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REEF CARE PROGRAM

Foundation™

Testing and Supplementing

User Manual

 **Red Sea**

IMPORTANT:

To guarantee accurate results from these highly sensitive laboratory grade tests the following basic lab practices must be observed.

Test vial cleanliness - Rinse the vials thoroughly after every use, as residue from prior tests will affect testing accuracy. To remove any residue soak the test vials in a weak acid solution (e.g. citric acid) and thereafter rinse in reverse osmosis water. Before doing a test always rinse the vial with some of the water to be tested.

Avoid contamination of the reagent syringes - Always use the same syringe for each reagent. In the event of multiple reagent in a syringe, dispose of the contents of the syringes. Disassemble the syringe and soak all parts in a weak acid solution and thereafter rinse in reverse osmosis water. Reassemble the syringe, flush with reverse osmosis water and allow to dry.

Red Sea's Reef Care Program - Recipes®

The complete Reef Care program is the result of years of research into the physiological demands of SPS, LPS & Soft Corals in the reef aquarium. Reef Care Recipes® translates the many years of practical experience with Red Sea's Reef Care Program on tens of thousands of diverse reef tanks worldwide into a simple to implement regimen of water management activities specifically for the most common types of hobby reef aquariums.

Water management refers to all of the water related activities such as water changes, testing and supplementing that needs to be done on a regular basis to ensure the success of your reef aquarium. This is not just limited to maintaining the ideal balance of the seawater but also deals with controlling nuisance algae and coral nutrition for their long term health and vitality.

In addition to the Foundation™ program, which is fully described below, the complete Reef Care program also includes the following:

Algae Management Program – Controlled nitrate & phosphate reduction that prevents nuisance algae and provides the fine control of Zooxanthellae populations that significantly affect coral growth rates and coloration.

Trace-Colors™ – Provides the essential minor and trace elements that are part of the coral skeleton and soft tissue and are specifically important for SPS corals to display their natural pigments.

Reef Energy® – Provides the carbohydrates, vitamins, amino and fatty acids that fuel all metabolic processes of corals.

For optimal results you should implement the complete program.

The Foundation™ Elements (Ca, KH & Mg)

A successful coral reef aquarium is dependent upon maintaining the appropriate water parameters that in turn provide the stable environment required by the corals. Although all the elements found in natural seawater have an important role in providing the

optimal water parameters, a few of them have a more significant role in the overall stability. These elements are the foundation of the reef environment and they include the three major elements: Calcium (Ca), Magnesium (Mg) and Bi-Carbonates (HCO_3). These 3 elements have a major effect on the water chemistry (pH stability, Alkalinity, sea water ionic strength) and on many of the coral's biological processes (skeleton formation, ions exchange, photosynthesis).

Coral Growth

Coral Growth (Skeletogenesis) is the process by which special cells within the corals soft tissue, combine the foundation elements together with Strontium and Barium from the surrounding water to form the building blocks of coral skeletons.

Corals build approximately 90% of their skeleton by combining Ca and CO_3 ions from the water to form Aragonite (CaCO_3). The rest of the skeleton is made up from Magnesite (MgCO_3), Strontianite (SrCO_3), Calcite (a more brittle crystal structure of CaCO_3), Fluorite (CaF_2) and other minor and trace minerals.

In unbalanced conditions such as low levels of Mg and/or Sr the skeleton will develop with a higher proportion of Calcite making it more brittle and more susceptible to damage.

The foundation elements complement each other in the formation of coral skeleton and if not available in the correct ratios one of them will quickly become the limiting factor of healthy coral growth.

Elevated levels of the foundation elements create a more positive ionic pressure enabling passive diffusion of the elements through the soft tissue making this process much more efficient (less energy required per gram of skeleton). Therefore balanced elevated levels of the foundation elements will result in accelerated coral growth rates.

When aiming to enhance coral coloration by reducing the levels of algae nutrients, lower balanced levels of the foundation elements should be maintained.

Optimal levels of the Foundation Elements

Unlike the natural reef environment, where there is an immense reservoir of the foundation elements, the reef aquarium is an artificial environment that is constantly affected by chemical changes and therefore the foundation elements must be monitored and replenished constantly. Furthermore, research has shown that the optimal levels of these elements should be maintained according to the variety and maturity of the specific coral population.

Optimal levels of salinity, alkalinity, calcium and magnesium according to type of aquarium

Aquarium Type	Supplement frequency	Salinity (ppt)	Alkalinity (dKH meq/l)	Ca (mg/l)	Mg (mg/l)
Mixed Reef	Daily	34	11.5/4.1	450	1350
SPS Dominant	Daily	35	8.0/2.9	430	1280
SPS Frag tank	Daily	35	12.6/4.5	465	1390
ULNS	Daily	33	7.0/2.5	410	1220
Marine Fish	Weekly	30	6.8/2.4	370	1100

Note: The alkalinity is a measure of the concentration of all buffering substances such as bicarbonate (HCO_3), carbonate (CO_3), hydroxide (OH) and borate (BO_3). Alkalinity is measured in mille equivalents per liter meq/L or in degrees of Carbonate hardness (dKH = meq/L x 2.8). Avoid using test kits that measure carbonates as this does not measure total alkalinity.

The Foundation™ Supplements

- **Foundation™ Calcium+** Contains Calcium, Strontium & Barium in the ratios as found in coral skeleton.
- **Foundation™ KH/Alkalinity** Contains Bicarbonates.
- **Foundation™ Magnesium** Contains Magnesium
- **Foundation™ ABC+** Contains Calcium, Strontium, Barium, Bicarbonates, Magnesium, Potassium, Boron, Iodine & Bromine formulated in the exact ratio as found in the coral skeleton. This unique powder supplement simplifies the daily dosing of more than just the foundation elements and is recommended for aquariums up to about 300 liters / 75 gallons.

The Foundation™ Test Kits

Calcium Pro test kit is an advanced titration test, measuring the level of calcium to a resolution of 5 ppm.

KH Alkalinity Pro test kit is an advanced titration test, measuring the level of buffers to a resolution of 0.05 meq/L (0.14dKH).

Magnesium Pro test kit is an advanced titration test, measuring the level of Magnesium to a resolution of 20 ppm.

Testing and Supplementing

Causes and effects of unbalanced levels of foundation elements

- New aragonite substrate - new aragonite surfaces can increase the non-biological precipitation of calcium and carbonates which will lead to their depletion from the water, causing a drop in calcium and alkalinity.
- Unbalanced salt mixture - low magnesium or high calcium can lead to alkalinity drops.
- Excessive dosing of calcium or buffer (without dosing magnesium) - Adding too much calcium (to saturation levels) can lead to a sudden drop in alkalinity. Adding too much buffer to an aquarium with calcium at saturation levels will cause precipitation, leading to low calcium levels.

The phenomena listed above are typical to many chemically unbalanced marine and reef tanks causing stress to the inhabitants as well as to the aquarist. Balanced supplementation should therefore be implemented to maintain calcium, magnesium and alkalinity at the recommended levels.

General instructions for testing and supplementing:

1. Before carrying out any water testing always check the salinity and make adjustments as necessary. If you have made adjustments to the water wait 10 minutes for the water parameters to stabilize. (e.g. 1 ppt increase in salinity due to evaporation of fresh water will result in approximate increases of 13ppm Ca and 40ppm Mg)
2. Test only with high resolution test kits such as Red Sea's Foundation™ program (Calcium, Alkalinity & Magnesium) Pro Titration Kits
3. All of the Red Sea Reef Care Program supplements have dosing charts (on back of product) based on treating 100 liters / 25 gallons of water. Estimate your total volume of water (aquarium & sump less volume of live rocks etc) to calculate the correct dosage for your system.
4. Supplements should be added to the sump. If you do not have a sump, add the supplements slowly to an area with high water flow to prevent direct contact with fish and corals.
5. To prevent stress to the corals the maximum daily increases of each of the elements are as follows: Calcium 20ppm; Alkalinity 0.5 meq/l (1.4 dkh); Magnesium 10ppm. Larger adjustments should be spread over a few days according to the daily maximum.
6. In order to prevent the effects of unbalanced levels of the foundation elements the supplements should be added in the following order allowing 10 minutes between each:
 - 1st - Magnesium
 - 2nd - Alkalinity
 - 3rd - Calcium

Initial adjustment of Foundation Elements to optimal levels

When first using the Foundation™ products or after a water-change, test the levels of the foundation elements and supplement as necessary to achieve the optimal levels.

Supplementing weekly - (Marine Fish)

Test the foundation elements every week and dose each supplement to replenish back to the optimal levels.

Supplementing daily

Ensure that all of the foundation elements are at optimal values and run the aquarium for 4 days at a stable salinity (compensate for evaporation daily by adding fresh water) without adding any supplements. At the end of the 4 days, test the foundation elements and calculate the “4 day dosage” of each supplement to replenish back to the optimal levels. Add the “4 day dosage” to the system. Divide this “4 day dosage” by 4 and use as the daily dosage for the next week.

After a week of adding the daily dosage, test the foundation elements and calculate the “adjusting dosage” of each supplement to replenish back to the optimal levels.

- If the adjusting dosage is significantly different from the previous daily dosage amend (increase/decrease) the daily dosage as appropriate.
- If the measured level of a specific element is above the optimal level wait for the excess of the element to be depleted before restarting the daily supplementation with the amended daily dosage.

Continue testing all of the elements every week and make adjustments to the daily dosages as required. As your corals grow or you add or remove livestock the uptake of the elements in your aquarium will gradually change. It is recommended to keep a log book of the weekly measurements and dosages.

If you miss one or more days of supplementing add the complete amount that you have missed but do not exceed the maximum recommended daily increase for any of the elements.

Specific instructions for Foundation™ ABC+

Red Sea's Foundation™ ABC+ is a uniquely formulated powder supplement containing all of the elements of Foundation™ Calcium+, KH/Alkalinity & Magnesium, plus Red Sea's Trace-Colors™ Iodine+ & Potassium+ (potassium, boron, iodine & bromine) formulated in the exact ratio as found in the coral skeleton. Although there are slight differences between the coral species, the mean ratio between these elements is fairly constant. Supplementing all of these elements in a fixed ratio according to the uptake of calcium will ensure an accurate replenishment based on the metabolic demands of the corals.

Foundation™ ABC+ should be dosed on a daily basis according to a measured uptake of calcium. Over time an imbalance may occur between the foundation elements. If dosing daily, test all of the foundation elements weekly and make adjustments with the individual Calcium+, KH/Alkalinity & Magnesium supplements.

Note: Only supplement the elements included in Trace-Colors Iodine+ and Potassium+ according to measured uptake of iodine and potassium.

Foundation™ ABC+ should be added directly to the sump and **not dissolved in top-up water**.

Do not use Foundation™ ABC+ to make periodic adjustments to the calcium level.

Do not add more than 60g of Foundation™ ABC+ at one time to any system irrespective of size. Larger doses can be added in 10 minute intervals between spoons to allow the powder to dissolve without causing precipitation.

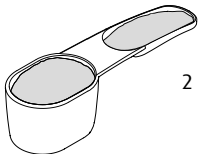
Making stock solutions from Foundation™ Calcium+, KH/Alkalinity & Magnesium powder supplements

To produce stock solutions, dissolve the powder in RO water as follows:

Supplement	Concentration of stock solution	Metric		USA	
		Dosage g/liter	Dissolve 1kg of powder in (liters)	Dosage oz/pint	Dissolve 2.2lb of powder in (pints)
Foundation™ Calcium+	1 ml/100 liters = 2ppm Ca	550	1.82	9.2	3.8
Foundation™ KH/Alkalinity	1 ml/100 liters = 0.012meq/l 0.034dKH	100	10	1.7	21
Foundation™ Magnesium	1 ml/100 liters = 1ppm Mg	600	1.67	10	3.5

Measuring spoon for Foundation™ ABC+ & powder supplements:

20 g / 0.7 oz



2 g / 0.07 oz

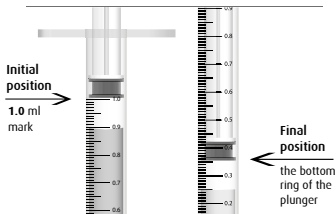
Important notes for using the Foundation™ Pro Titration Test Kits

- Before testing clean the glass vial and the large syringe by rinsing with the water to be tested.
- After testing rinse all syringes and vials with RO or distilled water before storing. If vials are left unwashed a residue can form that will affect the results of future tests. Use a slightly acidic solution such as vinegar to remove the residue.
- In order to ensure an accurate drop size **always hold reagent bottle vertically** above the test vial, and gently squeeze out each drop.
- Close all reagents tightly immediately after use.
- The test reagents are stable up to the date stated on the pack when stored closed between 15 – 25 °C.
- Store the reagents in the plastic box to prevent damage from prolonged exposure to light.

Note for filling the 1ml titration syringe:

Raise the plunger of the syringe until the bottom ring of the plunger (see arrow in diagram) is at the 1.0 ml mark. The surface of the liquid will be approximately 0.1 – 0.15 ml below the plunger.

Do not try to remove the air trapped between the liquid and the plunger. This small volume of air corresponds to the liquid held inside the plastic tip.



Directions for Magnesium Pro Test Kit

1. Using the large syringe provided, place exactly 2 ml of the water to be tested into the glass vial.
2. Add 5 drops of Mg Pro Reagent A, shaking the vial for 15 seconds after each drop.
3. Add 5 drops of Mg Pro Reagent B and mix the reagent gently with the water sample.
4. Screw the glass vial onto the bottom of the Titrator and wait for approx 60 seconds for the test sample to obtain the titration start color as shown on the instruction card. A precipitate will form on the bottom of the vial.
5. Ensure that the dispensing tip is on the 1 ml titration syringe and fill with 1ml of Magnesium Pro Titrant (C). [see note for filling titration syringe.]
6. Insert the syringe into the center of the Titrator so that the volumetric scale on the side of the syringe is visible. The graduations of the volumetric scale are 0.01 ml, equivalent to 20 ppm of magnesium.
7. Add the first 0.4 ml of titrant (equivalent to 800ppm of magnesium) by pressing the plunger of the syringe while gently swirling the Titrator. Continue adding the titrant gradually, swirling the Titrator after each addition and paying attention to the color in the vial. As the color in the vial approaches the end color as shown on the instruction card, add one drop at a time, swirling after each drop, until the blue end color is first achieved.
Note: Shortly after the blue end color is achieved the liquid in the vial will turn from blue to violet. Do not continue adding titrant. If you have used more than 0.8ml of titrant you may have missed the end point and should redo the test. Note the amount of titrant used (according to the initial and final position of the plunger not the liquid surface) and use the table on the instruction card to calculate the level of magnesium in the water sample.
8. Return any unused quantity of titrant to the Magnesium Pro Titrant C bottle.

Directions for KH Alkalinity Pro Test Kit

1. Using the large syringe provided, place exactly 10 ml of the water to be tested into the glass vial.
2. Screw the glass vial onto the bottom of the Titrator.
3. Ensure that the dispensing tip is on the 1 ml titration syringe and fill with 1ml of Alkalinity Pro Titrant. [see note for filling titration syringe.]
4. Insert the syringe into the center of the Titrator so that the volumetric scale on the side of the syringe is visible. The graduations of the volumetric scale are 0.01 ml, equivalent to an alkalinity of 0.05 meq/L (0.14 dKH).
5. Add the first 0.4 ml of titrant (equivalent to an alkalinity of 2.0 meq/L – 5.6 dKH) by pressing the plunger of the syringe while gently swirling the Titrator. The test sample will obtain the titration start color as shown on the instruction card after the first few drops of titrant are added. Continue adding the titrant gradually, swirling the Titrator after each addition and paying attention to the color in the vial. As the color in the vial approaches the end color as shown on the instruction card, add one drop at a time, swirling after each drop, until the end color is achieved.

Note: If you have added 1 ml of alkalinity titrant, without reaching the end color, the alkalinity of your water sample is more than 5 meq/L (14 dKH). Refill the syringe and continue to add titrant until you reach the end color.

6. Note the amount of titrant used (according to the initial and final position of the plunger not the liquid surface) and use the table on the instruction card to calculate the level of alkalinity in the water sample.
7. Dispose of any unused quantity of titrant.

Directions for Calcium Pro Test Kit

1. Using the large syringe provided, place exactly 5 ml of the water to be tested into the glass vial.
2. Add 5 drops of Calcium Pro Reagent A and mix gently with the water sample.
3. Add a leveled measuring spoon of Calcium Pro Reagent B, close the vial with the cap and shake for 20 seconds. The test sample will now have the titration start color as shown on the instruction card.
4. Screw the glass vial onto the bottom of the Titrator.
5. Ensure that the dispensing tip is on the 1 ml titration syringe and fill with 1ml of Calcium Pro Titrant (C). [see note for filling titration syringe.]
6. Insert the syringe into the center of the Titrator so that the volumetric scale on the side of the syringe is visible. The graduations of the volumetric scale are 0.01 ml, equivalent to 5 ppm of calcium.
7. Add the first 0.6 ml of titrant (equivalent to 300ppm of calcium) by pressing the plunger of the syringe while gently swirling the Titrator. Continue adding the titrant gradually, swirling the Titrator after each addition and paying attention to the color in the vial. As the color in the vial approaches the end color as shown on the instruction card, add one drop at a time, swirling after each drop, until the end color is achieved.

Note: If you have added 1 ml of Calcium Titrant C, without reaching the end color, the calcium concentration of your water sample is more than 500 ppm. Refill the syringe and continue to add titrant until you reach the end color.

8. Note the amount of titrant used (according to the initial and final position of the plunger not the liquid surface) and use the table to calculate the level of calcium in the water sample.
9. Return any unused quantity of titrant to the Calcium Pro Titrant C bottle.

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