TEST CASE

HANNA HI-83203

Testing pond parameters has always been high on the list of priorities for any Koi keeper, but is it important enough to warrant spending the extra money on an electronic tester? Water-quality whizz **Syd Mitchell** reviews the Hanna HI-83203 to give you a crystal-clear idea…

Doubtless you will have heard the phrase "we don't keep fish, we keep water" somewhere in your Koi-keeping life, perhaps even from me! There are many different versions of this phrase but, basically, they all mean the same – it is not possible to keep healthy fish in poor-quality water.

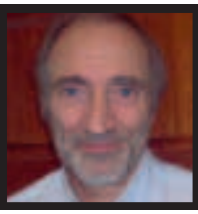
It is also not possible to simply look at a sample of pond water and decide whether important parameters such as dissolved oxygen, ammonia, nitrite and pH are within acceptable limits. The naked eye will simply not cut it. You have to add one or more different chemicals, called reagents, to the sample. They then change colour according to the value of a particular parameter, and the colour change is compared to a colour chart so that you can read the appropriate value.

The extra mile

There are many manual test kits that measure water parameters, but they all suffer from one disadvantage – accuracy. For example, some ammonia test kits, although made by a range of reputable manufacturers, only have five separate colours on their charts: 0, 0.25, 1.5, 3.0 and 5.0mgl. The pH in my area is 8.4, and in my quarantine tank, when I am heat-ramping the temperature, it reaches 28˚C. At this pH and temperature, the maximum safe value of (total) ammonia is 0.13mgl, so if I used that particular kit to check ammonia levels, the first colour change I could detect would already be almost twice the safe limit. Other ammonia kits show their first colour change at 0.4mgl – three times the limit in my quarantine tank and almost twice the safe limit in my pond when the temperature is only 20˚C. These kits are not extreme examples; one nitrite kit has its lowest reading at 5.0mgl – 25 times the safe limit!

The sample colour also has to be judged by eye to see which chart colour it matches. However, this is not quite as simple as you might imagine. Sometimes the colour of the water sample you've added the reagent to does not visibly match any of the colours on the chart given to you in the kit. You're then left wondering whether you've got levels of 0mgl, 0.25mgl or 1.5mgl! Clearly, to provide the best possible water for your Koi, you need a

Syd uses an electronic meter when part of the water-quality team at the South East Show



Syd Mitchell

Syd Mitchell has been studying water chemistry and filtration systems since 1984. He started off with a tank of tropical fish before building a Koi pond and, after joining a Koi club, he began advising hobbyists about water quality.

THE BRIEF

■ To test and assess the merits of an electronic water tester – in this case a Hanna photometer HI-83203.
■ To outline how useful it might be to a Koi keeper and deliver a reasoned verdict on its relative advantages and disadvantages.

piece of equipment that can give you more accuracy, especially at lower levels, and the answer is to use a photometer such as the Hanna multiparameter tester.

How a photometer works

Hanna Instruments make a range of photometers, and the most suitable model for Koi keepers is the HI-83203 which is the newer version of the famous C203. To those who have seen Hanna testers but never used one, they may look complicated but, believe me, they are not. The way photometers analyse water is actually similar to that of a manual test kit, although it is far more accurate.

With manual kits, reagents are added to a water sample and the colour change is compared to a colour chart. The human eye is poor at judging small colour changes. This is especially noticeable when the sample colour is not an exact match with one of colours on the chart and it is down to you to choose the nearest match, as I discussed before.

Photometers avoid this problem by adopting the principle of shining a light through the sample and electronically measuring how much comes out the other side. Since the intensity of the light going into the sample is constant, and the light coming out can be accurately measured by a photo cell, it is possible for the built-in computer circuitry to calculate how much light didn't get through. Obviously, if there was no colour change at all, then 100% of the light would pass through the sample. The circuitry would decide that, in this case, no loss of light through the sample meant there had been no colour change and therefore the display would show a 0 reading for this test – it's as simple as that.

If the sample changes colour due to a particular pollutant being present, then as the colour change became greater, it would become darker and more light would fail to get through. The circuitry measures how much light was lost, calculates what this means in terms of milligrams per litre of the pollutant, then shows an appropriate reading on the display.

What happens in a test

Diagram 1 on page 70 shows a simplified diagram of the optical arrangements and electronic circuitry of a photometer. In practice, it is much more sophisticated than this, but the diagram illustrates the principle involved. A light shines through the sample before the reagents are added. If the sample is clear and colourless, all light passes through. If there is a faint colouration in the water, a small proportion of the light will be stopped. The light falls on a sensitive light detector which converts it into an electrical signal. This is processed by the electronic circuitry and a zero value will be displayed. The electronics also remember how much light passed through the unreacted sample. ▸

TESTING TIMETABLE

TIME ELAPSED	ACTION
0 min	Add reagent to nitrite sample
1 min	Add reagent to ammonia sample
2 mins	Add reagent to nitrate sample
5 mins	'Zero' ammonia test using blank cuvette 'Read Direct' ammonia sample
6 mins	'Zero' nitrate test using blank cuvette 'Read Direct' nitrate sample
7 mins	'Zero' nitrite test using blank cuvette 'Read Direct' nitrite sample
8 mins	'Zero' pH test using blank cuvette Add reagent to it and 'Read Direct'

After adding the reagents and waiting for the reaction to take place, the sample will change colour. In the case of an ammonia test, for example, the sample turns yellow if ammonia is present. The greater the concentration of ammonia, the deeper the yellow colour will be. See **diagram 2** on the right (below). When the sample is re-tested, the same intensity of light goes into the sample but less passes through according to how deep the yellow colour has become. The photo cell measures the reduced amount of light and the electronics calculate how much was stopped by the reacted sample. The appropriate value of ammonia is displayed.

When testing other water parameters, different reagents are used and these cause different colours to develop, but the principle is the same – the greater the concentration in the sample, the deeper the colour and this allows less light to pass through. The reduction in light is measured and the appropriate value for the parameter is displayed.

DIAGRAM 1 ZEROING THE TESTER

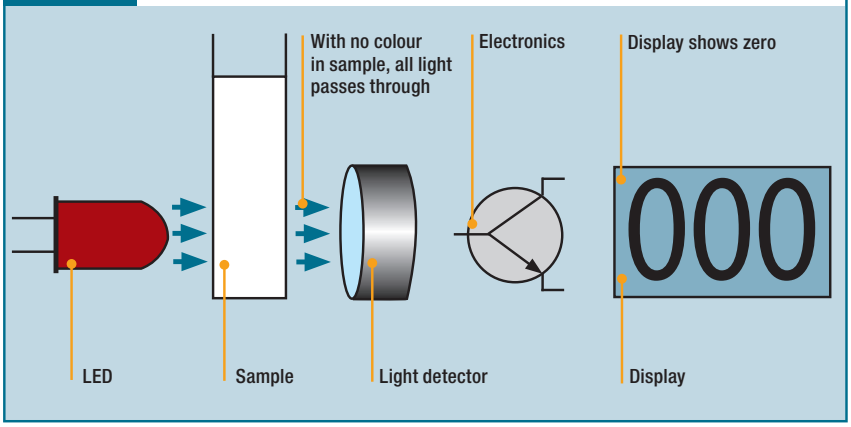
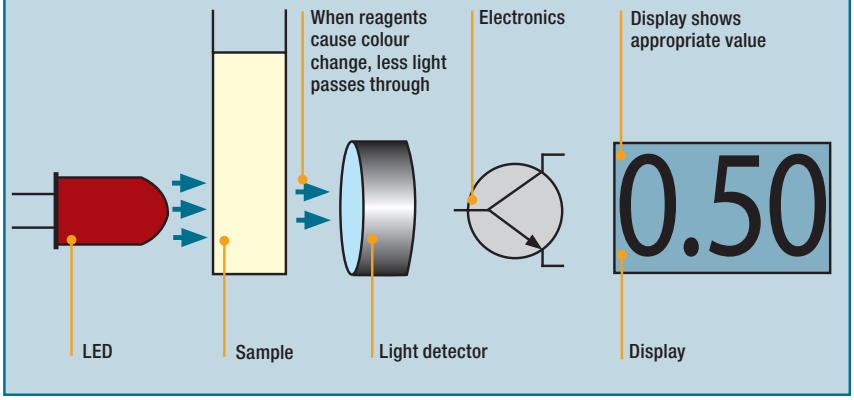


DIAGRAM 2 READING THE DEGREE OF COLOUR CHANGE



Accuracy levels

How does the accuracy of an electronic meter like the Hanna compare with the accuracy of manual test kits? Taking a typical example of a pond with a pH of 8.0 and a temperature of 20˚C, the maximum safe ammonia level in that pond is 0.52mgl. Referring back to the example of test kits discussed previously, the three colours to choose between were 0, 0.25 or 1.5mgl. A decision has to be made: is the level 0? Is it half the safe level? Is it three times the safe level? Those are the three choices. With a Hanna, the level is displayed in steps of 0.01 which means that it is able to show 52 separate values (53 counting zero) of ammonia concentration up to the safe level of 0.52mgl. There is no comparison where accuracy is concerned.

Obviously, ammonia levels should be as near zero as possible, but since it is impossible, in practice, to achieve true zero values, the next best thing is to know what the value actually is. A value that was rising by 0.01 each time it was measured would indicate that something was wrong in the biological filter allowing plenty of time to take corrective action. Whereas the first indication with a manual kit might be when it showed that the level had reached three times the safe value. The same argument applies where nitrite is concerned. It is far better to be able to notice the value rising by small but significant amounts each time it is tested, allowing time to investigate the cause, rather than be suddenly informed by a manual kit that the level has exceeded the safe value.

Other features

The Hanna has a built-in timer which allows time for the reagents to develop before the sample is measured. Before adding reagents, place the cuvette (special test tube) containing the sample into the tester and press zero. The machine measures how much light passes through the sample. Remove the cuvette, add the reagents, then replace it in the tester and press 'timer'. The computer circuitry sets the timer according to which test is being made and the countdown begins. When the time has elapsed, the sample is automatically re-tested and, according to how much the colour of the sample has changed, the value for that parameter is displayed.

Speeding things up

It is sometimes said that a disadvantage with the Hanna is that it is slow compared to manual test kits because it can only be used for one test at a time. The argument goes that it is necessary to wait while the developing time for one test completes, and for the result to be displayed, before beginning the next. With manual kits, there is also a waiting time while the reagents develop, but with a separate kit for each parameter, they can all be started at the same time, so they develop simultaneously and the results will all appear at roughly the same time.

However, it is my experience that the Hanna can also make more than one test at a time. To understand how, a short recap may help. The sample is placed in the machine and it is tested to establish a zero value. The sample is removed, reagents are added, then it is put back and the timer is started. When the time has elapsed, the sample is again tested and the result is displayed. What goes on while the timer is counting down? The answer is nothing; the tester is just waiting for the sample to develop. Samples could just as easily be developing outside the machine. With this in mind, by following the timetable on page 69, it is possible to dramatically speed up the testing process. You'll need four cuvettes, one each for the nitrite, ammonia and nitrate samples, plus a fourth for 'zeroing' before each test. You can also use the fourth to measure pH.

CUVETTE CARE

- Cuvettes are special, optical measuring test tubes made of quartz glass.
- Take care when handling cuvettes to avoid scratching them.
- Empty and rinse your cuvettes thoroughly after testing to avoid staining.
- Keep cuvettes clean and avoid fingerprints.
- Scratched, stained or dirty cuvettes reduce accuracy.

HOW DOES A HANNA METER WORK?

1 Read the instructions thoroughly before starting the testing procedure.

2 Make sure the cuvettes are thoroughly clean and scratch-free before using them.

3 Place a sample of your pond water into a clean cuvette.

4 Place this water sample straight into the Hanna machine.

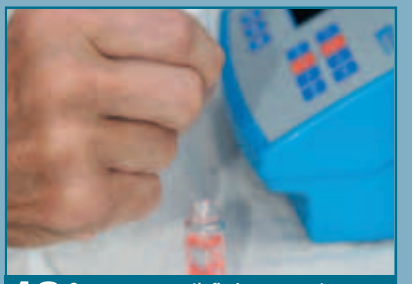
5 Press zero – 'zero testing' will increase the accuracy of testing the actual samples.

6 Once zero testing is complete, remove the cuvette from the machine and add the reagent.

7 Then leave the appropriate reagent to develop in the sample.

8 Place the sample in the machine, and press timer.

9 When the time is up, the machine will reveal the test results.



10 Once you are satisfied, move on to your next parameter and repeat the test.

If the timetable looks complicated, it's not – try it. You may need to slightly adjust the times to suit your own speed, but the whole process takes me less than nine minutes. Measuring these four parameters this way actually takes less than half the time required for a typical manual ammonia test kit!

Advanced testing

Where a single parameter, such as ammonia, has to be repeatedly checked, as would be the case with the many ponds of a Koi dealer or where a pond keeper has more than one pond, it is possible that the machine can be zeroed on a sample of plain water and then all pond samples checked against it. Clear, unpolluted water is the optimum condition and this is what we should be trying to achieve. This method is particularly effective because it evaluates each sample against the sample of optimum water and so I use it as part of the water-testing regime at the South East Koi Show, but the implications must be clearly understood before attempting it.

In the new HI-83203 handbook it states: "it is possible to take multiple readings in a row". This is qualified by a warning about using the same cuvette when zeroing and also following measurement procedures carefully 'for the most precise results'. Remember that, during the 'zeroing' process, the cuvette and the sample within it are assessed to determine how much light is lost before reagents are added. If the tester is 'zeroed' on plain water in one cuvette, and any of the other measuring cuvettes are dirty or the actual samples have a faint colouration, the displayed parameter reading for that sample would be slightly higher than it should be. If samples show turbidity, this method should not be used, they should be checked separately.

However, if all cuvettes are identically clean and there is no visible difference in turbidity between the plain water and the samples taken, then any error will be insignificant and you can carry on and use this method safely. ■

THE VERDICT

I am frequently asked why Koi keepers should fork out the extra money for an electronic meter and I always answer that, although manual kits are cheap and easy to use, they cannot give an accurate indication of water parameters, especially at low levels. This is very important with nitrite, where levels should be well below 0.2mgl, or ammonia where levels may have to be lower than 0.13mgl. An electronic meter, such as this Hanna meter, will give the level of accuracy that is required to ensure optimum pond water conditions. And with the new HI-83203K kit, specifically designed for Koi ponds, just hitting the shops (see *Koi news* on page 8 for more details), there has never been a better time to invest your money in this piece of kit. Thumbs up!