VIBS 2018 – Pacific Yacht Systems Presentation

Understand your Electrical, Manage your Power & Stay at Anchor Longer

By Jeff Cote

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design • installation • service • support

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A Little about PYS

- 11 years in business
- Genesis: wanted a reliable and safe electrical system
- What makes us different
  - Expertise through specialization & repetition
    - 2017: Over 750 boats
  - Teamwork breeds synergy
- Team members
  - Detailed oriented
  - Passion for doing it right the 1st time
  - Our installations are safe and follow:
    ABYC and NMEA standards

Agenda

- Background & Context
- Requirements of an electrical system
- Calculating your daily power needs
- Sizing your battery bank
- Recharging your batteries
  - Battery Chargers (aka converters)
  - Alternators
  - External Regulators
  - Smart Battery Combiner
  - Methanol Fuel Cell
  - Solar Panels

PYS Requirements of an Electrical System

- Prerequisites:
  - Safety
  - Reliability
- Objectives:
  - Run essential loads (engine, lights, water pump, etc.)
  - Provide comforts (refrigeration, AC loads, heat, music, etc.)
  - Stay longer at anchor or longer between engine/generator runtime

Calculate Your Power Needs

- What is your daily power need?
  - Varies depending on the season, examples:
    - Lights are run earlier in winter
    - Heating in the shoulder and winter season
- Largest DC loads
  - Refrigeration is the largest draw: 50 – 125 Amp-Hour per day
  - Inverter powering AC loads
  - DC loads from running diesel heater (especially hydronic)

Typical Daily Battery Usage

Typical daily AHr budgets	AHr
Beneteau 33	85
Catalina 36	150
Suncruiser 38	225
Grand Banks 42	175
Ocean Alexander 48	375
Meridian 580	500

Sizing Your Useable Battery Capacity

- Criteria to choose your battery bank
  - Daily Amp-Hour (AHr) budget
  - Estimated time between charging? How often do you charge your batteries?
    - Every ½ day
    - Every 2 days
- At a minimum, **usable** battery capacity needs to be
  - Daily AHr budget X Estimated time between charging
  - Example: 200 AHrs X 2 days = 400 AHrs of usable battery capacity

Lead Acid Battery Limitations

- To balance battery cost and life, you should never deplete your lead acid batteries below the following capacity:
  - Flooded: 50%
  - AGM/GEL: 30%
  - Firefly AGM 20%
- Due to lead acid battery chemistry, charging above 85% of capacity (absorption stage) is very time-consuming
- Therefore: while cruising effective battery capacity is:
  - Flooded: 35%
  - AGM/GEL: 55%
  - Firefly AGM 65%

Sidenotes:
AGM vs Flooded Batteries

	AGM	Firefly AGM	Flooded
Cost	$$	$$$$	$
Gassing	Limited	Limited	Yes
Useable capacity	55%	65%	35%
Maintenance	None	None	Regular top-off
Self-discharge	2% per month	2% per month	15% per month
Purpose	Dual	Dual	Single
Sulfation	Yes	No	Yes

Sizing your Battery Bank

- Depending on your choice of lead acid battery, you will require the following:

Type	Useable battery capacity
Flooded	3 Times
AGM/Gel	2 Times
Firefly AGM	1.5 Times

- Examples, if you need 200 AHr of useable battery capacity, you will require:
  - Flooded: 600 AHr
  - AGM/GEL: 400 AHr
  - Firefly AGM: 300 AHr

Sidenotes:
Battery Tips & Tricks #1

- Wire your batteries so they discharge evenly
  - Positive and negative at opposite ends

Sidenotes:
Battery Tips & Tricks #2

- Liquid in the bottom of your battery box is probably electrolyte, **NOT** water
  - Make sure battery box is leak proof
  - Why did it boil over?
  - Neutralize with baking soda

Sidenotes:
Battery Tips & Tricks #3

- Never expose your flooded battery plates to air
  - Once exposed, battery capacity lost

Sidenotes:
On Battery Sizes and Types

- Batteries come in all sizes
  - Group 24, Group 27, Group 31
  - 4D, 8D
  - Golf Carts
  - Slimline
  - L16
- All battery sizes come in different lead acid types:
  - Flooded , AGM, Firefly AGM, Gel
- Flooded batteries are built specifically for a purpose
  - Starter
  - Deep cycle
  - Dual purpose

Electrical Cornerstone: Battery Monitor

- Monitoring for system health
  - Available capacity
  - Usage patterns, planning
- “Fuel gauge” & “speedometer” functionality for your batteries
- Information on your system
  - Current draw/charge
  - Amp hours
  - Voltage

What is the Right Charge Rate?

- Importance of sizing **minimum** charge rate to battery size
  - Minimum: ~ 10% of capacity
- Reduce your charging time by increasing your charge rate
  - Maximum: ~ 25% of capacity (AGM/Gel: ~ 40%)
  - How often to you want to run genset/engine per day?

Different Charge Methods

- Ways to create power
  - Charger(s)
  - Alternator(s)
  - Methanol Fuel Cell
  - Solar
  - DC Genset
  - Wind Turbine

Smart Battery Charger

- Charges batteries from AC shore-power
- **Reduce** the charge time
- Three-phase smart charge cycle:
  - Bulk, Absorption, Float
- Right rate of charge for extended battery life
  - Minimize sulfation

Smart Charger Application - Multiple Units

- Reduce genset runtime by adding 2nd or 3rd charger in parallel
  - E.g. 1 hour morning and evening
- Charge at the right rate
- Min and Max Charge Rate
  - Flooded: 10% to 25%
  - AGM: 10% to 40%

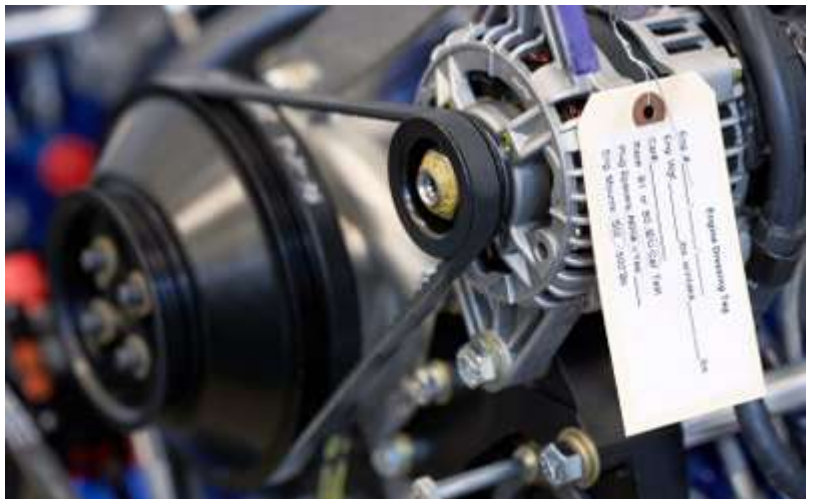
Sidenotes:
Old vs New Chargers

- Ferroresonant vs Smart Charger

	Ferroresonant	Smart Charger
Rate of charge	Half rated output	Full rated output
Charge curve	Simple	3 stage
Overcharging	Yes - Trickle	No - Float
Battery type settings	Flooded	Flooded, AGM, Gel
Temperature - compensated	No	Yes
Looks	Ugly	Pretty
Weight	Heavy	Light

Alternator(s)

- Converting engine power to DC power
  - Note: AC power has nothing to do with alternator output
- Why maximize alternator output
  - No or reduced genset runtime
  - Typical little engine runtime (sailboat or fast power boat)
- Variables for choosing a larger alternator output
  - V-Belt or Serpentine belt
  - Engine recommendations
  - Physical constraints



Alternator Realities

- Stock Alternator: 55 Amps with internal regulator
- 55 amps is cold rated,
  - after ½ hour of running: de-rate by ~ 15%
- Internal regulator limits output to about 2/3rd of output
- Realistic Output: 30 to 35 Amps
- Consider loads (5A to 30A) while engine is running
- Effective Charge Rate =

  (Alternator output) minus (loads while running)

External Regulator

- Makes alternator output smart
  - 3 phase charging
- Significantly increases alternator output
  - When compared to internal regulator
- Properly chargers different battery chemistries

Methanol Fuel Cell

- DC Charging with:
  - No noise
  - No vibration
  - No smoke
- Extends time at anchor
- Great for boats
  - Without genset
  - Limited battery bank
  - Limited alternator output

Methanol Fuel Cell - Purchasing Tips

- Choose the right daily output:
  - 85, 140, 210 amp-hours
- Carry extra fuel onboard
- Popular model
  - EFOY

Methanol Fuel Cell - Installation Tips

- Unit needs some ventilation
- Outputs distilled water
- Mount in a locker
- Fuel cartridge needs to be close to unit
- Choose right DC cable based on distance to battery

Imagine…

- Staying an extra day or two at anchor without more battery
- Offsetting the loads associated with the fridge
- Recharging the batteries without any noise, vibration, smoke
- For sailors: not worrying about motoring between anchorages to recharge batteries
- Running a genset less or NOT at all

Solar Innovations

- Flexible panels: similar wattage per area to rigid panels

Northwest Advantages

- During peak summer months: 15 + hours of sunlight a day
- Relatively sunny days during summer months
- Most boaters have extensive canvas covers (e.g. bimini, dodger) or hardtops

Flexible Panels: Endless Mounting Options

- Lightweight
- Mounted on:
  - cabin roof (no ventilation space needed)
  - canvas (bimini, dodger, cockpit enclosure)
- Zippers, grommets, Velcro, snaps, adhesive

Wide Selection of Panel Size

Choice: Mono or Poly?

- Monocrystalline cells
  - Highest efficiency
- Polycrystalline cells
  - Best value

Solar Power Efficiency Defined

What do the different efficiencies mean?

- The efficiency of the panel is included in the wattage rating
  - a poly 100W panel will be larger than a mono 100W panel, but
  - both will produce the same energy
- The efficiency is a measure of how much of the sun's energy is captured by the panel
  - lower efficiencies mean a larger panel is required to capture the same energy

What Makes a Great Panel?

- Depends on construction:
  - Quality of encapsulation: EVA (Ethylene vinyl acetate)
    - Prevents yellowing <- similar effect to shading
  - Connections between cells: silver alloy
  - Redundant pathways between cells (32 times more connection)
  - Top ones are hand-made
  - High end cells
    - German made (Day4)
  - Sealed and waterproof junction box and MC-4
  - IP67
  - Visual and tactile inspection
  - Test individually (in-house) for 24 hr before shipping
    - Xenon Sun Lamp

Expected Life

- Expected life: 20 years
  - Plastic life proven
- Warranties: 5 years

Panels Shade-Protected?

- Make sure solar panels include a bypass diode to prevent a shaded cell from de-powering the entire panel
- These diodes effectively split the panel into two independent power sources
- Without diodes in evening and night reverse current

Solar – How Many Watts?

- Solar panels can be sized to power
  - daily Ah demand
  - refrigeration Ah demand
  - effectively, extend your time at anchorage: e.g. 3 days instead of 2 days

Sample - Quick Calculation

- Rule of thumb: 25% of wattage = daily Ah output
  - Watts X 25% or Watts / 4
  - E.g. A 100 Watt panel will produce 25 Ah
    - 100 X 20% = 25 Ah

- Optimistic: factor of 3 or 33 Ah
- Conservative: factor of 5 or 20 Ah

Making it Work vs. Doing it Right

The PYS Difference

- We are boaters too!
- It’s all we do.
- Many electrical “fixes” are indicators of the bigger picture.
- We can help you prioritize safety.
- Our business is based on referrals.

Connect with PYS

- Starting Point: PYS Electrical Audit for your boat
  - 90 minutes: Batteries, DC distribution, charger, alternator, inverter
  - Written report: observations & recommendations
  - Cost: $189
- PYS Design Services for DIYers
  - Electrical system designed by PYS (collaborative and to code)
  - Installed by yourself or other outfit
- Pacific Yachting magazine - Monthly Tech Talk Column
- www.pysystems.ca 100s of articles
- Monthly email newsletter

Questions?

Pacific Yacht Systems

marine electronics & electrical

Full-service shop delivering marine electrical and navigation solutions tailored to your vessal and your boating needs.

boating made simple *by design*

design • installation • service • support

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