CHARTS TO GUIDE DECISION MAKING

Load Testing Before & After Reconditioning

<table>
<tr><th rowspan="2">OEM* PARAMETERS</th><th colspan="5">Cut Off Voltage Under Load Test
Test lapse is 15 Seconds</th></tr>
<tr><th colspan="4">PASSING LOAD TEST</th><th rowspan="2">FAILING</th></tr>
<tr><th>DC VOLTAGE</th><th>Strong</th><th>Fair</th><th colspan="2">Weak</th></tr>
<tr><td>6.3 volts</td><td>6.3 — 5.5</td><td>5.3 — 5.0</td><td>4.9</td><td>4.8</td><td>Below 4.8</td></tr>
<tr><td>8.4 volts</td><td>8.4 — 7.6</td><td>7.5 — 7.0</td><td>6.9</td><td>6.4</td><td>Below 6.4</td></tr>
<tr><td>12.6 volts</td><td>12.6 — 10.9</td><td>10.8 — 10.4</td><td>10.3</td><td>9.5</td><td>Below 9.5</td></tr>
<tr><td>Capacity</td><td rowspan="5">100% SR*</td><td rowspan="5">75% SR</td><td rowspan="5">50% SR</td><td rowspan="5">25% SR</td><td rowspan="5">None</td></tr>
<tr><td>Cycle Life Span</td></tr>
<tr><td>Design Life Span</td></tr>
<tr><td>Warranty</td></tr>
<tr><td>Guaranteed</td></tr>
<tr><td>Resistance (Ohm)</td><td>Normal ≈ OEM</td><td>Plus 25%</td><td>Plus 45%</td><td>Plus 75%</td><td>Abnormal</td></tr>
</table>

**OEM= Original Equipment Manufacturer. *SR= Success Ratio.*
Life span and guaranteed is referenced to OEM standard given by manufacturer or retail outlet when battery is new. The higher the voltage under load the higher the capacity of the battery.

OEM parameters refer to the various specifications that the manufacturer details in the data sheet or MSDS that accompanies new batteries. Each OEM standard varies according to battery manufacturer and country. Thus, each battery type made by a manufacturer will have different parameter values for their batteries, but generally the OEM parameters listed under this column in the table above are the most used.

At the manufacturing facility, battery specialists test the new batteries to ensure they meet company and international standards of manufacturing. These tests are usually specified in their website and in the MSDS or data sheet where they profiled what are the performance parameters of a new battery. This is why we list the parameters in the table above. We also understand that OEM parameters correlate to the voltage under load, which it is a quick capacitance test commonly done to cranking batteries. If you fully discharge the battery to test capacity you also have a reliable proof of the capacity of the battery. This capacity can be measured in amp-hours or in cranking amps depending on the application assigned for the battery. In summary, the table above illustrates how all these parameters correlate to each other.

We propose herein that if you know any of the OEM parameters when the battery was new, then you can calculate the parameters you obtained after servicing batteries with our methodology. Here is how you calculate new parameters after servicing batteries: use the % SR value and multiply it with any of the parameters values obtained from the manufacturer. Below is a sample general equation:

OEM Design Life (in months) **x** *% SR = Reconditioned Design Life Span*

OEM Replacement Guaranteed (in months) **x** *% SR = Reconditioned Replacement Guaranteed**

OEM Cycle Life (# of cycles) **x** *% SR = Reconditioned Cycle Life*

Reconditioned Resistance = OEM Resistance **+** *(OEM Resistance* **x** *% Resistance)*

***NOTE:** Please keep in mind that our advice regarding replacement guaranteed after reconditioning is to use it as a pricing tool. Our rule of thumb advice to you is: "*The higher the reconditioned replacement guaranteed then the closer the cost of the reconditioned battery is to a new one.*"

This Chart Is To Be Used Before & After Reconditioning

BATTERY VARIOUS STATES OF CHARGE Readings taken at least 4 hours after charge. Temperature is assumed at 25°C (77°F).							
% SOC	% SOS	Specific Gravity	6.3 Volt Nominal	8.4 Volts Nominal	12.6 Volts Nominal	Voltage per Cell	COMMENTS
100	0	1.275+	6.37	8.49	12.70+	2.12	Discharging in this zone ensures longer life span.
95	5	1.265	6.33	8.41	12.60	2.10	
90	10	1.260	6.30	8.33	12.50	2.08	
80	20	1.240	6.25	8.25	12.40	2.06	
70	30	1.220	6.19	8.16	12.30	2.05	
60	40	1.210	6.12	8.07	12.20	2.03	Discharging to this zone is recommended only as ocasional practice.
50	50	1.200	6.05	7.97	12.05	2.00	
40	60	1.175	5.98	7.88	11.90	1.98	
30	70	1.150	5.91	7.77	11.75	1.95	
20	80	1.125	5.83	7.67	11.55	1.92	Discharging a battery to this zone shortens its life span severely.
10	90	1.100	5.75	7.60	11.30	1.88	
Dead	100	1.000	5.25 or less	7.30 or less	10.5 or less	1.75 or less	

SOS = State of Sulfation. After reconditioning SOS is not significant because low capacity in the battery is due to other causes like shedding or less active paste material on the plates. Temperature below freezing point can reduce SOC capacity by 30% or more.

State of Sulfation refers to how much capacity the battery has lost due to depolarization caused by hardening of lead sulfate. Before reconditioning: the lower the *sate of charge* then the higher the *state of Sulfation* and the lower the capacity of the battery.

The State of Charge above for each of the battery voltages included in this chart is only approximations. The reason for this is that every battery made will not exhibit exactly the same parameters for voltage, specific gravity, and resistance or any other performance parameter you choose. Purity of lead materials, standards and process of manufacturing, quantity of electrolyte and specific gravity, mistakes, and others conditions can influence how each battery of the same configuration is at the end of the manufacturing process. Therefore, all cranking or deep cycle batteries of 12 volts from one manufacturer will vary slightly on the parameters listed above. Still, the chart provides a general understanding of what a battery should exhibit for nominal voltage and specific gravity as it relates to capacity or state of charge.

Finally, the State of Charge chart above has to type of uses. One is with reference to cranking batteries while other is for deep cycle batteries. If you use it on cranking batteries, then the comments on the outer right column refer only to cranking batteries. Deep cycle batteries were designed and built for deep discharges and the comments in that column has no significance. Still you can find the state of charge of cranking or deep cycle batteries by comparing open circuit voltage or specific gravity of the electrolyte. If you do a capacity test discharging deep cycle batteries at a constant load rate to measure the capacity of the battery, then this table can inform you of the capacity of the battery as you measure the open circuit voltage of the battery during the discharge process. As you can see, when you reach 10.5 volts open circuit, you are at zero percent state of charge.