

C 99 & C 200 Series is a line of 17 different bench, microprocessor-based photometers to measure more than 50 different parameters in water and wastewater. These multipurpose meters are manufactured to measure the most important parameters of the application they have been especially designed for:

C 99	Laboratories, with COD	C 200	Laboratories
C 203	Aquaculture	C 205	Boilers & Cooling Towers
C 206	Environmental Testing	C 207	Industrial Wastewater
C 208	Water Conditioning	C 209	Education
C 210	Pulp & Paper Mills	C 211	Chemical Manufacturers
C 212	Power Plant Utilities	C 213	Municipal Wastewater
C 214	Wastewater Treatment Applic.	C 215	Nutrient Analyses
C 216	Pool & Spa Applic.	C 218	Environmental Applic.
C 226	Pool & Spa Applic.		

The reagents are in liquid or powder form and are supplied in bottles and ready-to-use vials or in packets. The amount of reagent is precisely dosed to ensure the maximum repeatability.

Display codes aid the user in routine operations.

The meters have an auto-shut off feature that will turn off the instrument after 10 minutes of non-use.

The C 99 & C 200 Series can be connected to a personal computer via the HI 920010 three wire RS 232 cable. The HI 92000 Hanna Windows® Compatible Software aids the user to manage all test data.

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 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

C115-00300	5 mL graduated syringe
C9800-01	Hanna Reactor (115 VAC)
C9800-02	Hanna Reactor (230 VAC)
HI 710005	110VAC to 12VDC voltage adapter
HI 710006	220VAC to 12VDC voltage adapter
HI 721310	9V battery (10 pcs)
HI 731311	glass vials with cap (5 pcs)
HI 731318	Tissue for wiping cuvets (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 920010	PC connection cable
HI 93703-50	Cuvets cleaning solution (230 mL)

STANDARD METHODS

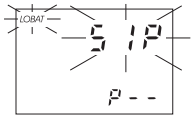
Description	Range	Method
Ammonia LR	0.00 to 3.00 mg/L	Nessler
Ammonia HR	0 to 100 mg/L	Nessler
Chlorine, Free	0.00 to 5.00 mg/L	DPD
Chlorine, Total	0.00 to 5.00 mg/L	DPD
Nitrate	0.0 to 30.0 mg/L	Chromotropic Acid
Nitrogen, Total	0.0 to 25.0 mg/L	Chromotropic Acid
Nitrogen, Total HR	10 to 150 mg/L	Chromotropic Acid
COD LR	0 to 150 mg/L	Dichromate, Mercuric Sulphate
COD MR	0 to 1500 mg/L	Dichromate, Mercuric Sulphate
COD HR	0 to 15000 mg/L	Dichromate, Mercuric Sulphate
Phosphorus, Reactive	0.00 to 5.00 mg/L	Ascorbic Acid
Phosphorus, Acid Hydrolyzable	0.00 to 5.00 mg/L	Ascorbic Acid
Phosphorus, Total	0.00 to 3.50 mg/L	Ascorbic Acid
Phosphorus, Reactive HR	0.0 to 100.0 mg/L	Vanadomolybdophosphoric Acid
Phosphorus, Total HR	0.0 to 100.0 mg/L	Vanadomolybdophosphoric Acid

BATTERY REPLACEMENT

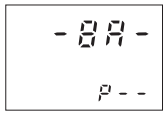
Besides the 12 VDC supply, this meter can also be fed by two 9V batteries.

To prolong battery life, switch your meter off after use. However, the meter has an auto-shut off feature that will turn itself off after 10 minutes of non-use.

A blinking "LOBAT" on the display, while a measurement is in progress, indicates low voltage and the batteries should be replaced.



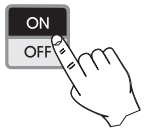
If the batteries are not replaced immediately, in order to prevent erroneous readings due to low voltage, "-BA-" is displayed soon afterwards. At this point the batteries must be changed.



Battery replacement must only take place in a non-hazardous area using two 9V alkaline batteries.

Remove the battery cover on the back of photometer, attach two fresh 9V batteries, while paying attention to the correct polarity, and replace the cover.

The meter will turn on automatically when a new battery is connected. You can turn it off by pressing ON/OFF.



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	2 x 9 V batteries / 12 to 20 VDC through voltage adapter
Auto-Shut off	After 10' of non-use
Dimensions	230 x 165 x 70 mm (9.0 x 6.5 x 2.8")
Weight	640 g (22.6 oz.)

For specifications related to each single parameter (e.g. range, precision, etc.), refer to the related measurement section.

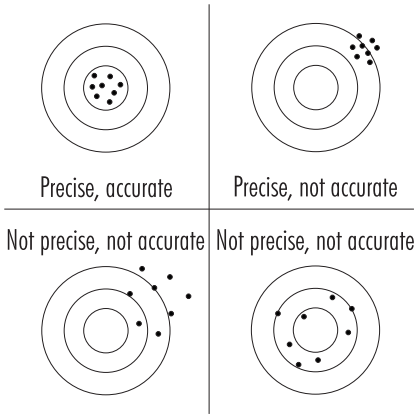
PRECISION AND ACCURACY

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 parameter, the precision is expressed in the related measurement section as standard deviation at a specific concentration value of the analite. The standard deviation is obtained with a single instrument using a representative lot of reagents.



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

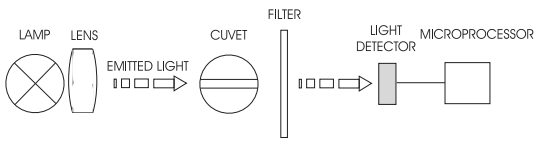
Therefore, the concentration "c" can be calculated from the absorbance of the substance as the other factors are known.

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 Hanna's C 99 & C 200 Series multiparameter photometers is based on special subminiature tungsten lamps and narrow-band interference filters to guarantee both high performance and reliable results.

Four measuring channels (at four different wavelengths) allow a wide range of tests.



C 200 Series block diagram (optical layout)

/PUP - Program Up

/PDN - Program Down

/PTM - Turn Test Mode On

/Brx - Set the baud rate

1 - 300	2 - 600
3 - 1200	4 - 2400

/KBL - Lock Keyboard

/KBU - Unlock Keyboard

?PR# - Send Current Program Number

?BRQ - Send current baud rate

1 - 150	2 - 300
3 - 600	4 - 1200
5 - 2400	

?CNQ - Send Concentration (three bytes)

conc

decimal point

unit

m - ppm	b - ppb
t - ppt	u - pcu
h - pH	

?ERR - send error / status information

0 - No error
1 - CAP
2 - HI
3 - ZERO
4 - LO
5 - IDLE
6 - ZERO DONE
7 - TIMED READ

INTERFACE WITH PC

To connect your meter to the PC use the optional **HI 920010** (available from your Hanna Dealer). Make sure that your meter is switched off and plug the connectors, one into the meter RS 232C socket, the other into the serial port of your PC.

Note: Cables other than **HI 920010** may use a different configuration, in which case, communication between the meter and the PC may not be possible.

SETTING THE BAUD RATE

The transmission speed (baud rate) of the meter and the external device must be identical. The meter is factory set to 2400.

If you wish to change this value, please contact your nearest Hanna Center.

SENDING COMMANDS FROM PC

With terminal programs such as, for example, Telix®, Windows Terminal®, it is possible to remotely control your Hanna Instruments bench meter. Use **HI 920010** cable to connect the meter to the PC, start the terminal program and set the communication options as follows: 8, N, 1, no flow control.

Command Types

To send a command to the meter the scheme is:

<DLE> <*command*> <CR>

This line makes the computer send a Data Link Escape character (/ or ?), the command expressed as a number or a 3-character sequence and a CR character.

Note: Windows Terminal® and all the other terminal programs that support the ANSI escape sequence, represent the DLE character by the string '^P' and the CR character by the string '^M'.

Type of Commands

/OFF - Turn the meter OFF

/PDR - Press Read Direct

/PTR - Press Timer

/PZR - Press Zero

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A microprocessor controlled special tungsten lamp emits radiation which is first optically conditioned and beamed to 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_0 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.

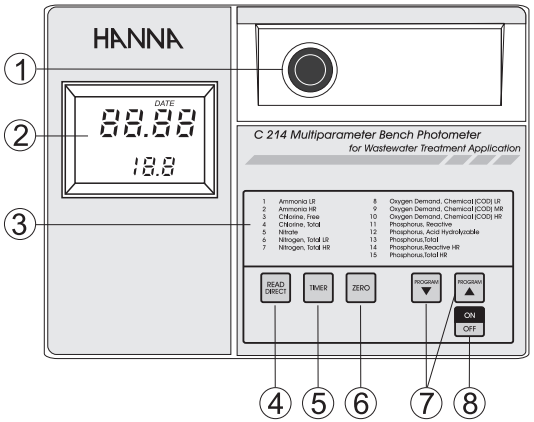
The vial has a very important role because it is an optical element and thus requires particular attention. It is important that both the measurement and the calibration (zeroing) vials are optically identical to provide the same measurement conditions. Most of parameters use the same vial for both. In each case, insert the test vials always in the same position into the holder.

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 close the vial to prevent any contamination.

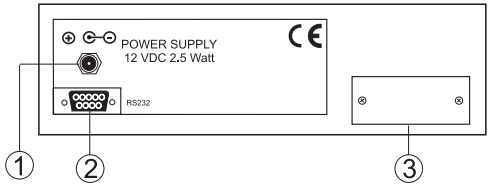
FUNCTIONAL DESCRIPTION

FRONT PANEL



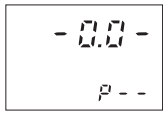
1) Vial Holder
2) Dual Level Liquid Crystal Display (LCD)
3) Programs List
4) READ DIRECT, to perform measurement immediately
5) TIMER, to perform measurement after a preprogrammed countdown
6) ZERO, to zero the meter prior to measurement
7) Program ▼ and ▲, to select the desired parameter
8) ON/OFF, to turn the meter on and off

REAR PANEL

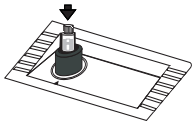


1) Power Supply 12 VDC 2.5 Watt
2) RS 232 Socket
3) Batteries Compartment

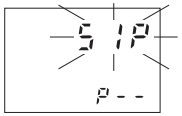
- Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement.



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



- Press READ DIRECT and "SIP" will blink on the display.



- The instrument directly displays concentration in **mg/L of phosphate** (PO_4^{3-}) on the Liquid Crystal Display.
  The method detects free (orthophosphate), condensed inorganic forms (meta-, pyro- and other polyphosphates) and organic forms of phosphates present in the sample.
- To convert the reading to mg/L of P_2O_5, multiply by a factor of 0.748.
- To convert the reading to mg/L of phosphorus (P) concentration, multiply by a factor of 0.326.

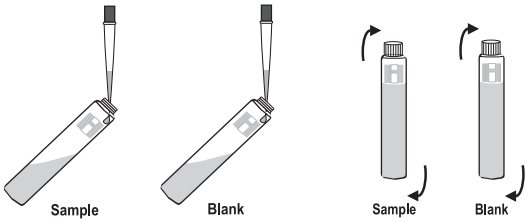
Note: for accurate measurements
1) wash glassware only with phosphate-free detergents
2) clean all glassware with 1 : 1 hydrochloric acid solution and rinse with deionized water.

INTERFERENCES

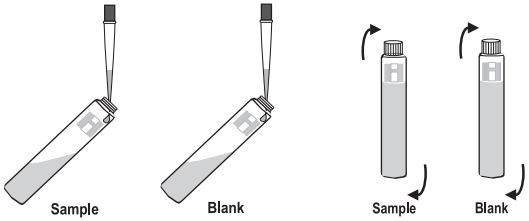
Arsenate:	positive error
pH:	the sample should have a neutral pH
Temperature:	the method is temperature sensitive. It is recommended to add the Molybdovanadate Reagent and to run measurements at T = 20 to 25 °C: T < 20 °C causes a negative error T > 25 °C causes a positive error
Turbidity:	turbidity 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.

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

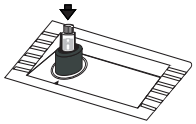
- Select the program number corresponding to Total Phosphorus High Range on the secondary LCD by pressing PROGRAM ▼ and ▲.
- Remove the cap from the vials and add exactly 2.0 mL of Sodium Hydroxide (NaOH) Solution 1,54 N to each vial, while keeping the vials at a 45-degree angle. Replace the cap tightly and mix by inverting the vials a couple of times.



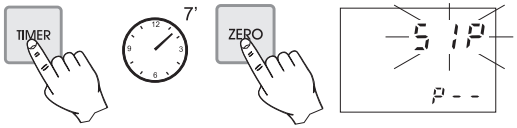
- Remove the cap from the vials and add exactly 0.5 mL of HI 93763B-0 Molybdovanadate Reagent to each vial, while keeping the vial at a 45-degree angle. Replace the cap tightly and mix by inverting the vials a couple of times.



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

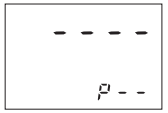


- Press TIMER and the display will show the countdown prior to the measurement. Alternatively, wait for 7 minutes and press ZERO. In both cases "SIP" will blink during measurement.

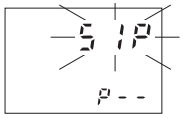


GUIDE TO DISPLAY CODES

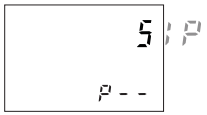
Note: The secondary LCD below shows a generic "P– –", whereas the meter will indicate the exact program number (e.g. "P1" for Ammonia LR).



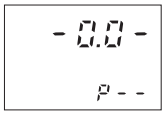
This indicates that the meter is in a ready state and zeroing can be performed.



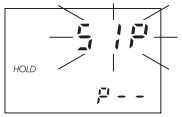
Sampling in progress. This flashing prompt appears each time the meter is performing a measurement.



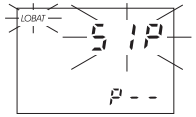
The microprocessor is adjusting the light level, indicated by a scrolling "SIP".



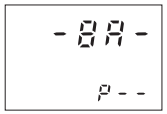
This indicates that the meter is in a zeroed state and measurement can be performed.



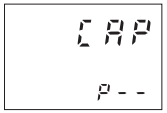
The instrument is performing an internal check-up.



The blinking "LOBAT" indicates that the battery voltage is getting low and the batteries need to be replaced.



This indicates that the batteries are dead and must be replaced.



Light over range. The vial is not inserted correctly and an eccess ambient light is reaching the detector. If the vial is properly inserted, then contact your dealer or the nearest Hanna Customer Service Center.

-LO- p--	The lamp is not working properly. Contact your dealer or the nearest Hanna Customer Service Center.
-HI- p--	The lamp is not working properly. Contact your dealer or the nearest Hanna Customer Service Center.
CONF p--	This indicates that the meter has lost its configuration. Contact your dealer or the nearest Hanna Customer Service Center.

ERROR MESSAGES

a) on zero reading:

0.0 p--	This indicates that the zeroing procedure failed due to a low signal-to-noise ratio. In this case press ZERO again.
no L p--	The instrument cannot adjust the light level. Please check that the vial does not contain any debris.
L Lo p--	There is not enough light to perform a measurement. Please check the preparation of the zero vial.
L Hi p--	There is too much light to perform a measurement. Please check the preparation of the zero vial.

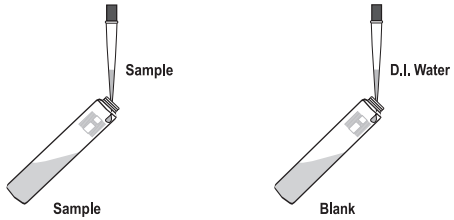
b) on sample reading:

-SA- p--	There is too much light for the sample measurement. Please check if the right sample vial is inserted.
Inv p--	The sample and zero vial are inverted.

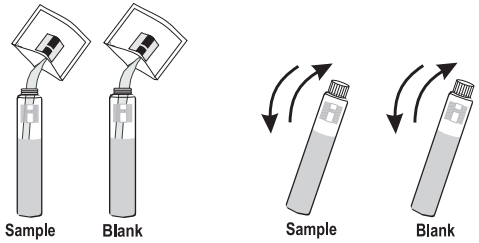
Reagent Blank Correction: This method needs a reagent blank correction. A single blank vial may be used more than once; the blank vial is stable up to one day (room temperature). For most accurate measurement, run a blank for each set of measurements and always use the same lot of reagents for blank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

- Preheat the Hanna Reactor C 9800 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 because leaking samples can generate a corrosive and possibly explosive atmosphere.
- Remove the cap 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.

PHOSPHORUS, TOTAL HIGH RANGE

SPECIFICATIONS

Range	0.0 to 100.0 mg/L (as PO_4^{3-})
Resolution	0.1 mg/L
Precision	±3.0 @ 75.0 mg/L
Typical EMC Deviation	±0.1 mg/L
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
*	Reagent Vial	1 vial	50 vials
---	Deionized Water	5 mL	1 bottle
---	Potassium Persulfate	1 packet	50 packets
---	NaOH Solution 1.54 N	2 mL	1 bottle
HI 93763B-0	Molybdovanadate Reagent	0.5 mL	1 bottle

* *Reagent Vial identification*: **P**, **white** cap.

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 77.

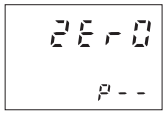
REQUIRED ACCESSORIES

C 9800-01	Hanna reactor (115 VAC)
C 9800-02	Hanna reactor (230 VAC)
HI 740216	test tube cooling rack (25 holes)
HI 740217	Laboratory bench safety shield

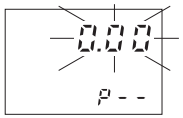
For other accessories see page 77.

MEASUREMENT PROCEDURE

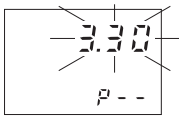
Before starting to use the reagent kit it is recommended to read carefully all the instructions and the Health & Safety Data Sheet (HSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.



A zero reading was not taken. Follow the instruction described in the measurement procedures for zeroing the meter.



Under range. A blinking "0.00" indicates that the sample absorbs less light than the zero reference. Check the procedure and make sure that you use the same vial for reference (zero) and measurement (unless a reagent blank correction procedure is prescribed).



1) A flashing value of the maximum concentration indicates an over range condition. The concentration of the sample is beyond the programmed range: dilute the sample and rerun the test.

2) A flashing value lower than the maximum concentration indicates a low signal-to-noise ratio condition. In this case accuracy of the result is not guaranteed. Repeat the reading procedure.

TIPS FOR AN ACCURATE MEASUREMENT

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

COLLECTING AND MEASURING SAMPLES

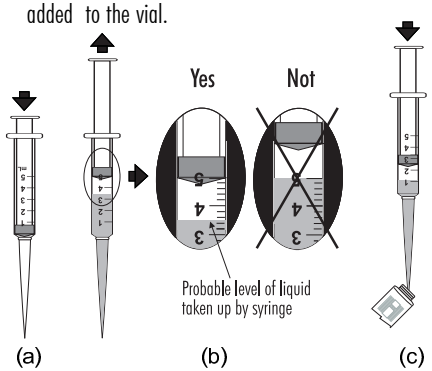
- For adding the exact amount of sample or liquid reagent to the reagent vials it is strongly recommended to use the available Hanna automatic fixed-volume pipettes or class A laboratory pipettes (symbolized like a generic pipette tip in the following parameter related chapters):

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

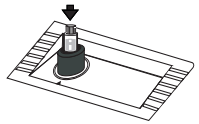
For correct use of the automatic pipette, please follow the related Instruction Sheet.

Alternatively, it is possible to use the optional **HI 740142** 1 mL graduated syringe or **C115-00300** 5 mL graduated syringe. For the correct use of the syringes, see instructions below.

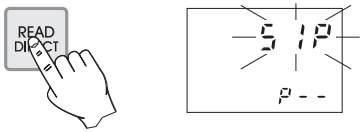
1. In order to measure exactly e.g. 5 mL of reagent with the 5 mL syringe:
   (a) push the plunger completely into the syringe and insert the tip into the solution.
   (b) pull the plunger up until the lower edge of the seal is exactly on the 5 mL mark.
   (c) take out the syringe and clean the outside 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. Now the exact amount of 5 mL has been added to the vial.



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



- Press READ DIRECT and "SIP" will blink on the display.



- The instrument directly displays concentration in **mg/L of phosphate** (PO_4^{3-}) on the Liquid Crystal Display.
- To convert the reading to mg/L of P_2O_5, multiply by a factor of 0.748.
- To convert the reading to mg/L of phosphorus (P) concentration, multiply by a factor of 0.326.

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.

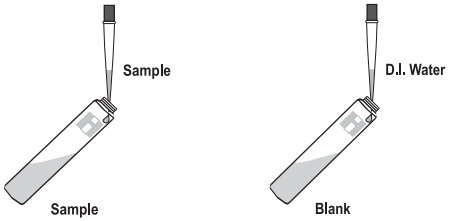
INTERFERENCES

Interference may be caused by:

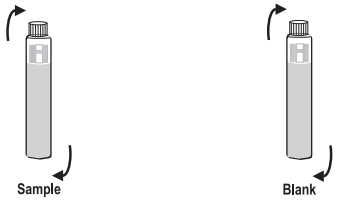
Bismuth:	negative error
Fluoride:	negative error
pH:	the sample should have a neutral pH
Sulfide:	negative error . To eliminate sulfide: add Bromine Water drop-wise until a pale yellow color develops; remove Bromine Water excess by adding Phenol solution drop-wise.
Temperature:	the method is temperature 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:	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.

- Select the program number corresponding to Reactive Phosphorus High Range on the secondary LCD by pressing PROGRAM ▼ and ▲.
- Remove the cap from two Reagent Vials.

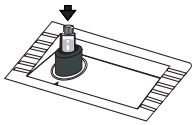
- Add exactly 5.0 mL of sample to one vial (sample vial), and 5.0 mL of deionized water to the other vial (blank vial), while keeping the vials at a 45-degree angle.



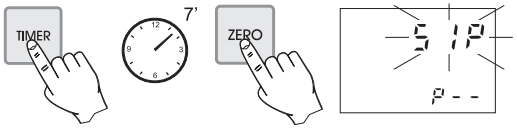
- Replace the cap and mix by inverting each vial a couple of times.



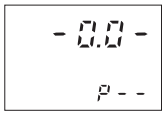
- Place the blank vial into the holder and push it completely down.



- Press TIMER and the display will show the countdown prior to the measurement. Alternatively, wait for 7 minutes and press ZERO. In both cases "SIP" will blink during measurement.

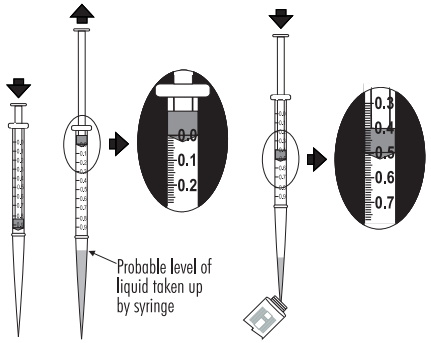


- Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement.



- Remove the blank vial.

2. In order to measure exactly e.g. 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.



(a) (b) (c)

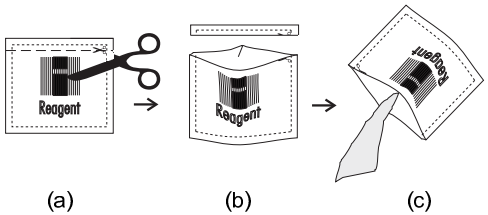
- Color or suspended matter in large amounts may cause interference, therefore, these should be removed by treatment with active carbon and by prior filtration.

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.

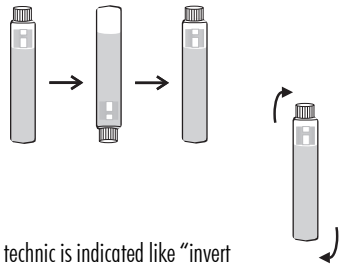
(a) (b)

- 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, or the cuvet 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 parameter 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 right speed of this mixing technic takes 30 seconds to complete 10 inversions.



This mixing technic is indicated like "invert to mix", with the icon:

invert to mix

PHOSPHORUS, REACTIVE HIGH RANGE

SPECIFICATIONS

Range	0.0 to 100.0 mg/L (as PO_4^{3-})
Resolution	0.1 mg/L
Precision	±3.0 @ 75.0 mg/L
Typical EMC Deviation	±0.1 mg/L
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
*	Reagent Vial	1 vial	50 vials
---	Deionized Water	5 mL	1 bottle

* *Reagent Vial identification*: **P**, **green** cap.

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

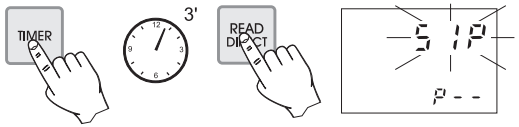
For other accessories see page 77.

MEASUREMENT PROCEDURE

Before starting to use the reagent kit it is recommended to read carefully all the instructions and the Health & Safety Data Sheet (HSDS). 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 needs 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.

- Press TIMER and the display will show the countdown prior to the measurement. Alternatively, wait for 3 minutes and press READ DIRECT. In both cases "SIP" will blink during measurement.



- The instrument directly displays concentration in **mg/L of phosphate** (PO_4^{3-}) on the Liquid Crystal Display.
  The method detects free (orthophosphate), condensed inorganic forms (meta-, pyro- and other polyphosphates) and organic forms of phosphates present in the sample.
- To convert the reading to mg/L of P_2O_5, multiply by a factor of 0.748.
- To convert the reading to mg/L of phosphorus (P) concentration, multiply by a factor of 0.326.

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:

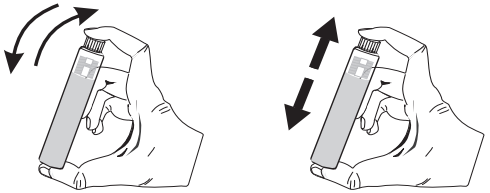
Arsenate: at any level

Silica: above 50 mg/L

Sulfide: above 90 mg/L.

Turbidity: 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.

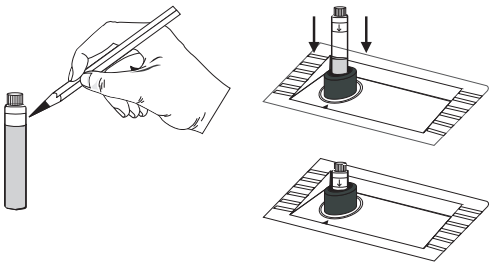
(b) **shake the vial**: move the vial up and down. The movement may be gentle or vigorous.



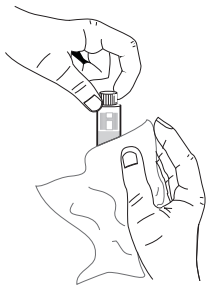
This mixing method is indicated like “shake gently” or “shake vigorously”, with the icons:

shake gently *shake vigorously*

- To obtain most reproducible readings, insert the test vial always in the same way into the holder: place an orientation sign by marking the vial with a pencil on the white band. As reference you can use the alignment indicator on the top of the casing.
  Pay attention to push the vial completely down in the holder.



- Whenever the vial is placed into the measurement cell, it must be dry 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, or accuracy will be lost.
- 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 carefully the measurement procedures).
- All the reaction times reported in this manual are referred to 20°C (68°F). As a general rule of thumb, they should be doubled at 10°C (50°F) and halved at 30°C (86°F).

DIGESTION

- Some analytical methods do require digestion of the sample. Use for digestion of the vials only the **Hanna C9800 block heater**. Use of 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**.

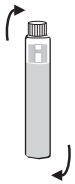
REAGENT BLANK CORRECTION

- The measurement procedure of some parameters requires 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 parameter in the related chapter.

INTERFERENCES

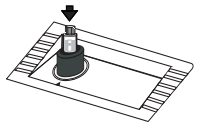
- In the parameter related measurement sections we have reported the most common interferences that may be present in an average wastewater matrix. It may be that for a particular treatment process other compounds do interfere with the method of analysis.

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

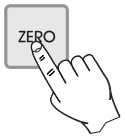


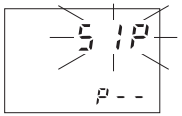
- Mark the vial with a pencil on the white band to place an orientation sign. Use this sign to insert the test vial always in the same position into the holder.

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

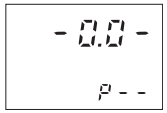


- Press ZERO and "SIP" will blink on the display.

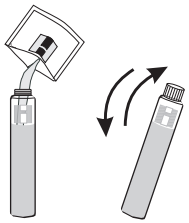




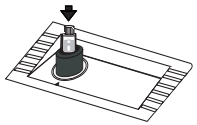
- Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement.



- 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 reacted sample.

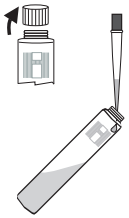


- Place the vial into the holder and push it completely down. Ensure that the vial orientation respect to the holder is the same as the blank.



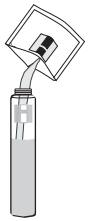
- Preheat the Hanna Reactor C 9800 to 150 °C (302°F). For correct use of the reactor follow Reactor Instruction Manual.
  Use of the optional HI 740217 safety shield is strongly recommended.
  Do not use an oven or microwave because leaking samples can generate a corrosive and possibly explosive atmosphere.

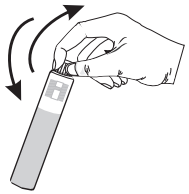
- Remove the cap from a Reagent Vial.



- 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.



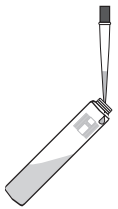


- Insert the vial into the reactor and heat it for 30 minutes at 150°C.

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

- Select the program number corresponding to Total Phosphorus on the secondary LCD by pressing PROGRAM ▼ and ▲.

- 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.



PARAMETERS REFERENCE TABLES

C 214 - WATER TREATMENT APPLICATION

Program n°	Parameter code	Parameter description	Page
1	HI 93764A	Ammonia LR	22
2	HI 93764B	Ammonia HR	25
3	HI 93701	Chlorine, Free	28
4	HI 93711	Chlorine, Total	31
5	HI 93766	Nitrate	34
6	HI 93767A	Nitrogen, Total LR	37
7	HI 93767B	Nitrogen, Total HR	43
8	HI 93754A	Oxygen Demand, Chemical (COD) LR	47
9	HI 93754B	Oxygen Demand, Chemical (COD) MR	50
10	HI 93754C	Oxygen Demand, Chemical (COD) HR	53
11	HI 93758A	Phosphorus, Reactive	56
12	HI 93758B	Phosphorus, Acid Hydrolyzable	59
13	HI 93758C	Phosphorus, Total	63
14	HI 93763A	Phosphorus, Reactive HR	67
15	HI 93763B	Phosphorus, Total HR	70

VIALS IDENTIFICATION

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

- The letter refers to:
  A : ammonia
  N : nitrate; total nitrogen
  P : phosphorus
  (no letter) : chemical oxygen demand (COD) and generic empty vials.
- The cap color allows distinguishing different vials that are used to measure the same analyte (indicated by the letter code), but for a different range, or between different vials used in a single measurement procedure.

Note that different parameters use sometimes the same vials (thus with the same letter **and** same cap color).

Parameter		Vial letter	Vial cap color
HI 93764A	Ammonia LR	A	white
HI 93764B	Ammonia HR	A	green
HI 93701	Chlorine, Free	(no letter)	white
HI 93711	Chlorine, Total	(no letter)	white
HI 93766	Nitrate	N	white
HI 93767A	Nitrogen, Total LR	N	green (digestion vial) white (reagent vial)
HI 93767B	Nitrogen, Total HR	N	red (digestion vial) white (reagent vial)
HI 93754A	Oxygen Demand, Chemical (COD) LR	(no letter)	red
HI 93754B	Oxygen Demand, Chemical (COD) MR	(no letter)	white
HI 93754C	Oxygen Demand, Chemical (COD) HR	(no letter)	green
HI 93758A	Phosphorus, Reactive	P	red
HI 93758B	Phosphorus, Acid Hydrolyzable	P	white
HI 93758C	Phosphorus, Total	P	white
HI 93763A	Phosphorus, Reactive HR	P	green
HI 93763B	Phosphorus, Total HR	P	white

PHOSPHORUS, TOTAL

SPECIFICATIONS

Range	0.00 to 3.50 mg/L (as PO_4^{3-})
Resolution	0.01 mg/L
Precision	±0.06 @ 2.50 mg/L
Typical EMC Deviation	±0.01 mg/L
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
*	Reagent Vial	1 vial	50 vials
---	Potassium Persulfate	1 packet	50 packets
---	NaOH Solution 1.54 N	2 mL	1 bottle
HI 93758-0	Phosphorus Reagent	1 packet	50 packets

* *Reagent Vial identification*: **P**, **white** cap.

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 77.

REQUIRED ACCESSORIES

C 9800-01 Hanna reactor (115 VAC)
C 9800-02 Hanna reactor (230 VAC)
HI 740216 test tube cooling rack (25 holes)
HI 740217 Laboratory bench safety shield

For other accessories see page 77.

MEASUREMENT PROCEDURE

Before starting to use the reagent kit it is recommended to read carefully all the instructions and the Health & Safety Data Sheet (HSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

- The instrument directly displays concentration in **mg/L of phosphate** (PO_4^{3-}) on the Liquid Crystal Display.
  The method detects free (orthophosphate) and condensed inorganic forms (meta-, pyro- and other polyphosphates) of phosphates present in the sample.
- To convert the reading to mg/L of P_2O_5, multiply by a factor of 0.748.
- To convert the reading to mg/L of phosphorus (P) concentration, multiply by a factor of 0.326.

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: 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.

HEALTH & SAFETY

The chemicals contained in the reagent kits may be hazardous if improperly handled. Read the Health & Safety Data Sheet before performing tests.

Safety equipment: Wear suitable eye protection and clothing when required, and follow instructions carefully.
Reagent spills: If reagent spillage 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.

OPERATIONAL GUIDE

POWER CONNECTION

Plug the 12VDC adapter (**HI 710005** - 110VDC, or **HI 710006** - 220VDC) into the DC socket. Plug the adapter into the outlet.

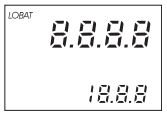
Alternatively, remove the battery cover on the back of the meter; attach 2 fresh 9V batteries and replace the cover.

Note: Insure the main line is surge protected.

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

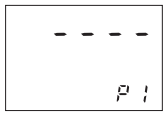
MEASUREMENT PROCEDURE

- Turn the meter on by pressing ON/OFF.



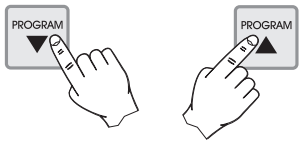
- The meter will first perform an LCD auto diagnostic test by displaying a full set of figures.

- Then it will show a scrolling "c 214 Hanna Inst" message.



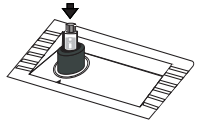
- When the LCD displays "----", the meter is ready. On the secondary LCD "P1" will appear to inform that the first parameter measurement procedure (Ammonia LR) can be performed.

- Press the PROGRAM ▼ and PROGRAM ▲ keys to select the desired parameter.



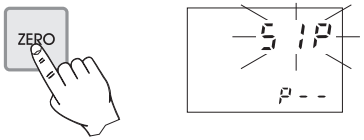
For the program number, see the parameters reference table on page 17 or look at the list printed on the mask of the meter.

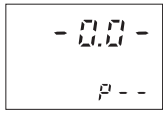
- Mark the vial with a pencil on the white band to place an orientation sign. Use this sign to insert the test vial always in the same position into the holder.



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

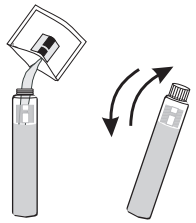
- Press ZERO and "SIP" will blink on the display.



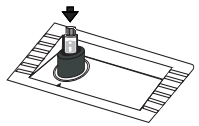


- Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement.

- Remove the vial.

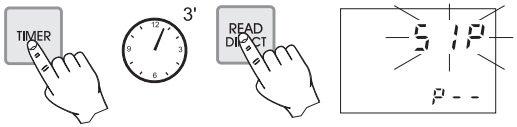


- Remove the cap and add the content of one packet of HI 93758-0 Phosphorus Reagent.
- Replace the cap tightly and shake gently to mix for 2 minutes until most of the powder is dissolved. This is the reacted sample.



- Place the vial into the holder and push it completely down. Ensure that the vial orientation respect to the holder is the same of the blank.

- Press TIMER and the display will show the countdown prior to the measurement. Alternatively, wait for 3 minutes and press READ DIRECT. In both cases "SIP" will blink during measurement.

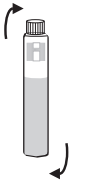


- Preheat the Hanna Reactor C 9800 to 150 °C (302°F). For correct use of the reactor follow Reactor Instruction Manual.
  Use of the optional HI 740217 safety shield is strongly recommended.
  Do not use an oven or microwave because leaking samples can generate a corrosive and possibly explosive atmosphere.

- 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.

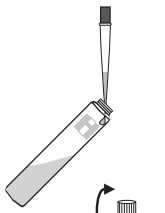


- Insert the vial into the reactor and heat it for 30 minutes at 150°C.

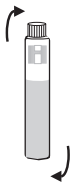
- At the end of the digestion place the vials carefully in the test tube rack and allow to cool to room temperature.
  Warning: as the vials are still hot, be careful in handling them.

- Select the program number corresponding to Acid Hydrolyzable Phosphorus on the secondary LCD by pressing PROGRAM ▼ and ▲.

- 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.

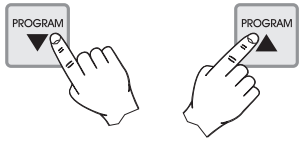


- Replace the cap tightly and mix by inverting the vial a couple of times. This is the blank.

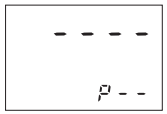


- After the desired program number appears on the secondary display, follow the measurement procedure described in the related chapter.

- Select a new parameter measurement procedure by pressing the PROGRAM ▼ and PROGRAM ▲ keys.



Note: in the following measurement sections, a generic "P– –" will be placed on the secondary LCD instead of the exact related message (e.g. "P2" for Ammonia HR).



- Before performing a test read carefully all the instructions related to the selected parameter.

AMMONIA LOW RANGE

SPECIFICATIONS

Range	0.00 to 3.00 mg/L (as NH_3-N)
Resolution	0.01 mg/L
Precision	±0.03 @ 1.50 mg/L
Typical EMC Deviation	±0.01 mg/L
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
*	Reagent Vial	1 vial	25 vials
HI 93764-0	Nessler Reagent	4 drops	1 bottle

* *Reagent Vial identification*: **A**, **white** cap.

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

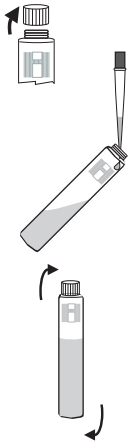
REAGENT SET

HI 93764A-25 Reagents for 25 tests

For other accessories see page 77.

MEASUREMENT PROCEDURE

- Select the program number corresponding to Ammonia LR on the secondary LCD by pressing PROGRAM ▼ and ▲.
- 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 couples of times. This is the blank.



PHOSPHORUS, ACID HYDROLYZABLE

SPECIFICATIONS

Range	0.00 to 5.00 mg/L (as PO_4^{3-})
Resolution	0.01 mg/L
Precision	±0.06 @ 2.50 mg/L
Typical EMC Deviation	±0.01 mg/L
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
*	Reagent Vial	1 vial	50 vials
---	NaOH Solution 1.20 N	2 mL	1 bottle
HI 93758-0	Phosphorus Reagent	1 packet	50 packets

* *Reagent Vial identification*: **P**, **white** cap.

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 77.

REQUIRED ACCESSORIES

C 9800-01	Hanna reactor (115 VAC)
C 9800-02	Hanna reactor (230 VAC)
HI 740216	test tube cooling rack (25 holes)
HI 740217	Laboratory bench safety shield

For other accessories see page 77.

MEASUREMENT PROCEDURE

Before starting to use the reagent kit it is recommended to read carefully all the instructions and the Health & Safety Data Sheet (HSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

- The instrument directly displays concentration in **mg/L of phosphate** (PO_4^{3-}) on the Liquid Crystal Display.
- To convert the reading to mg/L of P_2O_5, multiply by a factor of 0.748.
- To convert the reading to mg/L of phosphorus (P) concentration, multiply by a factor of 0.326.

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

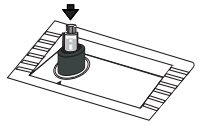
Silica: above 50 mg/L

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.

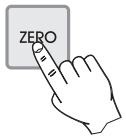
Turbidity: turbidity and suspended matter in large amounts may cause interference because the reaction conditions may dissolve suspended matter or cause desorption of phosphates from particles. Turbidity or suspended matter should be removed before measurement by treatment with active carbon and by prior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

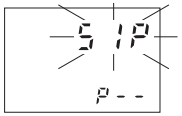
- Mark the vial with a pencil on the white band to place an orientation sign. Use this sign to insert the test vial always in the same position into the holder.

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

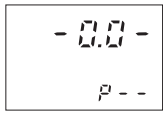


- Press ZERO and "SIP" will blink on the display.

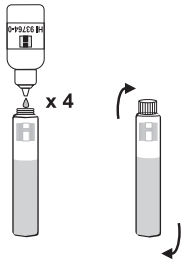




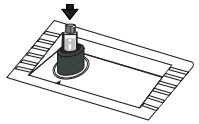
- Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement.



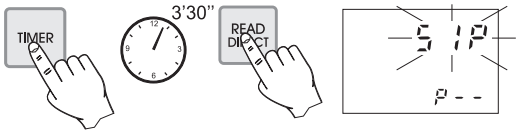
- Remove the vial.
- Remove the cap and add 4 drops of HI 93764-0 Nessler Reagent.
- Replace the cap tightly and mix by inverting the vial a couples of times. This is the sample.



- Place the vial into the holder and push it completely down. Ensure that the vial orientation respect to the holder is the same as the blank.



- Press TIMER and the display will show the countdown prior to the measurement. Alternatively, wait for 3 minutes and 30 seconds and press READ DIRECT. In both cases "SIP" will blink during measurement.



- The instrument directly displays concentration in **mg/L of ammonia nitrogen** (NH_3-N) on the Liquid Crystal Display.
- To convert the reading to mg/L of ammonia (NH_3), multiply by a factor of 1.214.

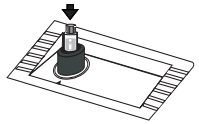
INTERFERENCES

Interference may be caused by:

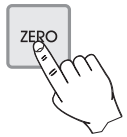
- Organic compounds like: chloramines, various aliphatic and aromatic amines, glycine or urea above 10 ppm N (positive error).
  To eliminate these interferences distillation is required.
- Organic compounds like: aldehydes, alcohols (e.g. ethanol) or acetone above 0.1 % (negative error).
  To eliminate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

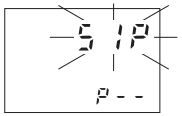
- Mark the vial with a pencil on the white band to place an orientation sign. Use this sign to insert the test vial always in the same position into the holder.

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

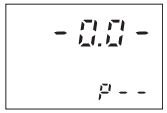


- Press ZERO and "SIP" will blink on the display.

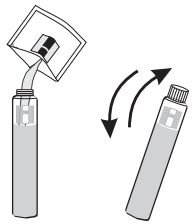




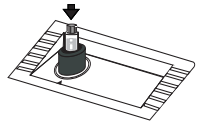
- Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement.



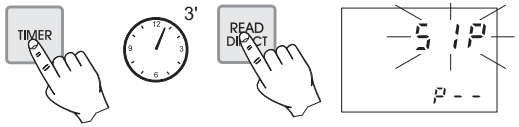
- Remove the vial.
- Remove the cap and add the content of one packet of HI 93758-0 Phosphorus Reagent.
- Replace the cap tightly and shake gently to mix for 2 minutes until most of the powder is dissolved. This is the reacted sample.



- Place the vial into the holder and push it completely down. Ensure that the vial orientation respect to the holder is the same as the blank.



- Press TIMER and the display will show the countdown prior to the measurement. Alternatively, wait for 3 minutes and press READ DIRECT. In both cases "SIP" will blink during measurement.



PHOSPHORUS, REACTIVE

SPECIFICATIONS

Range	0.00 to 5.00 mg/L (as PO_4^{3-})
Resolution	0.01 mg/L
Precision	±0.05 @ 2.50 mg/L
Typical EMC Deviation	±0.01 mg/L
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
*	Reagent Vial	1 vial	50 vials
HI 93758-0	Phosphorus Reagent	1 packet	50 packets

* *Reagent Vial identification*: **P**, **red** cap.

REAGENT SET

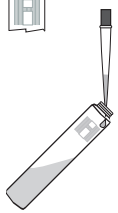
HI 93758A-50 Reagents for 50 tests

For other accessories see page 77.

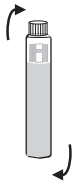
MEASUREMENT PROCEDURE

- Select the program number corresponding to Reactive Phosphorus on the secondary LCD by pressing PROGRAM ▼ and ▲.
- 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.



AMMONIA HIGH RANGE

SPECIFICATIONS

Range	0 to 100 mg/L (as NH_3-N)
Resolution	1 mg/L
Precision	±3 @ 50 mg/L
Typical EMC Deviation	±1 mg/L
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
*	Reagent Vial	1 vial	25 vials
HI 93764-0	Nessler Reagent	4 drops	1 bottle

* *Reagent Vial identification*: **A**, **green** cap.

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

REAGENT SET

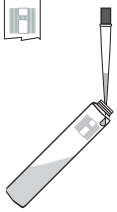
HI 93764B-25 Reagents for 25 tests

For other accessories see page 77.

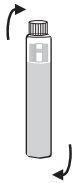
MEASUREMENT PROCEDURE

- Select the program number corresponding to Ammonia HR on the secondary LCD by pressing PROGRAM ▼ and ▲.
- 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.

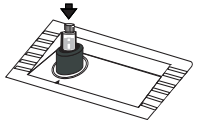


- Replace the cap and mix by inverting the vial a couples of times. This is the blank.

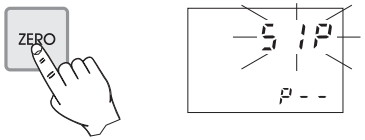


- Mark the vial with a pencil on the white band to place an orientation sign. Use this sign to insert the test vial always in the same position into the holder.

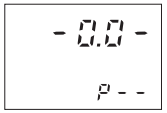
- Place the vial into the holder and push it completely down.



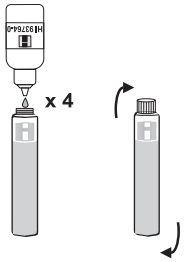
- Press ZERO and “SIP” will blink on the display.



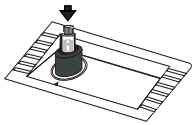
- Wait for a few seconds and the display will show “-0.0-”. Now the meter is zeroed and ready for measurement.



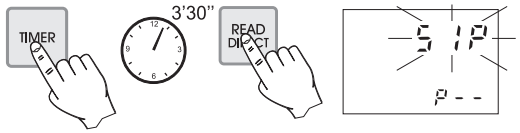
- Remove the vial.
- Remove the cap and add 4 drops of HI 93764-0 Nessler Reagent.
- Replace the cap tightly and mix by inverting the vial a couples of times. This is the sample.



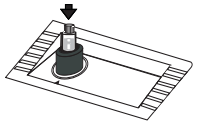
- Place the vial into the holder and push it completely down. Ensure that the vial orientation respect to the holder is the same as the blank.



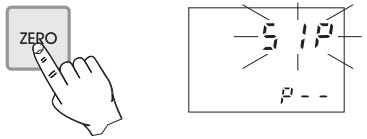
- Press TIMER and the display will show the countdown prior to the measurement. Alternatively, wait for 3 minutes and 30 seconds and press READ DIRECT. In both cases "SIP" will blink during measurement.



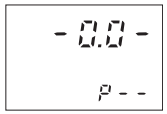
- Select the program number corresponding to Oxygen Demand, Chemical HR (COD) on the secondary LCD by pressing PROGRAM ▼ and ▲.
- Place the blank vial into the holder and push it completely down.



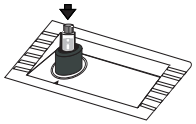
- Press ZERO and "SIP" will blink on the display.



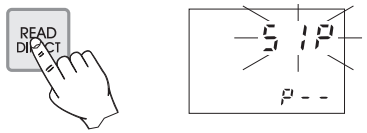
- Wait for a few seconds and the display will show “-0.0-”. Now the meter is zeroed and ready for measurement.



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



- Press READ DIRECT and "SIP" will blink during measurement.



- Multiply the reading on the Liquid Crystal Display by 10 to obtain the concentration in **mg/L of oxygen demand**.

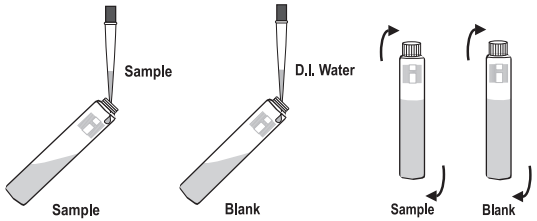
INTERFERENCES

Interference may be caused by:

Chlorides (Cl^-): above 20000 mg/L.
Samples with higher chloride concentration should be diluted.

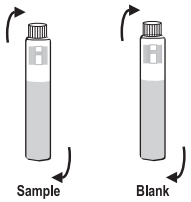
- Choose a homogeneous sample. Samples containing settleable solids need to be homogenized with a blender.
- Preheat the Hanna Reactor C 9800 to 150 °C (302°F). For correct use of the reactor follow Reactor Instruction Manual.
  Use of the optional HI 740217 safety shield is strongly recommended.
  Do not use an oven or microwave because leaking samples can generate a corrosive and possibly explosive atmosphere.
- Remove the cap 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: as the vials become very hot during mixing, be careful in 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: as the vials are still hot, be careful in 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.



- The instrument directly displays concentration in **mg/L of ammonia nitrogen** (NH_3-N) on the Liquid Crystal Display.
- To convert the reading to mg/L of ammonia (NH_3), multiply by a factor of 1.214.

INTERFERENCES

Interference may be caused by:

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

CHLORINE, FREE

SPECIFICATIONS

Range	0.00 to 5.00 mg/L
Resolution	0.01 mg/L from 0.00 to 0.99 mg/L; 0.1 mg/L above 0.99 mg/L
Precision	±0.04 @ 1.00 mg/L
Typical EMC Deviation	±0.01 mg/L
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

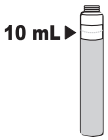
HI 93701-01	Reagents for 100 tests
HI 93701-03	Reagents for 300 tests

For other accessories see page 77.

MEASUREMENT PROCEDURE

- Select the program number corresponding to Free Chlorine on the secondary LCD by pressing PROGRAM ▼ and ▲.
- Fill an empty sample vial with 10 mL of unreacted sample, up to the center of the white band, then replace the cap. This is the blank.

  Note: the exact measurement of the sample volume is not needed: just fill the vial to a level between the lower and the upper edge of the white band.



- Mark the vial with a pencil on the white band to place an orientation sign. Use this sign to insert the test vial always in the same position into the holder.

OXYGEN DEMAND, CHEMICAL HIGH RANGE

SPECIFICATIONS

Range	0 to 15000 mg/L
Resolution	10 mg/L
Precision	±220 @ 10000 mg/L
Typical EMC Deviation	±10 mg/L
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
*	Reagent Vial	1 vial	25 vials
---	Deionized Water	0.2 mL	optional

* *Reagent Vial identification*: **(no letter)**, **green** cap.

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

C 9800-01	Hanna reactor (115 VAC)
C 9800-02	Hanna reactor (230 VAC)
HI 740216	Test tube cooling rack (25 holes)
HI 740217	Laboratory bench safety shield

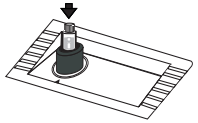
For other accessories see page 77.

MEASUREMENT PROCEDURE

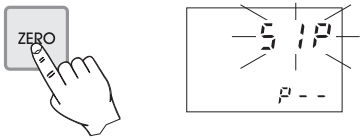
Before starting to use the reagent kit it is recommended to read carefully all the instructions and the Health & Safety Data Sheet (HSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

Reagent Blank Correction: This method needs 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.

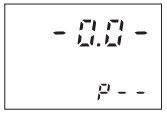
- Select the program number corresponding to Oxygen Demand, Chemical MR (COD) on the secondary LCD by pressing PROGRAM ▼ and ▲.
- Place the blank vial into the holder and push it completely down.



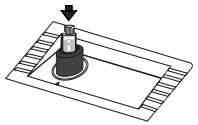
- Press ZERO and "SIP" will blink on the display.



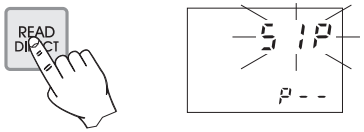
- Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement.



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



- Press READ DIRECT and "SIP" will blink during measurement.



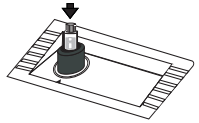
- The instrument directly displays concentration in **mg/L of oxygen demand** on the Liquid Crystal Display.

INTERFERENCES

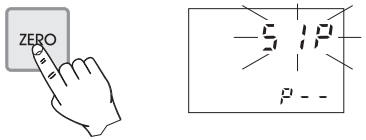
Interference may be caused by:

Chlorides (Cl^-): above 2000 mg/L.
Samples with higher chloride concentration should be diluted.

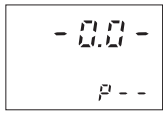
- Place the vial into the holder and push it completely down.



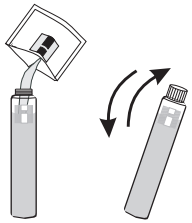
- Press ZERO and "SIP" will blink on the display.



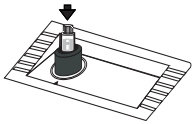
- Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement.



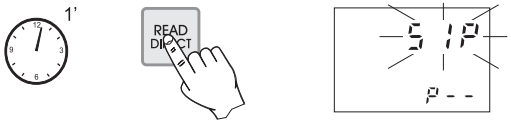
- Remove the vial.
- Remove the cap and add the content of one packet of HI 93701-0 Free Chlorine Reagent.
- Replace the cap and shake gently to mix for about 20 seconds. This is the reacted sample.



- Place the vial into the holder and push it completely down. Ensure that the vial orientation respect to the holder is the same as the blank.



- Wait for 1 minute and press READ DIRECT. "SIP" will blink during measurement.



- The instrument directly displays concentration in **mg/L of free chlorine** on the Liquid Crystal Display.

INTERFERENCES

A positive interference may be caused by:
Bromine (Br_2)
Iodine (I_2)

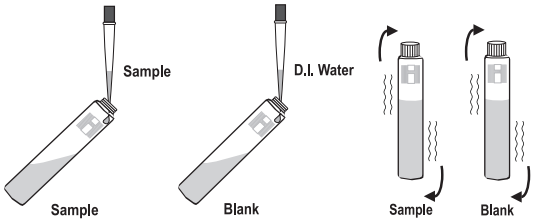
Oxidized forms of Chromium and Manganese
Ozone (O_3)

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.

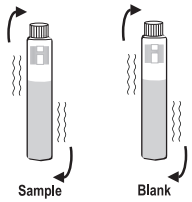
- Choose a homogeneous sample. Samples containing settleable solids need to be homogenized with a blender.
- Preheat the Hanna Reactor C 9800 to 150 °C (302°F). For correct use of the reactor follow Reactor Instruction Manual.
  Use of the optional HI 740217 safety shield is strongly recommended. Do not use an oven or microwave because leaking samples can generate a corrosive and possibly explosive atmosphere.
- Remove the cap 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: as the vials become very hot during mixing, be careful in 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: as the vials are still hot, be careful in 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.

OXYGEN DEMAND, CHEMICAL MEDIUM RANGE

SPECIFICATIONS

Range	0 to 1500 mg/L
Resolution	1 mg/L
Precision	±22 @ 1000 mg/L
Typical EMC Deviation	±1 mg/L
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
*	Reagent Vial	1 vial	25 vials
---	Deionized Water	2.0 mL	optional

* *Reagent Vial identification*: **(no letter)**, **white** cap.

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

C 9800-01	Hanna reactor (115 VAC)
C 9800-02	Hanna reactor (230 VAC)
HI 740216	Test tube cooling rack (25 holes)
HI 740217	Laboratory bench safety shield

For other accessories see page 77.

MEASUREMENT PROCEDURE

Before starting to use the reagent kit it is recommended to read carefully all the instructions and the Health & Safety Data Sheet (HSDS). 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 needs 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.

CHLORINE, TOTAL

SPECIFICATIONS

Range	0.00 to 5.00 mg/L
Resolution	0.01 mg/L from 0.00 to 0.99 mg/L; 0.1 mg/L above 0.99 mg/L
Precision	±0.04 @ 1.00 mg/L
Typical EMC Deviation	±0.01 mg/L
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

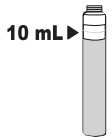
For other accessories see page 77.

MEASUREMENT PROCEDURE

- Select the program number corresponding to Total Chlorine on the secondary LCD by pressing PROGRAM ▼ and ▲.

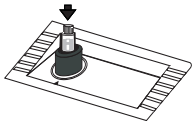
Fill an empty sample vial with 10 mL of unreacted sample, up to the center of the white band, then replace the cap. This is the blank.

Note: the exact measurement of the sample volume is not needed: just fill the vial to a level between the lower and the upper edge of the white band.

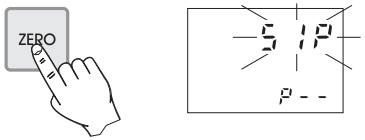


- Mark the vial with a pencil on the white band to place an orientation sign. Use this sign to insert the test vial always in the same position into the holder.

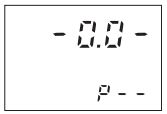
- Place the vial into the holder and push it completely down.



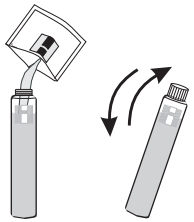
- Press ZERO and “SIP” will blink on the display.



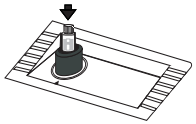
- Wait for a few seconds and the display will show “-0.0-”. Now the meter is zeroed and ready for measurement.



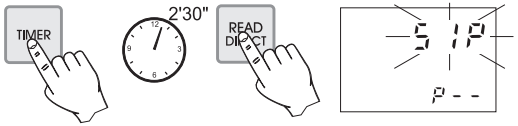
- Remove the vial.
- Remove the cap and add the content of one packet of HI 93711-0 Total Chlorine Reagent.
- Replace the cap and shake gently to mix for about 20 seconds. This is the reacted sample.



- Place the vial into the holder and push it completely down. Ensure that the vial orientation respect to the holder is the same as the blank.

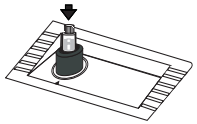


- Press TIMER and the display will show the countdown prior to the measurement. Alternatively, wait for 2 minutes and 30 seconds and press READ DIRECT. In both cases "SIP" will blink during measurement.

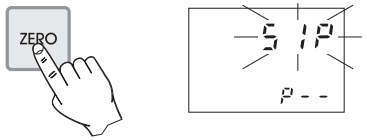


- The instrument directly displays concentration in **mg/L of total chlorine** on the Liquid Crystal Display.

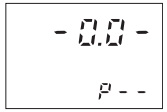
- Select the program number corresponding to Oxygen Demand, Chemical LR (COD) on the secondary LCD by pressing PROGRAM ▼ and ▲.
- Place the blank vial into the holder and push it completely down.



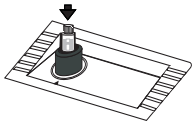
- Press ZERO and "SIP" will blink on the display.



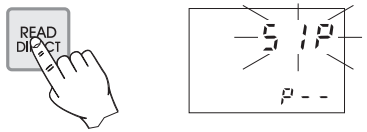
- Wait for a few seconds and the display will show “-0.0-”. Now the meter is zeroed and ready for measurement.



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



- Press READ DIRECT and "SIP" will blink during measurement.



- The instrument directly displays concentration in **mg/L of oxygen demand** on the Liquid Crystal Display.

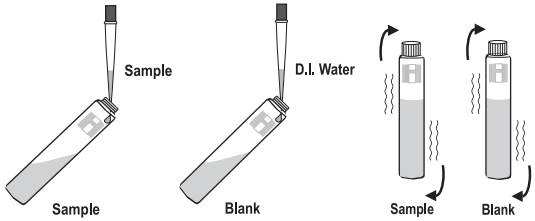
INTERFERENCES

Interference may be caused by:

Chlorides (Cl^-): above 2000 mg/L.
Samples with higher chloride concentration should be diluted.

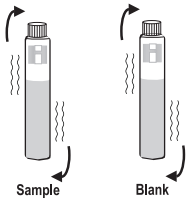
- Choose a homogeneous sample. Samples containing settleable solids need to be homogenized with a blender.
- Preheat the Hanna Reactor C 9800 to 150 °C (302°F). For correct use of the reactor follow Reactor Instruction Manual.
  Use of the optional HI 740217 safety shield is strongly recommended. Do not use an oven or microwave because leaking samples can generate a corrosive and possibly explosive atmosphere.
- Remove the cap 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: as the vials become hot during mixing, be careful in 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: as the vials are still hot, be careful in 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.

INTERFERENCES

A positive interference 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 (as NO_3^--N)
Resolution	0.1 mg/L
Precision	±0.5@ 25.0 mg/L
Typical EMC Deviation	±0.1 mg/L
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
*	Reagent Vial	1 vial	50 vials
HI 93766-0	Nitrate Reagent	1 packet	50 packets

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

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

REAGENT SET

HI 93766-50 Reagents for 50 tests

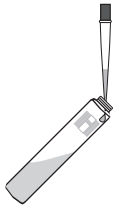
For other accessories see page 77.

MEASUREMENT PROCEDURE

Before starting to use the reagent kit it is recommended to read carefully all the instructions and the Health & Safety Data Sheet (HSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

- Select the program number corresponding to Nitrate on the secondary LCD by pressing PROGRAM ▼ and ▲.
- 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.



OXYGEN DEMAND, CHEMICAL LOW RANGE

SPECIFICATIONS

Range	0 to 150 mg/L
Resolution	1 mg/L
Precision	±4 @ 150 mg/L
Typical EMC Deviation	±1 mg/L
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
*	Reagent Vial	1 vial	25 vials
---	Deionized Water	2.0 mL	optional

* *Reagent Vial identification*: **(no letter)**, **red** cap.

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

C 9800-01	Hanna reactor (115 VAC)
C 9800-02	Hanna reactor (230 VAC)
HI 740216	Test tube cooling rack (25 holes)
HI 740217	Laboratory bench safety shield

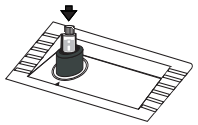
For other accessories see page 77.

MEASUREMENT PROCEDURE

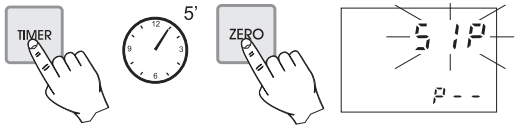
Before starting to use the reagent kit it is recommended to read carefully all the instructions and the Health & Safety Data Sheet (HSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

Reagent Blank Correction: This method needs 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.

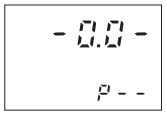
- Place the blank vial into the holder and push it completely down.



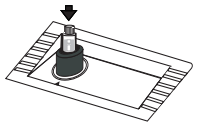
- Press TIMER and the display will show the countdown prior to the measurement. Alternatively, wait for 5 minutes and press ZERO. In both cases "SIP" will blink during measurement.



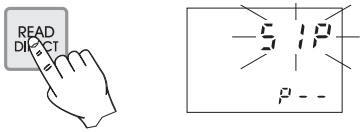
- Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement.



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



- Press READ DIRECT and "SIP" will blink on the display.



- The instrument directly displays concentration in **mg/L of total nitrogen** (N) on the Liquid Crystal Display. The method detects all organic and inorganic forms of nitrogen present in the sample.
- To convert the reading to mg/L of ammonia (NH_3), multiply by a factor of 1.22.
- To convert the reading to mg/L of nitrate NO_3^-, multiply by a factor of 4.43.

INTERFERENCES

Interference may be caused by:

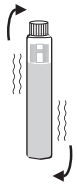
Bromide (Br^-): above 240 mg/L (positive error)

Chloride (Cl^-): above 3000 mg/L (positive error)

Chromium (Cr^{3+}): above 0.5 mg/L

- Replace the cap tightly and invert the vial 10 times. This is the blank.

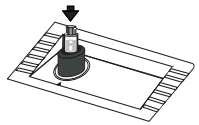
  Warning: as the vial becomes hot during mixing, be careful in handling it.



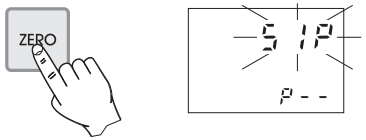
  Note: the method is technique sensitive: to obtain reproducible results it is strongly recommended to follow carefully the "invert" procedure described on page 14.

- Mark the vial with a pencil on the white band to place an orientation sign. Use this sign to insert the test vial always in the same position into the holder.

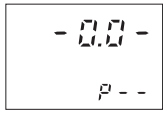
- Place the vial into the holder and push it completely down.



- Press ZERO and "SIP" will blink on the display.

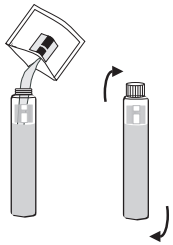


- Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement.

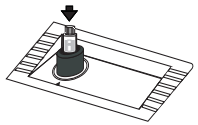


- Remove the vial.
- Remove the cap and add the content of one packet of HI 93766-0 Nitrate Reagent.
- Replace the cap tightly and invert the vial 10 times. This is the reacted sample.

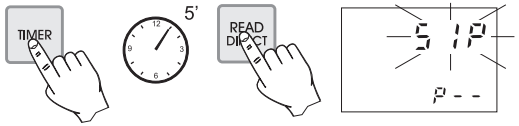
  Note: the method is technique sensitive: to obtain most reproducible results it is strongly recommended to follow carefully the "invert" procedure described on page 14.



- Place the vial into the holder and push it completely down. Ensure that the vial orientation respect to the holder is the same as the blank.



- Press TIMER and the display will show the countdown prior to the measurement. Alternatively, wait for 5 minutes and press READ DIRECT. In both cases "SIP" will blink during measurement.



- The instrument directly displays concentration in **mg/L of nitrate-nitrogen** (NO_3^--N) on the Liquid Crystal Display.
- To convert the reading to mg/L of nitrate NO_3^-, multiply by a factor of 4.43.

INTERFERENCES

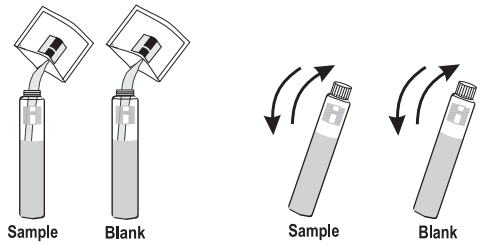
Interference may be caused by:

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

Chloride (Cl^-): above 1000 mg/L

Nitrite (NO_2^-): above 50 mg/L (positive error).
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 dissolution is complete, then proceed with the usual measurement procedure.

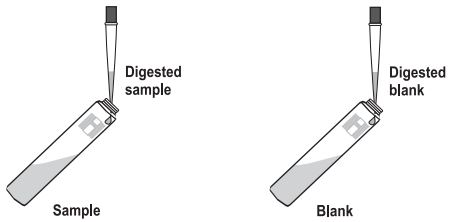
- Remove the cap from the vials and add the content of one packet of HI 93767-0 Total Nitrogen Reagent to each vial. Replace the cap tightly and shake gently the vials for 15 seconds.



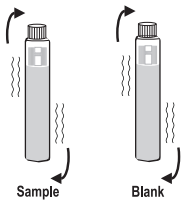
- Wait for 2 minutes (without shaking the vials) to allow the reaction to complete.

- Remove the cap from two Reagent Vials (**white** cap vials).

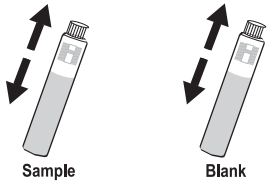
- Add exactly 2.0 mL of digested sample (from the digested red cap sample vial) to one Reagent Vial (sample vial), and 2.0 mL of digested blank (from the digested red cap blank vial) to the other vial (blank vial), while keeping the vials at a 45-degree angle.



- Replace the cap tightly and invert the vials 10 times.
  Warning: as the vials become hot during mixing, be careful in 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 14.



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

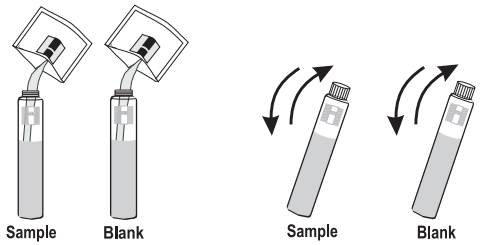


- Insert the vials into the reactor and heat them for 30 minutes at 105°C. **Note**: to obtain most accurate results, it is strongly recommended to remove the vials frome the reactor after exactly 30 minutes.

- At the end of the digestion place the vials carefully 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 the program number corresponding to Total Nitrogen HR on the secondary LCD by pressing PROGRAM ▼ and ▲.

- 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.



- Wait for 3 minutes (without shaking the vials) to allow the reaction to complete.

NITROGEN, TOTAL LOW RANGE

SPECIFICATIONS

Range	0.0 to 25.0 mg/L
Resolution	0.1 mg/L
Precision	±0.5 @ 15.0 mg/L
Typical EMC Deviation	±0.1 mg/L
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
*	Digestion Vial	1 vial	50 vials
---	Deionized Water	2 mL	1 bottle
---	Potassium Persulfate	1 packet	50 packets
---	Sodium Metabisulfite	1 packet	50 packets
HI 93767-0	Total Nitrogen Reagent	1 packet	50 packets
**	Reagent Vial	1 vial	50 vials

* *Digestion Vial identification*: **N**, **green** cap.

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

Note: 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 both HI 93767A and HI 93767B parameters.

For other accessories see page 77.

REQUIRED ACCESSORIES

C 9800-01	Hanna reactor (115 VAC)
C 9800-02	Hanna reactor (230 VAC)
HI 740216	test tube cooling rack (25 holes)
HI 740217	Laboratory bench safety shield

For other accessories see page 77.

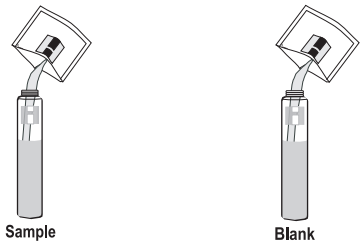
MEASUREMENT PROCEDURE

Before starting to use the reagent kit it is recommended to read carefully all the instructions and the Health & Safety Data Sheet (HSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

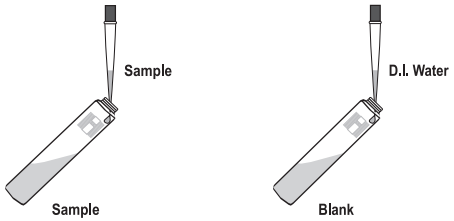
Reagent Blank Correction: This method needs a reagent blank correction. A single blank vial may be used more than once; the blank vial is stable up to one week if stored in a dark place at room temperature. Always use the same lot of reagents for blank and samples. For most accurate measurement run a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

- Preheat the Hanna Reactor C 9800 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 because leaking samples can generate a corrosive and possibly explosive atmosphere.
- Remove the cap from two Digestion Vials (**green** cap vials).

- 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.



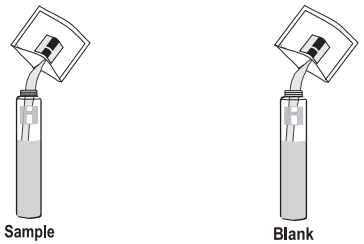
MEASUREMENT PROCEDURE

Before starting to use the reagent kit it is recommended to read carefully all the instructions and the Health & Safety Data Sheet (HSDS). Pay particular attention to all warnings, cautions and notes. Failure to do so may result in serious injury to the operator.

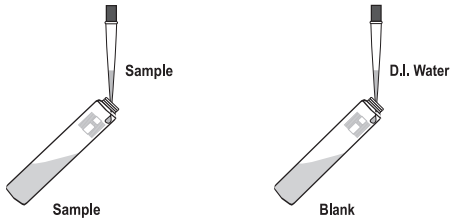
Reagent Blank Correction: This method needs a reagent blank correction. A single blank vial may be used more than once; the blank vial is stable up to one week if stored in a dark place at room temperature. Always use the same lot of reagents for blank and samples. For most accurate measurement, run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

- Preheat the Hanna Reactor C 9800 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 because leaking samples can generate a corrosive and possibly explosive atmosphere.
- Remove the cap from two Digestion Vials (**red** cap vials).

- 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.



NITROGEN, TOTAL HIGH RANGE

SPECIFICATIONS

Range	10 to 150 mg/L
Resolution	1 mg/L
Precision	±3 @ 75 mg/L
Typical EMC Deviation	±1 mg/L
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
*	Digestion Vial	1 vial	50 vials
---	Deionized Water	0.5 mL	1 bottle
---	Potassium Persulfate	1 packet	50 packets
---	Sodium Metabisulfite	1 packet	50 packets
HI 93767-0	Total Nitrogen Reagent	1 packet	50 packets
**	Reagent Vial	1 vial	50 vials

* *Digestion Vial identification*: **N**, **red** cap.

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

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 both HI 93767A and HI 93767B parameter.

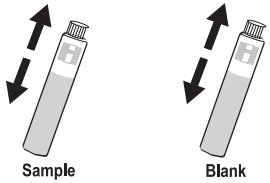
For other accessories see page 77.

REQUIRED ACCESSORIES

C 9800-01	Hanna reactor (115 VAC)
C 9800-02	Hanna reactor (230 VAC)
HI 740216	test tube cooling rack (25 holes)
HI 740217	Laboratory bench safety shield

For other accessories see page 77.

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

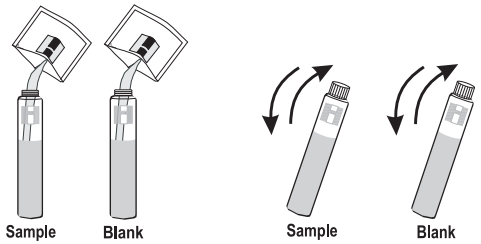


- Insert the vials into the reactor and heat them for 30 minutes at 105°C. **Note**: to obtain most accurate results, it is strongly recommended to remove the vials frome the reactor after exactly 30 minutes.

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

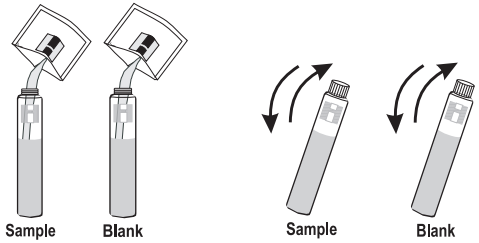
- Select the program number corresponding to Total Nitrogen LR on the secondary LCD by pressing PROGRAM ▼ and ▲.

- 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.



- Wait for 3 minutes (without shaking the vials) to allow the reaction to complete.

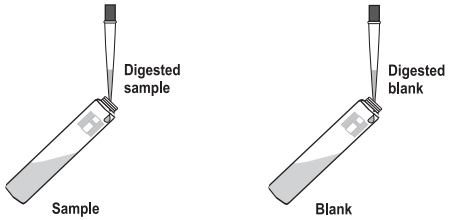
- Remove the cap from the vials and add the content of one packet of HI 93767-0 Total Nitrogen Reagent to each vial. Replace the cap tightly and shake gently the vials for 15 seconds.



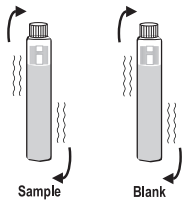
- Wait for 2 minutes (without shaking the vials) to allow the reaction to complete.

- Remove the cap from two Reagent Vials (**white** cap vials).

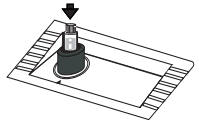
- Add exactly 2.0 mL of digested sample (from the digested green cap sample vial) to one Reagent Vial (sample vial), and 2.0 mL of digested blank (from the digested green cap blank vial) to the other Reagent Vial (blank vial), while keeping the vials at a 45-degree angle.



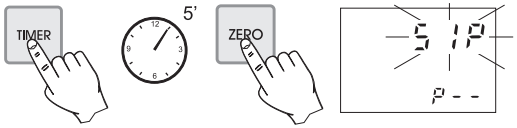
- Replace the cap tightly and invert the vials 10 times.
  Warning: as the vials become hot during mixing, be careful in handling them.
  Note: the method is technique sensitive: to obtain most reproducible results it is strongly recommended to follow carefully the "invert" procedure described on page 14.



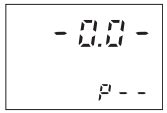
- Place the blank vial into the holder and push it completely down.



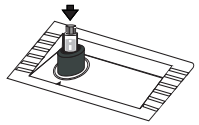
- Press TIMER and the display will show the countdown prior to the measurement. Alternatively, wait for 5 minutes and press ZERO. In both cases "SIP" will blink during measurement.



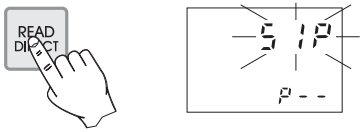
- Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement.



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



- Press READ DIRECT and "SIP" will blink on the display.



- The instrument directly displays concentration in **mg/L of total nitrogen** (N) on the Liquid Crystal Display. The method detects all organic and inorganic forms of nitrogen present in the sample.
- To convert the reading to mg/L of ammonia (NH_3), multiply by a factor of 1.22.
- To convert the reading to mg/L of nitrate NO_3^-, multiply by a factor of 4.43.

INTERFERENCES

Interference may be caused by:

Bromide (Br^-): above 60 mg/L (positive error)
Chloride (Cl^-): above 1000 mg/L (positive error)
Chromium (Cr^{3+}): above 0.5 mg/L