2430-87

Fish Farmer's Water Quality Test Kit Manual

Test Kit Model FF-1A

Cat. No. 2430-02

aa/dk 3ed 12/99

TABLE OF CONTENTS

Introduction.....3
Alkalinity 4
Ammonia.....8
Carbon Dioxide 12
Chloride 14
Dissolved Oxygen 16
Nitrite 20
pH 22
Supersaturation.....24
Total Hardness.....25
Reagents and Apparatus 27

INTRODUCTION

Aquaculture has developed into a highly sophisticated field that uses scientific techniques to maintain the water where aquatic plants and animals live. The ability to optimize parameters affecting water quality is important for efficient production, and sensitive and accurate testing methods are essential.

Hach's Model FF-1A Fish Farmer's Water Quality Test Kit is designed to meet this need. The kit includes chemicals and apparatus for the determination of nine important water parameters and a rugged, armored thermometer for temperature readings. Packaged in a durable, portable case, the kit is well suited for measurements in the field.

Ammonia nitrogen, nitrite nitrogen, and pH determinations are colorimetric tests. Results are obtained by matching the developed color of the sample to a color disc. Units are stamped on each disc so results can be read directly. Alkalinity, carbon dioxide, chloride, dissolved oxygen, and total hardness tests are conducted by titration using the drop-count method. A simple test for supersaturation is also included.

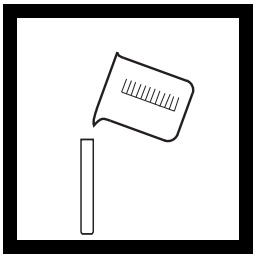
With this aquaculture kit, a fish farmer can obtain the data necessary for making the right management decisions.

ALKALINITY

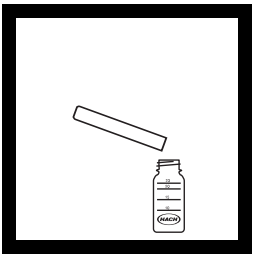
Alkalinity refers to the amount of titratable bases in water expressed as milligrams per liter of equivalent calcium carbonate. The presence of carbonates, bicarbonates, and hydroxides is the most common cause of alkalinity in natural waters. Alkalinity is an important indicator of the need for water treatments, such as the addition of lime.

Alkalinity is expressed as phenolphthalein alkalinity or as total (methyl orange) alkalinity. Phenolphthalein alkalinity indicates the total hydroxide and one-half the carbonate present. Total alkalinity includes all carbonate, bicarbonate, and hydroxide alkalinity.

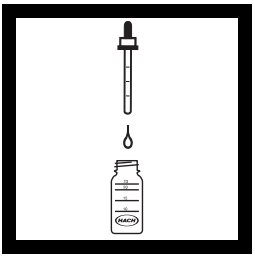
High Range, 1 to 20 gpg



1. Fill the plastic measuring tube to the top with sample.



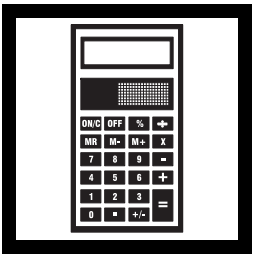
2. Pour the contents of the tube into the mixing bottle.



3. Add one drop of Phenolphthalein Indicator Solution.

4. Swirl to mix. If the water remains colorless, the phenolphthalein alkalinity is zero. If it is, skip to *step 7*.

5. If the sample turns pink, add Sulfuric Acid Standard Solution one drop at a time. Count each drop. Swirl the mixing bottle after each drop. Add drops until the sample turns colorless.

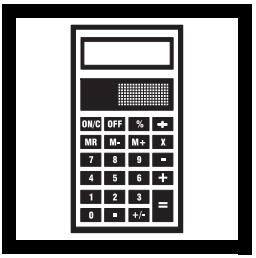


6. The number of drops = phenolphthalein alkalinity in grains per gallon calcium carbonate (gpg $CaCO_3$).

gpg x 17.1 = mg/L.

7. Add the contents of one Bromcresol Green-Methyl Red Indicator Powder Pillow. Swirl to mix.

8. Add more Sulfuric Acid Standard Solution one drop at a time. Count each drop. Swirl the mixing bottle after each drop is added. Add drops until the sample changes from blue-green to pink.



9. The total number of drops in both steps 5 and 8 = total alkalinity in gpg $CaCO_3$.

gpg x 17.1 = mg/L.

Low Range, 0.4 to 8 gpg

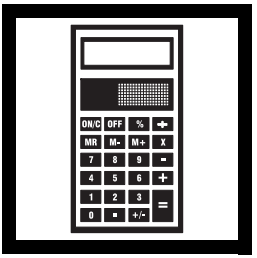
1. Fill the mixing bottle to the 15-mL mark with sample.

2. Follow *steps 3* through *5* of the High Range procedure.

3. The drops ÷ 2.5 = phenolphthalein alkalinity in gpg $CaCO_3$.

gpg x 17.1 = mg/L.

4. If the sample remains colorless after the addition of phenolphthalein, follow *steps 7* through *8* of the High Range procedure.



5. The total number of drops in both steps 5 and 8 ÷ 2.5 = total alkalinity in gpg $CaCO_3$.

gpg x 17.1 = mg/L.

Table 1 Alkalinity Relationship Table

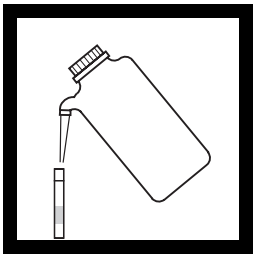
Result of Titration	Hydroxide Alkalinity	Carbonate Alkalinity	Bicarbonate
Phenolphthalein alkalinity = 0	0	0	Equal to total
Phenolphthalein alkalinity less than half of total alkalinity	0	2 times the phenolphthalein alkalinity	Total alkalinity minus 2 times phenolphthalein alkalinity
Phenolphthalein alkalinity equal to half of total alkalinity	0	2 times the phenolphthalein alkalinity	0
Phenolphthalein alkalinity greater than half of total alkalinity	2 times the phenolphthalein alkalinity minus total alkalinity	2 times the difference between total and phenolphthalein alkalinity	0
Phenolphthalein alkalinity equal to total alkalinity	Equal to the total alkalinity	0	0

REAGENTS AND APPARATUS

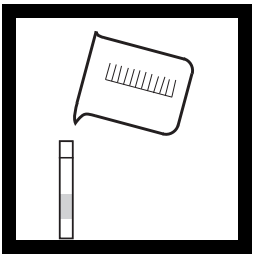
Description	Cat. No.
Bottle, mixing (6/pkg)	2327-06
Bromcresol Green-Methyl Red Indicator Powder Pillows (100/pkg)	943-99
Measuring Tube, plastic	438-00
Phenolphthalein Indicator Solution, 15 mL	1897-36
Sulfuric Acid Standard Solution, 100 mL	26205-32

AMMONIA

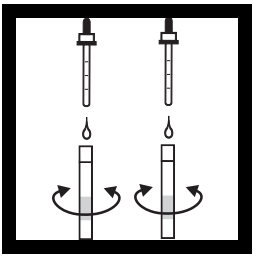
The presence of ammonia in fish waters is normal due to natural fish metabolism and microbiological decay of organic matter. In water, ammonia nitrogen can exist in two forms, un-ionized ammonia (NH_3) and ammonium ion (NH_4^+). Un-ionized ammonia is toxic to fish, while the ammonium ion is non-toxic except at extremely high levels. The pH and temperature of water regulate the proportion of each form. *Table 2* on page *10* lists the percentages of un-ionized ammonia at various pH and temperature levels. The Nessler Method for ammonia nitrogen testing is a sensitive, single reagent test. Interference due to high water hardness is eliminated by adding Rochelle Salt Solution to the sample.



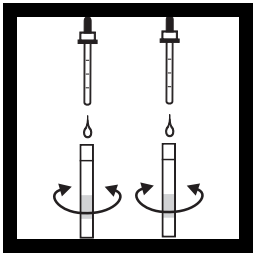
1. Fill one viewing tube to the 5-mL mark with deionized water. This will be the reagent blank.



2. Fill the second viewing tube to the 5-mL mark with sample. This will be the prepared sample.

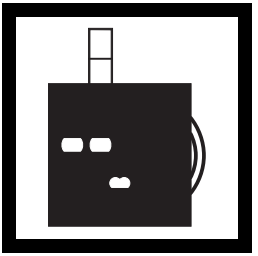


3. Add 1 drop of Rochelle Salt Solution to each viewing tube and swirl to mix.



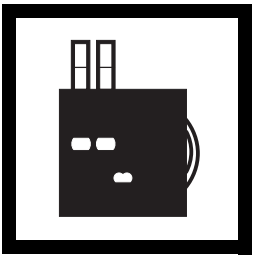
4. Add 3 drops of Nessler Reagent to each viewing tube and swirl to mix. Stopper both tubes.

5. Allow 10 minutes for color development.

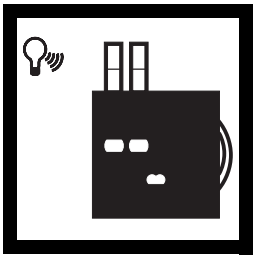


6. Insert the prepared sample into the right-hand opening of the Color Comparator.

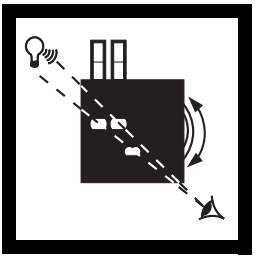
Note: *Ensure the Ammonia Color Disc is in the Comparator.*



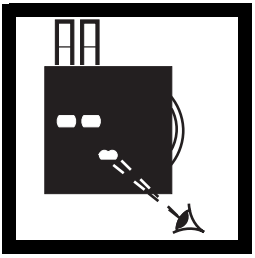
7. Insert the reagent blank into the left-hand opening.



8. Hold the Comparator up to a light source.



9. Rotate the disc until the colors in the left and right windows match.



10. Read the concentration of ammonia nitrogen in mg/L (N) through the scale window.

To express test results as toxic *ammonia* (NH_3), use the following equation:

$$\frac{\text{mg/L } NH_3 \text{ as N} \times \text{value from Table 2}}{100} \times 1.2 = \text{mg/L } NH_3$$

To express results as *ammonium* ion (NH_4^+), use the following equation:

$$\frac{\text{mg/L } NH_3 \text{ as N} \times (100 - \text{value from Table 2})}{100} \times 1.3 = \text{mg/L } NH_4^+$$

Table 2 Percentage Un-ionized Ammonia in Aqueous Solution by pH Value and Temperature Calculated from data in Emerson, et. al*

	Temperature (°C)														
pH	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**	**28**	**30**	**32**
7.0	0.11	0.13	0.16	0.18	0.22	0.25	0.29	0.34	0.39	0.46	0.52	0.60	0.69	0.80	0.91
7.2	0.18	0.21	0.25	0.29	0.34	0.40	0.46	0.54	0.62	0.82	0.83	0.96	1.10	1.26	1.44
7.4	0.29	0.34	0.40	0.46	0.54	0.63	0.73	0.85	0.98	1.14	1.31	1.50	1.73	1.98	2.26
7.6	0.45	0.53	0.63	0.73	0.86	1.00	1.16	1.34	1.55	1.79	2.06	2.36	2.71	3.10	3.53
7.8	0.72	0.84	0.99	1.16	1.35	1.57	1.82	2.11	2.44	2.81	3.22	3.70	4.23	4.82	5.48
8.0	1.13	1.33	1.56	1.82	2.12	2.47	2.86	3.30	3.81	4.38	5.02	5.74	6.54	7.43	8.42
8.2	1.79	2.10	2.45	2.86	3.32	3.85	4.45	5.14	5.90	6.76	7.72	8.80	9.98	11.29	12.72
8.4	2.80	3.28	3.83	4.45	5.17	5.97	6.88	7.90	9.04	10.31	11.71	13.26	14.95	16.78	18.77
8.6	4.37	5.10	5.93	6.88	7.95	9.14	10.48	11.97	13.61	15.41	17.37	19.50	21.78	24.22	26.80
8.8	6.75	7.85	9.09	10.48	12.04	13.76	15.66	17.73	19.98	22.41	25.00	27.74	30.62	33.62	36.72
9.0	10.30	11.90	13.68	15.65	17.82	20.18	22.73	25.46	28.36	31.40	34.56	37.83	41.16	44.53	47.91
9.2	15.39	17.63	20.08	22.73	25.58	28.61	31.80	35.12	38.55	42.04	45.57	49.09	52.58	55.99	59.31
9.4	22.38	25.33	28.47	31.80	35.26	38.84	42.49	46.18	49.85	53.48	57.02	60.45	63.73	66.85	69.79
9.6	31.36	34.96	38.38	42.49	46.33	50.16	53.94	57.62	61.17	64.56	67.77	70.78	73.58	76.17	78.55
9.8	42.00	46.00	50.00	53.94	57.78	61.47	64.99	68.31	71.40	74.28	76.92	79.33	81.53	83.51	85.30
10.0	53.44	57.45	61.31	64.98	68.44	71.66	74.63	77.35	79.83	82.07	84.08	85.88	87.49	88.92	90.19
10.2	64.53	68.15	71.52	74.63	77.46	80.03	82.34	84.41	86.25	87.88	89.33	90.60	91.73	92.71	93.58

* Emerson, K., R. C. Russo, R.E. Lund, and R.V. Thurston. 1975. Aqueous ammonia equilibrium calculations: effect of pH and temperature. *J. Fish. Res. Board Can.*, 32:2379-2383.

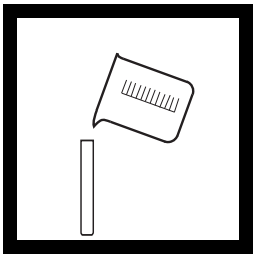
REAGENTS AND APPARATUS

Description	Cat No.
Color Comparator Box	1732-00
Color Disc, Ammonia Nitrogen	1854-00
Color Viewing Tubes, plastic (4/pkg)	46600-04
Nessler Reagent, 100 mL	21194-32
Rochelle Salt Solution, 29 mL	1725-33
Water, deionized, 100 mL*	272-42

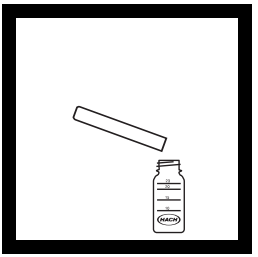
* Not included in kit.

CARBON DIOXIDE

Carbon dioxide is present in all surface waters in amounts generally less than 10 mg/L, although higher concentrations in ground waters are not uncommon. High concentrations of carbon dioxide may be tolerated by fish if dissolved oxygen concentrations are also high. Fish are known to avoid areas of high carbon dioxide levels. The relationship of carbon dioxide to fish respiration and photosynthesis creates daily fluctuations in CO_2 concentrations. Levels usually increase during the night and decrease during the day. High levels of carbon dioxide, such as those that occur after plankton die-offs, will suppress absorption by fish and may become toxic when dissolved oxygen levels are critically low.



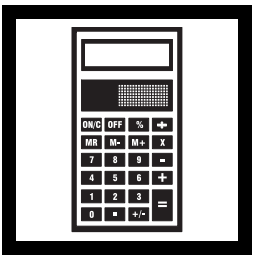
1. Fill the plastic measuring tube to the top with sample.



2. Pour the contents of the tube into the mixing bottle.

3. Add one drop of Phenolphthalein Indicator Solution.

4. Add Sodium Hydroxide Solution one drop at a time. Count each drop. Swirl the bottle after each drop. Continue to add drops until the solution becomes light pink.



5. Total drops x 5 = mg/L carbon dioxide (CO_2).

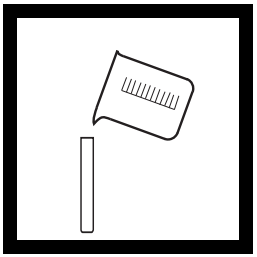
REAGENTS AND APPARATUS

Description	Cat. No.
Bottle, mixing (6/pkg)	2327-06
Measuring Tube, plastic	438-00
Phenolphthalein Indicator Solution, 15 mL	1897-36
Sodium Hydroxide Standard Solution, 0.01 N, 100 mL	671-32

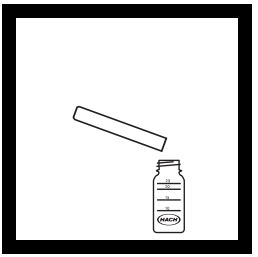
CHLORIDE

Chlorides are present in all fish waters in highly variable levels. Concentrations are usually higher near coastal regions. Measure chloride before and after adding salt to fish waters to estimate pond levels.

High Range, 0 to 2500 mg/L Sodium Chloride



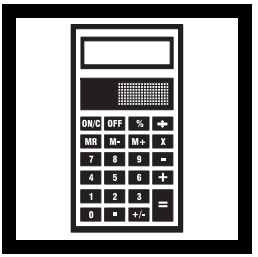
1. Fill the plastic measuring tube to the top with sample.



2. Pour the contents of the tube into the mixing bottle.

3. Add the contents of one Chloride 2 Indicator Powder Pillow. Swirl to mix.

4. Add Silver Nitrate Solution one drop at a time. Swirl the bottle after each drop is added. Count each drop until the water changes from yellow to red-brown.



5. Total drops x 50 = mg/L sodium chloride (NaCl).

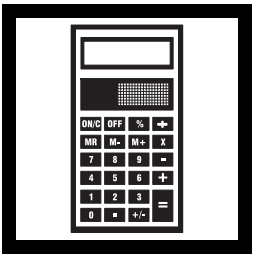
NaCl x 0.6 = mg/L chloride.

Low Range, 0 to 500 mg/L Sodium Chloride

1. Fill the mixing bottle to the 23-mL mark with sample.

2. Add the contents of one Chloride 2 Indicator Powder Pillow. Swirl to mix.

3. Add Silver Nitrate Solution one drop at a time. Swirl the bottle after each drop is added. Count each drop until the sample changes from yellow to red-brown.



4. Total drops x 12.5 = mg/L sodium chloride (NaCl).

NaCl x 0.6 = mg/L chloride.

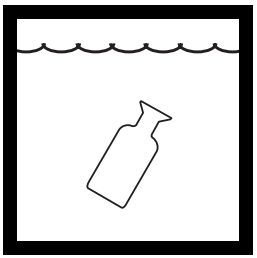
REAGENTS AND APPARATUS

Description	Cat. No.
Bottle, mixing (6/pkg)	2327-06
Chloride 2 Indicator Powder Pillows (100/pkg)	1043-99
Measuring Tube, plastic	438-00
Silver Nitrate Solution, 100 mL	397-32

DISSOLVED OXYGEN

Probably the single most important water quality parameter in aquaculture is the dissolved oxygen (DO) content. Suitability of water for fish and other organisms can be measured or estimated from DO values. DO concentrations in water depend on many variables including temperature, sunlight, atmospheric pressure, salinity, plant life, and water turbulence. Oxygen from the air will slowly diffuse into natural waters. However, the primary source of oxygen in fish waters originates from photosynthesis by phytoplankton. Prolonged exposure to low concentrations of DO can be harmful to aquatic life. Frequent DO measurements are essential for adequate control.

High Range, 1 to 20 mg/L

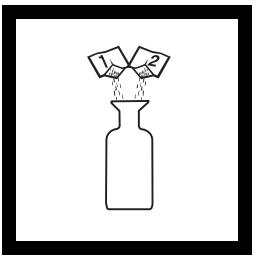


1. Submerge the glass-stoppered DO bottle in the water to be tested. Allow it to fill to the top.

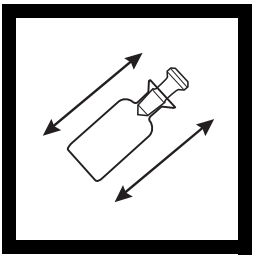
Note: *Collect and prepare the sample in the DO bottle. Transferring the sample from one container to another could contaminate it with atmospheric oxygen.*

2. Be certain that no air bubbles are present by inclining the bottle slightly and inserting the stopper with a quick thrust. This will force air bubbles out of the sample. If bubbles become trapped in *steps 2 or 3*, the sample should be discarded and the test begun again.

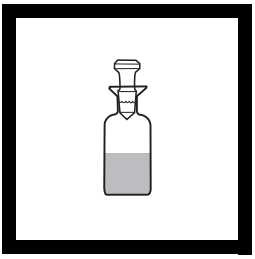
Note: *Start the test immediately after collecting the sample.*



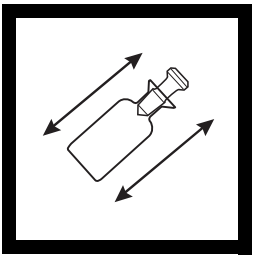
3. Carefully remove the stopper from the bottle. Add the contents of one Dissolved Oxygen 1, and one Dissolved Oxygen 2 Reagent Powder Pillow. Stopper the bottle firmly to avoid trapping air.



4. Grip the bottle and shake vigorously. A delay in mixing the solution may result in the powder not dissolving properly. A flocculent precipitate will form. If oxygen is present, the precipitate will be brownish-orange. A small amount of powdered reagent may remain at the bottom of the bottle. This will not affect the results.

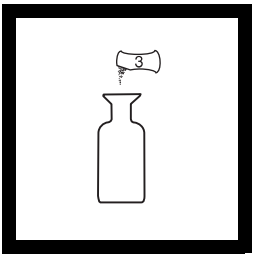


5. Allow the sample to stand until the floc has settled half-way and the upper half of the bottle is clear.

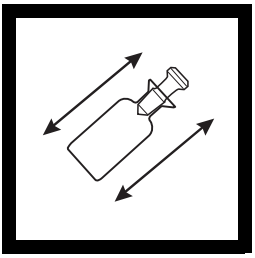


6. Shake the bottle again.

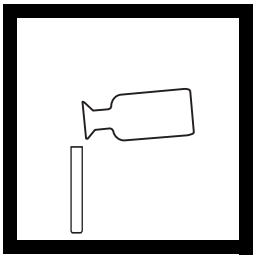
7. Allow the floc to settle again.



8. Remove the stopper and add the contents of one Dissolved Oxygen 3 Powder Pillow.



9. Carefully replace the stopper and shake to mix. The floc will dissolve and a yellow color will develop in the presence of oxygen. This is the prepared sample.

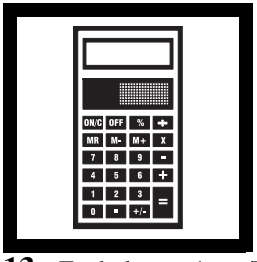


10. Fill the plastic measuring tube to the top with the prepared sample.

11. Pour the contents of the tube into the mixing bottle.

12. Add Sodium Thiosulfate Standard Solution one drop at a time to the contents of the mixing bottle. Swirl the bottle after each drop. Count each drop. Continue until the sample changes from yellow to colorless.

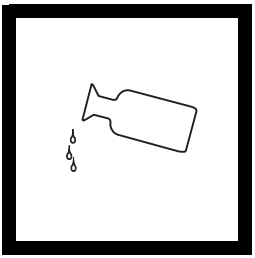
See the note on the next page.



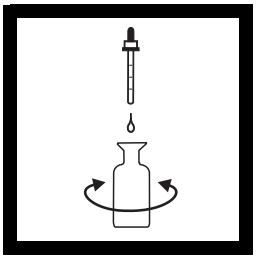
13. Each drop = 1 mg/L dissolved oxygen.

Low Range, 0.2 to 4 mg/L

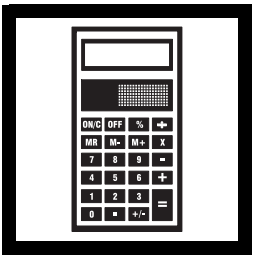
If the result of *step 13* in the High Range test is 3 mg/L or less, it is advisable to test a larger sample to obtain a more sensitive result. This may be done by titrating directly into the DO bottle as follows:



1. Pour off the prepared sample leftover from *step 10* in the High Range test to the 30-mL mark.



2. Add Sodium Thiosulfate Standard Solution one drop at a time to the bottle. Swirl after each drop. Continue until the color changes from yellow to colorless.



3. Each drop = 0.2 mg/L dissolved oxygen.

Note: *A more sensitive end point can be obtained using Starch Indicator Solution (Cat. No. 349-32) while titrating the sample with Sodium Thiosulfate Standard Solution. To use effectively, titrate the sample until the color just begins to change from yellow-brown to light yellow. Add two drops of Starch Indicator Solution and continue the titration until the color changes from blue to colorless. Starch Indicator Solution is not included in this kit, but may be ordered from Hach.*

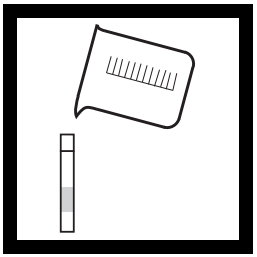
REAGENTS AND APPARATUS

Description	Cat. No.
Bottle, dissolved oxygen, glass-stoppered	1909-02
Bottle, mixing (6/pkg)	2327-06
Clippers	968-00
Dissolved Oxygen 1 Reagent Powder Pillows (100/pkg)	981-99
Dissolved Oxygen 2 Reagent Powder Pillows (100/pkg)	982-99
Dissolved Oxygen 3 Reagent Powder Pillows (25/pkg)	987-68
Measuring Tube, plastic	438-00
Sodium Thiosulfate Standard Solution, 0.0109 N, 100 mL	24089-32
Starch Indicator Solution, 100 mL*	349-32

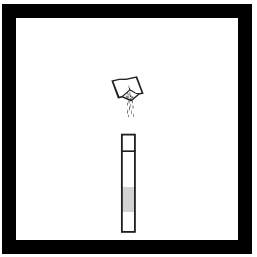
* Not included in kit.

NITRITE

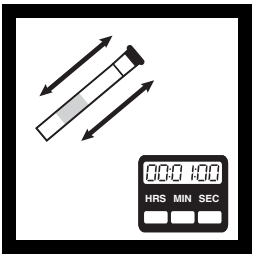
Nitrite nitrogen occurs as an intermediate stage in the biological decomposition of compounds containing organic nitrogen. Nitrites are not often found in surface waters because in aerobic conditions they are readily oxidized to nitrates. Levels of nitrites greater than natural residual amounts can be acutely toxic to fish. The test shown below is very sensitive to low nitrite concentrations. Samples containing more than 0.5 mL nitrite–nitrogen should be diluted with deionized water and the results corrected for the volume added.



1. Rinse a viewing tube several times with sample, then fill to the 5-mL mark.

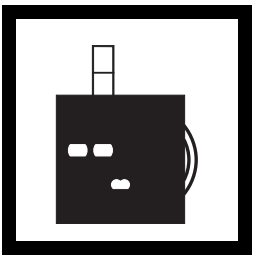


2. Add the contents of one NitriVer®* 3 Powder Pillow for 5-mL Sample.



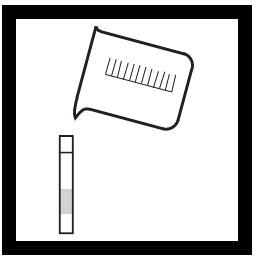
3. Stopper the tube and shake vigorously for exactly one minute. A pink color will develop if nitrite is present.

4. Allow this prepared sample to sit undisturbed for 10, but not more than 15 minutes.



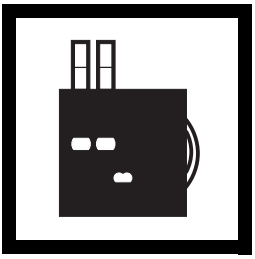
5. Place the tube into the right opening of the Color Comparator.

Note: *Ensure that the Nitrite–Nitrogen Color Disc is in place.*

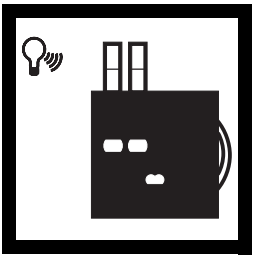


6. Fill another tube to the 5-mL mark with untreated sample.

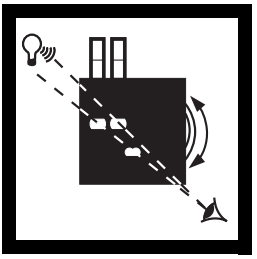
* NitriVer is a registered trademark of Hach Company.



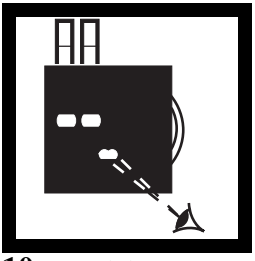
7. Place it into the left opening.



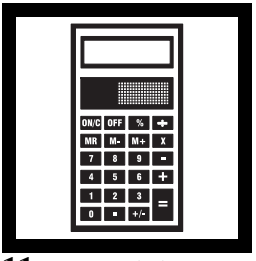
8. Hold the Comparator up to a light source.



9. Rotate the color disc until the colors in the left and right windows match.



10. Read the mg/L nitrite–nitrogen (N) through the scale window.



11. mg/L nitrite–nitrogen x 3.3 = mg/L nitrite (NO_2^-).

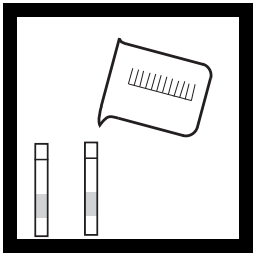
REAGENTS AND APPARATUS

Description	Cat. No.
Color Comparator Box	1732-00
Color Disc, nitrite–nitrogen	14084-00
Color Viewing Tubes, plastic (4/pkg)	46600-04
NitriVer® 3 Powder Pillows for 5-mL Sample (100/pkg)	14078-99

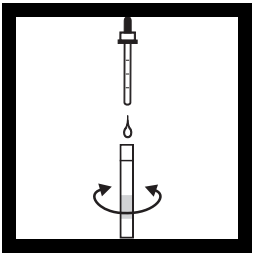
pH

The pH of water is a measure of the hydrogen ion concentration on a scale of 0 (very acidic) to 14 (very basic), with pH 7 being the neutral point. The pH value represents the instantaneous hydrogen ion activity rather than the buffering capacity or total reserve as in acidity or alkalinity tests. The pH of most natural water ranges from 4 to 9 and is greatly influenced by the presence of carbon dioxide, carbonates, bicarbonates, and acid rain. Phytoplankton and other aquatic plant life will remove carbon dioxide from the water during photosynthesis, causing the pH to rise during the day. In order to assess the pH cycle of a body of water, pH measurements should be made at different times. Waters with pH values of about 6.5 to 9 at daybreak are considered best for fish production. The acid and alkaline death points for most fish are approximately pH 4 and pH 11.

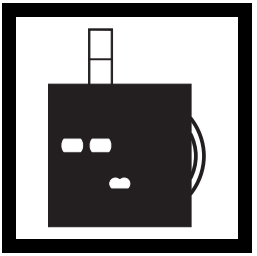
Chlorine in the sample may interfere with the test. To remove up to 50 mg/L chlorine, add one drop of Sodium Thiosulfate Solution before adding the pH Indicator.



1. Thoroughly rinse two viewing tubes with sample and fill to the 5-mL marks.

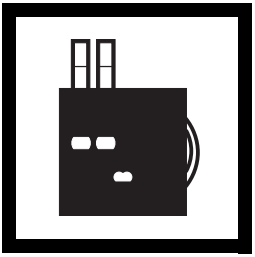


2. Add 6 drops of Wide Range 4 pH Indicator Solution to one of the tubes and swirl to mix.

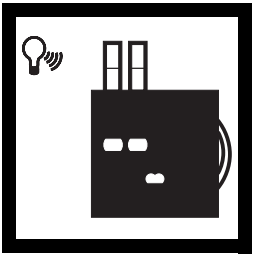


3. Insert the tube containing Indicator into the right-hand opening of the Color Comparator.

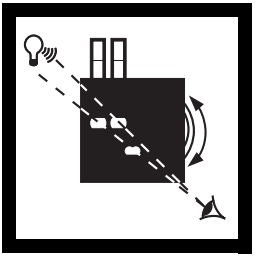
Note: *Ensure the Wide Range pH Color Disc is in place.*



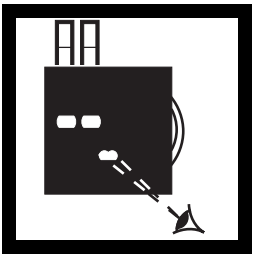
4. Insert the tube of untreated sample into the left-hand opening of the Comparator.



5. Hold the Comparator up to light.



6. View through the two openings in the front. Rotate the color disc until a color match is obtained.



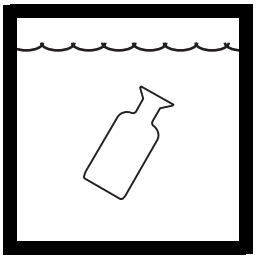
7. Read the pH through the scale window.

REAGENTS AND APPARATUS

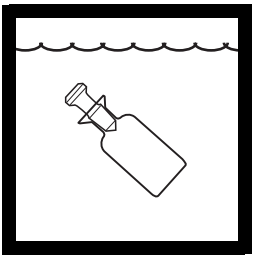
Description	Cat. No.
Color Comparator Box	1732-00
Color Disc, wide range pH	1919-00
Color Viewing Tubes, plastic (4/pkg)	46600-04
Sodium Thiosulfate Standard Solution, 0.0109 N 100 mL	24089-32
Wide Range 4 pH Indicator Solution, 100 mL	23293-32

SUPERSATURATION

The following procedure may be used for a simple but effective test for supersaturation. Supersaturation is a condition in which the solution contains more gas than is soluble at a given temperature.



1. Fill the 60-mL Dissolved Oxygen Bottle to overflowing after letting the bottle soak to attain temperature equilibrium.



2. Stopper and invert the bottle while keeping it in the water so that the temperature does not change.

3. Observe periodically for several hours.

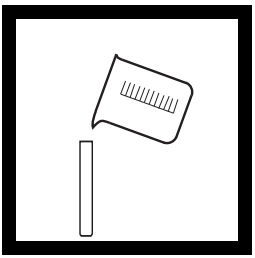
Formation of gas bubbles indicates the water is supersaturated with a gas.

APPARATUS

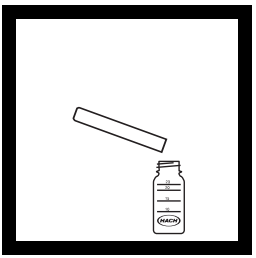
Description	Cat. No.
Bottle, dissolved oxygen, glass-stoppered	1909-02

TOTAL HARDNESS

Calcium and magnesium are the most abundant alkaline earth metals found in natural waters. Hardness is defined as the characteristic of water that represents the total concentration of calcium and magnesium expressed as their calcium carbonate equivalent. Other divalent ions also contribute to hardness, but their effects are usually negligible in natural waters. Treatment plans may be necessary when levels of total hardness are too low or differ significantly from total alkalinity.



1. Fill the plastic measuring tube to the top with sample.

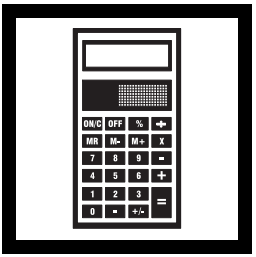


2. Pour the contents of the tube into the mixing bottle.

3. Add three drops of Hardness 1 Buffer Solution and swirl to mix.

4. Add one or two drops of Hardness 2 Test Solution and swirl to mix.

5. Add Hardness 3 Titrant Reagent one drop at a time. Dispense the solution no faster than one drop per second. Do not allow the dropper to contact the side of the mixing bottle. Swirl the mixing bottle after each drop. Count each drop. Continue until the solution color changes from pink to blue.



6. Each drop = 1 grain per gallon (gpg) hardness as calcium carbonate.

gpg x 17.1 = mg/L hardness.

REAGENTS AND APPARATUS

Description	Cat. No.
Bottle, mixing (6/pkg)	2327-06
Hardness 1 Buffer Solution, 100 mL	424-32
Hardness 2 Test Solution, 100 mL	425-32
Hardness 3 Titrant Reagent, 100 mL	426-32
Measuring Tube, plastic	438-00

REAGENTS AND APPARATUS

Description	Cat. No.
Bottle, DO, glass-stoppered	1909-02
Bottle, mixing, square (6/pkg)	2327-06
Bromcresol Green-Methyl Red Indicator Pillows (100/pkg)	943-99
Chloride 2 Indicator Powder Pillows (100/pkg)	1043-99
Clippers	968-00
Color Comparator Box	1732-00
Color Disc, ammonia nitrogen	1854-00
Color Disc, nitrite nitrogen	14084-00
Color Disc, wide range pH	1919-00
Color Viewing Tubes, plastic (4/pkg)	46600-04
Dissolved Oxygen 1 Powder Pillows (100/pkg)	981-99
Dissolved Oxygen 2 Powder Pillows (100/pkg)	982-99
Dissolved Oxygen 3 Powder Pillows (25/pkg)	987-68
Dropper, glass (5/pkg)	14197-05
Fish Farmer's Water Quality Test Kit Manual, Model FF-1A	2430-87
Hardness 1 Buffer Solution, 100 mL	424-32
Hardness 2 Test Solution, 100 mL	425-32
Hardness 3 Titrant Reagent, 100 mL	426-32
Measuring Tube, plastic	438-00
Nessler Reagent, 100 mL	21194-32
NitriVer® 3 Powder Pillows for 5-mL Sample (100/pkg)	14078-99
Phenolphthalein Indicator Solution, 15 mL	1897-36
Rochelle Salt Solution, 29 mL	1725-33
Silver Nitrate Solution, 100 mL	397-32
Sodium Hydroxide Solution 0.01 N, 100 mL	671-32
Sodium Thiosulfate Standard Solution 0.0109 N, 100 mL	24089-32
Sulfuric Acid Standard Solution 0.030 N, 100 mL	26205-32
Thermometer, pocket, –30 to 120 °F	1895-00
Wide Range 4 pH Indicator Solution, 100 mL	23293-32

Optional Reagents and Apparatus

Dissolved Oxygen Sampler	1962-00
Sodium Thiosulfate Standard Solution 0.1 N, 100 mL	323-32
Starch Indicator Solution, 100 mL	349-32
Water, deionized, 100 mL	272-42

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