Testing Test Kits

By Norm Meck

I consider it a minimum requirement for the average pond keeper to have the capability to measure at least the Ammonia, Nitrite, and Nitrate concentrations as well as pH, and temperature of the pond. One doesn't need to test an established pond daily or even weekly. Once a month is usually appropriate or whenever anything out of the ordinary is observed. Daily tests may be required when starting up a new pond and/or filter system. Don't fall into the common trap of not testing since the tests always read the same. Tests can provide advance warning of an impending problem or help solve a current problem. One of your best test kits is the fish themselves. Watch them daily and get to know their behavior. Get out the chemical test kits when any changes are observed.

So, feeling a bit negligent, you go out to the garage and dig out that test kit, blow the dust off of it, and add your drops or pills or powders to the test tube of pond water. The resulting color is something resembling that found in the cat's litter box. You decide it is kind of brownish-purple, but the color chart says it should be a shade of pink. Actually this isn't such a bad situation since it is obvious that something is wrong. Either with the test kit or something is in the water that is interfering with the test kit's chemical reactions. A bad situation is where the test kit is indicating the presence of a substance when it really isn't there. The worst situation is where it is showing none and something is actually there.

Would you keep and use a prescription medicine considerably past its expiration date? What about that jar of Cheese Whiz in the back of your refrigerator that says, "Best if used before January 1994"? Date your test kits when you purchase them even though you probably don't know how long they have been on the dealer's shelf. I applaud Aquarium Pharmaceuticals as one of the few hobbyist test kit manufacturers that date their products. Unless otherwise indicated, I recommend that liquid based test kits be replaced one year after purchase, or two years for those that use sealed pill/powder reagents. (An exception is that pH test kits will normally keep twice as long as other types) In any case, throw them away when expired and purchase replacements.

Most test kits will have a longer shelf life if kept in the refrigerator (do not freeze). Do not let them sit in the hot sun or in a closed car on a summer day. Just a short time exposed to high heat can destroy many test kits.

Clean the test tubes (and caps) between uses and rinse several times with the sample water before use. Just a very small amount of residue from one type of test may affect the results of a different test.

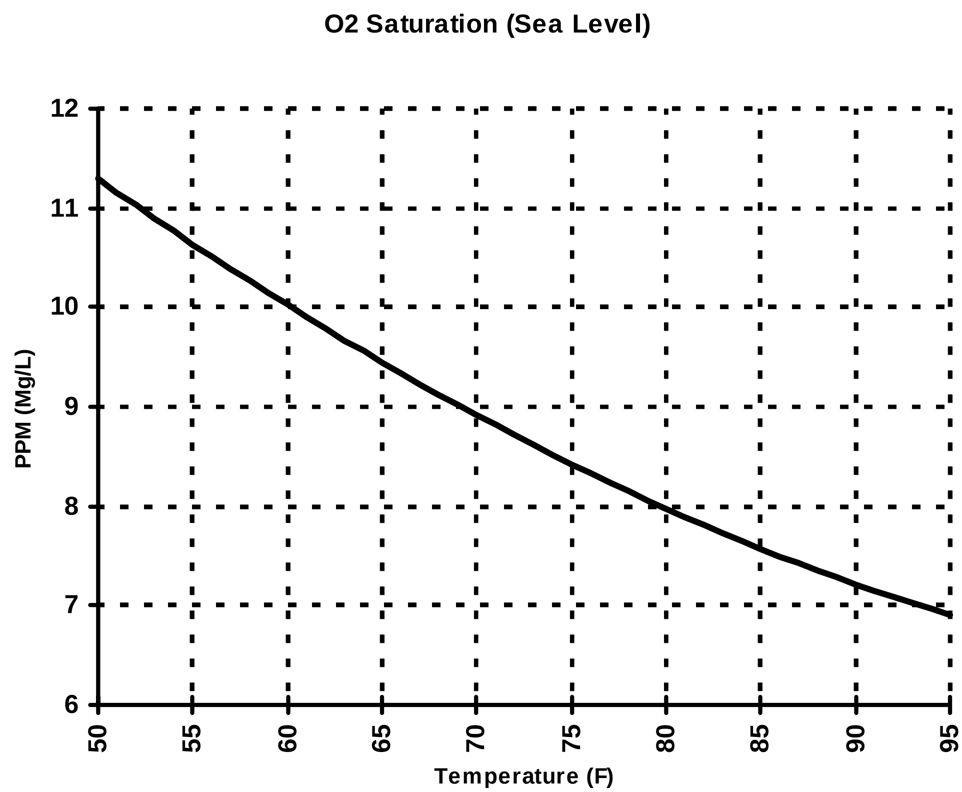
When comparing the results with the color chart, look for the hue (tint or shade), not the intensity of the color.

But the question still comes up, "Are my test kits correctly indicating the water conditions?" What can we do to have confidence in the results of the tests we are running? A simple initial step is to run the tests on distilled water to check for a proper zero reading. This is great for the Ammonia, Nitrite, and Nitrate tests (as well as Chlorine, Total Alkalinity, Salinity, Copper, Iron, Phosphate, Hardness, and others), but it will not work for temperature, pH or Dissolved Oxygen.

For temperature, compare your thermometer reading with that of a couple other thermometers. Having three that read the same should give a pretty good idea that they are providing accurate information. This same comparison procedure can be used for any of the chemical tests if you happen to have multiple kits available to test for the same thing.

The pH of absolutely pure water is undefined. Usually, distilled water will have a pH somewhere around 5 caused by absorption of carbon dioxide from the air. Just the addition of the reagent used to measure the pH will cause the pH of distilled water to change. We need a known checkpoint. For pH, dissolve two teaspoons of Sodium Bicarbonate (simple baking soda, not baking powder) in a cup of distilled water. A pH test of the mixture should read very close to 8.0.

For Dissolved Oxygen, place an air stone in a cup of distilled water for several minutes and then check for a reading to be equal to saturation at the temperature of the sample. (See chart below)



The zero tests we conducted above against distilled water are fine but only show one point of the test kits range. It doesn't mean that they are necessarily accurate at other readings. For measurements other than zero, we need a known standard solution, which is a bit more complex to make. What follows is a procedure for making standard solutions for the more common tests. I might also point out that these standards could constitute the basis for an excellent club meeting program. Make up a set of the standard solutions and have everyone bring their test kits to the meeting. Everyone gets to participate in the program and not only see if their test kits are accurate, but if they are conducting and interpreting the tests correctly.

Since most of our desired measurements are in parts per million, the quantity of a substance we need to make a standard solution is extremely small. Remember that one part per million is one unit of weight of a substance in one million of the same units of weight of water (or another substance). To be absolutely accurate, we should actually mix our 1 unit of substance with 1 million units less 1 unit of water so we end up with 1 million total units of the mixture.

I prefer to work in metric units for this task because it makes the math much easier. In metric units, 1 cubic centimeter (cc) of water is one milliliter (ml) and weighs one gram. This makes things work out nicely in that 1 gram of a substance mixed with 1 liter (1000 grams) of water is 1 part per thousand or 1000 parts per million. For some reason, in English units, one fluid ounce of water weighs 1.0425 ounces (avoirdupois). Therefore, in English units, we would have to use 0.03336 ounces of the substance in a quart of water (32 fluid ounces, which is 33.36 ounces by weight). Don't ask why, just go metric.

To make one liter of a 1 ppm solution, we would have to be able to accurately measure one thousandth of a gram. This is tough to do so we will make a higher concentration solution and then dilute it down to the desired concentration. To make our concentrated standard solutions, we will still need an accurate gram scale (beam or balance) capable of measuring hundredths of a gram. A gun powder shell reloading beam scale is inexpensive, widely available, and does a good job. We will also need a way to accurately measure the amounts of water and solution in milliliters.

I suggest we start off with a 2 liter soda bottle. With our liquid calibrated measure, fill the cleaned soda bottle with two liters of tap water and mark the level. Dump, rinse with a bit of distilled water and refill the bottle to the 2 liter mark with distilled water.

For 2 liters of a 1000 ppm (1 ppt) standard solution, dissolve:

Standard Type	Chemical Used	Amount (grams)
Ammonia	Ammonium Chloride, NH_4Cl	6.3
Nitrite	Sodium Nitrite, $NaNO_2$	3.00
Nitrate	Potassium Nitrate, KNO_3	3.26
Salinity	Sodium Chloride (salt), NaCl	2.00

As you can see, we don't need much of the chemicals to make even these concentrated standards. Just one ounce of salt will make 14 liters (over 3 1/2 gallons) of the 1000 ppm salinity standard. When I purchased my Sodium Nitrite and Potassium Nitrate, the smallest amounts I could find were five pound containers, so I have lots left over. I later found that some toy stores stock replacement bottles of chemicals for chemistry sets. These will work well and not clutter up your garage with large amounts of leftovers.

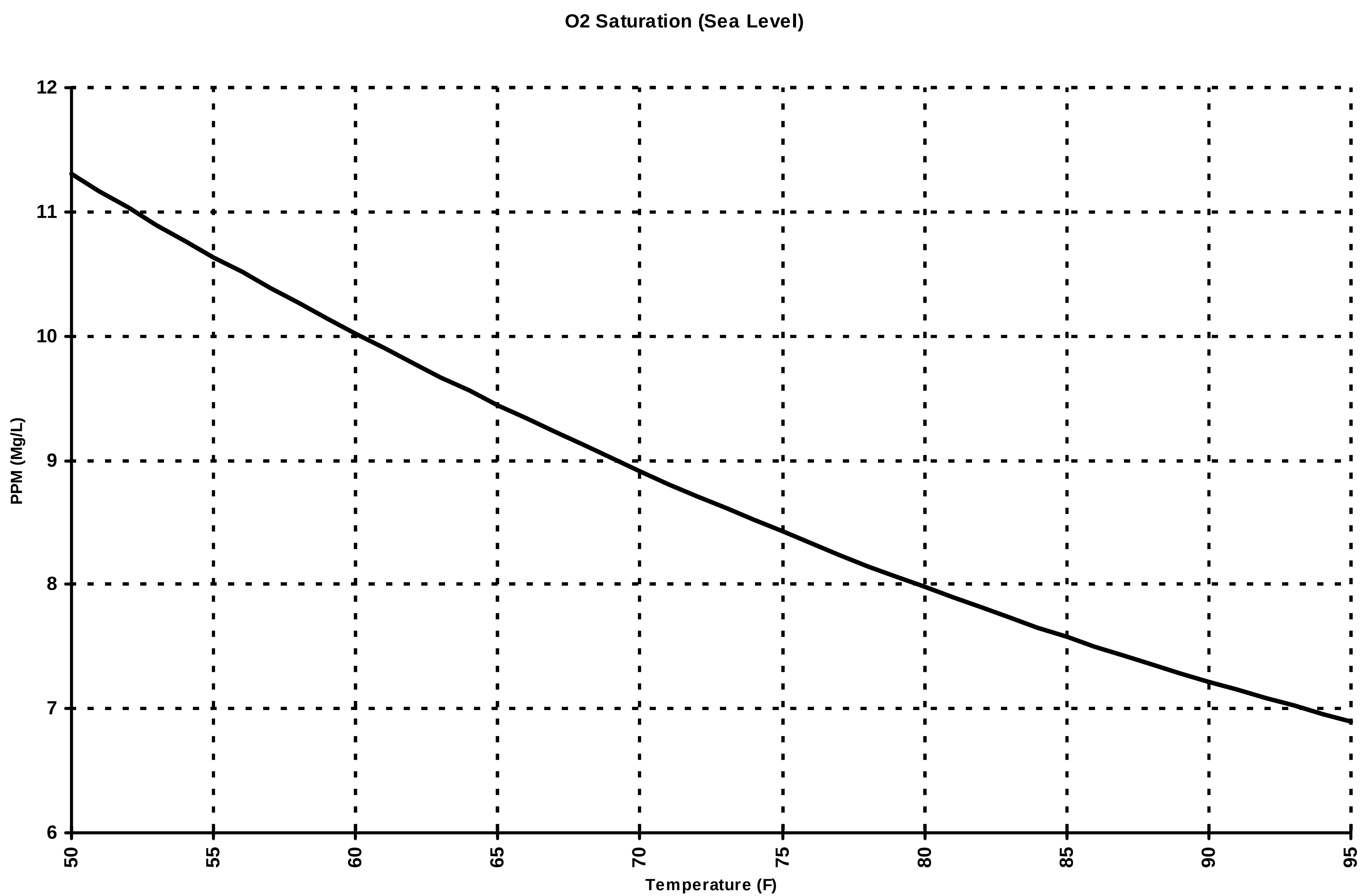
Although the chemicals have a long shelf life, after being mixed with the water the standards themselves have a shorter shelf life than the test kits. Most should be accurate for a couple months if kept capped and in a reasonably cool place.

The salinity standard can probably be used just as it is since 1 ppt (0.1%) is right in the range we would normally be measuring with our salinity test kits. The others are too concentrated for our purposes and will have to be diluted before use.

For example, suppose we want a 50 ppm nitrate standard solution. All we have to do is to add 50 ml of our 1000 ppm standard nitrate solution to 950 ml of distilled water and we end up with 1 liter (1000 ml) of a 50 ppm standard nitrate solution ready for use.

For a 1 ppm ammonia or nitrite standard, just add 1 ml of the 1000 ppm standard to 1 liter (or to be totally accurate, 999 ml) of distilled water. A calibrated syringe works well for this. (Remember, 1 ml = 1 cc).

Is all this really necessary? Probably not, but it can be a fun project and give you that warm fuzzy feeling that your test kits are accurately indicating the water conditions in your pond.


O2 Saturation (Sea Level)
PPM (Mg/L)
12
11
10
9
8
7
6
50
55
60
65
70
75
80
85
90
95
Temperature (F)