



Electrical Systems

Skipper/XO Training

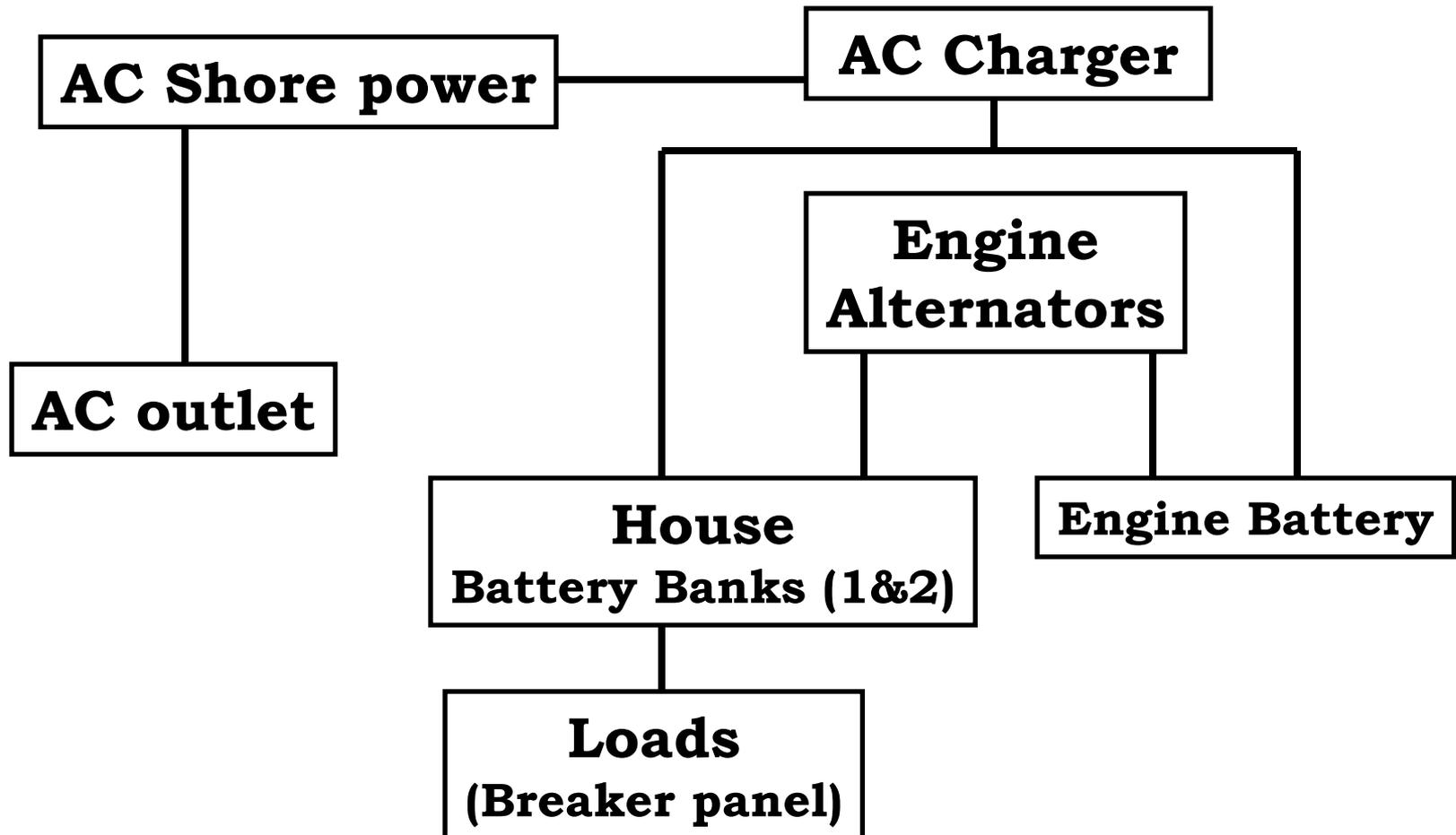


SAFETY

- **The electrical system can kill you**
- The 120 VAC can electrocute you
- The 12 VDC can burn you
- The rotating engine components can sever your fingers or hands

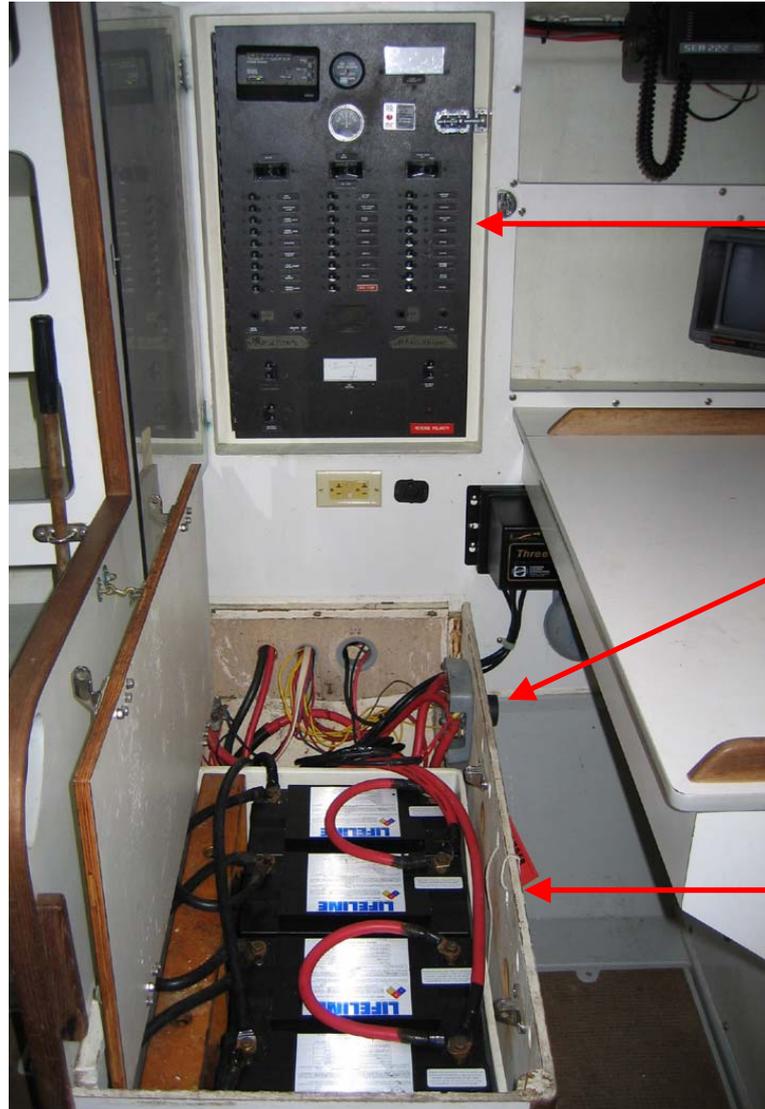


Navy 44 Electrical System





Nav Station



Switchboard

Battery switch

Battery box



Switchboard



Monitoring

DC section

AC section

REVERSE POLARITY



AC Section





DC Section





Monitoring Section





House Battery Switch





Battery Box

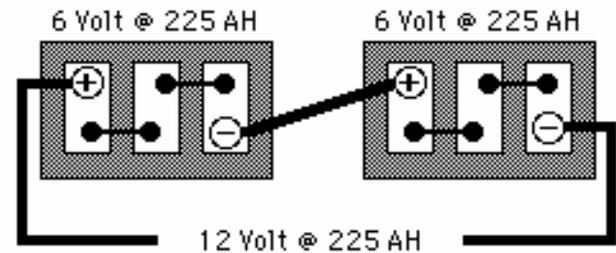




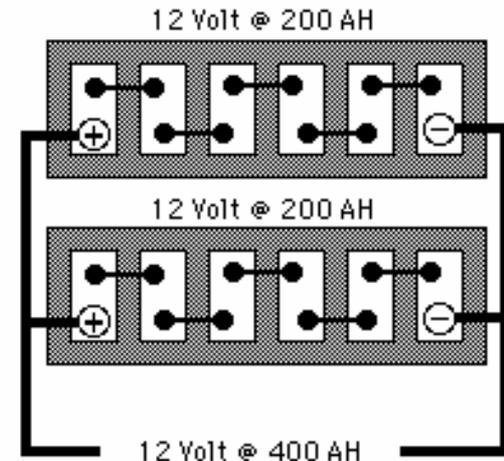
Why we put batteries in parallel

- Connecting in series doubles the voltage but not the total capacity (AH)
- Connecting in parallel doubles the total capacity (AH) but not voltage

Series Connection



Parallel Connection



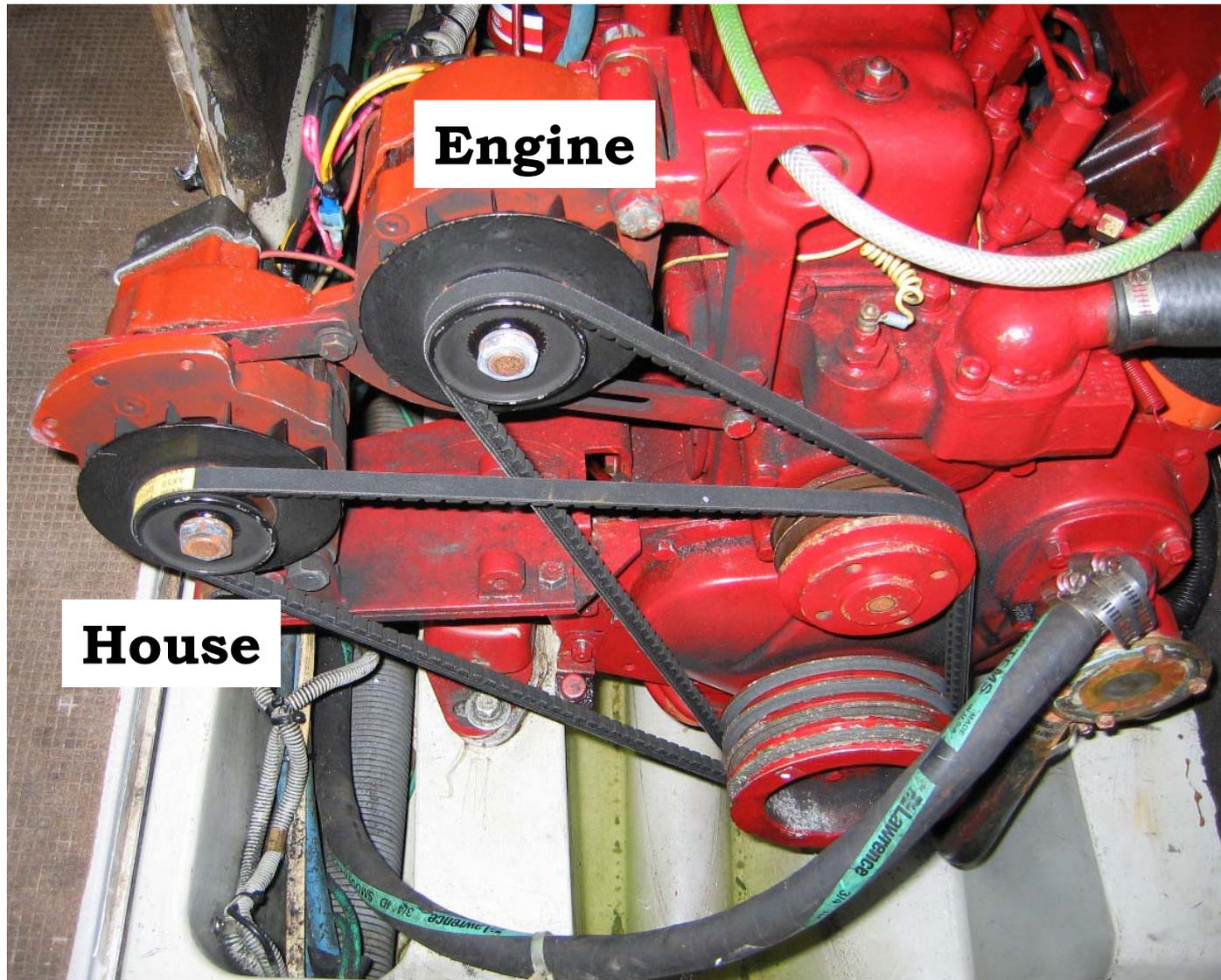


Engine Battery





Alternators



Engine

House



AC Battery Charger





Shore Power (120 VAC)



- You don't ever want one end of an energized power cable dropped in the water
- When getting the boat ready to get underway, the shore end of the power cord is disconnected first
- When securing the boat, the shore end is connected last

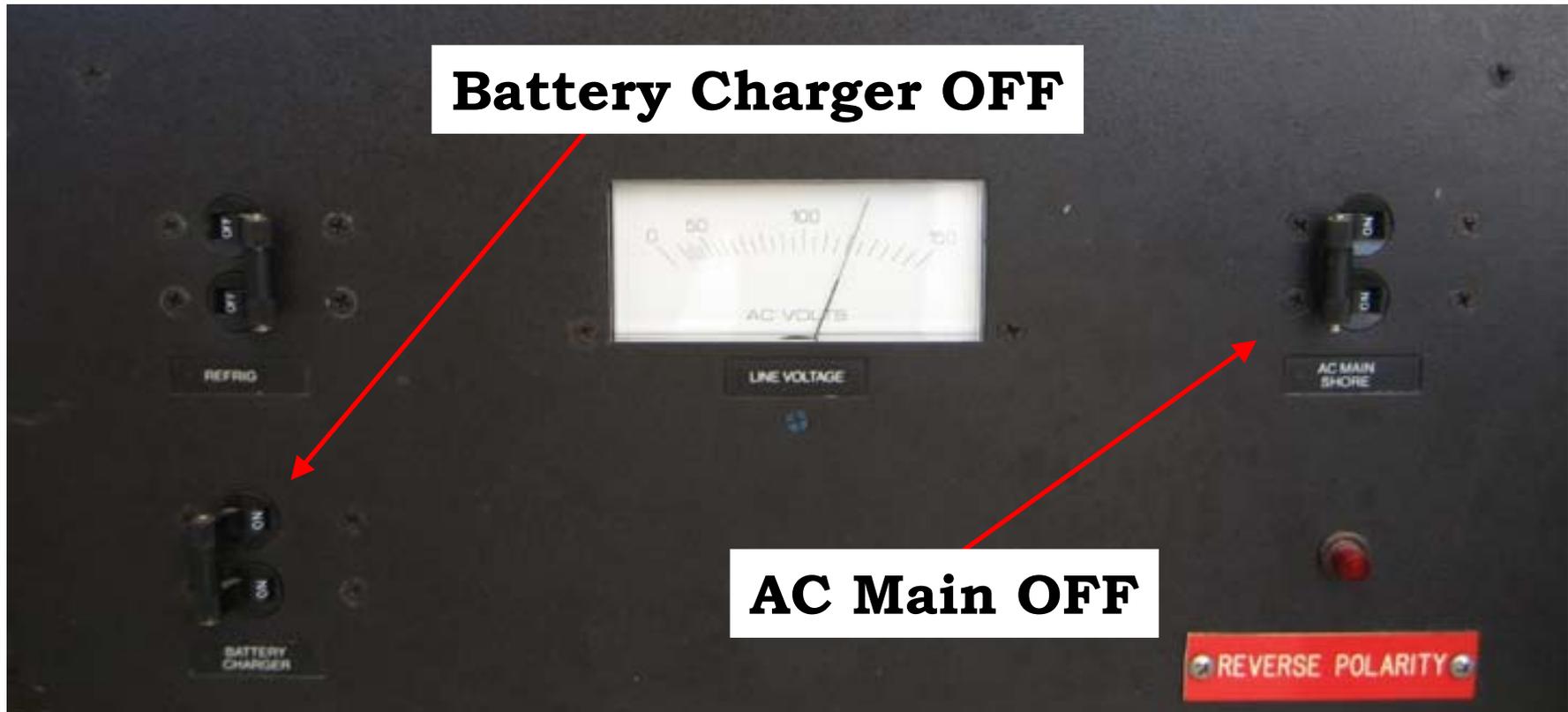


Getting Underway

- Power down AC section
 - Battery Charger **OFF**
 - AC Main Shore circuit breaker **OFF**
 - **You must secure this breaker before moving the 120 VAC power cable in order to prevent arcing as the leads are separated.**



Shore Power AC Breakers



Battery Charger OFF

AC Main OFF

REVERSE POLARITY



Getting Underway

- Disconnect shore power
 - **THEN DISCONNECT SHORE END OF 120 VAC (Shore) POWER CABLE**
 - Disconnect boat end of the 120 VAC power cable
- Power up DC switchboard
 - Ship Service (House) Battery Switch to **Both**
 - Main DC breaker **ON**
 - Alternator field breakers **ON**



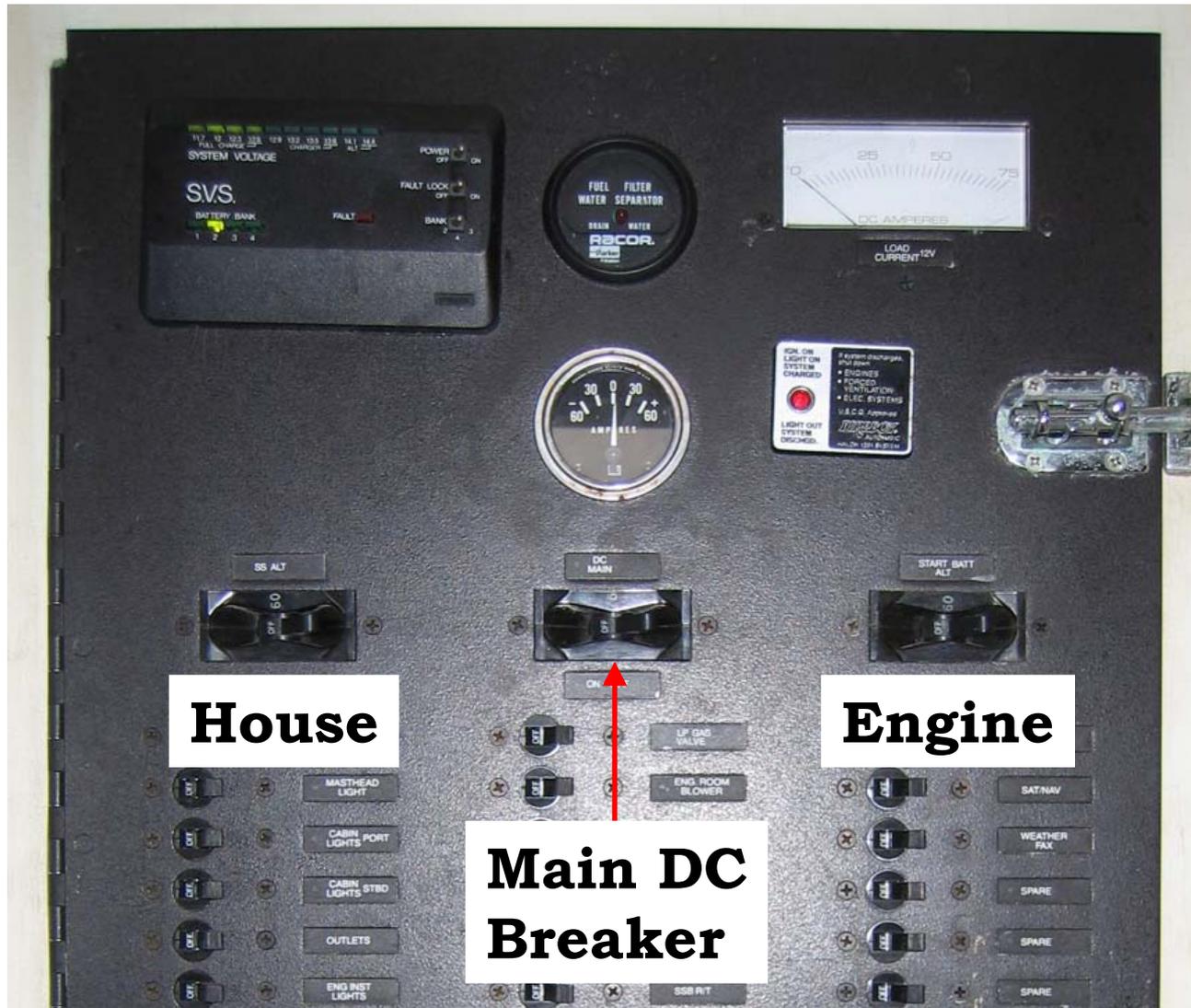
House Battery Switch



Select Both



DC & Alternator Breakers



House

Engine

Main DC Breaker



Getting Underway

- Verify battery bank 1&2 status with the SVS
- Log voltages
- Do not move engine battery switch from OFF until engine inspections are complete



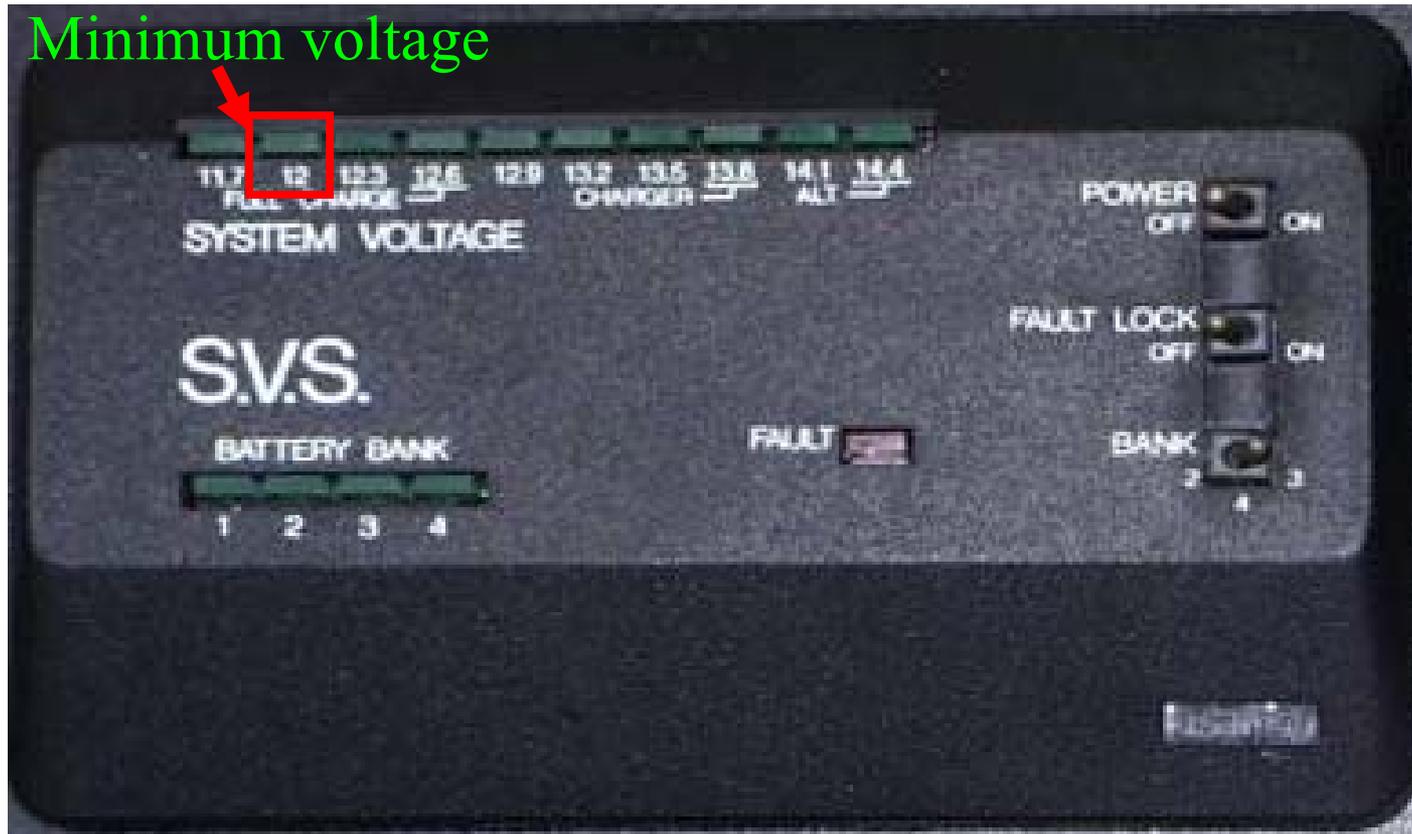
System Voltage Status

1 = House Bank 1

2 = House Bank 2

3 = Engine Start

Minimum voltage





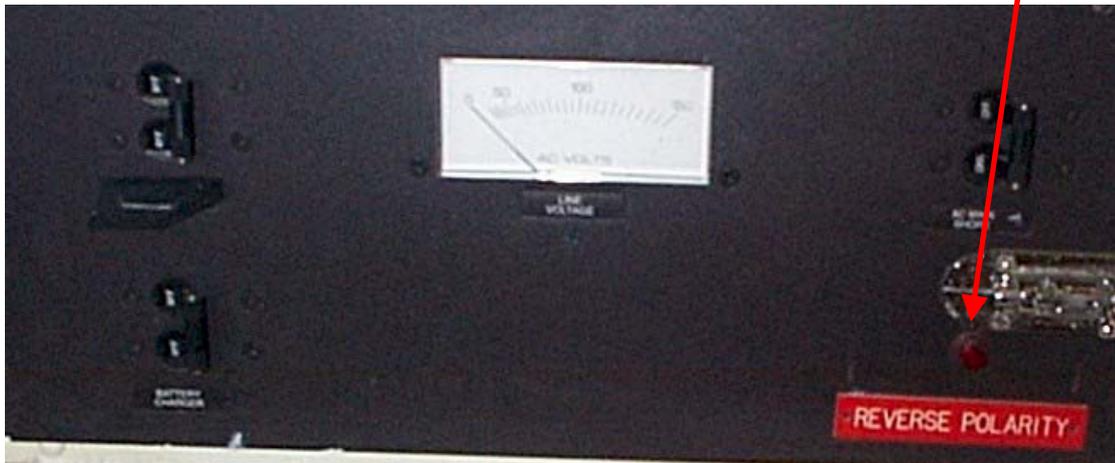
Securing the Electrical System

- Secure individual system breakers
- Secure the DC main breaker
- Turn off the alternator field breakers
- Turn off the battery switches
- Connect the boat end of the 120 VAC power cable
- **THEN CONNECT THE SHORE END OF 120 VAC (Shore) POWER CABLE**



Securing the Electrical System

- Verify no “Reverse Polarity” light lit



- Turn on the AC Shore Power breaker
- Turn on the Battery Charger breaker



Reverse Polarity

- What happens if the hot and neutral wires are reversed?
 - High currents will flow via the neutral ground connection and the boats underwater fittings.
 - This can lead to devastating stray-current corrosion which in extreme cases can destroy fittings in days.
 - Most important it can, and has, killed Swimmers in the water!



Battery Operation Underway



- Batteries should never be operated under 12 volts as indicated by the SVS
- When 12 VDC is reached, the engine should be started and charging begun
- When the engine is operating, the alternators should be on and connected to a battery
- If a battery bank is not selected by the battery switch, it is NOT being charged



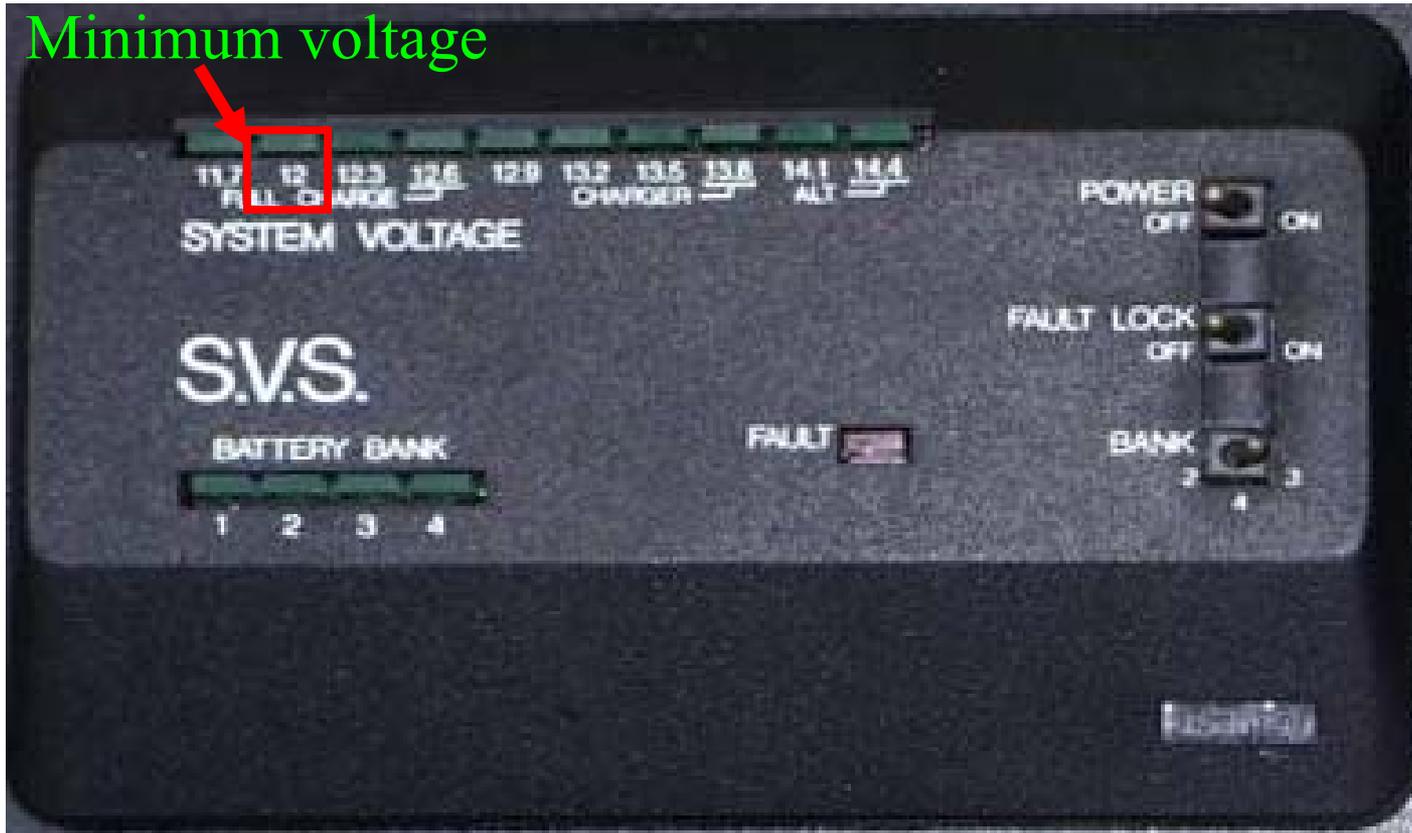
System Voltage Status

1 = House Bank 1

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Minimum voltage





Battery Operation Underway

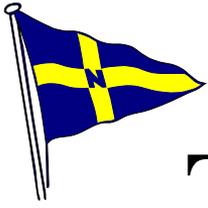


- Battery voltage should be logged hourly
 - Time, battery banks, voltage
- Length of service from a battery bank is dependant on the load being drawn
- Failure of a battery bank is indicated by a short length of service
- AGM – sealed (don't pry open to add water)



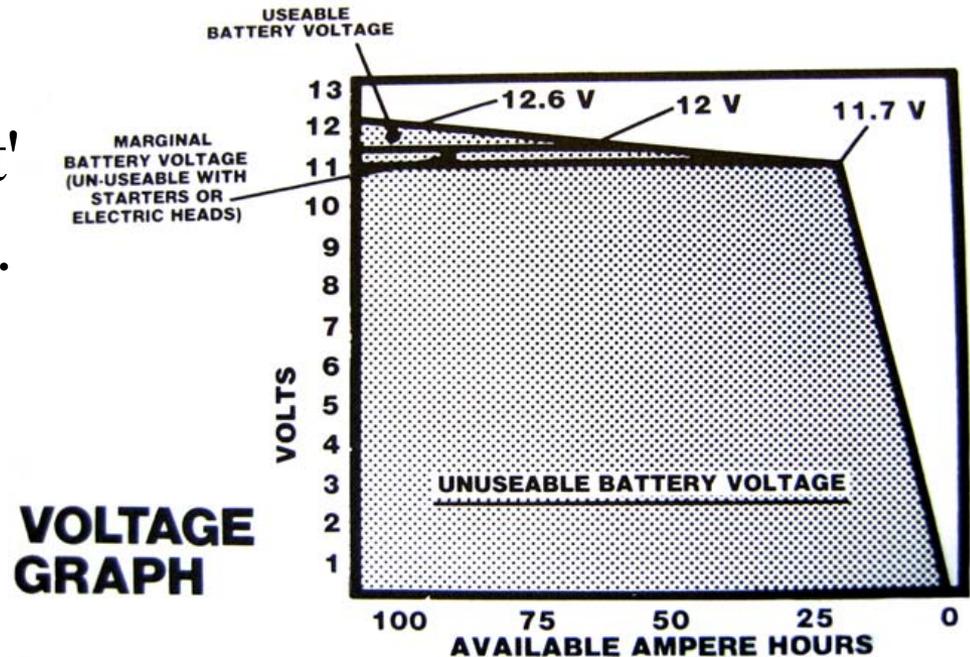
Marine 12 VDC Battery





Taking care of your batteries

- Avoid deep discharging batteries below 50% of their capacity.
 - A 50% discharged battery has an 'at rest' voltage of ~12 Volts.





Battery charging

- Alternators & battery chargers have automatic controls which taper the charge rate as the batteries come up in charge.
- It should be noted that a decrease to a few amperes while charging does not mean that the batteries have been fully charged.



How to Switch SS Batteries

- After the battery switch is turned on, battery banks are selected by always going through BOTH



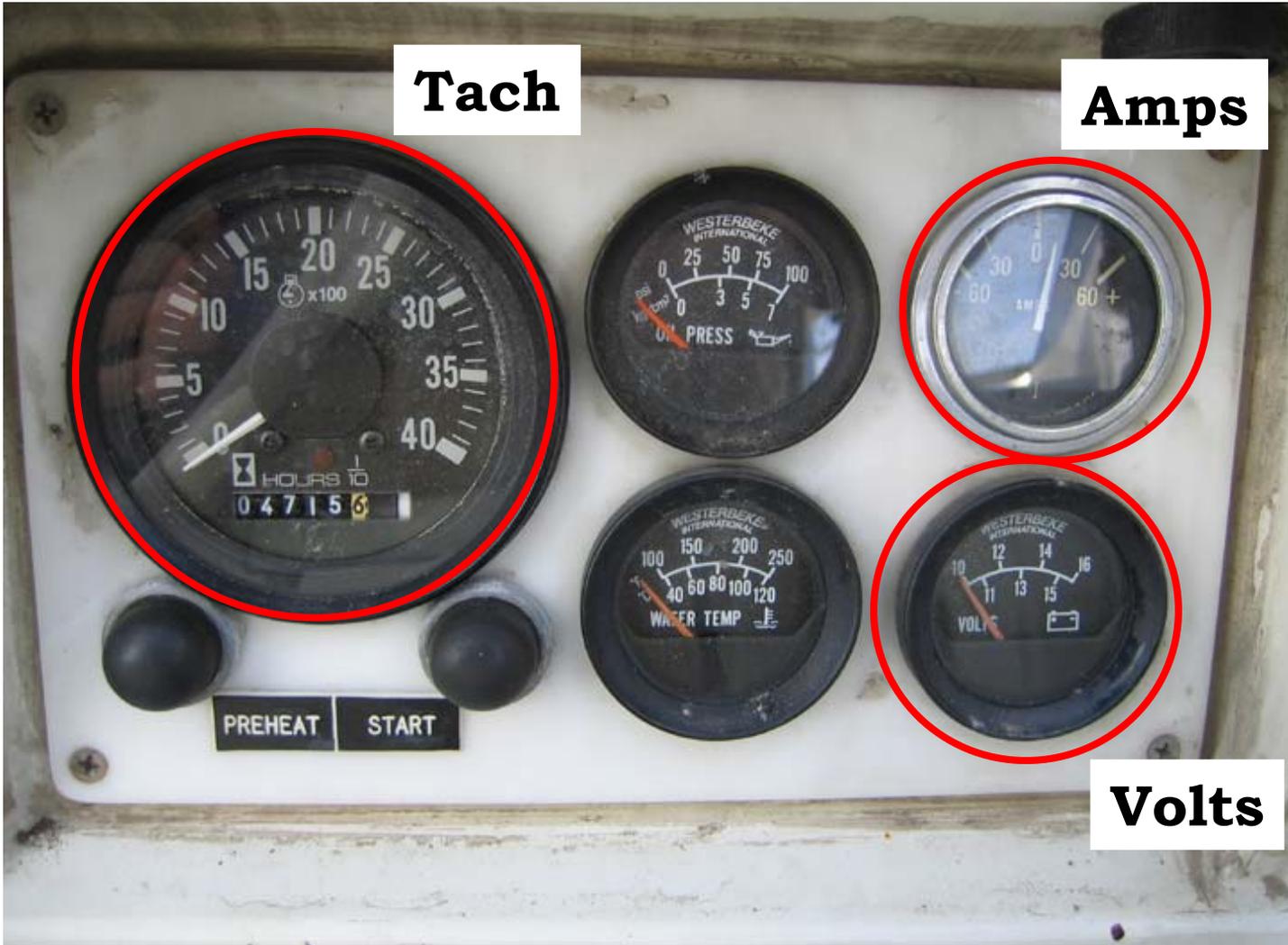


Engine Starting Battery

- Verify starting alternator field breakers on
- Charging current and voltage is indicated on the engine instruments located on the stbd side of the helm
- The engine tach is derived from the engine alternator field circuit



Verification of Alternator Function



Tach

Amps

Volts



Verification of Alternator Function





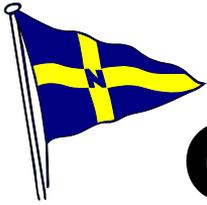
Alternator Circuit

- The alternators will operate only if oil pressure exceeds the pressure required to deactivate the alarm switch
- Should the oil pressure switch fail, and the engine oil is functioning, the switch will have to be bypassed or replaced for the associated alternator to function



Oil Pressure Switch Failure

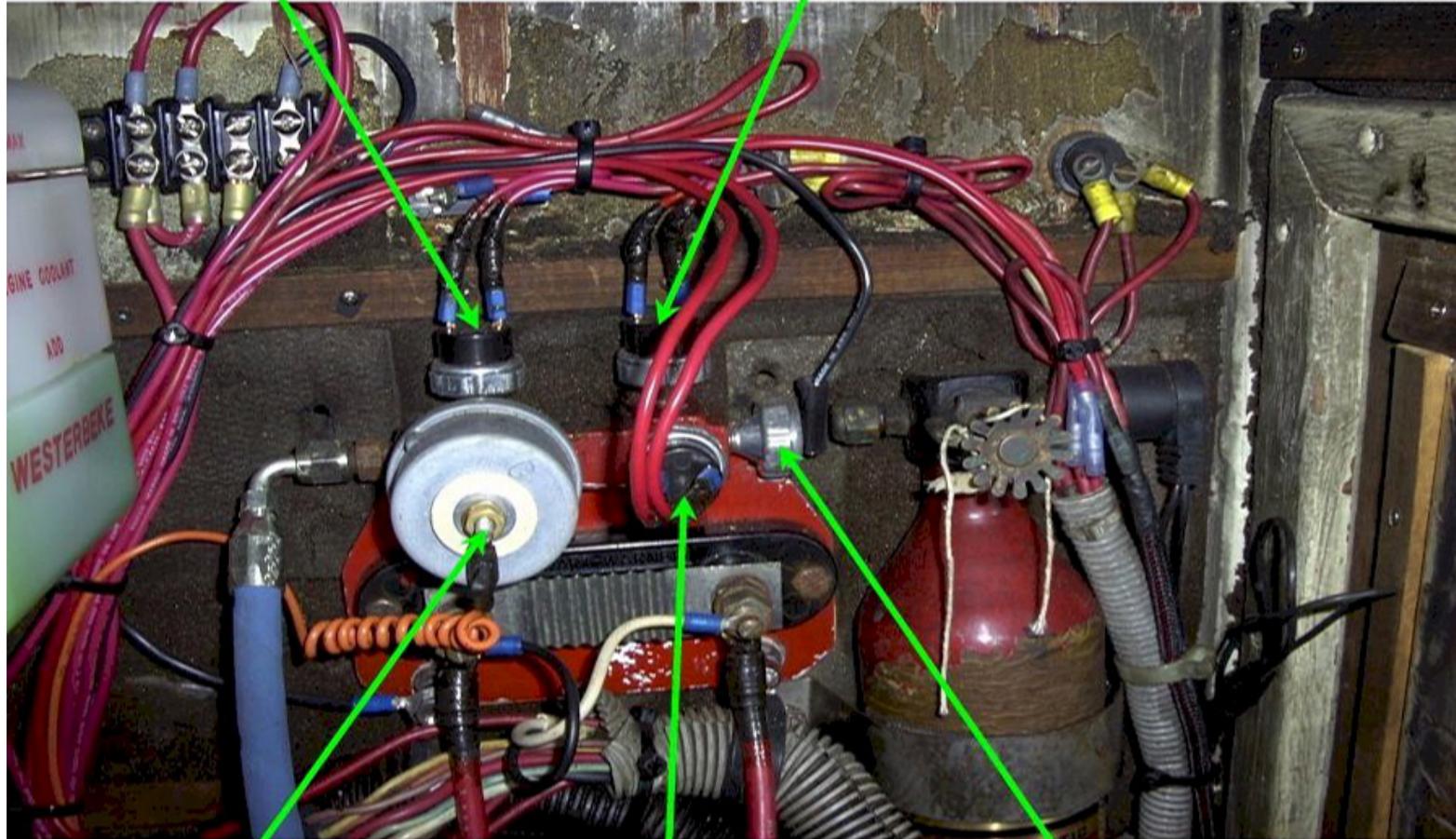
- Oil pressure switch failure is indicated by a proper oil pressure gauge reading and:
 - Low SVS voltage readings for associated banks
 - Amp meter is not indicating a charge
 - Breaker panel for House alternator
 - Eng inst panel for Eng start alternator
 - Tachometer not functioning (Eng start alt)



Oil Pressure Switch Location

Engine Start Alternator

Ship Service Alternator



Oil Pressure Gauge

Alternator Failure

Oil Pressure Alarm

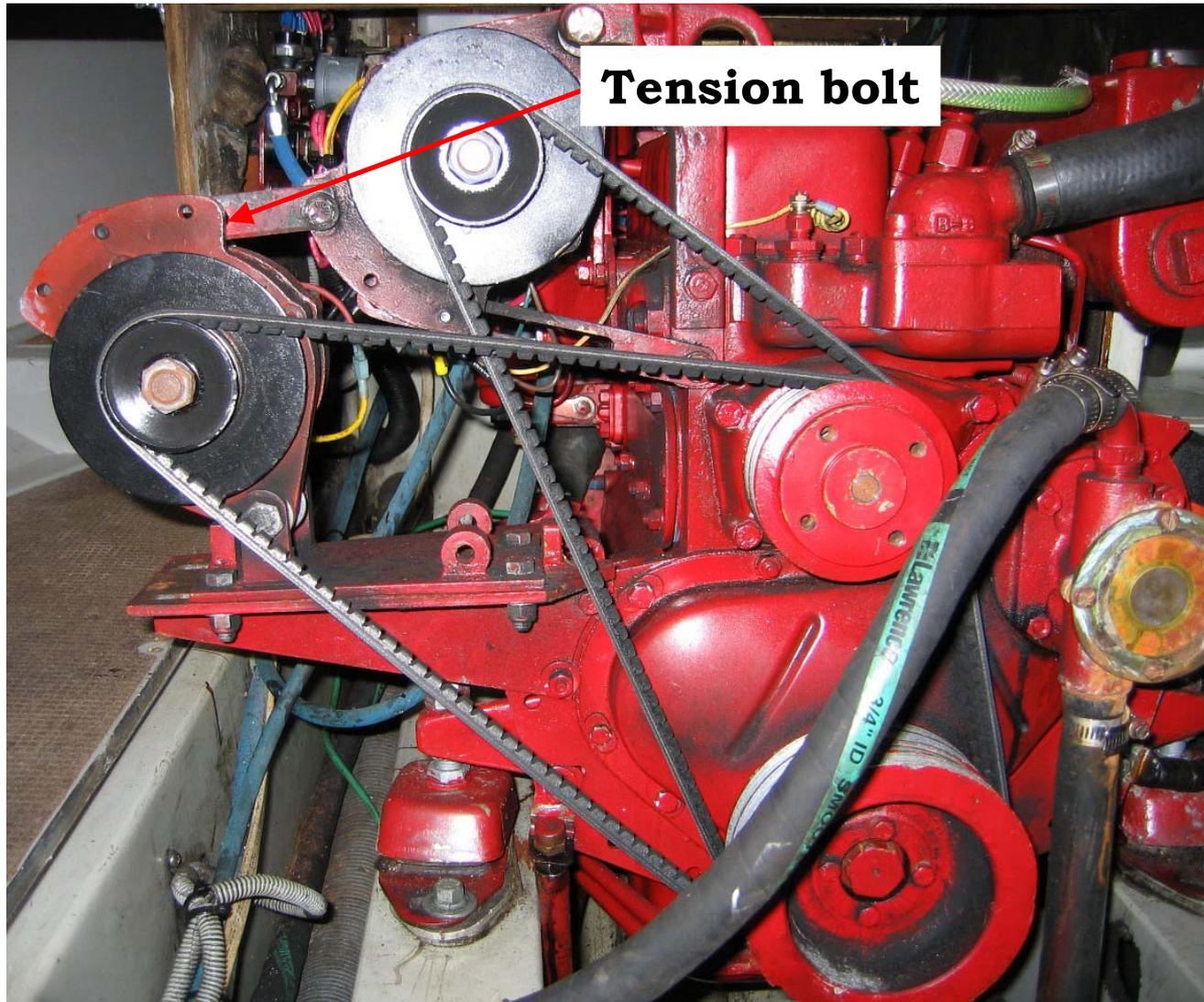


Other Alternator failures

- **Belt tension too loose**
 - Causes the belt to slip over the alternator wheel without causing it to rotate
 - If you can spin the alternator fan blades by hand, then the belt is too loose
- **Alternator goes bad**
 - No current or voltage output with no other issues
 - Use “Alternator Failure” switch until can be replaced



Alternator



Tension bolt



Alternator Failure Switch



**Parallels House & Eng
Start alternators**

START PARALLEL
BATTERIES

ON
ALT. FAILURE
OFF



Individual Electrical Systems

- Individual electrical systems are energized and secured by turning on or off **system breakers** at the **electrical panel**
- Always verify component power switch status



System Loads (Amps)

- | | | | |
|----------------|---------|---------------|--------|
| • Nav (10) | 6 | • Tricolor | 3 |
| • Cabin lights | 6 | • Fans | 6 |
| • Bilge pump | 15 | • MSD pump | 20 |
| • VHF | 1.2/6.3 | • SSB | 2.5/17 |
| • WEFAX | 1.2/2.2 | • Radar | 4.2 |
| • Loran | 0.8 | • B&G | 0.66 |
| • Reefer | 6.8 | • Water pumps | 6 |

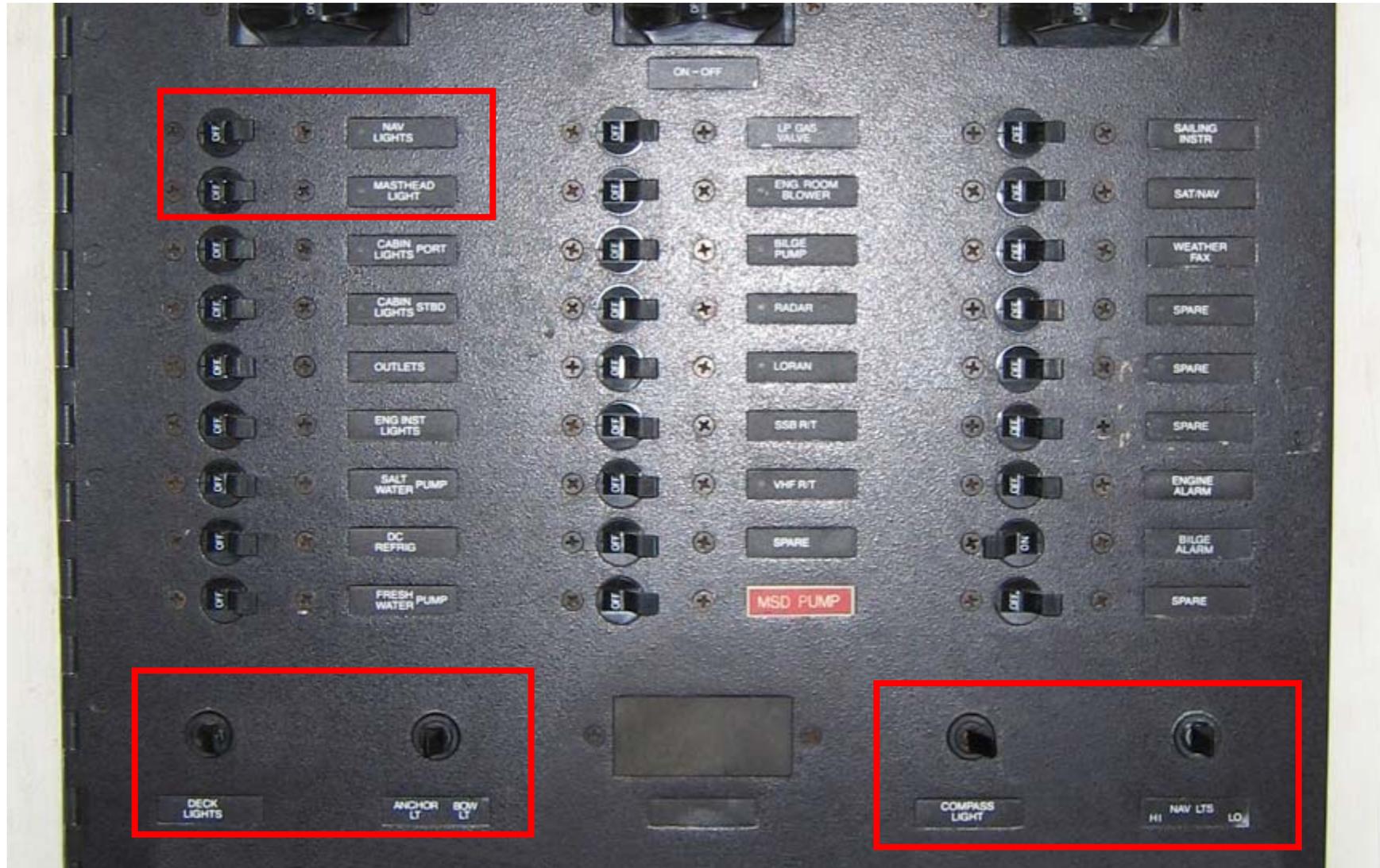


Navigation Lights

- Nav lights are turned on from sunset to sunrise, and in restricted visibility
- Anchor, steaming and deck lights are also considered nav lights on the panel



Nav Light Breakers





Nav Light Breaker Configuration



- The MASTHEAD LIGHT bkr provides power to the DECK LIGHTS and ANCHOR/BOW LTS
- The NAV LIGHTS bkr provides power to the COMPASS LIGHT and NAV LTS switches





Deck Light Switch

- Right OFF
- Left ON





Anchor-Bow Light Switch

- Selects between Anchor light (colocated with the Tricolor at the top of the mast) and the Deck light (lights up the foredeck)
- Mid position is OFF





Nav Light Switch

- HI selects Tricolor
- LO selects bow and stern lights



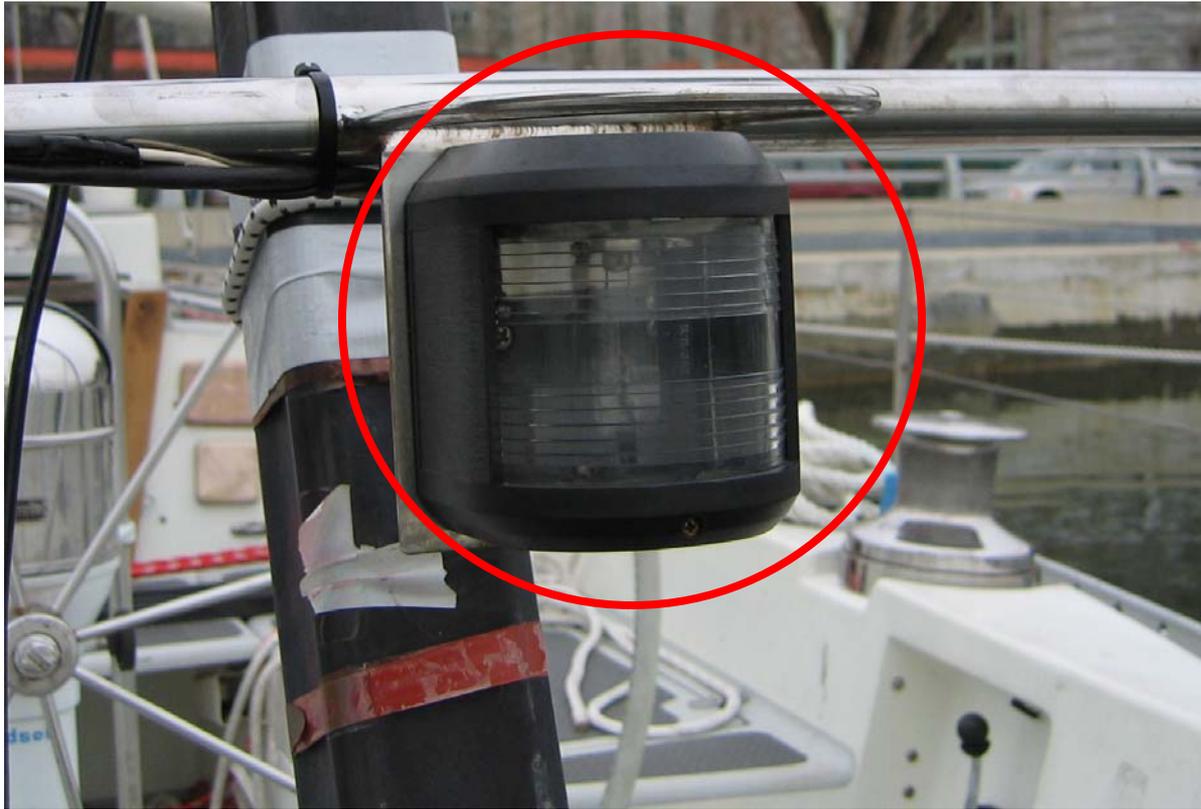


Tricolor





Stern Light





Bow Light





Steaming/Deck Light



**Steaming
light**

Deck light



Racor Fuel Filter





Racor Fuel Filter





General Electrical Failures

- No power to multiple systems
 - Verify DC breakers are ON
 - Verify battery switches are properly set
 - Verify status of Batter Bank (SVS)



Component failures

- **No power to one component**
 - **Check fuse**
 - Over current protection
 - Replace
 - **Check circuit Breaker**
 - Over current protection
 - Can reset once, but need to investigate why if it trips again.

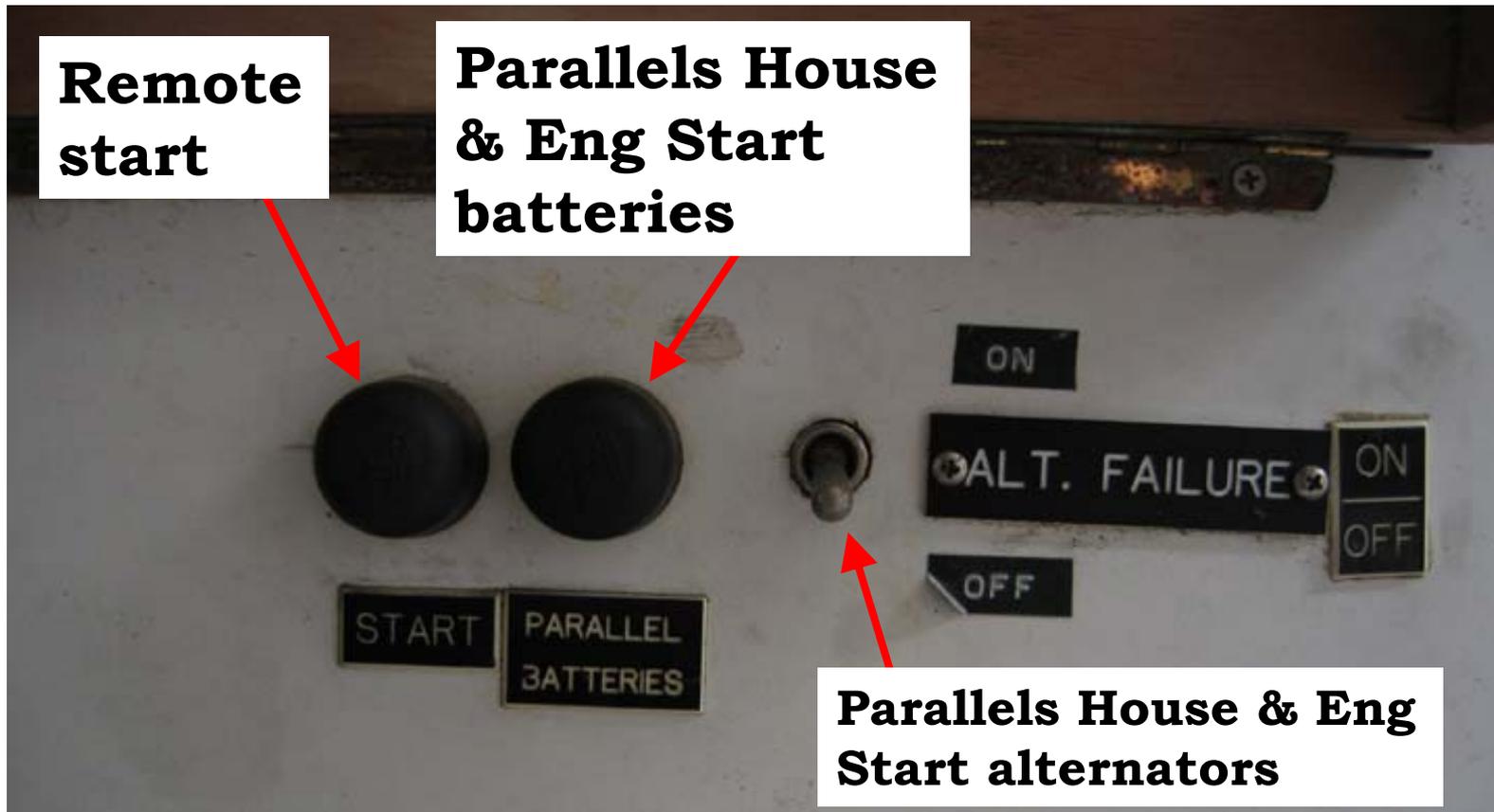


Emergency Engine Start





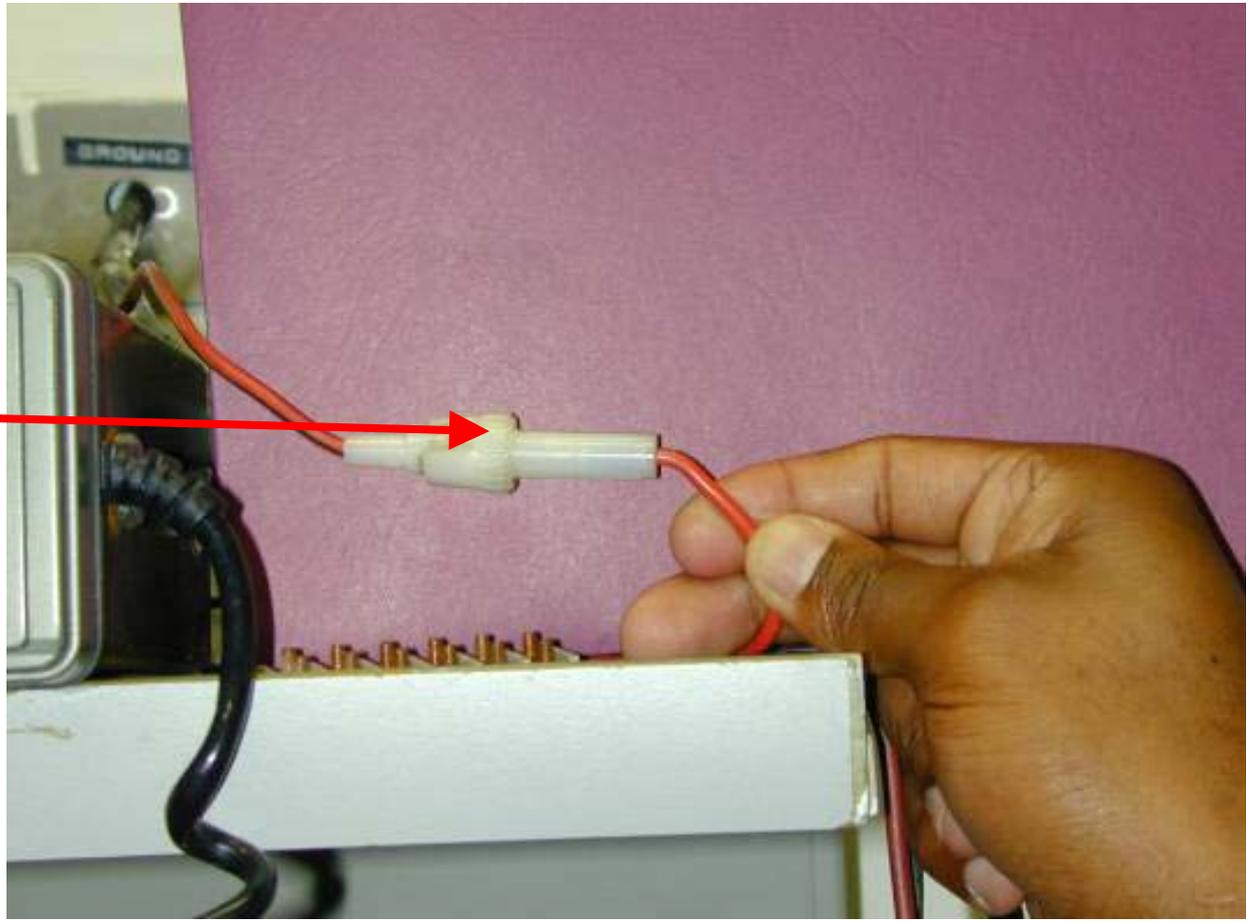
Emergency Engine Start





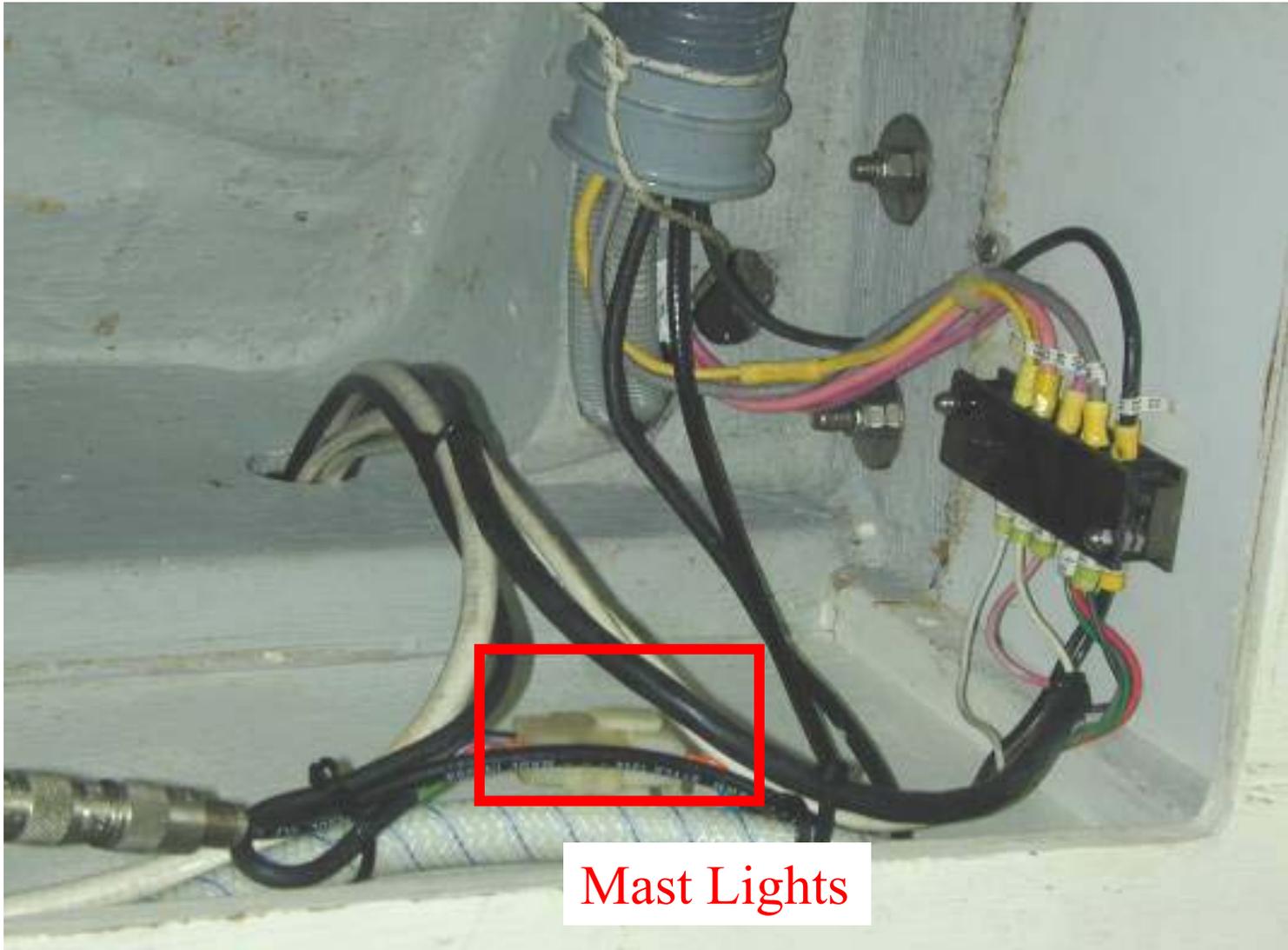
Electronics fuses

fuse





Navigation Lights connectors



Mast Lights



Stove LPG Solenoid fuse

fuse





Questions?