

# VIBS 2017 – Pacific Yacht Systems Presentation

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

By Jeff Cote

Pacific Yacht Systems Inc.

design • installation • service • support

# A Little about Us



- 10 years in business
- Genesis: I too wanted a reliable and safe electrical system
- What makes us different
  - Expertise through specialization & repetition
    - 2016: Over 600 boats
  - Teamwork breeds synergy
- Team members
  - Detailed oriented
  - Passion for doing it right the 1<sup>st</sup> 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



	<b>AGM</b>	<b>Firefly AGM</b>	<b>Flooded</b>
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 do 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 2<sup>nd</sup> or 3<sup>rd</sup> 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 charges 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
    - $100 \times 25\% = 25 \text{ Ah}$
- Optimistic: factor of 3 or 33 Ah
- Conservative: factor of 5 or 20 Ah

# Sidenotes: Inverters



- Provide AC power (120V) from batteries
- Essential components: often missing
  - Wire size
  - Electronic fuse
  - Switch
- Be wary of stand-by
  - Unintentional use causes DC failure
  - Large draw



# Sidenotes: Fuses and Breakers



- Protect wiring, not just appliances
  - Located at the source of power
    - e.g. Battery, alternator, charger
- Size to load **and** wiring





# 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



- Inquire about Electrical Audit for your boat
  - 90 minutes
  - Batteries, DC distribution, charger, alternator, inverter
  - Written report: observations & recommendations
  - Cost: \$189
- Pacific Yachting magazine Tech Talk Column
- [www.pysystems.ca](http://www.pysystems.ca) 100s of articles
- Online newsletter



Questions?



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