

Phosphorus & Phosphates in your Reef tank:

Understanding the HI713 and HI736



Introduction

Measuring phosphates is a critical component of reef tank water testing practices. Phosphates are one of the many forms of phosphorus compounds found in marine waters. Excessive phosphate levels can prevent calcification, skeletal formation, and growth of many coral species, particularly those referred to as SPS or small-polyp stony. In addition, high phosphate levels can cause nuisance algae growth in your reef tank. This can become problematic because algae often outcompetes sessile organisms for light, nutrients, and space, jeopardizing long term coral health in your reef. There are several compounds containing phosphorus in the marine aquaria, but almost every test kit used in the aquarium industry measures orthophosphates.

Orthophosphate analysis is the only type of phosphorus test which can be performed without sample preparation involving a digestion in acid. Orthophosphates are compounds containing both phosphorus and oxygen atoms, and are commonly referred to as phosphate. Tests for orthophosphates are usually displayed as either PO_4^{3-} (phosphates) or $\text{PO}_4\text{-P}$ (orthophosphate as phosphorus). The former combines the oxygen atoms into the results while the latter only considers the phosphorus atoms. Orthophosphate tests which display results as phosphorus are not to be confused with a total phosphorus test, which requires a digestion and is much more difficult to perform.

Understanding the Conversion

Converting $\text{PO}_4\text{-P}$ to PO_4^{3-} is a simple equation where $\text{PO}_4\text{-P}$ (orthophosphate as phosphorus) is multiplied by 3.066 to equal PO_4^{3-} (phosphate) concentration. The conversion factor of 3.066 is based off of the atomic weights for oxygen and phosphorus molecules. One phosphorus atom has the atomic weight of about 31 g/mol while an oxygen molecule has an atomic weight of 16 g/mol. Since an orthophosphate molecule has one phosphorus atom weighing 31g/mol and four oxygen molecules (64g/mol (or 16 g/mol each) the total molecular weight is 95 g/mol.

We can divide the total weight of an orthophosphate molecule by the weight of one phosphorus atom to get the conversion factor of 3.066. To convert parts per billion (ppb) to parts per million (ppm) we simply divide by 1,000. To convert the HI736 ULR Phosphorus Checker reading to ppm phosphate multiply the results by 3.066 then divide by 1,000.

$$\text{PO}_4^{3-} = 16 \times 4 + 31 = 95 \text{ g/mol}$$

$$95\text{g/mol} \div 31 \text{ g/mol} = 3.066 \text{ Conversion Factor}$$

Testing your Reef Tank's Phosphate

Our primary orthophosphate testing instruments for the hobbyist reef market are the HI713 Low Range (LR) Phosphate Checker HC and the HI736 Marine Ultra Low Range (ULR) Phosphorus Checker. The HI736 is labeled "marine" because it is specifically designed for saltwater and utilizes an absorbance curve for marine environments, while the HI713 can be used in either freshwater or saltwater. The HI736 ULR Phosphorus Checker has a range of 0 to 200 ppb $\text{PO}_4\text{-P}$ orthophosphate as phosphorus, which correlates to 0.003ppm to 0.613ppm PO_4^{3-} . The HI713 LR Phosphate Checker has a range of 0.00 to 2.50 ppm PO_4^{3-} orthophosphate. Both Checkers use an adaptation of the Ascorbic Acid method, with an LED light source at a wavelength of 525 nm and a silicon photocell as a light detector.

The HI713 LR Phosphate Checker is a better fit for reef tanks housing coral species less sensitive to phosphate, such as certain soft corals. The HI713 LR Phosphate Checker is also ideal for aquarists who have freshwater aquariums or fish only saltwater tanks (FOWLR). The HI736 ULR Phosphorus Checker is designed for reef tank owners keeping SPS corals and aquariums aiming for low phosphate levels less than 0.03ppm. While the HI713 LR Phosphate Checker will work for any saltwater aquarium, the unit has an accuracy statement of $\pm 0.04 \text{ ppm} \pm 4\%$ of reading. This means if your HI713 LR Phosphate Checker displays a result of 0.08ppm, the measurement uncertainty is from 0.04ppm to 0.12ppm, which can be problematic for certain reef aquarists. Displaying the results in part per billion phosphorus gives a narrower range for detection, but increased accuracy at low range phosphate concentrations desired by many reef tank hobbyists. The HI736 Marine ULR Phosphorus Checker should not be confused with a total phosphorus test. Testing for orthophosphates is standard practice for saltwater aquariums and provides valuable insight into your reef tank's water chemistry to help ensure long-term coral health.