**Specific Gravity:**

The most accurate and direct way to test the state of charge of a battery cell is to determine the specific gravity of the battery electrolyte. The higher the specific gravity of the electrolyte the higher the state of charge. The best way to truly monitor your system over its life is to regularly take and record specific gravity readings.

Unfortunately, hydrometers are not easy to use. Testing can be time-consuming, there are possibilities for error and safety must be considered. For these reasons, we present this bulletin.

**Hydrometer Types**

Hydrometers come in many sizes and shapes. We recommend a hydrometer with a float, contained in a glass vessel with a rubber bulb to draw the acid into the tube. Stay away from floating colored balls as the extra inaccuracy results in very subjective testing. The hydrometer should give you a numeric reading directly from the instrument. A good hydrometer is accurate to +/- 0.005 points so 1.265 could read from 1.260-1.270. The instrument accuracy should be known.

**Checking Calibration**

As with all measuring equipment drawing conclusions from the results is not worth the effort if the equipment is not calibrated.

The correct way to check the calibration of a hydrometer is to test the hydrometer against a known master that is accurate to one more decimal point. These hydrometers are; however, very expensive ($100-150 USD) and can be easily broken.

The simplest and cheapest way, when facilities exist, is to measure out a volume of acid and weigh it. A small graduated cylinder and an electronic balance are perfect. The specific gravity is then calculated as follows:

SG = Mass (g) / Volume (ml)

The metric units must be used to convert to the specific gravity scale based on water. The hydrometer is calibrated if it agrees with the sample within its manufacturing tolerance.

**Method of Use**

Exact procedures is instrument dependent and this is given as a general procedure and assumes a hydrometer with glass float and body.

1. Put on eye protection and rubber gloves.
2. It is recommended to disconnect the battery especially if on a high rate of charge/discharge.
3. Remove vent cap. Carefully insert the hydrometer into the cell, not pushing down on the top of the plates.
4. Carefully draw liquid into the hydrometer and avoid "bumping" the hydrometer. Be careful the float is not flooded (too much liquid) or sticking to the sides of the glass tube.
5. Obtain a reading by looking directly at the float.
6. Repeat steps 3-5 to reconfirm reading.
7. RECORD the cell number and result.
8. If it is very warm or very cold correct the specific gravity for temperature. If the ambient temperature is fairly consistent and original gravities are taken when the batteries are put into service temperature correction is not as critical and only necessary if problems arise. Make sure the electrolyte is not hot if just taken out of service. Let it reach room temperature.

An easy procedure is to number the cells starting with the positive cell and move from cell to cell towards the negative terminal. If this is part of a preventive maintenance program it is helpful to number the batteries.

**Temperature Correction**

SG of acid is temperature dependent. If the temperature is very cold or very hot this can lead to incorrect readings. To correct for temperature use the following equations the equations or below 70ºF subtract points (0.003 per 10ºF) and above 70ºF add points.

* Correction factor = (0.331 x Cell Temp ºF - 23) / 1000 or 0.003 pts per 10 ºF
* Correction factor = (0.595 x Cell Temp ºC – 12.5) / 1000

This is valid for 0-130ºF or -17.8- 54.4ºC

The following shows the approximate state of charge at various specific gravities at 77ºF / 25ºC.

|  |  |
| --- | --- |
| **Charged** | **Specific Gravity** |
| **100%** | **1.255-1.275** |
| **75%** | **1.215-1.235** |
| **50%** | **1.180-1.200** |
| **25%** | **1.155-1.165** |
| **0%** | **1.110-1.130** |

Hydrometers are at best accurate to +/-0.005 points. Voltage can be used to estimate the state of charge, however, caution must be taken when interpreting voltage readings.

<https://www.youtube.com/watch?v=O2dg4v-5--A>