



## Water Parameter / Testing Quick Reference Guide

**WHEN TO TEST** – Individual, one-time tests are only important if the test results indicate a toxic or dangerous condition, such as high ammonia, where corrective action has to be taken immediately. The greatest benefit of testing, however, is obtained when results are plotted on graph paper over a period of several tests, so that trends or directions can be noted early. By knowing the direction your pond's water quality is taking, you can take corrective action before a potential problem gets out of hand.

PARAMETER	DESCRIPTION
PH	<p><b>pH</b> is a measurement of the free hydrogen ions in the system. pH is measured on a scale of 1 to 14, but the pH required for life lies between 5.5 and 8.5. Stay above pH 7.0 for best results with Koi. At higher pH values, ammonia is more toxic. pH can "crash" to 5.5 overnight due to fish, plant and bacterial activity without adequate buffering of water - fatalities result. See Hardness and Alkalinity below. Acceptable pH range = 7.0-9.0, most important is to minimize fluctuation within this range.</p>
Ammonia	<p>Target range for ammonia is 0. Max recommended is 0.25ppm. Made from rotting fish wastes/urine/food. High levels of ammonia cause redness of fins, general poor health, excess mucus production, flashing, and by chronic auto-intoxication: Pinecone disease. Ammonia is more toxic at pH above 8.0. Ammonia is removed from the environment by beneficial bacteria called "Nitrosomonas". You can control Ammonia with a "balanced pond", partial water changes or addition of Zeolites.</p> <p>There is a big difference between <b>Total Ammonia</b> (the sum) vice <b>Free Ammonia</b> and <b>Bound Ammonia</b> (the parts of the sum). What most of us want to know is what the <b>Free Ammonia</b> level is in our water. It is the <b>Free Ammonia</b> that is going to do the most damage to the gills of our fish and eventually cause death if not countered.</p> <p>The two most common test kits are:</p> <ol style="list-style-type: none"> <li>1. <b>Nessler</b> reagent type test kit, which is a one step, quick reacting test. It is fine for untreated water, but gives false readings in water treated with ammonia binders. These kits <b>read total ammonia only</b>.</li> <li>2. <b>Salicylate</b> reagent type test kit, which is a two step/part test kit and slower to react to give final readings. Again, these kits read <b>total ammonia only</b>.</li> </ol> <p>How do I know what type I have? The easiest answer is that the Nessler test is clear when negative and turns yellow when positive; the salicylate test is yellow when negative and turns green when positive.</p> <p>Most of these test kits will have their readings affected by ammonia binding chemicals. Good test kits give true total ammonia readings in the presence of Amquel, Prime or similar products. These types of products (and others like them) are Chlorine/Chloramine neutralizers, but also contain ammonia binders that will interfere with normal Nessler test kits, causing false readings. Test kits known to me that are not affected are the Mydor Ammonia test kit, Kordon's AquaTru Test Kit, Seachem's Multitest Free and Total Ammonia Test Kit and the LaMotte Salicylate test kit for use with Amquel or the Hach test kit (the latter two are more expensive and may be beyond the cost vs. needs of most hobbyists).</p>
Nitrite	<p>Target range for Nitrite is 0. Max recommended is 0.25ppm. Nitrite is less toxic than ammonia, but still very toxic because it inhibits the ability of the blood to carry oxygen. Ammonia is converted to Nitrite by</p>

	Nitrite level is elevated according to your test results, make a partial water change and add bacteria high in Nitrobacter. Nitrite toxicity is temporarily reduced by the addition of salt at 8 pounds per 1,000 gallons (0.1%).
Nitrate	Nitrate is the end product of the nitrifying phase of the nitrogen cycle. It is much less toxic for koi than either ammonia or nitrite. It is, however, a nitrogen compound that is the food and fertilizer for algae/plants. Partial water changes of 1/10 <sup>th</sup> per week will flush out accumulating Nitrate. Acceptable range is 20-60ppm (the lower the better). If the Nitrate level is over 60 ppm as indicated by a test, water changes are recommended. Nitrate is toxic to koi above 120ppm. Elevated levels of Nitrates stunt koi growth and slows wound healing.
Hardness	<b>GH: General Hardness</b> - measures the water's buffering capacity in terms of "units of carbonate buffering capacity." General Hardness is a number, which combines Hardness (mineral content) and Carbonate activity. Desired level for koi ~100ppm (GH and KH). Be careful, greater than 120ppm can cause shimmies. <b>KH: Carbonate Hardness</b> - basically the GH (General Hardness) with the mineral number subtracted, leaving carbonates (i.e. See Total alkalinity below). CaCl can be used to quickly raise (General) hardness. See <b>Oyster Shell</b> below. Harder water allows koi to ease up on osmoregulation and therefore reduces stress.
Total Alkalinity	Alkalinity could be described as the "intensity of pH". Addition of <b>Baking Soda</b> (Sodium Bicarbonate) results in a higher Carbonate Alkalinity (i.e pH Buffer), but does nothing to Hardness. Check Total Alkalinity before its use, though. (Use one teaspoon per ten gallons if the TA <100ppm). <b>Oyster Shell</b> is nothing but Calcium Carbonate and Magnesium Carbonate. When the Oyster shell dissolves due to the presence of acid water, it liberates Calcium, Magnesium, and Carbonates. These mineral liberations increase the hardness of the water (contributing nothing to Buffering capacity) and the Carbonates increase the Alkalinity. Thus, the pH is stabilized. Your water will be clearer with a higher Total (carbonate) Alkalinity. <b>Plaster of Paris</b> can be used to make a "pH pill" or puck of white chalky material you can toss into the pond, and it will slowly dissolve, liberating carbonates, Calcium, Magnesium and gypsum. The dissolution of the "pH pill" increases hardness, alkalinity and more in the water being treated. <b>All of the above will also increase pH.</b>
Dissolved Oxygen	Dissolved oxygen is usually only a warm weather concern, as it is associated with water temperature and algae. However, the larger the koi, the greater the oxygen demand. Low levels will stress and kill your biggest koi. The colder the water, the greater its capacity to hold dissolved oxygen (and vice versa). Algae/plants take up oxygen at night, but create it during the day. The time of day with the lowest dissolved oxygen in the pond water is early morning. Beware if your pond is heavily stocked with koi, you have lots of plants, in the middle of a Summer heat wave and your power goes out (especially at night). It's a combination which can quickly spell disaster for koi.  The recommended minimum level of oxygen in a koi pond is 8 ppm (complete saturation is 14ppm). Temporary minor fluctuations below this should cause few problems providing other water quality parameters (pH, Ammonia and Nitrite) are acceptable. However a permanent value below 8 ppm is destined to cause koi health problems. Koi will survive for a few days at 5 ppm, but if the oxygen concentration drops to 3 ppm the fish will start suffering severe oxygen shortage, and will soon die of hypoxia. Should you record a dangerously low concentration of dissolved oxygen in your pond there is a temporary solution to get you out of trouble until the cause of the shortage can be found out. A solution of 3% hydrogen peroxide should be squirted into the pond just under the water surface. Carefully decant the solution into a spray bottle, or preferably use a spray atomizer attachment that will fit onto the peroxide bottle. Use roughly 60 squirts per 86 gallons (388 L) of pond water. This is a laborious process in large ponds but will raise the oxygen levels giving your koi and filters vital oxygen, and giving you roughly 4 hours to get the oxygen levels back up by more conventional means. Do not apply the chemical on or near the fish or gill damage will occur. Do not rely on this process regularly. If oxygen shortage is a consistent problem, then buy an air-pump or venturi. Hydrogen peroxide is great for emergencies, and should only be used as such.
Temperature	Koi can <b>survive</b> in water temperatures from 32F to 95F, but are stressed at the extremes. Koi can <b>thrive</b> in water temperatures from 50F to 80F.
Salt	0.1% helps koi with osmoregulation (8 pounds per 1,000 gallons). As little as 0.05% will begin to kill some (anacharis) pond plants, although some (lilies) are unharmed at 0.2%. If using zeolite to reduce ammonia, beware when adding salt. As salt is used to recharge zeolite and will cause it to release all its ammonia back into your pond.

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