



# C120 OWNERS MANUAL

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# VESSEL SPECIFICATIONS

VESSEL NAME:	
REGISTRATION NUMBER:	
HULL IDENTIFICATION NUMBER: US -	
MANUFACTURER: <i>Aspen</i>	MODEL: <i>C120</i>
LENGTH OVERALL: <i>43'-10"</i>	
LENGTH AT WATER LINE: <i>38'</i>	
BEAM: <i>14'</i>	DRAFT: <i>39"</i>
DISPLACEMENT: <i>22,500lbs</i>	HULL MATERIAL: <i>Fiberglass</i>
RUDDER TYPE: <i>Bronze</i>	KEEL TYPE: <i>Fixed</i>
BOTTOM PAINT: <i>SeaHawk Biocop</i>	

GENERATOR 1: <i>Kohler</i>	
MODEL NUMBER: <i>EGEKOD</i>	SERIAL NUMBER: <i>SGM32MDN7</i>
FUEL TYPE: <i>Diesel</i>	ZINC SIZE: <i>0.25" x 0.78"</i>
ALTERNATOR AMPERAGE: <i>50 @ 120V AC</i>	
ALTERNATOR BELT SIZE: <i>ED0024403380-S</i>	
PRIMARY FUEL FILTER: <i>Racor 30 Micron</i>	
SECONDARY FUEL FILTER: <i>ED0037302020-S</i>	
AIR FILTER:	OIL FILTER: <i>ED0021752850-S</i>
ENGINE OIL TYPE: <i>SAE 15W-40</i>	ENGINE OIL QUANTITY: <i>2.6 quarts</i>
IMPELLER PUMP MAKE: <i>Kohler</i>	IMPELLER PUMP MODEL: <i>229826</i>

# SERIAL NUMBERS

<b>ENGINE</b>	
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<b>GENERATOR</b>	
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<b>DINGHY</b>	
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<b>TRANSMISSION</b>	
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<b>ELECTRONICS</b>	8612 GPSMAP	
	8612 GPSMAP	
	8616 GPSMAP	
	8612xsv Display Screen	
	GHC 20 Flybridge	
	GMR Fantom 24	
	Autopilot Pump	
	Garmin Smart Pump V2	
	AIS 800	
	Reactor 40 CCU	
	GPS 19x	
	GHC 20 Helm	

# CAPACITY SPECIFICATIONS

<b>Unit</b>	<b>Capacity</b>		<b>Material</b>
<b>Waste Port</b>	<b>38</b>	<b>Gallons</b>	<b>Polypropylene</b>
<b>Waste Starboard</b>	<b>45</b>	<b>Gallons</b>	<b>Fiberglass</b>
<b>Water Port</b>	<b>52</b>	<b>Gallons</b>	<b>Polypropylene</b>
<b>Water Starboard</b>	<b>53</b>	<b>Gallons</b>	<b>Polypropylene</b>
<b>Fuel Port</b>	<b>92</b>	<b>Gallons</b>	<b>Aluminum</b>
<b>Fuel Starboard</b>	<b>137</b>	<b>Gallons</b>	<b>Aluminum</b>
<b>Engine Oil</b>	<b>5.28</b>	<b>Gallons</b>	
<b>Transmission Fluid</b>	<b>1.84</b>	<b>Gallons</b>	
<b>Generator Oil</b>	<b>2.4</b>	<b>Quarts</b>	
<b>Hot Water</b>	<b>11</b>	<b>Gallons</b>	
<b>Batteries House Bank</b>	<b>514</b>	<b>Amp Hours</b>	

# SERVICE POINTS & PARTS

<b>1</b>	<b>OIL CHANGE</b>		
	Crank Case Breather Filter(D6-435)	3584145	1 ea
	Volvo Oil Filter (D6)	22030848	1 ea
	Volvo Oil Filter By-Pass (D6)	22030852	1 ea
	Delo 15W-40 Motor Oil GALLON		5.28 gallons

<b>2</b>	<b>TRANSMISSION FLUID CHANGE</b>		
	Transmission Filter	3312199031	1 ea
	Trans Oil (D6 435)	ATF Dexron iii	1.84 gallons

<b>3</b>	<b>GENERATOR SERVICE KOHLER 6EKOD</b>		
	Oil Filter	ED2175-285-S	1 ea
	Oil		
	Secondary Fuel Filter	ED2175-288-S	1 ea
	Zinc	90802150	1 ea
	Belt Sea Water Pump	229125	1 ea
	Impeller repair kit	229826	1 ea

<b>4</b>	<b>ZINCS</b>		
	Transom Zinc	MFG# CMDIVERMINI	2
	Trim Tab Zinc (2-13/16")	MFG# CMR02	1
	Sand Bar Zinc	MFG# CMM24	1
	Swim Step Zinc	MFG# CMX07	4
	Bow Thruster Zinc	MFG # SM71190A	2
	Stern Thruster Zinc	MFG # SM71190A	1

# ENGINE SPECIFICATIONS

ENGINE MANUFACTURER: <i>Volvo Penta</i>	
MODEL NUMBER:	SERIAL NUMBER:
FUEL TYPE: <i>Diesel</i>	ZINC SIZE: <i>N/A</i>
ALTERNATOR AMPERAGE: <i>210 / 180</i>	
ALTERNATOR BELT SIZE: <i>Part #21407028</i>	
PROPELLOR SHAFT DIAMETER: <i>2"</i>	
PROPELLOR SHAFT ROTATION: <i>Right</i>	
PROPELLOR DIAMETER: <i>23"</i>	PROPELLOR PITCH: <i>20"</i>
NUMBER OF BLADES: <i>4</i>	PROPELLOR MATERIAL: <i>Bronze</i>
PRIMARY FUEL FILTER: <i>Racor 30 Micron</i>	
SECONDARY FUEL FILTER: <i>Part #21718912</i>	
AIR FILTER: <i>Part #21702999</i>	OIL FILTER: <i>#22030848 BYPASS #22030852</i>
ENGINE OIL TYPE: <i>15W-40</i>	ENGINE OIL QUANTITY: <i>5.3 gal</i>
IMPELLER PUMP MAKE & MODEL: <i>Volvo</i>	
TRANSMISSION MANUFACTURER: <i>ZF</i>	
TRANSMISSION REDUCTION RATIO: <i>2:1</i>	
TRANSMISSION FLUID TYPE: <i>ATF</i>	
TRANSMISSION FLUID QUANTITY: <i>1.8 US Gallons</i>	

# VOLVO D6 435 PARTS



**\*VOLVO 435 ACCESSORY BELT OVERVIEW\***



**\*Super Charger Belt (the one behind accessory belt)\***



**\*LEFT SIDE VIEW\***



**\*RIGHT SIDE VIEW\***



**\*OVERVIEW\***



Red Arrow = Dip Stick; Must be clicked down tight

Yellow Arrow = Manual Fuel Primer Pump; Used when re-priming engine

# ENGINE SPECTROGRAPHIC CHART

To: owners manual

## SPECTROGRAPHIC ANALYSIS DATA

ELEMENTS	DIESEL AND NATURAL GAS ENGINES		GASOLINE ENGINES		GEAR BOXES	
	Normal wear PPM	PROBLEMS INDICATED BY HIGH WEAR RATES	Normal wear PPM	PROBLEMS INDICATED BY HIGH WEAR RATES	Normal wear PPM	PROBLEMS INDICATED BY HIGH WEAR RATES
IRON	10-40	Rings, liners, cylinder walls, valves, shafts, gears.	30-250	Same as for diesel engs.	30-250	Gears, shafts.
CHROMIUM	1-8	Rings, liners, valves, shafts, gears, coolant leak (concentration inhibitor in cooling system).	1-12	Same as for diesel engines.	1-20	Gears, shafts.
NICKEL	1-5	Shafts, gears.	1-5	Same as for diesel engines.	1-10	Gears, shafts.
COPPER	5-33	Bearings, bushings, water from copper radiator.	5-40	Same as for diesel engines.	10-100	Bearings, bushings, facing plates.
LEAD	1-150	Bearings.	X	Base line contamination.	1-100	Bearings, bushings, facing plates.
TIN	1-3	Bearings, bushings.	1-12	Same as for diesel engines.	1-10	Bearings, bushings.
SILVER	1-3	Bearings in certain engines.	X	X	1-3	Hydraulic Systems.
ALUMINIUM	1-10	Pistons, etc. bearings, bearings in certain engines, etc.	1-15	Same as for diesel engines.	1-10	Thrust bearings, oil pumps, etc.
SODIUM	0-30	Oil additive, coolant, water treatment.	0-60	Same as for diesel engines.	0-10	Same as for diesel engines.
SILICON	1-14	Dust, dirt, grinding compounds, bearing sands, etc.	1-14	Same as for diesel engines.	1-30	Same as for diesel engines.

# ENGINE MAINTENANCE SCHEDULE

Your Volvo Penta engine and its equipment are designed for high reliability and long life. The engines are built to withstand the marine environment, but also to have the smallest possible environmental impact. If the engine and transmission are serviced regularly according to the schedule, these qualities will be retained and unnecessary malfunctions will be avoided.

C = Clean

R = Replace

A = Adjust

L = Lubricate

I = Inspect *(clean, adjust, lubricate or replace if necessary)*

FSI = First Service Inspection

A – F = Type of service *(regular service)*

<b>FSI: FIRST SERVICE INSPECTION, after 50–100 running hours</b>	
<i>Or within 180 days of the date of delivery, or the end of the first season, whichever comes first</i>	
Coolant level and antifreeze mixture	I
Drive belt and belt tensioner	I
Fuel pre-filter, draining water / contamination	I C
Outboard drive, corrosion protection	I
Outboard drive, oil level in Power Trim	I
Outboard drive, oil level in Power steering	I
<b>Start and warm up engine</b>	
Engine and transmission, oil / fuel / water leakage	I
Engine and transmission, abnormal noises	I
Power steering and Power Trim, function and leakage	I
<b>Stop engine</b>	
Reverse gear, oil level	I

**EVERY 100–200 HOURS / AT LEAST EVERY 12 MONTHS***Oil change intervals vary, depending on engine type, oil grade, and sulfur content of the fuel*

Engine oil and oil filters / by-pass filter	R
Crankcase ventilation filter	R
Coolant level and antifreeze mixture	I
Air filter	R
Fuel pre-filter and fuel fine filter	R
Seawater filter	I
Drive belt (tension)	I
Impeller, raw water pump	I
Reverse gear, oil and filter	R
Reverse gear, propeller shaft seal	I
Outboard drive, oil	R
Outboard drive, corrosion protection	R
Outboard drive, propeller shaft. Visual inspection of propeller seal	I L
Outboard drive, U-joint and primary bearing	L
Outboard drive, bellows, rubber hoses, and clamps	I
Checking exhaust line	I
Outboard drive, universal joint bellow	I
Hydraulic hoses and fittings. Thoroughly inspect for signs of leaks, wear, cracks, aging	I
Engine and transmission, oil / fuel / water leakage	I
Engine and transmission, touch up paint as required	L
Batteries, electrolyte level	I

**EVERY SECOND YEAR**

Impeller, seawater pump	R
Outboard drive, universal joint bellow	R

**EVERY FOUR YEARS**

Coolant	R
---------	---

**EVERY 400 HOURS / AT LEAST EVERY 4 YEARS**

Outboard drive, hydraulic valve oil and oil filter (steering control unit)	R
----------------------------------------------------------------------------	---

**A**

Recommended once a year		Every 200 hours ✓	
Check software status	Inspect	•	<input type="checkbox"/>
Engine oil and oil filters	Replace	•	<input type="checkbox"/>
Coolant level and antifreeze mixture	Inspect	•	<input type="checkbox"/>
Drive Belts	Inspect	• / o	<input type="checkbox"/>
Air Filter	Replace	•	<input type="checkbox"/>
Fuel pre-filter and Fuel fine filter	Replace	•	<input type="checkbox"/>
Seawater filter	Clean	• / o	<input type="checkbox"/>
Anode, protection system	Inspect	• / o	<input type="checkbox"/>
Impeller in seawater pump <sup>(1)(2)</sup>	Inspect	• / o	<input type="checkbox"/>
Rudder Actuator, oil <sup>(3)</sup>	Inspect	•	<input type="checkbox"/>
Crankcase ventilation filter	Replace	•	<input type="checkbox"/>
Exhaust hose	Inspect	•	<input type="checkbox"/>
Seawater Inlet	Clean	•	<input type="checkbox"/>
Transmission, oil	Replace	•	<input type="checkbox"/>

1) Engine version A-D: Replace every 200 hours / at least every 24 month.

2) Engine version E-F (engines without engine mounted seawater filter): Replace every 200 hours / at least every 24 month.

3) For inboard joystick installations only.

**B**

Recommended every second year		Every 400 hours ✓	
Impeller in seawater pump <sup>(1)(2)</sup>	Replace	•	<input type="checkbox"/>

1) Applies not for engine version A-D.

2) Applies not for engine version E-F, without engine mounted seawater filter.

**C**

Recommended every fourth year		Every 800 hours ✓	
Exhaust hose	Replace	•	<input type="checkbox"/>
Drive Belts	Replace	•	<input type="checkbox"/>
Compressor, oil	Replace	•	<input type="checkbox"/>
Rudder Actuator, oil <sup>(1)</sup>	Replace	•	<input type="checkbox"/>

1) For inboard joystick installations only.

**D**

Recommended every fourth year		Every 2000 hours ✓	
Coolant	Replace	•	<input type="checkbox"/>

Service Type A-D (in accordance with Service and Maintenance manual).

Operation "Inspect" includes if necessary: cleaning, adjustment, lubrication and replace.

• = Service operation is recommended to be performed by an authorized Volvo Penta dealer.

o = Service operation could be performed by owner/operator.

# **Aspen Power Catamarans Consumer Warranty**

At Aspen our goal is to build your new boat with the best materials available from the world's premier vendors. These are installed by very well trained experienced builders. Each system is fully function tested in our plant and then water tested during factory sea trials prior to delivery. So our expectation is that new owners will have a very very short list of items that need addressing after delivery.

## **Basic Agreement:**

On the issues where we erred we will take full responsibility and exceed your expectations in every way during its service. In short, we will be 110% responsible for our work, materials and equipment; we will also manage the suppliers warranty's when possible.

Aspen or our agent will provide dockside service at your marina for the first 3 months at our expense. There after Aspen will cover all parts and labor but dockside transit expenses are not covered. If the boat is located outside Puget Sound we will mutually agree to a local service provider and with your call Aspen will contact and manage the service at our expense. Aspen will provide parts and freight to the boat/service company. For complex projects, Aspen may send a team to the boat for service. In the rare instance the boat needs to return to the factory the cost of its return will be the responsibility of the owner.

## **What is Covered:**

Hull, Deck small fiberglass parts, structural 10 Years

Tanks, Steering, shaft, prop, rudder, 5 Years

Electrical Harness switches, breakers, fuse holders, 5 Years

Gel Coat blistering, crazing, 5 Years

Engine Transmission, (by vendor) Cummins/Volvo Twin Disc, 2 years

Electrical components, water pump, bilge pumps, 2 Years

Hardware, components 3 years

Electronics (by vendor) typically 2 years

## **What is Not Covered:**

Damage from abuse, impacts or groundings or commercial use

Damage from acid washing gel coat by boat cleaning companies

Normal wear and exposure in normal use under normal conditions

Transport or any expense associated with it being out of service I.E. living expenses, personal transportation

**Transferability:** Yes, first 3 years with a \$695 service fee

**Extended Warranty Available:** Yes Bow to Stern w/engine and gear, 5 years (Brunswick)  
(Contact Aspen for Price)

Effective 2016

Aspen Power Catamarans - 11656 Knudsen Rd - Burlington, WA 98233



**Welcome Aboard!** Aspen Power Catamarans has purchased a BoatU.S. Membership with Unlimited Saltwater & Freshwater Towing Service for you!

Your BoatU.S. Membership #: \_\_\_\_\_

Your Membership & Towing Service\* starts on \_\_\_\_\_ & is valid until \_\_\_\_\_

Your Membership includes the benefit of our Unlimited Towing Service that provides payment for on-water towing, jumpstarts, soft ungroundings and fuel delivery. You now have access to the nation’s largest towing fleet with over 600 towboats in 300+ ports nationwide and your towing service applies to all recreational boats you own, borrow or charter.

If you need assistance on-the-water or on-the-road, you can reach our 24/7 Dispatch Center by calling 800-391-4869, hailing TowBoatU.S. on VHF 16 or by using the BoatU.S. smartphone app (BoatUS.com/app.)

**Other Membership Benefits include:**

- Discounts on fuel, transient slips, repairs & more at over 1,000 boating businesses
- Roadside assistance for boaters who trailer their boat
- Earn \$10 reward certificates for every \$250 spent at our retail partner West Marine
- Subscription to BoatU.S. Magazine - 6 issues per year
- Low-cost boat and PWC insurance from dedicated experts
- Representation for boaters from local issues to Capitol Hill

**About BoatU.S:**

Boat Owners Association of The United States (BoatU.S.) is the nation’s leading advocate for recreational boaters providing its over half-million members with government representation, services such as 24-hour on water boat towing as well as roadside assistance for boat trailers and tow vehicles, feature-packed boat insurance programs, money-saving benefits that include marina and West Marine shopping discounts, and vital information that improves the boating, fishing and sailing lifestyle. Its member-funded BoatUS Foundation is a national leader promoting safe, clean and responsible boating.

**Questions about BoatU.S. or your Membership?  
Visit [www.BoatUS.com](http://www.BoatUS.com) or call 800-395-2628**

**\*Details and exclusions of Water & Roadside Towing can be found online at [BoatUS.com/towing/agree.asp](http://BoatUS.com/towing/agree.asp) or by calling 1-800-888-4869.**



INSURANCE



ON WATER TOWING



TRAILER ASSIST



DISCOUNTS



MAGAZINE



SAFETY

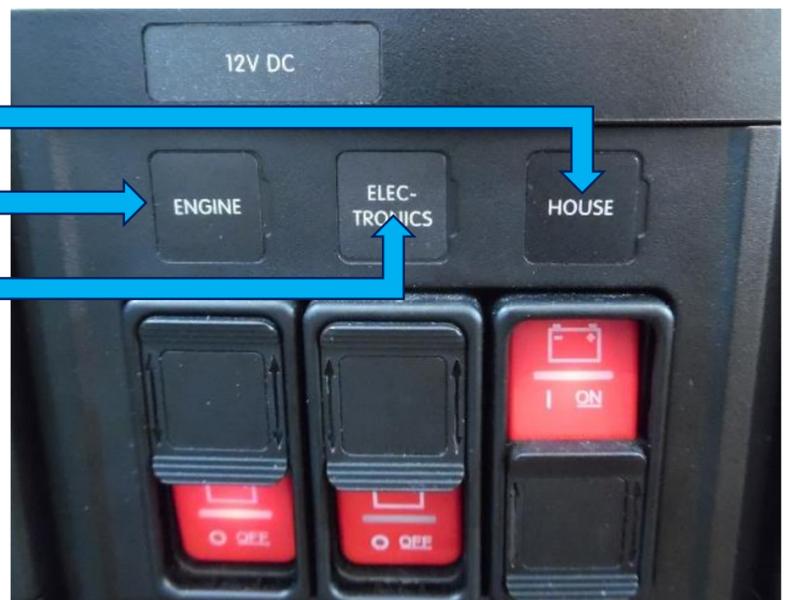


ADVOCACY

# BATTERY SWITCHES

The C120 has six main battery switches:

1	HOUSE ON/OFF	Top of DC Panel Dash
2	ENGINE ON/OFF	Top of DC Panel Dash
3	ELECTRONICS ON/OFF	Top of DC Panel Dash
4	BOW THRUSTER	Under Master Bed-Stbd
5	STERN THRUSTER	Stbd Lazarette - left lip
6	EMERGENCY PARALLEL	Starboard Lazarette

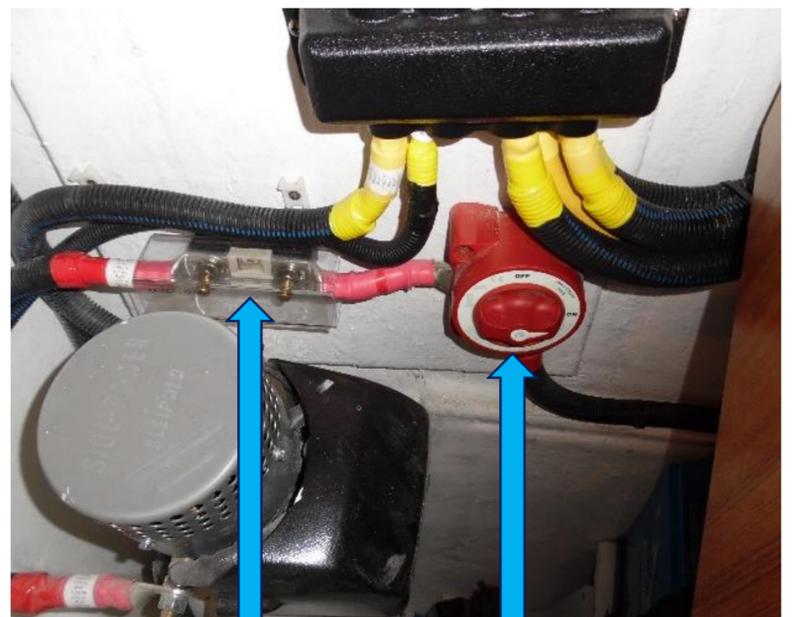


Normal operation position is to leave all three House, Electronics, and Engine switches in the ON position. Emergency Parallel should be in the OFF position and is rarely used and then only for 3 to 5 minutes max.

**Thruster battery switches. *These must be switched OFF when swimmers are in the water, or for service.*** The thrusters are very powerful and will suck objects in the water toward them.

Do not operate the thruster for more than 30 seconds at a time or the motor's thermal breaker may shut the motor off until it cools down.

**Thruster Fuses:** Bow is 400 AMP ANL Slow Blow. Stern Is a 275 AMP ANL Slow Blow. (**Note: Stern thruster will NOT operate if bow thruster fuse is blown.**)



BOW THRUSTER FUSE

BOW THRUSTER SWITCH



## STARBOARD LAZARETTE

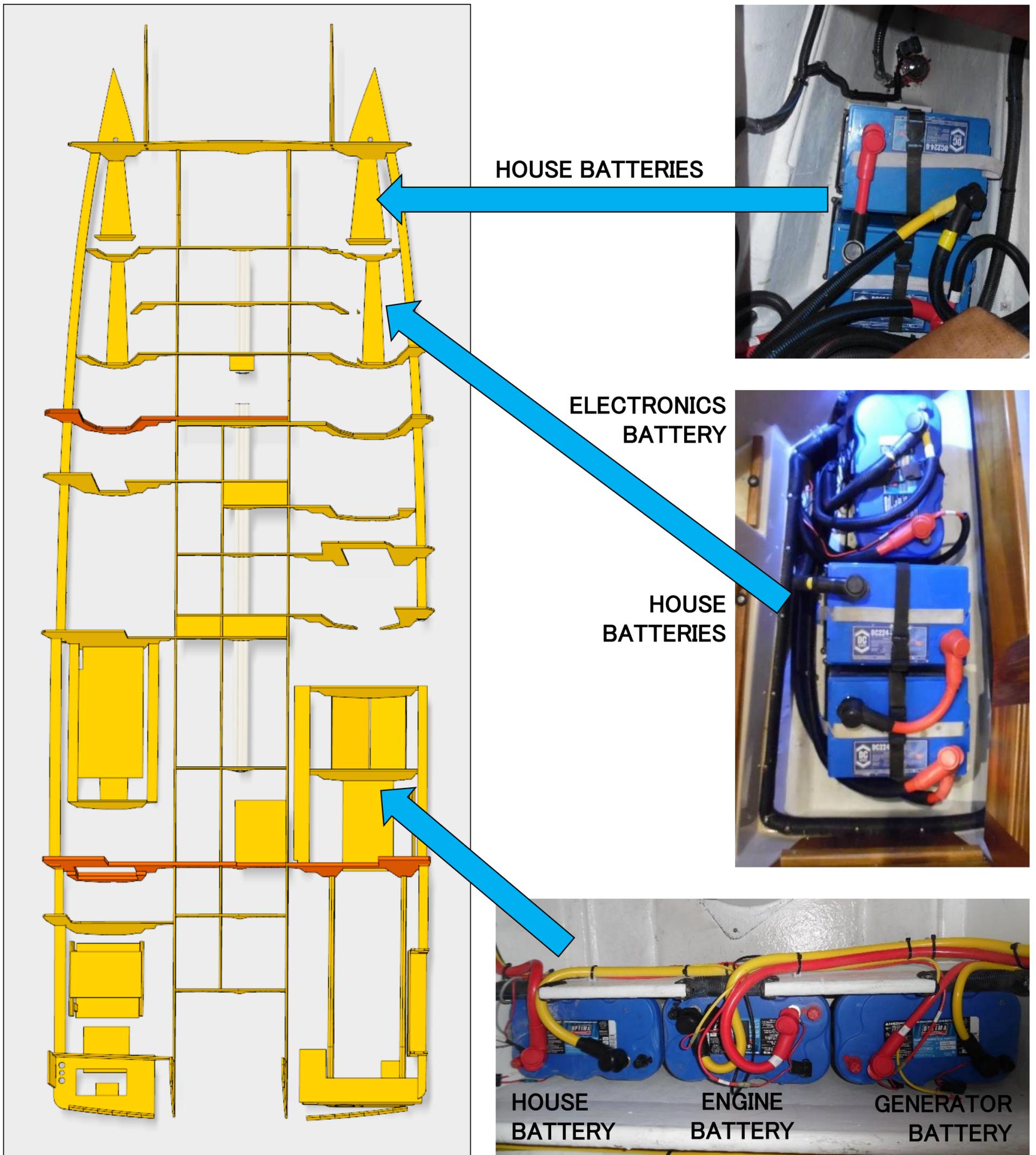
STERN THRUSTER FUSE

STERN THRUSTER SWITCH

EMERGENCY PARALLEL SWITCH

# BATTERY LOCATIONS

The C120 house battery bank is located in the starboard forward bow under the bed steps and floor compartments. It's comprised of 4 AGM 6 Volt golf cart style batteries (in series for 12 volts) and one G-27 style batteries. The G-27 house battery is near the engine and generator batteries under the starboard queen beds aft cushion, this makes the run for the aft thruster shorter and more powerful.



# MAGNUM CHARGER INVERTER

## STARBOARD COMPANION WAY



The Magnum 1,000 or Opt 2,000 inverter charger are combo units that supply 120V AC power and also supply 12 volt 3 stage charging either 60 or 100 amps. If the units were in the on position when power was disconnected they typically come back on when they see 120V power again. To work you need to see 120 volt power at the 120 V panel display and have the breakers on. The Magnum inverter charger display will light up and show its activity initially typical “Bulk Charging 100 amps” this will ramp down as the batteries fill up. The charger is a three stage-smart unit that charges aggressively when the battery is low and then ramps down as it charges. They stop completely when the battery is fully charged and do a small topping charge as needed. The design greatly extends battery life and prevents overcharging and subsequent battery damage. Note: the chargers must be set to the AGM setting to properly charge AGM batteries. Also with AGM batteries there is no water level to check they have a gel inside. This is good but AGM batteries do not like being run dead flat and will only do this 2-3 times before they must be replaced. We chose AGM as they out gas hydrogen (flammable) far less than lead acid batteries and with their location in the boat this is important to safety. **If you replace the batteries you must replace with AGM**

**NOTE:** *Chargers will only charge if they see voltage. If batteries are dead you will need to use the Emergency Parallel Switch and charge for maximum 4-6 minutes for the charger to see the battery and begin charging.*

# MAGNUM CHARGER INVERTER



This unit has two jobs, first is to charge the house batteries when in port or when the generator is switched on and the slide switched moved to Generator position. If the unit sees inbound 120 Volt AC power it passes it right through to those outlets connected to the inverter. It can make 120 volt power as well by drawing 12Volt power from the house batteries. But understand this works well for a micro waving a cup of coffee or two or reheating dinner or charging phones and computers. But if you're going to use a LOT of inverted power, say to run a hair dryer for 10 minutes, you will deplete the house batteries very fast. The house bank is 420 amp hrs. so if you flatten them it will take 4 hrs. with your 100 amp inverter charger to refill or 2 hrs. of running at cruise with the optional 210 amp dedicated house alternator option to bring them back to full charge. For big AV 120 volt loads its best to start the generator let it warm up for 5 minutes and then do any AC load you want. **Note: Heavy loads on a cold engine will damage the engine.**

There are many settings and options on the inverter charger I typically keep the charge capacity at 100 % with the size of our house bank 100 Amps is just fine (no damage will occur) the only time you may want to idle down the charger is when connected to a limited capacity dock outlet if its popping you can reduce the draw by lowering the charge amps. In normal use after docking and using the thrusters the Magnum display will initially show bulk charging 60-90 amps, next it will show float charging 4-12amps (often stays in this position when you using lights, chargers and other small loads). Just note that if there are no green lights and nothing on the magnum display showing you are not charging. The inverter is located in a wall cabinet between the Queen berth and head.

# CHARGING SOURCES

The House batteries have two charging sources:

## 1) 110 V Electric Battery Chargers:

- ❖ House Inverter Charger (60 Amps for House battery bank) Note: On boats with optional 2,000 watt inverter, the house bank has 100 Amp charging. Shore power is connected and AC breakers above ¼ berth are switched on. Inverter is switched on charging is switched on, displays amps output on screen. Inverter charger can receive power from Shore Power or Generator.
- ❖ Engine Generator Charger: 25 AMP

2) Engine driven alternator: Engine battery is an excellent charge source while cruising. (Optional 210 AMP house bank charger.)



ENGINE  
GENERATOR  
CHARGER



HOUSE  
CHARGER

# FULL-TIME POWER BREAKER

The **Full-Time Power Breaker (Hot Float)** is **always on**. The 12V power fuse is mounted in a cabinet, inboard, starboard forward stateroom. **It is important to leave this on** as it supplies power to the boat's seven automatic bilge pumps and other devices that need power to save memory settings. It is not affected by the battery switch position.

**NOTE:** *When the yellow lever is out/seen, the breaker is off. If the breaker has popped or fuse is burned out, there is no bilge pump protection from leaks.*



# DC PANELS

## DC SYSTEM OVERVIEW:

The C120 Has two main battery banks and two accessory batteries; one for the generator and one for the electronics. In all there are 9 batteries in the system. These are all AGM batteries and the chargers are set for AGM charge. The house bank is comprised of 4ea 6 volt GC golf cart style batteries and one G27 to support the stern thruster, the house bank supports the lights, pumps, heads, thrusters and Inverter. The primary house bank is located under the floor boards forward in the master stateroom Port hull. The dedicated electronics battery is also located in this area. The battery switches and fuses for the house bank are located in the teak cupboard just above the batteries as is the switch and Voltage Sensitive relay for the electronics battery. This switch compartment also includes the Hot Float switch breaker that powers the 7 bilge pumps even when the batteries are switched off (keeps the pumps active at all times)  
Note: If you see the yellow tang hanging down this breaker is off = bad.



*The main engine batteries G27s are located in the starboard hull mid ships under the aft end of the queen berth as is the G27 Stern Thruster boost battery. This compartment is accessed by the removable bed cushion and the hatch under. The engine exhaust and engine battery charger are also in this compartment. The aft bulkhead here is removable for easy access to shaft coupler and forward engine mounts.*

# DC PANEL LAYOUT



**Pumps Panel:** The pumps panel controls the bilge pumps and shower sump pump. Most of these are automatic, but these switches allow you to manually turn on each of the six pumps for each water-tight compartment. With the exception of the fresh water switch, these switches are normally in the off position. This panel is fed from the pumps breaker on the main DC panel. **The automatic portion of the bilge pumps is not affected by this panel.**

**NOTE:** *The engine room has a seventh pump (1100GPH) which serves as an emergency pump. It is wired to a very loud horn behind the dash. Should you lose an engine hose and the engine room begins to fill, this pump will automatically start and the horn will sound. **Stop and fix the problem.***



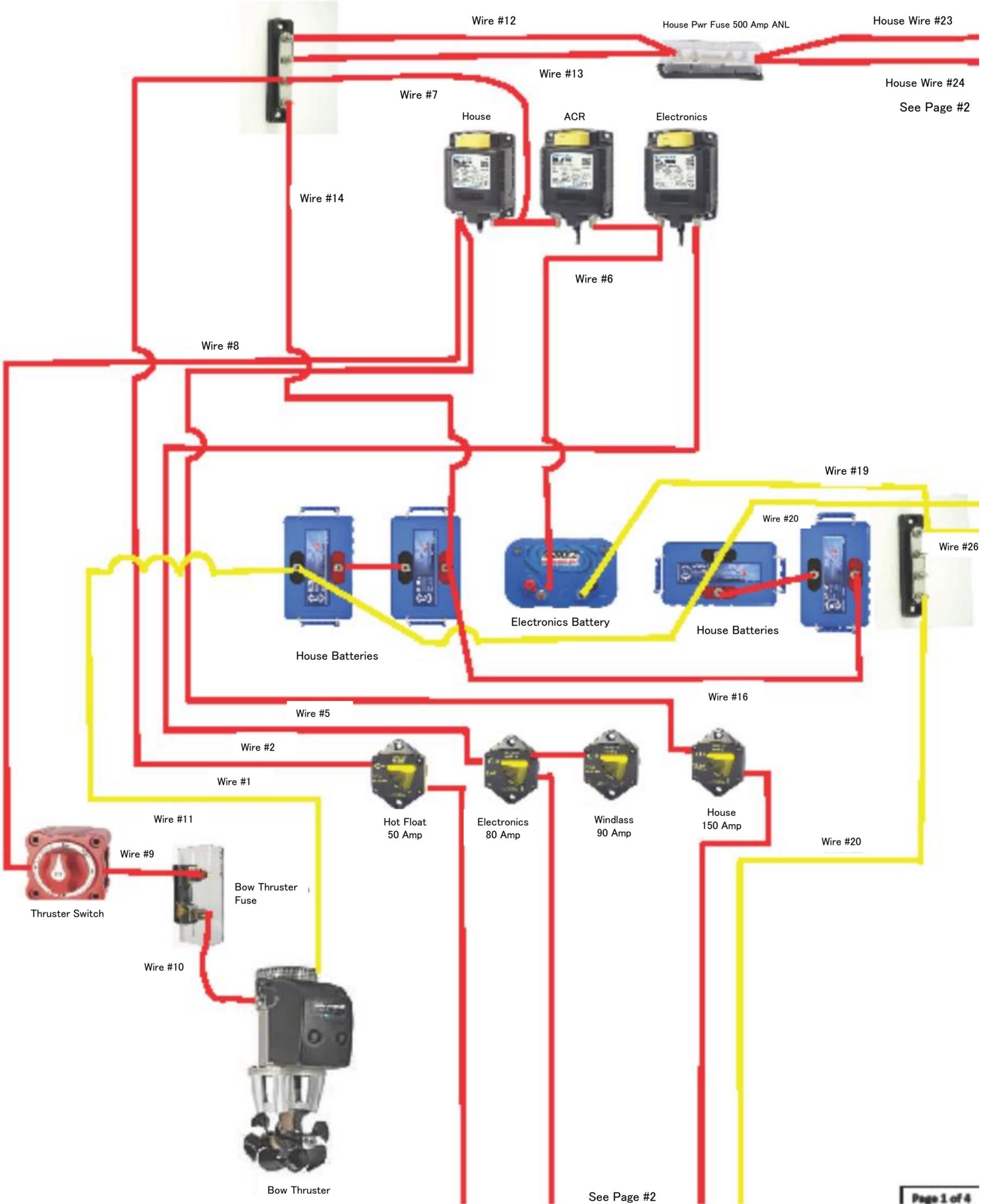
**Ship Systems Panel:** This panel includes controls for navigation lights, blower, and many other ship systems. Like the Pumps Panel, it is fed from the main DC panel breaker.

**These panels have separate resettable circuit breakers, ranging from 5- to -20 amps.** If a breaker has tripped, determine and fix the cause and reset the breaker by pushing the clear button in. (Possible causes could be debris in pump, shorted wire, etc.)

# ELECTRICAL DRAWING

1 of 4

Starboard Bow Under Steps

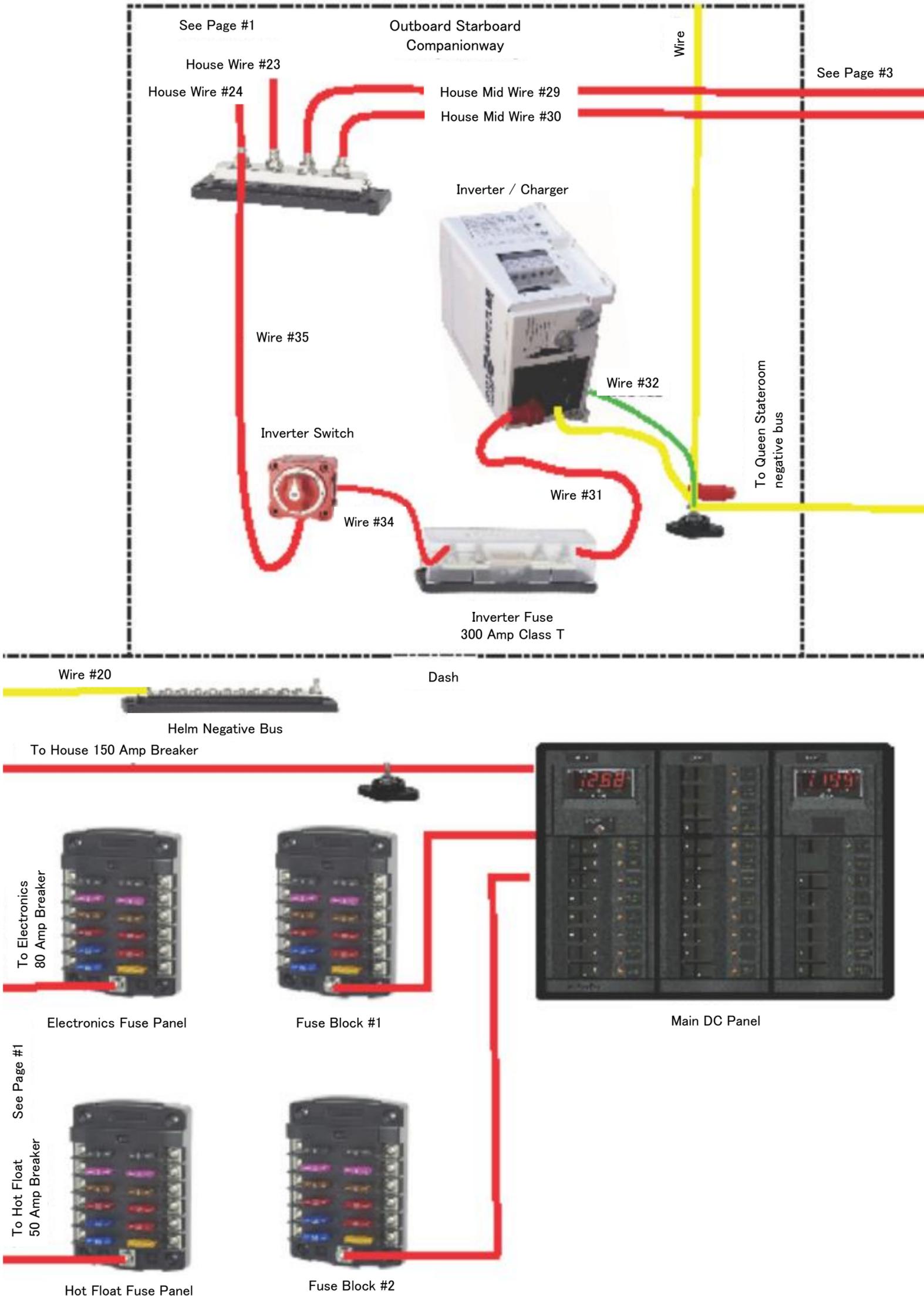


House Wire #24  
See Page #2

See Page #2

# ELECTRICAL DRAWING

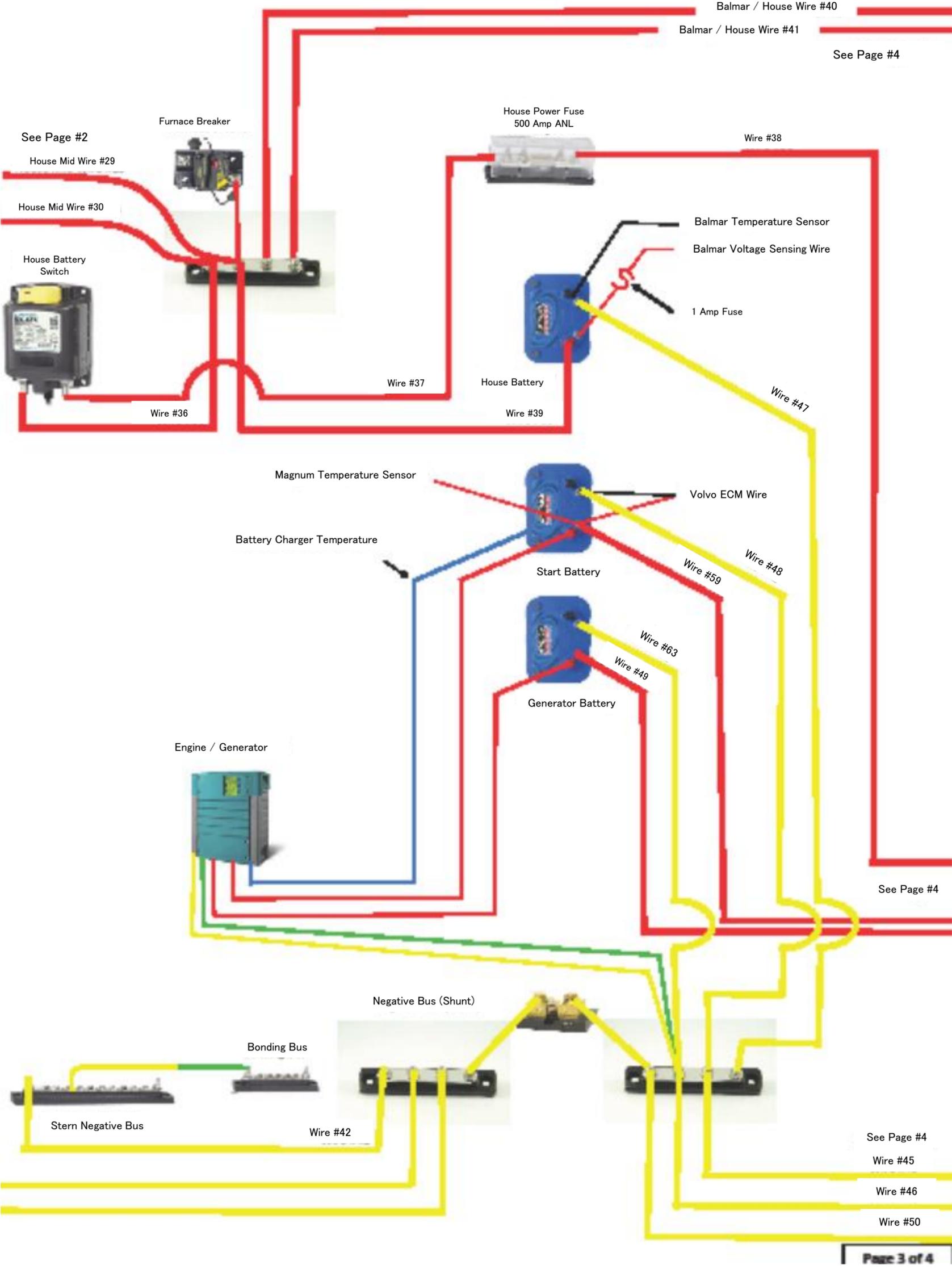
2 of 4



# ELECTRICAL DRAWING

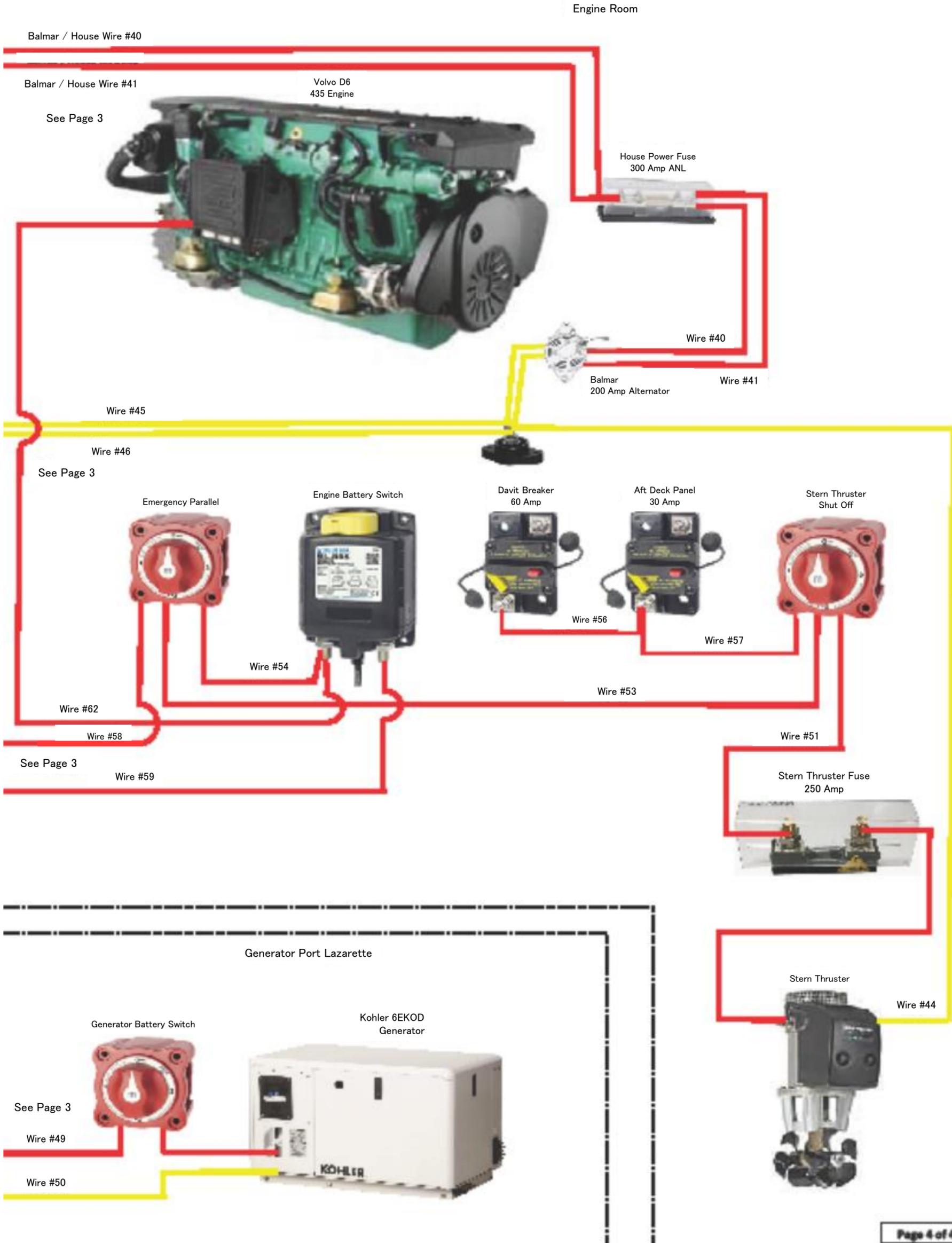
3 of 4

Queen Stateroom Under Berth



# ELECTRICAL DRAWING

4 of 4





# SHORE POWER DISCONNECT



1) SWITCH OFF BREAKER



2) UNPLUG CORD



PORT DECK TRAIL

***\* NOTE: NEVER LEAVE A HOT OR LOOSE CORD ON DOCK, IT COULD SHOCK SWIMMERS IF IT FELL IN THE WATER. IF A CORD DOES FALL IN THE SALT WATER, REPLACE THE ENTIRE CORD; A FIRE COULD OCCUR AS IT CORRODES INSIDE.***

# AC SHORE POWER SYSTEM

**Overview:** The C120 AC (Alternating Current) system is robust with all US made components, with three sources of power. The first is shore power through a 30 amp 120 volt shore power plug (Note: on boats with Air Conditioning there is a second 30 Amp Plug for the two Air units). The second AC source is a 6KW Kohler Diesel generator typically used while cruising or at anchor. The final AC source is the 12 volt DC to 120 volt AC Magnum Inverter Charger. This unit takes DC (Direct Current) from the house batteries and converts it to Alternating Current (house type power). The Magnum Inverter also doubles as the house battery bank charger 60 or 100 amp depending on how the boat was ordered.

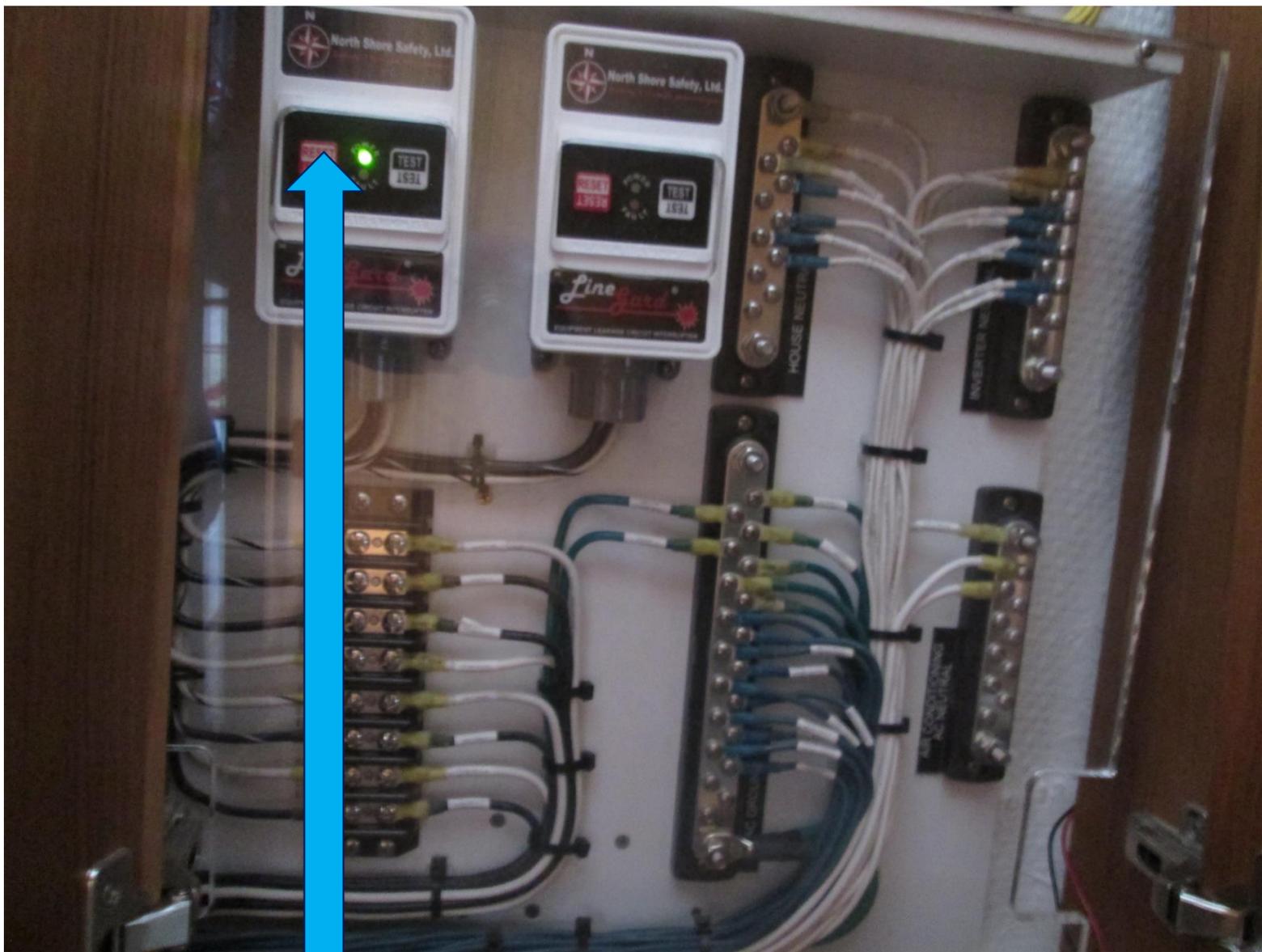
**Shore Power:** The 30 amp connection is on the port side deck, mid ship. Once connected and the breaker on the dock is on you'll need to come just inside the salon door to the left and position the Shore power or generator slide switch up and toggle the Shore breaker to the on position. You have it right when the OLED panel along the wall lights up showing volts typically 120v 1-30/hertz typically 60. Next to get power throughout the boat the individual breakers need to be in the on position "flush" (typically all left on except water heater) Once shore power is on you should also walk fwd. to the dash DC breaker panel area (left side of dash belt level) and find the Magnum Inverter Charger controller if it was in the on position when power was turned off it typically comes back on when power is reconnected, you'll want to see the display showing three green lights to its left side, Power, Invert, and Charging all on typically.

**NOTE:** *Turn on hot water only when needed.*



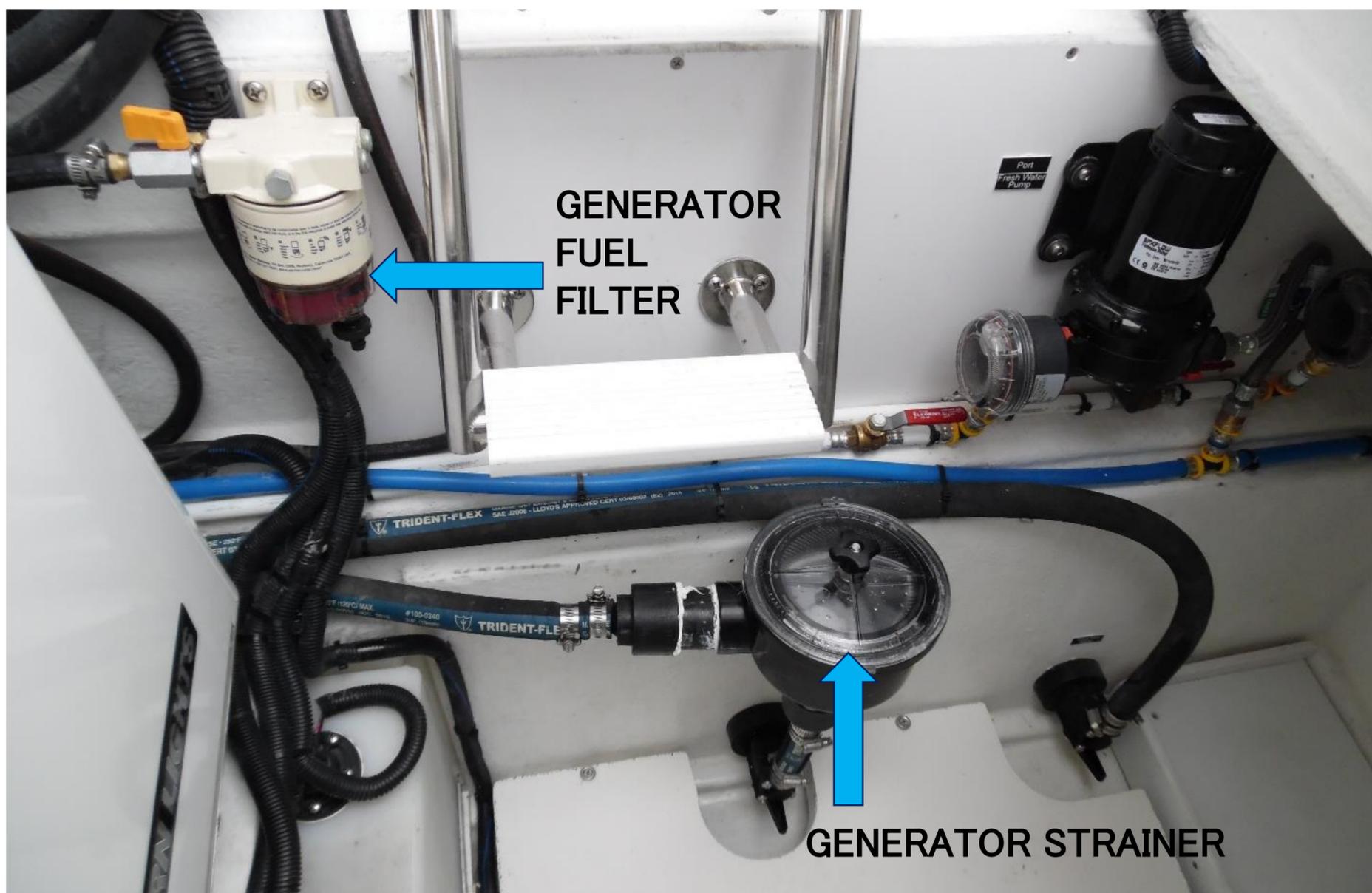
# AC SHORE POWER SYSTEM

The AC panel is fed through the whole boat ELCI, mounted just behind the deck side shore panel connection. The whole boat ELCI does have a reset button on it. If the Green light is on, everything is good. If the Red light is on, check your dock-side shore power, then reset.



**RESET BUTTON**

# GENERATOR



**Generator:** The boat's standard generator is a 6 Kw diesel by Kohler, we also offer a Northern lights 5Kw. Both are reliable and quiet but depending on or area of use the service can favor one unit vs the other. In normal use you will go to the generator control panel engage the glow plug toggle for 10 seconds and then the crank toggle, the generator will start. Typically it runs lumpy and with a little smoke for the first minute or two then smooths out. Let it warm up for 5 minutes before moving the slide switch and engaging the generator breaker. Remember 80% of the wear and damage to a motor occurs during warm up, heavy loads cold is hard on the unit. Once you slide the breaker switch and turn on the breaker you should see the power display light up showing Volts/Amps and Hertz. If you don't see power on the display you don't have power yet. The Generator itself has a breaker on it that can pop if overloaded, so you may want to check that if the gen's running but you have nothing on the display. One area to be careful of other than checking generator oil from time to time is the raw water strainer mounted hull side just behind the generator. Because often when you're running the generator while stationary (i.e. anchored) the high-speed pickup and raw water strainer can catch seaweed. You'll typically get one overheat shut down cycle from the unit before you melt off the generators raw water impeller blades. If it shuts down, the first thing to check is if the raw water strainer has sea weed blocking the cooling water flow. Also, check to see flow once restarting. While at a show we had the unit shut down and found both the strainer and hull side pickup packed with seaweed.

# GENERATOR PROCEDURES



## GENERATOR START/STOP PROCEDURES

### START

1. Momentarily press the green light side of the switch
2. Press in and let off quickly

### STOP

1. Press and hold the green side of the switch until the generator stops

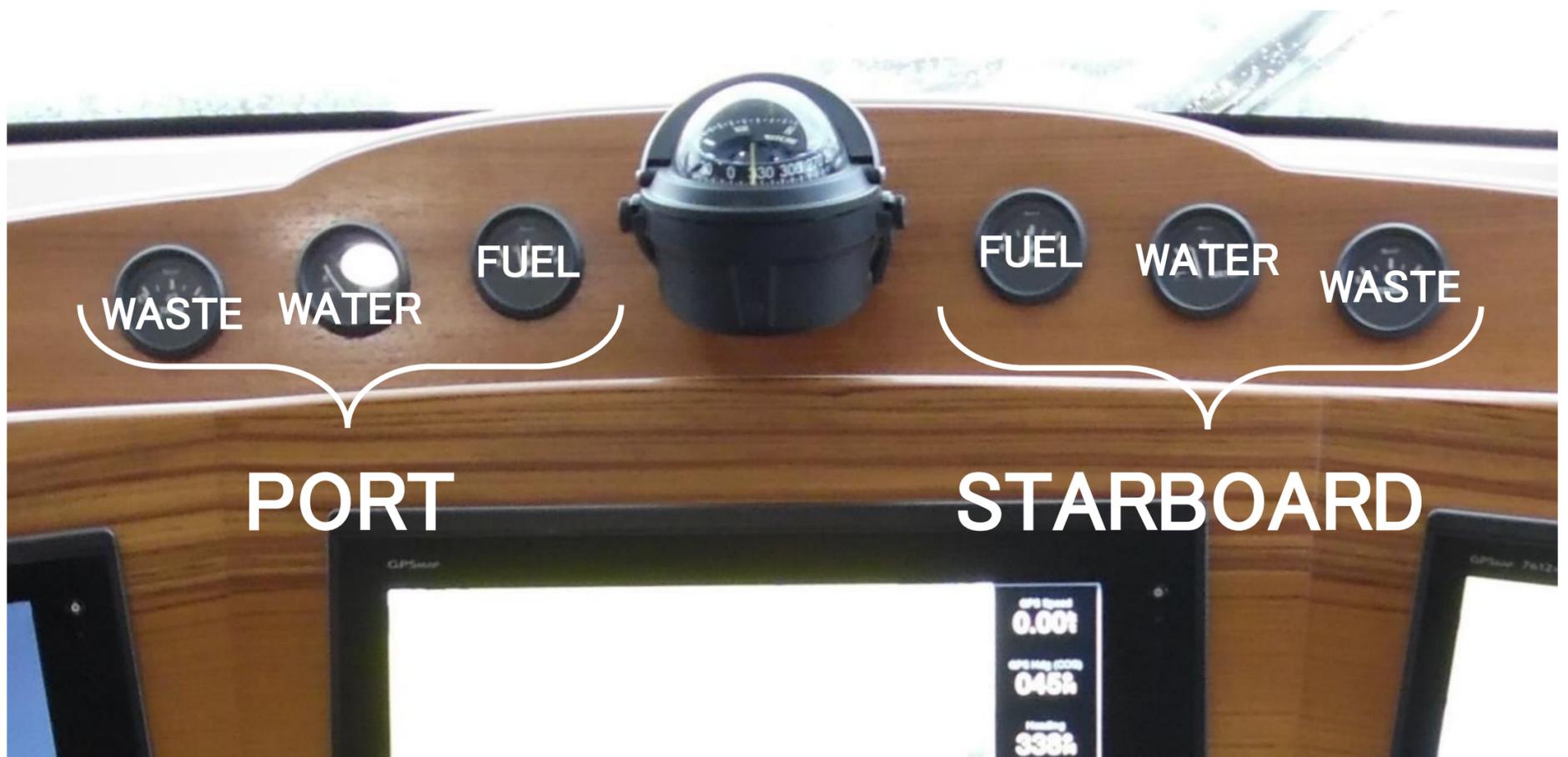


## PANEL RE-SET ERROR CODES

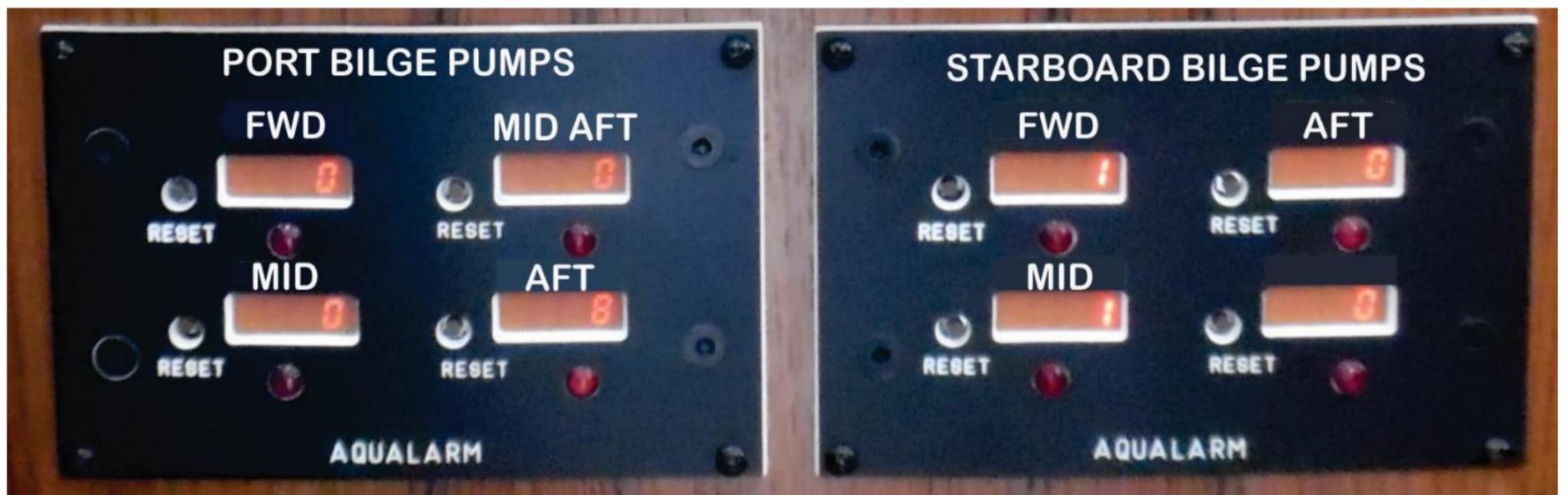
1. Spin dial until overview shows up in panel
2. Push dial in
3. The fault code you're looking for should appear
4. Press dial again
5. Clear fault will appear
6. Scroll to "yes", click button again

Light indicator will turn green

# TANK GAUGES



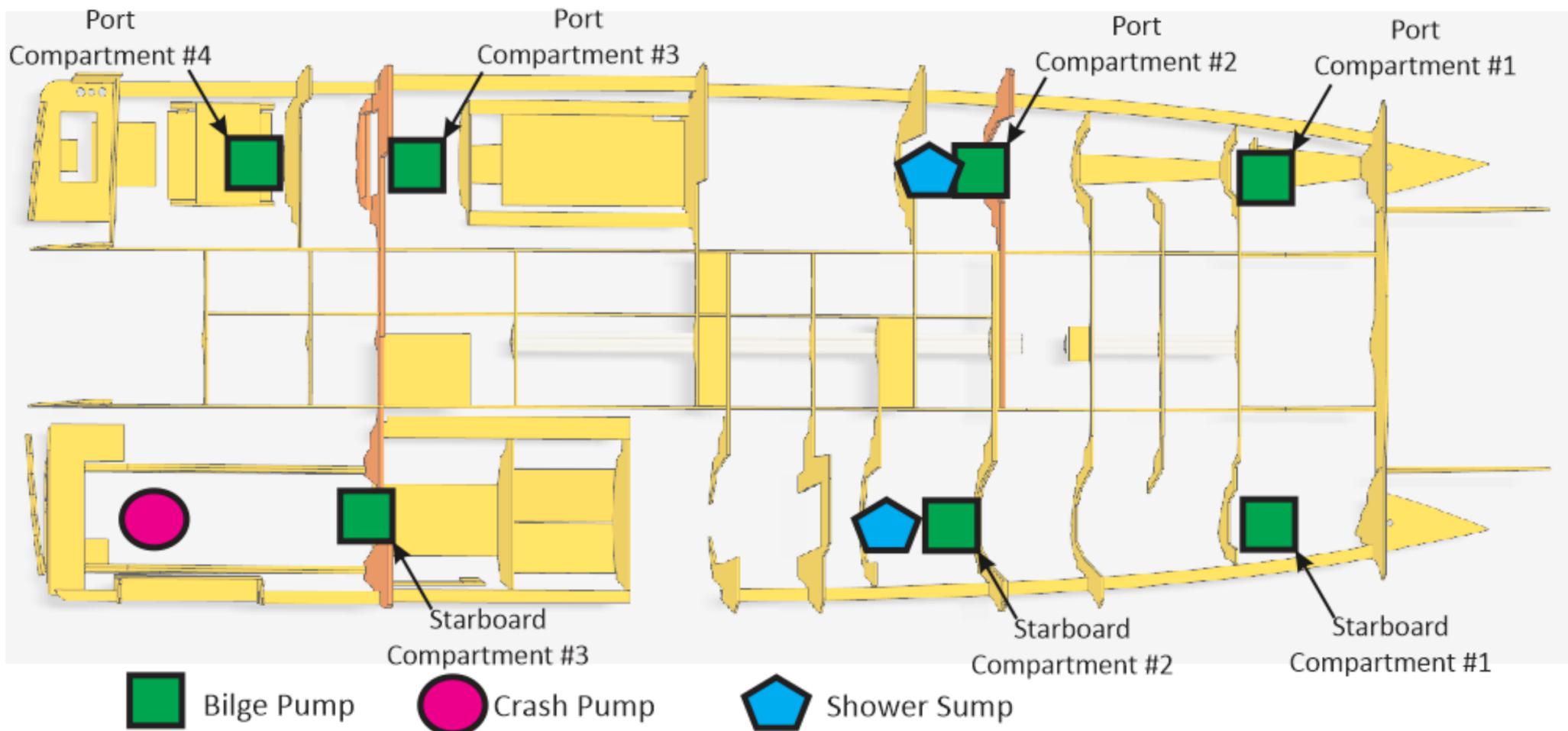
# BILGE PUMP COUNTERS



**PORT BILGE PUMPS:** Port side contains 4 bilge pumps. Compartment 1 indicates the most forward bilge pump in the bow, then goes in order with Compartment 4 indicating the most aft bilge pump in the stern.

**STARBOARD BILGE PUMPS:** Starboard side only contains 3 bilge pumps. Compartment 1 indicates the pump located in the bow, Compartment 2 indicates the pump located Mid-Ship, Compartment 3 indicates the pump located in the Stern.

# PUMP LOCATIONS



**CRASH PUMP:** Located Aft of the Engine in the STBD Lazarette, this is a high volume pump that is activated automatically by a float switch only and pumps water overboard. It also has an alarm at the dash to notify you when it activates.

**SHOWER SUMP PUMPS:** Located Port & STBD heads below companion way floor. These pumps are automatically activated when water accumulates from shower use and pumps overboard. These pumps are wired to your constant DC power source and can act as back-up bilge pumps.

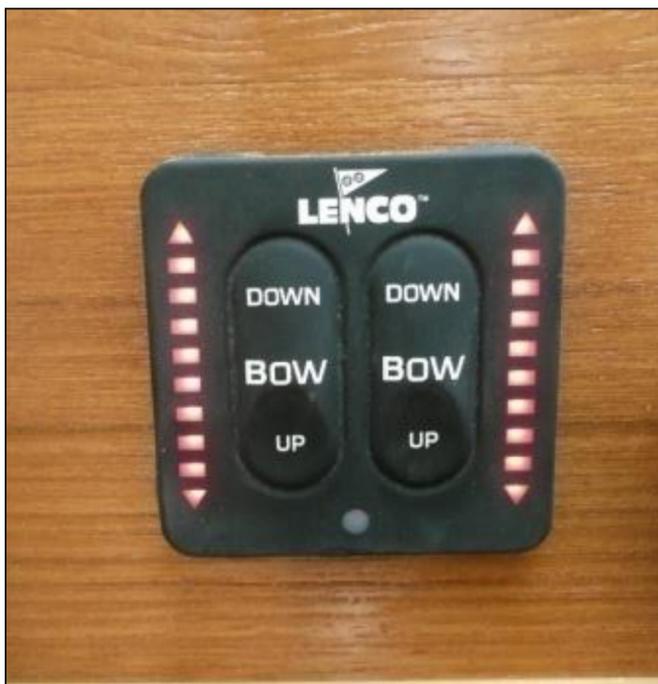
# LENCO TRIM TABS

The C120 is equipped with large trim tabs. The tabs are primarily used to trim the boat for maximum efficiency and comfort while cruising. Due to their size and positioning, they can lift a great deal while creating very limited drag.

Typically, after setting for a given throttle RPM, you will level and trim down to find the maximum speed for that RPM. If the seas are choppy you may find that less trim is a softer and drier ride. Use your discretion. I find that in 0 – 12” seas full tabs are most efficient and a good ride. In 12 – 24” seas, you will need to reduce tabs to 2 / 3 or less and let the bow float through the seas. In larger seas you may find no tab is best. Please note your best ride in heavy seas will often be at 14 – 17Kts. If the boat is bouncing or thumping, try something different.

## Full Tabs:

Used for 0-1' seas: 14-17Kts



## Half Tabs:

Used for large seas: 14-20Kts



## Zero Tabs:

Used for large seas: 14-20Kts



**Full Tabs** is also used when there is excessive weight in Stern for best efficiency

**\*Note:** Retract tabs when not in use to protect actuator shaft from marine growth.

# GETTING READY TO GO

Before getting under-way, there are key things to do and check:

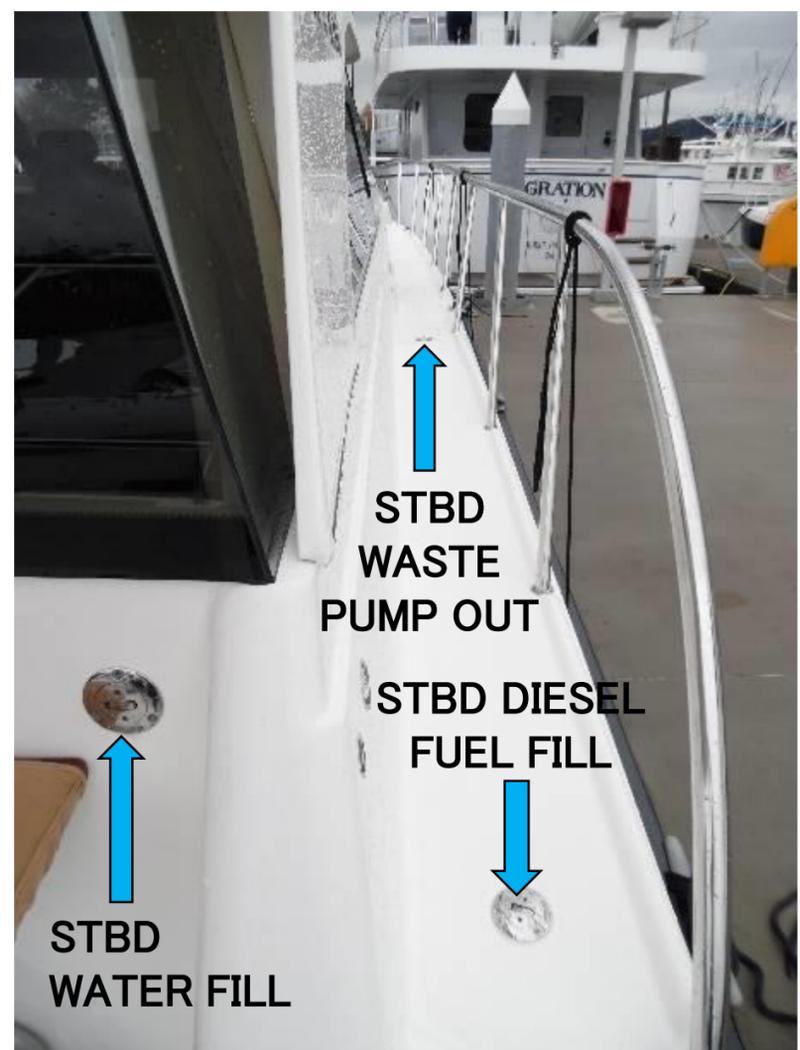
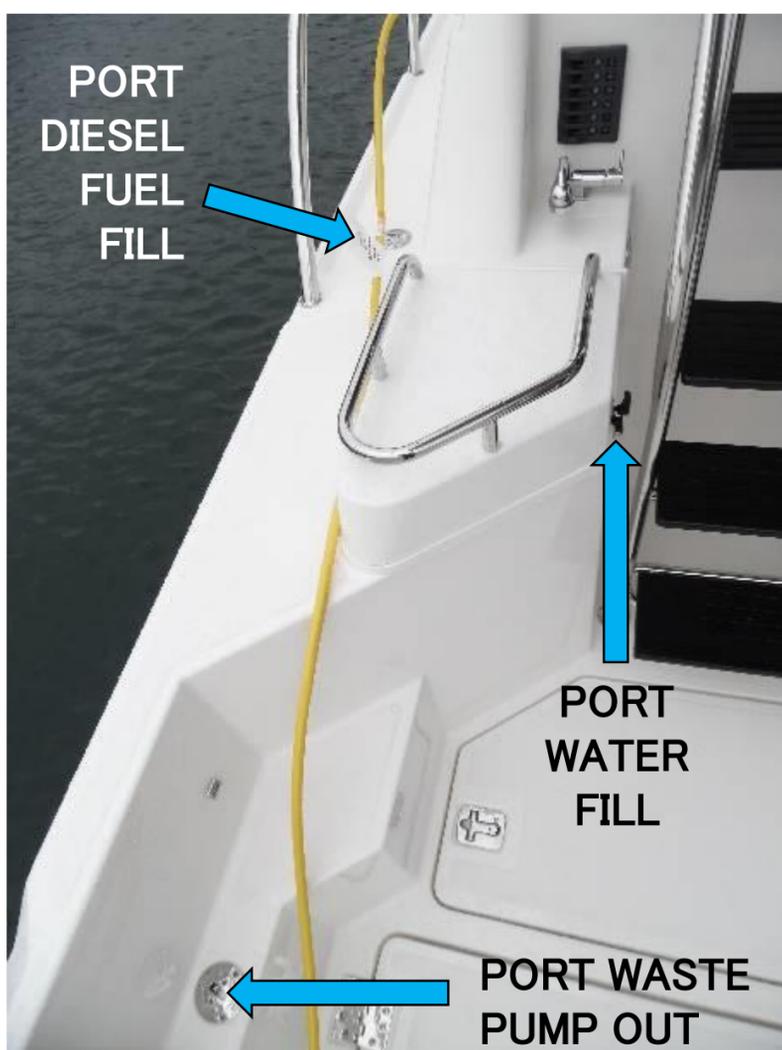
1. Check all safety equipment, bilges, machinery spaces and service points.
2. Turn on remote battery switches at the helm. Check voltage on House, Engine and Electronics batteries and make sure you have adequate voltage on all systems.



3. Check all seacock's and make sure they are in the open position. If handle is parallel to the valve, it is open. If the handle 90 degrees to the valve, it is closed.
4. Check tank capacity levels. Fill water & fuel tanks as needed. Be sure water is good – taste it! During long inactive periods, add a little chlorine to keep water fresh. **Note:** Fuel & Water are your heaviest loads; take what you need plus a good safety margin. Carrying full tanks uses significantly more fuel than 1/2 or 5/8' s.



5. Check engine and generator fluid levels, top off as needed.
6. Start Engine. Allow to idle while checking all of your gauges and make sure you have proper readings according to the Engine Manufacturer Specifications.
7. Always remember to follow safe navigation practices.



# GETTING STARTED: THRUSTERS, RADIO & WIPERS



**Thrusters:** These side power units are very handy while docking.

**Caution:** *Be certain no one is in the water near the boat when the thrusters are on. The thrusters work like a vacuum, sucking from a large area.*

To use, ensure battery switches are on, then press both ON buttons simultaneously.

Use in 5–10 second bursts and never for more than one minutes of continuous use to make sure motor keeps cool. Unit shuts off automatically after three minutes of inactivity.

A wireless remote is available for solo docking.

**NOTE:** *When using thrusters make sure inverters are off. Otherwise, the low voltage alarm will ring on the inverter. Thrusters use a lot of voltage and may even cause low voltage on the chart plotter. If you have an especially windy docking, you may want to run the generator with the inverter charger on. See special notes on using thrusters under Section 4 in your owners manual.*



## ICOM VHF Radio

Turn on by pushing the red button. Most conversations with other boaters will be on low power. Channel 16 is used only for hailing.

Switch to Channels 72 or 68 for other communication. Weather information is available by pushing the WX button. Use the lower knob to squelch background static.



## Wiper Motor

The controls are right of the wheel. The wipers have two speeds. Push the control to wash. Wash tank is located behind the dash on the port side. Rain-X works great on front and side windows to aid in visibility.

# GETTING STARTED: ENGINE



**Starting Engine:** Once batteries are on, you can start. Hold Key Fob flat with square edge toward key box and pass down over box. A green light will come on solid, then push start button after fuel pressure pump has stopped humming. ***Important:*** *you must warm the engine up slowly at RPM's under 2000 over a 10–15 minute period. DO NOT go above 2000 RPM until motor has reached 176 degrees. 80% of engine wear is while motor is cold.*

**Engine Computer:** The engine computer is very useful as it allows you to view engine data. Toggling the propeller button allows you to scan various details. It is fine to push the boat and horizon buttons for additional information. Oil pressure while running will be about 90 PSI and water temperature will be about 176 – 180 degrees.

**NOTE:** *If you hear a horn or beeping sound while underway you must stop and determine the cause. Engine manuals can be found under the helm seat in a black brief case.*

# GARMIN CHART PLOTTER

To start the chart plotter, locate the power button at the top right of the unit. Press and hold the power button for three seconds. The unit will start in approximately ten seconds.



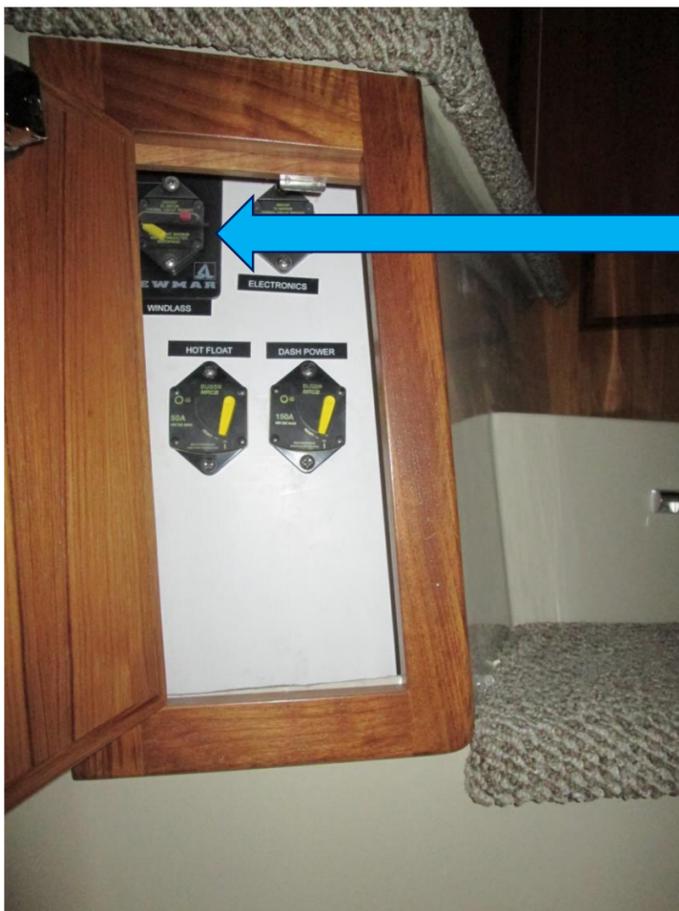
The screen will display chart and data fields. To zoom in, press the + key; to zoom out, press the - key. To change the page to sounder, press the home button and toggle to the desired page.



**GARMIN HELP LINE #1-800-800-1020**

# WINDLASS / ANCHOR (OPTION)

The Lewmar windlass is mounted on the front deck. For ease of use, it has power controls located at both the helm and front deck. The unit uses 5/16" chain, typically 50', and 250' of 1/2" line, typically triple-braid, that's been woven to the chain. The capstan can handle both the chain and line, transitioning automatically as the line moves through. When the line is new, it is a good idea to remove the anchor at its swivel and run the line up and down two-to-three times to clear any kinks in the line.



The windlass breaker is located in the master staterooms under the bed on the port side. **Note:** *The anchor line end must be secured to the bitter end cleat in the anchor locker. Be sure to secure the anchor with a bungee or line while underway.*

The windlass has a friction clutch built in to the capstan. Its tension is adjusted by turning the SS knob and tightening clockwise for more friction, counterclockwise for less friction. This is a delicate procedure, as too little tension causes the clutch to slip when lifting under-load. Too much tension while the anchor is lifted can cause damage. When the anchor rode has been purchased from Aspen, it includes depth markers every 30' to aid in anchoring.

# WINDLASS / ANCHOR (OPTION)

LEWMAR WINDLASS

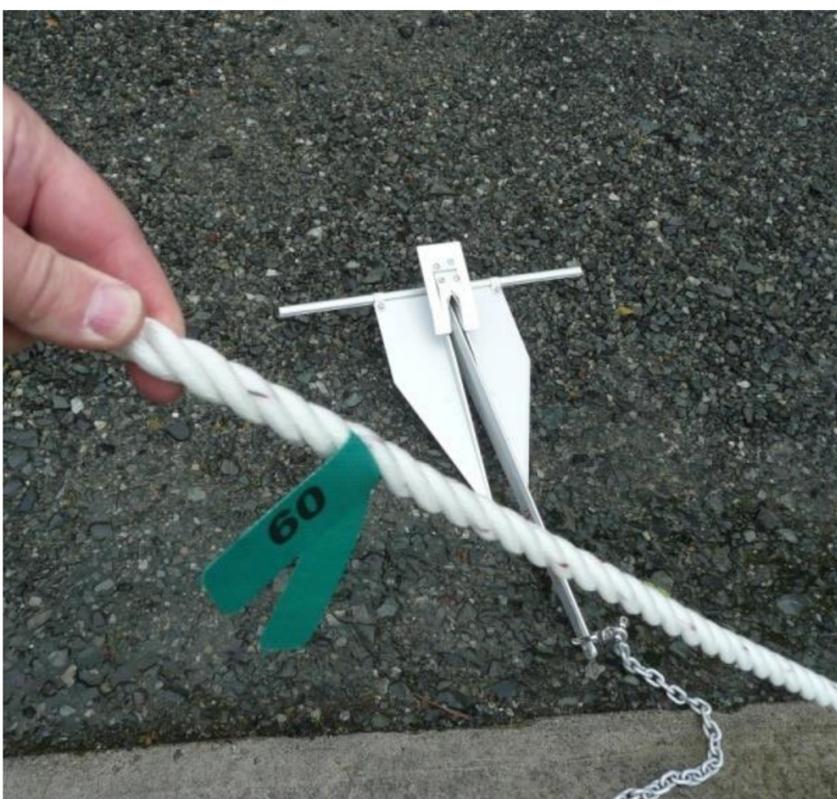


WINDLASS WRENCH



Use wrench to tighten/loosen clutch, capstan.  
*Note: The wrench is key to adjusting how much force the windlass pulls in with. Too tight and you will damage the roller assembly.*

ANCHOR DEPTH MARKERS



LINE AFTER STACKING – DETANGLE



# ENGINE & TRANSMISSION OIL

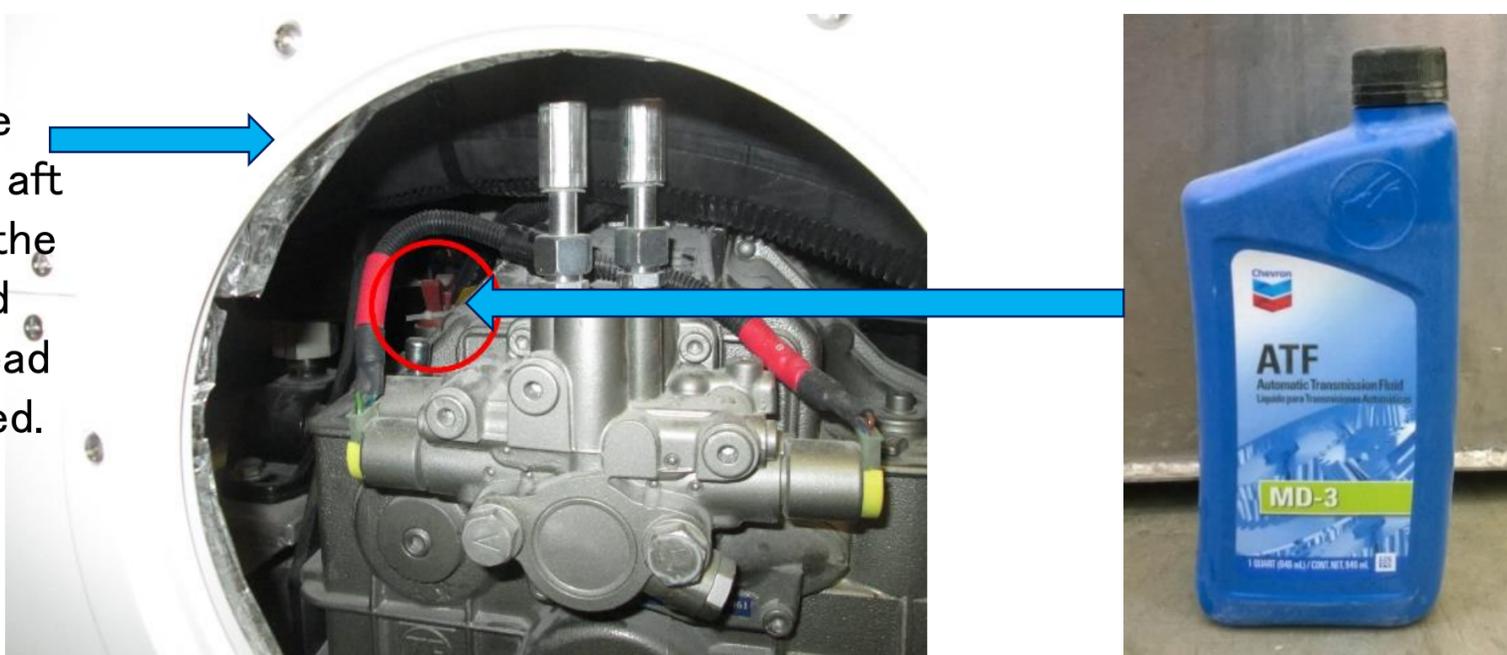
The Volvo D6 435 engine uses premium **15W-40 oil**. It's best to check oil levels prior to use. Be careful not to spill or overfill. Change your oil & filter at 100 hrs, then every 200 hours or every 12 months after.

Note: The engine dip-stick is located on the starboard side, just forward of primer unit (Red Stick). It has a flip top lever to open. You must snap down to lock in place or oil will blow out.



The ZF Transmission uses ATF Dexron iii (automatic trans fluid) oil for its gear lubrication and to engage its clutch. When you go to check the oil level, make sure the engine is warm (just after its been idling in neutral) but off. Check the oil with the dip stick pushed against the threads but not screwed into the housing. If the oil is low, the clutch will drop out and the boat will stop. Find the leak, repair it and refill the transmission oil. To top it off, it's easiest to fill through the dip stick opening with a hose and a funnel. Check frequently while filling, as overfilling can damage the transmission. Change after 100 Hrs and then every 200 hrs there after, and replace filter element (PN: 3312199031) with each oil change.

This is the view looking aft from under the queen bed after bulkhead was removed.



Note: The Transmission dip stick is accessible from the fwd engine hatch. The red knob/cap is under the 2" hose on the fwd outside corner of the engine.

# FUEL SYSTEM: FILTERS & PRIMING



The C120 fuel system includes two filters. In normal operation, you will only need to inspect the Racor Filters clear glass bowl for water (clear liquid). If water is present, you will need to remove the brass plug under the petcock (typically in finger tight) then drain it into a cup through the petcock at the bottom. Because the engine is protected by the Racor unit, it is not typically changed. The engine has a manual fuel pump activation button (port side fwd near the top). The Racor uses a 30 Micron 500 series diesel filter, and the Racor lever points to the filter in use (never points up or down).

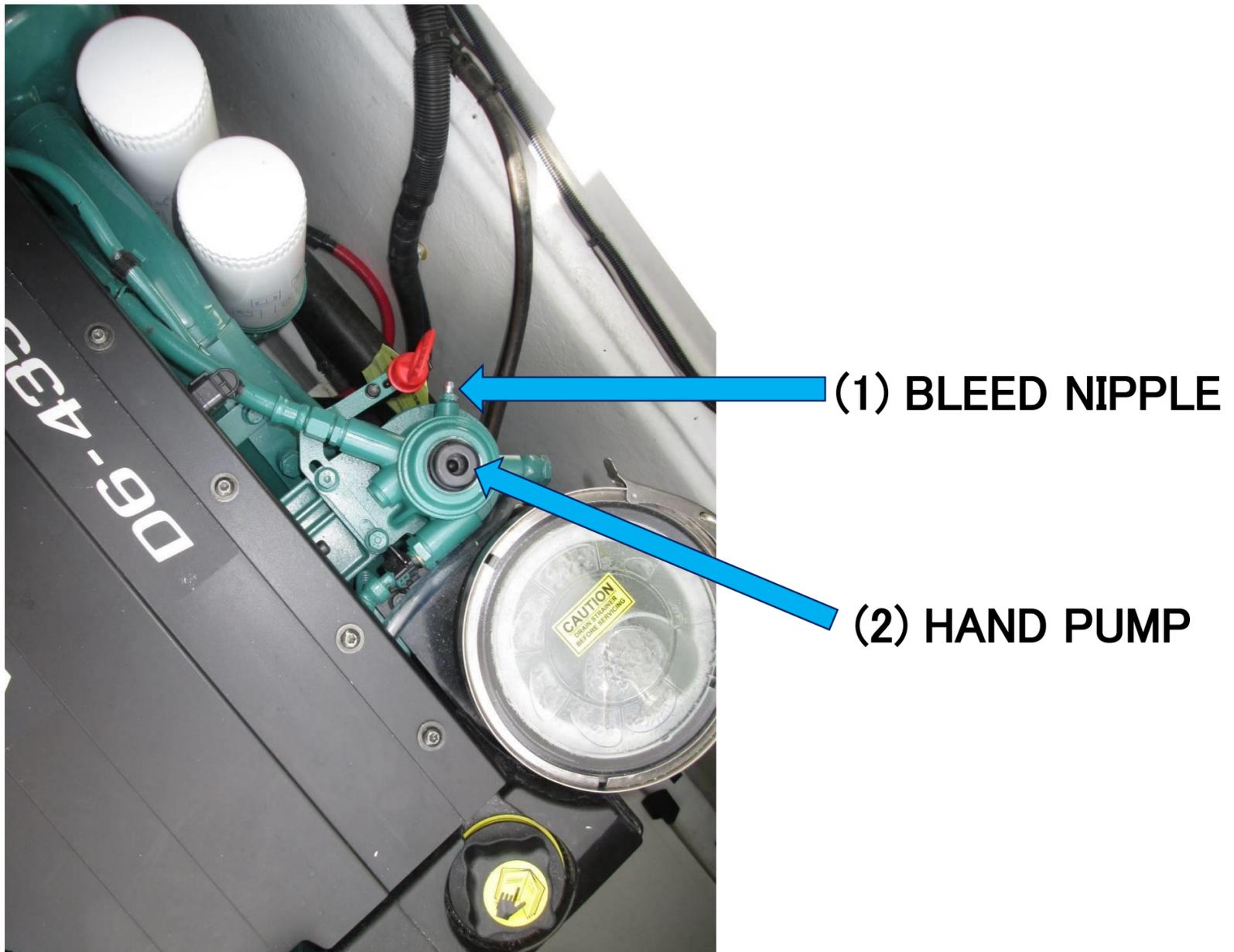


The Fuel Tank Switch is located on the left side of the dash. It is labeled Main and Aux. Main is the engine side of the tank, Aux is the port tank. Select the desired tank by pressing the switch of the desired tank. Typically you will run on one tank for 2 hours and then switch so the tanks drop equally while underway. The starboard tank is 137 gallons and the port tank is 92 gallons. This switch also swaps the engines fuel return lines at the same time. If your trim tabs are out of balance, it's desirable to burn one tank lower to trim.

# ENGINE PRIME PROCEDURES

## FUEL SYSTEM – BLEEDING

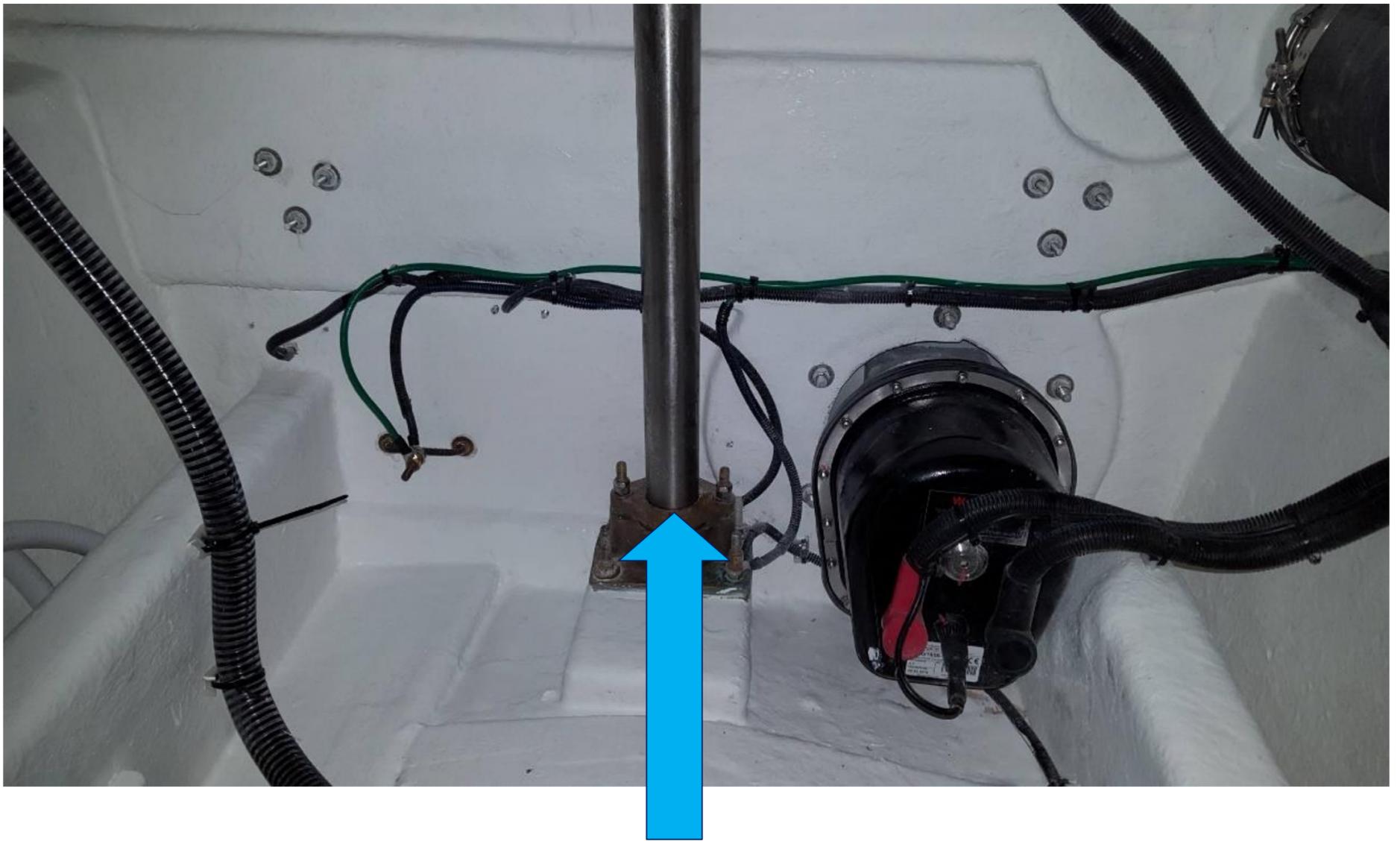
The fuel system must be bled after a filter change, if the fuel tank has been run dry and after a long-term stoppage.



**IMPORTANT:** never disconnect the pressure pipe.

1. Connect a transparent hose to the bleed nipple (1). Feed the hose to a container to avoid spillage.
2. Open the bleeding nipple and pump fuel with the hand pump (2) until the fuel is free from bubbles. Close and tighten the bleed nipple.
3. Pump a further 10 times on the hand pump. Resistance in the hand pump can feel heavy, but this is completely normal and necessary to bleed the system.
4. Tighten bleed nipple, remove the hose and fit the protective cap to the bleed nipple.

# RUDDER BEARING, PACKING GLAND & SHAFT SEAL



## RUDDER PACKING GLAND

The gland should be tightened just so it stops leaking and the nuts locked with blue loctite. Over tightening will make steering stiff.

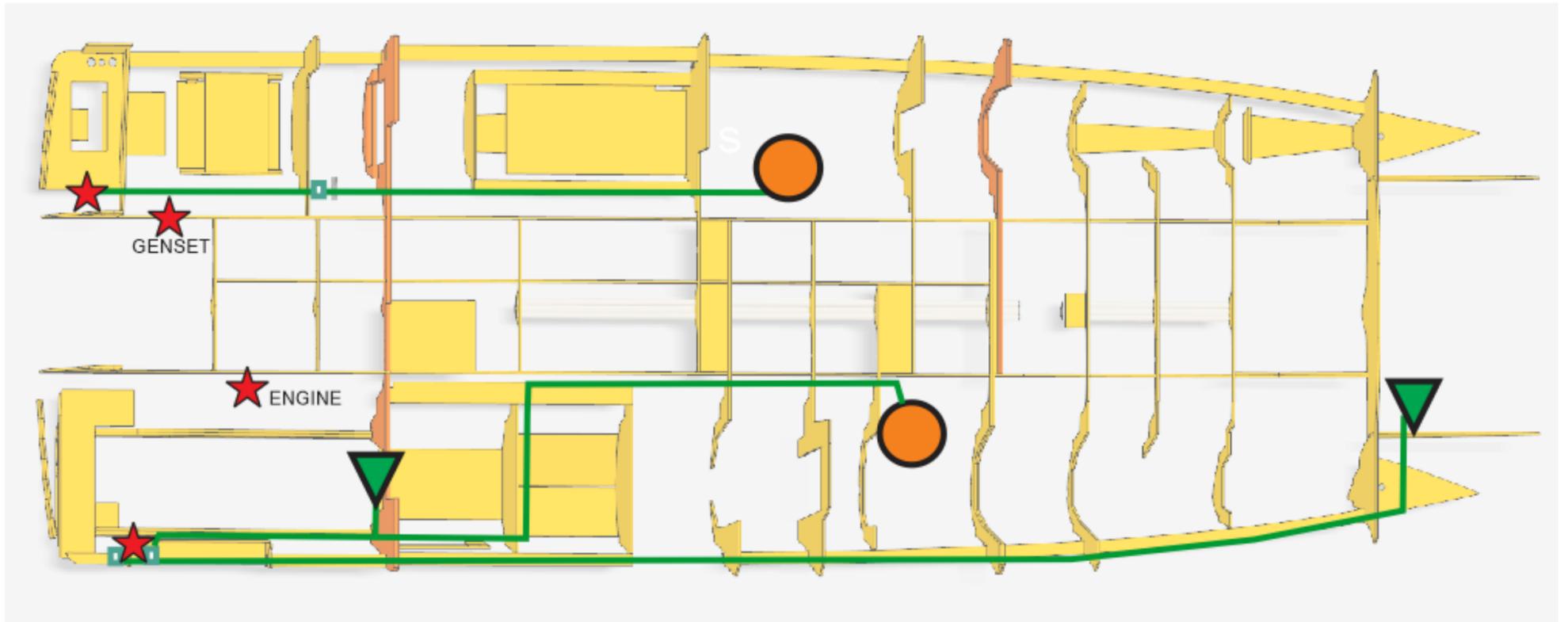


## PYI PSS SHAFT SEAL

It is maintenance free and water cooled from the raw water of the engine. This should be inspected with each oil change for leaks. If it leaks, Re adjust Stainless rotor

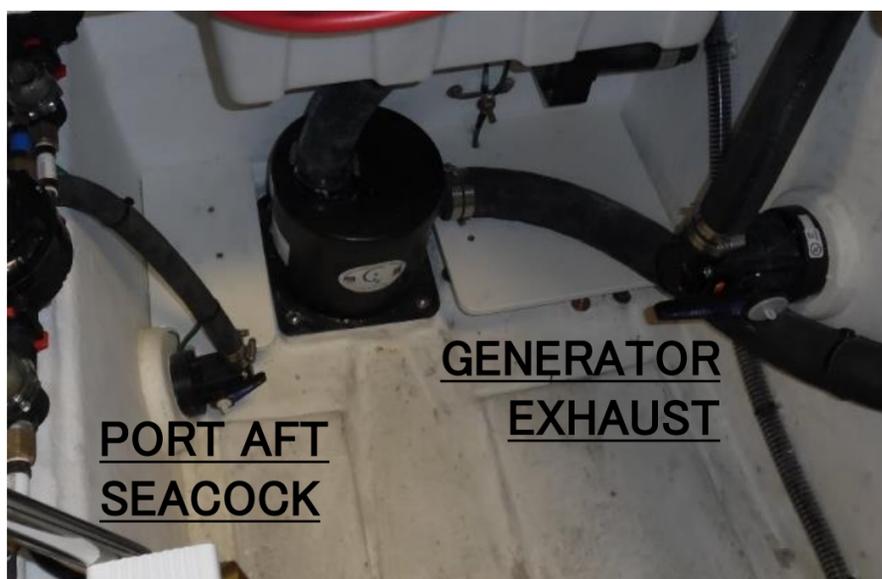
[www.shaftseal.com](http://www.shaftseal.com)

# RAW WATER BALL VALVES



★ Raw Water Intake   
 ■ Pump   
 ● Toilet   
 ▼ Raw Water Faucet

Valves should be left on while running the boat, as closing the valves while running the boat will damage the engine and impellers.



# Aspen Service Bulletin

1-30-19 LG

## All Inboards

### RAW WATER BALL VALVE CLOSURE – WHILE TOWING

As you all know we try hard to make sure all your days on the water are fun. We also share things we learn as we go – this is one of those things that on one hand is obvious but on the other not so much.

Towing an Aspen is very rare, so far in 9 years (70+ boats) I know of only two cases! But recently we had a 40 in South Florida that had an issue that originally started with a prop that was stopped very abruptly. The boat was towed for about 6 hours at 6-7Kts to a service yard. During the service the engine was found to have had some salt water in key components (i.e. Turbo and head).

We talked with the captain and owner to get some clues, neither really had an idea, but we did find that the raw water supply ball valve was ON during the towing process. Most owners would think that if the engine is off the water flow to the engine is stopped because the motors not turning. It would seem on the surface that the raw water pump would seal out, in bound water, and I even had a service yard manager tell me this. But how did the water get into the engine? As a test, I had our service team take a raw water pump from our service inventory, connect a 3ft tall hose to it, tip it up and pour water in... What Happens??

Well it leaks through the pump just fine. The 3' of hose filled with water took less than a minute to empty through the engine raw water pump. You may say 'but how did the water flow uphill on the engine while in the boat?' The cause is the brass high-speed pickup which is mounted on the lower hull side facing forward, and it's shaped and functions a bit like a funnel to feed water smoothly into the engine.

While towing at speed this funnel shape pressurizes the raw water feed which pushes the water through the pump, intercooler, transcooler, and heat exchanger. From there it flows up to the exhaust elbow and drops freely into the water lift muffler.

The problem is the water lift muffler works on the principle of hydraulic pressure where larger 12-15" diameter surface area in the muffler pushes the raw water up the 3-6" muffler exhaust tube with the pressure supplied by the running engines exhaust. In this case we have no pressure as the engine is OFF. This means we have no way for the water to exit. Over time it fills the muffler and backs up to the exhaust riser, at that point corrosive saltwater can flow back downhill into the engine components = BAD DAY – hello Mr. boat insurance.

### TOWING WITH THE RAW WATER BALL VALVE OPEN FLOODED THE ENGINE:

You may be wondering if there are any other details to towing that can cause havoc? Some owners have wondered if they need to lock the prop shaft while towing so the gear box is not damaged as it has no oil pressure. Our ZF transmission engineer says on short tows 1-6 hrs. no problem. On longer tows the concern is the output shaft bearing getting hot (over 170 degrees). When the engine's off and the transmission's input shaft is not spinning, the unit's oil pump is not working. There are two options: the first option is to top up the transmission

with ATF fluid which will submerge the output bearing in oil. The final option is to stop the shaft from spinning, possibly with a ratchet strap at the coupler. Note if you top up the transmission, be sure to have your mechanic pump the extra ATF fluid out prior to use.

One other failure mode we considered was if the cooling water line from the engine to the cutlass bearing could be pressurized by the prop shaft freely spinning in the rubber cutlass bearing.

Another failure mode we considered while towing was if we needed to be concerned about the PYI shaft seal staying cool as it's also cooled by the engine's raw water. I've talked with PYI about this and they say NO PROBLEM the PYI shaft seal is a ceramic graphite material that can take huge amounts of abuse and heat and keep on ticking. At trawler speeds it runs cool on its own. They also said this is one of its best features. If an owner plugs his raw water intake and stops the water flow, their seal can run uncooled far longer than any other shaft seal by design.

One last detail: if your being towed it's important to reach under your bow roller and connect the tow line to the bow eye. This area of the hull is reinforced and approximately 2" thick. It's also closer to the water line so the bow will not be pulled down from the torque of towing which can cause bow steering. Do not use the bow deck cleats center or side while being towed. They are very strong but the loads while towing, especially when climbing swells at 7-8 Kts are larger than you might think.

If you become the "tower" lending a fellow boater a hand on short tows at speeds of 4 Kts or less I's use the starboard stern cleat above the engine and rudder. For longer tows at higher speeds I'd use the two stern cleats set to a deep bridal 15' -20' behind the boat is best. You need a deep bridal off both cleats to share the load and not create a massive cross load on the cleats. Keep the towed boat back there 75-100' while out away from shore, keep the speeds under 6Kts. Be very thoughtful of the loads your tow line can take. If you break it, the line will re-coil like a bullet and can be VERY harmful - i.e. cause serious injury. When I get inside the break water I snubber the towed boat up close or bring him along side and tie him up while docking.

I know these are rare unlikely events, but typical Aspen Owners are much more techie than the average boater. Hope you enjoy the info and background!

Safe Boating, Larry G.

# FRESH WATER SYSTEM

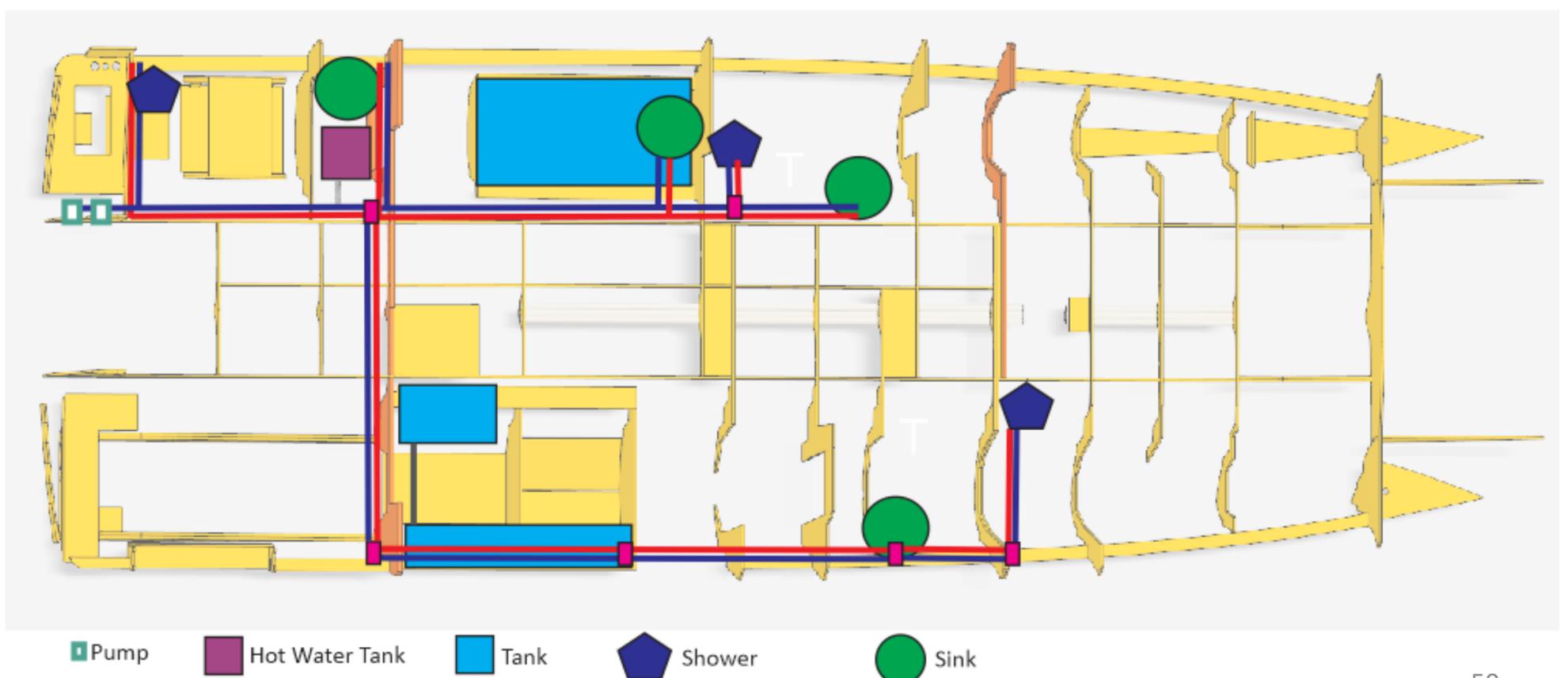


11 Gallon water heater is located in the  $\frac{1}{4}$  berth aft locker. It runs on 120 V while at dock or genset. Note it draws 1800 watts so you will not be able to run large additional loads while water heater is on. Switch its breaker on only when hot water is needed. While cruising the engines hot water is plumbed through the heater to heat water.

**WARNING: Because the engine runs at 180 degrees, the hot water will be at 180 degrees after a long cruise. This is VERY HOT!**

**Pressure Water Pump and Strainer:** The C120 has three water tanks (47 gallons port side and 21/32 gallons Starboard side – 100 gallons total) each side has a dedicated pump. The fresh water pump switch is located on the dashes lower DC switch panel.

Tanks are provide on both sides so owners can use water to trim the boat port to starboard if needed. Water like fuel is a heavy cargo, top off only if you need it. Water Tanks must be drained and system primed with RV antifreeze during winter storage.



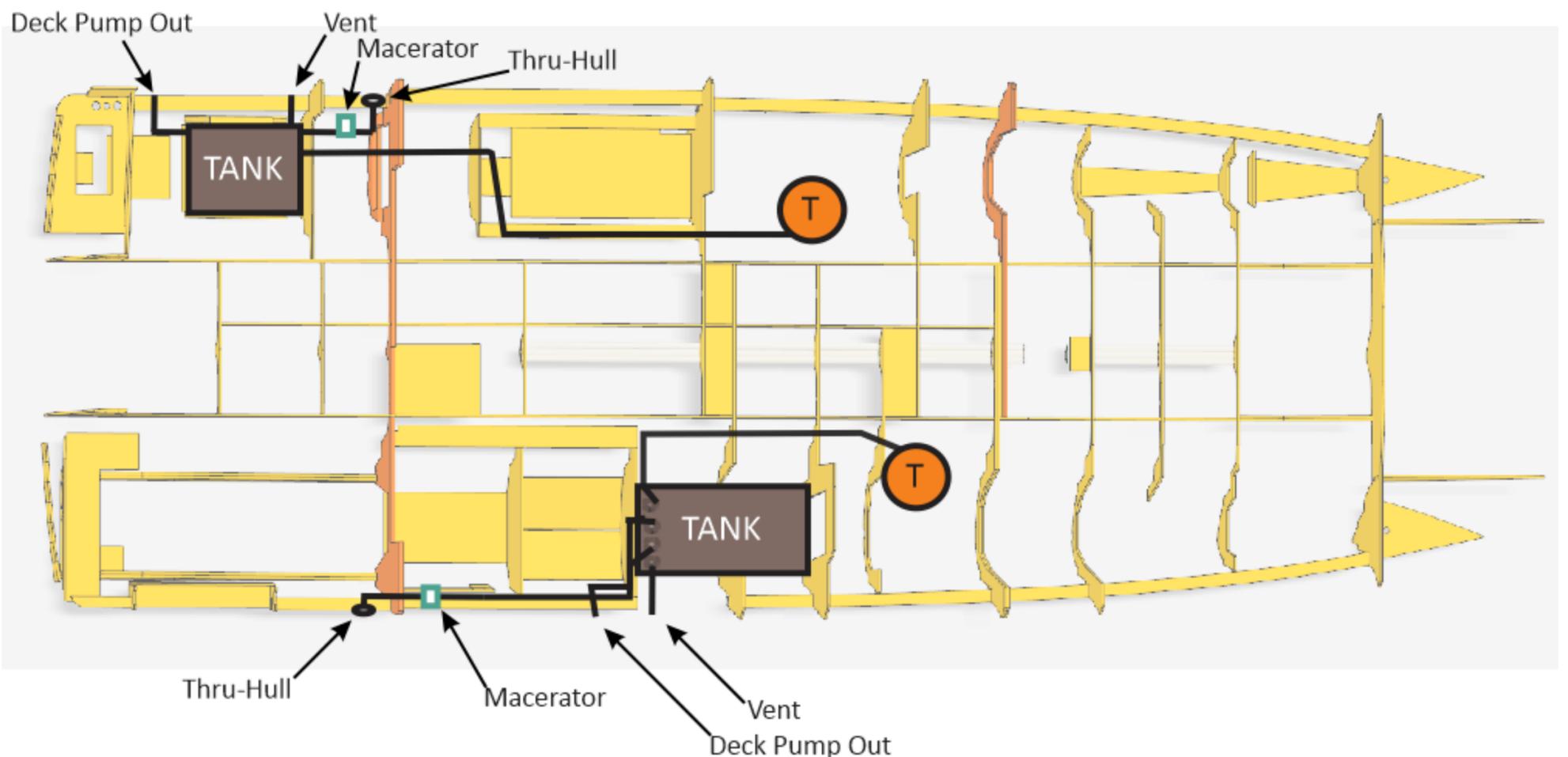
# HOLDING TANKS



The starboard holding tank is built into the floor of the liner. The lines run behind the floor step in the Queen Stateroom. This is a 45 gallon holding tank, with built in sensors and direct lines, so no need for a Y-valve.

**NOTE:** *It's best to drop back to idle when pumping tanks for best flow.*

The port holding tank is a 38-gallon tank. The port tank is located under the genset in the aft cockpit and is equipped with a Wema sensor gauge system located on the dash. If the tank is full the head will not flush. You must be three miles offshore and in an area with current that will flush to use the macerator switch at the dash. The tank can also be emptied at a pump-out station using the fitting near the transom door. The tank includes two dip tubes so there is no Y-valve to switch.



# LPG CONTROL DETECTION SYSTEM

The propane sniffer control unit is above the ¼ berth. This unit's power may be switched with the black switch just below it. The sensor is very sensitive and false alarms can be disconcerting. When its off, the solenoid valve in the tank is closed. When stove is not in use, tap the control button and turn the gas off. It will take about 30 seconds before the sensor can be turned to ON position.



LPG control system is powered from your DC constant power. There is an over-ride OFF switch on the main DC panel – typically this switch ON. But if you're getting false alarm's, it's OK to turn off, as this shuts the solenoid off anyway.

Gas is ON when the green Light is ON.

There are 2 LPG sensors on the C120: 1 is located in the Galley under the toe kick, and 1 is located on the aft bulkhead, low in the quarter berth. Be very careful not to expose these to spray sunscreen, hair spray, simple green, or any heavy fumed type material, they are damaged easily.

LPG – ON/OFF

Green light when Power is ON, but unit is OFF.



Gas is ON when the green Light is ON.



# LPG TANK STORAGE & OPERATION



**Propane tank** is in the Bustle on the swim platform. Note: Locker is plumbed with a hose to a through hull overboard so a gas leak would not enter the boat. If you ever smell gas, stop, turn off valve, and open boat to clear fumes. Find leak.



To use, make sure hose connection is tight, **open valve**, gauge will show approx. 90 Psi. If you hear a hissing or smell gas turn valve off, check connections w/ soap 50/50 water solution.. 15 pound tank will typically last 2-4 weeks.

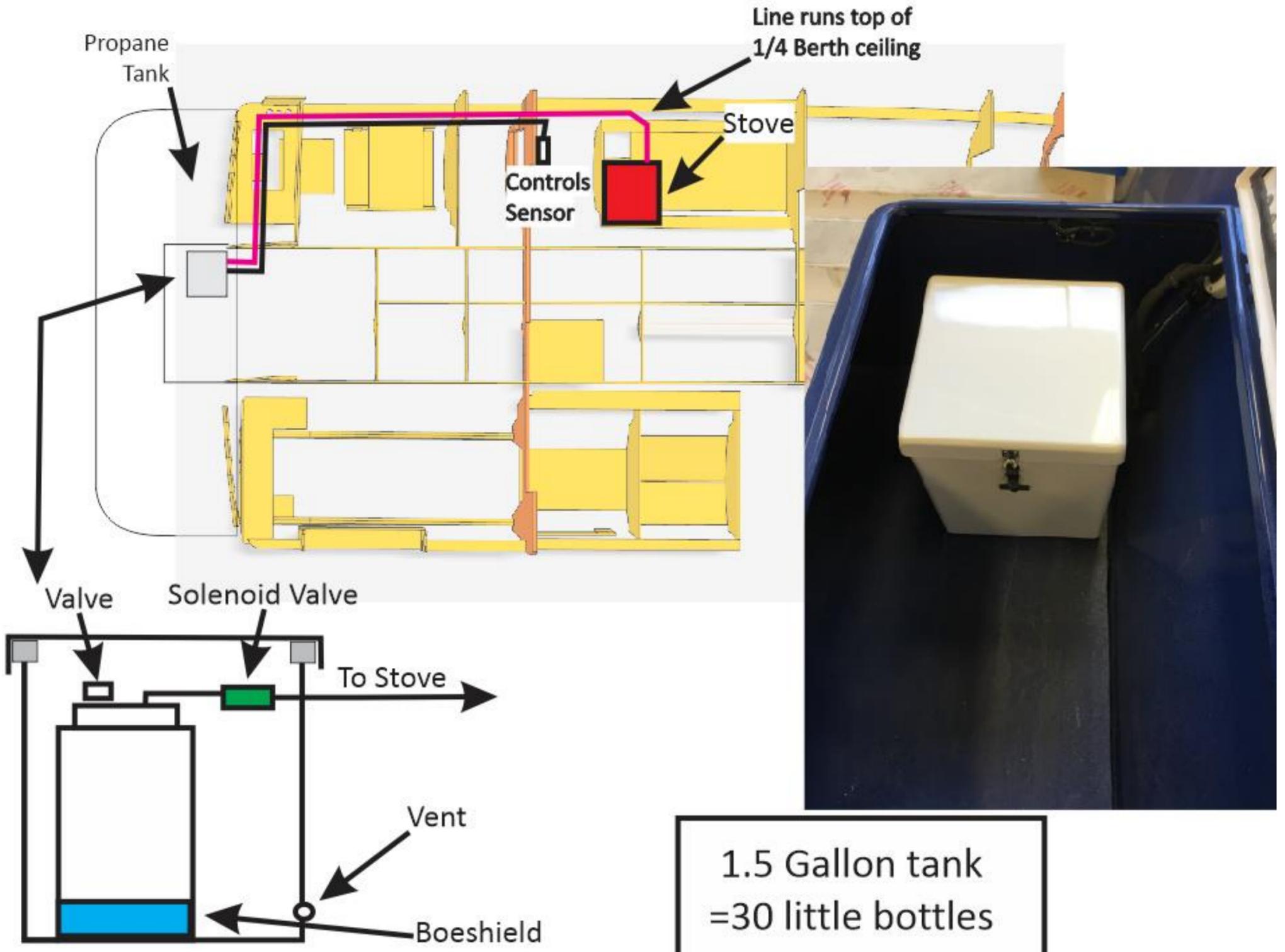


**Electric shut off valve** only comes on if gas controller by sink is on and sniffer smells no gas.



The tank must be centered in compartment to latch lid in place. Note: It's important to Boeshield the lower 1/2 of the tank every 6 months – the vent hose will allow salty air into the compartment.

# LPG SYSTEM



Apply twice a year to prevent corrosion.

# STOVE IGNITER BATTERY LOCATION

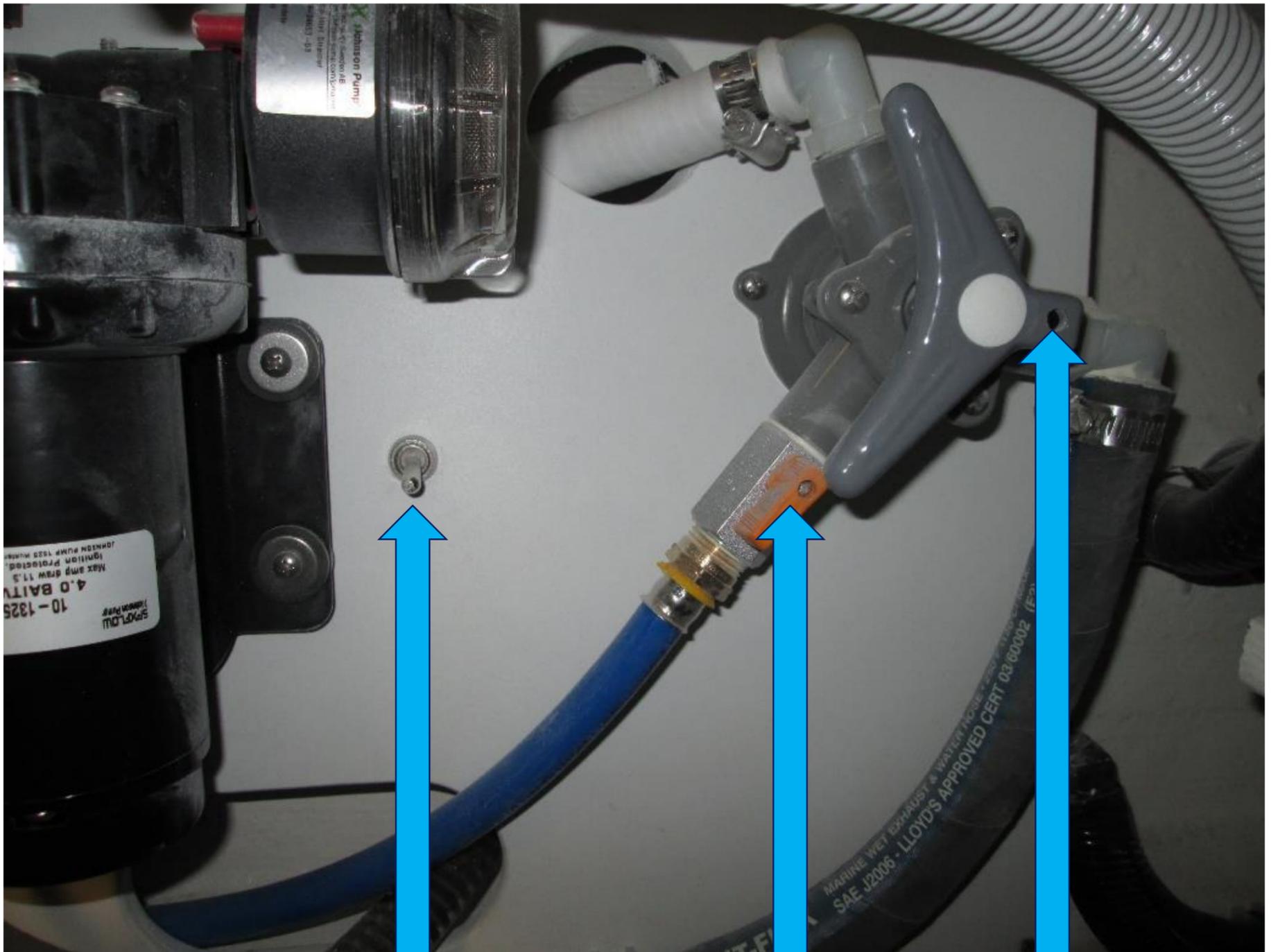


STOVE IGNITER BATTERY

LOCATION: UNDER GALLEY SINK

# TOILET FRESH WATER SEA WATER OPERATION

*Picture shown in Fresh Water Position*



**Toilet sea  
water pump  
ON/OFF switch**

**Toilet fresh  
water valve**

**Toilet fresh  
water sea  
water valve**

**OPERATION TO SWITCH TO SEA WATER:**

1. Turn toilet sea water pump switch OFF
2. Rotate toilet fresh water valve closed (orange handle rotate 90 degrees)
3. Turn toilet sea water valve handle clockwise until handle stops

# DINGHY LAUNCH

1) UN-CLIP SS SUPPORT RODS



2) LOWER DAVIT UNTIL UPPER ARMS ARE JUST BELOW LEVEL



3) DISENGAGE TRACK CAR LOCK PINS, SWING BOW OUT



4) SWING STERN OUT, EXTEND PAST SWIM PLATFORM



5) LOWER TO WATER, TIE TO CLEAT AND UN-CLIP FROM DAVIT.



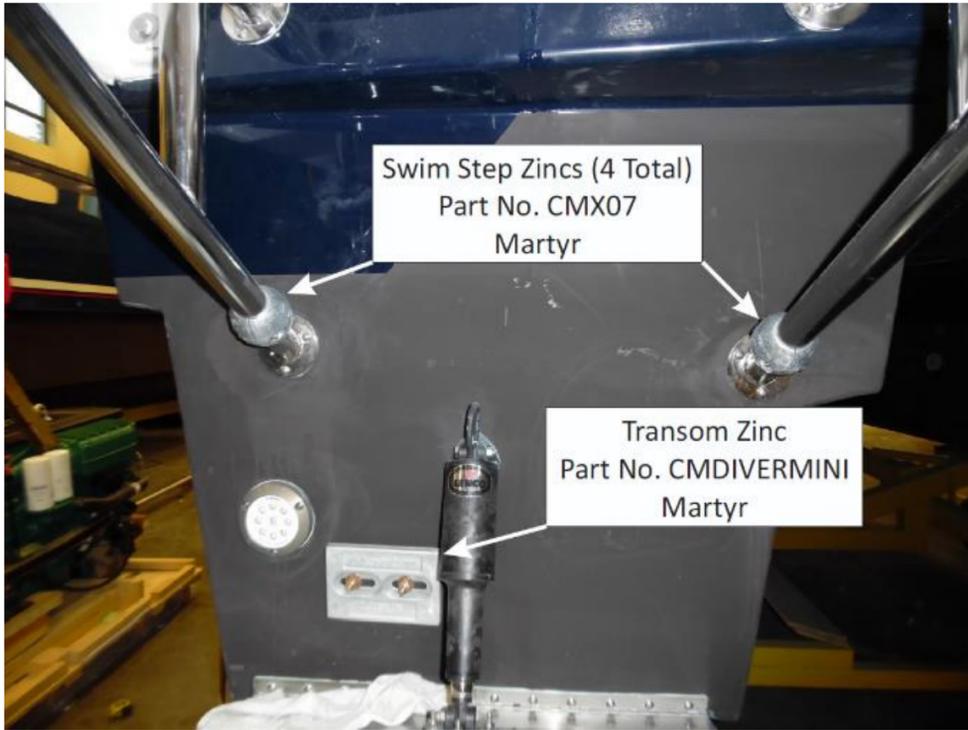
\*DAVIT MOTOR IS LOCATED IN THE PORT TRANSOM LOCKER.



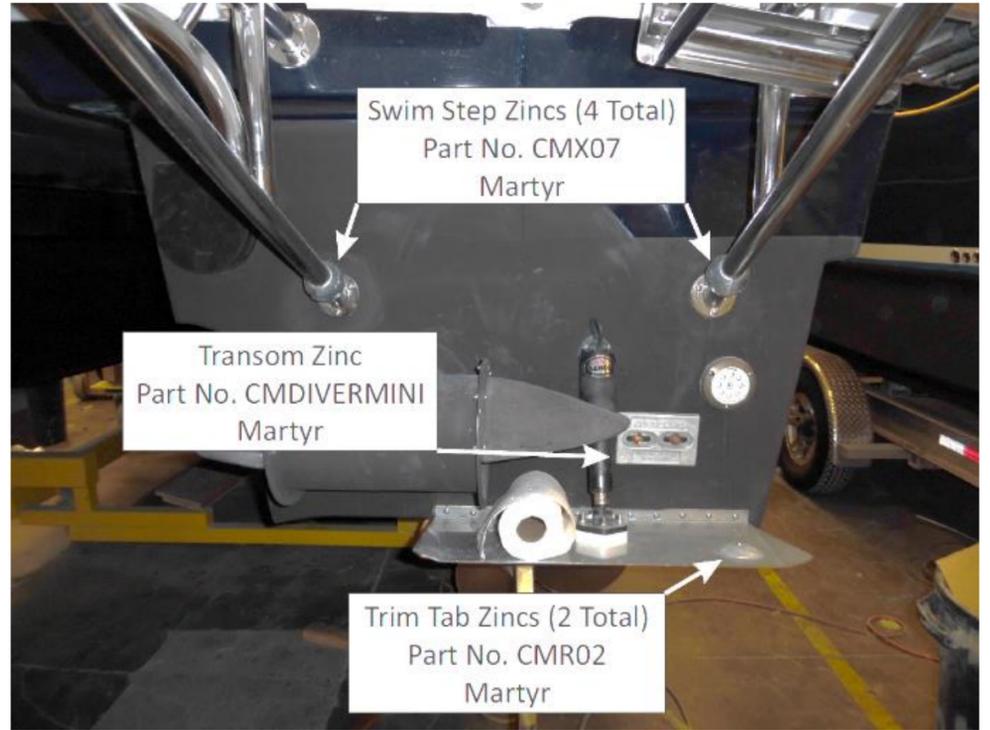
*NOTE: DAVIT SHOULD NOT REST IN THE DOWN POSITION BELOW WATER FOR EXTENDED PERIODS - 2-4 HOURS IS GOOD BUT OVERNIGHT TENDS TO TARNISH STAINLESS TUBE.*

# UNDERWATER GEAR

## PORT



## STARBOARD



## STARBOARD BOW THRUSTER



## STARBOARD STERN THRUSTER



# LIFTING STRAP LOCATION

## *SLINGING THE BOAT*



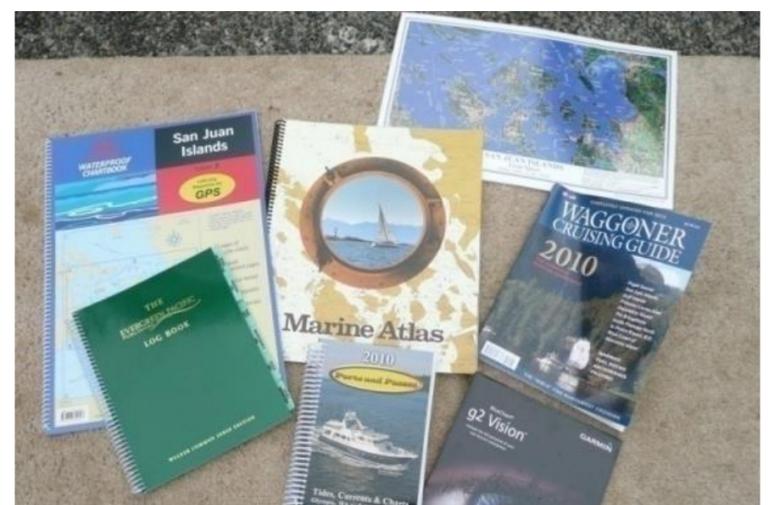
SEE “SLING” LABELS LOCATED ON HULL SIDES UNDER THE GUNNEL



# OUTFITTING YOUR BOAT



# OUTFITTING YOUR BOAT



# OUTFITTING YOUR BOAT



# OUTFITTING YOUR BOAT



# OUTFITTING YOUR BOAT



# BOAT CLEANING PRODUCTS



**MAGUIRE'S MARINE BOAT SOAP WITH WAX KEEPS THE BOAT WAX INTACT. GREAT FOR GEL-COAT.**



# BOAT CLEANING PRODUCTS



## T-9 BOESHIELD:

This is wonderful for your engine room's metal parts, all of them, bronze, SS clamps, motor metal parts, battery connections, bonding system connections and kicker motor. Keep away from plastic, and belts. Light re-coat every 6 months. Wipe up any excess while wet.



## 303 AEROSPACE PROTECTANT:

This material is for plastic that's out in the sun, I.E. Vinyl seats, Zodiac boats, recoat every 3 months.



## MEGUIAR'S FLAGSHIP WAX:

This is a premium wax that provides UV protection. Hand wax once per year in Northern climates, twice in southern. Wax both deck and hull. In the south, even the non skid may be waxed with a brush.

# STARBOARD OPEN HULL



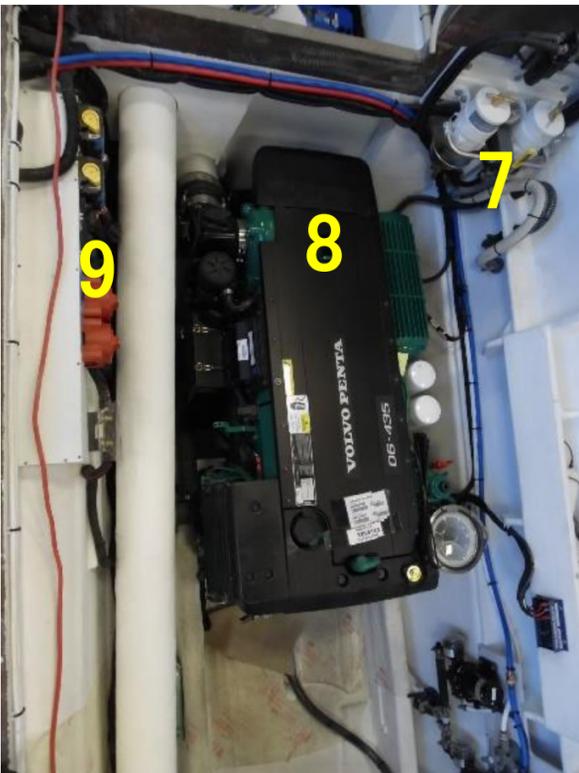
1. BOW THRUSTER
2. BOW THRUSTER SHUT OFF



3. FUEL TANK
4. WASTE PUMP
5. BATTERIES: HOUSE, START & GENERATOR



6. MAIN ENGINE MUFFLER
7. FUEL FILTER
8. MAIN ENGINE



9. THRUSTER SHUT-OFF / EMERGENCY PARALLEL SWITCH

# PORT OPEN HULL



1. TRANSDUCER

2. SHOWER SUMP PUMP

3. WATER TANK W/ FUEL TANK BELOW

4. WATER HEATER

5. TOILET SEA-WATER PUMP

6. WASTE PUMP

7. GENERATOR BATTERY SWITCH

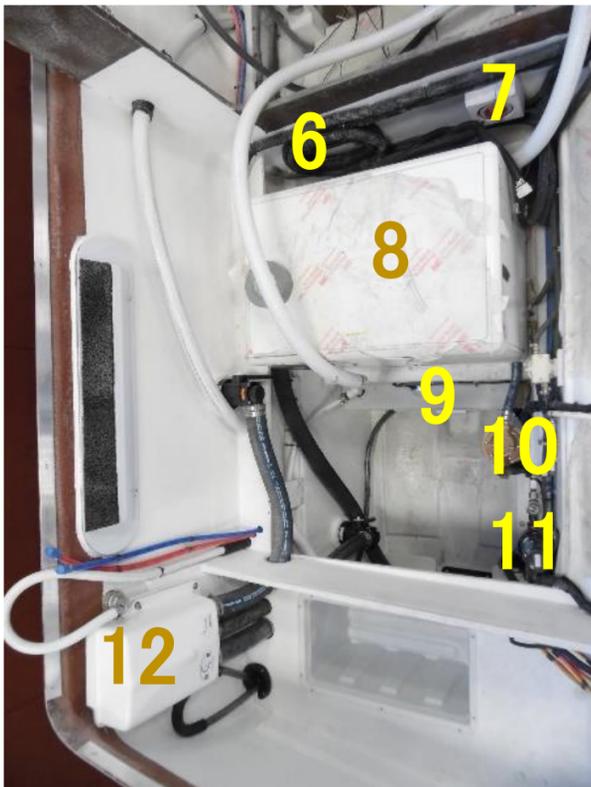
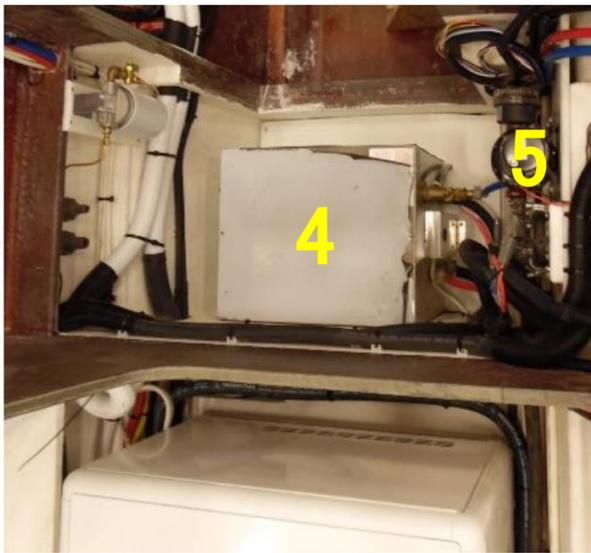
8. GENERATOR

9. WASTE TANK

10. GENERATOR STRAINER

11. FRESH WATER PUMPS

12. GENERATOR EXHAUST



# TROUBLE SHOOTING

*This list is developed from common customer questions.*

## ELECTRICAL

- **I hear beeping but can't figure out from where?** There are about 5 devices on the boat that can beep a warning. Here is a list of them and what to do.
  - **Co2 Sensor** is located in each stateroom. It's tan colored and about 3"x3". Its hard wired to the boat's hot float power supply (stays on even when battery switches are off). It will beep if it gets low voltage and keep beeping until power is back up to 12v. To reset it, you have to interrupt its power by turning off the switch at the DC panel – wait 10 seconds then reinstall, or pop off the hot float breaker near the battery switches and wait 10 seconds then reset it on. Hot float power is always left on. If you leave it off, the automatic bilge pumps are disabled. This sensor is easily damaged and very sensitive. Acetone fumes – hair spray – some aerosol cleaners will damage the sensitive/rare earth metals inside. If this happens it will need to be replaced. Its sensitivity is amazing. It can go off from a dinghy motor or generator 50 ft. away if the port lights are open. If you happen to be having a bad night intestinally, it can also go off. But its job is to keep you safe from invisible carbon monoxide fumes in situations like, if your neighbor runs his generator or furnace all night.
  - **Electronics** in general and auto pilot, especially, have the same beep horn as the above items. The auto pilot will beep incessantly if you're running a set course and it drops its inbound satellite signal. It wants you to note the loss of signal on the screen. It also beeps if it's lost the heading sensor/gyro compass signal. The CCU (Course Computer Unit) is mounted under the bed on centerline aft. It's important you do not store electrical things there. Things like vacuum cleaners with DC magnet motors really pull on the heading sensor, destroying its effectiveness.
  - **Stove propane Sensor/Auto shut off Computer.** This device is mounted just under the sink, smells for gas and is also very very sensitive, and easily damaged by cleaners. The black unit is in the corner near the floor, under is its sensing unit. To disable, flip the black power switch next to the unit off/down. This will also turn off the computer but also closes the solenoid valve in the propane tank stopping gas flow. It's the most annoying beep.
  - **Engine warnings.** These flash on the engine monitor and also beep on the chart plotter. You will see things like "low coolant level" or "over temp" on the engine in both units. These two are tied together through the NEMA backbone that shares information. Normally, resetting the error/acknowledging it on the Volvo/engine display will reset the chart plotter. If the chart plotter continues with its warning, stop and shut the engine and the chart plotter off. Then restart and turn plotter back on. If the engine is warning you they are not normally false, it's doing what it says and you need to address the issue. If you are getting warnings, for instance, "water in the fuel" erroneously, this sensor may need to be changed. Once they see water they often do not work well in the future. To reset the whole engine to factory, you can pull the main ECU fuse at the motor near the emergency off button (port side mid motor) But you will have to re-teach the throttles to the engine (single station) and so on, so not my favorite solution. You'll need the owner's manual to do this.

# TROUBLE SHOOTING

- **High water Alarm/Pump.** This alarm is behind the dash, it's tied to a second high capacity bilge pump (2200Gph most models). This pump is mounted 2" above the first pump in the engine room. If you hear a very loud alarm from behind the dash this is probably it. Do not ignore, go look in the engine room, you have big problems. It's designed so, should you melt a large pressurized hose or blow one off the engine, it will pump big volumes of water. But you need to fix the problem – shut the engine off, this stops the raw water pump.
- **Inverters 1000 – 2000 watt.** These devices take 12 volt power and step it up to 120Volts and also turn it into a sine wave (AC power). What most people don't understand is how much energy is in a typical 120 volt outlet and how that compares to 12V power. The formula is: Volts x Amps = Watts. A typical 120V outlet can pull 15 amps or 1,800 watts. 12V outlet at the same 15 amps (max typical) only produces 180 watts. So it would take TEN 12V outlets to run one 1800 watt hair dryer. The second factor in inverters is the size/capacity of the house battery bank where they pull the power. Ours typically run from 2ea 70 amp hour (140amp hr. C90) to 2ea 6V 120amp hour (240 amp Hr C100). So if you're running a 800 watt micro wave at 120 volts, your burning 66 amps at 12Volts (a lot). In a C100 you could do this for about 2 hrs. before your house bank got down to ½ charge. However, if you start the engine, warm it up and then run it at fast idle while you're running the inverter, the engines 125 amp alternator will put out approximately 70–80 amps working very much like a generator. Then after you're done with appliances, the house batteries are at, or still near full charge. These inverters are a “pass through type”, so when you're hooked to shore power and are switched ON, they feed the shore power automatically through and to the outlets without using 12V battery power.
- **12Volt central breaker panel.** This panel is the central distribution point for 12 volt ships power. It comes from the house batteries, forward in a finger thick cable through the breakers and then out to the ships switch panels, thrusters and also behind the dash to the four fuse panels, ships systems, electronics, lighting and options. The panel includes an LED display that shows both volts and amps being burned. This panel also lets you toggle from house battery to start battery, to read each voltage. Typically, these will be almost the same voltage as the Blue Seas voltage sensitive relay will be engaged and tying the house and start batteries together. But it's important to understand these breakers must be on to get any of the downstream equipment to work.
- **Voltage Sensitive Relay.** This device is mounted under the forward stateroom berth (3"x4" black box) opposite the battery switches. Its job is to automatically pair both your house and electronics batteries together so they can share the workload. It does this up to the point that the engine start battery drops below 12.3 volts after this voltage, the (VSR) voltage sensitive relay says nope, house you can't have any more power from us, we're protecting the electronics battery. This protection only works if the parallel switch is off.

# TROUBLE SHOOTING

- **Dash DC, left of helm switch panels.** The upper one controls the ship's pumps manually, the lower one controls ship equipment like Navigation lights, horn, macerator pump, refrigerator and freshwater pump. The freshwater pump toggles left for port pump, center for off, and right for starboard water tank. It's important to know that the panel's plastic cover pops off the panels and reveals a rubber boot that covers individual 12V GM type blade fuses for each device. If the fuse has blown, it typically is "not the problem", it's the symptom of a problem at the device. Inspect and identify the device before you put in a new fuse. Going larger is almost always the wrong solution.

## MECHANICAL SYSTEMS

- **Ships Hydraulic Steering.** Aspen uses a Teleflex Sea Star steering system made in Richmond, BC. The unit's hydraulic reservoir is filled by removing the rubber cover on top, then the black screw cap on top of helm. The boat ships with a clear hose with the fitting to attach to the bottle and the helm (in owner's manual bag). Once hoses are attached, you tip the bottle up and slowly turn the wheel port, then starboard while burping air out. Be careful not to over fill and have lots of rags nearby; this is a messy process. Also, it typically is low only if there is a leak in the system. It is a clear oil that's hard to see and better to touch. Look for loose fittings. Don't fill to the top it, should be down from the threads about 3/8<sup>th</sup> inch. The oil expands on warm days and will burp out the breather hole in the cap and make a mess.
- **Macerator Pumps.** The macerator is a diaphragm type pump located in the port aft lazarette and under queen berth (black pump with red ring around bellows section). To activate, hold on the spring-loaded switch at the dash. The design does not use a lock out key switch as the driver must hold the button to engage and there is no Y valve in the system. We use two dip tubes in the holding tank, one plumbed directly to the suck out fitting and one directly to the macerator. The rules about lockout don't apply as there is no Y valve in the system to position incorrectly. The pump is very robust and can pump amazing things, but it does have valves inside that do not like string, diaper wipes, nuts and non RV/Marine toilet paper. Nine out of ten times when they stop, it's due to these things. The pump will have to be disassembled, cleaned out and reassembled.
- **Windlass.** The windlass is a Lewmar unit. Use is pretty obvious, but few owners give it the respect it deserves. These are very strong geared down motors. Never try to have two people work the anchor at the same time. Keep your fingers and toes well clear of the chain and line, go slow, think. Tap on the control is good, especially when the anchor is nearing the bow roller. Many owners do not realize the motor's design includes a cone clutch under the tension cap (wheel that moves) this cap (or knob on some models) can be tightened or loosened, allowing the gear motor to slip a bit, rather than pull with full force. This is especially important as the anchor jams into the bow roller in the up position. It can, when locked tight, pull with 700 to 1,000 pounds of force. This can damage the roller and fiberglass. Spray the motor and anchor chain off with fresh water after long trips. Be sure to hook a bungee cord or safety line to the anchor when not in use. We had one owner who had his anchor deploy at cruising speed (loose clutch).

# TROUBLE SHOOTING

- **Hatches.** Easy to use but many owners miss the “open just a crack” option. If you look at the area where the handle latches, there are two tabs that protrude. If you open the hatch ¼ Inch and twist the latch, it locks in that position. This is handy, allowing some ventilation while keeping 90% of the water out except in big down pours. If you’re latched tight and still getting slight leaking at the gasket, often you can tighten the Philips screw in the handle for extra tension. In some cases, we have also fixed leaks by thinning the handles plastic slightly. If the hatch seems tight yet you’re still getting a drip, check the seal around the outside next to the fiberglass. We have, at times, seen the hatch plastic move just a bit with temperature, heating and breaking the seal.
- **Windows and Screens.** Issues here normally have to do with the screens being stiff to move/slide. The core issue is they ride in a vinyl track that has a center open section in the top so they can slide to this area and be lifted out for window cleaning. Owners will get off track a bit while sliding through this area and if they push really hard, they bend the plastic and derail the screen. The trick is to go easy and push out a bit while sliding. This plastic can be removed but at times the screen will vibrate annoyingly. The second window issue has to do with overloading the gutter tracks weep holes with heavy seas or boat wash hose. This will cause some dripping inside, typically aft. There is no great fix for this. If we increase the height of the inside track, then the screens can’t be removed for cleaning.
- **Engine Raw water Strainer.** This device protects the engine from seaweed and such getting into the engines cooling system. It’s accessed from the Starboard aft engine hatch. Common problems are; A. Owners pull the top off before they turn off the ball valve = wet bilge and lots of excitement. They reinstall the strainer upside down (cone Up) letting debris flow past the mesh without cleaning. The Strainer goes cone down, fitting over the cone at the bottom of the strainer, snug with no slip from side to side. The last area to be careful is with the square O-ring gasket at the top. It is greased with silicone to make assembly easy but it must be pressed in to the gutter all the way around before you push the clear cap back in place and snug the wing nut back on. Note: the wing nut does not have a gasket or O-ring, it fits tight against a machine surface. The VERY IMPORTANT to RE – Open the Ball Valve. Running the engine for even 2 minutes with the valve closed damages the raw water pump (I did this one day).
- **Garmin Electronics.** For set-up instructions, see your Garmin Manual. If you electronics aren’t working, it could be a loose plug, the fuse or breaker is off, it’s a faulty unit, or it may need an update. You can find updates on the Garmin website, or call their service # for further assistance:  
**1-800-800-1020**



## Trouble-shooting Guide for DC Thrusters

Post 2005 thrusters  
with IPC control system



Please read over the owners manuals and familiarize yourself with the product. There is a trouble-shooting section in each manual. This guide is meant to be a supplement to these providing illustrated instructions for more detailed trouble-shooting.

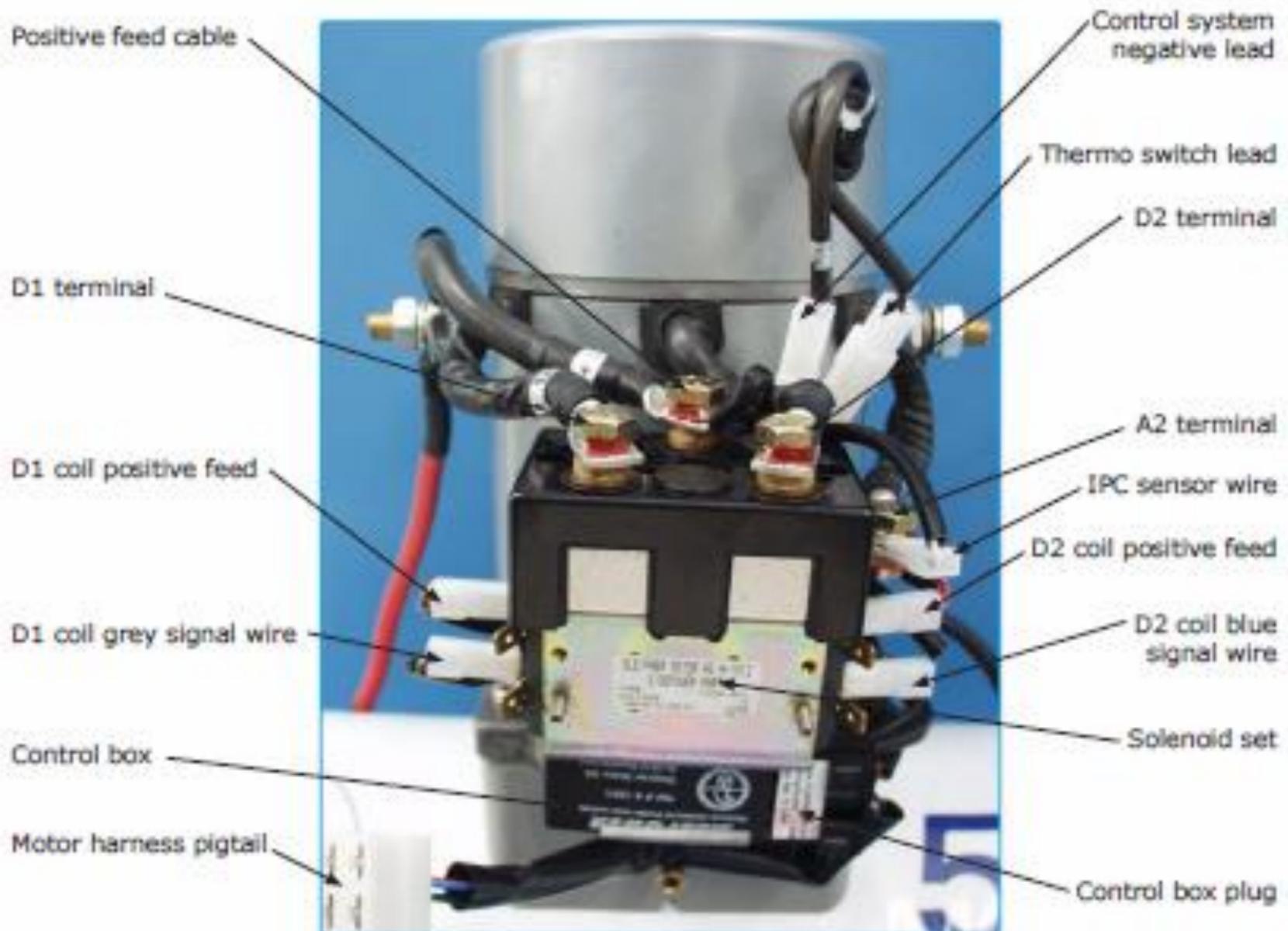
**Note: This guide is intended for Thrusters utilizing SIDE-POWER "Plug and Play" wiring only, and not intended for thrusters utilizing SIDE-POWER's Auto-Main Switch or SIDE-POWER's voltage conversion box.**

### Recommended Tools for Trouble-shooting:

- Metric Allen Wrenches, 4mm to 12 mm
- Metric wrenches or sockets
- Needle Nose Vise-Grips  
(for holding jam nuts when removing battery cables from motor)
- Phillips head screwdriver
- Small jumper wire  
(with male quick disconnect terminals if available, Fig. A)
- 12" jumper wire with alligator clips
- Multi-meter (with alligator clips if available)



## Identifying thruster parts



## If Control Panel does not turn on.

(Light between two On buttons does not light)

### 1. Check battery power.

- The control panel is powered through the bow thruster. The thruster is usually on its own circuit, meaning the positive and negative battery cables run directly between the thruster and the battery. A fuse should be installed on the positive cable within 72" of the battery, check that it is not blown. A battery switch is usually installed in close proximity to the fuse and battery, check that the battery switch is turned on.



Control panel on

### 2. Check voltage at the thruster.

- You should read battery voltage at the thruster. If there is no voltage at the thruster there is a problem with the power supply, check the battery, fuse, switch, or cabling.

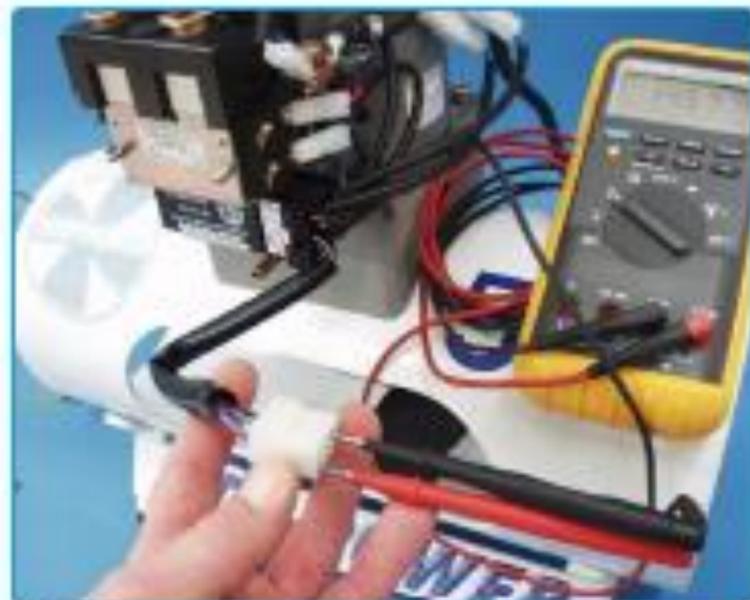


Checking voltage at thruster

### 3. Check for voltage on the control harness pigtail on motor and at control panel.

- With multi-meter set to DC volts, check from red wire (positive) to black wire (negative) on motor wiring harness pigtail. If there is battery voltage at the thruster battery cables, but no voltage at the motor harness pigtail, then proceed to step 4.

If there is battery voltage on the motor control harness repeat step 3 on control harness at the control panel to ensure there is no fault with the control harness run. If there is battery voltage at control panel then there is a problem with the control panel. Please contact your local Side-Power distributor for service support.



Checking voltage on motor harness



#### 4. Check control system positive and negative.

- Check for voltage between the battery negative stud and red wire on motor harness pigtail.
- **If no voltage is present**, then check that all motor harness and control box plug connections are tight and in place. If the motor harness checks out, then there may be a problem with the control box. Please contact your local Side-Power distributor for service support.



Checking voltage on motor harness to battery negative stud

- **If voltage is present**, locate the control system negative lead and unplug it from the motor harness. With multi-meter set on ohm ( $\Omega$ ), check for continuity between the control system negative lead and the A1 battery negative stud. There should be continuity; ohms will go close to 0 (usually about  $0.2\Omega$ - $0.5\Omega$ ).

- **If there is no continuity** between the control system negative lead and battery negative stud, then please contact your local Side-Power distributor for service support

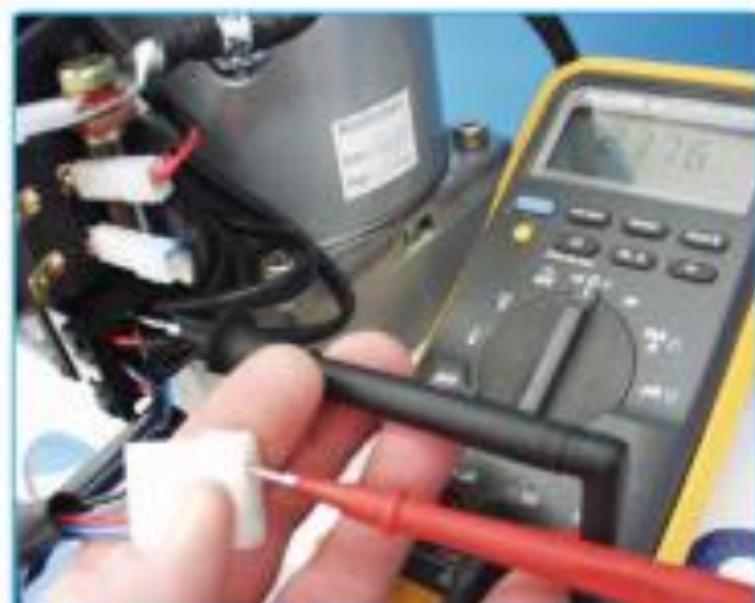


Checking continuity between negative lead and battery negative post

- **If there is continuity** between negative lead and battery negative stud, reconnect control system ground lead to motor harness, then check for continuity between the black wire on the motor harness pigtail and battery negative stud. Set the multi-meter on diode-test position, showing about 0.5V-0.7V. (A diode is fitted on the black wire).

**Note:** Be sure to have Positive lead connected to motor pigtail and negative lead to control box plug!

If there is no continuity between these two points than the motor harness has been damaged



Checking continuity between black in motor pigtail and control box plug

## If control panel does turn on but thruster does not run, or thruster runs in one direction only.

**NOTE:** The preceding tests are to be performed while the boat is in the water. Please contact your local Side-Power distributor for service support if you have any questions.

### 1. Bypass control panel and check thruster control box and solenoid operation.

- Remove control panel and unplug wiring harness or unplug control harness from motor harness pigtail, whichever is more convenient. On the four wire Amp connector (wiring harness if disconnected at control panel or motor pigtail if disconnected at motor), with short jumper wire, jump from red to blue for starboard run, and red to grey for port run.

**NOTE:** Be careful not to jump red to black as this will permanently damage the control box

- If thruster runs in both directions when jumping red to blue and red to grey on the motor harness pigtail, repeat this test on the control panels harness at the control panel. If the thruster runs then the control panel is likely damaged.
- If thruster does not run, or runs in only one direction, at the control panel, but runs in both directions at the motor harness pigtail, then the harness or terminals are damaged.

**NOTE:** Be sure that all control panels in the system are unplugged when doing this test!

- If thruster does not run, proceed to step 2.

### 2. Bypass thruster control box and check thruster solenoid operation.

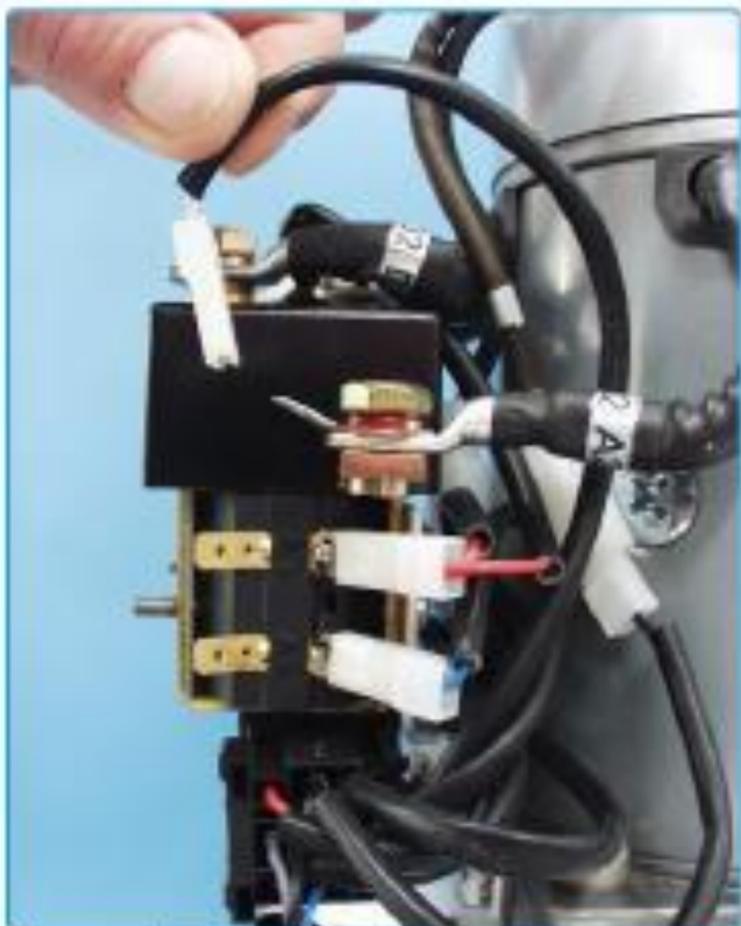
- Disconnect the white IPC sensor wire on the A2 terminal.



Jumping red to blue on motor pigtail



Jumping red to grey on motor pigtail



Disconnecting white IPC sensor wire

With long jumper wire, jump from negative battery stud to D1 coil grey signal wire for port run, and to D2 coil blue signal wire for starboard run.

- **If thruster runs properly,** proceed to step 3.
- **If thruster does not run,** proceed to step 4

### 3. Checking the thermo switch.

- Locate the thermo switch lead and unplug it from the motor harness. With multi-meter set on ohm ( $\Omega$ ), check for continuity between the thermo switch lead and the battery negative stud. There should be continuity; ohms will go close to 0 (usually about  $0.2\Omega$  -  $0.5\Omega$ ).
  - **If there is no continuity** between thermo switch lead and A1 battery negative stud, then either the thermo switch needs to be replaced or the A1 battery negative stud has been damaged internally. Verify that the A1 Battery negative stud is OK by checking for continuity between A1 and A2. If there is continuity then the A1 battery negative stud is OK.
  - **If there is continuity** between thermo switch lead and battery negative stud then there is a problem with the control box or the motor wiring harness. Please contact your local Side-Power distributor for service support.



Jumping ground to grey on D1 coil



Jumping ground to blue on D2 coil

### 4. Check for solenoid output.

- With jumper wire still attached and IPC wire detached from step 2, check for voltage on the A2 terminal.
  - **If no voltage is present** on A2 terminal then the solenoid pack may need to be replaced. Please contact your local Side-Power distributor for service support.
  - **If voltage is present** on A2 terminal then the motor may be damaged. Please contact Your local Side-Power distributor for service support.



Checking voltage on A2 with ground to blue jumper attached and IPC wire disconnected.

## 5. Check the operating voltage

- Once the thruster is operating properly, check the voltage between the battery positive post and the battery negative post while the thruster is running. The voltage will drop initially and then should level off after approximately 5-10 seconds.

The voltage should be no lower than 9.5 for a 12 volt thruster and 19 volts for a 24 volt thruster after the voltage has stabilized.

If the voltage does not stabilize and continues to drop below 9.5 or stabilizes below 9.5 for 12 volt thrusters (19 volts for 24 volt thrusters), then the battery source needs to be checked to ensure the amp capacity is sufficient to run the thruster or the cable run needs to be checked for voltage drop. Please contact your local Side-Power distributor for service support if you have low operating voltage.

## Distributors

### Argentina

Titner SA  
Buenos Aires  
Tel: +54 11 4580 0444  
Fax: +54 11 4580 0440  
www.titner.com.ar  
titner@titner.com.ar

### Australia

AMI Sales  
Parramatta, NSW  
Tel: +61 89 331 0000  
Fax: +61 89 314 3629  
ami@amisales.com.au

### Austria

G. Acherl GmbH  
Hard, Ingeratz  
Tel: +43 5274 09000  
Fax: +43 5274 0900-10  
www.acherl.at  
office@acherl.at

### Brazil

ASA Boat Electro  
Vitoria, Bahia  
Tel: +55 20 436 9100  
Fax: +55 20 436 9108  
www.asaboatelectro.br  
info@asaboatelectro.br

### Brazil

Electra Service Ltda.  
Guaraja  
Tel: +55 12 3354 3599  
Fax: +55 12 3354 3471  
www.electraservice.br.com  
aberton@electraservice.com.br

### Bulgaria

Yachting BG  
Burgas  
Tel: +359 56 919030  
Fax: +359 56 919031  
www.yachting.bg  
info@yachting.bg

### Canada

Intra Corporation  
New Bedford, MA  
Tel: +1 508 995 7000  
Fax: +1 508 995 5259  
www.intra.com  
side-power@intra.com

### China/Hong Kong

Storm Force Marine Ltd.  
Wanchai, Hong Kong  
Tel: +852 2868 0114  
Fax: +852 2868 9050  
www.stormforcemarine.com  
sales@stormforcemarine.com

### Croatia

Yacht Supplier  
Zadar  
Tel: +385 51 704 500  
Fax: +385 51 704 500  
sxy@net.hr

### Cyprus

Ocean Marine Equipment Ltd  
Limassol  
Tel: +357 253 69721  
Fax: +357 253 52678  
oceanm@oceanmet.com.cy

### Denmark

Gertsen & Olesen A/S  
Horsholm  
Tel: +45 4576 3600  
Fax: +45 4576 1772  
www.gertsen-olesen.dk  
info@gertsen-olesen.dk

### Estonia/Latvia/Lithuania

Intec Systems OÜ  
Tallin  
Tel: +372 5013667  
Fax: +372 5440211  
www.intec.ee  
tony@intec.ee

### Finland

Nautekuma OY  
Turku  
Tel: +358 2 2500 494  
Fax: +358 2 2518 472  
www.nautekuma.fi  
nautekuma@nautekuma.fi

### France

Kent Marine Equipment  
Nantes  
Tel: +33 240 921 584  
Fax: +33 240 921 318  
www.kent-marine.com  
contact@kent-marine.com

### Germany

Jahres GmbH  
Norderstedt  
Tel: +49 40 525 373-0  
Fax: +49 40 525 373-11

### Greece

Anathra Marine  
Athens  
Tel: +30 210 2588 885  
Fax: +30 210 2588 880  
www.anathramarine.com  
anathra@otenet.gr

### Italy

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# WINTERIZING YOUR BOAT

- 1) Drain water tanks, Port & Starboard: Flip on DC breakers. Then push toggle switch for water pump switch (**Left** = port tank, **Right** = starboard tank) and open faucets.
- 2) Hot Water Heater Drain: Flip open the hot water tank drain and drain to bilge, then turn on bilge pump to empty over.
- 3) Put 2–3 gallons of RV antifreeze in each water tank. You will need a funnel with hose attached to get this into the water tank fill as they are horizontal. Then run each pump till red comes out at all faucets.
- 4) Engine; Remove raw water feed hose from the strainer, drop it into the bilge and drain. Re-attach/re-seal for the spring. (**Only done on boats being stored out of water**)
- 5) Pump bilges dry and then vacuum the remaining.
- 6) Pump head out then pour in 1 gallon RV antifreeze until it touch's pump motor. The Head salt water in-feed line will drain when the boat comes out of the water. Run most of it into the waist tank leaving 2" in the bowl and hose. Open the ball valve on the raw water wash down pump so it can also drain out; freezing water in any of the pumps will damage them. Check/drain macerator pump. (**If boat is kept in the water, you need to drain the raw water pick-up manually**)
- 7) Turn off batteries. Coat the battery terminals with Boeshield.
- 8) Wash Motor with fresh water to spray off any salt. Once dry, coat any metal parts with Boeshield, NOT the belts or rubber/plastic parts.
- 9) Add Fleetguard Microbiocide to both Fuel Tanks; an anti-fungal stabilizer per Volvo recommendation.
- 10) Put in some type of heat or dehumidifier. We like a 1500 water boat heater (West Marine \$69), set to 400 watts or 600 watts on a thermostat so it keeps the boat about 50 degrees. This will keep the boat dry and not smelling old. Open all doors and compartments for air flow, even under the bed – both compartments.

# VOLVO D3 & D6 DETAILS

## *Notes from Larry Graf*

*As many of you know, we typically share details about our experience with the various engines and what our owners are seeing when they get serviced. The Volvo 220, in general, has been very reliable with few issues at all. But now that we have some owners with 500 to 1100 hrs., the experience base is getting large enough to show potential problem areas. Here is what we've seen so far in the last 3 years with approximately 24 boats in use.*

### **Fuel Injectors**

Each engine has 5 Bosch injectors. So far we've had two boats, out of 24, where they were changed. One boat had them changed twice; first time at 200 Hrs. and second time this spring at 1,000 hrs. The other boat had them changed early in its life at approximately 150 Hrs. The symptoms were poor idle at start up, some heavy smoke and a little oil in the water while cold. Also, the fuel economy is reduced when an injector is no longer working properly. The injectors are not re-buildable and cost \$850 each plus several hrs. to change.

Why injectors fail is a little bit of a mystery. Dirt/sludge seems to be the most often sighted cause, followed by water drops passing through and even small air bubbles. The other common problem has to do with the EPA changing the fuel mix to a low sulfur mix which has less lubricating qualities than earlier fuels. The injectors and the high-pressure fuel pumps with many small, very high precision parts that move very fast to adjust the fuel mixture during the engines explosion cycle, must run just right and do so hundreds of times per minute.

Things to review and do to help your injectors life:

Check your Racor filters clear bowl for dirt, sediment and water monthly. Drain bowl and replace filter if you have debris.

Add a Fuel Additive to each tank of fuel. Volvo recommends and approves Stanadyne lubricating cleaner (available at Fisheries Supply – Item ID# STY 38560P). Personally, on my diesel truck, I've used 1 Qtr. of automotive ATF type F (automatic transmission fluid per 25–35 gallons) for the last 3 years and 230,000 miles. It's a good cleaner (full of detergents) and lubricant and not too expensive (I buy the base \$4–5 per Qtr. **ATF type F fluid**). My friends with the same truck, not using a fuel treatment, have had to replace their injectors at 100K to 120K. But its officially not "approved" and may not meet EPA requirements. I found out about using ATF fluid from a trucker friend and recently asked the owner of a brand new Peterbuilt who was hauling a C120 to Florida what he used, "ATF-type F every 50 gallons". A third option is Shell Rotella DFT (Diesel Fuel Treatment) available at many truck stops.

While the engine is at cruise speed, check the fuel filters clear bowl for air bubbles. A few very fine bubbles is normal but if you're seeing lots of air, some mechanics feel this can cause premature injector wear. The air may be from a loose hose connection in the fuel system or possibly obstructions in the fuel system.

### **Water Pumps**

The Volvo water pump itself seems to be a very robust design. The bearings are larger than others we've used and the pump impellers we've changed at 150–200 hrs. have been in fairly good shape. Like any impeller, running them dry makes them fail in a minute or less at cruise speed. The pump housings we have replaced at 500 hrs. still look OK but there is no way to tell if they would have kept running and our owners did not want to take the risk. The pumps pulley is metal and have been 100% reliable so far. On another company's engine, they use a plastic pulley that failed at times.

# VOLVO D3 & D6 DETAILS

## *Continued notes from Larry Graf*

### **Raw Water Intake Hose Collapsing**

On two boats, so far, the 1 ½" factory installed hose that crosses over the aft right side of the engine, in route to the raw water pump, collapses at full throttle due to the raw water pumps vacuum. This limits the raw water flow, causing the engine temperature to climb unexpectedly. Temps typically run 178–185 degrees. At WOT (wide open throttle) with the hose collapsed, the temperature climbs to 190–200 degrees and the intercooler over heat warning typically comes on – it's raw water cooled and an early indicator of trouble. Slowing down to idle drops the vacuum and allows the hose to reshape and the engine, if not run at full throttle, works just fine again. If you've had this, Coastal in Seattle has the updated hoses in stock. Replacing it takes about 1 hr. The soft hoses that cause this were in production for only about 4 months, 2 years ago, so not many boats got them.

### **Loose Hose Clamps**

This is typically on a newer engine but there are quite a few hose connections on the 220 Volvo, and during our 50 Hr. service, we often find 1–2 that are not snug after the engines been warm. A loose clamp can cause a bad day and even spray your engine with salt water (corrosive). Depending on the clamp, you could end up with the engines very capable raw water pump (think mini fire hose) spraying and flooding the engine room. If you hear a very loud buzzing alarm from behind the dash, your high water 1700 GPH bilge pump has come on. It's time to stop, shut down the engine, and identify the problem. If this happens, it's very important to call us to get our detailed procedure on washing the engine clean of the salt, as well as the wire harness and plugs and turbo/turbo blanket. Not cleaning very thoroughly will cause you frustration down the road. One note on hose clamp tightness: Snug is good but trying to tighten them every week is a problem – cuts the hose.

### **Loose Ground Cables**

This has happened on 2 boats, so far, where the large ground cable that connects low on the engine, near the starter, has come loose. The symptom is typically intermittent starting or the engine stops mid-stream, you restart and all seems fine, then 2 hrs. later it stops again. Any loose battery cable connection can do this and this is why we locktight or use locking washers on all big cable connections.

### **Throttles Left in Weather Failing**

For those fishermen who opted for the outside throttles, we've had one owner who had to replace his electronic throttle unit (6 months out of warranty) due to corrosion. When this throttles not in use, it's a good idea to have a Sunbrella bag over it to protect it from the elements. The replacement part cost \$2,200 plus 2 hrs. labor.

### **Cables & Communications Bus**

On two boats we've had intermittent problems with the computers communicating with each other. The engine has three computers and each throttle is also smart. They communicate and check each other continuously over many, very precise, multi-wire cables and water proof plugs. The system is designed with many fail safe modes. If the communications don't check each time requested (happens many times per minute) the system shuts down and goes idle, or shuts the engine down completely. Re-setting the computers by turning off the engine, turning off the engine battery switch, and then turning everything back on, the system almost always runs fine again, often for days or weeks. It's very frustrating and because what it seems to be is in the wire harness itself, the computer's ability to self-diagnose is often wrong or gives erroneous error messages. This leads to a wild goose chase. Volvos Tech team has gotten a good handle on this problem over the last 6 months, but initially it was very difficult to figure out. The fix may involve replacing the engines harness and computers which means the engine is pulled for easy access (seems like a big deal but actually only about 2 hrs. or less each way on an Aspen 32).

# VOLVO D3 & D6 DETAILS

## *Continued notes from Larry Graf*

### **Muffler Crack**

On 2 boats, we've seen the Cyntec Muffler develop a hair line crack after use, just under where the exhaust hose connects. The symptom is a little puddle of water under the hose connection caused by a fine mist from the crack area when at cruise speed. We suspect it's one of two things; 1) A manufacturing flaw when the muffler was made or 2) Overtightening of the hose clamps just above the crack. Again, there is snug and tight with hose clamps. If you tighten a clamp into a rubber hose and then heat it, after heating the rubber will flow just slightly away from the clamp. If you retighten again, the same will occur again. We've seen some boats where tech's have tightened clamps over and over and the clamp has cut ½ way through the hose. So, snug is good but be thoughtful and keep an eye on your tech's in the field.

### **Fuel Water Sensor**

We've seen this on about 5 boats. The Volvo engine has a water sensor in the bottom of its engine mounted 2-micron fuel filter/ water separator. This sensor is connected to the engines warning computer system. It's a very specialized component that's very sensitive, and should its wire harness be interrupted in any way, it can fail on. Water in the fuel of a diesel engine is BAD. It can damage fuel pumps, injectors and even internal engine components. But with this sensor, in our experience, 7 out of 10 warnings seem to be false or at least the Racor pre-filter (30 Micron) we install with its vortex water separator bowl, shows no water or debris. Most often slowing down and re-setting the error code, the fault disappears, often for months. If it's a regular occurrence with the Racor bowl showing no clear fluid in the bottom (IE water), the Volvo sensor has probably gone bad (we suspect that once its seen water once it's likely to be intermittent after).

### **Dip Stick Oil Leak**

4 boats. Here what's happening. When checking the engine oil, the owner puts the dip stick back in, but forgets to push it down until it clicks-positive. The engine is a positive crank case pressure design, designed to meet EPA rules. If this dip stick is not seated, it will blow fume's and oil back up the dip stick. In heavy seas, we had one owner who pushed so much oil out the dip stick he had the low oil pressure warning alarm come on. Makes a BIG mess in the engine room. So, push down to the Click.

### **Melted Transmission Dip Stick**

Twice now, owners who try travelling with their dock lines attached / tied to rail mid ship, have the line fall into the water while underway. It is sucked into the prop (Very large Vacuum) and wraps around the prop stopping the motor abruptly. In both cases, it pulled the engine out of alignment and damaged (melted) the end of the shaft log. For one owner, they were not sure what happened and in a windy situation next to a piling breakwater, attempted to continue pushing hard with the shaft locked. This caused a great deal of friction and heat build-up in the transmission, IE melted the dip stick. It may need a new transmission.

Attached is a spread sheet with details and costs. It is important to remember all these problems did not happen to one owner this is everything we have EVER seen or had happen. But I think it's good to know what to keep an eye open for while your inspecting or operating your boat.

Best Regards and good times on the Water!

Larry Graf

# VOLVO 435 D6 SERVICE HISTORY

## *Notes from Larry Graf*

*Information is based upon experience with 4 boats over 2 years (updated as of November 18, 2016)*

ITEM	DESCRIPTION	DETAILS	NUMBER OF BOATS	ESTIMATED COST	FIX
A	ENGINE MOUNT BOLTS LOOSE	These are very large bolts – nuts top and bottom, they can rattle loose, the motor settles and alignment goes out and vibration begins.	2	\$200	Re-align, lock nuts with full sized wrench
B	SUPER CHARGER IDLER FELL OFF	New engine at start up after 1 hour, the bolt that holds the belt tensioner pulley failed – was loose. Belt is behind main accessory belt cam. Bolt went through that belt and made a mess – damaging both belts. Replacing Super Charger belt requires a special tensioner tool which we provide with each boat.	1	Warranty Super Charger #21405494 \$48	Replace both belts. Note: must be Volvo high grip belt (not a Napa belt). Note: belt routing is very hard. Use photo is owners manual or take a few with yours early on.
C	ALTERNATOR BELT SLIPS/SQUEAKS	Belt routing wrong or a non Volvo low slip belt was used. Can be caused by having battery switches set disabling 210amp accessory alternator forcing all house/thruster loads to engine 110amp alternator belts heat and fail.	2	\$75 + \$40 #21405493	Note: when replacing the belt, the crank pulley has one extra groove; it should be showing toward the stern of the boat, or belt will pop off. See photo for belt routing; it's complex.
D	BALMAR 210 AMP ALTERNATOR	We've had 2 issues with these units: 1) the bracket came loose; best to locktight and reinstall bolts. 2) the controller fuse failed; it's located under the remote charge controller on hull side, near alternator. The RED alternator on the engine is the 210amp unit.	2		*Locktight fasteners *Replace fuse * Re-program charge parameters to delay and slow ramp up of load
E	WATER IN FUEL WARNING	The Volvo D6 on board fuel filter has a water sensor at the bottom. It's a very fine coil of wire that senses water molecules that can gather at the bottom of the filter. Many of the activations are false; no debris or water was in the Racor filter assembly, the first area it should collect and be visible. This water sensor is very sensitive.	1	Warranty \$90+\$80 #21718912	Owners go through reset and clear error often gone for months. If it repeats, we can replace the filter and the sensor. If you do get dirt/water in filter, it will let you know. 2 Micron Volvo fuel filter
F	WATER PUMP IMPELLER/PUMP	These wear out, normally about 200–250 hours. We have seen them go in 100 hours or less if the intake gets plugged, even for 1 minute. Never use Sierra aftermarket impeller = poor synthetic rubber.	1	\$910+\$160 #21380890 #3593573	Replace, full pump at 500 hours. Replace impeller every 100–150 hours.
G	CRANKCASE FILTER PLUGS	The filter is part of the breather system and can get plugged with soot/dirt if it does the engine will spit oil – typically out the intercooler drain	0	\$140+\$40	Replace annually or 150–200 hours or at each oil change.

ITEM	DESCRIPTION	DETAILS	NUMBER OF BOATS	ESTIMATED COST	FIX
H	ENGINE AIR CLEANER DIRTY	Low power	1	\$90 + \$40	Typically replace bi-annually
I	ELECTRONICS THROTTLES EXTERIOR	Electronic Throttle units left uncovered out in salty environment failed after 2 years; gave all kinds of error messages.	0	\$2,400 + \$180	Replaced part, made canvas cover to protect when not in use
J	FUEL INJECTORS PLUG	Motor runs poor, lumpy, worst at idle. Add Stanadyne fuel treatment to each tank of fuel, lubricates, and cleans. I use ATF fluid on my diesel truck; 1 quart per 25 gallons lubes and cleans. Add just before each fill up. My last truck had 250,000 miles.	0	\$22	Use Fuel Treatment Stanadyne Diesel fuel additive lubricity formula
K	FUEL INJECTORS FAIL	Typically from lack of lubrication due to new EPA diesel fuel requirements and soot build up. Boats with dirty or bad injectors can have unburned fuel in water at startup; extra smoke at start up and be slow to start. If they don't seal well, the fuel pressure leaks down while at rest. Take time to re-pressurize.	0	\$895 + \$200	Per Injector (expensive vs. ATF fluid or Stanadyne Fuel Treatment)
L	RAN OUT OF FUEL - PRIMING	One owner got mixed up in his fuel switches and ran one tank empty, then needed to switch to the tank with fuel with the selector switch at the dash. Open the engine hatch. On top right, there's a primer button about 1.5 inches in diameter. When pushed, it springs down about ½ inch. It's a small pump so will take several minutes to pump fuel in and build pressure. Once hard, crank the engine; it will sputter. Then pump hard again. Repeat until she starts. There is also a bleeder port next to the pump but most owners don't use it.	1	Time feelings	Typically takes 20-30 minutes to get going again. May need to put anchor down.
M	LONG-TERM SERVICE ITEMS TO WATCH	<ol style="list-style-type: none"> <li>1. Water Pump Impellers</li> <li>2. Accessory/Fan Belts</li> <li>3. Trans Oil cooler replacement (or inspection) for corrosion</li> <li>4. Fuel treatment for injector cleaning</li> <li>5. Raw water pump replacement - complete unit (bearings can go out)</li> </ol>	Hours: <ol style="list-style-type: none"> <li>1. 150</li> <li>2. 500</li> <li>3. 4-5 yrs.</li> <li>4. Fill ups</li> <li>5. 500</li> </ol>	Cost: <ol style="list-style-type: none"> <li>1. \$200</li> <li>2. \$150</li> <li>3. \$695</li> <li>5. \$1100</li> </ol>	Typically grows white crystals on ends.

# PETTIT HYDROCOAT PROCEDURES

## *Notes from Larry Graf*

Notes as of November 18, 2016:

Washington State law will eliminate copper bottom paint next year (2017). We began testing copper free paint last year (2015).

*These are notes from a discussion with Rachael Cartwright of Pettit paints after our one-year test of Rich Pettit's C100 (no relation) using the new Hydrocoat ECO water based copper free bottom paint. The active ingredients are 6% Ecomea (a Biocide by Jansen Pharmaceuticals) and 2% Zinc, similar to the zinc in shampoos. The balance is binders and adhesives that slowly degrade, allowing the paint to sluff and resurface.*

**Results:** After 12 months: The boat came out of the water extremely clean, almost no slime, NO barnacles on the hull anywhere, even where the paint had sluffed off one section 6"x18". The hull was clean, the biocide around the area missing the paint seems to have kept the paint free area clean. The trim tabs, actuators and rudder coated with Prop Gold did have growth. They face the sun and has had more growth than most boats with Prop Gold have, so his marinas got the critters, yet his bottom was VERY CLEAN. The Zincs were in unusually good condition, 80% still there except for the keel sand bar Zinc.

**Problems:** On the port side, the paint had mini bubbles in about 25% of the surface in a sweeping, almost rag stroke, pattern. We suspect that we wiped the old Interlux Ultra with 216 solvent before coating with Hydrocoat (standard procedure for Interlux paints) and that may not have fully evaporated prior to recoating or that it affected the Interlux surface. It's also possible that the surface was not scuffed as aggressively in the areas that bubbled. The bubbles were about 1/8<sup>th</sup> inch to 3/16<sup>th</sup> inch in diameter, approximately 200 on the port side only. They did have water inside.

**Plan Forward:** Pettit will supply 2 more gallons of Hydrocoat ECO. We will remove the bottom paint, then re-prepare the port side area where the bubbles occurred, being careful to follow application procedure. We need to get this system figured out. Washington State, starting in January 2017, is implementing "no copper based paints" allowed on new builds. Starting in January 2018, no re-coats are allowed with copper based paints.

**Details:** The process of repainting an ablative paint has some risks. As the paint ages, the adhesive has to dissolve just slightly slowly so the outside layer can ablate and self-clean over time. The actual glue holding things together degrades and goes away and the paint flakes off, taking anything on top away with it; IE, possibly the new paint. It happens when the paint dries after pulling it out of the water. We've had this on two boats this year, both 4-5 years old. It's frustrating and an exceptionally labor intensive process to get the hull back to gel coat to restart the process. One boat took over 80 man hrs. to clean, sand and recoat. The old paint is a bit like sanding tar; uses lots of pads and goes slow. Soda blasting is faster but you must be careful to not damage the gel coat. Rachael w/ Pettit also recommended we try coating the metal parts and Tab cylinders' w ECO Hydro Coat after priming with 1792 Barnacle Barrier primer. I was concerned about how well the paint would hold on the prop considering the volume of water passing by and positive and negative pressures working on it. While swimming on each boat on this year's trip up north in Princess Louisa, I checked this application after approximately 20 hrs. and the paint on the prop was 95% intact and the other metal parts were 100% as it had left the shop. The boat had no barnacle starts anywhere. Conversely on Gateway 5, which had been pressure washed 9 days prior but not repainted this year, there were 8-10 1/2" tall barnacles already - they do grow fast.

# PETTIT HYDROCOAT PROCEDURES

## *Continued notes from Larry Graf*

### **ECO Application Procedure:** Hull over Interlux Paint

- Clean/wash all growth off
- Light Sand/scuff w 60 grit – remove any loose paint and feather in chipped edges.
- Wash with WATER – Do Not use solvent to clean
- Re-coat with ECO Hydrocoat using 3/16<sup>th</sup> nap roller, Tip as you go with foam brush for smooth surface. It's OK to thin with water if needed. You do not want the paint thick, it causes problems.
- Let Dry 3 Hrs.; fans are OK to speed up drying
- Do 2<sup>nd</sup> coat every where
- Let Dry 3 hrs.
- Bow leading edge and Water line outside down 8", do 3<sup>rd</sup> coat tipping as you go
- Let dry 24 hrs., min 12 hrs., before splashing. Maybe sooner if fan dried.
- It's OK to put only Hydrocoat over transducer (none Copper)

### **Application Procedure:** Recoating Over Hydrocoat:

- Same as above but only Scuff with Scotch bright pad after cleaning
- Then Wash with water and re-coat.

### **Metal parts Coating:** Using Eco Hydro Coat to replace Prop Gold (It's copper free so it can be used with Bronze and stainless metal parts with no electrolysis damage).

- Clean Metal well. Scotch bright pad is OK to use, you want it very clean.
- Wash/wipe with Acetone.
- Coat with 1792 Barnacle Barrier (rattle can). It's a Primer for the ECO to be painted over.
- Coat Metal with Hydro Coat Eco (No Copper). It's OK to put in a Prevail sprayer. It works if you remove the screen at the bottom for trim tabs and detail parts.
- Let Dry 3 Hrs. – using fans to help dry is OK
- Re-coat, then Let Dry 12 Hrs. +

# THRUSTER LOGIC & STRATEGY

## *Notes from Larry Graf*

Notes as of November 18, 2016:

Bow and Stern Thrusters are wonderful assets while docking. They take 95% of the worry out of docking for most owners, allowing precise positioning. There are, however, some details to understand about the underlying engineering and physics of electric thrusters.

The units range in horse power from 2.5 Hp. on a 32' er to 7 Hp on a 40' er. Most owners don't realize that electric motors of this size draw from **280 amps to 580 amps at 12volts** (a huge load). They work just great if used for a minute or less during each docking – typically 5–10 second bursts six to 10 times to reposition the angle of the boat.

**Thrusters should be 10–15% of your docking strategy**, basically used to fine tune your main positioning done with the rudder and engine in gear (fwd. or reverse) at idle. Many owners make a game of seeing how often they can dock with no thrusters at all.

Other owners attempt to use their thrusters as 90% of their docking strategy. Getting within 50 feet of the dock and then beginning to thruster all the way to the dock against wind and current. Even at times using both bow and stern thrusters at the same time (= 870 amps on a 40' er). This type of docking is problematic; first it puts a huge instant drain on the battery bank basically ripping large chunks of battery power from the battery's which can heat and damage the battery bank. Next, the motors are basically marinized heavy duty truck starter motors designed for high output but short period of use. If you run them too much, they heat up and eventually shut down from a thermal protective breaker. If you do this regularly the windings in the motor or controller melt and you have a \$2–3K motor to replace. The other problem with getting to the thermal breaker is you then have no thrusters what-so ever for 20–30 minutes until it cools down.

To give you a comparative feel for battery loads, the refrigerator on a 32 Aspen on average uses 4 amps, the house lights use 5 amps if all are on, so 530 amps is a lot of power.

Several owners have asked about **installing more battery's** so they can thruster longer, one even did this. There are several issues with this; first is you still get to the thruster over heat thermal switch, then it's a question of where you put them. The one owner who did put two more Golf Cart batteries did it in front of the current house battery bank. It was an easy install but he then had no access under the floor boards to service or inspect his pumps, shaft seal or shaft grounding brush. Pulling the battery's each time he needed to inspect was not friendly. The next issue is weight and balance; each of these batteries weighs 75 pounds so 150 pounds' and does make the boat list a bit. In the end, this owner pulled the extra batteries back out.

One owner asked about having a **dedicated battery bank** just for thrusters so his house loads could be separate from his thruster loads. He was having issues with the Garmin low voltage alarm going on while thrusting. The first thing to check is the low voltage alarm set point on the Garmin unit. Some were set to 12.5 volts which means if you thruster at all it comes on. I recommend resting it to 10.7 volts, this is above the 10 volts needed for the Garmin units but low enough that during typical docking, the alarm will not go off. My strategy while designing the house battery bank was to size it first for typical thruster docking while still having sufficient capacity to overnight easily without being plugged in. I did assume we'd get 5 amps of Solar Charging while anchored for six hrs. each day. Most owners find they have more than enough power to anchor for 2–3 days during the summer.

One last area that owners have noticed is that their initial thrusting (first minute) is very powerful then they notice a **distinct drop in thruster power**. This stems from the **VSR (voltage sensitive relay)** that typically ties the house and start battery banks together. At the beginning of thrusting, both battery banks are full but after about a minute, the thrusters have pulled enough power out of the combined battery bank to hit the separation voltage on the start battery. From this point on the thrusters are only drawing from the house bank. Once thrusting has stopped, the VSR will typically re-latch the house and start battery's together within 5 minutes. This is the source to recharge the house bank while underway. The other two house bank charge sources are the battery charger or inverter or the solar panels. The reason we install a VSR is so that no matter what loads are being pulled from the house bank the engine always has a dedicated battery for starting. Note: you can disable this protection if you switch the EMERGENCY parallel switch on (not a good idea).

Owners also wonder about the capacity of their house battery banks. When full the C100 32' er has

- C100 Two Golf Cart battery's GC2 group size combined capacity 115 amp hrs. (60 Minutes)
- C120 Four Golf Cart battery's GC2 AGM DC224–6 + 1 ea. G27 Combined 336 Amp Hrs.

# TOILET LOGIC: DETAILS & MAGIC

## *Notes from Larry Graf*

### Notes as of November 18, 2016:

Marine toilets are mission critical components in cruising but also one of the most problem prone areas for new owners. The goal is reliability and little or no smell while in use or storage. Our toilets are premium Dometic units with a very powerful macerator pump to blend debris into liquid making it easy to move into and out of the holding tank. The hose we use is Trident Marine triple wall premium hose that feeds into a double thick polyethylene holding tank. The triple wall hose and double thick holding tank (1/4") are to eliminate smells, wicking into to living spaces. The holding tank is vented overboard with a 5/8" fuel hose on our 32s and 3/4" on 40s. This vent being open and able to breath is critical to limit smells.

In use starting with an empty tank you add typically 1 Cup of Thetford biodegradable liquid holding tank treatment. We find this effective as both a detergent to keep the tank clean over the years and as a very good odor suppressant. Once the treated and before use its important to run 2-3 gallons of water into the head so the bottom of the tank starts with a wet surface. Not doing this can lead to a solids layer developing in the bottom of the tank especially in warm weather.

**Now it's ready to use**, do what every comes to mind, but do use RV or Marine toilet paper in a limited way no huge balls. This type of paper dissolves very fast when wet and never coagulates on the bottom of the tank. When flushing you will need to run the pump in the dual position "water in waste out at the same time" for about 5 seconds after bowl clears debris. This gets to the waste down the hose and clear of the pumps valves and such. **Prior to big jobs** It's a good idea to push the switch that add just water to the bowl to fill 2" of water or so in the bowl so you don't get stickies on the bowl. After you flush be sure to leave the opening in the bottom covered with water to seal out any fumes. Watch the gauges as you go, I typically pump every 2 days while out at the 1/2 to 3/4 full point, I like to get rid of this stuff often while it's very liquid and before it ferments. Pumping regularly and especially when you get back from a trip and before the boat sits idle for more than a day or two allows you to empty the tank before the solids can settle to the bottom of the tank. If they settle this sludge can over time and in warm weather start a biochemical reaction that has a horrific phosphorus odor that's very bad, especially when the toilet is flushed pushing new liquid in and pushing old air out of the tank. Your neighbors will notice this smell! Another reason to pump often is if you unexpectedly get full and then continue to pump debris in, it overflows out the tanks vent line (Bad Smell) and often plugs this line. If you have plugged the vent typically as you try to flush things away never to return. They do return the over time- you flush again and darn they return again. The tank is working like a spring. If this happens be sure the tanks empty (look at it if possible) then with a fresh water garden hose 40-80 psi back flush through the vent fitting back into the tank.

# TOILET LOGIC: DETAILS & MAGIC

## *Continued notes from Larry Graf*

**Note:** Be positive you are back flushing the waste tank vent and not a fuel tank vent, run the macerator pump and listening to the vent often helps identify which vent is waste or follow the vent hose up to the hull side fitting. You do not want water in your fuel.

**To empty the holding tank,** you have two options; first is to drive over to the marine pump-out station at your marina pull the waste cap (deck trail 40s or cockpit entry 32s) and suck it out. The second option is while offshore away from harbors to activate the macerator pump out switch at the dash. On 40s Both port and starboard can be activated at the same time. The gauges will drop but typically when the gauges hit empty the tanks will continue to pump for an additional 2-3 minutes as the tank sensor doesn't reach the bottom of the tank. Its best on the 40s to do this while at trolling speed, on the 32 and 28s this pumping can be done at speed.

Here's a list of things never to put in your Toilet.

- Diaper Wipes – instant Plug – locks macerator motor – pops fuse
- Feminine Products – will try to eat first 2 but by third and more they plug up hose to tank
- Nuts not chewed – plugs valves – can allow back flow of black water to bowl – bad smell
- Chlorine Bleach – damages rubber parts
- Comet – has Chlorine (limited occasional use OK)
- Seeds– Bones – Jamb macerator
- Home type toilet paper premium brands are worst (thicker)

### **Leaving The boat more than 2 Days**

On our 32s the heads always run on raw water (IE Salt Water). To conserve the fresh water on 40s the boat is pre plumbed so an owner can switch to fresh if he feels he has enough for both domestic and head use. Saltwater is just fine for heads if you understand a few things and follow the shutdown procedure noted bellow, I feel it's sort of a waste of fresh water to wash it down the toilet. Because Salt water is full of microbes (little critters) when you leave the boat and leave saltwater in the toilet bowl the critters first love it and multiply in the warm water. Then they die and then ferment and smell BIG BAD. When you come back to the boat it smells and takes 2-3 hrs. to clear out.

However just a little pre-boat departure procedure can eliminate this. Take the fresh water sink wand stretch it over to the bowel and put in 3-4" of water and flush it out using the flush down only button (no saltwater) then refill 2" more and let it sit. You're done, no smells no salt build up in the waste hoses. In the winter I put RV anti-freeze in the bowl and Thetford treatment in the empty tank with a little RV antifreeze. A second very common fix for the critters is to put a ¼ cup of White vinegar in the bowl before you leave kills the critters – no smell.

### **Coast Guard Inspections**

The Coast guard inspectors are required to see your Y valve is locked in the (waste in Tank Position). Aspen's don't have a Y valve as most boat owners don't position it correctly and things get plugged in the valve. In our design all the waste always goes into the holding tank, you have no way to pump directly from the head to the ocean. Once the waste is in the holding tank you have two options to clear it out. First is the deck waste fitting and a pump out station. Second is the boats macerator diaphragm pump which is controlled by the hold on switch at the dash. Since it only works when you physically hold it on, it meets the requirement. This will take a little bit for the guys to understand. The concept that the tank has two dip tubes down into the waste is unusual.

### **Transom Deck Vent**

This vent fitting being clear is critical to no or limited holding tank fumes. We install it on the transom to keep spray flowing past the hull side from entering the vent. However, because this surface is sloped fwd. if you do overflow your holding tank by accident clearing the debris and vent requires you to unclamp the hose from the fitting wash out the debris and clear the water from the low spot just under the hose connection. The shape of the vent component creates a catch for water and waste once its capped with liquid, the tanks wont vent like new and the aggressive fermentation process begins. One other very important detail is to make sure the screens have been pulled on the waste tank vent. This part is used on all types of tanks many need the screens but for waste vents they are typically pulled out at our factory. The screens plug with this type of fluid and they also can plug from buffing compound/fuzz during annual detailing = bad.

**DOES YOUR BOAT HAVE A HEAD?** Yeah? More than one? Yeah? That many? How much fun is that? Really? That doesn't sound like much fun at all. You know, you could have potentially avoided that scenario, if you'd spent some time on the, shall we say, pre-digestive end of things, taking care of the common problems and planning for a better-ventilated, better-smelling head compartment. Learn from our primer how to get your head checked — and take care of your boat's toilet and its attendant odors, too.

## ● Common Issues

Any number of things can go wrong in a marine head, but if you know the most common issues and how to deal with them, you improve your chances of being in the pink (instead of some other color).

### 1 | CLOGS.

Compared to their terrestrial brethren, marine toilets use very little water during flushing, which is one reason clogs are such a common problem. Another clog-inducing dilemma can be the toilet's multiple valves, pumps and impellers, which can have difficulty passing solid waste (much less paper towels, baby wipes and other products). Marine toilet paper will almost dissolve on contact with water, but so will the cheap, one-ply stuff available most anywhere. For everything else, that old saw about not putting anything in the toilet that hasn't passed through your body first is actually sage advice when it comes to clog-avoidance.

### 2 | BILGE FUNK.

One of the more unsanitary practices aboard boats is showers that drain directly into the bilge. It's a setup that not only generates odors but also introduces pump-clogging hair and soap scum into the bilge. A common

aftermarket solution is mounting a gravity-fed sump beneath the shower pan, which collects the water and automatically pumps it overboard or to a gray-water tank (using a small submersible pump and float switch mounted inside). A second option is connecting the shower-pan drain hose directly to a diaphragm pump, eliminating the need for a sump, as well as the odors and mechanical float failures often associated with them. Instead of an automatic float, users turn on the pump manually when showering, then off again when finished.

### 3 | HOSE BUILDUP.

Calcium deposits can form inside your sanitation hoses, valves, seacocks, etc., to the point that the system becomes difficult to flush, experiences leaking back into the bowl or simply clogs up. An ounce of prevention is worth a pound of cure or, in this case, pumping two cups of white vinegar through the toilet monthly will help prevent buildup.

## Tricks for a Better-Smelling Head

Since there's a fine line between an odor and a scent, we wanted to provide a few tips for elevating the former to the latter.

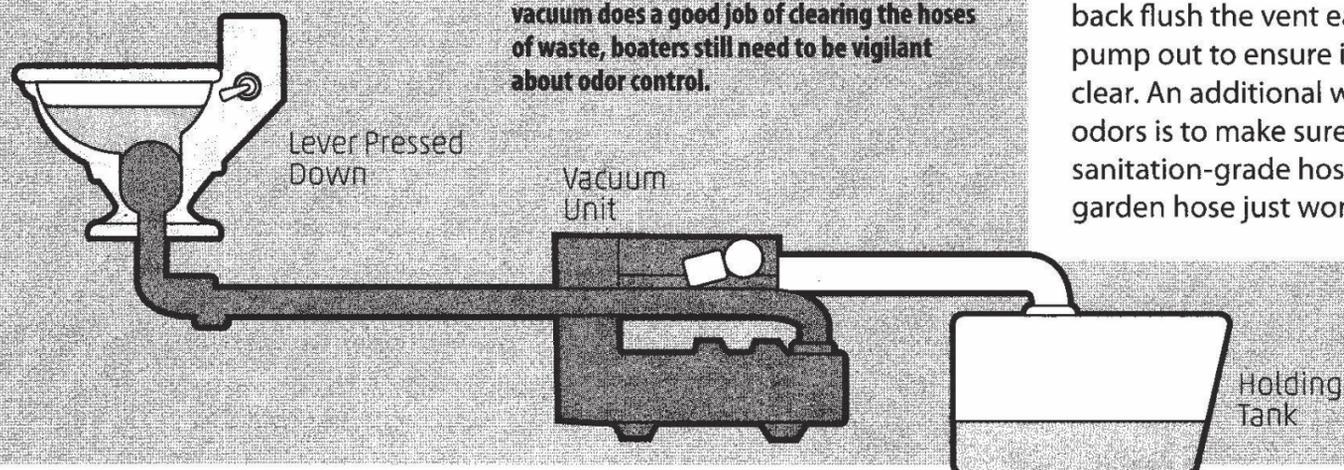
Leaks are one of the most common sources of head odors. Start at one end of your sanitation system and check each hose joint for leaks, ensuring all hose clamps are tight and corrosion free. Install double hose clamps where possible, but only if you have sufficient hose barb to allow it, otherwise you'll simply damage the hose and cause even more leaks.

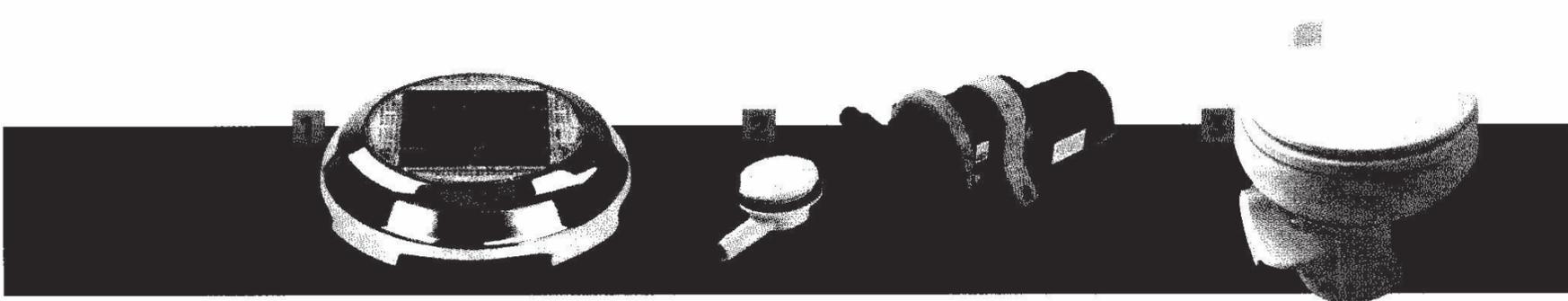
Always use proper sanitation hose when installing or replacing old hoses, including vent hoses. Sanitation-grade hose is expensive but imperative from a head odor-control standpoint. That red heater hose may have been a bargain, but your nose will soon tell you why it wasn't such a good choice to plumb your toilet and holding tank. Premium rubber sanitation hose has a thicker wall and features two-ply reinforcement and a wire helix. It may sound like overkill, but just remember it has to handle human waste that's roughly 30 times more concentrated than typical residential sewage.

Check your system and hose runs for places raw sewage can collect. Hose runs should be kept as short and straight as possible. Holding tank discharge hoses should also be self-draining — deck pumpout fitting hoses should drain back into the holding tank, while overboard discharge hoses should drain to the discharge seacock without loops or low spots.

Check your vent hose for clogging. Clogs are typically caused by overfilling your holding tank, which pushes solids into the hose and vent. When possible, back flush the vent each time you pump out to ensure it stays open and clear. An additional way to prevent odors is to make sure your vent hose is sanitation-grade hose (that length of garden hose just won't cut it).

HOW A VACUFLUSH HEAD WORKS





### 3 Good Upgrades

If you're looking for ways to improve the head in general, and you don't mind spending a little money, check out a few products that can help.

1 | Add a solar-powered vent to improve ventilation. Good air flow is crucial for head comfort. No great mind wants to contemplate the problems of the world astride a "thought enhancer" located in a stuffy head. Running on solar power during the day while charging a small battery to run at night, solar-powered vents freshen your head 24/7 with a constant flow of air and without the need for external power.

2 | Install a Gulley IC (Intelligent Control) shower

drain from Whale Pumps (whalepumps.com). The Gulley IC is a prewired system that consists of two components: a Gulley IC, essentially a "smart" shower drain, and a Gulper IC self-priming diaphragm pump. The shower gulley has a built-in electronic, water-sensing switch that automatically turns the pump on when water is present and off once the shower is dry. While a bit more expensive than a conventional pre-engineered sump, the Gulley IC system promises

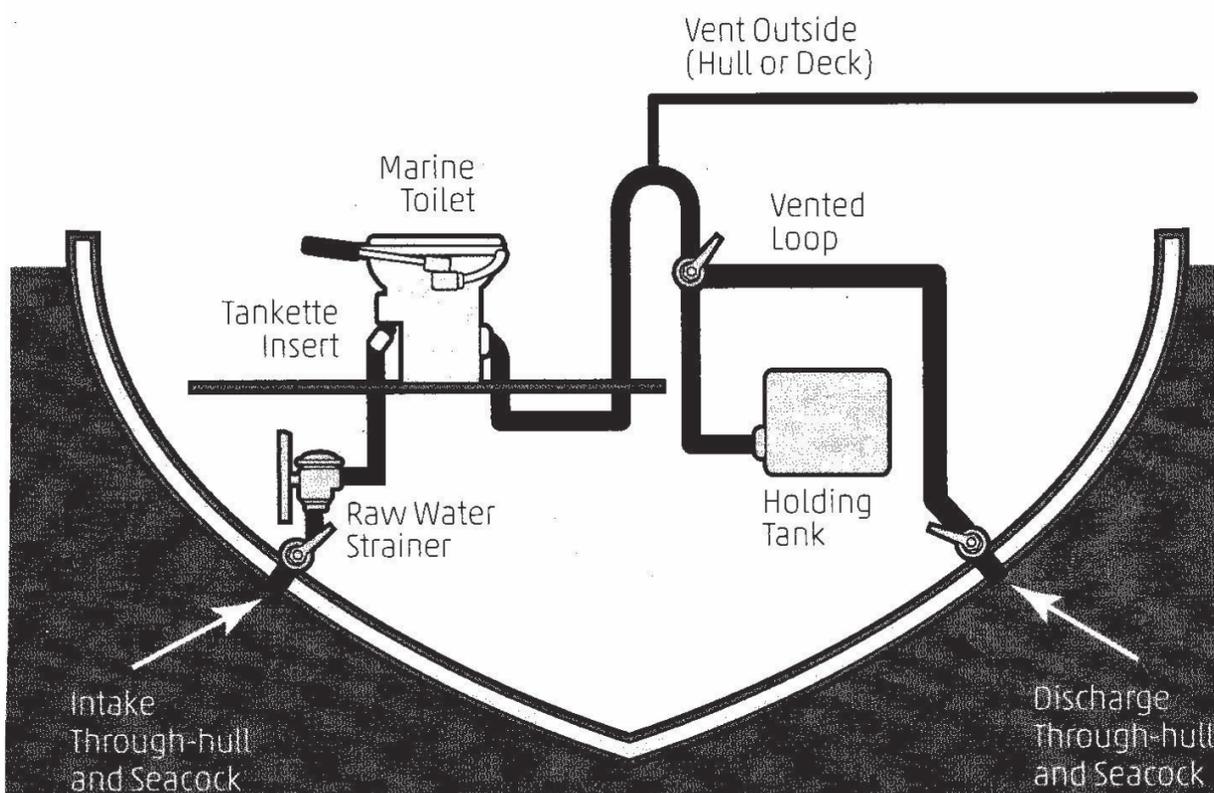
much greater reliability while presenting a good compromise between cost, ease of installation and convenience.

3 | Upgrade your antiquated "seat of ease" with a modern unit. Units such as the Vacuflush system use fresh water for flushing, which eliminates a lot of the smell associated with saltwater flush systems. As it uses a vacuum to pull water to the holding tank, it also does a better job of clearing the hoses of waste (another source of odor).

### Head Care

While cleaning to-do lists aren't particularly popular with most boaters, the Head item on the list is even less well-liked. No matter, it has to be done, and if you take care of the frequent tasks, the less frequent ones will be less ... memorable.

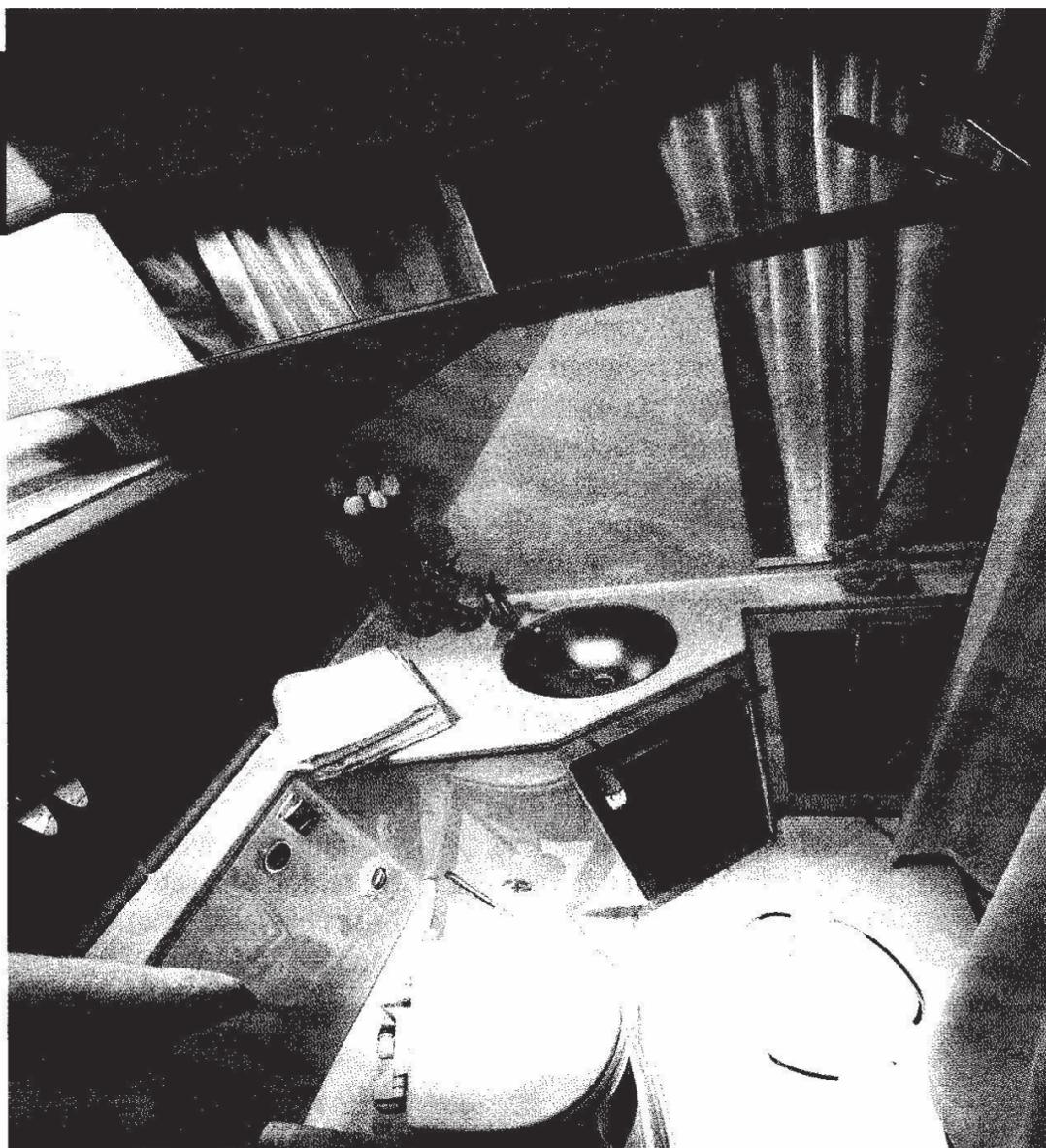
A TYPICAL HEAD SYSTEM



#### EVERY TIME YOU USE YOUR BOAT...

- ▶ Flush the head sufficiently to push sewage from the hoses, and rinse behind it. At the end of each trip, pour a half gallon or so of fresh water into the bowl and flush it through the system. Incorporating the task into your buttoning-up-the-boat routine before leaving will solve most odor problems.
- ▶ If you do your boating in salt water and your toilet uses raw water for flushing, follow the procedure in item number one (no pun intended): pour a gallon of fresh water into the bowl and flush it through the system at the end of your trip. Salt water contains tiny organisms that will die, decay and

While your system may look slightly different than this one, keeping hose runs short and straight and ensuring proper head cleaning is part of the buttoning-up procedure will keep head odors to a minimum.



Clean your head after each trip, especially the sink and the areas around and behind the toilet, unless you enjoy mid-cruise emergency repairs.

smell. Flushing the salt water from your bowl will help keep it odor free.

- ▶ Clean your head after each trip. Giving sinks, counters, and the areas around and behind the toilet (particularly if you have boating friends with bad aim) a good cleaning with disinfecting wipes or other such cleaners will leave Neptune's throne room smelling clean and ready for your next adventure.
- ▶ Shut all sanitation system seacocks when not in use (to prevent possible back siphoning and flooding).

#### **YEARLY...**

- ▶ Shock your holding tank at least once a year (spring or fall) to de-scale the inside and flush the system. Shock treatments (such as the Head-O-Matic Shock Treatment) help prevent odor buildup and can be used a second time if odors are noted mid-season. It is also recommended to shock the tank when you haul your boat out for the winter. Add shock treatment a week or so before the last pumpout, while still

using the boat, which gives the treatment time to slosh around in the holding tank to help de-scale the tank for the winter (it also helps ensure a clean final pumpout).

- ▶ Replace or blow out your vent hose. A clogged vent hose can promote smells and can damage your system due to the buildup of pressure each time the head is flushed. A clogged vent also creates negative pressure when pumping out, which can cause damage and possible collapse of the holding tank.
- ▶ Inspect your shower sump box. Opening it up allows you to clean the strainers, check the float switch for proper operation and check all electrical connections for corrosion and potential failure.

#### **AS NEEDED...**

- ▶ Change your hoses. Sewage will eventually permeate your sanitation system hoses, and while the frequency will depend on a number of factors (e.g., quality of hose, installation, use),

five years is probably the maximum time you want to go between changes. To see if your hose is permeated, wipe a section with a warm, damp cloth, drop it in a Ziploc bag, carry it above-decks into fresh air, open the bag and give a sniff.

- ▶ It's a fact: The more poop you have around, the worse things stink. Pump out your holding tank early and often, well before it hits the full mark.
- ▶ Check the holding tank vent line regularly for blockages. Mud daubers and other such insects love to build nests in vent lines, and if the tank is filled to overflowing, bits of sewage can clog the vent line.
- ▶ Rinse and flush the holding tank after each pumpout to dilute residual sewage and reduce odors. After pumping and rinsing, pour a mixture of one cup of liquid Calgon Water Softener to two gallons of hot water into the empty tank, then use the tank and pumpout when needed as you normally would. You can do this after each pumpout; however, the longer the water softener remains in the tank, the better, so try to time it between periods of heavy holding tank use and pumpouts (a week is ideal).
- ▶ Rebuild your toilet (new gaskets, seals, valves, impellers) every two years. The soft parts of your toilet will eventually dry out and become brittle, which leads to cracks and leaks. By replacing these parts on your own terms before they have a chance to fail, you've eliminated a boat owner's number-one nightmare: toilet failure (it never happens at a good time) and the emergency repairs necessary to fix them.
- ▶ To keep your toilet pump operating smoothly, follow your monthly vinegar flush with a dose of oil. The best choice for this is a lubricant specifically designed for use in marine toilets, which not only lubricates the pump wall (for easier pumping) but also helps keep the internal rubber parts oiled and supple. 🐾