YOU MUST READ AND BECOME FAMILIAR WITH THE FOLLOWING INFORMATION BEFORE RECORDING & SUBMITTING DO DATA FOR YOUR LAKE!!

General Guidelines for Using a Meter and Probe to Collect Dissolved Oxygen (DO) and Temperature Data

It is essential that you become thoroughly familiar with the following information. Failure to do so could raise questions concerning the data that you collect, and could ultimately result in the rejection of your data by the DEP and VLMP. We certainly do not want this to happen! The time that you spend gathering DO data is valuable to you and to us. We want to help ensure that you collect accurate and credible DO data for your lake.

The DO data that you collect can be influenced by several factors, including timely and proper maintenance of your monitoring equipment, proper calibration of your meter, and collecting the data under appropriate (reasonable) field conditions. Failure to address each of these influences every time that you monitor DO could result in questionable data.

This general guidance applies to most of the dissolved oxygen meters and probes that are being used by volunteers. We are most familiar with equipment manufactured by YSI, since many of the units currently in use by volunteers and professionals are manufactured by this company. Because a number of new models and designs become available every year, it is possible that these guidelines will not strictly apply to the unit you have chosen to use . *Please be sure to contact the VLMP with information about the unit that you will be using prior to attending a training workshop*. We will make an effort to research the unit that you plan to use. We would also be happy to assist you with choosing a DO meter, if you do not yet have one, or if you are replacing an older model.

Before Leaving Shore:

Note: Numbers 1-6 should take place in an indoor setting with adequate light at stable room temperature.

1. Check the external condition of the meter. If the unit has been stored in a container, was it allowed to dry out after it was last used? If not, moisture may have entered the case and the unit may not function properly. If the case is moist, the meter should be allowed to dry for several hours before attempting to operate. If the unit has not been used recently, check the condition of the batteries. Old batteries may have leaked, possibly causing damage to the meter. It is good practice to install new batteries at the beginning of the season and remove them at the end of the season, regardless of their condition.

2. Before turning the meter on:

    a. Inspect the probe for evidence of leakage: a white crusty substance formed around the edge of the membrane "O" ring (or around the edges of the screw-on membrane caps) indicates electrolyte (KCl solution) leakage. Also check for wrinkled membrane, or bubbles under the membrane. Replace the membrane if any of these conditions are found. Note: a line of salt along the outside of the probe usually indicates a cracked probe body, which will probably cause probe failure in deep water, and the need to replace the unit.
    b. Check to be sure that the sponge in the calibration chamber is moist, but not sitting in a pool of water. Pour out any standing water in the chamber. NOTE: If the sponge is not moist, the meter can not be accurately calibrated.
    c. Check the color of the electrodes. On some probes, the electrodes are a gold circle (cathode) and white triangle (anode), visible under the membrane. If the gold circle is not bright, remove the membrane and use a clean pink pencil eraser to gently burnish the surface. If the triangle is dull, gray or black, the probe should be soaked in a solution of ammonium hydroxide. Contact the VLMP or DEP for more information and assistance. Note: ammonium hydroxide fumes are toxic! On many of the newer probes, the gold electrode is visible at the end of the probe. Oxidation (discoloration or tarnish of the gold

color) of this component may cause inaccurate dissolved oxygen readings. YSI provides a piece of fine grit sandpaper to be used to gently remove the oxidized residue, however, we have found that a small piece of brown paper bag is a gentler abrasive. CAUTION: Aggressive sanding of the electrode may damage the probe. The outer surface of the cylinder visible when the membrane cap is removed is the anode on this model. This surface often becomes tarnished with loose residue. Burnishing with a small piece of brown paper bag often removes loose residue effectively. In extreme cases, it may be necessary to dip the electrode in a solution of ammonium hydroxide. Contact VLMP or DEP staff for more information about this. As always, refer to the operation manual for your more information.

d. Perform any necessary maintenance on the probe (new electrolyte and membrane, clean electrodes). Note: fresh electrolyte solution must be prepared from the dry powder provided by the manufacturer 24 hours prior to use. Shaking the solution to dissolve the powder causes tiny bubbles to be mixed with the solution. If this is added to the probe immediately, tiny bubbles in the solution will be trapped under the membrane, but may not be visible until hours after the membrane has been installed.
e. Replace probe in calibration chamber.
f. If you have any doubt about the condition of the probe, please contact the VLMP: 207-783-7733.

Calibrating the Meter: NOTE: DO meters must be calibrated every time they are used. Once this has been done, most meters will remain calibrated through the day. However, if the meter is intentionally or accidentally turned off – even for a very brief period – it must be recalibrated. Calibration of DO meters in the field may result in inaccurate DO data, especially if the calibration environment is very warm (hot, sunny days).

1. Following the inspection and maintenance of the unit, turn the meter on. Digital meters will display an error message if problems with the eletronics are detected. Refer to the operations manual to determine the specific nature of the problem.

2. *Most meters must be turned on continuously for a minimum of 20-30 minutes before calibration.* During that time, the equipment should be protected from sources of heat, including direct sunlight. The meter should be calibrated in a cool, temperature-stable environment, preferably indoors. *DO NOT REMOVE THE PROBE FROM THE CALIBRATION CHAMBER DURING THE WARMUP PERIOD! Proper calibration requires that the probe be in an environment of 100% humidity, or water saturated air. When the probe has been in the calibration chamber for at least 20 minutes, such conditions should exist.*

3. After the warm-up period, the device is ready to calibrate. Follow the specific calibration instructions for the particular model meter. *NOTE: Meters must be calibrated before taking readings.* Be sure to mark the calibration checkbox on each field sheet indicating that the unit has been calibrated. If this is not done, your data may be rejected.

4. Ideally, the meter should be calibrated in an environment that is within +/- 10 degrees Celsius of the lake surface temperature.

5. Carefully pack the meter and probe in a protective container and transport to the monitoring station. Be careful not to jar the equipment, or press/turn any of the control buttons while packing and unpacking the gear. *If the meter is accidentally turned-off, the calibration process must be re-started from the beginning, including the warm-up period.*

On The Water:

1. The boat must be firmly anchored to prevent drifting while readings are being taken. Avoid attempting to collect Secchi, temperature and dissolved oxygen (DO) data during periods of strong wind because 1) the boat is likely to drift off station and 2) the cable and probe may not hang straight, resulting in inaccurate depth measurements.

2. The probe cable should be weighted so that it and the probe will hang straight in the water column. The weight should be secured to the cable, just above the probe. It should not be attached in such a manner that it will hit the side of the probe while measurements are being taken. Avoid using more weight than is necessary to keep the cable straight.

3. Avoid collecting DO and temperature data on windy (white caps on waves) days. You will save time and avoid the risk of inaccurate data. During windy conditions, it may be necessary to wait a minute or two for the cable to hang straight before recording the reading. If the cable is not straight, the depth recorded for the reading will not be accurate.

4. The cable/probe should be moved up and down a few inches twice a second (continuously) while readings are being taken. This action forces water across the membrane. If the probe is not "jigged", oxygen readings will be lower than the actual concentration in the water.

5. It may take from 20-45 seconds, or longer, for the probe to stabilize at each depth. Do not record the data until both the temperature and oxygen readings have been stable for at least 10 seconds. If you are using a digital meter, the dissolved oxygen readings need only be stable to the nearest tenth of a part per million (ppm). If the meter has been programmed to read to the nearest hundredth of a ppm, disregard the hundredth reading while waiting for stability to occur and record the reading to the nearest tenth. Note that the greater the change in temperature or oxygen between depths, the longer the probe will take to stabilize.

6. The first reading should be taken just below the water surface. This reading is recorded as the "0.0" depth on the data form. The next reading should be taken at 1.0 meter depth, then at one-meter intervals until the probe is at the bottom.

7. After taking the surface and 1 meter readings, check the DO calibration chart to compare your readings with "saturated" DO readings for the water temperature. The DO concentration at the lake surface should be *close* to saturation for the temperature recorded. If it is not, there may be a calibration problem. Recheck the calibration and the condition of the meter and probe. Unless atmospheric conditions are unusual, or your lake is experiencing an algal bloom, the surface DO should be within +/- 0.5 ppm of the value on the chart. Elevation and atmospheric pressure will account for slight deviations from expected readings displayed on the chart. By getting into the habit of performing this check, you will get a feel for what is 'normal' variation for the model you use. Surface DO readings that deviate more than 1.0 ppm of the expected saturation value, may cause the entire profile to be rejected. *Note: In the early spring and late summer, DO concentrations at the lake surface may be somewhat higher than 100% saturation. However, the surface reading should still be relatively close to the chart saturation value.*

8. Be sure that temperature data (degrees Centigrade) are entered in the temperature column, and dissolved oxygen data (ppm or mg/l) in the oxygen column of the field form. Be sure that you understand the difference between the two readings on the meter display. Also, be sure that your meter is not set to display percent saturation when you are recording data. You should be recording the actual concentration of dissolved oxygen in mg/l, as shown on the screen/dial of your meter.

9. Be very careful when the probe is near the lake bottom. If the probe is touching the bottom sediments, the oxygen level will drop to near zero. *It is extremely important to distinguish between low concentrations of oxygen in the water, and a low oxygen reading on the meter caused by contact of the probe with the bottom sediments.* With practice, you should be able to feel when the probe is on the bottom of the lake, because the tension in the cable will

suddenly be reduced. Moreover, by knowing the depth of the water in advance, you should be aware of the point when the probe is approaching the lake bottom. Extended bouncing of the probe on the bottom of the lake can cause equipment damage. After touching sediments, it may be necessary to jig the probe well above the sediments to allow the mud to become dislodged from the probe. Mud on a probe may also interfere with the QA/QC readings you obtain when bringing the probe back up through the water column.

10. Required QA/QC Duplicate temp/oxygen reading(s) should be taken while bringing the cable and probe up through the water column after the profile has been completed. One set of readings (temperature and dissolved oxygen) at a determined depth should be repeated for every ten readings in the profile. The readings should be taken in an area of the water column where the temperature and oxygen are "stable". Do not take duplicate readings in the thermocline/metalimnion area, where both the temp and DO are likely to be changing rapidly between readings. It is generally safe to take duplicate readings below the thermocline (if oxygen levels are stable) and near the surface at about 2 meters depth, where both conditions are stable. Once the duplicate readings have stabilized, they should be recorded in the appropriate area of the field form. Please be sure to record the depth at which the duplicate reading(s) are taken. Beware that it generally takes the probe longer to stabilize when bringing it up through the water column than when being lowered down. That is because on the downward trip readings are usually taken at each meter, which gives the probe time to adjust to the new temperature gradually. In contrast, on the upward trip the probe is brought up through several meters of water relatively quickly, and therefore requires more time to warm up to the temperature at the shallower depth. If the temperature of a duplicate reading varies more than +/- 0.3 degrees C, or the dissolved oxygen varies more than +/- 0.3 ppm, you may not have waited long enough! If after giving the probe sufficient time to reach the temperature of the water, the duplicate reading(s) still varies greater than the acceptable variation, check the condition of the probe, and note any problems observed in the "comments" section of the field form. For example, if the wind is moderate, and you have experienced difficulty getting the probe and cable to hang straight, please be sure to note this possible cause of variation in the comments section of the filed form. **NOTE:** ***You must record the appropriate number of QA/QC duplicate readings for each profile. Failure to do so will result in the rejection of your data.***

11. Once the QA readings have been taken and recorded, the meter can be turned off. Be sure to make sure the probe is free of sediment and is stored in the moist calibration chamber, in order to prevent the membrane from drying out.

12. Replace the equipment in the storage container until you have reached the area where the unit is stored between field sessions. When you have reached the facility where the equipment is to be stored, open the container and allow the meter and cable to dry thoroughly.

Equipment Storage:

Dissolved oxygen meters, probes and cables are delicate instruments that can be easily damaged by physical shock (dropping, slapping, jolting, etc.), excessive exposure to heat, prolonged exposure of the meter to moisture, dust and grit, and other factors.

Given the significant cost of the equipment, and the importance of preventing damage to ensure that the unit is functioning properly, the use of a solid, padded case is highly recommended for transporting and storing the device. Cases can be purchased at nearly any hardware store that sells small tool boxes. They can also be purchased online from a number of vendors that sell lightweight cases for multiple uses. Be sure to use a case that allows ample space for all of the components (meter, cable, spool, probe, and probe maintenance kit, spare batteries). The case can be customized with soft foam that can be sized for each component.

Note: Protective storage cases may be airtight. Be sure to open the case after each field trip to allow the equipment to dry out. Failure to do so may cause damage to the meter unit.