The Offshore Electrical System for Yachts

~Presented by Ron Romaine

The proper offshore electrical system consists of:

- Design to meet **YOUR** needs
- Quality equipment
- Proper installation
- Management of system
    - Inspection and regular maintenance

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Designing your system starts with figuring your daily consumption expressed in amp-hours (Ah)

- Ah is the number of amps used over time
    - (10 amps for one hour = 10Ah)
- Energy chart to calculate how much you will use in a 24 hr day.
- Chart will list all the items you will use,
    - The amp draw and how long they will operate over 24hrs.
    - Running lights, cabin lights, electronics, pumps, electric winches, appliances, inverters, and so on
- Energy chart of your likely usage in Amp hours Ah
- Multiply by 2 to figure capacity required for a 1 day supply
    - (150Ah X 2 = 300Ah)

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Following the 50% discharge rule is a must for longest battery life

- Do not discharge your battery supply below 50% of capacity and it will deliver the most amp hours over its life
- A one day supply is not enough time between recharging cycles for most voyaging yachts
    - Multiply your daily capacity by the number of days desired to go before recharging
        - (300 Ah X 2 days = 600Ah)

- Approx. 3-pr (200 Ah/pr) Golf cart 6vdc, 3- 8D (220 Ah ea) 12vdc (big) or 6- GR 31(100Ah ea) (smaller) all 400-500# total weight range
- Space will have a major role in placement and arrangement

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Marine storage batteries come in three basic types:

- Wet Cell
- Gel Cell
- Absorbed Glass Mat (AGM)

- Each has advantages and disadvantages, which we will briefly discuss
- All types of batteries have both Good and Bad ones, so do your homework, ask you dock mates and other sailors

Wet Cell Batteries

- Advantages:
  - Common
  - Wider selection of sizes
  - Lower initial cost

- Disadvantages:
  - Maintaining with distilled water (watermaker also)
  - Ventilating properly
  - Containment in full battery boxes or enclosures
  - The sulfuric acid fumes
  - Will corrode nearby materials
  - If overcharging should occur it can render the below decks uninhabitable
  - Slower recharge rate than types like GEL or AGM
  - This relates to longer running time when recharging
  - Checking the fluid levels on a large battery bank can be quite time consuming and should be logged to track performance
  - The average life of a properly maintained wet cell battery is 5yrs

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Gel Cell Batteries

- Advantages:
  - NO need for distilled water, ventilation or full battery boxes
  - Won't contaminate your environment
  - No fumes escaping from recharging or battery acid to spill
  - Truly "maintenance free"
  - Come in most common sizes
  - Available worldwide
  - Accept a much higher rate of recharge then wet batteries
  - The average life of a good gel cell is 8-10 yrs and in most cases longer
  - The gel battery system has proven to be an excellent choice for the modern yacht
  - Work very well with the high demands of a performance cruising or racing electrical system

- Disadvantages:
  - Initial cost for upgrading your charging system to a proper performance cruising system
  - Cost per battery

AGM Absorbed Glass Mat Batteries

- Similar to a gel type with no water, ventilation or full boxes needed
- Are sealed, with little environmental impact
- Recharge at a higher rate
- Cost the same as a gel type battery
- Come in most sizes and are available worldwide
- The up grade costs would be the same as gel

Whichever type of battery system you choose, properly install & and maintain them!

- The most important need is restraint
  - The batteries can't move around or be dislodged in a knockdown
  - They must be secured well enough to handle the full weight of the bank (3-500#)
  - Take the time to do this correctly so you won't have a terrible SEA story

- There should be a main system fuse at the battery to prevent a catastrophic short out
  - This would be a Class T type from 300-1000 amp depending on your system size
  - Carry spares for replacements

Charging

- Give yourself the ability to properly recharge **your** type of batteries and use the least amount of engine running time (fuel savings).
- To do this
  - Determine what type, power rating (hp), type of V belt, and style of alternator mounting your engine
  - It is usually not too difficult to install a high output alternator with a multi step regulator on most engines
  - The different after market suppliers make direct replacements for most engines
  - The multi step regulator will make the alternator work at full output, unlike a standard alternator/regulator
  - The bigger the alternator the more power it will need to operate and possibly need multiple drive belts
  - For example you have a 35hp, single 1/2" V-belt and a 2" single mounting foot

Purpose Built Alternators

- Need from 6-9 hp to drive a 12 VDC 105 to180 amp hot-rated output.
- A small engine (18 -20hp) may need to use some type of a current limiting regulator, so it can use the power to drive the boat and use less for the alternator when needed
- If your engine uses a single 1/2" v-belt, the largest alternator you can use is an 180amp
    - It **must** have a heavy duty belt
    - The best is Gates Green Stripe (auto-truck) or Gates Heavy Duty Industrial types

- Since the V-belt drives the alternator it must be checked **regularly** to avoid the very big problem of belt slippage
  This can:
    - Break the belt
    - Damage the engine or alternator
    - Render your engine useless
- If you can turn the fins of the alternator by hand and it slips, it is too loose
    - Most single belts have about a 1/4" play at mid point
    - Some require less and some more depending on engine
- If you hear it squeal or smell it burning, stop and tighten it up before it becomes a **REAL** problem
- Carry spare belts
- Only use **Grade 8** type bolts and nuts as replacements if needed and if a mounting bracket must be fabricated, use steel not stainless steel.

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The Modern Multi-step Voltage Regulator

- Works with 3 basic steps:
    - First is the BULK charge, the alternator is at full amp output (per RPM), until the battery voltage rises to (14+VDC) the ABSORPTION set point
    - The ABSORPTION step keeps the voltage constant at (14+VDC) and lowers the amperage over the **timed** period or when it reaches full charge, and then it shifts to the FLOAT stage

    - The FLOAT is a constant lower voltage (13.6+/-) over the charging time. The float is only when the batteries are full and it prevents over charging on long motoring times

- Follow the instructions for the alt/reg units to properly install and adjust them for your application
- Most regulators can be set for any type of battery and have battery temperature sensors for proper temperature voltage compensation
- You will find that the settings for Wet-Gel-Agm are different and each charge at certain rates from 25-50% of Ah capacity
- Wet being lower (25-40%) and Gel/Agm being higher (50%+) which relates into engine run time
- Wet cells take longer to charge than Gel/Agm

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Re-charging Batteries

- Solar or Wind generation
    - Will require more equipment to properly charge the batteries in conjunction with the main engine charging
- Both use different technology and can be quite useful in reducing the engine runtime

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All systems on the boat MUST be regularly inspected & maintained properly

- This is the key to preventing failures and problems that plague many sailors
- All equipment should be installed with care to prevent water intrusion or physical damage to it
- Everything is working to damage your electrical and electronic systems 24/7
    - This means watertight enclosures, sealant, soldering, good heat shrink and placement in driest location if possible
- The less exposure the less failures and the more **FUN!**

- Lastly, you must manage your systems to stay within the 50% discharge rule and keep your systems operating properly
- The trick is a modern battery monitor system
- The volt and ammeter is not enough to properly and truly monitor battery capacity
- Voltage does NOT give a true indication of battery capacity
- Even with the time consuming art of logging your usage, you do not get close to actual power remaining in your battery bank
- With a monitor, this task becomes easy to manage your entire system
- You will know when the batteries will need to be replaced or the alt/reg. needs attention

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Take the time to:

Design

Use quality equipment

Properly install

Maintain your system

It will produce a more trouble free voyage!

OFFSHORE ELECTRICAL SYSTEM

10 POINT INSPECTION LIST

1.) Inspect your entire electrical system from bow to stern and masthead to bilge

2.) Make notes as to what areas need repair, maintenance or replacement

3.) Check all wire runs, they need to be supported and have anti-chafe protected in all areas

4.) Inspect batteries for water (if needed), clean and tighten connections, clean battery tops and boxes. Properly secure battery cables.

5.) Inspect all equipment and test for proper operation. -Lack of use is a BIG reason for failure.

6.) Repair or replace non-operating equipment

7.) Make a list of race required equipment and designate a good location for each

8.) Determine if your system needs upgrading for more battery power (see previous information on daily consumption)

9.) Make a list of spare tools needed for offshore sailing. Locate electrical tools, parts and supplies in one location. (i.e. Tool Box)

10.) Start your project **early** to give yourself time to use everything before you head out the gate.

Don't forget, the more you know about your boat and the systems, the easier time you will have when repairs are needed!