Battery Charging

- **Proper charging**
  - Set charge voltage to type of battery
    - WET, AGM, GEL

- **Bulk charge is based on current and voltage**
  - Current is 30% of C20 of battery bank
  - Voltage is the absorption voltage of the battery type
  - 85-90% capacity with bulk charge

- **Absorption voltage – use manufactures recommended voltage**
  - Absorption charge based on time
  - Needs to charge to 115-120% of what you discharged

- **Undercharge – Sulfate**

- **Overcharge – Gas off electrolyte**
## EPM – Charging parameters

<table>
<thead>
<tr>
<th>Stage</th>
<th>Gel</th>
<th>Agm</th>
<th>Flooded</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bulk Charge Stage</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Max Current Monobloc Design</strong></td>
<td>30% of C20</td>
<td>30% of C20</td>
<td>30% of C20</td>
</tr>
<tr>
<td><strong>Max Current Single Cell Design</strong></td>
<td>20% of C6</td>
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<tr>
<td><strong>Absorption (Regulation) Stage</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Constant Voltage</strong></td>
<td>2.35 – 2.40 vpc</td>
<td>2.30 – 2.35 vpc</td>
<td>2.40 – 2.45 vpc</td>
</tr>
<tr>
<td><strong>Float Charge</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Equalize Charge</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Constant Charge</strong></td>
<td>2.40 – 2.45 vpc</td>
<td>2.35 – 2.40 vpc</td>
<td>2.50 – 2.55 vpc</td>
</tr>
<tr>
<td><strong>Voltage Limits at 25C (77F)</strong></td>
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</tbody>
</table>
Charging parameters - ex

- Example of setting up correct charger
- Battery bank – 16 – 8G30H GEL
  - 4 strings of 4
  - 8G30H – 98 AH @ C20
- Bulk charge set at 30% of C20
  - 98 x 30% = 29.4 amps @ C20
  - 29.4 amps x 4 strings = 117.6 amps (max)
  - 117.6 max amperage to charge this battery bank
- Absorption voltage is 2.35 – 2.40 vpc (range)
  - 2.40 vpc x 6 cells = 14.40 x 4 batteries = 57.60 dc volts
  - Absorption time is set to a minimum of 3 hours
- Float Voltage is 2.25 – 2.30 vpc (range)
  - 2.30 vpc x 6 cells = 13.80 x 4 batteries = 55.20 dc volts
Absorption time recommendations

<table>
<thead>
<tr>
<th>Battery AmpHrs Capacity</th>
<th>Suggested Absorb Time</th>
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</tr>
</thead>
<tbody>
<tr>
<td>200 to 300</td>
<td>60 minutes</td>
<td>1310 to 1500</td>
<td>240 minutes</td>
</tr>
<tr>
<td>310 to 500</td>
<td>90 minutes</td>
<td>1510 to 1700</td>
<td>270 minutes</td>
</tr>
<tr>
<td>510 to 700</td>
<td>120 minutes</td>
<td>1710 to 1900</td>
<td>300 minutes</td>
</tr>
<tr>
<td>710 to 900</td>
<td>150 minutes</td>
<td>1910 to 2100</td>
<td>330 minutes</td>
</tr>
<tr>
<td>910 to 1100</td>
<td>180 minutes</td>
<td>2110 to 2300</td>
<td>360 minutes</td>
</tr>
<tr>
<td>1110 to 1300</td>
<td>210 minutes</td>
<td>2310 to 2500</td>
<td>390 minutes</td>
</tr>
</tbody>
</table>
Battery Charging

- Improper Battery Charging
  - Overcharging
  - Undercharging – (Solar)
  - Over Discharging

- Most Batteries do not fail due to a battery problem!
Battery Charging… cont.

Your batteries are a good indicator that you have either a good or a bad maintenance program.

- Failing batteries should raise a red flag:
  - Charger not working properly
  - Temperature probe not working/connected
  - Battery breaker off
  - Faulty products
  - Improperly designed system
Why Overcharging is Bad:

- Water (H₂O) split into H & O
  - Driven out of cell
  - Reduces electrolyte level or dries out SVR cell
  - Potentially explosive

- Internal Heat Increases:
  - Accelerates POS grid corrosion
  - Warps plates
  - Oxidizes (rusts) and weakens POS grid and separator
If Overcharging is so bad...
Why not Undercharge?

- Sulfate on both plates hardens:
  - to a point where it can not be driven back into electrolyte
- POS grid oxidizes in water:
  - Accelerates POS grid corrosion
  - Oxidizes (rusts) and weakens POS grid
- Hydration
  - $1.050 \text{ SpG} = \text{solubility of Pb in Sep.. pores}$
  - recharging = re-crystallization of Pb = Shorts
Over-Discharging

- Battery starts to break down and is in a vulnerable state when it is over-discharged
- Sealed Battery has visible characteristics
  - Battery creates a vacuum
  - Top and sides will often have ripples in them
- Starts when battery is discharged below 10.5 volts
- How can this happen?
  - Low voltage cut off not working
  - Parasitic loads
  - Overcharge/Undercharge
Over Discharging

- Parasitic Loads
  - Any DC externally wired load
  - Any DC load powered after LVD shuts off