



APPLICATION NOTE

How to ensure the accuracy of measurements

Proper handling of Exaqua reagents and overview of critical points in measurement procedures

Exaqua
photometer reinvented

Proper handling of Exaqua reagents and overview of critical points in measurement procedures

INTRODUCTION

Proper storage and handling of reagents, as well as strict adherence to measurement procedures for each parameter, are essential in obtaining reliable and repeatable test results when using Exaqua photometers and reagents.

This application note is as a guide for Exaqua users, providing key information on:

- reagents and measurement procedures,
- aspects to which special attention should be paid when storing and handling reagents,
- steps in procedures that, if performed incorrectly, can negatively affect the quality of the measurement.

The guidelines included in this document are based on frequently asked user questions and the identification of critical points in procedures.

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MEASUREMENT PROCEDURES AND RESULT REPEATABILITY

Following a measurement procedure in a thorough way is crucial for obtaining accurate results. It is highly recommended to pay attention to all aspects related to a measurement such as: correct sequence of operations, careful and precise taking of reagents and water, maintaining cleanliness of measurement glassware, proper use of syringes and spatulas, ensuring the specified time intervals between reagent addition and measurement, and many more specified in each procedure. Neglecting any of these recommendations may lead to falsely high or low results.

Table 1 presented in the further part of this application note, contains supplementary information on measurement procedures and defines critical points where common mistakes may be made. It can be referenced if measurement results using Exaqua reagent sets appear incorrect or if the measurement fails for unknown reasons.



Measurement procedures for users of Exaqua photometers are available in several places:

- In the user manual provided with the photometer, section **19 Method procedures**
- on the official website www.exaqua.com/products/ as downloadable files, available on each reagent set's page,
- as short guidelines displayed on the photometer screen after pressing the **GUIDE** button before starting a measurement procedure.

Before starting the first measurement, users should also refer to section **18 Methods** in the user manual, which provides essential explanations regarding:

- measurement conditions (e.g. optimal pH and temperature ranges for samples),
- general guidelines on proper handling of reagents,
- instructions on how to correctly take and dose reagents, use syringes and other measurement accessories.

HANDLING OF REAGENTS AND REPEATABILITY OF RESULTS

To obtain repeatable results, it is necessary to maintain proper composition and properties of reagents. For this reason, good practice in reagent storage and handling must be followed. The most basic recommendations are given below:

- » Always use original Exaqua reagent sets when performing measurement procedures with a photometer. Non-original reagents may have different composition and cause different coloration of sample solutions, thus leading to incorrect measurement results.
- » After completing a measurement, always close reagent bottles to prevent evaporation and changes in their properties.
- » Do not interchange, mix or combine reagents from kits with different product numbers except for deionized water (product no 8903 /100 ml).

- » Reagents should be stored in original packaging in a dry place at room temperature (recommended temperature range is 5 to 25 °C), away from heat and direct sunlight. Freezing must be avoided. After use, store reagents in dedicated packages or in the reagent case.

Each reagent has a unique composition and therefore requires specific handling. **Table 1**, presented in the further part of this application note, provides additional information specified for each Exaqua reagent set.



CAUTION

Handling chemicals contained in the reagents sets can be dangerous. Read the necessary Material Safety Data Sheets, follow instructions carefully and take all required safety precautions.

Keep the reagents out of reach of children and store locked up. Avoid eye or skin contact or breathing. In case of spillage, immediately clean up the reagent from surface and wipe the area with a damp cloth. In case of skin contact, rinse the affected area with running water for several minutes.

Safety kit

To enhance safety and convenience during measurement using Exaqua reagents, a special **Safety Kit** is available. Set provides essentials you need to organize proper work with Exaqua reagents, as well as basic protective materials: protective goggles and gloves, tray, wash bottle with cap, plastic beaker and vial holders.



The set contains:





Protective gloves in box – 10 pcs, Safety goggles – 1 pc., Tray – 1 pc., Wash bottle with cap – 1 pc., Plastic beaker – 1 pc., Vial holder – 4 pcs.







Product code 8940	Safety kit
Product code 8941	Safety kit with transport case




TABLE 1





Additional notes on Exaqua measurement procedures containing guidance on how to properly handle reagents and on what aspects special attention should be paid to obtain accurate measurement results.








Note: Detailed procedures for specific parameters are provided in section 19 [Method procedures](#) of the Exaqua photometer user manual. The table below supplements these instructions with guidance on proper reagent storage, handling, and how to avoid common mistakes during measurement procedures.





METHOD NUMBER	IMPORTANT HANDLING GUIDANCE
<p>Z010F Alkalinity KH Fresh water</p> <p>Z010M Alkalinity KH Marine water</p>  	<ul style="list-style-type: none"> • Vials used for measurement should be dry, clean, and free of streaks and scratches. • Make sure the correct method is selected depending on the type of the tested sample: <ul style="list-style-type: none"> - Z010F – for fresh water, - Z010M – for marine water. • Measure the volume of sample and reagent correctly. Dosing accuracy has a direct impact on the measurement result. • Maintain proper storage conditions for the KH reagent between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. • When taking a sample of the KH reagent by a syringe with a tip, it is normal that there appears empty space between the syringe plunger and the liquid level. This is because the part of the liquid volume remains in the tip fitted on the syringe. While drawing a proper volume of reagent, the position of the plunger and not the level of the liquid in the syringe should be considered. • After the measurement is complete, rinse the syringe twice with deionized water. It is of high importance that no reagent residue remains neither in the syringe nor the tip attached to the syringe. • Caution The reagent leaves blue stains that are difficult to remove. It is recommended to wear protective gloves and perform the procedure using a tray (see Safety Kit cat. no 8940/41).
<p>Z021 Total hardness GH</p> <p>Z022 Total hardness GH Low range</p>  	<ul style="list-style-type: none"> • Vials used for measurement should be dry, clean, and free of streaks and scratches. • Protect reagent packaging from direct sunlight and overheating, especially long-term. Especially, avoid overheating the GH-1 reagent. Storing the reagent at too high temperatures can negatively affect its properties. • Maintain proper storage conditions for the GH-1 and GH-2 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. • In case of samples with low hardness, the GH-2 titration reagent should be added slowly and the sample mixed thoroughly. • If the sample turns blue after adding the GH-1 reagent, it means that the value of total hardness is < 1°dH (Z021) or < 0.1°dH (Z022). • If during the titration (adding the GH-2 reagent) the color of the sample changes from pink to blue, and the photometer does not signal the end of the reaction, it is necessary to perform a new measurement by adding 2 - 3 drops of GH-1 reagent more. • When taking the GH-2 reagent by a syringe with a tip, it is normal that there appears empty space between the syringe plunger and the liquid level. This is because the part of the liquid volume remains in the tip fitted on the syringe. While drawing a proper volume of reagent, the position of the plunger and not the level of the liquid in the syringe should be considered.





METHOD NUMBER	IMPORTANT HANDLING GUIDANCE
<p>cont. Z021 Total hardness GH</p> <p>Z022 Total hardness GH Low range</p>	<ul style="list-style-type: none"> When reading the volume of GH-2 reagent used, hold the syringe exactly at eye level. After the measurement is complete, thoroughly remove all reagent residue from the syringe and tip. It is of high importance that no reagent residue remains neither in the syringe nor the tip attached to the syringe. Do not rinse the syringe with water.
<p>Z030 pH 4.5-6.0</p> <p>Z040 pH 6.0-8.5</p>  	<ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches. Protect reagent packaging from direct sunlight and overheating, especially long-term. Measure the volume of the reagent 4.5-6.0 or pH 6.0-8.5 correctly. Dosing accuracy has a direct impact on the measurement result. When taking the pH 4.5-6.0 or pH 6.0-8.5 reagent by a syringe with a tip, it is normal that there appears empty space between the syringe plunger and the liquid level. This is because the part of the liquid volume remains in the tip fitted on the syringe. While drawing a proper volume of reagent, the position of the plunger and not the level of the liquid in the syringe should be considered. Maintain proper storage conditions for the pH 4.5-6.0 or pH 6.0-8.5 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. After the measurement is complete, rinse the syringe twice with deionized water. It is of high importance that no reagent residue remains neither in the syringe nor the tip attached to the syringe.
<p>Z041 pH 6.5-8.5</p> 	<ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches. Protect reagent packaging from direct exposure to moisture.
<p>Z050 pH 4.5-9.0</p> 	<ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches. Make sure the correct method is selected depending on the type of the tested sample: <ul style="list-style-type: none"> - Z050F – for fresh water, - Z050M – for marine water. Maintain proper storage conditions for the pH 4.5-9.0 reagent between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results.
<p>Z210H Nitrate NO₃ High range</p> <p>Z210L Nitrate NO₃ Low range</p>  	<ul style="list-style-type: none"> Vials used for measurement should be dry, clean, free of streaks and scratches and should be rinsed at least twice with the tested water. Maintain proper storage conditions for the NO₃-1 and NO₃-3 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. Do not leave the NO₃-2 powder reagent container open longer than necessary for analysis and avoid its exposure to moisture. Do not store reagents in refrigerator, as excessive cooling can lead to condensation of water on the surface of the NO₃-2 reagent powder and thus degrading its performance. Always take the NO₃-2 powder reagent with a dry spatula that is dedicated to this test. A full, flat spatula of the reagent should be taken.





METHOD NUMBER	IMPORTANT HANDLING GUIDANCE
<p>cont. Z210H Nitrate NO₃ High range Z210L Nitrate NO₃ Low range</p>	<ul style="list-style-type: none"> • Make sure to select an appropriate measuring range. For low nitrate content (less than 30 mg/l), choose the method Z210L, for nitrate values above 30 mg/l, the method Z210H is suitable. If you do not know what NO₃ values to expect, it is recommended to measure with the Z210L method first. • Make sure you perform measurements according to the instructions. Special attention should be paid to: <ul style="list-style-type: none"> - waiting 30 seconds after adding the NO₃-1 and NO₃-2 reagents, - correct sample handling after adding the NO₃-2 reagent. After adding it to the sample, cap the vial and invert it exactly 10 times. <p>Caution: The number of rotations affects the result. The procedure for performing the test is described in detail in the instructions.</p>
<p>Z220H Nitrite NO₂ High range Z220L Nitrite NO₂ Low range</p>	 <ul style="list-style-type: none"> • Vials used for measurement should be dry, clean, free of streaks and scratches and should be rinsed at least twice with the tested water. • Make sure to select an appropriate measuring range. For low nitrite content (less than 1.5 mg/l), choose the method Z220L, for nitrite values above 1.5 mg/l, the method Z220H is suitable. If you do not know what NO₂ values to expect, it is recommended to measure with the Z220L method first. • Maintain proper storage conditions for the NO₂-1 and NO₂-2 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. • Make sure you perform measurements according to the instructions. Special attention should be paid to waiting 15 seconds after adding the NO₂-1 reagent.
<p>Z230 Total ammonia NH₄ Fresh water</p>	  <ul style="list-style-type: none"> • Vials used for measurement should be dry, clean, free of streaks and scratches and should be rinsed at least twice with the tested water. • Maintain proper storage conditions for the NH₄-1 and NH₄-3 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. • Do not leave the NH₄-2 powder reagent container open longer than necessary for analysis and avoid its exposure to moisture. • Do not store reagents in refrigerator, as excessive cooling can lead to condensation of water on the surface of the NH₄-2 reagent powder and thus degrading its performance. • Always take the NH₄-2 powder reagent with a dry spatula that is dedicated to this test. A full, flat spatula of the reagent should be taken. • Make sure the correct method is selected depending on the type of the tested sample. For the measurement of total ammonia NH₄ there are two variants of reagents and two different methods dedicated depending on the type of water tested: <ul style="list-style-type: none"> - Z230 – for fresh water, - Z231 – for marine water. • Make sure that the NH₄-2 reagent has dissolved completely when added to the sample and mixed.







METHOD NUMBER	IMPORTANT HANDLING GUIDANCE
<p>Z231 Total ammonia NH₄ Marine water</p>	<div style="display: flex; flex-direction: column; align-items: center;">   </div> <ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches and should be rinsed at least twice with the tested water. Make sure the correct method is selected depending on the type of the tested sample. For the measurement of total ammonia NH₄ there are two variants of reagents, and two different methods dedicated depending on the type of water tested: <ul style="list-style-type: none"> - Z230 – for fresh water, - Z231 – for marine water. Maintain proper storage conditions for the NH₄-1, NH₄-2 and NH₄-3 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. Note: The NH₄-3 reagent exhibits particular sensitivity to contact with air components, thus it is necessary to reduce the reagent bottle opening time to a minimum and ensure that it is tightly closed.
<p>Z240F Phosphate PO₄ Fresh water</p> <p>Z240M Phosphate PO₄ Marine water</p>	<div style="display: flex; flex-direction: column; align-items: center;">   </div> <ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches and should be rinsed at least twice with the tested water. Maintain proper storage conditions for the PO₄-1 reagent between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. Do not leave the PO₄-2 powder reagent container open longer than necessary for analysis and avoid its exposure to moisture. Do not store reagents in refrigerator, as excessive cooling can lead to condensation of water on the surface of the PO₄-2 reagent powder and thus degrading its performance. Always take the PO₄-2 powder reagent with a dry spatula that is dedicated to this test. A full, flat spatula of the reagent should be taken. Avoid contamination of the measuring vial or sample with phosphates. In everyday practice, it is quite common for the measuring vial as well as the water sample to become contaminated with phosphates from sources other than the tested water. Phosphates are commonly present in detergents and cleaning agents. Washing the vial with detergents can lead to phosphorus-containing compounds remaining on the surfaces, which then contaminate the test sample and lead to false-positive results. <u>Procedure for dealing with a false positive result with suspiciously high phosphate content:</u> <ul style="list-style-type: none"> - take 5 ml of the tested water and pour into the vial, - add 10 drops of PO₄-1 reagent, - cap the vial and shake for 30 seconds, - pour out the contents of the vial, - rinse the vial twice with the tested water, - perform the measurement according to the method procedure.

METHOD NUMBER	IMPORTANT HANDLING GUIDANCE
<p>Z410 Iron Fe</p>  	<ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches and should be rinsed at least twice with the tested water. Do not leave the Fe powder reagent container open longer than necessary to take the portion of the reagent required for analysis. Strictly protect the reagent from contact with water. Otherwise, it may lead to its degradation and negatively affect the accuracy of the measurement. Protect reagent packaging from direct sunlight and overheating, especially long-term. Do not store reagents in refrigerator, as excessive cooling can lead to condensation of water on the surface of the Fe reagent powder and thus degrading its performance. Always take the Fe powder reagent with a dry spoon that is dedicated to this test. A full, flat spoon of the reagent should be taken. Make sure that the whole portion of the Fe reagent has dissolved completely when added to the sample and mixed. The correct colour of the solution with the added Fe reagent, depending on the concentration, should be pink or pink-red. When a yellow coloration of the solution occurs, it is recommended to repeat the measurement according to the following procedure: <ul style="list-style-type: none"> - take 5 ml of the deionized water and add one portion of Fe reagent, - use the sample prepared in this way to carry out ZERO measurement, - follow the Z410 procedure, - see manual, section 'Method Z410 - Iron Fe' starting from step 4.
<p>Z420 Manganese Mn</p>    	<ul style="list-style-type: none"> Note: The Z420 Manganese Mn reagent set is designed only for freshwater testing. Vials used for measurement should be dry, clean, and free of streaks and scratches and should be rinsed at least twice with the tested water. Protect reagent packaging from direct sunlight and overheating, especially long-term. Maintain proper storage conditions for the Mn-2, Mn-3 and Mn-4 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. Do not leave the Mn powder reagent container open longer than necessary to take the portion of the reagent required for analysis. Strictly protect the reagent from contact with water. Otherwise, it may lead to its degradation and negatively affect the accuracy of the measurement. Do not store reagents in refrigerator, as excessive cooling can lead to condensation of water on the surface of the Mn-1 reagent powder and thus degrading its performance. Always take the Mn-1 powder reagent with a dry spatula that is dedicated to this test. A full, flat spatula of the reagent should be taken. Make sure that the whole portion of the Mn-1 reagent has dissolved completely when added to the sample and mixed.
<p>Z430F Copper Cu Fresh water</p> <p>Z430M Copper Cu Marine water</p> 	<ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches and should be rinsed at least twice with the tested water. Make sure the correct method is selected depending on the type of the tested sample: <ul style="list-style-type: none"> - Z430F – for fresh water, - Z430M – for marine water. Maintain proper storage conditions for the Cu-1 and Cu-2 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results.

METHOD NUMBER	IMPORTANT HANDLING GUIDANCE
<p>cont.</p> <p>Z430F Copper Cu Fresh water</p> <p>Z430M Copper Cu Marine water</p>	<ul style="list-style-type: none"> Perform the measurement exactly after the time specified in the instructions: <ul style="list-style-type: none"> - 6 min for method Z430F, fresh water, - 10 min for method Z430M, marine water. <p>Maintaining the correct time interval between adding the Cu-2 Reagent and taking the measurement is crucial for obtaining reliable result.</p>
<p>Z440 Silicon Si</p>  	<ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches and should be rinsed at least twice with the tested water. Maintain proper storage conditions for the Si-1 reagent between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. Do not leave the Si-2 powder reagent container open longer than necessary for analysis and avoid its exposure to moisture. Do not store reagents in refrigerator, as excessive cooling can lead to condensation of water on the surface of the Si-2 reagent powder and thus degrading its performance. Always take the Si-2 powder reagent with a dry spatula that is dedicated to this test. A full, flat spatula of the reagent should be taken. Avoid contamination of the water sample with silicon washed out from the glass surfaces of the glassware. In case of measurements of the silicon content, it is very important to rinse the measuring vial in a special way before the first use, see user's manual, method procedure Z440, point 2. Silicon is an element that can relatively easily contaminate a water sample. Silicon contamination can easily occur when the sample is stored in an unsuitable glass container, such as a jar. Storing a water sample in an unsuitable container before carrying out the measurement of the silicon content can cause falsely increased results. Silicon leaches from the glass surfaces of the container and diffuses into the solution. For storing water samples, it is recommended to use plastic containers.
<p>Z450H Potassium K High range</p> <p>Z450L Potassium K Low range</p> <p>Z450M Potassium K Marine water</p>  	<ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches and should be rinsed at least twice with the tested water. Do not leave the K powder reagent container open longer than necessary for analysis and avoid its exposure to moisture. Do not store reagents in refrigerator, as excessive cooling can lead to condensation of water on the surface of the K reagent powder and thus degrading its performance. Always take the K powder reagent with a dry spatula that is dedicated to this test. A full, flat spatula of the reagent should be taken. Make sure to select an appropriate measuring range and the right method for the specific type of sample: <ul style="list-style-type: none"> - <u>Fresh water</u> For low content of potassium (less than 20 mg/l), choose the Z450L method, for the value of potassium above 20 mg/l, the Z450H method is suitable. - <u>Marine water</u> Choose the Z450M method. If you do not know what the content of potassium to expect, it is recommended to measure using the Z450L method first. Remember to dilute the sample with deionized water when you proceed according to the Z450H method, see user's manual, method procedure Z450H, point 2. It is important to take the correct volume of powder reagent K, it must fully fill the spatula.

METHOD NUMBER	IMPORTANT HANDLING GUIDANCE	
<p>Z462 Calcium Ca Marine water</p>	 	<ul style="list-style-type: none"> • Vials used for measurement should be dry, clean, and free of streaks and scratches. • Measure the volume of sample and reagent correctly. Dosing accuracy has a direct impact on the measurement result. • Maintain proper storage conditions for the Ca-1 and Ca-3 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. • Do not leave the Ca-2 powder reagent container open longer than necessary for analysis and avoid its exposure to moisture. • Do not store reagents in refrigerator, as excessive cooling can lead to condensation of water on the surface of the Ca-2 reagent powder and thus degrading its performance. • Always take the Ca-2 powder reagent with a dry spatula that is dedicated to this test. A full, flat spatula of the reagent should be taken. • For some samples with high mineralization and/or low carbonate hardness, sometimes full colour development is not initially observed. • If the sample turns blue after adding Ca-1 and Ca-2 reagents, it means that the calcium content is < 200 mg/l. • If, after adding Ca-1 and Ca-2 reagents, the sample colour is not deep pink, and then despite adding of Ca-3 reagent and changing the colour of the sample from pink to blue, the photometer does not signal the end of the reaction, you should take the measurement again and make sure that you add a full flat spatula of Ca-2 reagent. • If after taking the measurement the result obtained is suspiciously low (e.g. half of the expected value), the measurement should be carried out again, however, instead of 13 drops of Ca-1 reagent, add 15 drops. Then, follow the standard procedure. • When taking the Ca-3 reagent by a syringe with a tip, it is normal that there appears empty space between the syringe plunger and the liquid level. This is because the part of the liquid volume remains in the tip fitted on the syringe. While drawing a proper volume of reagent, the position of the plunger and not the level of the liquid in the syringe should be considered. • When reading the volume of Ca-3 reagent used, hold the syringe exactly at eye level. • After the measurement is complete, remove the reagent residue from the syringe and a tip thoroughly. It is of high importance that no reagent residue remains neither in the syringe nor the tip attached to the syringe. Do not rinse the syringe with water.
<p>Z463 Manganese Mg Marine water</p>	 	<ul style="list-style-type: none"> • Vials used for measurement should be dry, clean, and free of streaks and scratches. • Measure the volume of sample and reagent correctly. Dosing accuracy has a direct impact on the measurement result. Make sure to take 3 ml of the tested water. • Protect reagent packaging from direct sunlight and overheating, especially long-term. • Maintain proper storage conditions for the Mg-1 and Mg-2 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. • If the sample turns blue after adding Mg-1 reagent, it means that the magnesium content is < 500 mg/l. • If during titration (adding Mg-2 reagent) the colour of the sample changes from pink to blue, and the photometer does not signal the end of the reaction, a new measurement should be carried out and 2 - 3 more drops of Mg-1 reagent should be added. • When taking the Mg-2 reagent by a syringe with a tip, it is normal that there appears empty space between the syringe plunger and the liquid level. This is because the part of the liquid volume remains in the tip fitted on the syringe. While drawing a proper volume of reagent, the position of the plunger and not the level of the liquid in the syringe should be considered.

METHOD NUMBER	IMPORTANT HANDLING GUIDANCE
<p>cont.</p> <p>Z463 Manganese Mg Marine water</p>	<ul style="list-style-type: none"> When reading the volume of Mg-2 reagent used, hold the syringe exactly at eye level. After the measurement is complete, remove the reagent residue from the syringe and a tip thoroughly. It is of high importance that no reagent residue remains neither in the syringe nor the tip attached to the syringe. Do not rinse the syringe with water.
<p>Z472 Calcium Ca Fresh water</p>  	<ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches. Measure the volume of sample and reagent correctly. Dosing accuracy has a direct impact on the measurement result. Maintain proper storage conditions for the Ca-1 and Ca-3 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. Do not leave the Ca-2 powder reagent container open longer than necessary for analysis and avoid its exposure to moisture. Do not store reagents in refrigerator, as excessive cooling can lead to condensation of water on the surface of the Ca-2 reagent powder and thus degrading its performance. Always take the Ca-2 powder reagent with a dry spatula that is dedicated to this test. A full, flat spatula of the reagent should be taken. For some samples with high mineralization and/or low carbonate hardness, sometimes full colour development is not initially observed. If the sample turns blue after adding Ca-1 and Ca-2 reagents, it means that the magnesium content is < 5 mg/l. If, after adding Ca-1 and Ca-2 reagents, the sample colour is not deep pink, and then despite adding of Ca-3 reagent and changing the colour of the sample from pink to blue, the photometer does not signal the end of the reaction, you should take the measurement again and make sure that you add a full flat spatula of Ca-2 reagent. If after taking the measurement the result obtained is suspiciously low (e.g. half of the expected value), the measurement should be carried out again, however, instead of 13 drops of Ca-1 reagent, add 15 drops. Then, follow the standard procedure. When taking the Ca-3 reagent by a syringe with a tip, it is normal that there appears empty space between the syringe plunger and the liquid level. This is because the part of the liquid volume remains in the tip fitted on the syringe. While drawing a proper volume of reagent, the position of the plunger and not the level of the liquid in the syringe should be considered. When reading the volume of Ca-3 reagent used, hold the syringe exactly at eye level. After the measurement is complete, remove the reagent residue from the syringe and a tip thoroughly. It is of high importance that no reagent residue remains neither in the syringe nor the tip attached to the syringe. Do not rinse the syringe with water.
<p>Z473 Manganese Mg Fresh water</p>  	<ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches. Measure the volume of sample and reagent correctly. Dosing accuracy has a direct impact on the measurement result. Protect reagent packaging from direct sunlight and overheating, especially long-term. Maintain proper storage conditions for the Mg-1 or Mg-2 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. If the sample turns blue after adding Mg-1 reagent, it means that the magnesium content is < 3 mg/l.

METHOD NUMBER	IMPORTANT HANDLING GUIDANCE
<p>cont.</p> <p>Z473 Manganese Mg Fresh water</p>	<ul style="list-style-type: none"> • If during titration (adding Mg-2 reagent) the colour of the sample changes from pink to blue, and the photometer does not signal the end of the reaction, a new measurement should be carried out and 2 - 3 more drops of Mg-1 reagent should be added. • When taking the Mg-2 reagent by a syringe with a tip, it is normal that there appears empty space between the syringe plunger and the liquid level. This is because the part of the liquid volume remains in the tip fitted on the syringe. While drawing a proper volume of reagent, the position of the plunger and not the level of the liquid in the syringe should be considered. • When reading the volume of Mg-2 reagent used, hold the syringe exactly at eye level. • After the measurement is complete, remove the reagent residue from the syringe and a tip thoroughly. It is of high importance that no reagent residue remains neither in the syringe nor the tip attached to the syringe. Do not rinse the syringe with water.
<p>Z480M Iodine I2 Marine water</p>	   <ul style="list-style-type: none"> • Vials used for measurement should be dry, clean, and free of streaks and scratches. • Protect reagent packaging from direct sunlight and overheating, especially long-term. • Maintain proper storage conditions for the I₂-1, I₂-2 and I₂-3 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. • Before starting the measurement procedure, press the GUIDE key that activates the method guide function (displaying instructions on the photometer screen during the measurement). Without activating the GUIDE function, it is not possible to measure the iodine content. • To perform the measurement, it is required to prepare two samples with the volume of 3 ml. It is recommended to mark the samples with the numbers 1 and 2, as the order of measurement has direct impact on the accuracy of the result. • Caution Reagent I₂-3 contains nitric acid in high concentration. Special care must be taken when dispensing it. In case of contamination of the skin of your hands, wash them with plenty of water and do not touch the area around the eyes.
<p>Z610F Sulphate SO₄ Fresh water</p> <p>Z610M Sulphate SO₄ Marine water</p>	  <ul style="list-style-type: none"> • Vials used for measurement should be dry, clean, and free of streaks and scratches. • Maintain proper storage conditions for the SO₄-1 reagent between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. • Do not leave the SO₄-2 powder reagent container open longer than necessary for analysis and avoid its exposure to moisture. • Do not store reagents in refrigerator, as excessive cooling can lead to condensation of water on the surface of the SO₄-2 reagent powder and thus degrading its performance. • Always take the SO₄-2 powder reagent with a dry spatula that is dedicated to this test. A full, flat spatula of the reagent should be taken.
<p>Z620 Dissolved oxygen O₂</p>	 <ul style="list-style-type: none"> • Vials used for measurement should be dry, clean, and free of streaks and scratches and should be rinsed at least twice with the tested water. • Always take a water sample into the measuring vial immediately before taking the measurement. Perform the measurement as quickly as possible. • Maintain proper storage conditions for the O₂-1 and O₂-2 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. • Pay special attention to maintaining a 2-minute time interval between adding the O₂-2 reagent and the measurement.











METHOD NUMBER	IMPORTANT HANDLING GUIDANCE
Z621 Active oxygen MPS	 <ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches and should be rinsed at least twice with the tested water. Protect reagent packaging from direct exposure to moisture.
Z630 Carbon dioxide CO₂	  <ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches. Always take a water sample into the measuring vial immediately before taking the measurement. Perform the measurement as quickly as possible. Measure the volume of sample and reagent correctly. Dosing accuracy has a direct impact on the measurement result. Before measurement, it is necessary to prepare a CO₂-2 solution from CO₂-2 concentrate. For this purpose, take 1 ml of the concentrated solution CO₂-2 using a dedicated syringe and pour into one of the bottles labelled 'deionized water for CO₂-2 reagent', then mix thoroughly. The reagent prepared in this way is used to determine the content of carbon dioxide in water. Write down the date when the solution was prepared, as the expiration date for the CO₂-2 reagent is 3 months. Maintain proper storage conditions for the CO₂-1 and CO₂-2 reagents between measurements, and in particular take care not to leave the reagent bottle uncapped for time longer than necessary for analysis. Leaving the bottle uncapped for too long results in the solvent evaporation and change of the solution properties, thus leading to incorrect measurement results. <p>Note: The CO₂-2 reagent exhibits particular sensitivity to contact with air components, thus it is necessary to reduce the reagent bottle opening time to a minimum and ensure that it is tightly closed.</p> <ul style="list-style-type: none"> When taking the CO₂-2 reagent by a syringe with a tip, it is normal that there appears empty space between the syringe plunger and the liquid level. This is because the part of the liquid volume remains in the tip fitted on the syringe. While drawing a proper volume of reagent, the position of the plunger and not the level of the liquid in the syringe should be considered. When reading the volume of CO₂-2 reagent used, hold the syringe exactly at eye level. After the measurement is complete, rinse the syringe and a tip twice with deionized water. It is of high importance that no reagent residue remains neither in the syringe nor the tip attached to the syringe.
Z640 Free chlorine Cl₂	 <ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches and should be rinsed at least twice with the tested water. Protect reagent packaging from direct exposure to moisture.
Z650 Total chlorine Cl₂	 <ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches and should be rinsed at least twice with the tested water. Protect reagent packaging from direct exposure to moisture.
Z660 Cyanuric acid CYA	 <ul style="list-style-type: none"> Vials used for measurement should be dry, clean, and free of streaks and scratches and should be rinsed at least twice with the tested water. Protect reagent packaging from direct exposure to moisture.

TABLE 2
Recommended storage
conditions for Exaqua reagent sets
(abridged version of table 1)

Method number	PARAMETER				
		PROTECT FROM MOISTURE	PROTECT FROM DIRECT SUNLIGHT	DO NOT LEAVE REAGENT BOTTLES OPEN	RECOMMENDED TEMPERATURE RANGE FOR STORAGE
Z010F/M	Alkalinity KH fresh/marine water			✓	5 – 25 °C
Z011	Alkalinity KH pool water	✓			5 – 25 °C
Z021	Total hardness GH		✓	✓	5 – 25 °C
Z022	Total hardness GH low range		✓	✓	5 – 25 °C
Z030	pH 4.5-6.0		✓	✓	5 – 25 °C
Z040	pH 6.0-8.5		✓	✓	5 – 25 °C
Z041	pH 6.5-8.5 pool water	✓			5 – 25 °C
Z050	pH 4.5 – 9.0		✓	✓	5 – 25 °C
Z210H/L	Nitrate NO3 high/ low range	✓		✓	5 – 25 °C
Z220H/L	Nitrite NO2 high / low range			✓	5 – 25 °C
Z230	Total ammonia NH4 fresh water	✓		✓	5 – 25 °C
Z231	Total ammonia NH4 marine water			✓	5 – 25 °C
Z240F/M	Phosphate PO4 fresh/marine water	✓		✓	5 – 25 °C
Z410	Iron Fe	✓	✓	✓	5 – 25 °C
Z420	Manganese Mn	✓	✓	✓	5 – 25 °C
Z430F/M	Copper Cu fresh/marine water			✓	5 – 25 °C
Z440	Silicon Si	✓		✓	5 – 25 °C
Z450H/L/M	Potassium K high/low range fresh water /marine water	✓		✓	5 – 25 °C
Z462	Calcium Ca marine water	✓		✓	5 – 25 °C
Z463	Magnesium Mg marine water		✓	✓	5 – 25 °C
Z472	Calcium Ca fresh water	✓		✓	5 – 25 °C
Z473	Magnesium Mg fresh water		✓	✓	5 – 25 °C
Z480M	Iodine I2 marine water		✓	✓	5 – 25 °C
Z610F/M	Sulphate SO4 fresh/marine water	✓		✓	5 – 25 °C
Z620	Dissolved oxygen O2			✓	5 – 25 °C
Z621	Active oxygen MPS pool water	✓		✓	5 – 25 °C
Z630	Carbon dioxide CO2			✓	5 – 25 °C
Z640	Free chlorine Cl2 pool water	✓			5 – 25 °C
Z650	Total chlorine Cl2 pool water	✓			5 – 25 °C
Z660	Cyanuric acid CYA pool water	✓			5 – 25 °C