Thermo Scientific Orion AQUAfast Powder and Tablet Reagent Chemistry User Guide

for use with AquaMate 7000 Vis and AquaMate 8000 UV-Vis Spectrophotometers

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Chapter 1 Overview

Thermo Scientific Orion AquaMate 8000 UV-Vis and AquaMate 7000 Vis spectrophotometers include a USB memory stick that contains over 260 preprogrammed methods for use with Orion AQUAfast, Merck and CHEMetrics reagent chemistries. Preprogrammed methods provide values for the test parameters required to run specific reagent chemistries on the instrument, including wavelength, cell path length, concentration factors/curves and measurement unit. All preprogrammed methods are stored on the USB memory stick, so operators can select and load only the methods needed for their applications. Up to 90 methods can be stored on the AquaMate spectrophotometer and stored methods can be added or removed as needed. AquaMate spectrophotometers allow a one point adjustment on any preprogrammed method using a known standard to correct for variations in batch to batch reagent chemistries. Operators can also modify preprogrammed methods or create their own custom methods, so additional parameters and test methods can be added at any time.

The following instructions are for using Orion AQUAfast reagent chemistries with the AquaMate spectrophotometer. Preprogrammed methods use a specific vial size (path length) in the formula, and the vial size specified in these instructions must be used for accurate analysis. The majority of AQUAfast reagent methods use a 24mm round vial, Cat. No. AC2V24. Other vial sizes are noted in the individual reagent chemistry instructions.

Use the information in the following table to identify method names on the USB memory stick and the test parameters associated with each method. This information is also included in the Thermo Scientific AquaMate Master Methods List available on the user guide CD or on our website at www.thermoscientific.com/water.

Table 1: Orion AQUAfast Power and Tablet Reagent Chemistries

Parameter	Reagent Part #	Method Name	Description	Reagent Type
Alkalinity	AC2002	AC2002	Alkalinity-M, Acid/Indicator Method	Tablet
Alkalinity	AC3002P	AC3002P	Alkalinity-P, Acid/Indicator Method	Tablet
Aluminum	AC2027	AC2027	Aluminum, Eriochrome Cyanine R Method	Tablet
Aluminum	AC4P27	AC4P27	Aluminum, Eriochrome Cyanine R Method	Powder, Liquid
Ammonia	AC2012	AC2012	Ammonia as Nitrogen (N), Indophenole/Phenate Method	Tablet
Ammonia	AC4P12	AC4P12	Ammonia as Nitrogen (N), Salicylate Method	Powder
Ammonia	ACR011	ACR011	Ammonia as Nitrogen (N), High Range, Salicylate Method	Reaction Tube
Ammonia	ACR012	ACR012	Ammonia as Nitrogen (N), Low Range, Salicylate Method	Reaction Tube
Bromine	AC2035	AC203524	Bromine, DPD Method	Tablet
Chloride	AC2017	AC2017	Chloride, Silver Nitrate/Turbidity Method	Tablet
Chlorine	AC2070	AC207024	Chlorine, Free & Total, DPD Method	Tablet
Chlorine	AC2071	AC207124	Chlorine, Free, DPD Method	Tablet
Chlorine	AC2072	AC207224	Chlorine, Total, DPD Method	Tablet
Chlorine	AC3072	AC3072	Chlorine, Total, High Range, KI / Acid Method	Tablet
Chlorine	AC4P71	AC4P71	Chlorine, Free, DPD Method	Powder
Chlorine	AC4P72	AC4P72	Chlorine, Total, DPD Method	Powder
Chlorine Dioxide	AC2099	AC209924	Chlorine Dioxide, DPD Method	Tablet
COD	CODL00	CODL00	COD, Low Range, Dichromate Reactor Digestion Method	Digestion Tube
COD	CODH00	CODH00	COD, Mid Range, Dichromate Reactor Digestion Method	Digestion Tube
COD	CODHP0	CODHP0	COD, High Range, Dichromate Reactor Digestion Method	Digestion Tube
Copper	AC2029	AC202924	Copper, Free & Total, Biquinoline Method	Tablet
Copper	AC2065	AC2065	Copper, Zincon Method	Tablet
Copper	AC4P29	AC4P29	Copper, Free, Bicinchoninate Method	Powder
Cyanuric Acid	AC2098	AC2098	Cyanuric Acid, Melamine Method	Tablet
Fluoride	AC2009	AC2009	Fluoride, SPADNS Kit Method	Liquid
Hardness	AC3032T	AC3032TL	Hardness, Total, Low Range, Metallphthalein Method	Tablet
Hardness	AC3032T	AC3032TH	Hardness, Total, High Range, Metallphthalein Method	Tablet

Hydrazine	AC2030	AC2030	Hydrazine, Dimethylamino-benzaldehyde Method	Powder
Iron	AC2078	AC207824	Iron, Low Range, III, Soluble, TPTZ Method	Tablet
Iron	AC4P78	AC4P78	Iron, II & III, Soluble, 1,10-Phenanthroline Method	Powder
Iron	AC4P79	AC4P79	Iron, Total, TPTZ Method	Powder
Manganese	AC2055	AC2055	Manganese, Formaldoxime Method	Tablet
Manganese	AC4P54	AC4P54	Manganese, Low Range, PAN Method	Powder, Liquid
Manganese	AC4P55	AC4P55	Manganese, High Range, Periodate Oxidation Method	Powder
Molybdate / Molybdenum	AC4P42	AC4P42	Molybdate / Molybdenum, Mercaptoacetic Acid Method	Powder
Nitrate	ACR007	ACR007	Nitrate as Nitrogen (N), Chromotropic Acid Method	Reaction Tube
Nitrite	AC2046	AC2046	Nitrite as Nitrogen (N), Diazotization (Azo) Method	Tablet
Nitrite	AC4P46	AC4P46	Nitrite as Nitrogen (N), Low Range, Diazotization (Azo) Method	Powder
Nitrogen, Total	ACD004	ACD004	Nitrogen, Total, Low Range, Persulfate Digestion Method	Digestion Tube
Nitrogen, Total	ACD007	ACD007	Nitrogen, Total, High Range, Persulfate Digestion Method	Digestion Tube
Ozone	AC2048	AC204824	Ozone, Indigo Blue Method	Tablet
pH	AC2001	AC2001	pH, Phenol Red Method	Tablet
pH	AC3001	AC3001	pH, Phenol Red Method	Liquid
Phosphate	AC2095	AC2095	Phosphate, Low Range, Phosphomolybdic Acid/Ascorbic Acid Method	Tablet
Phosphate	AC2096	AC2096	Phosphate, High Range, Vanadomolybdate Method	Tablet
Phosphate	AC4P95	AC4P95	Phosphate, Ortho, Ascorbic Acid Method	Powder
Phosphate	ACD095	ACD095	Phosphate as Phosphorous (P), Total, Persulfate Digestion/Ascorbic Acid Method	Digestion Tube
Phosphate	ACD095AH	ACD095AH	Phosphate as Phosphorous (P), Acid Hydrolyzable, Acid Digestion/Ascorbic Acid Method	Digestion Tube
Phosphate	ACR095	ACR095	Phosphate, Ortho, Ascorbic Acid Method	Reaction Tube
Silica	AC2060	AC2060	Silica, Silicomolybdate Method	Tablet
Silica	AC2061	AC2061	Silica, Silicomolybdate Method with Phosphate Removal	Tablet
Silica	AC4P60	AC4P60	Silica, High Range, Silicomolybdate Method	Powder
Sulfate	AC4P82	AC4P82	Sulfate, Barium Sulfate/Turbidity Method	Powder
Sulfide	AC2016	AC2016	Sulfide, Methylene Blue Method	Tablet
Zinc	AC2065	AC2065	Zinc, Zincon Method	Tablet

Chapter 2 Reagent Chemistry Instructions

The measurement ranges specified in the following test procedures are provided by the chemistry manufacturer and are based on standard solutions measured under ideal conditions. These ranges may vary due to the type of sample being measured, since various interferences can have a major influence on the accuracy of the method. Due to the fact that each sample is different, the only way to check the tolerance (precision) is the Standard Additions Method. According to this method, first the original sample is tested. Then further samples (2 to 4) are taken and small amounts of a standard solution are added, and further results are obtained. The amounts added range from approximately half, up to double the amount present in the sample itself. These supplementary results make it possible to estimate the actual concentration of the original sample by comparison.

Test methods and ranges are subject to change without notice. For a list of the most up-to-date test methods, visit www.thermoscientific.com/water.

Recommendations for Avoiding Measurement Errors

- Thoroughly clean vials, caps and stir rods after each analysis in order to prevent carry-over errors. Even minute reagent residues lead to incorrect measurements.
- Ensure that the outer walls of the vials are dry and clean before performing the analysis. Fingerprints or water droplets on the light entry surfaces of the vials lead to incorrect measurements.
- Blank and measurement procedures should be performed using the same vial whenever possible, since different vials can possess slightly different tolerances.
- Always take all readings with capped vials.
- Bubbles on the inside walls of the vial can lead to incorrect measurements. To prevent this, cap the vial and remove the bubbles by swirling the vial before performing the test.
- Always add the reagent to the sample straight from the foil. The reagent should never touch fingers or hands.
- Major temperature differentials between the instrument and environment can lead to incorrect measurements - i.e. due to the formation of condensate in the area of the lens or on the vial. Specified tolerances at T = 20 °C.
- For the best results, use a pipette to measure and add samples to vials or beakers.

Loading and Running a Water Analysis Method on the Spectrophotometer

The USB memory stick included with the AquaMate spectrophotometers contains over 260 preprogrammed methods for use with Orion AQUAfast, Merck and CHEMetrics reagent chemistries. Methods can be accessed directly from the USB memory stick when connected to the AquaMate spectrophotometer or up to 90 methods can be stored on the instrument for quick and easy access.

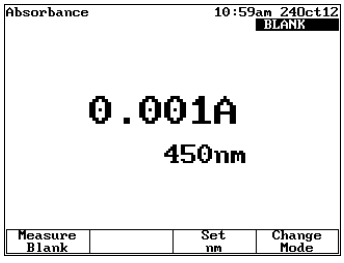
The USB memory stick contains four folders: Thermo, Orion, Merck and CHEMetrics. The Thermo folder is empty and all methods to be loaded on the AquaMate spectrophotometer need to be copied to the Thermo folder. The Orion, Merck and CHEMetrics folders contain preprogrammed methods specific to that manufacturer.

- Information for methods in the Orion folder can be found in this user guide and the Thermo Scientific Orion AquaMate Master Methods List document.
- Information for methods in the Merck and CHEMetrics folders can be found in the Thermo Scientific Orion AquaMate Master Methods List document and on the manufacturer's website.

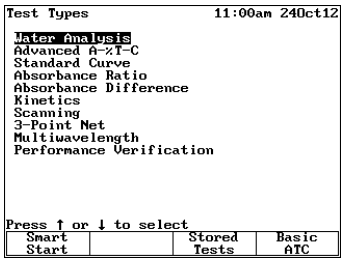
***Recommendation**: A copy of the methods on the USB memory stick should be saved to a computer or other data source in case the USB memory stick is accidentally deleted or otherwise corrupted.*

Loading a Test Method from the USB Stick to the AquaMate Instrument

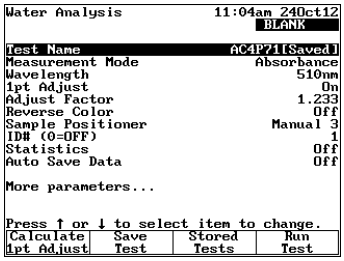
1. Access the USB memory stick using a computer.
2. Copy the desired test method(s) from the Orion, Merck and/or CHEMetrics folders to the Thermo folder.
3. Remove the USB memory stick from the computer and insert it into the USB port on the front of the AquaMate spectrophotometer.
4. When the AquaMate spectrophotometer is first powered on, it will display the initial measurement screen. Press the **Test** key to access the test types.



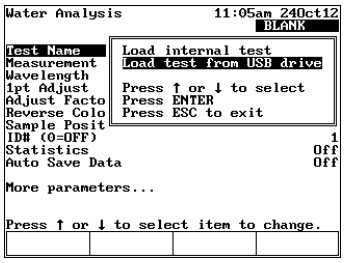
5. Press the ▲ / ▼ keys to highlight Water Analysis and press the **Enter** key.



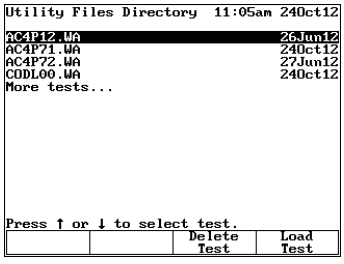
6. Press the **Stored Tests** function key.



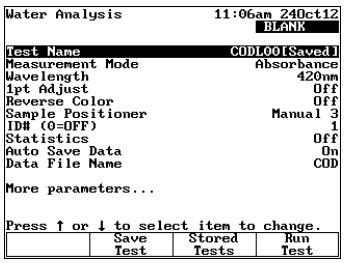
7. Press the ▲ / ▼ keys to highlight Load test from USB drive and press the **Enter** key.



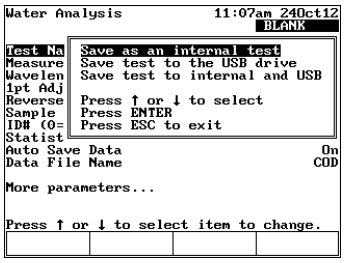
8. Press the ▲ / ▼ keys to highlight the test method to be loaded and press the **Load Test** function key.



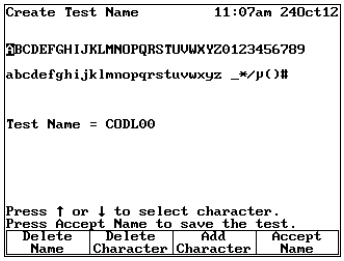
9. Press the **Save Test** function key.



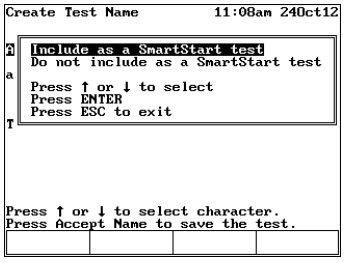
10. Press the ▲ / ▼ keys to highlight Save as an internal test and press the **Enter** key.



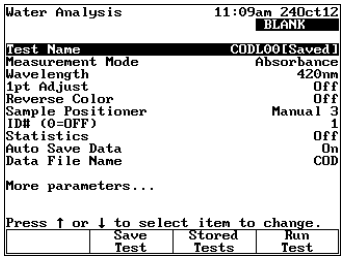
11. Press the **Accept Name** function key.



12. Press the ▲ / ▼ keys to highlight Include as a SmartStart test or Do not include as a SmartStart test and press the **Enter** key.



13. Press the **Run Test** function key to begin using the test method. Refer to the specific reagent chemistry section for detailed instructions.



Running a Test Method from the USB Stick

1. Make sure the test method to be run is in the Thermo folder on the USB stick and the USB stick is connected to the USB port on the front of the AquaMate spectrophotometer.
2. From the initial measurement screen, press the **Test** key to access the test types.
3. Press the ▲ / ▼ keys to highlight Water Analysis and press the **Enter** key.
4. Press the **Stored Tests** function key.
5. Press the ▲ / ▼ keys to highlight Load test from USB drive and press the **Enter** key.
6. Press the ▲ / ▼ keys to highlight the appropriate test method and press the **Load Test** function key.
7. Press the **Run Test** function key.

Running a Test Method from the AquaMate Instrument Library

1. From the initial measurement screen, press the **Test** key to access the test types.
2. Press the ▲ / ▼ keys to highlight Water Analysis and press the **Enter** key.
3. Press the **Stored Tests** function key.
4. Press the ▲ / ▼ keys to highlight Load internal test and press the **Enter** key.
5. Press the ▲ / ▼ keys to highlight the appropriate test method and press the **Load Test** function key.
6. Press the **Run Test** function key.

Running a Test Method from the AquaMate SmartStart Menu

1. From the initial measurement screen, press the **Test** key to access the test types.
2. Press the **SmartStart** function key.
3. Press the ▲ / ▼ keys to highlight the appropriate test method and press the **Load Test** function key.
4. Press the **Run Test** function key.

Using the One Point Adjustment Calibration Feature

Use the one point adjustment feature prior to running a preprogrammed test method to ensure accurate measurements. This procedure is recommended each time a new batch of reagents are used to account for variations in batch-to-batch reagent composition and other factors that affect the accuracy of a method with a fixed calibration curve.

When the one point adjustment feature is off, no adjustment is applied when running the test and test results are calculated exactly according to the preprogrammed equation.

1. Load the test method in the Water Analysis test menu.
2. If the 1pt Adjust parameter is set to Off, press the ▲ / ▼ keys to highlight 1pt Adjust and press the **Enter** key to set the parameter to On.
3. Prepare a blank, reagent blank (reverse color methods only) and calibration standard with a known concentration within the method range and near the expected sample concentration. Refer to the specific reagent chemistry section for detailed instructions.
4. Press the **Calculate 1pt Adjust** function key.
5. Use the numeric keypad to enter the concentration of the standard and press the **Enter** key.
6. Wipe the exterior of the blank vial and place the blank vial into the holder in the sample chamber. Close the sample chamber door.
7. Press the **Measure Blank** function key.
8. Open the sample chamber door and remove the vial from the sample chamber.
9. For reverse color methods only:
    a. Wipe the exterior of the reagent blank vial and place the reagent blank vial into the holder in the sample chamber. Close the sample chamber door.
    b. Press the **Measure Rgnt Blank** function key.
    c. Open the sample chamber door and remove the vial from the sample chamber.
10. Wipe the exterior of the standard vial and place the standard vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Standard** function key.
12. Open the sample chamber door and remove the vial from the sample chamber.

13. The display will show the standard concentration that was entered in step 5, the measured concentration without a correction and the calculated adjustment correction factor.
14. Press the **Accept** function key if the calculated adjustment correction factor is acceptable. Typically a correction factor of 0.7 to 1.3 (within 30%) is acceptable.
15. To save the adjustment correction factor to the test method, press the **Save Test** function key and overwrite the existing test method or save as a new test method.
16. Press the **Run Test** function key. When running a test with an adjustment correction factor in use, the display will show (1pt Adj) next to the test name.

Using the Reverse Color Feature

Reverse color methods use a reagent that, when prepared with samples, deceases in color as the concentration of the species being measured in the samples increases. Reverse color methods require the use of both a blank and a reagent blank. The blank is a clear solution (deionized water) with zero absorbance. The reagent blank is a mixture of the reagent and deionized water (or initial reagent and sample, as in the zinc by zincon method) and provides a zero concentration point with the darkest color (highest absorbance). The color of samples prepared with the reagent will decrease as the concentration increases. The following provides an overview how to perform a reverse color method.

1. Load and run the method. The Reverse Color parameter should be set to On for the method.
2. Fill a vial with deionized water. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add the reagent(s) to the vial. Close the vial tightly with the cap and mix the contents. Wipe the exterior of the vial.
7. Place the vial into the holder in the sample chamber. Close the sample chamber door.
8. Press the **Measure Rgnt Blank** function key to measure the reagent blank.
9. Open the sample chamber door and remove the vial from the sample chamber.
10. Empty and rinse the vial and then fill the vial with sample. Add the reagent(s) to the vial. Close the vial tightly with the cap and mix the contents. Wipe the exterior of the vial.
11. Place the vial into the holder in the sample chamber. Close the sample chamber door.
12. Press the **Measure Sample** function key to display the results.

AC2002 Alkalinity-M (Alkalinity to pH 4.3), Acid/Indicator Method, Tablet Test Procedure

5 – 200 mg/L $CaCO_3$

1. Load and run the AC2002 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Alka-M Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber. Close the sample chamber door.
9. Press the **Measure Sample** function key to display the result in mg/L total alkalinity.

Notes:

- The terms total alkalinity, alkalinity-m, m-value and alkalinity to pH 4.3 are identical.
- For accurate results exactly 10 ml of water sample must be taken for the test.

AC3002P Alkalinity-P (Alkalinity to pH 8.2), Acid/Indicator Method, Tablet Test Procedure

5 – 500 mg/L $CaCO_3$

1. Load and run the AC3002P method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Alka-P Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber. Close the sample chamber door.
9. Press the **Measure Sample** function key to display the result in mg/L total alkalinity.

Notes

- The terms alkalinity-p, p-value and alkalinity to pH 8.2 are identical.
- For accurate test results exactly 10 ml of water sample must be taken for the test.
- This method was developed from a volumetric procedure for the determination of alkalinity-p. Due to undefined conditions, the deviations from the standardized method may be greater.

AC2027 Aluminum, Eriochrome Cyanine R Method, Tablet Test Procedure

0.01 – 0.3 mg/L Al

1. Load and run the AC2027 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Aluminum No. 1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod and mix well to dissolve the tablet completely.
7. Add one Aluminum No. 2 Tablet straight from the foil to the same vial. Crush the tablet with a clean stir rod and mix well to dissolve the tablet completely.
8. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
9. Wait for a reaction period of 5 minutes.
10. Place the vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L aluminum.

Notes:

- Before use, clean the vials and the measuring beaker with hydrochloric acid (approximately 20%). Rinse them thoroughly with deionized water.
- To get accurate results the sample temperature must be between 20°C and 25°C.
- A low test result may be given in the presence of fluorides and polyphosphates. The effect of this is generally insignificant unless the water has fluoride added artificially.

AC4P27 Aluminum, Eriochrome Cyanine R Method, Powder & Liquid Test Procedure

0.01 – 0.25 mg/L Al

1. Load and run the AC4P27 method.
2. Use two clean AQUAfast 24mm round vials, Cat. No. AC2V24, and mark one as the blank.
3. Pour 20 ml of sample into a 100 ml beaker.
4. Add the contents of one Aluminum ECR F20 Powder Pack straight from the foil to the sample in the beaker. Dissolve the powder using a clean stirring rod.
5. Wait for a reaction period of 30 seconds.
6. Add the contents of one Hexamine F20 Powder Pack straight from the foil to the same sample in the beaker. Dissolve the powder using a clean stirring rod.
7. Add 1 drop of Aluminum ECR Masking Reagent in the vial marked as blank. Add 10 ml of the prepared sample to the same vial (this is the blank vial).
8. Add the remaining 10 ml of the prepared sample to the second vial (this is the sample vial).
9. Close the vials tightly with the caps and swirl or invert several times to mix the contents. Wipe the exteriors of the vials.
10. Wait for a reaction period of 5 minutes.
11. Place the blank vial into the holder in the sample chamber. Close the sample chamber door.
12. Press the **Measure Blank** function key to measure the blank.
13. Open the sample chamber door. Remove the blank vial from the holder.
14. Place the sample vial into the holder in the sample chamber. Close the sample chamber door.
15. Press the **Measure Sample** function key to display the result in mg/L aluminum.

Notes:

- Before use, clean the vials and the measuring beaker with hydrochloric acid (approximately 20%). Rinse them thoroughly with deionized water.
- To get accurate results the sample temperature must be between 20°C and 25°C.
- A low test result may be given in the presence of fluorides and polyphosphates. The effect of this is generally insignificant unless the water has fluoride added artificially.

AC2012 Ammonia as Nitrogen (N), Indophenole/Phenate Method, Tablet Test Procedure

0.02 – 1 mg/L N

1. Load and run the AC2012 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Ammonia No. 1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Add one Ammonia No. 2 Tablet straight from the foil to the same sample in the vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
9. Wait for a reaction period of 10 minutes.
10. Place the vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L ammonia as N.

Notes:

- The tablets must be added in the correct sequence.
- The Ammonia No. 1 Tablet will only dissolve completely after the Ammonia No. 2 Tablet has been added.
- The temperature of the sample is important for full color development. At a temperature below 20°C the reaction period is 15 minutes.
- Sea water samples: Ammonia conditioning reagent is required when testing sea water or brackish water samples to prevent precipitation of salts. Fill the test tube with the sample to the 10 ml mark and add one level spoonful of Conditioning Powder. Mix to dissolve and then continue as described in the test instructions.

AC4P12 Ammonia as Nitrogen (N), Salicylate Method, Powder Test Procedure

0.01 – 0.8 mg/L N

1. Load and run the AC4P12 method.
2. Use two clean AQUAfast 24mm round vials, Cat. No. AC2V24.
3. Pour 10 ml of deionized water into the first vial (this is the blank vial).
4. Pour 10 ml of sample into the second vial (this is the sample vial).
5. Add the contents of one Ammonia Salicylate F10 Powder Pack straight from the foil to each vial. Close the vials tightly with the caps and swirl or invert several times to mix the contents.
6. Wait for a reaction period of 3 minutes.
7. Add the contents of one Ammonia Cyanurate F10 Powder Pack straight from the foil to each vial. Close the vials tightly with the caps and swirl or invert several times to mix the contents. Wipe the exteriors of the vials.
8. Wait for a reaction period of 15 minutes.
9. Place the blank vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Blank** function key to measure the blank.
11. Open the sample chamber door. Remove the blank vial from the holder.
12. Place the sample vial into the holder in the sample chamber. Close the sample chamber door.
13. Press the **Measure Sample** function key to display the result in mg/L ammonia as N.

Notes:

- Extremely basic or acidic water samples should be adjusted with 0.5 mol/l (1 N) sulfuric acid solution or 1 mol/l (1 N) sodium hydroxide solution to pH 7.
- Interferences:

Interference	Interference Levels and Treatments
Calcium	Greater than 1000 mg/L $CaCO_3$
Iron	Interferes at all levels. To correct, determine the concentration of iron in the sample by performing a total iron test. Add the same iron concentration to the deionized water (step 3). Iron will be blanked out successfully.
Magnesium	Greater than 6000 mg/L $CaCO_3$
Nitrate	Greater than 100 mg/L NO_3-N
Nitrite	Greater than 12 mg/L NO_2-N
Phosphate	Greater than 100 mg/L PO_4-P
Sulfate	Greater than 300 mg/L SO_4
Sulfide	Intensifies the color
Glycine, Hydrazine, Color, Turbidity	Less common interferences such as hydrazine and glycine will cause intensified colors in the prepared sample. Turbidity and color will give erroneous high values. Samples with severe interferences require distillation.

ACR011 Ammonia as Nitrogen (N), HR, Salicylate Method, Reaction Tube Test Procedure

1 – 50 mg/L N

1. Load and run the ACR011 method.
2. Open one white capped 16mm reaction vial and add 0.1 ml of deionized water (this is the blank).
3. Open a second white capped 16mm reaction vial and add 0.1 ml of sample (this is the sample).
4. Add the contents of one Ammonia Salicylate F5 Powder Pack straight from the foil to each vial.
5. Add the contents of one Ammonia Cyanurate F5 Powder Pack straight from the foil to each vial.
6. Close the vials tightly with the caps and swirl or invert several times to mix the contents. Wipe the exteriors of the vials.
7. Wait for a reaction period of 20 minutes.
8. Place the blank vial into the holder in the sample chamber. Close the sample chamber door.
9. Press the **Measure Blank** function key to measure the blank.
10. Open the sample chamber door. Remove the blank vial from the holder.
11. Place the sample vial into the holder in the sample chamber. Close the sample chamber door.
12. Press the **Measure Sample** function key to display the result in mg/L ammonia as N.

Notes:

- Strong alkaline or acidic water samples must be adjusted to approximately pH 7 before analysis (use 1 mol/l hydrochloric acid or 1 mol/l sodium hydroxide).
- If chlorine is known to be present, add one drop of 0.1 mol/l sodium thiosulfate for each 0.3 mg/L Cl_2 in a one liter water sample.
- Iron interferes with the test. The interferences will be eliminated as follows: Determine the amount of total iron present in the water sample. To produce the blank add an iron standard solution with the same iron concentration to the vial (point 1) instead of deionized water

ACR012 Ammonia as Nitrogen (N), LR, Salicylate Method, Reaction Tube Test Procedure

0.02 – 2.5 mg/L N

1. Load and run the ACR012 method.
2. Open one white capped 16mm reaction vial and add 2 ml of deionized water (this is the blank).
3. Open a second white capped 16mm reaction vial and add 2 ml of sample (this is the sample).
4. Add the contents of one Ammonia Salicylate F5 Powder Pack straight from the foil to each vial.
5. Close the vials tightly with the caps and swirl or invert several times to mix the contents. Wipe the exteriors of the vials.
6. Wait for a reaction period of 20 minutes.
7. Place the blank vial into the holder in the sample chamber. Close the sample chamber door.
8. Press the **Measure Blank** function key to measure the blank.
9. Open the sample chamber door. Remove the blank vial from the holder.
10. Place the sample vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L ammonia as N.

Notes:

- Strong alkaline or acidic water samples must be adjusted to approximately pH 7 before analysis (use 1 mol/l hydrochloric acid or 1 mol/l sodium hydroxide).
- If chlorine is known to be present, add one drop of 0.1 mol/l sodium thiosulfate for each 0.3 mg/L Cl_2 in a one liter water sample.
- Iron interferes with the test. The interferences will be eliminated as follows: Determine the amount of total iron present in the water sample. To produce the blank add an iron standard solution with the same iron concentration to the vial (point 1) instead of deionized water

AC2035 Bromine, DPD Method, Tablet Test Procedure

0.05 – 13 mg/L Br_2

1. Load and run the AC203524 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
8. Add sample to the 10 ml mark on the vial.
9. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
10. Place the vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L bromine.

Notes:

- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of bromine may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
  Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- Preparing the sample: When preparing the sample, the escape of bromine gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagent tablet therefore contains a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Exceeding the measuring range: Concentrations above 22 mg/L bromine can lead to results showing 0 mg/L. In this event, the water sample must be diluted with water free of bromine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Oxidizing agents such as chlorine or ozone interfere as they react in the same way as bromine.

AC2017 Chloride, Silver Nitrate/Turbidity Method, Tablet Test Procedure

0.5 – 25 mg/L Cl

1. Load and run the AC2017 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Chloride T1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Add one Chloride T2 Tablet straight from the foil to the same vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl gently until the tablet is dissolved. Wipe the exterior of the vial.
9. Wait for a reaction period of 2 minutes.
10. Place the vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L chloride.

Notes:

- Ensure that all particles of the tablet are dissolved – chloride causes an extremely fine distributed turbidity with a milky appearance. Heavy shaking leads to bigger sized particles which can cause false readings.
- High concentrations of electrolytes and organic compounds have different effects on the precipitation reaction.
- Ions which also form deposits with silver nitrate in acidic media, such as bromides, iodides and thiocyanates, interfere with the analysis.
- Highly alkaline water should, if necessary, be neutralized using nitric acid before analysis.

AC2070 Chlorine, Free & Total, DPD Method, Tablet Test Procedure

0.01 – 6 mg/L Cl_2

1. Load and run the AC207024 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
8. Add sample to the 10 ml mark on the vial.
9. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
10. Place the vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L free chlorine.
12. Open the sample chamber door and remove the vial from the sample chamber.
13. Add one DPD No. 3 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
14. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
15. Wait for a reaction period of 2 minutes.
16. Place the vial into the holder in the sample chamber. Close the sample chamber door.
17. Press the **Measure Sample** function key to display the result in mg/L total chlorine.

Notes:

- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of chlorine may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
  Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- For individual testing of free and total chlorine, the use of different sets of glassware is recommended (EN ISO 7393-2, 5.3).
- Preparing the sample: When preparing the sample, the escape of chlorine gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.

- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagents therefore contain a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Exceeding the measuring range: Concentrations above 10 mg/L chlorine using tablets can lead to results showing 0 mg/L. In this event, the water sample must be diluted with water free of chlorine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Turbidity (can lead to errors): The use of the DPD No. 1 Tablet in samples with high calcium ion contents and/or high conductivity can lead to turbidity of the sample and therefore incorrect measurements. In this event, the reagent DPD No. 1 High Calcium Tablet should be used as an alternative. Even if turbidity does occur after the DPD No. 3 Tablet has been added, it can be prevented by using the DPD No. 1 High Calcium Tablet. It is not possible to give exact values, because the development of turbidity depends on the nature of the sample.
- Oxidizing agents such as bromine or ozone interfere as they react in the same way as chlorine.

AC2071 Chlorine, Free, DPD Method, Tablet Test Procedure

0.01 – 6 mg/L Cl_2

1. Load and run the AC207124 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
8. Add sample to the 10 ml mark on the vial.
9. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
10. Place the vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L free chlorine.

Notes:

- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of chlorine may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
  Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- For individual testing of free and total chlorine, the use of different sets of glassware is recommended (EN ISO 7393-2, 5.3).
- Preparing the sample: When preparing the sample, the escape of chlorine gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagents therefore contain a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Exceeding the measuring range: Concentrations above 10 mg/L chlorine using tablets can lead to results showing 0 mg/L. In this event, the water sample must be diluted with water free of chlorine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Turbidity (can lead to errors): The use of the DPD No. 1 Tablet in samples with high calcium ion contents and/or high conductivity can lead to turbidity of the sample and therefore incorrect

measurements. In this event, the reagent DPD No. 1 High Calcium Tablet should be used as an alternative. It is not possible to give exact values, because the development of turbidity depends on the nature of the sample.

- Oxidizing agents such as bromine or ozone interfere as they react in the same way as chlorine.

AC2072 Chlorine, Total, DPD Method, Tablet Test Procedure

0.01 – 6 mg/L Cl_2

1. Load and run the AC207224 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 1 Tablet and one DPD No. 3 Tablet straight from the foil to the vial. Crush the tablets with a clean stir rod.
8. Add sample to the 10 ml mark on the vial.
9. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
10. Wait for a reaction period of 2 minutes.
11. Place the vial into the holder in the sample chamber. Close the sample chamber door.
12. Press the **Measure Sample** function key to display the result in mg/L total chlorine.

Notes:

- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of chlorine may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
  Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- For individual testing of free and total chlorine, the use of different sets of glassware is recommended (EN ISO 7393-2, 5.3).
- Preparing the sample: When preparing the sample, the escape of chlorine gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagents therefore contain a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Exceeding the measuring range: Concentrations above 10 mg/L chlorine using tablets can lead to results showing 0 mg/L. In this event, the water sample must be diluted with water free of chlorine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.

- Turbidity (can lead to errors): The use of the DPD No. 1 Tablet in samples with high calcium ion contents and/or high conductivity can lead to turbidity of the sample and therefore incorrect measurements. In this event, the reagent DPD No. 1 High Calcium Tablet should be used as an alternative. Even if turbidity does occur after the DPD No. 3 Tablet has been added, it can be prevented by using the DPD No. 1 High Calcium Tablet. It is not possible to give exact values, because the development of turbidity depends on the nature of the sample.
- Oxidizing agents such as bromine or ozone interfere as they react in the same way as chlorine.

AC3072 Chlorine, Total, High Range, KI / Acid Method, Tablet Test Procedure

5 – 200 mg/L Cl_2

1. Load and run the AC3072 method.
2. Fill a clean AQUAfast 16 mm round vial, Cat. No. AC2V16, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Chlorine HR (KI) Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Add one Acidifying GP Tablet straight from the foil to the same vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Sample** function key to display the result in mg/L chlorine.

Notes:

- Oxidizing agents interfere as they react in the same way as chlorine.

AC4P71 Chlorine, Free, DPD Method, Powder Test Procedure

0.02 – 2 mg/L Cl_2

1. Load and run the AC4P71 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Chlorine Free-DPD / F10 Powder Pack straight from the foil to the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents (approximately 20 seconds). Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber. Close the sample chamber door.
9. Press the **Measure Sample** function key to display the result in mg/L free chlorine.

Notes:

- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of chlorine may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
  Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- For individual testing of free and total chlorine, the use of different sets of glassware is recommended (EN ISO 7393-2, 5.3).
- Preparing the sample: When preparing the sample, the escape of chlorine gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagents therefore contain a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Exceeding the measuring range: Concentrations above 2 mg/L chlorine using powder packs can lead to results showing 0 mg/L. In this event, the water sample must be diluted with water free of chlorine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Oxidizing agents such as bromine or ozone interfere as they react in the same way as chlorine.

AC4P72 Chlorine, Total, DPD Method, Powder Test Procedure

0.02 – 2 mg/L Cl_2

1. Load and run the AC4P72 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Chlorine Total-DPD / F10 Powder Pack straight from the foil to the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents (approximately 20 seconds). Wipe the exterior of the vial.
8. Wait for a reaction period of 3 minutes.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Sample** function key to display the result in mg/L total chlorine.

Notes:

- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of chlorine may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
  Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- For individual testing of free and total chlorine, the use of different sets of glassware is recommended (EN ISO 7393-2, 5.3).
- Preparing the sample: When preparing the sample, the escape of chlorine gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagents therefore contain a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Exceeding the measuring range: Concentrations above 2 mg/L chlorine using powder packs can lead to results showing 0 mg/L. In this event, the water sample must be diluted with water free of chlorine. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Oxidizing agents such as bromine or ozone interfere as they react in the same way as chlorine.

AC2099 Chlorine Dioxide, DPD Method, Tablet Test Procedure

0.05 – 11 mg/L ClO_2

Chlorine Dioxide Measurement in Absence of Chlorine

1. Load and run the AC209924 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
8. Add sample to the 10 ml mark on the vial.
9. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
10. Place the vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L chlorine dioxide.

Chlorine Dioxide Measurement in Presence of Chlorine

1. Load and run the AC209924 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Empty the vial, leaving a few drops of sample remaining in the vial.
7. Add one DPD No. 1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
8. Fill a second clean AQUAfast 24mm round vial with 10 ml of sample. Add one Glycine Tablet straight from the foil to the vial. Crush the tablets with a clean stir rod. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved.
9. Transfer the contents of the second vial into the first vial.
10. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
11. Place the vial into the holder in the sample chamber. Close the sample chamber door.

12. Press the **Measure Sample** function key to display the result in mg/L chlorine dioxide.

Notes:

- Vial cleaning: As many household cleaners (i.e. dishwasher detergent) contain reducing substances, the subsequent determination of chlorine dioxide may show lower results. To avoid any measurement errors, only use glassware free of chlorine demand.
  Preparation: Put all applicable glassware into sodium hypochlorite solution (0.1 g/l) for one hour and then rinse all glassware thoroughly with deionized water.
- Preparing the sample: When preparing the sample, the escape of chlorine dioxide gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- The DPD color development is carried out at a pH value of 6.2 to 6.5. The reagent tablet therefore contains a buffer for the pH adjustment. Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the tablet is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Exceeding the measuring range: Concentrations above 19 mg/L chlorine dioxide can lead to results showing 0 mg/L. In this event, the water sample must be diluted with water free of chlorine dioxide. 10 ml of the diluted sample should be mixed with the reagent and the measurement repeated.
- Oxidizing agents such as chlorine or ozone interfere as they react in the same way as chlorine dioxide.

CODL00 COD, Low Range, Dichromate Reactor Digestion Method, Digestion Tube Test Procedure

0 – 150 mg/L O_2

1. Open one white capped 16mm COD reaction vial and add 2 ml of deionized water (this is the reagent blank).
2. Open a second white capped 16mm reaction vial and add 2 ml of sample (this is the sample).
3. Close the vials tightly with the caps and gently invert the vials several times to mix the contents. **CAUTION:** The vials will become hot during mixing.
4. Heat the vials for 120 minutes in the preheated reactor at a temperature of 150 °C.
5. **CAUTION:** The vials will be hot.
   Remove the vials from the reactor and allow them to cool to 60 °C or less. Gently invert the vials several times to mix the contents while still warm. Then allow the vials to cool to ambient temperature before measuring. Wipe the exteriors of the vials.
6. Load and run the CODL00 method.
7. Fill a clean AQUAfast 16mm round vial, Cat. No. AC2V16, with deionized water (this is the blank). Close the vial tightly with the cap. Wipe the exterior of the vial.
8. Place the blank vial into the holder in the sample chamber. Close the sample chamber door.
9. Press the **Measure Blank** function key to measure the blank.
10. Open the sample chamber door. Remove the blank vial from the holder.
11. Place the reagent blank vial into the holder in the sample chamber. Close the sample chamber door.
12. Press the **Measure Rgnt Blank** function key to measure the reagent blank.
13. Open the sample chamber door. Remove the reagent blank vial from the holder.
14. Place the sample vial into the holder in the sample chamber. Close the sample chamber door.
15. Press the **Measure Sample** function key to display the result in mg/L COD.

Notes:

- Reverse color methods use a reagent that, when prepared with samples, deceases in color as the concentration of the species being measured in the samples increases. Reverse color methods require the use of both a blank and a reagent blank. The blank is a clear solution (deionized water) with zero absorbance. The reagent blank is a mixture of the reagent and deionized water and provides a zero concentration point with the darkest color (highest absorbance). The color of samples prepared with the reagent will decrease as the concentration increases for this method.
- Run samples and blanks with the same batch of vials. The blank is stable when stored in the dark and can be used for further measurements with vials of the same batch.

- Do not place the hot vials in the sample chamber. Cool the vials to room temperature for final measurements.
- Suspended solids in the vial lead to incorrect measurements. For this reason it is important to place the vials carefully in the sample chamber. The precipitate at the bottom of the sample should be not suspended.
- Clean the outside of the vials with a towel. Finger prints or other marks must be removed.
- Samples can be measured when the chloride content does not exceed 1000 mg/L.
- In exceptional cases, compounds contained in the water cannot be oxidized adequately, so results may be lower than reference methods.

CODH00 COD, Mid Range, Dichromate Reactor Digestion Method, Digestion Tube Test Procedure

0 – 1500 mg/L O_2

1. Open one white capped 16mm COD reaction vial and add 2 ml of deionized water (this is the blank).
2. Open a second white capped 16mm COD reaction vial and add 2 ml of sample (this is the sample).
3. Close the vial tightly with the cap and gently invert the vials several times to mix the contents. **CAUTION:** The vials will become hot during mixing.
4. Heat the vials for 120 minutes in the preheated reactor at a temperature of 150 °C.
5. **CAUTION:** The vials will be hot.
   Remove the vials from the reactor and allow them to cool to 60 °C or less. Gently invert the vials several times to mix the contents while still warm. Then allow the vials to cool to ambient temperature before measuring. Wipe the exteriors of the vials.
6. Load and run the CODH00 method.
7. Place the blank vial into the holder in the sample chamber. Close the sample chamber door.
8. Press the **Measure Blank** function key to measure the blank.
9. Open the sample chamber door. Remove the blank vial from the holder.
10. Place the sample vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L COD.

Notes:

- Run samples and blanks with the same batch of vials. The blank is stable when stored in the dark and can be used for further measurements with vials of the same batch.
- Do not place the hot vials in the sample chamber. Cool the vials to room temperature for final measurements.
- Suspended solids in the vial lead to incorrect measurements. For this reason it is important to place the vials carefully in the sample chamber. The precipitate at the bottom of the sample should be not suspended.
- Clean the outside of the vials with a towel. Finger prints or other marks must be removed.
- Samples can be measured when the chloride content does not exceed 1000 mg/L.
- In exceptional cases, compounds contained in the water cannot be oxidized adequately, so results may be lower than reference methods.
- For samples under 100 mg/L COD it is recommended to repeat the test using the reaction tube test for COD LR.

CODHP0 COD, High Range, Dichromate Reactor Digestion Method, Digestion Tube Test Procedure

0 – 15000 mg/L O_2

1. Open one white capped 16mm COD reaction vial and add 0.2 ml of deionized water (this is the blank).
2. Open a second white capped 16mm COD reaction vial and add 0.2 ml of sample (this is the sample).
3. Close the vial tightly with the cap and gently invert the vials several times to mix the contents. **CAUTION:** The vials will become hot during mixing.
4. Heat the vials for 120 minutes in the preheated reactor at a temperature of 150 °C.
5. **CAUTION:** The vials will be hot.
   Remove the vials from the reactor and allow them to cool to 60 °C or less. Gently invert the vials several times to mix the contents while still warm. Then allow the vials to cool to ambient temperature before measuring. Wipe the exteriors of the vials.
6. Load and run the CODHP0 method.
7. Place the blank vial into the holder in the sample chamber. Close the sample chamber door.
8. Press the **Measure Blank** function key to measure the blank.
9. Open the sample chamber door. Remove the blank vial from the holder.
10. Place the sample vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L COD.

Notes:

- Run samples and blanks with the same batch of vials. The blank is stable when stored in the dark and can be used for further measurements with vials of the same batch.
- Do not place the hot vials in the sample chamber. Cool the vials to room temperature for final measurements.
- Suspended solids in the vial lead to incorrect measurements. For this reason it is important to place the vials carefully in the sample chamber. The precipitate at the bottom of the sample should be not suspended.
- Clean the outside of the vials with a towel. Finger prints or other marks must be removed.
- Samples can be measured when the chloride content does not exceed 1000 mg/L.
- In exceptional cases, compounds contained in the water cannot be oxidized adequately, so results may be lower than reference methods.
- For samples under 1000 mg/L COD it is recommended to repeat the test using the reaction tube test for COD MR or for samples under 100 mg/L COD it is recommended to repeat the test using the reaction tube test for COD LR.

AC2029 Copper, Free & Total, Biquinoline Method, Tablet Test Procedure

0.05 – 5 mg/L Cu

1. Load and run the AC202924 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Copper No. 1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber. Close the sample chamber door.
9. Press the **Measure Sample** function key to display the result in mg/L free copper.
10. Open the sample chamber door and remove the vial from the sample chamber.
11. Add one Copper No.2 Tablet straight from the foil to the same vial. Crush the tablet with a clean stir rod.
12. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
13. Place the vial into the holder in the sample chamber. Close the sample chamber door.
14. Press the **Measure Sample** function key to display the result in mg/L total copper.

AC2065 Copper, Zincon Method, Tablet Test Procedure

0.02 – 1 mg/L Cu

1. Load and run the AC2065 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Copper / Zinc LR Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved.
8. Wait for a reaction period of 5 minutes.
9. Add one EDTA Tablet straight from the foil to the same vial. Crush the tablet with a clean stir rod.
10. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
11. Place the vial into the holder in the sample chamber. Close the sample chamber door.
12. Press the **Measure Sample** function key to display the result in mg/L copper.

Notes:

- The tablets must be added in the correct sequence.
- If the sample is zinc-free, it is not necessary to add the EDTA Tablet.

AC4P29 Copper, Free, Bicinchoninate Method, Powder Test Procedure

0.05 – 5 mg/L Cu

1. Load and run the AC4P29 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Cu 1 F10 Powder Pack straight from the foil to the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Wait for a reaction period of 2 minutes.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Sample** function key to display the result in mg/L free copper.

Notes:

- For determination of total copper digestion is required.
- Extremely acid water samples (pH 2 or less) must be adjusted between pH 4 and pH 6 before the reagent is added (with 8 mol/l potassium hydroxide solution KOH).
- Accuracy is not affected by undissolved powder.
- Interferences:

Cyanide (CN^-)	Cyanide prevents full color development. Add 0.2 ml formaldehyde to 10 ml water sample and wait for a reaction time of 4 minutes (cyanide is masked). After this perform test as described. Multiply the result by 1.02 to correct the sample dilution by formaldehyde.
Silver (Ag^+)	If turbidity remains and turns black, silver interference is likely. Add 10 drops of saturated potassium chloride solution to 75 ml of water sample. Filtrate through a fine filter. Use 10 ml of the filtered water sample to perform test.

AC2098 Cyanuric Acid, Melamine Method, Tablet Test Procedure

5 – 90 mg/L CyA

1. Load and run the AC2098 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Cyanuric Acid Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved (see notes below). Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber. Close the sample chamber door.
9. Press the **Measure Sample** function key to display the result in mg/L cyanuric acid.

Notes:

- If cyanuric acid is present a cloudy solution will occur. Small single particles are not necessarily caused by cyanuric acid.
- Dissolve the tablet completely (swirl the vial for approximately 1 minute). Undissolved particles of the tablet can cause results that are too high.
- Exceeding the measurement range: samples with concentration above 90mg/L must be diluted with water free of cyanuric acid. 10 ml of the diluted sample should be tested as described above and the displayed results calculated using the dilution factor.

AC2009 Fluoride, SPADNS Kit Method, Liquid Test Procedure

0.05 – 2 mg/L F

1. Load and run the AC2009 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with exactly 10 ml of deionized water. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add exactly 2 ml SPADNS Solution to the vial. **CAUTION:** The vial will be filled up to the top.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber. Close the sample chamber door.
9. Press the **Measure Rgnt Blank** function key to measure the reagent blank.
10. Open the sample chamber door and remove the vial from the sample chamber.
11. Empty the vial, rinse the vial and cap several times and fill the vial with exactly 10 ml of sample.
12. Add exactly 2 ml SPADNS Solution to the vial. **CAUTION:** The vial will be filled up to the top.
13. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
14. Place the vial into the holder in the sample chamber. Close the sample chamber door.
15. Press the **Measure Sample** function key to display the result in mg/L fluoride.

Notes:

- Reverse color methods use a reagent that, when prepared with samples, deceases in color as the concentration of the species being measured in the samples increases. Reverse color methods require the use of both a blank and a reagent blank. The blank is a clear solution (deionized water) with zero absorbance. The reagent blank is a mixture of the reagent and deionized water and provides a zero concentration point with the darkest color (highest absorbance). The color of samples prepared with the reagent will decrease as the concentration increases for this method.
- The same batch of SPADNS reagent solution must be used for testing (reagent blank and sample measurement) and one point calibration procedures. The one point calibration process needs to be performed for each new batch of SPADNS reagent solution (see Standard Methods 20th ed., 1998, APHA, AWWA, WEF 4500 F^- D, 4.a).
- During testing (blank, reagent blank and sample measurement) and one point calibration procedures the same vial should be used, as different vials may exhibit minor tolerances.
- The calibration solution and water samples should have the same temperature (+/- 1°C).

- As the test result is highly dependent on exact sample and reagent volumes, the sample and reagent volumes should always be measured using a 10 ml or 2 ml volumetric pipette (class A).
- The accuracy of the test methods decreases above a level of 1.2 mg/L fluoride. Although the results are sufficiently accurate for most applications, even more exact results can be achieved by 1:1 dilution of the sample prior to use and subsequent multiplication of the result by 2.
- SPADNS reagent solution contains arsenite. Chlorine concentrations up to 5 mg/L do not interfere.
- Seawater and wastewater samples must be distilled.

AC3032T Hardness, Total, Low Range, Metallphthalein Method, Tablet Test Procedure

2 – 50 mg/L $CaCO_3$

1. Load and run the AC3032TL method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Hardcheck P Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Wait for a reaction period of 5 minutes.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Sample** function key to display the result in mg/L total hardness.

Notes:

- Strong alkaline or acidic water samples must be adjusted between pH 4 and pH 10 before the tablet is added (use 1 mol/l hydrochloric acid or 1 mol/l sodium hydroxide).

AC3032T Hardness, Total, High Range, Metallphthalein Method, Tablet Test Procedure

20 – 500 mg/L $CaCO_3$

1. Load and run the AC3032TH method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 1 ml of sample and 9 ml of deionized water. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Hardcheck P Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Wait for a reaction period of 5 minutes.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Sample** function key to display the result in mg/L total hardness.

Notes:

- Strong alkaline or acidic water samples must be adjusted between pH 4 and pH 10 before the tablet is added (use 1 mol/l hydrochloric acid or 1 mol/l sodium hydroxide).

AC2030 Hydrazine, Dimethylamino-benzaldehyde Method, Powder Test Procedure

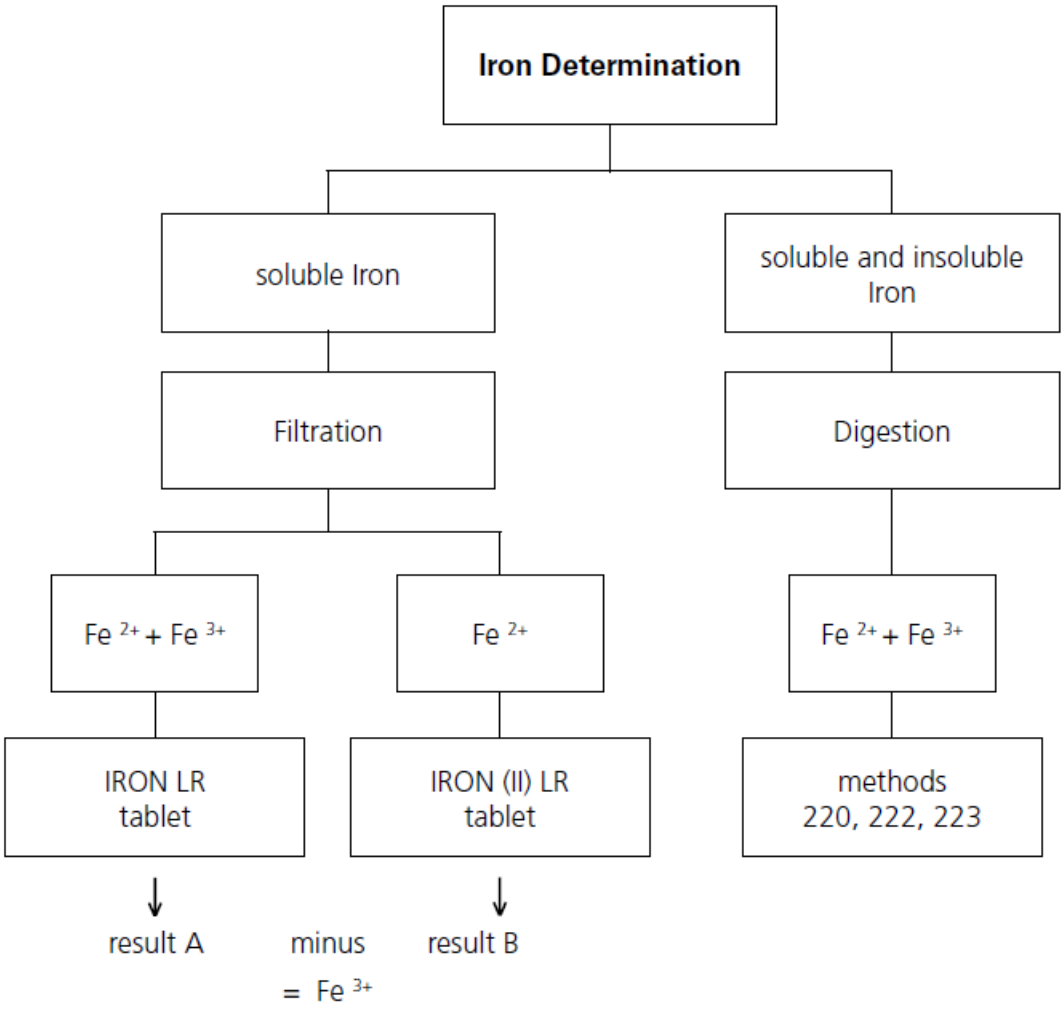
0.05 – 0.5 mg/L N_2H_4

1. Load and run the AC2030 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one gram (1 g) Hydrazine Powder to the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Wait for a reaction period of 10 minutes.
9. The slight turbidity that occurs when the reagent is added must be removed by filtration
10. Place the vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L hydrazine.

Notes:

- If the water sample is cloudy, you must filter it before performing the blank measurement.
- The temperature of the water sample should not exceed 21°C.
- Using the Hydrazine spoon: 1 g is equivalent to one level spoon.
- Qualitative folded filter papers for medium precipitates are recommended.
- In order to check whether the reagent has aged (if it has been stored for a lengthy period), perform the test as described above using tap water. If the result is above the detection limit of 0.05 mg/L, you should only use the reagent with reservations as there may be a major deviation in results.

Iron Digestion Method



Digestion procedure for the determination of total soluble and insoluble iron:

1. Add 1 ml of concentrated sulfuric acid to 100 ml water sample. Heat and boil for 10 minutes or until all particles are dissolved. After cooling down, the sample is set to a pH value of 3 to 6 by using ammonia solution. Refill with deionized water to the previous volume of 100 ml and mix well. 10 ml of this pre-treated solution is used for the following analysis. Perform as described by the selected test method.
2. Water which has been treated with organic compounds like corrosion inhibitors must be oxidized where necessary to break down the iron. Therefore add 1 ml concentrated sulfuric acid and 1 ml concentrated nitric acid to 100 ml water sample and boil to approximately half volume. After cooling down, proceed as described above.

AC2078 Iron, Low Range, III, Soluble, TPTZ Method, Tablet Test Procedure

0.01 – 1 mg/L Fe

1. Load and run the AC207824 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Iron LR Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Wait for a reaction period of 5 minutes.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Sample** function key to display the result in mg/L iron.

Notes:

- This method determines the total dissolved iron as Fe^{2+} and Fe^{3+}.
- The Iron (II) LR Tablet is used for differentiation, as described in the Iron Digestion Method section, instead of the Iron LR Tablet.
- For the determination of total dissolved and undissolved iron, digestion is required. An example is described in the Iron Digestion Method section.

AC4P78 Iron, II & III, Soluble, 1,10-Phenanthroline Method, Powder Test Procedure

0.02 – 3 mg/L Fe

1. Load and run the AC4P78 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Ferro F10 Powder Pack straight from the foil to the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Wait for a reaction period of 3 minutes.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Sample** function key to display the result in mg/L iron.

Notes:

- The reagent reacts with all soluble iron and most insoluble forms of iron in the water sample.
- Iron oxide requires prior digestion: use mild, vigorous or Digesdahl digestion. For an example of digestion with acid, refer to the Iron Digestion Method section.
- Very strong alkaline or acidic samples must be adjusted to a pH value between 3 and 5 before analysis.
- Accuracy is not affected by undissolved powder.
- Water samples containing visible rust should be allowed to react for at least five minutes.

AC4P79 Iron, Total, TPTZ Method, Powder Test Procedure

0.02 – 1.8 mg/L Fe

1. Load and run the AC4P79 method.
2. Use two clean AQUAfast 24mm round vials, Cat. No. AC2V24.
3. Pour 10 ml of deionized water into the first vial (this is the blank vial).
4. Pour 10 ml of sample into the second vial (this is the sample vial).
5. Add the contents of one Iron TPTZ F10 Powder Pack straight from the foil to each vial. Close the vials tightly with the caps and swirl or invert several times to mix the contents. Wipe the exteriors of the vials.
6. Wait for a reaction period of 3 minutes.
7. Place the blank vial into the holder in the sample chamber. Close the sample chamber door.
8. Press the **Measure Blank** function key to measure the blank.
9. Open the sample chamber door. Remove the blank vial from the holder.
10. Place the sample vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L iron.

Notes:

- For determination of total Iron digestion is required. TPTZ reagent recovers most insoluble iron oxides without digestion.
- Rinse all glassware with 1:1 hydrochloric acid solution first and then rinse with deionized water to remove iron deposits that can cause slightly high results.
- Strong alkaline or acidic water samples must be adjusted between pH 3 and pH 8 before the reagent is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- Interferences: When interferences occur, color development is inhibited or a precipitate is formed. The values below refer to a standard with an iron concentration of 0.5 mg/L. The following substances do not interfere when present up to the levels given:

Substance	No Interference To
Cadmium	4.0 mg/L
Chromium($^{3+}$)	0.25 mg/L
Chromium ($^{6+}$)	1.2 mg/L
Cobalt	0.05 mg/L
Copper	0.6 mg/L
Cyanide	2.8 mg/L

Substance	No Interference To
Manganese	50 mg/L
Mercury	0.4 mg/L
Molybdenum	4.0 mg/L
Nickel	1.0 mg/L
Nitrite Ion	0.8 mg/L

AC2055 Manganese, Formaldoxime Method, Tablet Test Procedure

0.2 – 4 mg/L Mn

1. Load and run the AC2055 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Manganese LR 1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Add one Manganese LR 2 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
9. Wait for a reaction period of 5 minutes.
10. Place the vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L manganese.

AC4P54 Manganese, Low Range, PAN Method, Powder & Liquid Test Procedure

0.01 – 0.7 mg/L Mn

1. Load and run the AC4P54 method.
2. Use two clean AQUAfast 24mm round vials, Cat. No. AC2V24.
3. Pour 10 ml of deionized water into the first vial (this is the blank vial).
4. Pour 10 ml of sample into the second vial (this is the sample vial).
5. Add the contents of one Ascorbic Acid Powder Pack straight from the foil to each vial. Close the vials tightly with the caps and swirl or invert several times to mix the contents.
6. Add 15 drops of Alkaline Cyanide Reagent Solution to each vial. Add drops of the same size by holding the bottle vertically and squeezing slowly. Close the vials tightly with the caps and swirl or invert several times to mix the contents.
7. Add 21 drops of PAN Indicator Solution to each vial. Add drops of the same size by holding the bottle vertically and squeezing slowly. Close the vials tightly with the caps and swirl or invert several times to mix the contents. Wipe the exteriors of the vials.
8. Wait for a reaction period of 2 minutes.
9. Place the blank vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Blank** function key to measure the blank.
11. Open the sample chamber door. Remove the blank vial from the holder.
12. Place the sample vial into the holder in the sample chamber. Close the sample chamber door.
13. Press the **Measure Sample** function key to display the result in mg/L manganese.

Notes:

- Rinse all glassware with 1:1 nitric acid solution first and then rinse with deionized water.
- Water samples that contain more than 300 mg/L $CaCO_3$ hardness: after adding the Ascorbic Acid Powder Pack add additionally 10 drops of Rochelle Salt Solution.
- After addition of the Alkaline Cyanide Reagent Solution a cloudy or turbid solution may form in some water samples. The turbidity should disappear after the PAN Indicator Solution is added.
- Water samples containing more than 5 mg/L iron should be allowed to react for at least 10 minutes.

AC4P55 Manganese, High Range, Periodate Oxidation Method, Powder Test Procedure

0.1 – 18 mg/L Mn

1. Load and run the AC4P55 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Citrat Powder Pack straight from the foil to the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents.
8. Add one Sodium Periodate Powder Pack straight from the foil to the vial.
9. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
10. Wait for a reaction period of 2 minutes.
11. Place the vial into the holder in the sample chamber. Close the sample chamber door.
12. Press the **Measure Sample** function key to display the result in mg/L manganese.

Notes:

- This test is applicable for the determination of soluble manganese in water and wastewater.
- Highly buffered water samples or extreme pH values may exceed the buffering capacity of the reagents and requires sample pre-treatment. If samples were acidified for storing, adjust the pH between 4 and 5 with 5 mol/l (5 N) Sodium hydroxide before test. Do not exceed pH 5, as manganese may precipitate.
- Interferences:

Interfering Substance	**Interference Level**
Calcium	Greater than 700 mg/L
Chloride	Greater than 70,000 mg/L
Iron	Greater than 5 mg/L
Magnesium	Greater than 100,000 mg/L

AC4P42 Molybdate / Molybdenum, Mercaptoacetic Acid Method, Powder Test Procedure

0.5 – 66 mg/L MoO_4 / 0.3 – 40 mg/L Mo

1. Load and run the AC4P42 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Molybdenum HR 1 F10 Powder Pack straight from the foil to the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents.
8. Add one Molybdenum HR 2 F10 Powder Pack straight from the foil to the same vial.
9. Close the vial tightly with the cap and swirl or invert several times to mix the contents.
10. Add one Molybdenum HR 3 F10 Powder Pack straight from the foil to the same vial.
11. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
12. Wait for a reaction period of 5 minutes.
13. Place the vial into the holder in the sample chamber. Close the sample chamber door.
14. Press the **Measure Sample** function key to display the result in mg/L Molybdate/Molybdenum.

Notes:

- Filter turbid water samples using filter paper and funnel before analysis.
- Highly buffered water samples or extreme pH values should be adjusted to a pH of nearly 7 with 1 mol/l nitric acid or 1 mol/l sodium hydroxide.
- Concentrations above 10 mg/L Cu causes too high test values if the reaction time of 5 minutes is increased. So it is very important to perform the test procedure as described.
- Substances which may interfere when present in concentrations at:

Aluminum	50 mg/L
Chromium	1000 mg/L
Iron	50 mg/L
Nickel	50 mg/L
Nitrite	All Levels

ACR007 Nitrate as Nitrogen (N), Chromotropic Acid Method, Reaction Tube Test Procedure

1 – 30 mg/L N

1. Load and run the ACR007 method.
2. Open one white capped 16mm reaction vial (Reagent A) and add 1 ml of deionized water (this is the blank).
3. Open a second white capped 16mm reaction vial (Reagent A) and add 1 ml of sample (this is the sample).
4. Add the contents of one Nitrate Chromotropic Powder Pack straight from the foil to each vial.
5. Close the vials tightly with the caps and invert gently about 10 times to mix the contents. Some solids may not dissolve. Wipe the exteriors of the vials.
6. Wait for a reaction period of 5 minutes.
7. Place the blank vial into the holder in the sample chamber. Close the sample chamber door.
8. Press the **Measure Blank** function key to measure the blank.
9. Open the sample chamber door. Remove the blank vial from the holder.
10. Place the sample vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L nitrate as N.

Notes:

- Conversion: mg/L NO_3 = mg/L N x 4.43

AC2046 Nitrite as Nitrogen (N), Diazotization (Azo) Method, Tablet Test Procedure

0.01 – 0.5 mg/L N

1. Load and run the AC2046 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Nitrite LR Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
8. Wait for a reaction period of 10 minutes.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Sample** function key to display the result in mg/L nitrite as N.

Notes:

- The following ions can produce interferences since under the reaction conditions they cause precipitation: antimony (III), iron (III), lead, mercury (I), silver, chloroplatinate, metavanadate and bismuth. Copper (II) ions may cause lower test results as they accelerate the decomposition of the diazonium salt. It is unlikely in practice that these interfering ions will occur in such high concentrations that they cause significant reading errors.
- Conversion: mg/L NO_2 = mg/L N x 3.29

AC4P46 Nitrite as Nitrogen (N), Low Range, Diazotization (Azo) Method, Powder Test Procedure

0.01 – 0.3 mg/L N

1. Load and run the AC4P46 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Nitri 3 Powder Pack straight from the foil to the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Wait for a reaction period of 20 minutes.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Sample** function key to display the result in mg/L Nitrite as N.

Notes:

- Interferences:
  - Strong oxidizing and reducing substances interfere.
  - Cupric and ferrous ions cause low results.
  - Antimonous, auric, bismuth, chloroplatinate, ferric, lead, mercurous, metavanadate and silver ions interfere by causing precipitation.
  - In samples with very high concentrations of Nitrate (> 100 mg/L N) a small amount of Nitrite will be found. Such high levels of Nitrate appear to undergo a slight amount of reduction to Nitrite, either spontaneously or during the reaction time of the test.

ACD004 Nitrogen, Total, Low Range, Persulfate Digestion Method, Digestion Tube Test Procedure

0.5 – 25 mg/L N

1. Open two TN Hydroxide LR Digestion Vials and add one TN Persulfate Reagent Power Pack straight from the foil to each vial. Use a funnel to add the reagent. Wipe off any persulfate reagent that may get on the lid or the tube threads.
2. Add 2 ml of deionized water to the first digestion vial (this is the blank).
3. Add 2 ml of sample to the second digestion vial (this is the sample).
4. Close the vials tightly with the caps and shake the vials for at least 30 seconds to mix the contents. The reagent many not dissolve completely.
5. Heat the digestion vials for 30 minutes in the preheated reactor at a temperature of 100 °C.
6. **CAUTION:** The vials will be hot.
   Remove the digestion vials from the reactor and allow them to cool to room temperature.
7. Open the cooled digestion vials and add one TN Reagent A Power Pack straight from the foil to each vial. Use a funnel to add the reagent.
8. Close the vials tightly with the caps and shake the vials for at least 15 seconds to mix the contents.
9. Wait for a reaction period of 3 minutes.
10. Open the digestion vials and add one TN Reagent B Power Pack straight from the foil to each vial. Use a funnel to add the reagent.
11. Close the vials tightly with the caps and shake the vials for at least 15 seconds to mix the contents. The reagent will not completely dissolve.
12. Wait for a reaction period of 2 minutes.
13. Open two TN Acid LR/HR (Reagent C) Vials and add 2 ml of the digested, treated blank to the first vial (this is the blank).
14. Add 2 ml of the digested, treated sample to the second vial (this is the sample).
15. Close the vials tightly with the caps and gently invert the vials at least 10 times to mix the contents. Hold the vial in a vertical position with the cap pointing up. Turn the vial upside-down. Wait for all of the solution to flow down to the cap. Return the vial to the upright position. Wait for all the solution to flow to the bottom of the vial. This process is one inversion; 10 inversions equal about 30 seconds. Wipe the exteriors of the vials.
    CAUTION: The vials will become warm during mixing.
16. Wait for a reaction period of 5 minutes.
17. Load and run the ACD004 method.
18. Place the blank vial into the holder in the sample chamber. Close the sample chamber door.

19. Press the **Measure Blank** function key to measure the blank.
20. Open the sample chamber door. Remove the blank vial from the holder.
21. Place the sample vial into the holder in the sample chamber. Close the sample chamber door.
22. Press the **Measure Sample** function key to display the result in mg/L nitrogen.

Notes:

- Appropriate safety precautions and a good lab technique should be used during the whole procedure.
- Volumes for samples and blank should always be metered by using 2 ml volumetric pipettes (class A).
- One blank is sufficient for each set of samples. After taking the blank measurement it is possible to measure several samples.
- It is very important to remove the vials from the reactor after exactly 30 minutes.
- Large quantities of nitrogen free, organic compounds which are included in some water samples may reduce the effectiveness of the digestion by reacting with the persulfate reagent. Samples which are well known to contents large quantities of organic compounds must be diluted and digestion and measurement must be repeated for checking the effectiveness of the digestion.
- Application: for water, wastewater and seawater.
- Interferences: Interfering substances that resulted in a concentration change of 10%: Bromide more than 60 mg/L and Chloride more than 1000 mg/L produce positive interferences.

ACD007 Nitrogen, Total, High Range, Persulfate Digestion Method, Digestion Tube Test Procedure

5 – 150 mg/L N

1. Open two TN Hydroxide HR Digestion Vials and add one TN Persulfate Reagent Power Pack straight from the foil to each vial. Use a funnel to add the reagent. Wipe off any persulfate reagent that may get on the lid or the tube threads.
2. Add 0.5 ml of deionized water to the first digestion vial (this is the blank).
3. Add 0.5 ml of sample to the second digestion vial (this is the sample).
4. Close the vials tightly with the caps and shake the vials for at least 30 seconds to mix the contents. The reagent many not dissolve completely.
5. Heat the digestion vials for 30 minutes in the preheated reactor at a temperature of 100 °C.
6. **CAUTION:** The vials will be hot.
   Remove the digestion vials from the reactor and allow them to cool to room temperature.
7. Open the cooled digestion vials and add one TN Reagent A Power Pack straight from the foil to each vial. Use a funnel to add the reagent.
8. Close the vials tightly with the caps and shake the vials for at least 15 seconds to mix the contents.
9. Wait for a reaction period of 3 minutes.
10. Open the digestion vials and add one TN Reagent B Power Pack straight from the foil to each vial. Use a funnel to add the reagent.
11. Close the vials tightly with the caps and shake the vials for at least 15 seconds to mix the contents. The reagent will not completely dissolve.
12. Wait for a reaction period of 2 minutes.
13. Open two TN Acid LR/HR (Reagent C) Vials and add 2 ml of the digested, treated blank to the first vial (this is the blank).
14. Add 2 ml of the digested, treated sample to the second vial (this is the sample).
15. Close the vials tightly with the caps and gently invert the vials at least 10 times to mix the contents. Hold the vial in a vertical position with the cap pointing up. Turn the vial upside-down. Wait for all of the solution to flow down to the cap. Return the vial to the upright position. Wait for all the solution to flow to the bottom of the vial. This process is one inversion; 10 inversions equal about 30 seconds. Wipe the exteriors of the vials.
    CAUTION: The vials will become warm during mixing.
16. Wait for a reaction period of 5 minutes.
17. Load and run the ACD007 method.
18. Place the blank vial into the holder in the sample chamber. Close the sample chamber door.

19. Press the **Measure Blank** function key to measure the blank.
20. Open the sample chamber door. Remove the blank vial from the holder.
21. Place the sample vial into the holder in the sample chamber. Close the sample chamber door.
22. Press the **Measure Sample** function key to display the result in mg/L nitrogen.

Notes:

- Appropriate safety precautions and a good lab technique should be used during the whole procedure.
- Volumes for samples and blank should always be metered by using 2 ml volumetric pipettes (class A).
- One blank is sufficient for each set of samples. After taking the blank measurement it is possible to measure several samples.
- It is very important to remove the vials from the reactor after exactly 30 minutes.
- Large quantities of nitrogen free, organic compounds which are included in some water samples may reduce the effectiveness of the digestion by reacting with the persulfate reagent. Samples which are well known to contents large quantities of organic compounds must be diluted and digestion and measurement must be repeated for checking the effectiveness of the digestion.
- Application: for water, wastewater and seawater.
- Interferences: Interfering substances that resulted in a concentration change of 10%: Bromide more than 60 mg/L and Chloride more than 1000 mg/L produce positive interferences.

AC2048 Ozone, Indigo Blue, Tablet Test Procedure

0.05 – 0.5 mg/L O_3

1. Load and run the AC204824 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of deionized water. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Rinse a clean beaker with deionized water. Add one Ozone Tablet straight from the foil to the beaker. Crush the tablet with a clean stir rod. Add exactly 20 ml of deionized water to the beaker. Carefully mix the solution using the stir rod until all particles are fully dissolved.
7. Empty and dry the vial and add the solution from the beaker to the 10 ml mark on the vial.
8. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Rgnt Blank** function key to measure the reagent blank.
11. Open the sample chamber door and remove the vial from the sample chamber.
12. Rinse a clean beaker with the sample to be measured. Add one Ozone Tablet straight from the foil to the beaker. Crush the tablet with a clean stir rod. Add exactly 20 ml of sample to the beaker. Carefully mix the solution using the stir rod until all particles are fully dissolved.
13. Empty the vial, rinse the vial and cap several times and add the solution from the beaker to the 10 ml mark on the vial.
14. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
15. Place the vial into the holder in the sample chamber. Close the sample chamber door.
16. Press the **Measure Sample** function key to display the result in mg/L ozone.

Notes:

- Reverse color methods use a reagent that, when prepared with samples, deceases in color as the concentration of the species being measured in the samples increases. Reverse color methods require the use of both a blank and a reagent blank. The blank is a clear solution (deionized water) with zero absorbance. The reagent blank is a mixture of the reagent and deionized water and provides a zero concentration point with the darkest color (highest absorbance). The color of samples prepared with the reagent will decrease as the concentration increases for this method.

- Preparing the sample: When preparing the sample, the escape of ozone gases, i.e. by pipetting or shaking, must be avoided. The analysis must take place immediately after taking the sample.
- Strong alkaline or acidic water samples must be adjusted between pH 6 and pH 7 before the tablet is added (use 0.5 mol/l sulfuric acid or 1 mol/l sodium hydroxide).
- The malonic acid in the tablet prevents chlorine from interfering with the process. Bromine (or bromide oxidized by the ozone) interferes with the analysis. 1 mol HOBr is equivalent to 0.4 mol ozone.
- H_2O_2 and organic peroxides react extremely slowly and the interference is therefore negligible.
- Fe(III) does not interfere. Mn(II) is oxidized by ozone and interferes with the analysis.

AC2001 pH, Phenol Red Method, Tablet Test Procedure

6.5 – 8.4 pH

1. Load and run the AC2001 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Phenol Red Meter Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber. Close the sample chamber door.
9. Press the **Measure Sample** function key to display the result in pH units.

Notes:

- For photometric determination of pH values only use Phenol Red Tablets in black printed foil pack and marked with Meter.
- Water samples with low values of alkalinity-m (below 35 mg/L $CaCO_3$) may give wrong pH readings.
- pH values below 6.5 and above 8.4 can produce results inside the measuring range. A plausibility test (pH meter) is recommended.
- The accuracy of the colorimetric determination of pH values depends on various boundary conditions (buffer capacity of the sample, salt contents etc.).
- Salt error: Correction of test results (average values) for samples with salt contents of:

Indicator	**Salt Content**		
Phenol Red	1 molar − 0.21	2 molar − 0.26	3 molar − 0.29

- The values of Parson and Douglas (1926) are based on the use of Clark and Lubs buffers. 1 Mol NaCl = 58.4 g/l = 5.8 %

AC3001 pH, Phenol Red Method, Liquid Test Procedure

6.5 – 8.4 pH

1. Load and run the AC3001 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add six drops of Phenol Red Solution to the vial. Add drops of the same size by holding the bottle vertically and squeezing slowly.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Place the vial into the holder in the sample chamber. Close the sample chamber door.
9. Press the **Measure Sample** function key to display the result in pH units.

Notes:

- When testing chlorinated water the residual chlorine contents can influence the color reaction of the liquid reagent. This can be avoided (without interfering with the pH measurement) by adding a small crystal of sodium thiosulfate ($Na_2S_2O_3 \bullet 5\ H_2O$) to the sample before adding the Phenol Red solution. Phenol Red tablets already contain thiosulfate.
- Due to differing drop sizes results can show a discrepancy in accuracy by comparison with tablets. This can be minimized by using a pipette (0.18 ml Phenol Red solution is equivalent to 6 drops).
- After use, replace the bottle cap securely.
- Store the Phenol Red solution in a cool, dry place ideally at between 6°C and 10°C.

AC2095 Phosphate, Ortho, Low Range, Phosphomolybdic Acid/Ascorbic acid Method, Tablet Test Procedure

0.05 – 4 mg/L PO_4

1. Load and run the AC2095 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Phosphate No. 1 LR 1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Add one Phosphate No. 2 LR Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
9. Wait for a reaction period of 10 minutes.
10. Place the vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L ortho-phosphate.

Notes:

- Only ortho-phosphate ions react.
- The tablets must be added in the correct sequence.
- The test sample should have a pH value between 6 and 7.
- Interferences: Higher concentrations of Cu, Ni, Cr (III), V (V) and W (VI) interfere due to their color. Silicates do not interfere (masked by citric acid in the tablets).
- Ortho-phosphate ions react with the reagent to form an intense blue color.
- Phosphate in organic and condensed inorganic forms (meta-, pyro- and polyphosphates) must be converted to ortho-phosphate ions before analysis. Pretreatment of the sample with acid and heat provides the conditions for hydrolysis of the condensed inorganic forms. Organically combined phosphates are converted to ortho-phosphate ions by heating with acid and persulfate. The amount of organically combined phosphates can be calculated:
  mg/L phosphate, organic = mg/L phosphate, total - mg/L phosphate, acid hydrolyzable
- Phosphate, ortho = Phosphorus, reactive

AC2096 Phosphate, Ortho, High Range, Vanadomolybdate Method, Tablet Test Procedure

1 – 80 mg/L PO_4

1. Load and run the AC2096 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Phosphate HR P1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Add one Phosphate HR P2 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
9. Wait for a reaction period of 10 minutes.
10. Place the vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L ortho-phosphate.

Notes:

- For samples under 5 mg/L PO_4 it is recommended to analyze the sample using the AC2095 method.
- Only ortho-phosphate ions react.
- Phosphate in organic and condensed inorganic forms (meta-, pyro- and polyphosphates) must be converted to ortho-phosphate ions before analysis. Pretreatment of the sample with acid and heat provides the conditions for hydrolysis of the condensed inorganic forms. Organically combined phosphates are converted to ortho-phosphate ions by heating with acid and persulfate. The amount of organically combined phosphates can be calculated:
  mg/L phosphate, organic = mg/L phosphate, total - mg/L phosphate, acid hydrolysable
- The ortho-phosphate ions react with the Vanadate-molybdate reagent under acid conditions to form a yellow colored product.
- Phosphate, ortho = Phosphorus, reactive

AC4P95 Phosphate, Ortho, Ascorbic Acid Method, Powder Test Procedure

0.06 – 2.5 mg/L PO_4

1. Load and run the AC4P95 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Phosphate Rgt. F10 Powder Pack straight from the foil to the vial.
7. Close the vial tightly with the cap and swirl or invert several times for 10-15 seconds to mix the contents. The powder will not dissolve completely. Wipe the exterior of the vial.
8. Wait for a reaction period of 2 minutes.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Sample** function key to display the result in mg/L ortho-phosphate.

Notes:

- Ortho-phosphate ions react with the reagent to form an intense blue color.
- Phosphate in organic and condensed inorganic forms (meta-, pyro- and polyphosphates) must be converted to ortho-phosphate ions before analysis. Pretreatment of the sample with acid and heat provides the conditions for hydrolysis of the condensed inorganic forms. Organically combined phosphates are converted to ortho-phosphate ions by heating with acid and persulfate. The amount of organically combined phosphates can be calculated:
  mg/L phosphate, organic = mg/L phosphate, total - mg/L phosphate, acid hydrolysable
- Application: for water, wastewater and seawater.
- Highly buffered samples or samples with extreme pH values should be adjusted between pH 2 and pH 10 before analysis (with 1 mol/l Hydrochloric acid or 1 mol/l sodium hydroxide).
- Phosphate, ortho = Phosphorus, reactive
- Interferences: Large amounts of turbidity may cause inconsistent results.

Interference	Interference Level
Aluminum	greater than 200 mg/L
Arsenate	at any level
Chromium	greater than 100 mg/L
Copper	greater than 10 mg/L
Iron	greater than 100 mg/L

Interference	Interference Level
Nickel	greater than 300 mg/L
Silica (Silicium dioxide)	greater than 50 mg/L
Silicate	greater than 10 mg/L
Sulfide	at any level
Zinc	greater than 80 mg/L

ACD095 Phosphate as Phosphorous (P), Total, Persulfate Digestion/Ascorbic Acid Method, Digestion Tube Test Procedure

0.02 – 1.1 mg/L P

1. Open one white capped 16mm PO4-P Acid Reagent Digestion Tube and add 5 ml of sample.
2. Add one Potassium Persulfate F10 Power Pack straight from the foil to the vial. Use a funnel to add the reagent.
3. Close the vial tightly with the cap and invert the vial several times to mix the contents.
4. Heat the vial for 30 minutes in the preheated reactor at a temperature of 100 °C.
5. **CAUTION:** The vials will be hot.
   Remove the vial from the reactor and allow it to cool to room temperature.
6. Open the cooled digestion vial and add 2 ml of 1.54 N Sodium Hydroxide Solution to the vial.
7. Close the vial tightly with the cap and gently invert the vial several times to mix the contents. Wipe the exterior of the vial.
8. Load and run the ACD095 method.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Blank** function key to measure the blank.
11. Open the sample chamber door. Remove the vial from the holder.
12. Add one Phosphate Rgt. F10 Power Pack straight from the foil to the vial. Use a funnel to add the reagent.
13. Close the vial tightly with the cap and swirl the vial for 10-15 seconds to mix the contents. The reagent will not completely dissolve. Wipe the exterior of the vial.
14. Wait for a reaction period of 2 minutes.
15. Place the vial into the holder in the sample chamber. Close the sample chamber door.
16. Press the **Measure Sample** function key to display the result in mg/L total phosphate.

Notes:

- Appropriate safety precautions and good lab technique should be used during the whole procedure.
- Ortho-phosphate ions react with the reagent to form an intense blue color.
- Phosphate in organic and condensed inorganic forms (meta-, pyro- and polyphosphates) must be converted to ortho-phosphate ions before analysis. Pretreatment of the sample with acid and heat provides the conditions for hydrolysis of the condensed inorganic forms. Organically combined phosphates are converted to ortho-phosphate ions by heating with acid and persulfate. The amount of organically combined phosphates can be calculated:
  mg/L phosphate, organic = mg/L phosphate, total - mg/L phosphate, acid hydrolysable

- Application: for water, wastewater and seawater.
- Highly buffered samples or samples with extreme pH values should be adjusted between pH 2 and pH 10 before analysis (with 1 mol/l Hydrochloric acid or 1 mol/l sodium hydroxide).
- Phosphate, ortho = Phosphorus, reactive
- Interferences: Large amounts of turbidity may cause inconsistent results.

Interfering Substance	**Interference Level**
Aluminum	greater than 200 mg/L
Arsenate	at any level
Chromium	greater than 100 mg/L
Copper	greater than 10 mg/L
Iron	greater than 100 mg/L
Nickel	greater than 300 mg/L
Silica (Silicium dioxide)	greater than 50 mg/L
Silicate	greater than 10 mg/L
Sulfide	at any level
Zinc	greater than 80 mg/L

ACD095AH Phosphate as Phosphorous (P), Acid Hydrolyzable, Acid Digestion/Ascorbic Acid Method, Digestion Tube Test Procedure

0.02 – 1.6 mg/L P

1. Open one white capped 16mm PO4-P Acid Reagent Digestion Tube and add 5 ml of sample.
2. Close the vial tightly with the cap and gently invert the vial several times to mix the contents.
3. Heat the vial for 30 minutes in the preheated reactor at a temperature of 100 °C.
4. **CAUTION:** The vials will be hot.
   Remove the vial from the reactor and allow it to cool to room temperature.
5. Open the cooled digestion vial and add 2 ml of 1.00 N Sodium Hydroxide Solution to the vial.
6. Close the vial tightly with the cap and gently invert the vial several times to mix the contents. Wipe the exterior of the vial.
7. Load and run the ACD095AH method.
8. Place the vial into the holder in the sample chamber. Close the sample chamber door.
9. Press the **Measure Blank** function key to measure the blank.
10. Open the sample chamber door. Remove the vial from the holder.
11. Add one Phosphate Rgt. F10 Power Pack straight from the foil to the vial. Use a funnel to add the reagent.
12. Close the vial tightly with the cap and swirl the vial for 10-15 seconds to mix the contents. The reagent will not completely dissolve. Wipe the exterior of the vial.
13. Wait for a reaction period of 2 minutes.
14. Place the vial into the holder in the sample chamber. Close the sample chamber door.
15. Press the **Measure Sample** function key to display the result in mg/L acid hydrolysable phosphate.

Notes:

- Appropriate safety precautions and good lab technique should be used during the whole procedure.
- Ortho-phosphate ions react with the reagent to form an intense blue color.
- Phosphate in organic and condensed inorganic forms (meta-, pyro- and polyphosphates) must be converted to ortho-phosphate ions before analysis. Pretreatment of the sample with acid and heat provides the conditions for hydrolysis of the condensed inorganic forms. Organically combined phosphates are converted to ortho-phosphate ions by heating with acid and persulfate. The amount of organically combined phosphates can be calculated:
  mg/L phosphate, organic = mg/L phosphate, total - mg/L phosphate, acid hydrolysable
- Application: for water, wastewater and seawater.

- Highly buffered samples or samples with extreme pH values should be adjusted between pH 2 and pH 10 before analysis (with 1 mol/l Hydrochloric acid or 1 mol/l sodium hydroxide).\
- Phosphate, ortho = Phosphorus, reactive
- Interferences: Large amounts of turbidity may cause inconsistent results.

Interfering Substance	**Interference Level**
Aluminum	greater than 200 mg/L
Arsenate	at any level
Chromium	greater than 100 mg/L
Copper	greater than 10 mg/L
Iron	greater than 100 mg/L
Nickel	greater than 300 mg/L
Silica (Silicium dioxide)	greater than 50 mg/L
Silicate	greater than 10 mg/L
Sulfide	at any level
Zinc	greater than 80 mg/L

ACR095 Phosphate, Ortho, Ascorbic Acid Method, Reaction Tube Test Procedure

0.06 – 5 mg/L PO_4

1. Load and run the ACR095 method.
2. Open one white capped 16mm PO4-P Dilution Tube and add 5 ml of sample. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door. Remove the vial from the holder.
6. Add one Phosphate Rgt. F10 Power Pack straight from the foil to the vial. Use a funnel to add the reagent.
7. Close the vial tightly with the cap and swirl the vial for 10-15 seconds to mix the contents. The reagent will not completely dissolve. Wipe the exterior of the vial.
8. Wait for a reaction period of 2 minutes.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Sample** function key to display the result in mg/L ortho-phosphate.

Notes:

- Ortho-phosphate ions react with the reagent to form an intense blue color.
- Phosphate in organic and condensed inorganic forms (meta-, pyro- and polyphosphates) must be converted to ortho-phosphate ions before analysis. Pretreatment of the sample with acid and heat provides the conditions for hydrolysis of the condensed inorganic forms. Organically combined phosphates are converted to ortho-phosphate ions by heating with acid and persulfate. The amount of organically combined phosphates can be calculated:
  mg/L phosphate, organic = mg/L phosphate, total - mg/L phosphate, acid hydrolysable
- Application: for water, wastewater and seawater.
- Highly buffered samples or samples with extreme pH values should be adjusted between pH 2 and pH 10 before analysis (with 1 mol/l Hydrochloric acid or 1 mol/l sodium hydroxide).
- Phosphate, ortho = Phosphorus, reactive
- Interferences: Large amounts of turbidity may cause inconsistent results.

Interference	Interference Level
Aluminum	greater than 200 mg/L
Arsenate	at any level
Chromium	greater than 100 mg/L
Copper	greater than 10 mg/L
Iron	greater than 100 mg/L

Interference	Interference Level
Nickel	greater than 300 mg/L
Silica (Silicium dioxide)	greater than 50 mg/L
Silicate	greater than 10 mg/L
Sulfide	at any level
Zinc	greater than 80 mg/L

AC2060 Silica, Silicomolybdate Method, Tablet Test Procedure

0.05 – 4 mg/L SiO_2

1. Load and run the AC2060 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Silica No. 1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved.
8. Wait for a reaction period of 5 minutes.
9. Add one Silica No. 2 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
10. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
11. Wait for a reaction period of 1 minute.
12. Place the vial into the holder in the sample chamber. Close the sample chamber door.
13. Press the **Measure Sample** function key to display the result in mg/L silica.

Notes:

- The tablets must be added in the correct sequence.

AC2061 Silica, Silicomolybdate Method with Phosphate Removal, Tablet Test Procedure

0.05 – 4 mg/L SiO_2

1. Load and run the AC2061 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Silica No. 1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved.
8. Wait for a reaction period of 5 minutes.
9. Add one Silica PR Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
10. Add one Silica No. 2 Tablet straight from the foil to the same vial. Crush the tablet with a clean stir rod.
11. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
12. Wait for a reaction period of 1 minute.
13. Place the vial into the holder in the sample chamber. Close the sample chamber door.
14. Press the **Measure Sample** function key to display the result in mg/L silica.

Notes:

- The tablets must be added in the correct sequence.
- Phosphate ions do not interfere under the given reaction conditions.
- If phosphate is known to be absent, the addition of the Silica PR Tablet may be omitted.

AC4P60 Silica, High Range, Silicomolybdate Method, Powder Test Procedure

1 – 90 mg/L SiO_2

1. Load and run the AC4P60 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Temperature of the sample should be 15 °C to 25 °C. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Silica HR Molybdate F10 Powder Pack straight from the foil to the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents.
8. Add one Silica HR Acid Rgt. F10 Powder Pack straight from the foil to the same vial. If silica or phosphate is present a yellow color will develop.
9. Close the vial tightly with the cap and swirl or invert several times to mix the contents.
10. Wait for a reaction period of 10 minutes.
11. Add one Silica Citric Acid F10 Powder Pack straight from the foil to the same vial. In this step, any yellow color due to phosphate is removed.
12. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
13. Wait for a reaction period of 2 minutes.
14. Place the vial into the holder in the sample chamber. Close the sample chamber door.
15. Press the **Measure Sample** function key to display the result in mg/L silica.

Notes:

- Interferences:

Substance	**Interference**
Iron	Large amounts interfere
Phosphate	Does not interfere at concentrations less than 50 mg/L PO_4 At 60 mg/L PO_4 the interference is approximately 2% At 75 mg/L PO_4 the interference is approximately 11 %
Sulfide	Interferes at all levels

- Occasionally water samples contain forms of silica which reacts very slowly with molybdate. The nature of these forms is not known.

- A pre-treatment with sodium hydrogen carbonate and then with sulfuric acid will make these forms reactive to molybdate (pre-treatment is given in “Standard Methods for the Examination of Water and Wastewater” under “Silica Digestion with Sodium Bicarbonate”).

AC4P82 Sulfate, Barium Sulfate/Turbidity Method, Powder Test Procedure

5 – 100 mg/L SO_4

1. Load and run the AC4P82 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Sulpha 4/F10 Powder Pack straight from the foil to the vial.
7. Close the vial tightly with the cap and swirl or invert several times to mix the contents. Wipe the exterior of the vial.
8. Wait for a reaction period of 5 minutes.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Sample** function key to display the result in mg/L sulfate.

Notes:

- If sulfate ions are present a cloudy solution will appear.

AC2016 Sulfide, Methylene Blue Method, Tablet Test Procedure

0.04 – 0.5 mg/L S

1. Load and run the AC2016 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of sample. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Open the sample chamber door and remove the vial from the sample chamber.
6. Add one Sulfide No. 1 Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Add one Sulfide No. 2 Tablet straight from the foil to the same vial. Crush the tablet with a clean stir rod.
8. Close the vial tightly with the cap and swirl or invert several times until the tablets are dissolved. Wipe the exterior of the vial.
9. Wait for a reaction period of 10 minutes.
10. Place the vial into the holder in the sample chamber. Close the sample chamber door.
11. Press the **Measure Sample** function key to display the result in mg/L sulfide.

Notes:

- The tablets must be added in the correct sequence.
- Chlorine and other oxidizing agents which react with DPD do not interfere with the test.
- To avoid loss of sulfide collect the sample carefully with a minimum of aeration. It is essential to test the sample immediately after collection.
- The sample temperature should be 20°C. A different temperature can lead to higher or lower results.

AC2065 Zinc, Zincon Method, Tablet Test Procedure

0.02 – 1 mg/L Zn

1. Load and run the AC202924 method.
2. Fill a clean AQUAfast 24mm round vial, Cat. No. AC2V24, with 10 ml of deionized water. Close the vial tightly with the cap. Wipe the exterior of the vial.
3. Place the vial into the holder in the sample chamber. Close the sample chamber door.
4. Press the **Measure Blank** function key to measure the blank.
5. Empty and dry the vial and then fill the vial with 10 ml of sample.
6. Add one Copper / Zinc LR Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
7. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
8. Wait for a reaction period of 5 minutes.
9. Place the vial into the holder in the sample chamber. Close the sample chamber door.
10. Press the **Measure Rgnt Blank** function key to measure the reagent blank.
11. Open the sample chamber door and remove the vial from the sample chamber.
12. Add one EDTA Tablet straight from the foil to the vial. Crush the tablet with a clean stir rod.
13. Close the vial tightly with the cap and swirl or invert several times until the tablet is dissolved. Wipe the exterior of the vial.
14. Place the vial into the holder in the sample chamber. Close the sample chamber door.
15. Press the **Measure Sample** function key to display the result in mg/L zinc.

Notes:

- Reverse color methods use a reagent that, when prepared with samples, deceases in color as the concentration of the species being measured in the samples increases. Reverse color methods require the use of both a blank and a reagent blank. The blank is a clear solution (deionized water) with zero absorbance. The reagent blank is a mixture of the reagent and sample (with no EDTA reagent) and provides a zero concentration point with the darkest color (highest absorbance). The color of samples prepared with the EDTA reagent will decrease as the concentration increases for this method.
- Measuring the reagent blank needs to be done with each sample analysis.
- The tablets must be added in the correct sequence.
- In the case of high levels of residual chlorine, perform the analysis with a dechlorinated water sample. To dechlorinate add one Dechlor Tablet to the water sample in step 2. Crush and mix to dissolve the tablet. Then add the Copper / Zinc LR Tablet (step 3) and continue with the test procedure as described above.

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