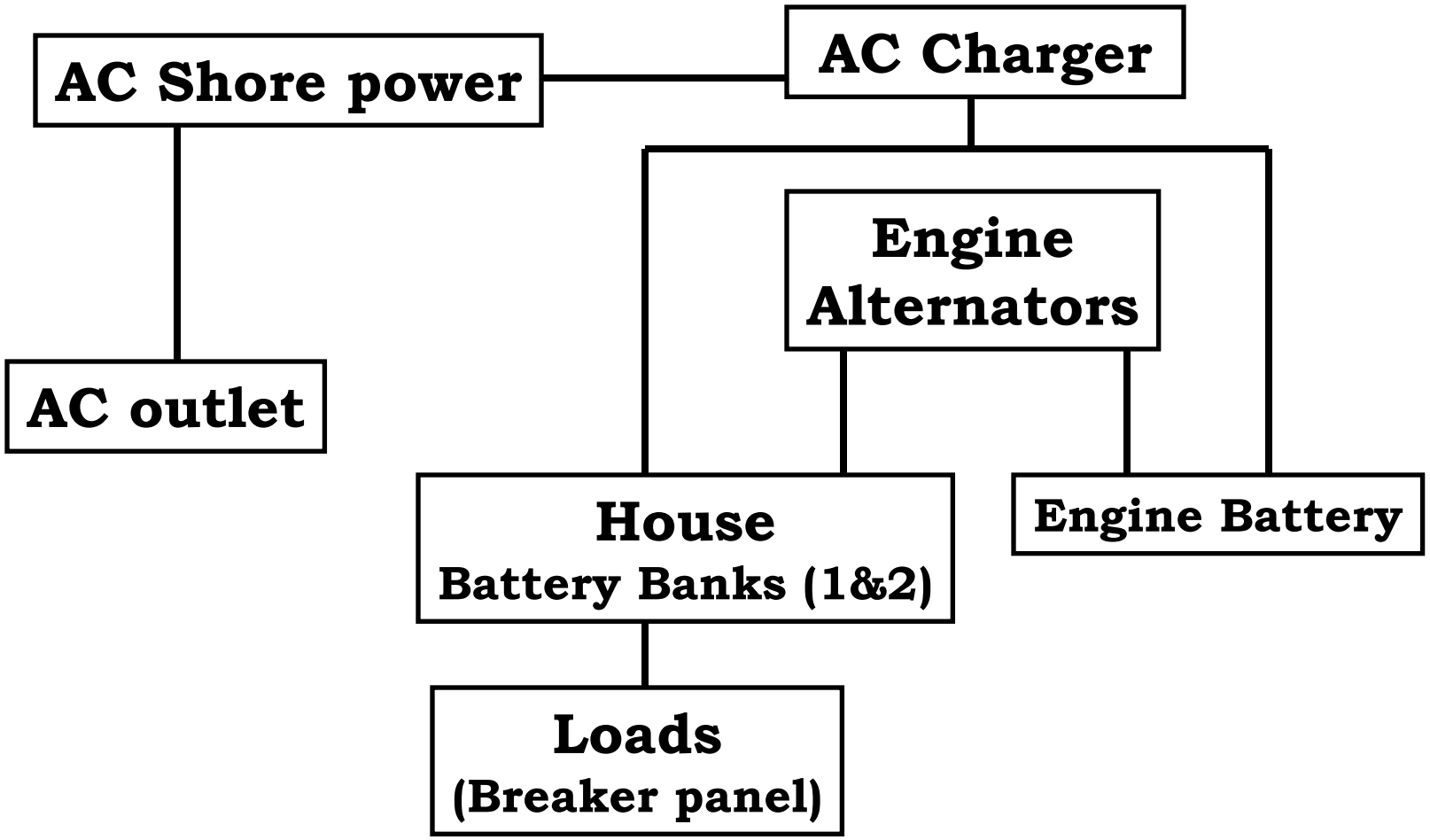
Electrical Systems

Skipper/XO Training

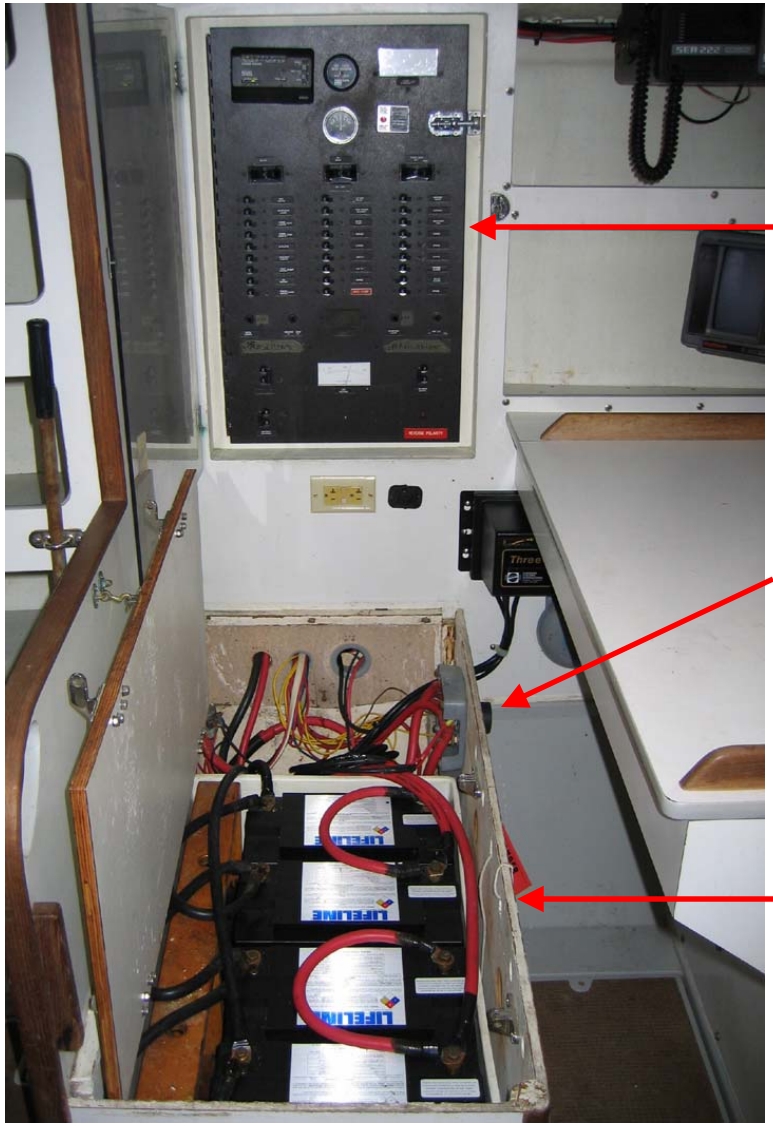
SAFETY

- **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

Monitoring

DC section

AC section

AC Section

REFRIG
LINE VOLTAGE
AC MAIN SHORE
BATTERY CHARGER
REVERSE POLARITY

DC Section

SS ALT
DC MAIN
START BATT ALT
ON - OFF
NAV LIGHTS
MASTHEAD LIGHT
CABIN LIGHTS PORT
CABIN LIGHTS STBD
OUTLETS
ENG INST LIGHTS
SALT WATER PUMP
DC REFRIG
FRESH WATER PUMP
LP GAS VALVE
ENG. ROOM BLOWER
BILGE PUMP
RADAR
LORAN
SSB R/T
VHF R/T
SPARE
MSD PUMP
SAILING INSTR
SAT/NAV
WEATHER FAX
SPARE
SPARE
SPARE
ENGINE ALARM
BILGE ALARM
SPARE
DECK LIGHTS
ANCHOR LT
BOW LT
COMPASS LIGHT
NAV LTS
HI
LO

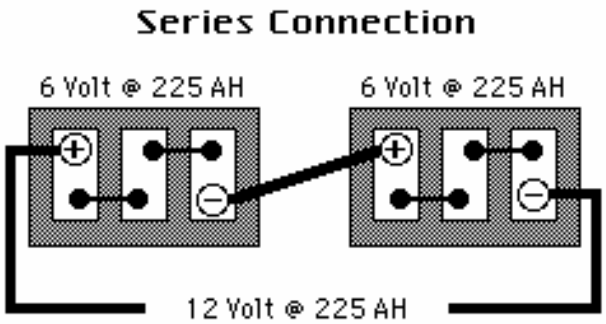
Monitoring Section

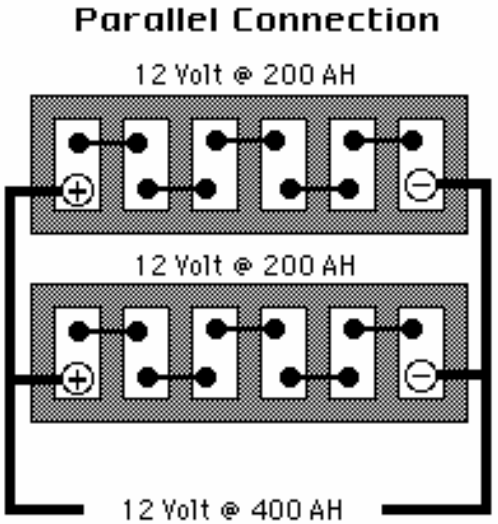
House Battery Switch

Battery Box

Why we put batteries in parallel

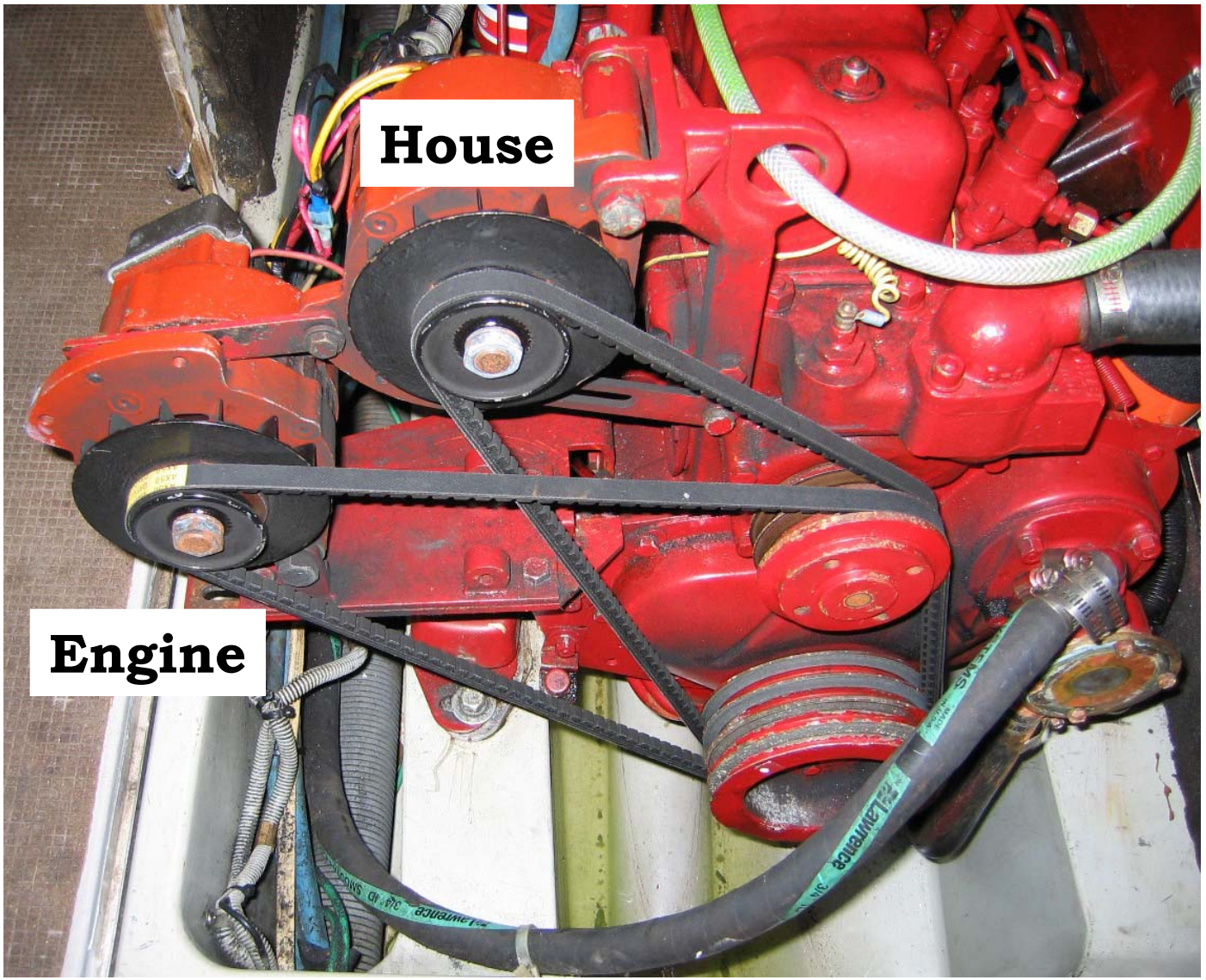
- Connecting in series doubles the voltage but not the total capacity (AH)
- Connecting in parallel doubles the total capacity (AH) but not voltage





Engine Battery

Alternators



AC Battery Charger

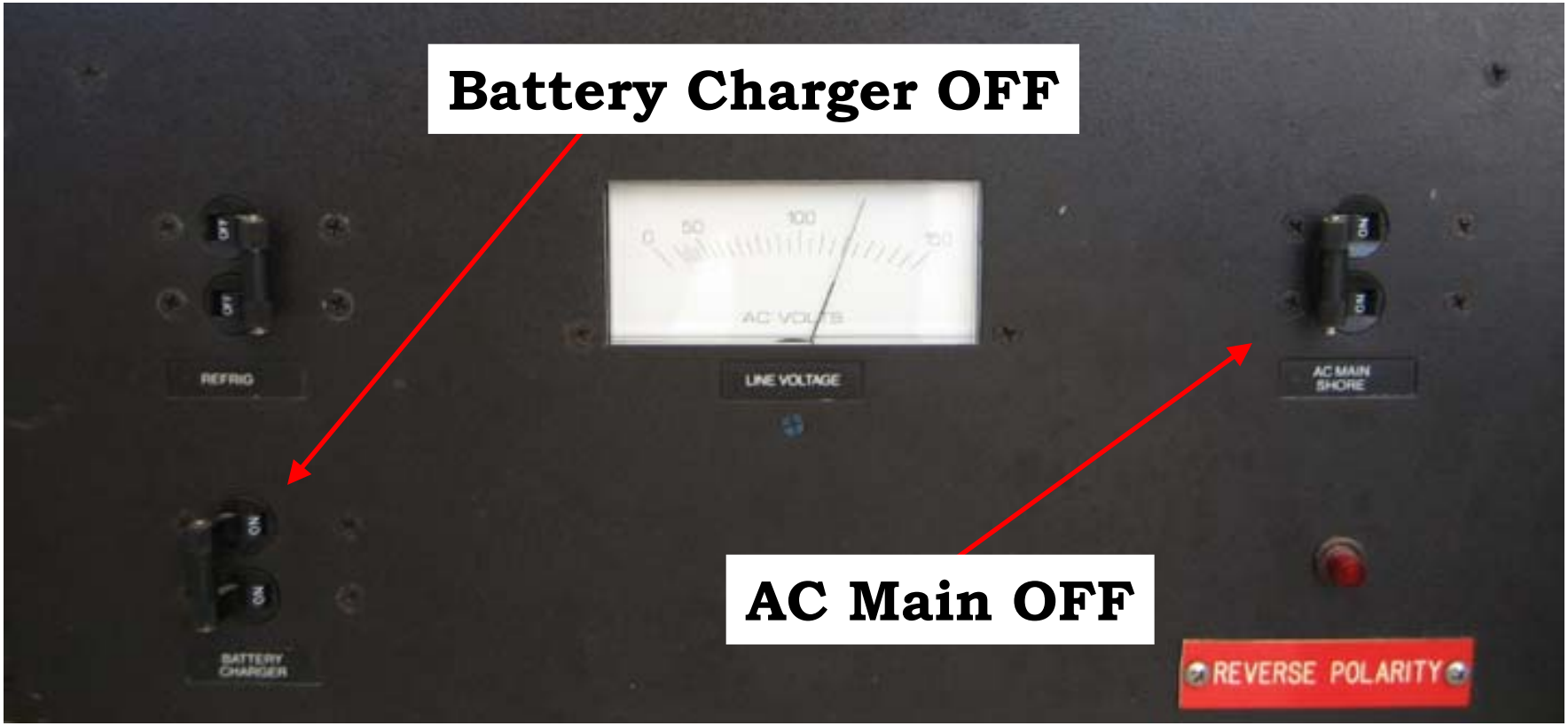
Shore Power (120 VAC)

- 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 arching as the leads are separated.**

Shore Power AC Breakers



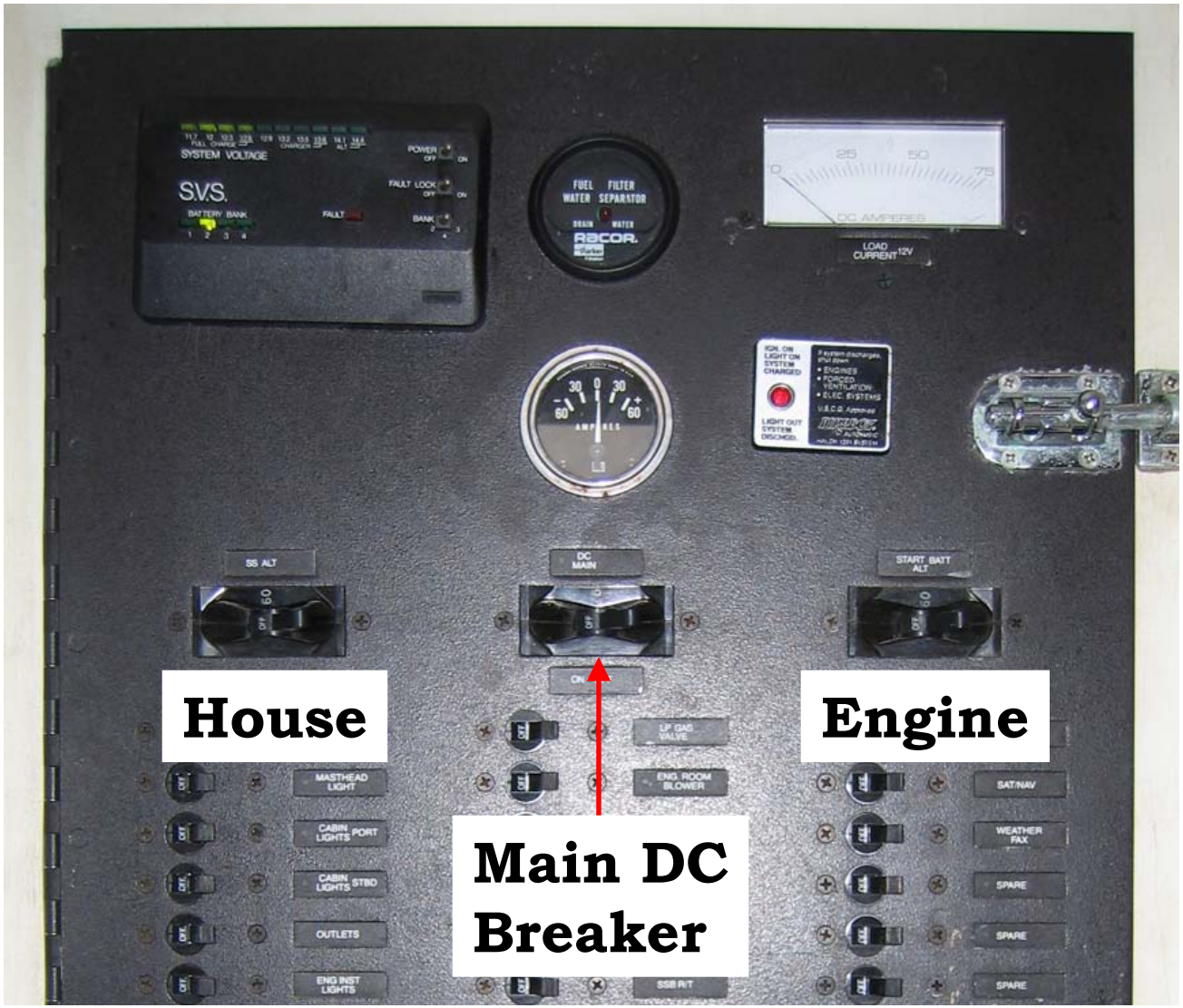
Getting Underway

- 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

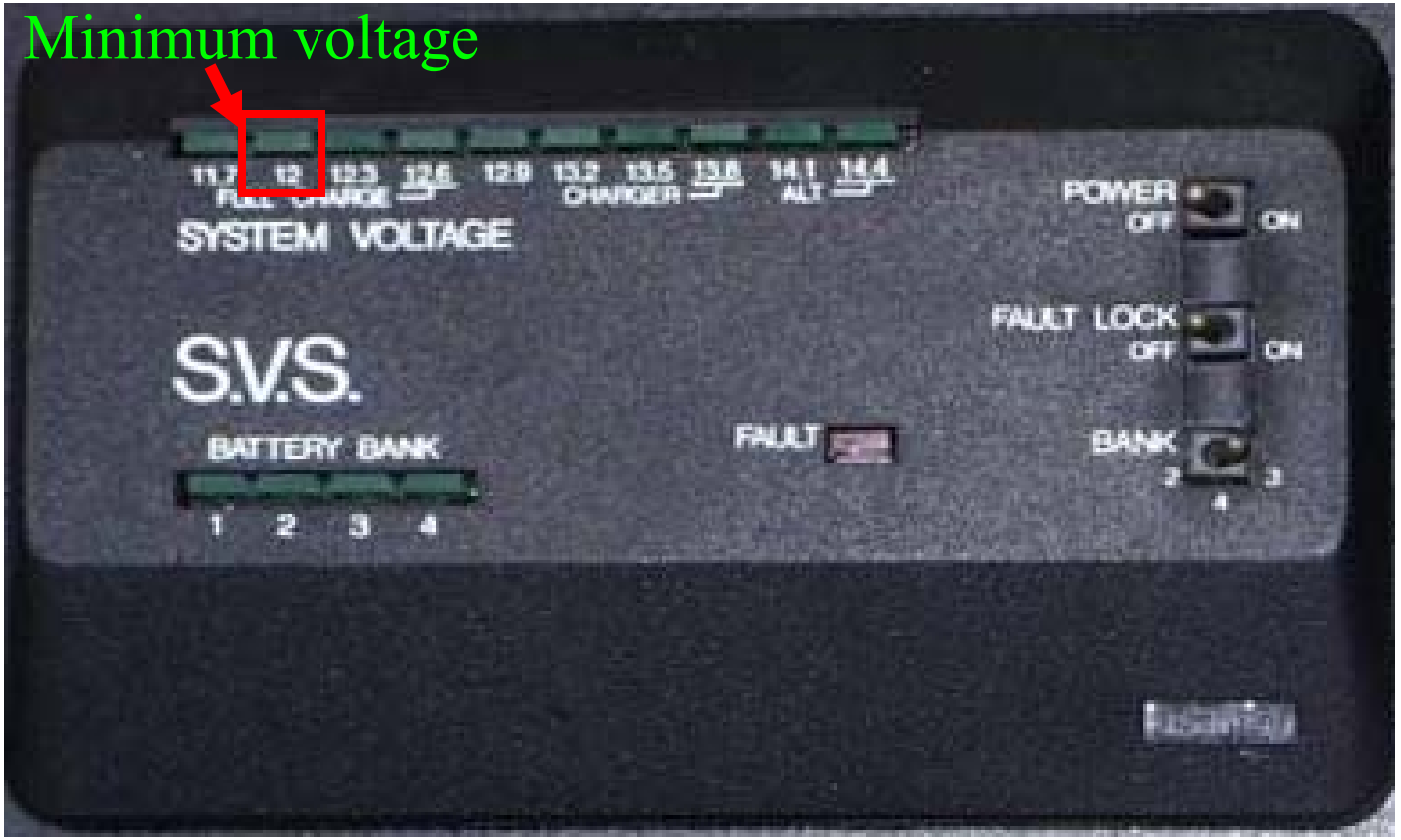


Getting Underway

- 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



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

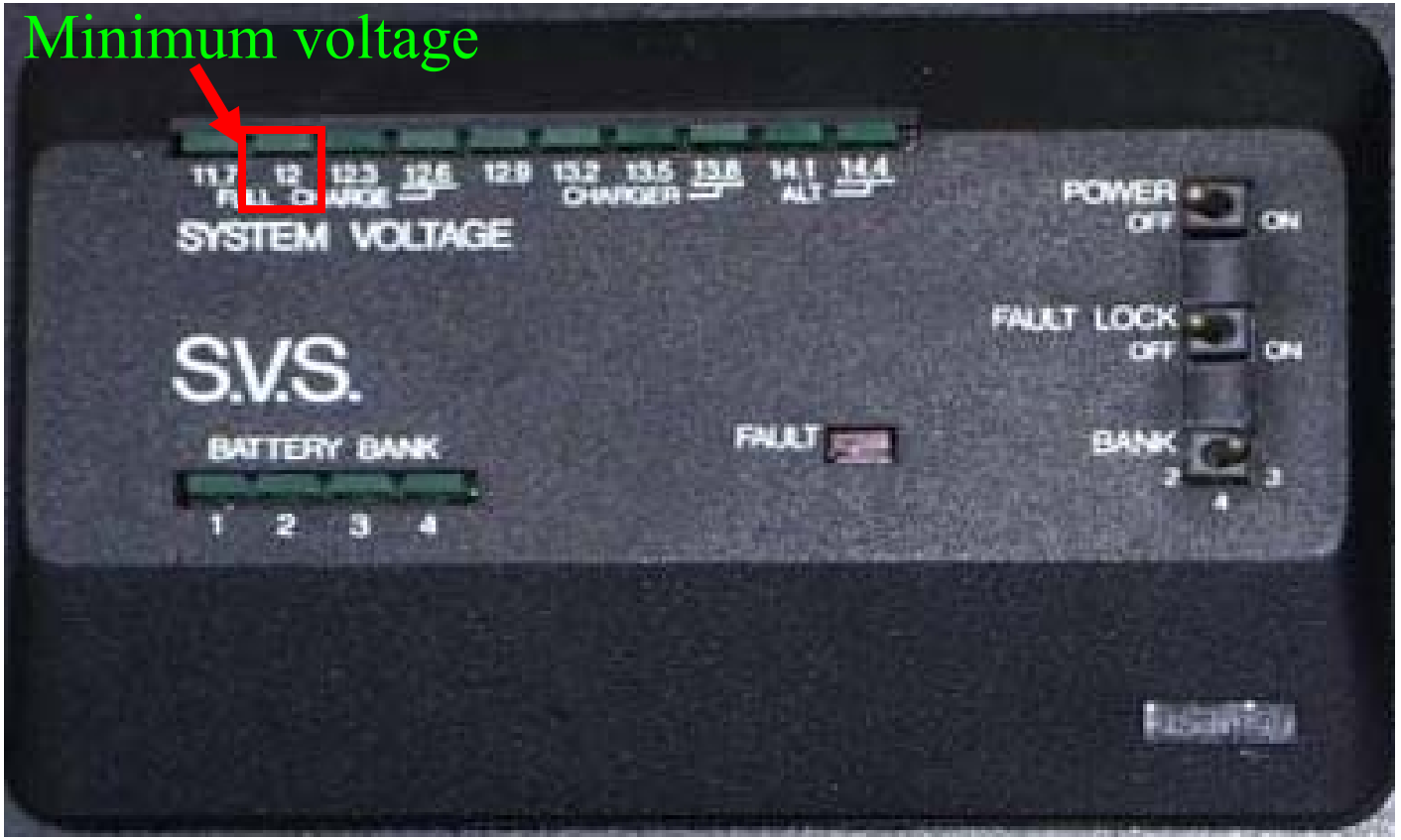
- What happens if the hot and neutral wires are reversed?
  - High currents will flow via the neutral ground connection and the boats underwater fittings.
  - This can lead to devastating stray-current corrosion which in extreme cases can destroy fittings in days.
  - Most important it can, and has, 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 2 = House Bank 2 3 = Engine Start



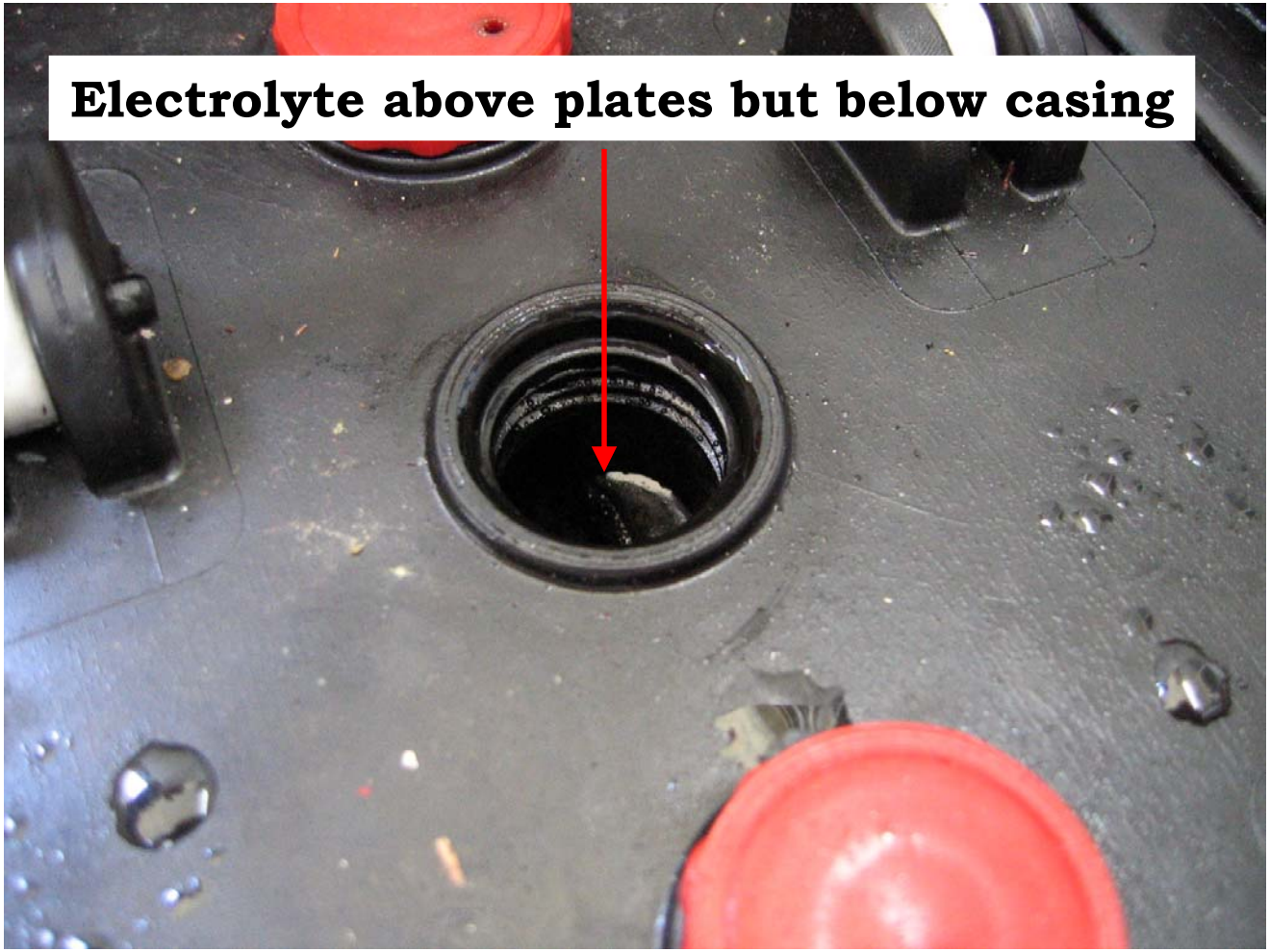
Battery Operation Underway

- 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

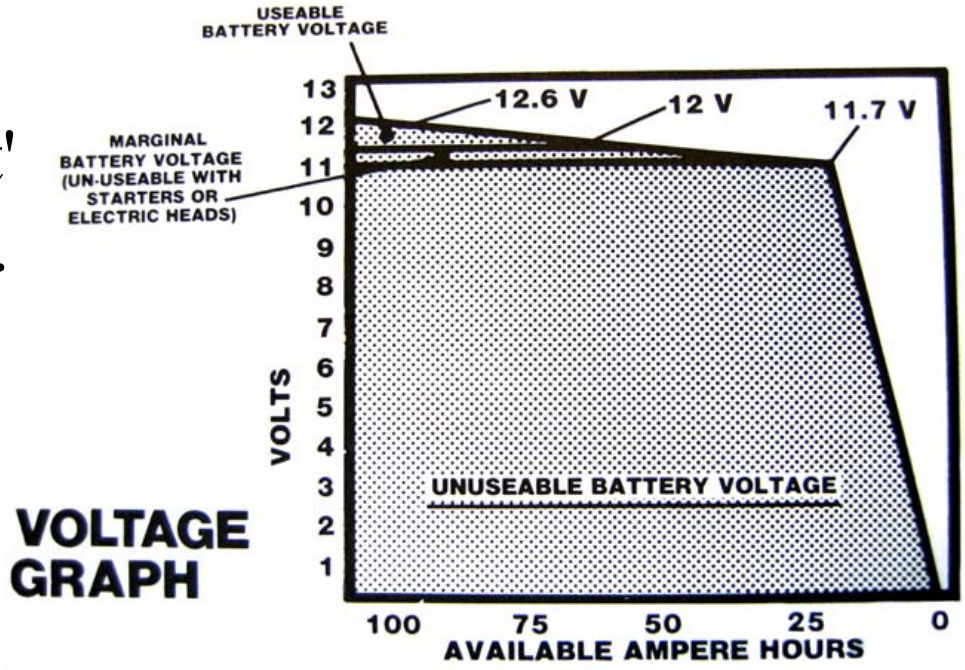
Marine 12 VDC Battery

Correct Electrolyte Level



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.

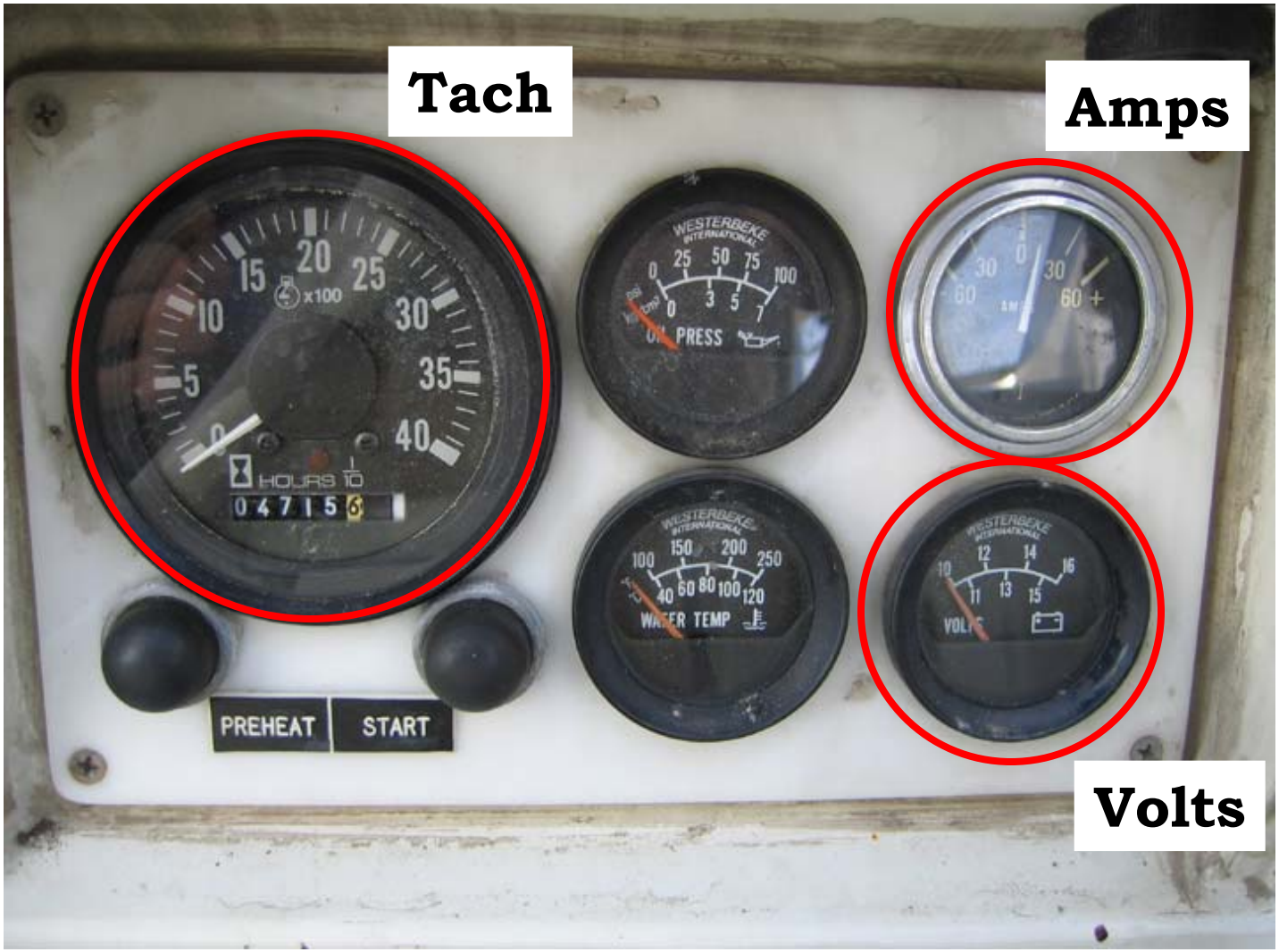
How to Switch SS Batteries

- 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



Verification of Alternator Function

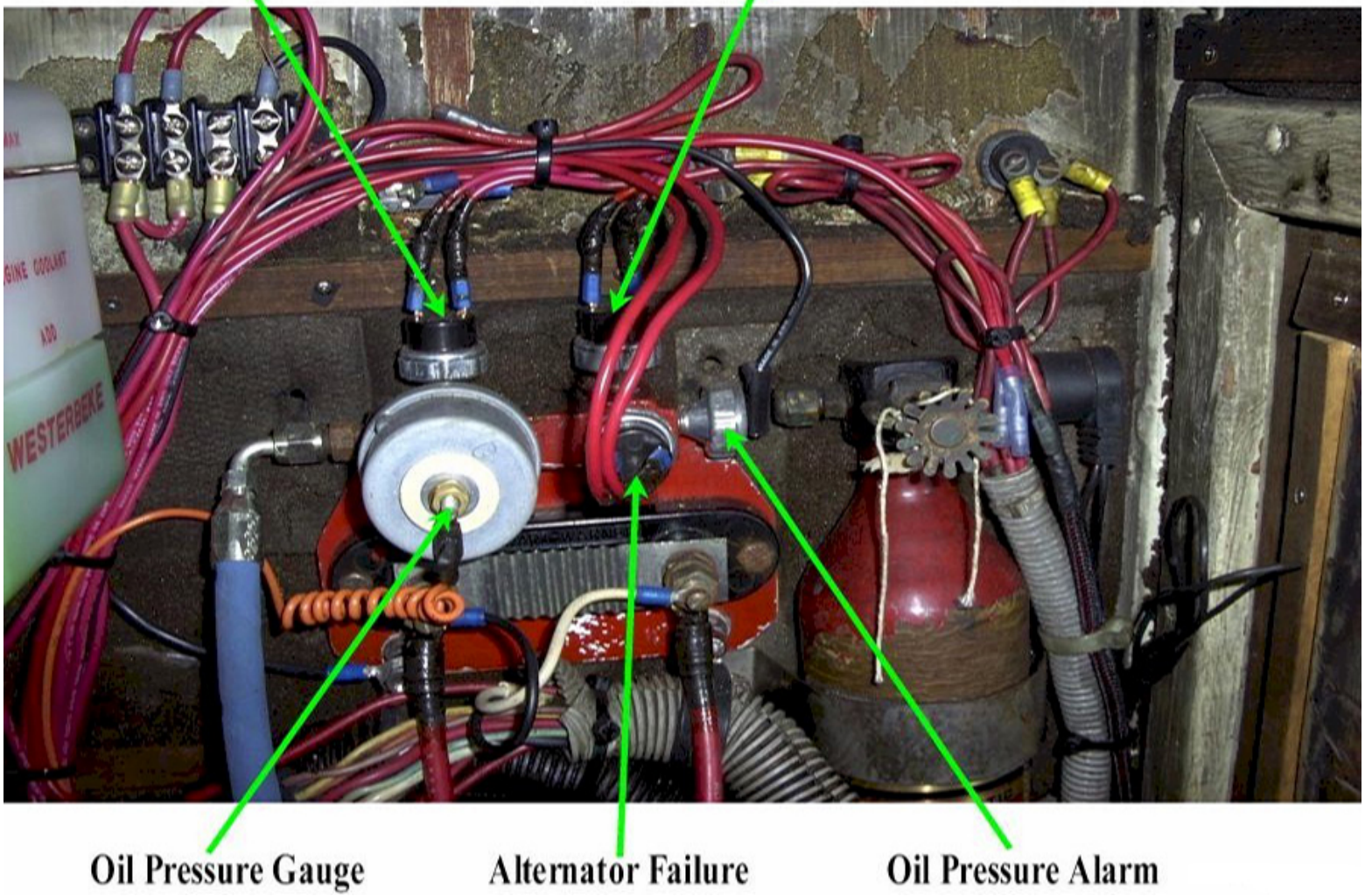
Alternator Circuit

- 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)

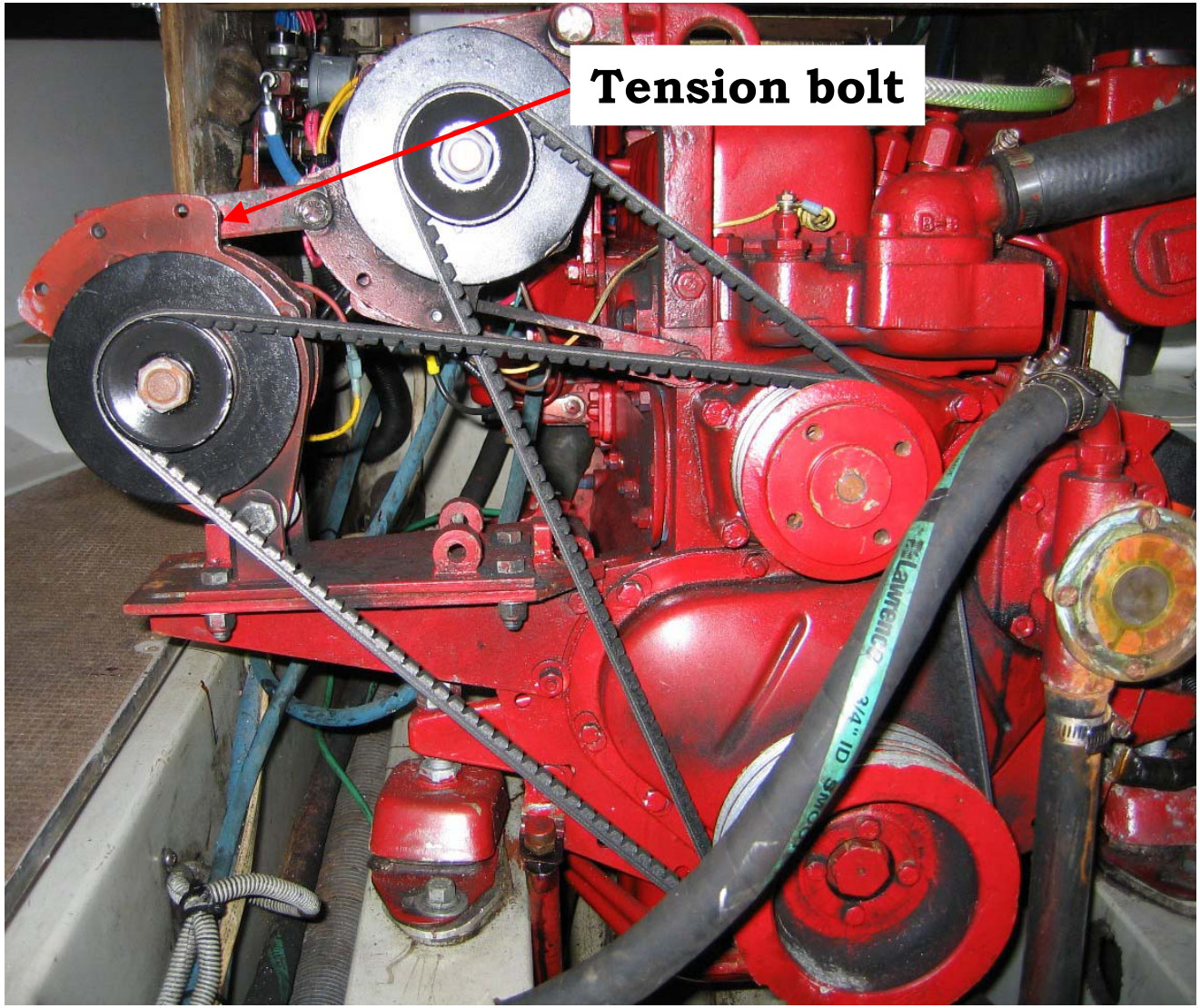
Oil Pressure Switch Location



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



Alternator Failure Switch

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

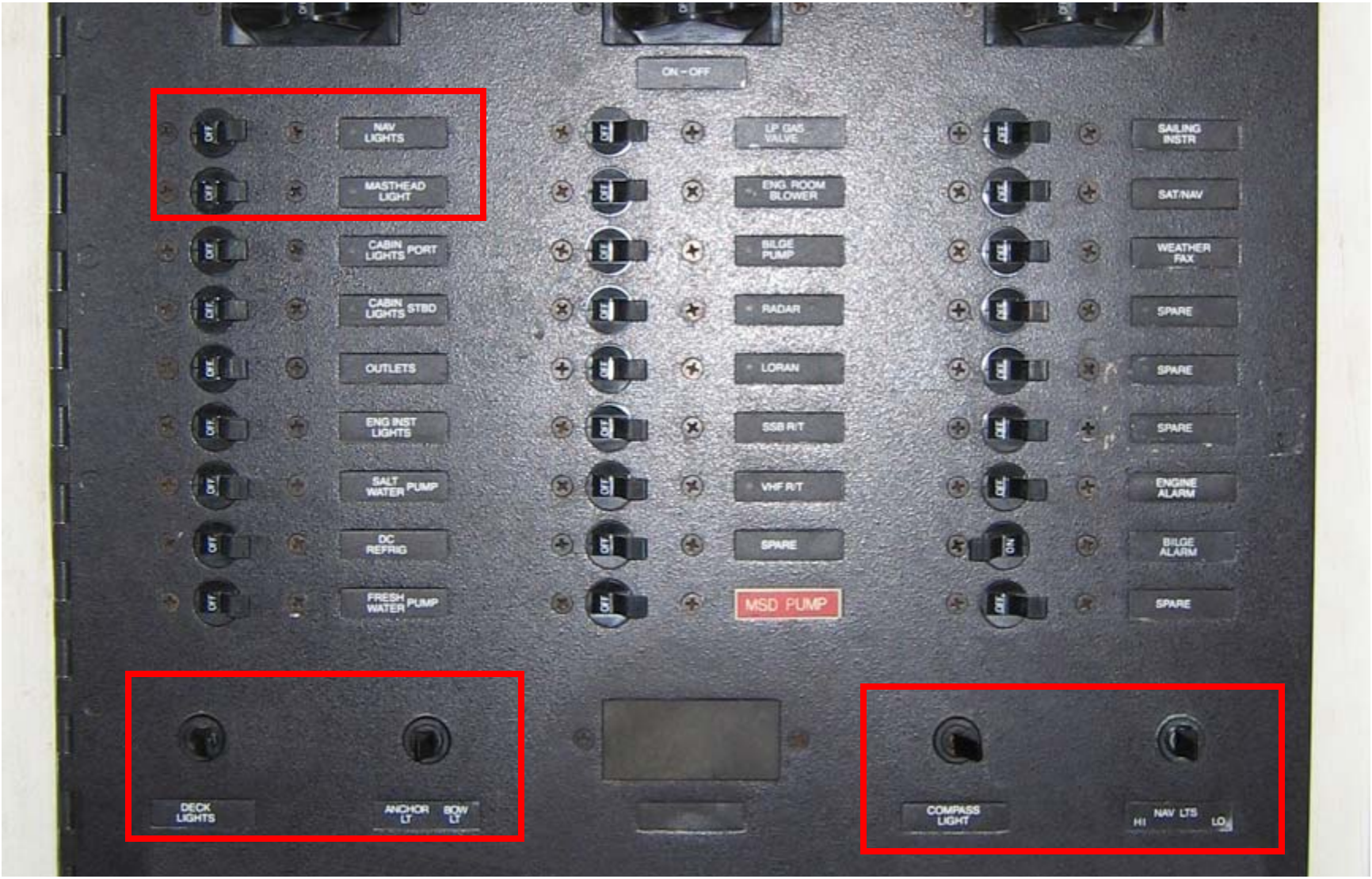
System Loads (Amps)

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

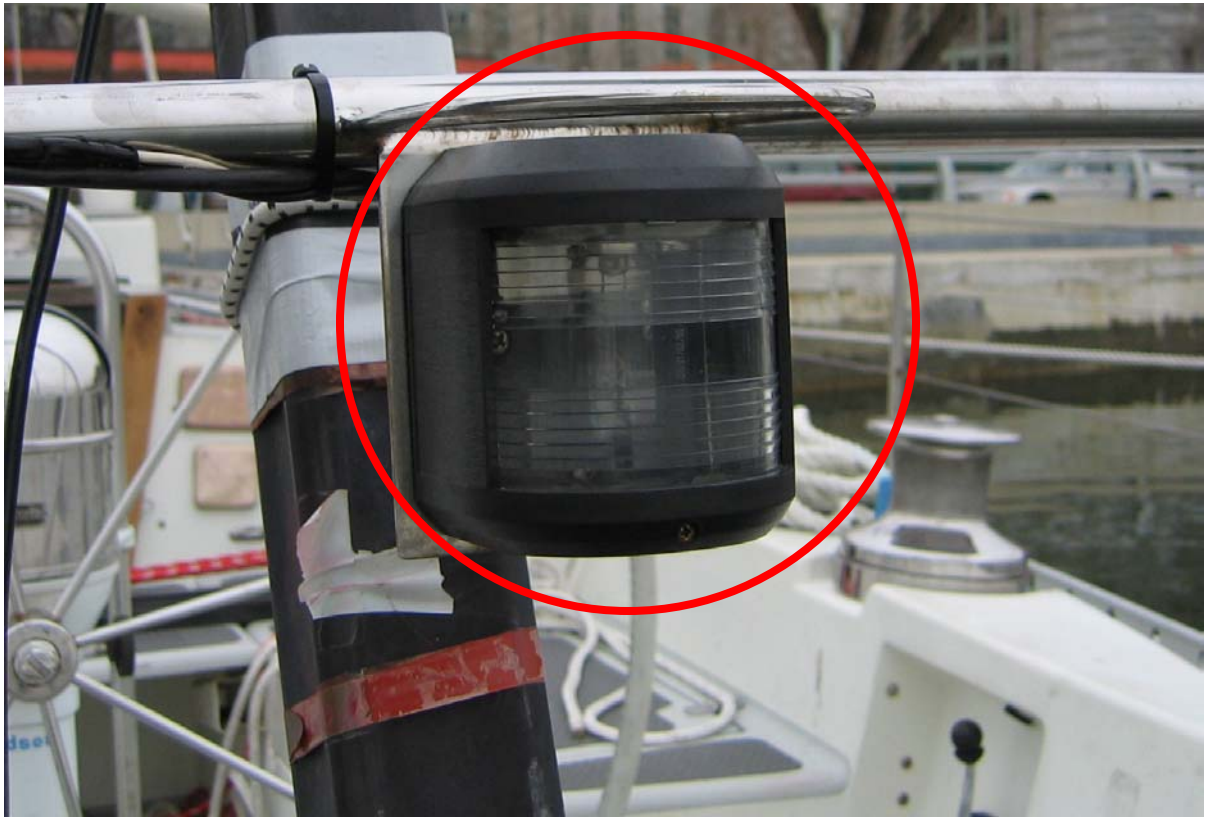
- Selects between Anchor light (colocated with the Tricolor at the top of the mast) and the Deck light (lights up the foredeck)
- Mid position is OFF

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

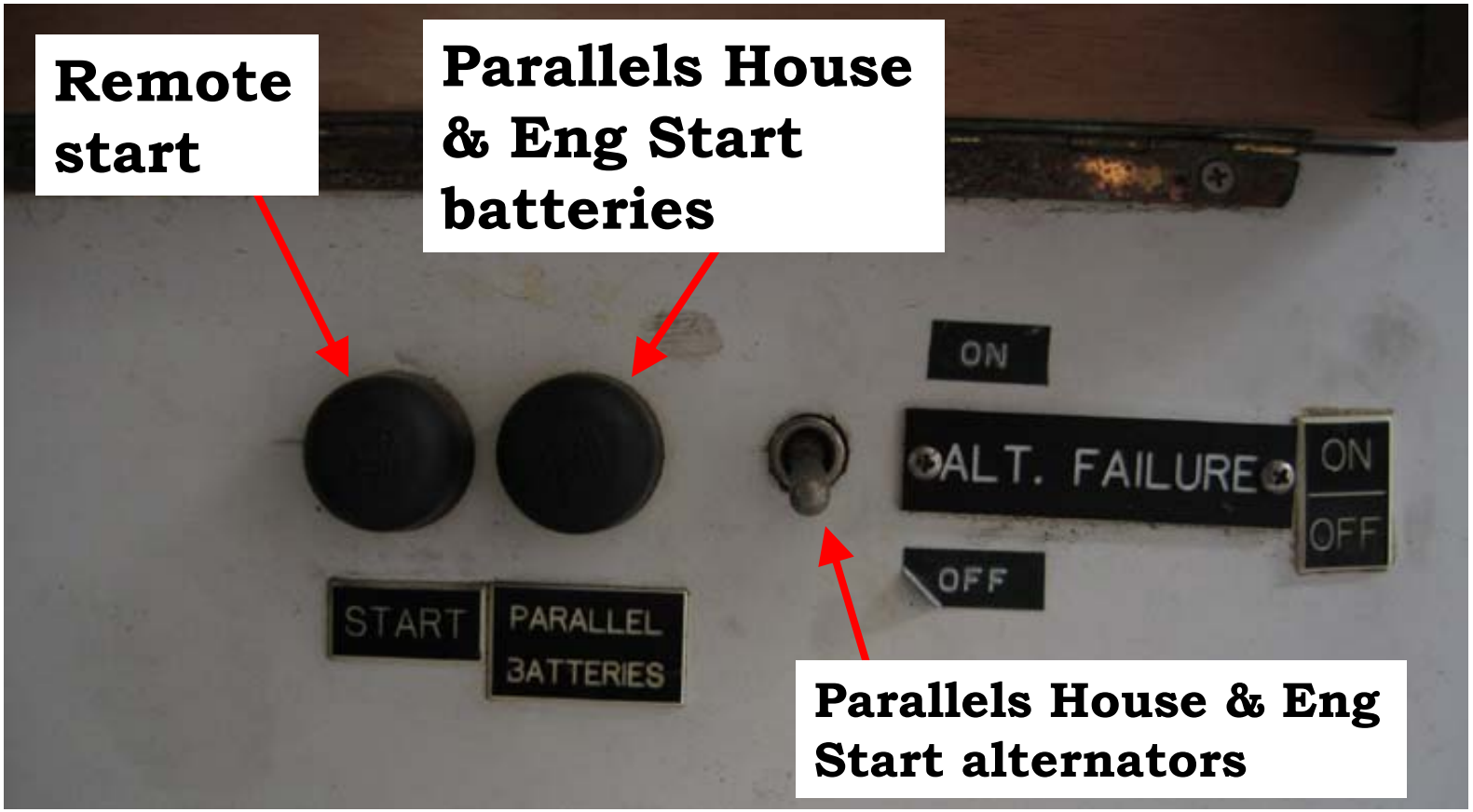
- No power to multiple systems
  - Verify DC breakers are ON
  - Verify battery switches are properly set
  - Verify status of Batter Bank (SVS)

Component failures

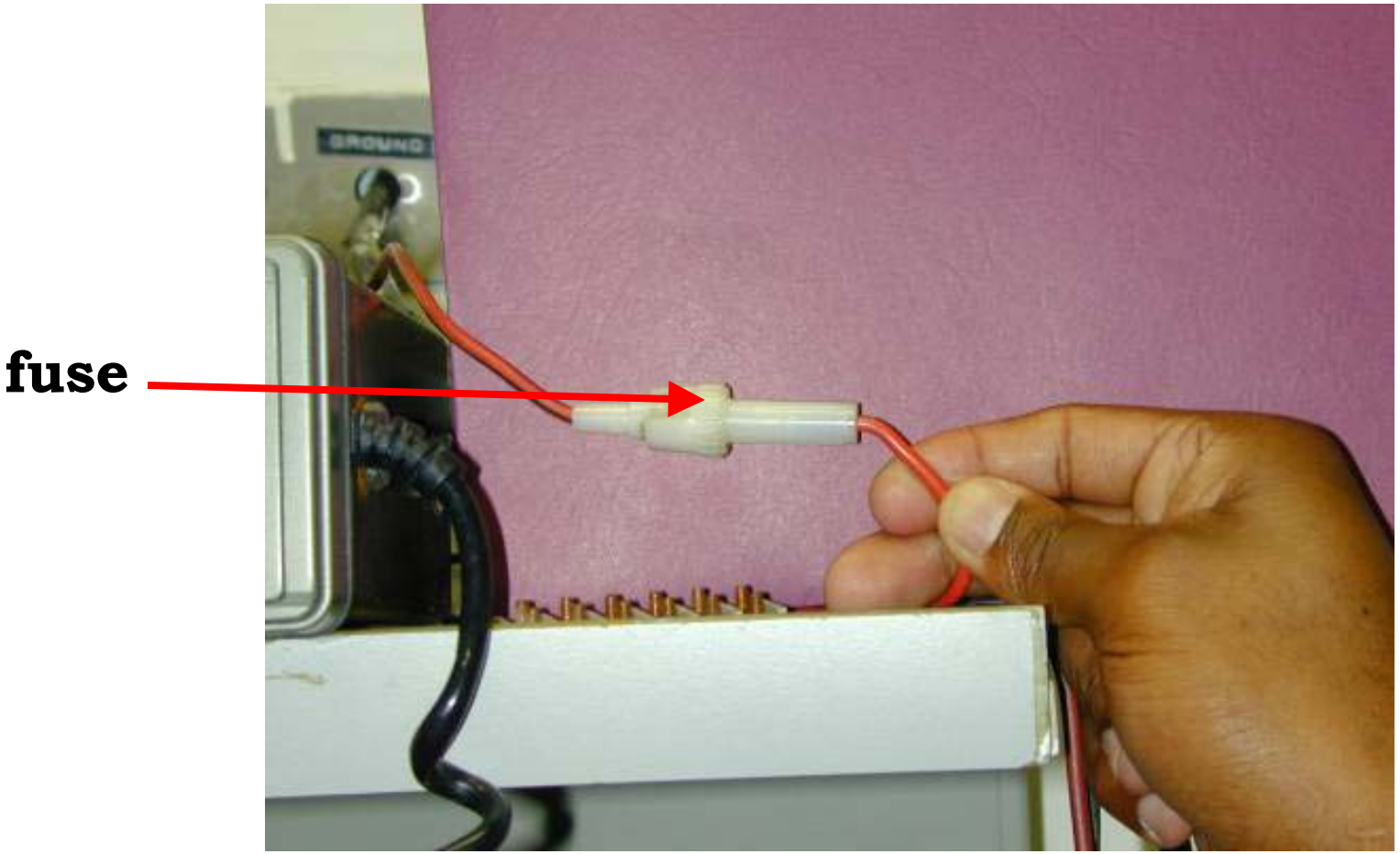
- **No power to one component**
  - **Check fuse**
    - Over current protection
    - Replace
  - **Check circuit Breaker**
    - Over current protection
    - Can reset once, but need to investigate why if it trips again.

Emergency Engine Start

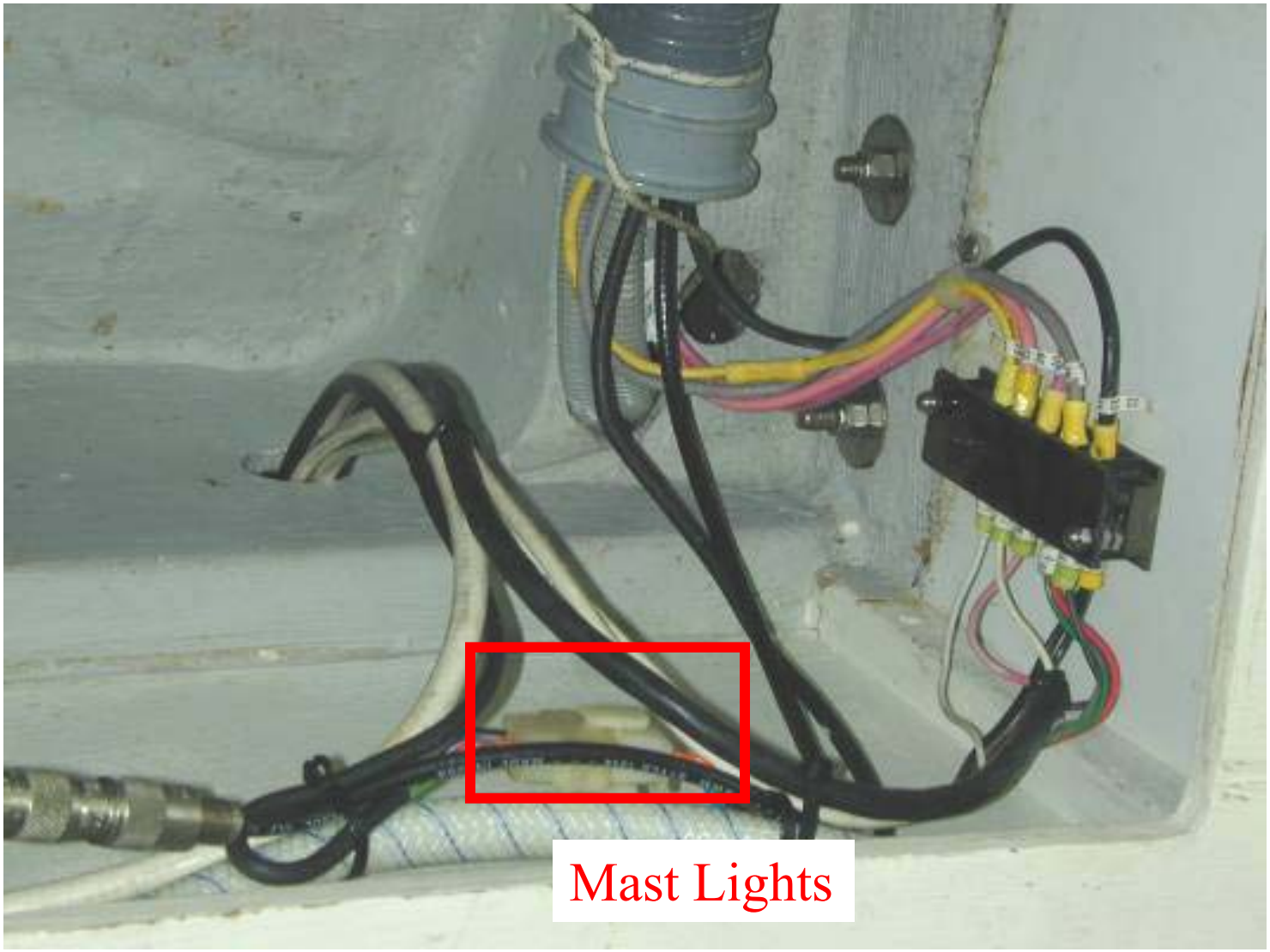
Emergency Engine Start



Electronics fuses



Navigation Lights connectors



Stove LPG Solenoid fuse

Questions?