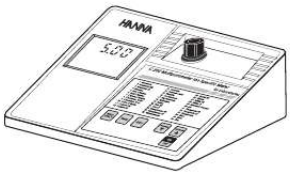
Instruction Manual

C 99 & C 200 Series

Multiparameter Bench Photometers



HANNA instruments
Manufacturers since 1978

CE
These instruments are in Compliance with the CE Directives

1

Manual abstract:

@@@@@@3 GENERAL DESCRIPTION .....
.....
.....
. 3 SPECIFICATIONS .....

.....
.....
.....
. 4 PRINCIPLE OF OPERATION .....

..... 4 FUNCTIONAL DESCRIPTION ...
.....
.....
.. 6 GUIDE TO DISPLAY CODES .....

..... 7 TIPS FOR AN ACCURATE MEASUREMENT .
.....
.....
.....

.....
.....
.....
.. 10 PARAMETERS REFERENCE TABLES ... 12 OPERATIONAL GUIDE .....

.....
.....
.. 19 ABBREVIATIONS...
.....

.....
.....
.....
20 ALUMINUM .....

.....
.....
.....
..... 21 AMMONIA HIGH RANGE .....

.....
... 23 AMMONIA MEDIUM RANGE ..
.....
..... 25 AMMONIA LOW RANGE ....

.....
.....
27 BROMINE .....
.....

.....
.....
.....
.. 29 FREE CHLORINE .....

.....
.....
.....
31 FREE CHLORINE HIGH RANGE .....

34 TOTAL CHLORINE .....
.....
.....
..... 37 TOTAL CHLORINE HIGH RANGE ...

 2 PRELIMINARY EXAMINATION Remove the instrument from the packing material and examine it carefully to make sure that no damage has occurred during shipment. If there is any damage, notify your Dealer.
Each Meter is supplied complete with: · Two Sample Cuvets and Caps* · One Transport Cap · Two 9 V Batteries · 12 VDC Transformer (HI 710005 or HI 710006) Note: Save all packing material until you are sure that the instrument functions correctly. Any defective item must be returned in its original packing with the supplied accessories. * C99 & C200, C206, C207, C209, C210 and C213 are supplied with 3 cuvets and caps GENERAL DESCRIPTION C 99 & C 200 Series is a line of 15 different bench, microprocessorbased photometers that measure up to 46 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 215 Nutrient Analyses C 216 Swimming Pool Applic. C 218 Environmental Applic.
All meters use an exclusive positive-locking system to ensure that the cuvet is in the same position every time it is placed into the measurement cell. The reagents are in liquid or powder form and are supplied in bottles 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, turning the unit off 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. 3 SPECIFICATIONS Life of the instrument Silicon Photocell 0 to 50°C (32 to 122°F); max 95% 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, accuracy, etc.

), refer to the related measurement section. Light Life Light Detector Environment 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 physicochemical characteristics of substance according to the Lambert-Beer Law: -log I/Io = c d or A = c d Where: -log I/Io=Absorbance (A) Io =intensity of incident light beam I =intensity of light beam after absorption =molar extinction coefficient at wavelength 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. 4 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 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 Block diagram (optical layout) A microprocessor controlled special tungsten lamp emits radiation which is first optically conditioned and beamed to the sample contained in the cuvet. The optical path is fixed by the diameter of the cuvet.

Then the light is spectrally filtered to a narrow spectral bandwidth, to obtain a light beam of intensity Io 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 cuvet 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) cuvets are optically identical to provide the same measurement conditions. Whenever possible use the same cuvet for both. It is also necessary that the surface of the cuvet 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 cuvet walls with hands.

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

5 FUNCTIONAL DESCRIPTION FRONT PANEL 1) 2) 3) 4) 5) Cuvet Holder Dual Level Liquid Crystal Display Programs List READ DIRECT, to perform measurement immediately TIMER, to perform measurements 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 6 GUIDE TO DISPLAY CODES Note: The secondary LCD below shows a generic "P ", whereas the meter will indicate the exact program number (e.g. in C 200, "P1" for Aluminum). 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 light level is accepted. The instrument is ready to perform a zero reading. This flashing prompt will only appear when a second zero reading needs to be performed. Follow the measurement procedure described in the related chapter. 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. 7 Light over range. The cuvet is not inserted correctly and an eccess ambient light is reaching the detector. If the cuvet is properly inserted, then contact your dealer or the nearest Hanna Customer Service Center.
The lamp is not working properly. Contact your dealer or the nearest Hanna Customer Service Center. The lamp is not working properly. Contact your dealer or the nearest Hanna Customer Service Center. 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: This indicates that the zeroing procedure failed due to a low signal-to-noise ratio. In this case press ZERO again. The instrument cannot adjust the light level. Please check that the sample does not contain any debris.
There is not enough light to perform a measurement. Please check the preparation of the zero cuvet. There is too much light to perform a measurement. Please check the preparation of the zero cuvet. 8 b) on sample reading: There is too much light for the sample measurement. Please check if the right sample cuvet is inserted. The sample and zero cuvet are inverted. 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 cuvet for reference (zero) and measurement. 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. 9 TIPS FOR AN ACCURATE MEASUREMENT The instructions listed below should be carefully followed during testing to ensure best accuracy. · Color or suspended matter in large amounts may cause interference, therefore, these should be removed by treatment with active carbon and by prior filtration.
· For a correct filling of the cuvet: the liquid in the cuvet forms a convexity on the top; the bottom of this convex- 10 mL ity must be at the same level of the 10 mL mark. · In order to measurCode Parameter 1 Ammonia MR 2 Ammonia LR 3 Free Chlorine 4 Total Chlorine 5 Copper HR 6 Copper LR 7 Nitrate Page 25 27 31 37 52 54 102 Code Parameter 8 Nitrite HR 9 Nitrite LR Page 104 106 10 Oxygen, Dissolved 117 11 pH 120 12 Phosphate HR 122 13 Phosphate LR 124 13 C 205 - BOILERS & COOLING TOWERS Code Parameter 1 Aluminum 2 Ammonia MR 3 Ammonia LR 4 Bromine 5 Free Chlorine 6 Total Chlorine 7 Chlorine Dioxide 8 Chromium VI HR 9 Chromium VI LR 10 Copper HR 11 Copper LR 12 Hydrazine Page 21 Code Parameter 13 Iron HR 14 Iron LR 15 Molybdenum 16 Nitrate 17 Nitrite HR 18 Nitrite LR Page 84 86 94 102 104 106 25 27 29 31 37 43 46 48 52 54 79 19 Oxygen, Dissolved 117 20 pH 120 21 Phosphate HR 22 Phosphate LR 23 Silica 24 Zinc 122 124 128 134 C 206 - ENVIRONMENTAL TESTING Code Parameter 1 Ammonia MR 2 Ammonia LR 3 Free Chlorine 4 Total Chlorine 5 Chromium VI HR 6 Chromium VI LR 7 Color of Water 8 Copper HR 9 Copper LR 10 Cyanuric Acid 11 Molybdenum 12 Nickel HR Page 25 27 31 37 46 48 50 52 54 59 94 97 Code Parameter 13 Nickel LR 14 Nitrate 15 Nitrite HR Page 99 102 104 16 Nitrite LR 106 17 Oxygen, Dissolved 117 18 pH 19 Phosphate HR 20 Phosphate LR 21 Phosphorus 22 Silica 23 Silver 24 Zinc 120 122 124 126 128 131 134 14 C 207 - INDUSTRIAL WASTEWATER Code Parameter 1 Aluminum 2 Free Chlorine 3 Total Chlorine 4 Color of Water 5 Copper HR 6 Copper LR 7 Fluoride 8 Manganese HR 9 Manganese LR 10 Molybdenum Page 21 Code Parameter 11 Nickel HR 12 Nickel LR 13 Nitrate Page 97 99 102 31 37 50 52 54 61 89 91 94 14 Oxygen, Dissolved 117 15 pH 120 16 Phosphate HR 122 17 Phosphate LR 18 Phosphorus 19 Silver 20 Zinc 124 126 131 134 C 208 - WATER CONDITIONING Code Parameter 1 Ammonia MR 2 Ammonia LR 3 Free Chlorine 4 Total Chlorine 5 Copper HR 6 Copper LR 7 Fluoride 8 Iron HR 9 Iron LR 10 Manganese HR 11 Manganese LR 12 Molybdenum Page 25 27 31 37 52 54 61 84 86 89 91 94 Code Parameter 13 Nickel HR 14 Nickel LR Page 97 99 15 Nitrate 102 16 Oxygen, Dissolved 117 17 pH 120 18 Phosphate HR 19 Phosphate LR 20 Phosphorus 21 Silica 22 Silver 23 Zinc 122 124 126 128 131 134 15 C 209 - EDUCATION Code Parameter 1 Ammonia MR 2 Ammonia LR 3 Free Chlorine 4 Total Chlorine 5 Chromium VI HR 6 Chromium VI LR 7 Color of Water 8 Copper HR 9 Copper LR 10 Nitrate Page 25 27 31 37 46 48 50 52 54 102 Code Parameter 11 Nitrite HR Page 104 12 Nitrite LR 106 13 Oxygen, Dissolved 117 14 pH 120 15 Phosphate HR 16 Phosphate LR 17 Phosphorus 18 Silica 19 Silver 20 Zinc 122 124 126 128 131 134 C 210 - PULP & PAPER MILLS Code Parameter 1 Aluminum 2 Free Chlorine 3 Total Chlorine 4 Chlorine Dioxide Page 21 Code Parameter 7 pH 8 Phosphate HR 9 Phosphate LR 10 Silica 11 Silver 12 Zinc Page 120 122 124 128 131 134 31 37 43 5 Color of Water 50 6 Dissolved Oxygen 117 16 C 211 - CHEMICAL MANUFACTURERS Code Parameter 1 Aluminum 2 Ammonia MR 3 Ammonia LR 4 Chromium VI HR 5 Chromium VI LR 6 Copper HR 7 Copper LR 8 Cyanuric Acid 9 Iodine 10 Iron HR 11 Iron LR Page 21 Code Parameter 12 Molybdenum 13 Nickel HR 14 Nickel LR 15 pH 16 Phosphate HR 17 Phosphate LR 18 Phosphorus 19 Silica 20 Silver 21 Zinc Page 94 97 99 120 122 124 126 128 131 134 25 27 46 48 52 54 59 82 84 86 C 212 - POWER PLANT UTILITIES Code Parameter 1 Ammonia MR 2 Ammonia LR 3 Free Chlorine 4 Total Chlorine 5 Copper HR 6 Copper LR 7 Hydrazine Page 25 27 31 37 52 54 79 Code Parameter 8 Molybdenum 9 Phosphate HR 10 Phosphate LR 11 Phosphorus 12 Silica 13 Silver Page 94 122 124 126 128 131 17 C 213 - MUNICIPAL WASTEWATER Code Parameter 1 Aluminum 2 Ammonia MR 3 Ammonia LR 4 Bromine 5 Free Chlorine 6 Total Chlorine 7 Chromium VI HR 8 Chromium VI LR 9 Color of Water 10 Copper HR 11 Copper LR 12 Iodine Page 21 Code Parameter 13 Nickel HR 14 Nickel LR 15 Nitrate 16 Nitrite HR 17 Nitrite LR Page 97 99 102 104 106 25 27 29 31 37 46 48 50 52 54 82 18 Oxygen, Dissolved 117 19 pH 120 20 Phosphate HR 21 Phosphate LR 22 Phosphorus 23 Silver 24 Zinc 122 124 126 131 134 C 216 - SWIMMING POOL APPLICATION Code Parameter Page 1 Free Chlorine HR 34 2 Total Chlorine HR 40 3 Cyanuric Acid 4 Bromine 59 29 Code Parameter Page 5 pH 120 6 Total Hardness LR 76 7 Total Hardness MR 73 8 Total Hardness HR 70 C 218 - ENVIRONMENTAL APPLICATION Code Parameter 1 Ammonia MR 2 Ammonia HR 3 Cyanide 4 Chromium VI HR 5 Chromium VI LR Page 25 23 56 46 48 Code Parameter 6 Phosphorus 7 Nitrite HR 8 Nitrite LR 9 Nitrate Page 126 104 106 102 18 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 self diagnostic test by displaying a full set of figures. · Then it will show a scrolling "c --- 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 (e.g. in C200, P1 for Aluminum) can be performed. · Press the PROGRAM and PROGRAM desired parameter. keys to select the For the program number, see the tables on page 12 or look at the list printed on the mask of the meter. 19 · 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. in C 200, "P1" for Aluminum).

· Before performing a test read carefully all the instructions related to the selected parameter. ABBREVIATIONS °C: °C EPA: EPA °F: °F g/L: g/L HR: HR LR LR: mg/L: mg/L mL: mL MR: MR g/L: µg/L PAN: PAN TPTZ: TPTZ degree Celsius US Environmental Protection Agency degree Fahrenheit grams per liter (ppt) High Range Low Range milligrams per liter (ppm) milliliter Medium Range micrograms per liter (ppb) 1-(2-pyridylazo)-2-naphtol 2,4,6-tri-(2-pyridyl)-1,3,5-triazine 20 ALUMINUM SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.00 to 1.00 mg/L 0.01 mg/L ±0.02 mg/L ±4% of reading ±0.01 mg/L Tungsten lamp with narrow band interference filter @ 525 nm Adaptation of the aluminon method. The reaction between aluminum and reagents causes a reddish tint in the sample. Description Ascorbic acid Aluminon reagent Bleaching powder Quantity 1 packet 1 packet 1 packet REQUIRED REAGENTS Code HI 93712A-0 HI 93712B-0 HI 93712C-0 REAGENT SETS HI 93712-01 Reagents for 100 tests HI 93712-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Aluminum on the secondary LCD by pressing PROGRAM and .

· Fill a graduated beaker with 50 mL of sample. · Add the content of one packet of HI 93712A Ascorbic acid reagent and mix until dissolution is complete. · Add the content of one packet of HI 93712B Aluminon reagent and mix until dissolution is complete. This is the sample. 21 Aluminum · Fill two cuvets with 10 mL of sample each (up to the mark).

10 mL 10 mL #1 #2 · Add the content of one HI 93712C Bleaching powder packet to one of the two cuvets. Replace the cap and shake vigorously until dissolution is complete. This is the blank. · Place the blank into the holder and ensure that the notch on the cap is positioned securely into the groove. #1 #1 · Press TIMER and the display will show the countdown prior to zeroing the blank.

Alternatively wait for 15 minutes and then press ZERO. "SIP" will blink during zeroing. · Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement. · Remove the blank and insert the other cuvet into the instrument. #2 · Press READ DIRECT. "SIP" will blink during measurement. · The instrument directly displays concentration in mg/L of aluminum on the Liquid Crystal Display. INTERFERENCES Interference may be caused by: Iron above 20 mg/L Alkalinity above 1000 mg/L Phosphate above 50 mg/L Fluoride must be absent Aluminum 22 AMMONIA HIGH RANGE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.

0 to 50.0 mg/L 0.1 mg/L ±0.5 mg/L ±5% of reading ±0.1 mg/L Tungsten lamp with narrow band interference filter @ 420 nm 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 Quantity HI 93733A-0 Nessler Reagent 4 drops (in fresh and seawater) HI 93733B-0 Ammonia Reagent 9 mL (in fresh and seawater) REAGENT SETS HI 93733-01 Reagents for 100 tests HI 93733-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Ammonia HR on the secondary LCD by pressing PROGRAM and . · Fill a cuvet with 1 mL of unreacted sample, by means of the syringe. 1 mL of sample 9 mL · Add 9 mL of HI 93733B Ammonia Reagent, by means of the 3 mL plastic pipette.

Place the cap and swirl the solution to mix. 23 Ammonia HR @@Now the meter is zeroed and ready for measurement. · Remove the cuvet. · Add 4 drops of HI 93733A Nessler Reagent. Replace the cap and mix the solution.

x4 · Reinsert the cuvet into the instrument. · Press TIMER and the display will show the countdown prior to measurement or, alternatively, wait for 3 minutes and 30 seconds and then press READ DIRECT. In both cases the display will show "SIP" during measurement. · The instrument directly displays concentration in mg/L of Ammonium ion (NH4+) on the Liquid Crystal Display. · To convert the reading to mg/L of ammonia (NH3), multiply by a factor of 0.944. · To convert the reading to ammonia nitrogen (NH3-N), multiply by a factor of 0.776. INTERFERENCES Interference may be caused by: acetone, alcohols, aldehydes, glycine, hardness above 1 g/L, iron, organic chloramines, sulfide, various aliphatic and aromatic amines. Ammonia HR 24 AMMONIA MEDIUM RANGE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.00 to 10.00 mg/L 0.01 mg/L ±0.05 mg/L ±5% of reading ±0.01 mg/L Tungsten lamp with narrow band interference filter @ 420 nm 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. Description First Reagent Second Reagent Quantity 4 drops (6 drops in seawater) 4 drops (10 drops in seawater) REQUIRED REAGENTS Code HI 93715A-0 HI 93715B-0 REAGENT SETS HI 93715-01 Reagents for 100 tests HI 93715-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Ammonia MR on the secondary LCD by pressing PROGRAM and . · Fill the cuvet with 10 mL of unreacted sample (up to the mark) and replace the cap.

@@· Press ZERO and "SIP" will blink on the display. 10 mL · Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement. 25 Ammonia MR · Remove the cuvet. · Add 4 drops of the First reagent (6 drops in case of seawater analysis). Replace the cap and mix the solution. x4 · Add 4 drops of the Second reagent (10 drops in case of seawater analysis). Replace the cap and mix the solution. x4 · Reinsert the cuvet into the instrument. · Press TIMER and the display will show the countdown prior to the measurement or, 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 (NH3-N) on the display. · To convert the reading to mg/L of ammonia (NH3), multiply by a factor of 1.216. INTERFERENCES Interference may be caused by: acetone, alcohols, aldehydes, glycine, hardness above 1 g/L, iron, organic chloramines, sulfide, various aliphatic and aromatic amines.

Ammonia MR 26 AMMONIA LOW RANGE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.00 to 3.00 mg/L 0.01 mg/L ±0.04 mg/L ±4% of reading ±0.01 mg/L Tungsten lamp with narrow band interference filter @ 420 nm 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. Description First Reagent Second Reagent Quantity 4 drops (6 drops in seawater) 4 drops (10 drops in seawater) REQUIRED REAGENTS Code HI 93700A-0 HI 93700B-0 REAGENT SETS HI 93700-01 Reagents for 100 tests HI 93700-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Ammonia LR on the secondary LCD by pressing PROGRAM and . · Fill the cuvet with 10 mL of unreacted sample, up to the mark, and replace the cap.

@@· Press ZERO and "SIP" will blink on the display. 10 mL · Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement. 27 Ammonia LR · Remove the cuvet. · Add 4 drops of the First reagent (6 drops in case of seawater analysis). Replace the cap and mix the solution. x4 · Add 4 drops of the Second reagent (10 drops in case of seawater analysis). Replace the cap and mix the solution. x4 · Reinsert the cuvet into the instrument.

· Press TIMER and the display will show the countdown prior to the measurement or, 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 (NH3-N) on the display. · To convert the reading to mg/L of ammonia (NH3), multiply the display by a factor of 1.216.

INTERFERENCES Interference may be caused by: acetone, alcohols, aldehydes, glycine, hardness above 1 g/L, iron, organic chloramines, sulfide, various aliphatic and aromatic amines. Ammonia LR 28 BROMINE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.00 to 8.00 mg/L 0.01 mg/L ±0.

08 mg/L ±3% of reading ±0.01 mg/L Tungsten lamp with narrow band interference filter @ 525 nm Adaptation of the Standard Methods for the Examination of Water and Wastewater, 18th edition, DPD method. The reaction between bromine and the reagent causes a pink tint in the sample. Description DPD Reagent Quantity 1 packet REQUIRED REAGENTS Code HI 93716-0 REAGENT SETS HI 93716-01 Reagents for 100 tests HI 93716-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Bromine on the secondary LCD by pressing PROGRAM and . · Fill the cuvet with 10 mL of unreacted sample (up to the mark) and replace the cap. @@· Press ZERO and "SIP" will blink on the display. 10 mL 29 Bromine · Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement.

· Remove the cuvet and add the content of one packet of HI 93716 reagent. Replace the cap and shake gently for about 20 seconds to dissolve most of the reagent. · Reinsert the cuvet into the instrument. · Press TIMER and the display will show the countdown prior to the measurement or, 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 bromine on the Liquid Crystal Display. INTERFERENCES Interference may be caused by: Chlorine, Iodine, Ozone, Oxidized forms of Chromium and Manganese. In case of water with hardness greater than 500 mg/L CaCO3, shake the sample for approximately 2 minutes after adding the reagent. In case of water with alkalinity greater than 250 mg/L CaCO3 or acidity greater than 150 mg/L CaCO3, the color of the sample may develop only partially, or may rapidly fade. To resolve this, neutralize the sample with diluted HCl or NaOH.

Bromine 30 FREE CHLORINE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.00 to 2.50 mg/L 0.01 mg/L ±0.03 mg/L ±3% of reading ±0.

01 mg/L Tungsten lamp with narrow band interference filter @ 525 nm Adaptation of the EPA DPD method 330.5. The reaction between free chlorine and the DPD reagent causes a pink tint in the sample. REQUIRED REAGENTS POWDER: Code HI 93701-0 LIQUID: Code HI 93701A-F HI 93701B-F Description DPD Description DPD1 Indicator DPD1 Buffer Quantity 1 packet Quantity 3 drops 3 drops REAGENT SETS HI 93701-F Reagents for 300 tests (liquid) HI 93701-01 Reagents for 100 tests (powder) HI 93701-03 Reagents for 300 tests (powder) For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Free Chlorine on the secondary LCD by pressing PROGRAM and .

10 mL · Fill the cuvet with 10 mL of unreacted sample (up to the mark) and replace the cap. 31 Free Chlorine @@Now the meter is zeroed and ready for measurement. · Remove the cuvet. Powder reagents procedure · Add the content of one packet of HI 93701 DPD reagent. Replace the cap and shake gently for 20 seconds (or 2 minutes in case of seawater analysis). · Wait for a minute to allow the undissolved reagent to precipitate and reinsert the cuvet into the instrument. · Press READ DIRECT and the display will show "SIP" during measurement. · The instrument directly displays concentration in mg/L of free chlorine on the Liquid Crystal Display. Free Chlorine 32 Liquid reagents procedure · To an empty cuvet add 3 drops of HI 93701A-F DPD1 indicator and 3 drops of HI 93701B-F DPD1 buffer.

Swirl gently to mix, and immediately add 10 mL of unreacted sample.

Replace the cap and shake gently again. x3 x3 · Reinsert the cuvet into the instrument. · Press READ DIRECT and the display will show "SIP" during measurement. · The instrument directly displays concentration in mg/L of free chlorine on the Liquid Crystal Display. INTERFERENCES Interference may be caused by: Bromine, Iodine, Ozone, Oxidized forms of Chromium and Manganese. In case of water with hardness greater than 500 mg/L CaCO3, shake the sample for approximately 2 minutes after adding the powder reagent. In case of water with alkalinity greater than 250 mg/L CaCO3 or acidity greater than 150 mg/L CaCO3, the color of the sample may develop only partially, or may rapidly fade. To resolve this, neutralize the sample with diluted HCl or NaOH. 33 Free Chlorine FREE CHLORINE HIGH RANGE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.0 to 10. 0 mg/L 0.1 mg/L ±0.1 mg/L ±3% of reading ±0.1 mg/L Tungsten lamp with narrow band interference filter @ 525 nm Adaptation of the EPA DPD method 330.5.

The reaction between free chlorine and the DPD reagent causes a pink tint in the sample. REQUIRED REAGENTS Code Description HI 93701-0 DPD HI 93734B-0 Free & Total Chlorine HR Reagent Quantity 1 packet 5 mL REAGENT SETS HI 93734-01 HI 93734-03 Reagents for 100 tests Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Free Chlorine HR on the secondary LCD by pressing PROGRAM and . · Add to the cuvet 5 mL of HI 93734B reagent by means of the 5 mL syringe. 5 mL Free Chlorine HR 34 Note: To measure exactly 5 mL of reagent with the syringe, push the plunger completely into the syringe and insert the tip into HI 93734B reagent bottle.

Pull the plunger out until the lower edge of the seal is on the 5 mL mark of the syringe. probable level of liquid taken up by syringe 5 mL of sample · Fill the cuvet up to the 10 mL mark with 5 mL of unreacted sample, using the 3 mL plastic pipette. Note: rinse the 3 mL plastic pipette 2 or 3 times with sample before adding it to the cuvet with reagent. 10 mL · Replace the cap and shake gently. @@@@Now the meter is zeroed and ready for measurement. 35 Free Chlorine HR · Remove the cuvet. · Add the content of one packet of HI 93701 DPD reagent. Replace the cap and shake gently for 20 seconds (or 2 minutes in case of seawater analysis). · Wait for a minute to allow the undissolved reagent to precipitate and reinsert the cuvet into the instrument. · Press READ DIRECT and the display will show "SIP" during measurement.

· The instrument directly displays concentration in mg/L of free chlorine on the Liquid Crystal Display. INTERFERENCES Interference may be caused by: Bromine, Iodine, Ozone, Oxidized forms of Chromium and Manganese. Alkalinity above 250 mg/L or acidity above 150 mg/L 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 1000 mg/L CaCO3, shake the sample for approximately 1 minute after adding the powder reagent. Free Chlorine HR 36 TOTAL CHLORINE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.00 to 3.50 mg/L 0.01 mg/L ±0.03 mg/L ±3% of reading ±0.

01 mg/L Tungsten lamp with narrow band interference filter @ 525 nm Adaptation of the EPA DPD method 330.5. The reaction between the chlorine and the DPD reagent causes a pink tint in the sample. REQUIRED REAGENTS POWDER: Code HI 93711-0 LIQUID: Code HI 93701A-T HI 93701B-T HI 93701C Description DPD Description DPD1 indicator DPD1 buffer DPD3 solution Quantity 1 packet Quantity 3 drops 3 drops 1 drop REAGENT SETS HI 93701-T Reagents for 300 total chlorine tests (liquid) HI 93711-01 Reagents for 100 total chlorine tests (powder) HI 93711-03 Reagents for 300 total chlorine tests (powder) For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Total Chlorine on the secondary LCD by pressing PROGRAM and .

· Fill the cuvet with 10 mL of unreacted sample (up to the mark) and replace the cap. 10 mL 37 Total Chlorine @@Now the meter is zeroed and ready for measurement. · Remove the cuvet. Powder reagents procedure · Add 1 packet of HI 93711 reagent. Replace the cap and shake gently for 20 seconds (or 2 minutes in case of seawater analysis).

· Reinsert the cuvet into the instrument. · Press TIMER and the display will show the countdown prior to the measurement or, 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. Liquid reagents procedure · To an empty cuvet add 3 drops of HI 93701A-T DPD1 indicator, 3 drops of HI 93701B-T DPD1 buffer and 1 drop of HI 93701C DPD solution. Swirl gently to mix and immediately add 10 x3 x3 x1 Total Chlorine 38 mL of unreacted sample. Replace the cap and shake gently again. · Reinsert the cuvet into the instrument. · Press TIMER and the display will show the countdown prior to the measurement or, 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. Note: free and total chlorine have to be measured separately with fresh unreacted samples following the related procedure if both values are requested. INTERFERENCES Interference may be caused by: Bromine, Iodine, Ozone, Oxidized forms of Chromium and Manganese. In case of water with hardness greater than 500 mg/L CaCO3, shake the sample for approximately 2 minutes after adding the powder reagent. In case of water with alkalinity greater than 250 mg/L CaCO3 or acidity greater than 150 mg/L CaCO3, the color of the sample may develop only partially, or may rapidly fade. To resolve this, neutralize the sample with diluted HCl or NaOH. 39 Total Chlorine TOTAL CHLORINE HIGH RANGE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.0 to 10.0 mg/L 0.1 mg/L ±0.

1 mg/L ±3% of reading ±0.1 mg/L Tungsten lamp with narrow band interference filter @ 525 nm Adaptation of the EPA DPD method 330.5. The reaction between free chlorine and the DPD reagent causes a pink tint in the sample. REQUIRED REAGENTS Code HI 93701-0 HI 93734B-0 HI 93734C-0 Description DPD Free & Total Chlorine HR Reagent Total Chlorine HR Reagent Quantity 1 packet 5 mL 3 drops REAGENT SETS HI 93734-01 HI 93734-03 Reagents for 100 tests Reagents for 300 tests For other accessories see page 141.

MEASUREMENT PROCEDURE · Select the program number corresponding to Total Chlorine HR on the secondary LCD by pressing PROGRAM and . · Add to the cuvet 5 mL of HI 93734B reagent by means of the 5 mL syringe. 5 mL Total Chlorine HR 40 Note: To measure exactly 5 mL of reagent with the syringe, push the plunger completely into the syringe and insert the tip into HI 93734B reagent bottle. Pull the plunger out until the lower edge of the seal is on the 5 mL mark of the syringe. probable level of liquid taken up by syringe 5 mL of sample · Fill the cuvet up to the 10 mL mark with 5 mL of unreacted sample, using the 3 mL plastic pipette.

Note: rinse the 3 mL plastic pipette 2 or 3 times with sample before adding it to the cuvet with reagent. 10 mL · Replace the cap and shake gently. @@@@Now the meter is zeroed and ready for measurement. 41 Total Chlorine HR · Remove the cuvet. · Add 3 drops of HI 93734C reagent to the cuvet. · Add the content of one packet of HI 93701 DPD reagent to the cuvet. Replace the cap and shake gently for 20 seconds (or 2 minutes in case of seawater analysis). · Reinsert the cuvet into the instrument. x3 · Press TIMER and the display will show a countdown prior to the measurement or, alternatively, wait for 2 minutes and 30 seconds and press READ DIRECT. The display will show "SIP" during measurement.

· The instrument directly displays concentration in mg/L of total chlorine on the Liquid Crystal Display. INTERFERENCES Interference may be caused by: Bromine, Iodine, Ozone, Oxidized forms of Chromium and Manganese. Alkalinity above 250 mg/L or acidity above 150 mg/L 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 1000 mg/L CaCO3, shake the sample for approximately 1 minute after adding the powder reagent. Total Chlorine HR 42 CHLORINE DIOXIDE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.00 to 2.00 mg/L 0.01 mg/L ±0.10 mg/L ±5% of reading ±0. 01 mg/L Tungsten lamp with narrow band interference filter @ 575 nm Adaptation of the Chlorophenol Red method. The reaction between chlorine dioxide and reagents causes a colorless to purple tint in the sample. Description Reagent A Dechlorinating Reagent B Reagent C Reagent D Quantity 1 mL 1 packet 1 mL 1 mL REQUIRED REAGENT Code HI 93738A-0 HI 93738B-0 HI 93738C-0 HI 93738D-0 REAGENT SETS HI 93738-01 Reagents for 100 tests HI 93738-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Chlorine Dioxide on the secondary LCD by pressing PROGRAM and . · Fill two graduated mixing cylin#1 #2 ders (#1 & #2) up to the 25 mL mark with the sample.

25 ml 25 ml · Add 0.5 mL of HI 93738A chlorine dioxide reagent to each cylinder (#1 & #2), close them and invert several times to mix. #1 & #2 #1 #2 43 Chlorine Dioxide · Add the content of one packet of HI 93738B dechlorinating reagent to only one of the two cylinders (#1), close and invert it several times until it is totally dissolved. This is the blank. #1 · Add precisely 0.

5 mL of HI 93738C chlorine dioxide reagent to each cylinder (#1 & #2), close them and invert several times to mix. #1 & #2 #1 #2 · Add 0.5 mL of HI 93738D chlorine dioxide reagent to each cylinder (#1 & #2), close them and invert several times to mix. Cylinder #2 is the reacted sample. #1 & #2 #1 #2 #1 · Fill a cuvet with 10 mL of the blank (#1) up to the mark and replace the cap. · Place the blank (#1) into the holder and ensure that the notch on the cap is positioned securely into the groove. Chlorine Dioxide 10 mL #1 44 @@Now the meter is zeroed and ready for measurement. · Fill another cuvet with 10 mL of the reacted sample (#2) up to the mark and replace the cap. #2 10 mL · Insert the sample into the instrument. #2 · Press READ DIRECT and "SIP" will blink during measurement.

· The instrument directly displays concentration in mg/L of chlorine dioxide on the Liquid Crystal Display. SAMPLING PROCEDURE It is recommended to analyze chlorine dioxide samples immediately after collection. Chlorine dioxide samples must be stored in dark glass stoppered bottles, with minimal head space. Excessive heat (above 25°C/78°F), agitation and exposure to light must be avoided. INTERFERENCES Interferences may be caused by strong oxidants. 45 Chlorine Dioxide CHROMIUM VI HIGH RANGE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0 to 1000 µg/L 1 µg/L ±5 µg/L ±4% of reading ±1 µg/L Tungsten lamp with narrow band interference filter @ 525 nm Adaptation of the ASTM Manual of Water and Environmental Technology, D1687-92, Diphenylcarbohydrazide method. The reaction between chromium VI and the reagent causes a purple tint in the sample. Description Powder reagent Quantity 1 packet REQUIRED REAGENTS Code HI 93723-0 REAGENT SETS HI 93723-01 Reagents for 100 tests HI 93723-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Chromium VI HR on the secondary LCD by pressing PROGRAM and . · Fill the cuvet up to the mark with 10 mL of unreacted sample and replace the cap. @@· Press ZERO and "SIP" will blink on the display. 10 mL · Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement. Chromium VI HR 46 · Remove the cuvet and add the content of one packet of HI 93723 reagent.

Replace the cap and shake vigorously for about 10 seconds. · Reinsert the cuvet into the instrument. · Press TIMER and the display will show the countdown prior to the measurement or, alternatively, wait for 6 minutes and press READ DIRECT. In both cases "SIP" will blink during measurement. · The instrument directly displays concentration in µg/L of chromium VI on the Liquid Crystal Display.

INTERFERENCES Interference may be caused by: Vanadium above 1 ppm. However, waiting 10 minutes before reading, the interference is removed Iron above 1 ppm Mercurous and mercuric ions cause slight inhibition of the reaction. 47 Chromium VI HR CHROMIUM VI LOW RANGE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0 to 300 µg/L 1 µg/L ±1 µg/L ±4% of reading ±1 µg/L Tungsten lamp with narrow band interference filter @ 525 nm Adaptation of the ASTM Manual of Water and Environmental Technology, D1687-92, Diphenylcarbohydrazide method.

The reaction between chromium VI and the reagent causes a purple tint in the sample. Description Powder reagent Quantity 1 packet REQUIRED REAGENTS Code HI 93749-0 REAGENT SETS HI 93749-01 Reagents for 100 tests HI 93749-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Chromium VI LR on the secondary LCD by pressing PROGRAM and . · Fill the cuvet with 10 mL of unreacted sample (up to the mark) and replace the cap. @@· Press ZERO and "SIP" will blink on the display. 10 mL · Wait for a few seconds and the display will show "-0.0-".

Now the meter is zeroed and ready for measurement. Chromium VI LR 48 · Remove the cuvet and add the content of one packet of HI 93749 reagent. Replace the cap and shake vigorously for about 10 seconds. · Reinsert the cuvet into the instrument. · Press TIMER and the display will show the countdown prior to the measurement or, alternatively, wait for 6 minutes and press READ DIRECT. In both cases "SIP" will blink during measurement. · The instrument directly displays concentration in µg/L of Chromium VI on the Liquid Crystal Display. INTERFERENCES Interference may be caused by: Vanadium above 1 ppm. However, waiting 10 minutes before reading, the interference is removed Iron above 1 ppm Mercurous and mercuric ions cause slight inhibition of the reaction. 49 Chromium VI LR COLOR OF WATER SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0 to 500 PCU (Platinum Cobalt Units) 1 PCU ±10 PCU ±5% of reading ± 1 PCU Tungsten lamp with narrow band interference filter @ 420 nm Adaptation of the Standard Methods for the Examination of Water and Wastewater, 18th edition, Colorimetric Platinum Cobalt method.
REQUIRED ACCESSORIES 0.45 µm membrane for true color measurement. For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Color of Water on the secondary LCD by pressing PROGRAM and . · Fill one cuvet up to the mark with deionized water and replace the cap.
This is the blank. · Place the blank (# 1) into the holder and ensure that the notch on the cap is positioned securely into the groove. · Press ZERO and "SIP" will blink on the display. 10 mL #1 #1 · Wait for a few seconds and the display will show "-0.0-".
Now the meter is zeroed and ready for measurement. · Remove the blank. Color of Water 50 · Fill another cuvet up to the mark with unfiltered sample and replace the cap. This is the apparent color. · Filter 10 mL of sample through a filter with a 0.45 µm membrane into the third cuvet, up to the 10 mL mark and replace the cap. This is the true color. 10 mL #2 #3 · Insert the apparent color cuvet (# 2) into the instrument and ensure that the notch on the cap is positioned securely into the groove. · Press READ DIRECT and "SIP" will blink on the display. #2 · The meter directly displays the value of apparent color in PCU on the Liquid Crystal Display.

· Remove the cuvet, insert the true color cuvet (# 3) into the instrument and ensure that the notch on the cap is positioned securely into the groove. · Press READ DIRECT and "SIP" will blink on the display. #3 · The meter directly displays the value of true color in PCU on the Liquid Crystal Display. 51 Color of Water COPPER HIGH RANGE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.00 to 5.00 mg/L 0.01 mg/L ±0.02 mg/L ±4% of reading ±0.01 mg/L Tungsten lamp with narrow band interference filter @ 575 nm Adaptation of the EPA method. The reaction between copper and the bicinchoninate reagent causes a purple tint in the sample.
Description Bicinchoninate Quantity 1 packet REQUIRED REAGENTS Code HI 93702-0 REAGENT SETS HI 93702-01 Reagents for 100 tests HI 93702-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Copper HR on the secondary LCD by pressing PROGRAM and . · Fill the cuvet with 10 mL of unreacted sample (up to the mark) and replace the cap. @@· Press ZERO and "SIP" will blink on the display. 10 ml · Wait for a few seconds and the display will show "-0.
0-". Now the meter is zeroed and ready for measurement. Copper HR 52 · Remove the cuvet. · Add the content of one packet of HI 93702 reagent. Replace the cap and shake gently for about 15 seconds.
· Reinsert the cuvet into the instrument. · Press TIMER and the display will show the countdown prior to the measurement or, alternatively, wait for 45 seconds and press READ DIRECT. In both cases "SIP" will blink during measurement. · The instrument directly displays concentration in mg/L of copper on the Liquid Crystal Display. INTERFERENCES Interference may be caused by: Silver Cyanide For samples overcoming buffering capacity of reagent (around pH 6.8), pH should be adjusted between 6 and 8. 53 Copper HR COPPER LOW RANGE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0 to 1000 µg/L 1 µg/L ±10 µg/L ±5% of reading ±1 µg/L Tungsten lamp with narrow band interference filter @ 575 nm Adaptation of the EPA method. The reaction between copper and the bicinchoninate reagent causes a purple tint in the sample. Description Bicinchoninate Quantity 1 packet REQUIRED REAGENTS Code HI 93747-0 REAGENT SETS HI 93747-01 Reagents for 100 tests HI 93747-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Copper LR on the secondary LCD by pressing PROGRAM and .

· Fill the cuvet with 10 mL of unreacted sample (up to the mark) and replace the cap. @@· Press ZERO and "SIP" will blink on the display. 10 mL · Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement. Copper LR 54 · Remove the cuvet. · Add the content of one packet of HI 93747 reagent. Replace the cap and shake gently for about 15 seconds. · Reinsert the cuvet into the instrument. · Press TIMER and the display will show the countdown prior to the measurement or, alternatively, wait for 45 seconds and press READ DIRECT.
In both cases "SIP" will blink during measurement. · Multiply the reading on the Liquid Crystal Display by 10 to obtain the concetration in mg/L of oxygen demand. INTERFERENCES Interference may be caused by: Silver Cyanide For samples overcoming buffering capacity of reagent (around pH 6.

8), pH should be adjusted between 6 and 8. 55 Copper LR CYANIDE SPECIFICATIONS Range Resolution Accuracy Typical EMC Dev. Light Source Method 0.000 to 0.200 mg/L 0.001 mg/L ±0.005 mg/L ±3% of reading ±0.
001 mg/L Tungsten lamp with narrow band interference filter @ 610 nm Adaptation of the Standard Methods for the Examination of Water and Wastewater, 18th edition, Pyridine-Pyrazolone method. The reaction between cyanide and reagents causes a blue tint in the sample. Description Reagent A Reagent B Reagent C Quantity 1 spoon 1 packet 1 packet REQUIRED REAGENTS Code HI 93714A-0 HI 93714B-0 HI 93714C-0 REAGENT SETS HI 93714-01 Reagents for 100 tests HI 93714-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Cyanide on the secondary LCD by pressing PROGRAM and . · Fill the cuvet with 10 mL of unreacted sample (up to the mark) and replace the cap. @@· Press ZERO and "SIP" will blink on the display. 10 mL · Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement. Cyanide 56 · Remove the cuvet and add 1 level spoon of HI 93714A Cyanide Reagent.

Remember to close the reagent bottle immediately after use. Note: Pay attention to the way the spoon is filled: - do not press the powder; - do not overfill it. · Place the HDPE plastic stopper and cap immediately, to prevent the escape of chlorine gas which is developed during the reaction, and shake gently for 30 seconds. · Wait for 30 seconds leaving the cuvet tightly capped and undisturbed, then add the content of one packet of HI 93714B reagent and shake gently for 10 seconds. 12 9 10" 3 6 · Immediately add the content of one packet of HI 93714C reagent, replace the cap and shake vigorously for 20 seconds. · Reinsert the cuvet into the instrument. 57 Cyanide · Press TIMER and the display will show the countdown prior to the measurement or, alternatively, wait for 25 minutes and press READ DIRECT. In both cases "SIP" will blink during measurement. Note: Shake gently the cuvet 4 or 5 times during the first 20 minutes of the countdown prior to the measurement. Accuracy is not affected by undissolved reagent powder.
· The instrument directly displays concentration in mg/L of cyanide on the Liquid Crystal Display. · To convert the result in mg/L of Potassium Cyanide (KCN) multiply by a factor of 2.5. Note: for most accurate results perform the test at 20-25 °C. INTERFERENCES Interference may be caused by large amounts of turbidity that will cause high readings.
Oxidizing (like chlorine) or reducing agents (such as sulfide or sulfur dioxide) are known to interfere with the measurement. Distillation will remove these. Samples with high pH values should be adjusted to approximately pH 7 before testing. CAUTION: cyanides, their solutions, and hydrogen cyanide liberated by acids, are very poisonous. Cyanide 58 CYANURIC ACID SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0 to 80 mg/L 1 mg/L ±1 mg/L ±15% of reading ±1 mg/L Tungsten lamp with narrow band interference filter @ 525 nm Adaptation of the turbidimetric method. The reaction between cyanuric acid and the reagent causes a white suspension in the sample. Description Powder reagent Quantity 1 packet REQUIRED REAGENTS Code HI 93722-0 REAGENT SETS HI 93722-01 Reagents for 100 tests HI 93722-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Cyanuric Acid on the secondary LCD by pressing PROGRAM and . · Fill the cuvet with 10 mL of unreacted sample (up to the mark) and replace the cap. @@· Press ZERO and "SIP" will blink on the display. 10 mL · Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement. 59 Cyanuric Acid · Fill a graduated beaker up to the 25 mL mark with the sample, add the content of one packet of HI 93722 reagent and swirl gently to mix. · Fill a second cuvet with 10 mL of the reacted sample up to the mark.

Replace the cap. 10 mL · Reinsert the cuvet into the instrument. · Press TIMER and the display will show the countdown prior to the measurement or, alternatively, wait for 45 seconds and press READ DIRECT. In both cases "SIP" will blink during measurement. · The instrument directly displays concentration in mg/L of cyanuric acid on the Liquid Crystal Display. Cyanuric Acid 60 FLUORIDE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.00 to 2.00 mg/L 0.01 mg/L ±5% of reading ±0.01 mg/L Tungsten lamp with narrow band interference filter @ 575 nm Adaptation of the Standard Methods for the Examination of Water and Wastewater, 18th edition, SPADNS method.
The reaction between fluoride and the liquid reagent causes a red tint in the sample. Description SPADNS Reagent Quantity 4 mL REQUIRED REAGENT Code HI 93729-0 REAGENT SETS HI 93729-01 Reagents for 100 tests HI 93729-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Fluoride on the secondary LCD by pressing PROGRAM and . · Add 2 mL of HI 93729 SPADNS reagent to two cuvets. 2 ml · Fill one of the cuvets with distilled water (up to the mark), replace the cap and invert several times to mix. · Fill the other cuvet with sample (up to the mark), replace the cap and invert several times to mix. 61 10 ml #1 10 ml #2 Fluoride · Place the cuvet with the reacted distilled water (# 1) into the holder and ensure that the notch on the cap is positioned securely into the groove. #1 · Press TIMER and the display will show the countdown prior to zeroing the blank or, alternatively, wait for two minutes and 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 cuvet. · Insert the other cuvet (# 2) with the reacted sample into the instrument. #2 · Press READ DIRECT and "SIP" will blink on the LCD during measurement. · The instrument directly displays concentration in mg/L of fluoride on the Liquid Crystal Display. Note: For wastewater or seawater samples, before performing measurements, distillation is required. Note: For most accurate results, use two graduated pipettes to deliver exactly 8 mL of distilled water and 8 mL of sample. Fluoride 62 INTERFERENCES Negative interferences may be caused by: Alkalinity (as CaCO3) above 5000 mg/L Aluminum above 0.

1 mg/L Iron, ferric above 10 mg/L Positive interferences may be caused by: Chloride above 700 mg/L Phosphate, ortho above 16 mg/L Sodium hexametaphosphate above 1.0 mg/L Sulfate above 200 mg/L Highly colored and turbid samples may require distillation Highly alkaline samples can be neutralized with nitric acid.

63 Fluoride CALCIUM HARDNESS SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.00 to 2.70 mg/L 0.01 mg/L ±0.11 mg/L ±5% of reading ±0.01 mg/L Tungsten lamp with narrow band interference filter @ 525 nm Adaptation of the Standard Methods for the Examination of Water and Wastewater, 18th edition, Calmagite method. The reaction between calcium and reagents causes a reddish-violet tint in the sample. Description Ca & Mg indicator Alkali solution EGTA solution Quantity 0.5 mL 0.5 mL 1 drop REQUIRED REAGENTS Code HI 93720A-0 HI 93720B-0 HI 93720C-0 REAGENT SETS HI 93720-01 Reagents for 100 tests HI 93720-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Hardness Ca on the secondary LCD by pressing PROGRAM and . · Rinse a graduated beaker several times with unreacted sample, before filling it to the 50 mL mark with the sample. · Add 0.5 mL of HI 93720A Calcium indicator solution and swirl to mix. · Add 0.

5 mL of HI 93720B Alkali solution and swirl to mix. Use this solution to rinse 2 cuvets before filling them up to the 10 mL mark. Hardness Ca #1 #2 64 · Add 1 drop of HI 93720C EGTA solution to one cuvet (# 1), replace the cap and invert the cuvet several times to mix. This is the blank. #1 · Place the blank (# 1) into the holder and ensure that the notch on the cap is positioned securely into the groove.

· Press ZERO and "SIP" will blink on the display. #1 · Wait for a few seconds and the display will show "-0.0-". Now the meter is zeroed and ready for measurement. · Remove the blank and insert the second cuvet (# 2) into the instrument. #2 · Press READ DIRECT. "SIP" will blink during measurement. · The instrument directly displays concentration in mg/L of calcium hardness, as CaCO3, on the Liquid Crystal Display. · To convert the reading to mg/L of calcium (Ca), multiply by a factor of 0.4.

65 Hardness Ca Note: The test will detect any calcium contamination in the beaker, measuring syringes or sample cells. To test cleanliness, repeat the test multiple times until you obtain consistent results. Note: For better accuracy wash glassware with HCl 6N. SAMPLE DILUTION This meter is designed to determine low levels of hardness, typically found in water purification systems. When testing some other sources of water, it is not uncommon to come across levels of hardness that are greater than the range of this meter. This problem can be overcome through dilution. Dilutions must be performed with hardness-free water or the readings will be erroneous. A dilution to reduce the level of hardness by a factor of one hundred is performed as follows: · Fill a 1 mL syringe with the sample. · Place the syringe in a 50 mL beaker, making sure that the beaker is clean and empty, and inject 0.5 mL into the beaker.

· Fill the beaker up to the 50 mL mark with hardness-free water. Now, follow normal measurement procedure. The true value of the sample is the reading obtained multiplied by a factor of one hundred (the dilution factor). The conversion factors to convert readings in mg/L to French degrees (FD), German degrees (DD) and English degrees (ED) of hardness are as follows: 1 mg/L = 0.1 FD = 0.

0556 DD = 0.07 ED. INTERFERENCES Interference may be caused by excessive amounts of heavy metals. Hardness Ca 66 MAGNESIUM HARDNESS SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 0.00 to 2.

00 mg/L 0.01 mg/L ±0.11 mg/L ±5% of reading ±0.02 mg/L Tungsten lamp with narrow band interference filter @ 525 nm Adaptation of the Standard Methods for the Examination of Water and Wastewater, 18th edition, EDTA colorimetric method. The reaction between magnesium and reagents causes a reddish-violet tint in the sample. Description Mg indicator Alkali solution EDTA solution EGTA solution Quantity 0.5 mL 0.5 mL 1 drop 1 drop REQUIRED REAGENTS Code HI 93719A-0 HI 93719B-0 HI 93719C-0 HI 93719D-0 REAGENT SETS HI 93719-01 Reagents for 100 tests HI 93719-03 Reagents for 300 tests For other accessories see page 141. MEASUREMENT PROCEDURE · Select the program number corresponding to Hardness Mg on the secondary LCD by pressing PROGRAM and . · Rinse a graduated beaker several times with unreacted sample, before filling it to the 50 mL mark with the sample.

· Add 0.5 mL of HI 93719A Magnesium indicator solution, then swirl to mix. 67 Hardness Mg · Add 0.5 mL of HI 93719B Alkali solution and swirl to mix. Use this solution to rinse 2 cuvets. · Fill both cuvets up to the 10 mL mark. 10 mL 10 mL #1 #2 · Add 1 drop of HI 93719C EDTA solution to one cuvet (# 1), replace the cap and invert the cuvet several times to mix. This is the blank. #1 · Add 1 drop of HI 93719D EGTA solution to the second cuvet (# 2), replace the cap and invert the cuvet several times to mix. This is the sample.

#2 · Place the blank (# 1) into the holder and ensure that the notch on the cap is positioned securely into the groove. #1 @@Now the meter is zeroed and ready for measurement. Hardness Mg 68 · Remove the blank (# 1) and insert the sample (# 2) into the instrument, making sure that the notch on the cap is positioned securely into the groove. #2 · Press READ DIRECT. "SIP" will blink during measurement.

· The instrument directly displays concentration in mg/L of magnesium hardness, as CaCO3, on the Liquid Crystal Display. · To convert the result to mg/L of magnesium (Mg), multiply by a factor of 0.243. Note: The test will detect any magnesium contamination in the beakers, measuring syringes or sample cells. To test cleanliness, repeat the test multiple times until you obtain consistent results.

SAMPLE DILUTION This meter is designed to determine hardness typically found in water purification systems. In order to measure samples with high hardness, follow dilution procedure explained on page 66 (Ca Hardness). The conversion factors to convert readings in mg/L to French degrees (FD), German degrees (DD) and English degrees (ED) of hardness are as follows: 1 mg/L = 0.1 FD = 0.0556 DD = 0.07 ED INTERFERENCES Interference may be caused by excessive amounts of heavy metals. 69 Hardness Mg TOTAL HARDNESS HIGH RANGE SPECIFICATIONS Range Resolution Accuracy Typical EMC Deviation Light Source Method 400 to 750 mg/L 5 mg/L ±10 mg/L ±2% of reading ±5 mg/L Tungsten lamp with narrow band interference filter @ 466 nm Adaptation of the EPA method 130.